United States
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Office of Chemical Safety and
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# Draft Risk Evaluation for Asbestos Part 2 – Supplemental Evaluation Including Legacy Uses and Associated Disposals of Asbestos

## Systematic Review Supplemental File:

### Data Quality Evaluation and Data Extraction Information for Environmental Release and Occupational Exposure

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This supplemental file contains information regarding the data extraction and quality evaluation results for data sources that were considered for the Supplement to *Draft Risk Evaluation for Asbestos Part 2: Supplemental Evaluation Including Legacy Uses and Associated Disposals of Asbestos* and that underwent systematic review. The systematic review steps are further described in Supplement to the *Draft Risk Evaluation for Asbestos Part 2: Supplemental Evaluation Including Legacy Uses and Associated Disposals of Asbestos*. EPA conducted data extraction, and quality evaluation based on author-reported descriptions and results; additional analyses (*e.g.*, statistical analyses) potentially conducted by EPA are not contained in this supplemental file. EPA used the TSCA systematic review process described in the *Draft Systematic Review Protocol Supporting TSCA Risk Evaluations for Chemical Substances* (also referred to as the '2021 Draft Systematic Review Protocol').

Data that met the RESO screening criteria during the full-text screening was extracted by three data types, general facility, occupational exposure, and environmental release, as explained in Section 6.2 of the 2021 draft systematic review protocol. Five different data quality evaluation forms were used depending on the data type and condition of use (COU), as explained in Appendix M of the 2021 draft systematic review protocol. All references with data points containing monitoring data (*e.g.*, measured occupational exposures) underwent data quality evaluation as described in Section M.6.1, using the monitoring data quality metrics. All references with data points containing environmental release data (*e.g.*, measured or calculated quantities of chemical release across facility fence line) underwent data quality evaluation as described in Section M.6.2, using the environmental release data quality metrics. All references with data points containing published models for environmental release or occupational exposure (*e.g.*, published models used to calculate occupational exposure or environmental releases) underwent data quality evaluation as described in Section M.6.3, using the published models for environmental release or occupational exposure quality metrics. All references with data points containing completed exposure or risk assessments (*e.g.*, completed exposure or risk assessments containing a broad range of data types) underwent data quality evaluation as described in Section M.6.4, using the completed exposure or risk assessments quality metrics. All references with data points containing reports for data or information other than exposure or release data (*e.g.*, process description) underwent data quality evaluation as described in Section M.6.5, using the reports for data or information other than exposure or release data quality metrics. The extracted data and their data quality evaluation are available in the tables below.

Additionally, each data type and condition of use is evaluated independently within a given study; therefore, each reference may have more than one overall quality determination (OQD) to reflect the quality of each outcome and the exposures and releases more appropriately as described by the study authors. No OQD is determined for each reference, as a whole, if it contains data from more than one evidence stream.

# Table of Contents

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| **Study Citation:** | Abundo, M.,-L, Almaguer, D., Driscoll, R. (1994). Health hazard evaluation report no. HETA 93-1133-2425, Electrode Corporation, Chardon, Ohio. |
| **HERO ID:** | 3970520 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Incoming crates of anodes are opened and counted in the shipping and receiving department. These crates are unpacked and evaluated in the diaphragm pre-coat area. Glanor anodes (a subset of diaphragm anodes) may become contaminated with asbestos during use, by the customer, in chemical cells where an asbestos diaphragm is used to separate the anode and cathode. (pdf page 4) |
| Physical form: | solid, 80 to 90% chrysotile asbestos (pdf page 12) |
| Area sampling data: | Five bulk material and three settled-dust samples were collected in the diaphragm pre-coat area. Bulk material samples were collected using tweezers and samples were stored in glass vials. (pdf page 6)Bulk material samples were analyzed for asbestos fibers with polarized light microscopy (PLM) according to NIOSH Method 9002 (pdf page 6)Three bulk material samples collected from unwashed diaphragm anodes (pdf page 12) |
| Number of workers: | two employees who opened this crate of asbestos-contaminated anodes (pdf page 12) |
| Personal protective equipment: | employees wore 3M No. 8500 Non-Toxic Particle Masks. or nothing (pdf page 12) |
| Engineering control: | General ventilation is supplied to the production areas through five air make-up units located throughout the facility....Large pedestal fans are used throughout the plant for cooling, and workers can also open outside doors and windows. (pdf page 3) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | High | Sampling/analytical methodology is approved NIOSH Method 9002 |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for use as Chemical Substances in Construction, Paint, Electrical, and Metal Products, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Monitoring data are greater than 20 years old (1993) |
| | Metric 5: | Sample Size | Medium | Sample distribution characterized by limited statistics (e.g., min, max) but discrete samples not provided and distribution not fully characterized. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | All metadata provided. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | Variability addressed by multiple samples in multiple areas of the facility, but uncertainty is not addressed. |

## Overall Quality Determination High

**Study Citation:** Achutan, C., King, B. (2007). Health hazard evaluation report no. HETA 2005-0369-3034, Hurricane Katrina Response.
**HERO ID:** 3970534
**Conditions of Use:** Disposal

**EXTRACTION**

| Parameter | Data |
|---|---|
| Worker activity description: | Investigators conducted air sampling on personnel actively involved in the disposal of a pile of suspected Transite™ material found among debris from Hurricane Katrina. |
| Personal sampling data: | The fiber concentrations on two of the three PBZ samples were non-detectable. The third PBZ sample, taken on a trackhoe operator, had a very low fiber concentration. [PDF Pg. 23] |
| Area sampling data: | The fiber concentration on the area air sample was below the limit of detection. [PDF Pg. 23] |
| Personal protective equipment: | Recommended to wear high efficiency-filtered half-mask respirators, disposable coveralls, boot coverings, and gloves during clean up of the asbestos-containing material. [PDF Pg. 13] |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Sampling and Analytical Methodology | High | Sampling or analytical methodology is an approved OSHA or NIOSH method or is well described and found to be equivalent to approved OSHA or NIOSH methods. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | Data are from the U.S. |
| Metric 3: | Applicability | High | The data are for an occupational scenario within the scope of the risk evaluation. |
| Metric 4: | Temporal Representativeness | Medium | Monitoring data are greater than 10 years old but no more than 20 years old. |
| Metric 5: | Sample Size | N/A | Samples were either ND or below limit of detection. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Medium | Monitoring data include most critical metadata, such as sample type and exposure type, but lacks additional metadata, such as sample durations, exposure durations, and exposure frequency. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Medium | Variability is addressed by including both personal and area samples but uncertainty is not addressed. |

## Overall Quality Determination High

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|---|---|
| **Study Citation:** | Adams, R. C., Holton, M. W. (2012). Legacy hazards: One organization's assessment of occupational exposures. Professional Safety 57(5):58-67. |
| **HERO ID:** | 6907151 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Gasket removal associated with plant activities for gaskets, packing, pipe insulation, electrical wire insulation, electrical panels and other materials.Electricians doing electrical maintenance may perform work inside electrical cabinets such as tightening contacts, removing components, stripping and cutting wire, as well as vacuuming, wiping or blowing out settled dusts. |
| Area sampling data: | Table 1 on PDF page 3 provides Asbestos exposures associated with Gasket Removal Activities. Table 2 on PDF page 3 provides Asbestos exposures associated with electrical maintenance activities.Table 1: - 1978 samples from Navy had levels from <0.05 to 0.13 f/cc. Reported range of <0.03 to 0.39 f/cc.- 1991 samples had range from 0.11 to 1.4 f/cc- Another set of 1991 samples had average levels of 0.24 f/cc with range of 0.05 to 0.44 f/cc- 1996 samples had maximum TWA level of 0.005 f/cc- 1998 samples had TWA range of <0.045 to 0.008 f/cc- 2002 samples had average exposure of 21.8 f/cc with range of 9.3 to 31 f/cc. TWA of 2.3 to 3.6 f/cc- Another set of 2002 samples had average TWA exposures of 0.014 f/cc with a range of 0.00 to 0.035 f/cc.- 2006 samples had average TWA of 0.03 f/cc with a range of 0.01 to 0.08 f/cc.Table 2:- 1999 Wire stripping activity sampled for 30 minutes had one detection at 0.11 f/cc, the remaining samples were below the detection limits- 1990 Cutting and stripping wire sampled for 2 hours had exposure level of 0.006 f/cc- 1994 Cutting and stripping electrical cable samples for 8-hour had exposure level of <0.007 to 0.073 f/cc- 1997 cable splicing activity sampled from 20- to 30- minutes had exposure of <0.011 to 0.073 f/cc.- 1996 electrical repairs activity sampled for 8-hours had exposure level of 0.0034 to 0.052 f/cc. |
| Engineering control: | No controls provided however Figure 1 provides a general methodology for assessing occupational exposures which recommends adding controls for an unacceptable exposure. |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Medium | Several monitoring studies are referenced, each with unique sampling and analytical methodologies that are not expected to lead to lower quality data. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Several monitoring studies are referenced and most data is assumed to be from the United States. |
| | Metric 3: | Applicability | High | Data are for industrial/commercial use in construction or electrical products, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Nearly all monitoring data are greater than 20 years old. |
| | Metric 5: | Sample Size | Medium | Sample distribution characterized by limited statistics (average, range) but discrete samples are not provided and distribution not fully characterized. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Monitoring data include most critical metadata such as sample type and exposure type, but lacks additional metadata such as exposure duration and exposure frequency. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | The monitoring study addresses variability by considering multiple worker activities, but measurement uncertainty is not characterized. |

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|---|---|
| **Study Citation:** | Adams, R. C., Holton, M. W. (2012). Legacy hazards: One organization's assessment of occupational exposures. Professional Safety 57(5):58-67. |
| **HERO ID:** | 6907151 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

| | | **EVALUATION** | |
|---|---|---|---|
| Domain | Metric | Rating | Comments |
| **Overall Quality Determination** | | **Medium** | |

| | |
|---|---|
| **Study Citation:** | Addison, J. (1999). Minimising health hazards associated with derogated products containing chrysotile asbestos. Annals of Occupational Hygiene 43(7):496-498. |
| **HERO ID:** | 3581694 |
| **Conditions of Use:** | Other: |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Exposure route: | Inhalation. |
| Comments: | Source is for Chrysotile Asbestos. Source doesn't contain any sampling data but recommends concentrations that are adequate for use in any setting. |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Low | Sampling/analytical methodology is not specified. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Medium | Data are from UK, an OECD country. |
| | Metric 3: | Applicability | Uninformative | Data are for hypotheticals which is not in-scope or similar to an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Monitoring data are greater than 20 years old. |
| | Metric 5: | Sample Size | Low | Sample distribution is described qualitatively. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Uninformative | Sample type and exposure type not provided. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Uninformative

| | |
|---|---|
| **Study Citation:** | Adgate, J. L., Cho, S. J., Alexander, B. H., Ramachandran, G., Raleigh, K. K., Johnson, J., Messing, R. B., Williams, A. L., Kelly, J., Pratt, G. C. (2011). Modeling community asbestos exposure near a vermiculite processing facility: Impact of human activities on cumulative exposure. Journal of Exposure Science and Environmental Epidemiology 21(5):529-535. |
| **HERO ID:** | 1005280 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Area sampling data: | 0.142 - 0.568 f/ccScenario 3 (Installed insulation) 0.0018 f/cc* month 10th %tile 0.0018 f/cc* month 25th %tile 0.0073 f/cc* median 0.025 f/cc* month 75th %tile 0.091 f/cc* month 90th %tile 0.075 f/cc* month mean |
| Exposure duration: | 0.5-8 hours per day |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Low | Sampling or analytical methodology is not specified - data used in this study were from other studies |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | US |
| | Metric 3: | Applicability | High | The data are for an occupational scenario (construction/removal) within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Medium | 2011- after PEL (1986) more than 10 years old. |
| | Metric 5: | Sample Size | Medium | Statistics for monitoring data not provided but extrapolated exposure data (f/cc*month) has a full set of descriptive statistics (mean, median, SD) |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Monitoring data include most critical metadata, such as sample type, exposure type, and exposure durations, but lacks additional metadata, such as sample durations, exposure frequency, and/orworker activities. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | The monitoring study did not provide any discussion of the uncertainty or variability for the sampled site. but sufficient statistics were provided for exposure ( f/cc*month to evaluate variability in the data. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Albin, M., Engholm, G., Hallin, N., Hagmar, L. (1998). Impact of exposure to insulation wool on lung function and cough in Swedish construction workers. Occupational and Environmental Medicine 55(10):661-667. |
| **HERO ID:** | 3081074 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Occupations within the construction industry: insulators, carpenters, sheet metal workers, painters |
| Exposure route: | inhalation |
| Physical form: | solid |
| Personal sampling data: | The median concentrations of respirable fibres were between 0.06 and 0.50 f/ml (75th percentile 0.06–0.70 f/ml). (p.2)Table 3. Respirable fibre concentrations for different occupations with the construction industryInsulators: Spraying insulation wool - Samples = 18, Mean sampling time = 4.17 hr, Mean concentration = 0.91 f/mL, Conc Range = 0.08-5.08; Spraying mixed gypsum and insulation wool - Samples = 5, Mean sampling time = 4.84 hr, Mean concentration = 0.42 f/mL, Conc Range = 0.19-0.74; Manual application of mattresses - Samples = 57, Mean sampling time = 3.01 hr, Mean concentration = 0.18 f/mL, Conc Range = 0.00-1.41Carpenters: Tasks performed several days/week - Samples = 36, Mean sampling time = 1.95 hr, Mean concentration = 0.36 f/mL, Conc Range = 0.07-1.90Sheet metal workers: Varying frequency - Samples = 1, Mean sampling time = 4.30 hr, Mean concentration = 0.06 f/mLPainters: Varying frequency - Samples = 4, Mean sampling time = 6.60 hr, Mean concentration = 0.47 f/mL, Conc Range = 0.19-0.71Presented by Clausen et al. for Danish insulators. Their typical exposure conditions were, as estimated from personal sampling, 0.03–1 f/ml, which is close to the mean values for the Swedish insulators 1978–90 (0.2–0.9 f/ml). The range of total airborne dust concentrations was also similar (1–10 mg/m3 and 2–11 mg/m3, respectively) (p. 6) |
| Exposure duration: | See personal sampling data field |
| Exposure frequency: | See personal sampling data field |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Medium | Sampling or analytical methodology is not equivalent to an approved OSHA or NIOSH method and EPA review of information indicates the methodology is acceptable. Differences inmethods are not expected to lead to lower quality data. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Medium | The data are from an OECD country. other than the U.S., and locality-specific factors (e.g., potential differences in regulatory occupational exposure limits, industry/ process technologies) may impact exposures relative to the U.S. |
| | Metric 3: | Applicability | High | The data are for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Low | Metadata on the operations, equipment, and worker activities associated with the data show that the data agree representative of outdated operations, equipment, and activities rather than current operations, equipment, and worker activities. The data are more than 20 years old. |
| | Metric 5: | Sample Size | Medium | Distribution of samples is characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Monitoring data include most critical metadata, such as sample type and exposure type, but lacks additional metadata, such as sample durations, exposure durations, exposure frequency, and/orworker activities. |

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| | |
|---|---|
| **Study Citation:** | Albin, M., Engholm, G., Hallin, N., Hagmar, L. (1998). Impact of exposure to insulation wool on lung function and cough in Swedish construction workers. Occupational and Environmental Medicine 55(10):661-667. |
| **HERO ID:** | 3081074 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

| | | EVALUATION | |
|---|---|---|---|
| Domain | Metric | Rating | Comments |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Medium | The monitoring study provides limited discussion of the variability between the activities of the workers being monitored. Uncertainty is not addressed. |

## Overall Quality Determination — Medium

| | |
|---|---|
| **Study Citation:** | Albrecht, W. N. (1982). Health Hazard Evaluation Report, No. HETA-82-131-1098, U.S. Department of Justice, Washington, D.C. |
| **HERO ID:** | 3653569 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | office work - page 3 |
| Area sampling data: | 4 samples, sampling duration averaged 330 minutes, ”no asbestos was found in the air samples” - page 3 |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | High | Sampling/analytical methodology is an approved NIOSH method. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | Uninformative | Atmospheric monitoring data for buildings without asbestos-containing material disturbance is outside the scope of the legacy asbestos occupational risk assessment. |
| | Metric 4: | Temporal Representativeness | Low | Monitoring data are greater than 20 years old. |
| | Metric 5: | Sample Size | Low | Distribution of samples is qualitative or characterized by no statistics. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Low | Monitoring data include sample type, but no other metadata pertinent to occupational risk assessment. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | The monitoring study does not address variability or uncertainty. |

## Overall Quality Determination Uninformative

| | |
|---|---|
| **Study Citation:** | Almaguer, D., Matte, T. (1987). Health hazard evaluation report no. HETA 86-524-1851, Four Wheel Drive Corporation, Clintonville, Wisconsin. |
| **HERO ID:** | 3970490 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | assembling brake shoes (page 5) |
| Physical form: | solid chrysotile asbestos (page 1) |
| Personal sampling data: | Results of personal and general area air sampling for asbestos in the brake shoe assembly area indicated that airborne concentrations of asbestos were below the analytical limit of detection (page 10) |
| Area sampling data: | Results of personal and general area air sampling for asbestos in the brake shoe assembly area indicated that airborne concentrations of asbestos were below the analytical limit of detection (page 10) |
| Personal protective equipment: | the workers observed in the brake shoe machining process area was not wearing appropriate personal protective equipment (page 13) |
| Engineering control: | the brake shoe machining process was equipped with local exhaust ventilation (page 13) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Sampling and Analytical Methodology | High | Sampling/analytical methodology is an approved NIOSH method (NIOSH method #7400). |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | High | Data are from the U.S. |
| | Metric 3: Applicability | High | Data are for manufacturing braking components, an in-scope occupational scenario. |
| | Metric 4: Temporal Representativeness | Low | Monitoring data are greater than 20 years old (1987) |
| | Metric 5: Sample Size | Medium | Sample distribution characterized by limited statistics (states all samples were below analytical level of detection, does not list a value for the corresponding level of detection) but discrete samples not provided and distribution not fully characterized. |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | Medium | Sample type and exposure type provided but missing sample frequency, duration, worker activities, and number of workers |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Almaguer, I.,.H. (1986). Health hazard evaluation report no. HETA 86-223-1742, Grundy Industries, Inc., Joliet, Illinois. |
| **HERO ID:** | 3970532 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | One employee works directly with the 50 kilogram cakes of asbestos, opening and loading them onto a conveyor system. Empty asbestos bags are placed in cardboard boxes, and sent to a trash compactor for disposal. Another employee is responsible for operation of the control panel which monitors and regulates the amount of ingredients in the asphalt/asbestos mixture. The remaining employees are involved in the packaging of the final products and their duties include dispensing, capping, and labeling. Finished products are placed on pallets and transported by forklift trucks to storage areas within the facility. Additionally, one employee working in the packaging area substitutes for the bag opener as necessary (pdf page 2) |
| Personal sampling data: | six air samples where the Total fiber counts ranged from 0.08 to 0.37 fibers per cubic centimeter of air (fibers/cc) as a time-weighted average (TWA) concentration (Page 5)Discrete sample results provided on page 9 |
| Exposure duration: | 232, 211, 234, 213, 476, and 474 minute sample duration |
| Number of workers: | 4 employees - asbestos bag opener, control panel operator, forklift driver, dispensing line worker |
| Personal protective equipment: | employees (bag opener and control panel operator) are required to wear a single use disposable mask and disposable coveralls as additional protection. (pdf page 3) |
| Engineering control: | Local exhaust ventilation is provided at the bag opening operation (pdf page 3)Since the time of the first NIOSH Health Hazard Evaluation the company has: 1) made modifications in the local exhaust ventilation system at the asbestos bag opening operation; 2) installed a dust collection system equipped with a high efficiency particulate air (HEPA) filter at the asbestos bag opening operation; 3) built a change and shower room for employees working in the bag opening area; 4) added a pneumatic platform to aid the bag opener with the lifting of the 50 kilogram cake of asbestos; 5) installed a dust collection system equipped with a HEPA filter at the trash compactor; and 6) enclosed the trash compactor by building walls around the equipment. (pdf page 3) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Sampling and Analytical Methodology | High | Sampling/analytical methodology is approved NIOSH method 7400 |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | High | Data are from the U.S. |
| | Metric 3: Applicability | High | Data are for use of a Chemical Substance in Construction, Paint, Electrical, and Metal Products, an in-scope occupational scenario. |
| | Metric 4: Temporal Representativeness | Low | Monitoring data are greater than 20 years old (1986) |
| | Metric 5: Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | Medium | Monitoring data include most critical metadata, such as worker activities, sample type, exposure type, and sample durations, but lacks additional metadata, such as exposure frequency, and exposure duration |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Medium | Uncertainty is addressed in sampling/analytical methodology but variability is not addressed. |

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|---|---|
| **Study Citation:** | Almaguer, I.,.H. (1986). Health hazard evaluation report no. HETA 86-223-1742, Grundy Industries, Inc., Joliet, Illinois. |
| **HERO ID:** | 3970532 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

| | | EVALUATION | |
|---|---|---|---|
| Domain | Metric | Rating | Comments |
| **Overall Quality Determination** | | **High** | |

| | |
|---|---|
| **Study Citation:** | Altree-Williams, S., Preston, J. S. (1985). Asbestos and other fibre levels in buildings. Annals of Occupational Hygiene 29(3):357-363. |
| **HERO ID:** | 295 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Office workers and plant workers. (5/7) |
| Physical form: | fibers (5/7) |
| Area sampling data: | (SEM) Area samples in office and plant buildings ranged from 0-22 fibers/L. (6/7) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | High | Sampling/analytical methodology is equivalent to an approved [OSHA/NIOSH] method. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Medium | Data are from Australia, an OECD country. |
| | Metric 3: | Applicability | Uninformative | Data are inhalation monitoring of background concentrations in occupational settings which is not in scope for the occupational exposure assessment. |
| | Metric 4: | Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| | Metric 5: | Sample Size | Medium | Sample distribution characterized by limited statistics (means) but discrete samples not provided and distribution not fully characterized. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Sample type and exposure type provided, but missing exposure duration, frequency, number of workers, particle size, PPE, and engineering control. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | High | Uncertainty is addressed in sampling/analytical methodology. Variability addressed by sampling 22 sites. |

## Overall Quality Determination Uninformative

| | |
|---|---|
| **Study Citation:** | Amer Tech Lab, (1979). Atmosphere filtering monitoring report [878210730]. |
| **HERO ID:** | 4158217 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | asbestos removal |
| Exposure route: | Inhalation |
| Physical form: | Fiber |
| Personal sampling data: | 0.0009 f/cc (20 min, 2 samples) |
| Area sampling data: | 0.001 f/cc (20 min, 1 sample)0.0003 f/cc (30 min, 3 samples) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Sampling and Analytical Methodology | Low | Sampling or analytical methodology is not specified. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | The data are from the United States and are representative of the industry being evaluated. |
| Metric 3: | Applicability | High | The data are for an occupational scenario within the scope of the risk evaluation. |
| Metric 4: | Temporal Representativeness | Low | The data were collected before the most recent PEL establishment or update or are more than 20 years old if no PEL is established. |
| Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Medium | Monitoring data include most critical metadata, such as sample type and exposure type, but lacks additional metadata, such as exposure durations, exposure frequency, and worker activities. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Medium | Variability is addressed by including personal and area monitoring data but uncertainty is not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Amer Tech Lab, (1979). Atmosphere filtering monitoring report [878210736]. |
| **HERO ID:** | 4158219 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Removal of asbestos from the engine room of the U.S.S. Manley |
| Exposure route: | Inhalation |
| Physical form: | Fibers |
| Personal sampling data: | During asbestos removal in the engineer room of the U.S.S. Manley, personal samples were 0.09 f/cc (2.5-hr sample) and 0.03 f/cc (3-hr sample). |
| Area sampling data: | During asbestos removal in the engine room of the U.S.S. Manley, area samples were 0.07 f/cc (2.5-hr sample) and 0.05 f/cc (3-hr sample). |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Low | Sampling methodology not specified. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for industrial use in construction materials, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Exposure type and sampling data provided, but missing number of workers, exposure duration and frequency, engineering controls, PPE, and particle size. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | Monitoring report addresses variability through multiple sampling types (area and personal) in multiple locations, but measurement uncertainty is not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Amer Tech Lab, (1979). Atmosphere filtering monitoring report [878210737]. |
| **HERO ID:** | 4158220 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Removal of asbestos-containing insulation material from the Fire Room of the USS Manley. |
| Exposure route: | Inhalation |
| Physical form: | Fibers |
| Personal sampling data: | 1.3 f/cc measured during insulation removal with 8-hr sampling time. |
| Area sampling data: | 1 f/cc measured during insulation removal with 8-hr sampling time.0.08 f/cc measured after insulation removal with 30-min sampling time. |
| Exposure duration: | 8 hr sampling (personal+area; pg 5-6); 0.5 sampling (certificate; pg 7) |
| Engineering control: | Area was closed off |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Low | Sampling/analytical methodology is not specified. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for construction materials, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Monitoring data include most critical metadata such as sample type and exposure type, but lacks additional metadata such as exposure durations, exposure frequency, and worker activity details. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | The monitoring report addresses variability through collecting multiple sample types (area and personal), but measurement uncertainty is not characterized. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Amer Tech Lab, (1982). Certificate of analysis or test for asbestos. |
| **HERO ID:** | 4158234 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Removing asbestos material from a boiler room. |
| Exposure route: | Inhalation |
| Physical form: | Fibers |
| Area sampling data: | Outside the building: 0.02-0.05 f/cc. Inside the building while removing asbestos material: 1.05-1.36 f/cc. Inside building after removing asbestos material: 0.04-0.95 f/cc. |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Low | Sampling methodology not specified. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | Medium | Data are for removal of asbestos containing material, but specific material is not specified. |
| | Metric 4: | Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Low | Sampling data provided, but it is unclear if the data is area or personal breathing zone. Also, most critical metadata are missing such as number of workers, exposure duration, frequency, engineering controls, PPE, and particle size. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination **Low**

| | |
|---|---|
| **Study Citation:** | Amer Tech Lab, (1979). Monitoring the atmosphere filtering [878212085]. |
| **HERO ID:** | 4158263 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Removal of asbestos [PDF Pg. 5]. |
| Exposure route: | Inhalation |
| Personal sampling data: | Sample taken during removal of asbestos: 0.009 f/cc (2 samples) |
| Area sampling data: | Sample taken during asbestos removal: 0.007 f/cc (1 sample), 0.0001 f/cc (3 samples) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Low | Sampling/analytical methodology is not specified. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for Chemical Substances in Construction, Paint, Electrical, and Metal Products, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Monitoring data are greater than 20 years old. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Sample type and exposure type provided but missing exposure frequency. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | Variability addressed by both personal and area sampling, but uncertainty is not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Amer Tech Lab, (1979). Monitoring the atmosphere filtering [878212092]. |
| **HERO ID:** | 4158268 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Asbestos insulation removal in Main Machine Room of USS Saratoga. |
| Personal sampling data: | Upper Level: 1.5 f/cc (2.5-hr sampling time); Lower Level: 0.95 f/cc (2.5-hr sampling time) |
| Area sampling data: | Certificate: 0.05 f/cc (30-min sampling time); Upper Level: 1.1 f/cc (2.5-hr sampling time); Lower Level: 0.9 f/cc (2.5-hr sampling time) |
| Engineering control: | Work area was closed off |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Sampling and Analytical Methodology | Low | Sampling/analytical methodology is not specified. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | Data are from the U.S. |
| Metric 3: | Applicability | High | Data are for construction materials, an in-scope occupational scenario. |
| Metric 4: | Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Medium | Monitoring data include most critical metadata such as sample type and exposure type, but lacks additional metadata such as exposure durations, exposure frequency, and worker activity details. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Medium | The monitoring report addresses variability through multiple sampling types (area and personal), as well as multiple sampling locations, but measurement uncertainty is not characterized. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Amer Tech Lab, (1979). Monitoring the atmosphere filtering [878210777]. |
| **HERO ID:** | 4158274 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Asbestos removal and clean-up from the U.S.S. Tattnall. (5/8) |
| Exposure route: | inhalation (6/8) |
| Physical form: | fibers |
| Personal sampling data: | Personal sampling during asbestos removal on the U.S.S. Tattnall was 0.70 f/cc (6/8) |
| Area sampling data: | Area sampling during asbestos removal on the U.S.S. Tattnall was 0.85 f/cc & after clean-up was 0.03 f/cc. |
| Engineering control: | The removal area was secured from other parts of the ship. (5/8) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Sampling and Analytical Methodology | Low | Sampling or analytical methodology is not specified. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | Data are from the U.S. |
| Metric 3: | Applicability | High | Data are for demolition of asbestos products, an in-scope occupational scenario. |
| Metric 4: | Temporal Representativeness | Low | The data were collected before the most recent PEL establishment or update or are more than 20 years old if no PEL is established. |
| Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Medium | Exposure type and sampling data provided, but missing number of workers, exposure duration, frequency, particle size, and PPE. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Medium | Variability addressed by including personal and area samples but uncertainty is not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Amer Tech Lab, (1979). Monitoring the atmosphere filtering [878212084]. |
| **HERO ID:** | 4158279 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Removal of asbestos from the U.S.S. Patterson |
| Exposure route: | Inhalation |
| Physical form: | Fibers |
| Personal sampling data: | 0.008 f/cc measured during asbestos removal using 30-min sampling time and 2 LPM flowrate. |
| Area sampling data: | 0.004 f/cc measured during asbestos removal using 30-min sampling time and 2 LPM flowrate.0.0008 f/cc measured after asbestos removal using 30-min sampling time and 2 LPM flowrate. |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Sampling and Analytical Methodology | Low | Sampling methodology not specified. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | Data are from the U.S. |
| Metric 3: | Applicability | High | The data are for an occupational scenario within the scope of the risk evaluation. |
| Metric 4: | Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Medium | Exposure type and sampling data provided, but missing number of workers, exposure duration, frequency, PPE, particle size, and engineering controls. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Medium | Monitoring report addresses variability through multiple sampling types (area and personal), but measurement uncertainty is not characterized. |

## Overall Quality Determination Medium

**Study Citation:** Amer Tech Lab, (1979). Monitoring the atmosphere filtration [878212094].
**HERO ID:** 4158281
**Conditions of Use:** Other:

**EXTRACTION**

| Parameter | Data |
|---|---|
| Physical form: | fibers (4/6) |
| Area sampling data: | Area samples in the aux staircase of the U.S.S. Saratoga were 0.0001 f/cc. (4/6) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Low | Sampling methodology not specified. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | Uninformative | Condition of use unknown. |
| | Metric 4: | Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Exposure type and sampling data provided, but missing worker information, exposure duration, frequency, PPE, particle size, and engineering controls. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Uninformative

| | |
|---|---|
| **Study Citation:** | Amer Tech Lab, (1979). Monitoring the atmosphere filtering [878212083]. |
| **HERO ID:** | 9606068 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Removal of asbestos containing material on USS Patterson. |
| Exposure route: | Inhalation |
| Physical form: | Dermal |
| Personal sampling data: | 0.006 fibers/cm3 measured during asbestos removal with 30-min sampling time and 2 LPM flowrate. |
| Area sampling data: | 0.005 fibers/cm3 measured during asbestos removal with 30-min sampling time and 2 LPM flowrate.0.003 fibers/cm3 measured after asbestos removal with 30-min sampling time and 2 LPM flowrate. |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Sampling and Analytical Methodology | Low | Sampling or analytical methodology is not specified. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | High | The data are from the United States. |
| | Metric 3: Applicability | High | The data are for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: Temporal Representativeness | Low | Data more than 20 years old. |
| | Metric 5: Sample Size | High | Discrete data measurements provided. |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | Medium | Monitoring data include most critical metadata, such as sample type and exposure type, but lacks additional metadata such as exposure durations, exposure frequency, and-worker activity details. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Medium | Monitoring report addresses variability through multiple sampling types(area and personal), but does not characterize measurement uncertainty. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Amer Tech Lab, (1979). Monitoring the atmosphere filtering [878212095]. |
| **HERO ID:** | 9607109 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Removal of asbestos containing material from water heater on USS Saratoga |
| Exposure route: | Inhalation |
| Physical form: | Fiber |
| Personal sampling data: | 0.70 fibers/cm3 measured while removing asbestos containing material from water heater with 2-hr sampling time and 2 LPM flowrate (2 samples). |
| Area sampling data: | 0.85 fibers/cm3 measured while removing asbestos containing material from water heater with 2-hr sampling time and 2 LPM flowrate (1 sample). 0.007 fibers/cm3 measured after removal of asbestos containing material from water heater with 30-min sampling time and 2 LPM flowrate (3 samples). |
| Engineering control: | Area closed off during removal. |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Sampling and Analytical Methodology | Low | Sampling or analytical methodology is not specified. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | High | The data are from the United States. |
| | Metric 3: Applicability | High | The data are for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: Temporal Representativeness | Low | Data more than 20 years old. |
| | Metric 5: Sample Size | High | Statistical distribution of samples is fully characterized. |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | Medium | Monitoring data include most critical metadata, such as sample type and exposure type, but lacks additional metadata such as exposure durations and exposure frequency. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Medium | Monitoring report addresses variability through multiple types of sampling (personal and area), but does not characterize measurement uncertainty. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Amer Tech Lab, (1979). Monitoring the atmosphere filtration [878212093]. |
| **HERO ID:** | 9607541 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Removal of insulation material |
| Personal sampling data: | 0.95 fibers/cc, 2 hr sample (p. 6) |
| Area sampling data: | 0.005 - 0.85 fibers/cc, 2 hr sample (p. 5, p. 7) |
| Exposure duration: | 2 hrs (per sample/task) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Low | Sampling or analytical methodology is not specified. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | The data are from the United States and are representative of the industry being evaluated. |
| | Metric 3: | Applicability | High | The data are for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Medium | Metadata on the operations, equipment, and worker activities associated with the data show that the data agree representative of outdated operations, equipment, and activities rather than current operations, equipment, and worker activities (data are more than 20 years old) |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Low | Monitoring data includes sample type and exposure type, but lacks additional metadata, such as exposure durations, exposure frequency, and more detailed worker activities |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | The monitoring study does not address variability or uncertainty. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Amer Tech Lab, (1979). Monitoring the atmosphere filtering [878210778]. |
| **HERO ID:** | 9609471 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Asbestos removal and clean-up on USS Tattnall |
| Exposure route: | Inhalation |
| Physical form: | Fiber |
| Personal sampling data: | 0.95 fibers/cm3 measured during asbestos removal on USS Tattnall with 3 hr sampling time and 2 LPM flowrate |
| Area sampling data: | 1.0 fibers/cm3 measured during asbestos removal on USS Tattnall with 3 hr sampling time and 2 LPM flowrate0.06 fibers/cm3 measured after clean-up on USS Tattnall with 30 min sampling time and 2 LPM flowrate |
| Engineering control: | Area secured during asbestos removal. |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Low | Sampling or analytical methodology is not specified. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | The data are from the United States. |
| | Metric 3: | Applicability | High | The data are for asbestos removal and clean-up, which are occupational scenarios within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Low | Data are more than 20 years old. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Monitoring data include most critical metadata, such as sample type and exposure type, but lacks additional metadata such as exposure durations and exposure frequency. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | Monitoring report addresses variability through multiple sampling types (personal and area), but does not describe measurement uncertainty. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Amer Tech Lab, (1979). Atmosphere filtering monitoring report [878210782]. |
| **HERO ID:** | 9609926 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Asbestos removal and clean-up |
| Exposure route: | Inhalation |
| Physical form: | Fiber |
| Personal sampling data: | (2 samples) 1.0 fibers/cm3 measured during asbestos removal on USS Yosemite with 6 hr sampling time and 2 LPM flowrate |
| Area sampling data: | (1 sample) 0.9 fibers/cm3 measured during asbestos removal on USS Yosemite with 6 hr sampling time and 2 LPM flowrate(3 samples) 0.9 fibers/cm3 measured after asbestos removal on USS Yosemite with 1 hr sampling time and 2 LPM flowrate(4 samples) 0.9 fibers/cm3 measured after clean-up on USS Yosemite with 30 min sampling time and 2 LPM flowrate |
| Engineering control: | Area secured during asbestos removal and clean-up |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Sampling and Analytical Methodology | Low | Sampling or analytical methodology is not specified. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | The data are from the United States. |
| Metric 3: | Applicability | High | The data are for asbestos removal and clean-up, which are occupational scenarios within the scope of the risk evaluation. |
| Metric 4: | Temporal Representativeness | Low | Data are more than 20 years old. |
| Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Medium | Monitoring data include most critical metadata, such as sample type and exposure type, but lacks additional metadata such as exposure durations and exposure frequency. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Medium | Monitoring report addresses variability through multiple sampling types (personal and area), but does not describe measurement uncertainty. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Amer Tech Lab, (1979). Atmosphere filtering monitoring report [878210783]. |
| **HERO ID:** | 9610119 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Asbestos removal and clean-up |
| Exposure route: | inhalation |
| Physical form: | Fiber |
| Personal sampling data: | 2 sample: Asbestos removal 0.85 f/cc (6 hrs)2 samples: Asbestos removal 0.5 f/cc; (6.5 hrs) |
| Area sampling data: | 1 sample: Asbestos removal 1.3 f/cc (6 hrs)3 samples: After clean-up 0.07 f/cc (30 min) |
| Engineering control: | Secure area from other areas during asbestos removal. |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Sampling and Analytical Methodology | Low | Sampling or analytical methodology is not specified. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | The data are from the United States and are representative of the industry being evaluated. |
| Metric 3: | Applicability | High | The data are for an occupational scenario within the scope of the risk evaluation. |
| Metric 4: | Temporal Representativeness | Low | The data were collected more than 20 years ago. |
| Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Medium | Monitoring data include most critical metadata, such as sample type and exposure type, but lacks additional metadata, such as exposure durations and exposure frequency. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Medium | Variability is addressed by including personal and area samples but uncertainty is not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Amer Tech Lab, (1979). Atmosphere filtering monitoring report [878210784]. |
| **HERO ID:** | 9610281 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Asbestos removal and clean-up |
| Exposure route: | Inhalation |
| Physical form: | Fiber |
| Area sampling data: | 0.75 fibers/cm3 measured during asbestos removal on USS Yosemite with 6.5 hr sampling time and 2 LPM flowrate.0.08 fibers/cm3 measured after clean-up on USS Yosemite with 30 min sampling time and 2 LPM flowrate. |
| Engineering control: | Area secured during asbestos removal |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Sampling and Analytical Methodology | Low | Sampling or analytical methodology is not specified. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | The data are from the United States. |
| Metric 3: | Applicability | High | The data are for asbestos removal and clean-up, which are occupational scenarios within the scope of the risk evaluation. |
| Metric 4: | Temporal Representativeness | Low | Data are more than 20 years old. |
| Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Medium | Monitoring data include most critical metadata, such as sample type and exposure type, but lacks additional metadata such as exposure durations and exposure frequency. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Low | The monitoring study does not address variability or uncertainty. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Amer Tech Lab, (1979). Atmosphere filtering monitoring report [878210785]. |
| **HERO ID:** | 9610388 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Asbestos removal and clean-up |
| Exposure route: | Inhalation |
| Physical form: | Fiber |
| Personal sampling data: | 0.7 fibers/cm3 measured during asbestos removal on the USS Yosemite with a 7.5 hr sampling period and 2 LPM flowrate. |
| Area sampling data: | 0.95 fibers/cm3 measured during asbestos removal on the USS Yosemite with a 7.5 hr sampling period and 2 LPM flowrate.0.01 fibers/cm3 measured after clean-up on the USS Yosemite with a 30 min sampling period and 2 LPM flowrate. |
| Engineering control: | Area was secured during asbestos removal. |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Low | Sampling or analytical methodology is not specified. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | The data are from the United States. |
| | Metric 3: | Applicability | High | The data are for asbestos removal and clean-up, which are occupational scenarios within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Low | Data are more than 20 years old. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Monitoring data include most critical metadata, such as sample type and exposure type, but lacks additional metadata such as exposure durations and exposure frequency. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | Monitoring report addresses variability through multiple sampling types (personal and area), but does not describe measurement uncertainty. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Anania, T. L., Price, J. H., Evans, W. A. (1978). Health hazard evaluation report no. HHE 77-34-417, Midwest Steel Division, National Steel Corporation, Portage, Indiana. |
| **HERO ID:** | 3970508 |
| **Conditions of Use:** | Disposal |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Deep We11Waste sulfuric acid from the continuous pickler is disposed of down a 4,300 feet deep well. A product containing asbestos is used in thetreatment process. An operation adds approximately two to four 50-pound bags of the product into the deep well. This process takes about 10-15 minutes and occurs once every five days or so. |
| Exposure route: | inhalation |
| Physical form: | fiber |
| Personal sampling data: | Pre treatment operator 15 fibers of asbestos per cubic centimeter |
| Area sampling data: | 15 fibers of asbestosper cubic centimeter (15 fibers/cc) |
| Number of workers: | 800 affected employees |
| Personal protective equipment: | The respirator used during this operation is NIOSH approved for asbestos-containing dusts. Respirator protection should be continued until exposures to asbestos can be lowered to acceptable levels. |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | High | NIOSH study |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | US |
| | Metric 3: | Applicability | High | The data are for an occupational scenario (steel processing) within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Low | 1977- prior to PEL (1986) and more than 20 years old |
| | Metric 5: | Sample Size | Medium | Uncertainty was not discussed but assumed that it was addressed in the NIOSH method used. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | Monitoring data include all associated metadata, including sample types, exposure types, sample durations, exposure durations worker activities, and exposure frequency. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | Neither variability nor uncertainty were discussed but assumed that it was addressed in the NIOSH method used. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Anonymous, (2006). Did the employer take sufficient precautions?. Safety Compliance Letter (2575):9, 15. |
| **HERO ID:** | 6907347 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Electricians in a building containing asbestos (1/3) |
| Physical form: | dust (1/3) |
| Personal sampling data: | 8h TWAs on the electricians were 0.1 f/cc and 0.037 f/cc. A 30 minute sample was 1.8 f/cc. (1/3) |
| Number of workers: | 2 electricians (1/3) |

**EVALUATION**

| Domain | | Metric | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Low | Sampling methodology not specified. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for commercial use in construction materials, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Medium | Monitoring data were collected after the most recent PEL and greater than 10 years old. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Exposure type and sampling data provided, but missing exposure duration, frequency, PPE, engineering controls, and particle size. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Anttila, P., Heikkilä, P., Mäkelä, M., Schlünssen, V., Priha, E. (2009). Retrospective exposure assessment for carcinogenic agents in bitumen waterproofing industry in Finland and denmark. Annals of Occupational Hygiene 53(2):139-151. |
| **HERO ID:** | 2596391 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | preparation of an asbestos-containing coating bitumen mixture and to the surfacing of roofing membranes with talc, which contained tremolite asbestos as a contaminant (pg 5) |
| Exposure route: | inhalation |
| Personal sampling data: | mixer operators during adding of asbestos: 2 f/cm3 (pg 5)mean annual exposure level with respect to airborne asbestos for exposed production line workers was estimated to have been high, >0.5 f cm/3 , until the mid-1970s (Table 6). From the mid-1970s to the mid-1980s, when only asbestos-containing talc was applied, the level of exposure was estimated as low, in the range of 0.01 f /cm3. For exposed mixer operators, the mean annual work-related exposure level was estimated to have been medium (0.1–0.5 f /cm3) during the 1970s (pg 6)As the proportion of total working time during which bitumen roofers were in contact with asbestos-containing products was only a few percent, the mean annual work-related exposure levels to asbestos were estimated at <0.01f /cm3 from the 1950s to the 2000s (Table 6). (pg 6)mean annual work-related exposure of production line workers to airborne asbestos was estimated as low, in order of 0.01–0.1 f/cm3, from the mid-1960s to the mid-1980s, when talc was used as surfacing material, and ceased in the mid-1980s (Table 6). For the mixer operators, the exposure levels of exposed workers were estimated to have been medium (0.1–0.5 f /cm3) from the mid-1960s to the late 1970s and to have decreased to low (0.01–0.1 f /cm3) in the beginning of 1980s and ceased in the mid-1980s. (pg 6)Table 6 (described above), pg 7 |
| Area sampling data: | the mean air concentration of asbestos during asbestos surfacing (5 f/cm3) was estimated based on measurement data from other industries (pg 5)air concentration of asbestos during the surfacing <0.1 f/cm3 (pg 5)background level in mixing area: 0.2 f/cm3 (pg 5)Table 5 (pg 6): various activities/sources presenting means, with a range of 0.006-2 f/cm3 |
| Exposure duration: | The mean proportion of working time during which the production line workers were exposed to asbestos was estimated at 15% (pg 5)The mean proportion of working time during which the production line workers were exposed to asbestos-containing talc was some 20% (pg 5) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Low | Sampling/analytical methodology is not specified. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Medium | Data are from Finland and Denmark, OECD countries. |
| | Metric 3: | Applicability | High | Data are for construction materials, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Medium | Data presented for both before and after the most recent PEL and are greater than 10 years old. |
| | Metric 5: | Sample Size | Medium | Sample distribution characterized by limited statistics (means, ranges) but discrete samples not provided and distribution not fully characterized. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Sample type and exposure type provided but missing metadata such as exposure frequency. |
| Domain 4: Variability and Uncertainty | | | | |

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|---|---|
| **Study Citation:** | Anttila, P., Heikkilä, P., Mäkelä, M., Schlünssen, V., Priha, E. (2009). Retrospective exposure assessment for carcinogenic agents in bitumen waterproofing industry in Finland and denmark. Annals of Occupational Hygiene 53(2):139-151. |
| **HERO ID:** | 2596391 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

| | | **EVALUATION** | |
|---|---|---|---|
| Domain | Metric | Rating | Comments |
| | Metric 7: Metadata Completeness | Medium | Variability addressed by providing sampling data for multiple activities, but uncertainty is not addressed. |

## Overall Quality Determination Medium

**Study Citation:** Armco Inc, (1982). Industrial hygiene survey for total weld fume and the cyclohexane-soluble fraction of total asphalt fumes.
**HERO ID:** 1577135
**Conditions of Use:** Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Welding |
| Exposure route: | inhalation |
| Physical form: | inhalable fibers |
| Personal sampling data: | Welder 0.01 f/cc0.03 f/cc0.12 f/cc0.02 f/cc0.02 f/cc |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Medium | Asbestos fibers were taken 0.8 micrometer pore size, mixed cellulose-ester at a calibrated flow rate of approximately 2 liters per minute. Analysis was by phase contrast microscopy (method IH-2-79) |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | US |
| | Metric 3: | Applicability | High | The data are for an occupational scenario (culvert pipe fabrication) within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Low | 1982 - prior to the PEL and more than 20 years old. |
| | Metric 5: | Sample Size | Medium | Statistics were not provided but results from individual sampling events can be summarised into appropriate statistics |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Monitoring data include most critical metadata, such as sample type and exposure type, sample durations, and worker activities, but lacks additional metadata, such as exposure durations and exposure frequency. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | Information on variability was not provided but results from individual sampling events can be evaluated for variance. Uncertainty was not quantified. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Armco Inc, (1976). Air samples for asbestos bonding line, coating department with cover letter. |
| **HERO ID:** | 4158328 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Paper cutters (3/5) |
| Exposure route: | inhalation (3/5) |
| Physical form: | fibers (3/5) |
| Area sampling data: | Area samples were 0.03-0.13 f/cc at the tearing station, 0.03-0.14 f/cc at the tar machine, 0.01 f/cc at the lunch table, 0.01 f/cc at the bonding mill, 0.06-0.07 f/cc at the end of the bonding mill, 0.01-0.04 f/cc at the paper cutter, 0.01-0.05 f/cc at another tar machine, 0.01 f/cc at another lunch table, 0.01 f/cc at the top of the roll stand, 0.02-0.11 f/cc at another paper cutter, and 0.01-0.03 at a third lunch table. (5/5) |
| Number of workers: | 3 employees (3/5) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Sampling and Analytical Methodology | Low | Sampling methodology not specified. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | High | Data are from the U.S. |
| | Metric 3: Applicability | High | Data are for industrial use in construction materials, an in-scope occupational scenario. |
| | Metric 4: Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| | Metric 5: Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | Medium | Exposure type and sampling data provided, but missing, exposure duration, frequency, particle size, engineering controls, and PPE. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Medium | Variability is addressed by sampling on three different days. Uncertainty isn't addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Armco Inc, (1978). Asbestos fiber survey, Raleigh, NC, Plant-MPD MPD request no. IH-108 (10/17/78) S. I. 78607, Report no.1 final with cover memo & attachment. |
| **HERO ID:** | 4158339 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Welders and fitting makers (5/5) |
| Physical form: | fibers (5/5) |
| Personal sampling data: | Personal samples for a welder were <0.02-0.56 f/cc during assembling and welding, and 0.11 f/cc during torch-cutting. Personal samples for the fitting maker were <0.02 f/cc during torch cutting, <0.02-0.10 f/cc during welding, and 0.02 f/cc during assembly. (5/5) |
| Exposure duration: | 8 hours (3/5) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Sampling and Analytical Methodology | Low | Sampling methodology not specified. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | Data are from the U.S. |
| Metric 3: | Applicability | High | Data are for industrial use in metal products, an in-scope occupational scenario. |
| Metric 4: | Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Medium | Exposure type and sampling data provided, but missing number of workers, exposure frequency, particle size, engineering controls, and PPE. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Armco Inc, (1982). Industrial hygiene sampling report with attachments. |
| **HERO ID:** | 4158340 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Welding asbestos bonded pipe. [PDF Pg. 3] |
| Exposure route: | Inhalation (assumed from respiratory protection). [PDF Pg. 6] |
| Personal sampling data: | [PDF PG. 9]Welding bonded pipe (2 samples, both f/cm3, TWA values): 0.02 (sampling time 125 min), 0.02 (sampling time 344 min) |
| Personal protective equipment: | 3M 9920 respirator. [PDF Pg. 6] |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Low | Sampling or analytical methodology is not specified. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for Chemical Substances in Construction, Paint, Electrical, and Metal Products, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. (1982) |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Monitoring data include most critical metadata such as sample type and exposure type, but lacks additional metadata such as exposure durations and exposure frequency. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | Variability addressed by taking samples in different sized spaces (30ft and 50ft bays), but measurement uncertainty is not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Armco Inc, (1979). Industrial hygiene survey - asbestos-bonded line-Ashland Works SI-78570 final with attachment. |
| **HERO ID:** | 4158341 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Operator helper, operator, paper cutter. [PDF Pg. 4] |
| Exposure route: | Inhalation. |
| Personal sampling data: | [PDF Pg. 4]Operator Helper: 0.02, 0.04, 0.07 (f/cm^3)Operator: 0.01, 0.04, 0.05 (f/cm^3)Paper Cutter: 0.11. 1.45, 0.29, 0.28, 0.31, 0.17, 0.19, 0.14, 0.21 (f/cm^3) |
| Comments: | Asbestos was determined by the NIOSH phase contrast microscopy technique. [PDF Pg. 3] Area samples were not for asbestos but total particulate. |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Sampling and Analytical Methodology | High | Sampling/analytical methodology is an approved NIOSH/OSHA method. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | Data are from the U.S. |
| Metric 3: | Applicability | High | Data are for Chemical Substances in Construction, Paint, Electrical, and Metal Products, an in-scope occupational scenario. |
| Metric 4: | Temporal Representativeness | Low | Monitoring data are greater than 20 years old. |
| Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Medium | Sample type and exposure type provided but missing exposure duration and exposure frequency. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | High | Uncertainty is addressed in sampling/analytical methodology. Variability addressed by sampling multiple worker activities. |

## Overall Quality Determination High

**Study Citation:** Armco Inc, (1976). Industrial hygiene survey asbestos bonded line, Ashland Works S.I. 76-226 with attachment.
**HERO ID:** 4158343
**Conditions of Use:** Other:

**EXTRACTION**

| Parameter | Data |
|---|---|
| Area sampling data: | <0.01-0.15 f/cc (pg 4) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Low | Sampling/analytical methodology is not specified. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | Uninformative | Data are for asbestos product manufacturing, a non-legacy use. |
| | Metric 4: | Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Low | Sample type provided but no other metadata. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Uninformative

| | |
|---|---|
| **Study Citation:** | Armco Inc, (1982). Industrial hygiene survey for asbestos brake and clutch lining storage National Drilling Equipment Torrance, California SI-82336, report #1-final survey 82-1 with attachment. |
| **HERO ID:** | 4158345 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Dust cleanup of brake and clutch storage area |
| Exposure route: | inhalation |
| Physical form: | solid |
| Personal sampling data: | 5 samples between 86 - 100 minutes0.03, 0.04, 0.04, 0.07, 0.1 f/cc |
| Area sampling data: | 3 samples between 88-107 minute duration0.04, 0.04, 0.09 f/cc |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Medium | Sampling or analytical methodology is specified, but not equivalent to an approved OSHA or NIOSH method. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | The data are from the United States and are representative of the industry being evaluated. |
| | Metric 3: | Applicability | Medium | The data are for an occupational scenario that is similar to an occupational scenario within the scope of the risk evaluation, in terms of the type of industry, operations, and work activities. |
| | Metric 4: | Temporal Representativeness | Low | The data were collected more than 20 years ago. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Monitoring data include most critical metadata, such as sample type and exposure type, but lacks additional metadata, such as exposure durations, exposure frequency, and worker activities. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | The monitoring study provides only limited discussion of the variability in the determinants of exposure for the sampled site or sector. The monitoring study provides no discussion of the uncertainty in the exposure estimates. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Armco Inc, (1982). Industrial hygiene survey for asbestos-bonding line-Ashland Works SI-81291, report #1-final survey 6-11 with attachments. |
| **HERO ID:** | 4158349 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Workers bond asbestos paper to zinc-coated steel strips. Excess paper is trimmed off. (3/5) |
| Exposure route: | inhalation (3/5) |
| Physical form: | fibers (4/5) |
| Personal sampling data: | (PCM) Personal samples for operators and operator helpers ranged from 0.02-0.04 f/cc. Personal samples for paper cutters ranged from 0.02-0.10 f/cc. (4/5) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Sampling and Analytical Methodology | High | Sampling/analytical methodology is equivalent to an approved [OSHA/NIOSH] method. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | Data are from the U.S. |
| Metric 3: | Applicability | High | Data are for industrial use in metal products, an in-scope occupational scenario. |
| Metric 4: | Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Medium | Exposure type and sampling data provided, but number of workers, exposure duration, frequency, particle size, and PPE. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Armco Inc, (1979). Industrial hygiene survey-Assembly Dept. Area No.12-Torrance, California-National Supply Co. SI-79165, report no.1 final with attachment. |
| **HERO ID:** | 4158353 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Personal sampling data: | [PDF Pg. 4]Assembler (1/17/1979): 0.47 (fibers/cc)Assembler (1/18/1979): 0.30 (fibers/cc) |
| Area sampling data: | [PDF Pg. 5]Workshop table 6 ft from assembly work: 0.21; 0.05 (fibers/cc)Assembly Area: 0.18; 5.08; 0.65 (fibers/cc) |
| Comments: | Unknown if the use is for automotive brake pads. Ambient air drawn through 0.8 um pore size filters at a calibrated flowrate of approximately 2 lpm. Asbestos fiber counts were made by phase contrast microscopy at 600X. |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Sampling and Analytical Methodology | High | Sampling/analytical methodology is equivalent to an approved OSHA/NIOSH method. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | Data are from the U.S. |
| Metric 3: | Applicability | High | Data are for Chemical Substances in Construction, Paint, Electrical, and Metal Products, an in-scope occupational scenario. |
| Metric 4: | Temporal Representativeness | Low | Monitoring data are greater than 20 years old. |
| Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Low | Sample type provided but no other metadata. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | High | Uncertainty is addressed in sampling/analytical methodology. Variability addressed by sampling at multiple areas of the facility. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Armco Inc, (1978). Industrial hygiene survey-Jacksonville, Florida, Plant-Metal Products Division S. I. 78368 final MPD request #IH-103 with attachments. |
| **HERO ID:** | 4158356 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Welding of asbestos bonded corrugated sheets. [PDF Pg. 3] |
| Area sampling data: | Beside Tool Crib [PDF Pg. 4]: zero asbestos fibers found. |
| Exposure duration: | 5 hours/day [PDF Pg. 4] |
| Comments: | Asbestos counts were performed using 600Xphase contrast microscopy. [PDF Pg. 3] Personal sample did not include analysis for asbestos due to containing too much material. |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Sampling and Analytical Methodology | High | Sampling/analytical methodology is equivalent to an approved OSHA/NIOSH method. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | High | Data are from the U.S. |
| | Metric 3: Applicability | High | Data are for Chemical Substances in Construction, Paint, Electrical, and Metal Products, an in-scope occupational scenario. |
| | Metric 4: Temporal Representativeness | Low | Monitoring data are greater than 20 years old. |
| | Metric 5: Sample Size | Low | Sample distribution is characterized by no statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | Low | Sample type provided but no other metadata. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Medium | Uncertainty is addressed in sampling/analytical methodology but variability is not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Armco Inc, (1972). Industrial hygiene-asbestos bonded galvantized-Ashland Works S.I. 72-429 with attachment. |
| **HERO ID:** | 4158359 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Area sampling data: | 15 samples ranging from 0.015 - 0.285 f/cc (p. 4) |
| Comments: | galvanized asbestos processing (out of scope) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Low | Sampling or analytical methodology is not specified. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | The data are from the United States and are representative of the industry being evaluated. |
| | Metric 3: | Applicability | Uninformative | The data are from an occupational or non-occupationalscenario that does not apply to any occupational scenario within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Low | Data collected more than 20 years ago |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Low | Monitoring data include sample type (e.g., personal breathing zone) but no other metadata. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | The monitoring study provides only limited discussion of the variability in the determinants of exposure for the sampled site or sector. The monitoring study does not discuss uncertainty. |

## Overall Quality Determination Uninformative

**Study Citation:** Armco Inc, (1973). Industrial hygiene-asbestos dust survey asbestos bonded galvanized-Ashland Works S.I. 73-408 with attachment.
**HERO ID:** 4158360
**Conditions of Use:** Other:

**EXTRACTION**

| Parameter | Data |
|---|---|
| Worker activity description: | paper cutter, tar machine, roll stand (pg 4) |
| Area sampling data: | Table on pg 4 presents sampling data for the 5 sampled locations, results range from <0.01-0.05 f/ml |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Low | Sampling/analytical methodology is not specified. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | Low | Data are for milling, a non-legacy use, however data may still be informative. |
| | Metric 4: | Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Low | Sample type provided but no other metadata. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Low

| | |
|---|---|
| **Study Citation:** | Armco Inc, (1984). Industrial hygiene survey for airborne fibers-bonding line - Ashland Works. |
| **HERO ID:** | 4158384 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Pot tenders, paper cutters, bond mill operators, laborers (6/16) |
| Exposure route: | inhalation (4/16) |
| Physical form: | fibers (4/16) |
| Personal sampling data: | (PCM) Personal samples ranged from 0.009-0.1 f/cc. (6/16) |
| Area sampling data: | (PCM) Area samples ranged from 0.005-0.10 f/cc (4/16). |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Sampling and Analytical Methodology | High | Sampling/analytical methodology is equivalent to an approved [OSHA/NIOSH] method. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | Data are from the U.S. |
| Metric 3: | Applicability | High | Data are for industrial use in metal products, an in-scope occupational scenario. |
| Metric 4: | Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Medium | Sample type and exposure type provided, but missing exposure duration, frequency, particle size, number of workers, PPE, and engineering controls. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Low | Uncertainty and variability not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Arthur D. Little Inc, (1990). Evaluation of asbestos released from boiler caulking during application and removal with cover letter dated 040891. |
| **HERO ID:** | 4158392 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | application and removal of asbestos containing sealant (pg 5) |
| Exposure route: | inhalation |
| Physical form: | putty-like (asbestos containing sealant) (pg 5)airborne fibers (exposure) |
| Personal sampling data: | Table 1 (pg 7)application: <0.01 structures/ccremoval: <0.01 - 0.01 s/cc |
| Comments: | transmission electron microscopy (pg 7) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Medium | Sampling/analytical methodology is not an approved OSHA/NIOSH method but is an acceptable methodology. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for construction materials, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Low | Monitoring data include most critical metadata such as sample type and exposure type, but lacks additional metadata such as exposure durations, exposure frequency, and worker activity details. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | The monitoring study does not address variability or uncertainty. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Arthur D. Little Inc, (1992). Evaluation of asbestos release from hi-heat dum dum caulking during application and removal with cover letter dated 122392. :1-8. |
| **HERO ID:** | 4158399 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Experiment was meant to replicate actual worker activities. Activities included coating by troweling to steel panels. Removal included using a putty knife and scraper to remove the Hi-Heat Dum Dum product. |
| Exposure route: | inhalation |
| Physical form: | liquid paint, dust during removal |
| Personal sampling data: | 5 out of 6 personal samples were below the limit of detection. The limit of detection was <0.01 structures/cubic centimeters. Structures include fibers, bundles, clumps, and matrix.Samples taken during first application of product, second application of product, first removal, first removal replicated, and second removal all had concentrations below the limit of detection. The sample taken during the third removal had an exposure concentration at the limit of detection of 0.01 s/cc. |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Sampling and Analytical Methodology | Medium | Sampling/analytical methodology is not an approved OSHA/NIOSH method but is an acceptable methodology. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | Data are from the U.S. |
| Metric 3: | Applicability | High | Data are for industrial/commercial use in construction, an in-scope occupational scenario. |
| Metric 4: | Temporal Representativeness | Low | Monitoring data are greater than 20 years old. |
| Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Medium | Sample type and exposure type provided but missing nearly all other metadata. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Medium | Variability addressed by sampling during applying product and removal of product, but uncertainty is not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Arthur D. Little Inc, (1992). Evaluation of asbestos release from exterior masonry weatherproofing mastic during application and removal with cover letter dated 122392. |
| **HERO ID:** | 4158400 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | coating application (spray) and removal simulation (pg 5) |
| Physical form: | mastic-type coating (pg 5) |
| Personal sampling data: | Table 1 (pg 7)Application (80-min): <0.01-0.01 structures/ccRemoval: <0.01 s/cc |
| Area sampling data: | Table 1 (pg 7)Application (80-min): <0.01 structures/ccRemoval: <0.01 s/cc |
| Comments: | transmission electron microscopy (pg 6) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Sampling and Analytical Methodology | Medium | Sampling/analytical methodology is not an approved OSHA/NIOSH method but is an acceptable methodology. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | High | Data are from the U.S. |
| | Metric 3: Applicability | High | Data are for construction materials, an in-scope occupational scenario. |
| | Metric 4: Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| | Metric 5: Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | Medium | Monitoring data include most critical metadata such as sample type and exposure type, but lacks additional metadata such as general exposure durations and exposure frequency. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Medium | The monitoring report addresses variability through collection of multiple sample types (area and personal), but measurement uncertainty is not characterized. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Arthur D. Little Inc, (1992). Evaluation of asbestos releases from chimney weatherproofing mastic during application and removal with cover letter dated 122392. |
| **HERO ID:** | 4158401 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | application/removal of weatherproofing mastic-type coating applied to chimney exteriors (tested in a controlled indoor environment) (pg 5)application is by brush or spray (pg 5; spray was tested per pg 6) |
| Exposure route: | inhalation |
| Personal sampling data: | Application: 0.088 and 0.024 structures/ccRemoval: <0.01 s/cc (table 1, pg 7) |
| Area sampling data: | 10 ft from spray site (5 ft elevation): 0.024 structures/cc (application); <0.01 s/cc (removal) (table 1, pg 7) |
| Comments: | transmission electron microscopy (pg 6) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Medium | Sampling/analytical methodology is not an approved OSHA/NIOSH method but is an acceptable methodology. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for construction materials/paint (coating), in-scope occupational scenarios. |
| | Metric 4: | Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Low | Sample type provided but no other metadata. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Medium

**Study Citation:** ATSDR, (2008). Letter health consultation: Former Stella Cardwell Hospital: Stella, Newton County, Missouri: EPA facility id: MON000704954.
**HERO ID:** 3970343
**Conditions of Use:** Disposal

**EXTRACTION**

| Parameter | Data |
|---|---|
| Worker activity description: | asbestos removal and building demolition |
| Physical form: | asbestos-containing building materials |
| Area sampling data: | "Air samples were collected during and after asbestos abatement activities and demolition of the building. A total of 9 air samples were collected at the perimeter of the site during asbestos abatement. The concentration of asbestos in one sample was reported by the laboratory as less than 0.03 f/cc, but all others were 0.01 f/cc or less. A total of 15 air samples were taken during asbestos abatement right at the work areas. The highest concentration of asbestos at these locations was one sample that showed 0.05 f/cc asbestos in air; the other sample results were 0.01 f/cc or lower. Finally, 18 air samples were also collected in areas of the building where abatement was complete to verify that asbestos did not remain in ambient air. Three of these samples were above 0.01 f/cc, including one sample at 0.21 f/cc. The remainder of the samples were all below 0.01 f/cc. The three samples above 0.01 f/cc were believed to be associated with removal of exterior asbestos-containing siding very near the interior sample collection point.Corresponding background air samples at the site perimeter that day showed asbestos levels of 0.004 f/cc or less, indicating that the exterior siding removal may have created localized elevations of asbestos concentrations, but did not contribute to significant levels of asbestos migrating off site" (pg 5) |
| Comments: | references/summarizes data from another report |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Sampling and Analytical Methodology | Low | Sampling/analytical methodology is not specified. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | Data are from the U.S. |
| Metric 3: | Applicability | High | Data are for disposal of asbestos materials, an in-scope occupational scenario. |
| Metric 4: | Temporal Representativeness | Medium | Monitoring data were collected after the most recent PEL and greater than 10 years old. |
| Metric 5: | Sample Size | Medium | Sample distribution characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Medium | Sample type and exposure type provided but missing exposure duration and associated worker activities during sampling. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Medium | Variability addressed by different locations sampled at perimeter of site and onsite during demolition, but uncertainty is not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | ATSDR, (2010). Health consultation: Johns Manville Manufacturing Plant: Nashua, Hillsborough County, New Hampshire. |
| **HERO ID:** | 3970347 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | EPA's contractor (OHM Remediation Services Corp.) proposed a method that provided for the demolition of the structures ona section by section basis utilizing: 1) selective cutting and removal of key structural elements (piping systems, beams, etc.) during the pre-demolition phase, 2) controlled and predictable dismantling of consecutive 16 ft. x 28 ft. wall and roof sections, and 3) managing debris piles until disposal. The plan specified the need for constant dust control using water suppression (misting) during the demolition phase and either water suppression or tarping of asbestos wastes until it could be removed from thesite (5). [PDF Pg. 2] |
| Exposure route: | Inhalation |
| Physical form: | Dust (solid) [PDF Pg. 2] |
| Area sampling data: | Between September, 1996 and June, 1997 a total of 1324 air samples were collected at the site in support of the removal action (10). Asbestos fiber concentrations in ambient air collected at perimeter air monitoring stations were in the range 0.001 to 0.008 fibers/cc with the average concentration close to the detection limit of 0.001 fibers/cc. [PDF Pg. 4] |
| Comments: | Samples were analyzed by Phase Contrast Microscopy (PCM) in accordance with approved OSHA or NIOSH analytical procedures, with additional analysis being performed by Transmission Electron Microscopy (TEM) utilizing NIOSH Method 7402 (7). [PDF Pg. 3] |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Sampling and Analytical Methodology | High | Sampling/analytical methodology is an approved NIOSH/OSHA method. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | Data are from the U.S. |
| Metric 3: | Applicability | High | Data are for Chemical Substances in Construction, Paint, Electrical, and Metal Products, an in-scope occupational scenario. |
| Metric 4: | Temporal Representativeness | Low | Monitoring data are greater than 20 years old. |
| Metric 5: | Sample Size | Medium | Sample distribution characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Medium | Sample type and exposure type provided but missing exposure frequency and duration. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Medium | Uncertainty is addressed in sampling/analytical methodology but variability is not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | ATSDR, (2012). Health consultation: Milwaukee Die Casting site: Milwaukee, Wisconsin. |
| **HERO ID:** | 3970358 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Comments: | This article is a study of an abandoned facility's health risk to the community. The presence of asbestos in the building does not make it fit the scenario. There are no occupational exposures and no quantified environmental releases. |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Medium | Report uses high quality data that are not from frequently-used sources and there are no known quality issues. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | Uninformative | Data are for an abandoned site study which is not in-scope or similar to an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Uninformative | Report is based on data that are unacceptable based on the abandoned status of the building with no planned/extrapolated activities to the site moving forward. |
| | Metric 5: | Sample Size | Low | Sample distribution is characterized by no statistics. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Methods, results, and assumptions are clearly documented, but underlying data sources are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Uninformative

| | |
|---|---|
| **Study Citation:** | Bailey, S., Conchie, A., Hiett, D. M., Thomas, C. (1988). Personal exposure to asbestos dust during clearance certification. Annals of Occupational Hygiene 32(3):423-426. |
| **HERO ID:** | 3083031 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | 68% of clearance inspections sampled were concerned predominantly with asbestos coating or thermal insulation removal and 32% with the removal of asbestos insulating board or asbestos cement (PDF pg 2) |
| Exposure route: | inhalation |
| Physical form: | airborne fibers |
| Personal sampling data: | Highest TWA was 0.4 fiber/ml, mean TWA was 0.04 fiber/mlHighest 4 hr TWA was 0.1 fiber/ml and mean 4 hr TWA was less than 0.01 fiber/ml (PDF pg 2)Table on PDF pg 3 has sampling results (both sample duration TWAs and 4 hr TWAs) ranging from <0.01 fiber/ml to >0.5 fiber/ml |
| Exposure duration: | 5-194 min, with an average time of 39 min (PDF pg 2) |
| Engineering control: | negative pressure filtration equipment (PDF pg 1) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Medium | Sampling/analytical methodology is not an approved OSHA/NIOSH method but is an acceptable methodology. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Medium | Data are from the UK, an OECD country. |
| | Metric 3: | Applicability | High | Data are for construction materials, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Monitoring data are greater than 20 years old. It is not clear whether the sampled data is before or after the PEL (established in 1986, source is dated 1988) |
| | Metric 5: | Sample Size | Medium | Sample distribution characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Sample type and exposure type provided but missing other metadata |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | Variability addressed by sampling different exposure activities, but uncertainty is not addressed. |

## Overall Quality Determination Medium

**Study Citation:** Bamber, H. A., Butterworth, R. (1970). Asbestos hazard from protective clothing. Annals of Occupational Hygiene 13(1):77-79.
**HERO ID:** 3084935
**Conditions of Use:** Other:

**EXTRACTION**

| Parameter | Data |
|---|---|
| Worker activity description: | Test simulated the work environment and worker activities. These included carrying objects, walking, and bench work. (PDF Page 1). |
| Personal sampling data: | Fiber concentration (fibers/cm^3) on the chest ranged from 3.27-4.60 with an average of 4.06. 95% conf. limits were +/- 0.47 and the 99% conf. limits were +/- 0.72.Fiber concentration on the head ranged from 2.37-4.15 with an average of 3.55. 95% conf. limits were +/- 0.61 and the 99% conf. limits were +/- 0.93.(PDF Page 2). |
| Area sampling data: | Fiber concentration (fibers/cm^3) around the lab ranged from 0.75-3.41 with an average of 2.11. 95% conf. limits were +/- 0.87 and the 99% conf. limits were +/- 1.32. (PDF Page 2) |
| Personal protective equipment: | Asbestos apron and asbestos gauntlets were the PPE used in the work environment. (PDF Page 1) |
| Comments: | Tests were done in a laboratory setting that simulated the work environment. |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Medium | Sampling/analytical methodology is detailed but unsure if it is an approved OSHA/NIOSH method. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Medium | Data is from the UK, an OECD country. |
| | Metric 3: | Applicability | Medium | The data are for general industrial plant use but does not specify what industry. |
| | Metric 4: | Temporal Representativeness | Low | Data is greater than 20 years old. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Sample type, PPE, and worker activity provided but no other metadata. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | Does not address variability or uncertainty. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Beaucham, C., Eisenberg, J. (2019). Evaluation of fire debris cleanup employees' exposure to silica, asbestos, metals, and polyaromatic hydrocarbons. |
| **HERO ID:** | 7598688 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Cleanup of wildfire debris, including task leaders, operators, and laborers (5/54) |
| Exposure route: | inhalation (36/54) |
| Physical form: | fibers (18/54) |
| Personal sampling data: | (PCM) Laborers had the highest mean concentration of fibers (0.090 f/cc), followed by skid steer operators (0.03 f/cc), and last by excavator operators (0.007 f/cc). The fiber concentrations across these jobs ranged from 0.004–0.15 f/cc. (18/54) |
| Area sampling data: | (PCM) The fiber concentration of the area samples ranged from 0.002–0.007 f/cc. (18/54) |
| Personal protective equipment: | All employees were required to wear personal protective equipment (PPE), including respirators, Tyvek® suits, boots or boot covers, hearing protection (sometimes), and gloves (work gloves and/or nitrile) when they entered the lot. (15/54) |
| Engineering control: | Dust suppression methods included water spray from a large tanker and from a hand-held hose spray from a portable water tanker.(21/54) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | High | Sampling/analytical methodology is an approved NIOSH method. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | The data are for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | High | Monitoring data were collected after the most recent PEL and no more than 10 years old. |
| | Metric 5: | Sample Size | Medium | Sample distribution characterized by limited statistics (means, ranges) but discrete samples not provided and distribution not fully characterized. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Exposure type and sampling data provided, but missing additional metadata such as number of workers and exposure duration. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | High | Uncertainty is addressed in sampling/analytical methodology. Variability is addressed in a limitations paragraph in the supplementary information. |

## Overall Quality Determination — High

**Study Citation:** Belanger, P. L., Elesh, E. (1979). Health hazard evaluation report no. HETA 78-73-612, Kentile Floors, Inc., Chicago, Illinois.
**HERO ID:** 3970489
**Conditions of Use:** Other:

**EXTRACTION**

| Parameter | Data |
|---|---|
| Worker activity description: | Asbestos weigher, resin scale operator, mixer operator, scrap tile loader, pigment scale operator (20/24) |
| Exposure route: | inhalation (11/24) |
| Physical form: | fibers (11/24) |
| Personal sampling data: | (PCM) Personal samples for asbestos 8-hr TWAs ranged from ND (multiple jobs) -0.61 f/cc (resin scale operator). (20/24) |
| Exposure duration: | 9.5 hours/day (3/24) |
| Exposure frequency: | 5 days/week (3/24) |
| Number of workers: | 300 workers (2/24) |
| Personal protective equipment: | Workers are required to wear coveralls, respirators, and safety shoes, (3/24) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Sampling and Analytical Methodology | High | Sampling/analytical methodology is an approved NIOSH method. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | Data are from the U.S. |
| Metric 3: | Applicability | Uninformative | Data are for manufacturing of asbestos-containing products, which isn't in scope. |
| Metric 4: | Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Medium | Exposure type and sampling data provided, but missing particle size, and engineering controls. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Medium | Uncertainty is addressed in sampling/analytical methodology. Variability isn't addressed. |

## Overall Quality Determination Uninformative

| | |
|---|---|
| **Study Citation:** | Bell, A. (1976). Industrial hygiene and occupational health studies in Australian (New South Wales) shipyards. Environmental Research 11(2):198-212. |
| **HERO ID:** | 13987 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Shipyard welders (Page 1). Work situations included hand cutting and hand edge smoothing of dry laminated asbestos board, boring holes in and jigsaw cutting board, the wet spray application of asbestos. |
| Exposure route: | Inhalation |
| Physical form: | Dust, fibers |
| Personal sampling data: | Table 4 (Page 11) is the results of an asbestos investigation. (TD = total dust; RD = respirable asbestos dust)Wet spraying of asbestos in galley1) Breathing zone of operator - RD 0.25Wet asbestos application1) Crew quartersi) Breathing zone of operators - RD 37.7Cutting of asbestos sheets1) Breathing zone of employee using power band saw - RD 2.3 |
| Area sampling data: | Table 4 (Page 11) is the results of an asbestos investigation. (TD = total dust; RD = respirable asbestos dust)Cutting of asbestos sheets1) Breathing zone of employee using power band saw - RD 2.3Wet asbestos application1) Crew quartersi) 10 feet from operator - RD 39.72) General atmosphere in smoking room with exposed dry insulation on ceiling - RD 2.03) Upper wheel house: general atmosphere - sweeping dried asbestos material - RD 2.6Shaping of fire retardant board1) Locally exhaust band saw trimming - TD 1.05 Fiber dust exposure; 0.3 mpcf2) Hole drilling and hand operated jigsaw - TD 0.85 Fiber dust exposure; 0.45 mpcfSpraying of limpet asbestos in confined space of 1) Messromi) Adjacent to spray operator - TD 1.5ii) In passageway 20 ft. downwind - 2.5 RD about one third2) Galley 18 ft away - TD 0.9Wet spraying of asbestos in galley1) General atmosphere - RD 0.25Adventitious exposures from spray insulation process1) Foot traffic disturbance of spillage and overspray - TD 0.4 RD 0.1Hand cutting and hand edge smoothing1) Dry laminated asbestos board - TD 9.8; RD 3.8Bandsaw cutting of laminated asbestos board - RD >0.2Boring holes and jigsaw cutting - RD 10Machining of "ferrobestos" in tool room - RD 0.1Cleaning up of asbestos floor spillage in boiler room of naval vessel1) Whilst old lagging being removed (test carried out away from direct fallout) - RD 1.22) Whilst cleaning up - RD 0.6 |
| Number of workers: | Table 1 (Page 2) Number of Australia sites with ship and boat building, repairing, and marine engineering:1963-1964: 14,253 persons employed in Australia, 8,846 employed in New South Wales; 1967-1968: 18,192 persons employed, 10,444 employed in New South Wales |
| Personal protective equipment: | Protective clothing, approved respirators. (page 12) |
| Engineering control: | Local exhaust system |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Sampling and Analytical Methodology | Low | Sampling/analytical methodology is not specified. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | Medium | Data are from Australia, an OECD country. |
| Metric 3: | Applicability | High | Data are for industrial use of various asbestos boards, an in-scope occupational scenario. |
| Metric 4: | Temporal Representativeness | Low | Monitoring data are greater than 20 years old. |
| Metric 5: | Sample Size | Low | Data is characterized by no statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Medium | Includes area and personal sampling data, exposure type, some PPE and engineering controls, and worker activity. Lacks worker duration and frequency. |
| Domain 4: Variability and Uncertainty | | | |

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| | |
|---|---|
| **Study Citation:** | Bell, A. (1976). Industrial hygiene and occupational health studies in Australian (New South Wales) shipyards. Environmental Research 11(2):198-212. |
| **HERO ID:** | 13987 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

| | | EVALUATION | |
|---|---|---|---|
| Domain | Metric | Rating | Comments |
| | Metric 7: Metadata Completeness | Medium | Variability is addressed by including different tasks but uncertainty is not addressed. |

## Overall Quality Determination — Low

| | |
|---|---|
| **Study Citation:** | Bell, J. (1985). Asbestos: A panic exposed. New Scientist 106(1453):3. |
| **HERO ID:** | 6916064 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Area sampling data: | A study of Canadian buildings found an average level of 0.001 f/mL |

**EVALUATION**

| Domain | | Metric | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Low | Sampling or analytical methodology is not specified. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Medium | The data are from an OECD country. other than the U.S., and locality-specific factors (e.g., potential differences in regulatory occupational exposure limits, industry/ process technologies) may impact exposures relative to the U.S. |
| | Metric 3: | Applicability | High | The data are for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Low | Metadata on the operations, equipment, and worker activities associated with the data show that the data agree representative of outdated operations, equipment, and activities rather than current operations, equipment, and worker activities. The data were collected before the most recent PEL establishment or update. |
| | Metric 5: | Sample Size | Low | Distribution of samples is qualitative or characterized by no statistics. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Low | Monitoring data include sample type (area samples) but no other metadata. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | The monitoring study does not address variability or uncertainty. |

## Overall Quality Determination **Low**

| | |
|---|---|
| **Study Citation:** | Benke, G., Trotman, J. (2017). 0480 Measurement of asbestos fibre release during removal works in a variety of diy asbestos removal scenarios. :A151.3-A152. |
| **HERO ID:** | 6905037 |
| **Conditions of Use:** | Consumer Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | DIY asbestos removal. (2/2) |
| Physical form: | fibers (2/2) |
| Personal sampling data: | (SEM/PCM)For personal sampling removal of asbestos cement (AC) sections using an angle grinder resulted in exposure of 13.23 f/ml. Dry cutting of holes for installation of flues in AC roofing was 2.79 f/ml. (2/2) |
| Area sampling data: | (SEM/PCM) All static sample scenarios were below 0.15 f/ml. (2/2) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Medium | Sampling/analytical methodology is not an approved OSHA/NIOSH method but is an acceptable methodology. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Medium | Data are from Australia, an OECD country. |
| | Metric 3: | Applicability | Low | Data are for consumer DIY demolition of asbestos products, which is similar to the in-scope occupational scenario demolition of asbestos products. |
| | Metric 4: | Temporal Representativeness | High | Monitoring data were collected after the most recent PEL and no more than 10 years old. |
| | Metric 5: | Sample Size | Medium | Sample distribution characterized by limited statistics (ranges, select individual data) but discrete samples not provided and distribution not fully characterized. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Exposure type and sampling data provided, but missing number of workers, exposure duration, frequency, PPE, particle size, and engineering controls. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Bird, M. J., Macintosh, D. L., Williams, P. L. (2004). Occupational exposures during routine activities in coal-fueled power plants. Journal of Occupational and Environmental Hygiene 1(6):403-413. |
| **HERO ID:** | 1020681 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Products not Described by Other Codes |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Electricians Electricians Apprentice electriciansFossil fuel services (FFS) Coal equipment operators (CEO) Switchman/samplers Mechanic tractor operators (MTO)Instruments and controls (I&C) Senior instrument technicians Instrument techniciansMechanics Mechanics Apprentice mechanicsOperations Boiler turbine operators (BTO) Assistant boiler turbine operators (ABTO) Auxiliary equipment operators (AEO) |
| Area sampling data: | Area Asbestos (NIOSH Method 7400) - Area asbestos sampling was conducted at four of the five facilities. Sampling pumps were placed in areas near asbestos containing materials that employees would potentially encounter during a work shift (e.g., removed turbine shells, piping containing asbestos, or in areas with asbestos warning signs). At each site a sample was placed on a tripod or on equipment near the breathing zone of an average-sized person.Sixty-one area asbestos samples were taken among the 4 plants; 12 of these had concentrations greater than the limit of detection (0.003 f/cc). Two of these samples were collected at Plant 1, 3 at Plant 2, 1 at Plant 3, and 6 at Plant 4. The values ranged from 0.003–0.007 f/cc and were below the OSHA PEL of 0.1 f/cc. |
| Exposure duration: | 8 hours per day some up to 10 hours. |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | High | NIOSH method 7400 used |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | US |
| | Metric 3: | Applicability | High | The data are for an occupational scenario (coal-fired power plant) within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Medium | 2001 - after PEL (1986) but more than 20 years old. |
| | Metric 5: | Sample Size | Medium | Distribution of samples is characterized by a range. Though uncertain was not discussed it was assumed it was addressed in Method 7400. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Monitoring data include most critical metadata, such as sample type and exposure type, typical sample durations ( noting range of durations), and worker activities but lacks additional metadata, such as exposure durations, and exposure frequency. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | Variability was not discussed and though uncertain was not discussed it was assumed it was addressed in Method 7400. |

## Overall Quality Determination — High

| | |
|---|---|
| **Study Citation:** | Blake, C. L., Dotson, G. S., Harbison, R. D. (2008). Evaluation of asbestos exposure within the automotive repair industry: a study involving removal of asbestos-containing body sealants and drive clutch replacement. Regulatory Toxicology and Pharmacology 52(3):324-331. |
| **HERO ID:** | 2599024 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Mechanics removed asphalt-based undercoatings with a hand-scraper and with a pneumatic chisel. (2/8) |
| Exposure route: | inhalation (4/8) |
| Physical form: | fibers (2/8) |
| Personal sampling data: | (PCM) Personal samples taken during sealant removal were 0.0061 f/cc during hand scraping and 0.0059 during pneumatic chipping. (4/8) (TEM) Mean TEM personal concentrations were 0.0134 f/cc for all activities. (5/8) |
| Area sampling data: | (PCM) Area samples taken during sealant removal were 0.0037 f/cc at 50 feet away and 0.0054 f/cc at 5 feet away. (4/8) (TEM) Mean TEM area concentrations were 0.0053 f/cc for pneumatic chipping and 0.0006 f/cc for manual scraping. (5/8) |
| Exposure duration: | 8 hours (4/8) |
| Number of workers: | 900,000 mechanics and garage workers have been exposed to asbestos. (1/8) |
| Engineering control: | Wheel hubs were covered with disposable plastic bags to prevent liberation of asbestos fibers. (2/8) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Sampling and Analytical Methodology | High | Sampling/analytical methodology is an approved NIOSH method. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | High | Data are from the U.S. |
| | Metric 3: Applicability | High | Data are for commercial use of adhesives and sealants, an in-scope occupational scenario. |
| | Metric 4: Temporal Representativeness | Medium | Monitoring data were collected after the most recent PEL and greater than 10 years old. |
| | Metric 5: Sample Size | Medium | Sample distribution characterized by limited statistics (means, ranges, standard deviations) but discrete samples not provided and distribution not fully characterized. |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | Medium | Exposure type and sampling data provided, but missing exposure frequency, particle size, and PPE. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | High | Uncertainty is addressed in sampling/analytical methodology. Variability is addressed by analyzing samples with PCM and TEM. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Blake, C. L., Harbison, S. C., Johnson, G. T., Harbison, R. D. (2011). Airborne asbestos exposures associated with work on asbestos fire sleeve materials. Regulatory Toxicology and Pharmacology 61(2):236-242. |
| **HERO ID:** | 2571820 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Furnishing, Cleaning, Treatment Care Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Putting asbestos fireproofing sleeves over aircraft hoses. (4/7) |
| Exposure route: | inhalation (1/7) |
| Physical form: | fibers (1/7) |
| Personal sampling data: | (PCM) During hose assembly, 8h-TWAs from personal sampling were 0.012, 0.007, 0.013, and 0.022 f/mL. During cleanup, 8h-TWAs were 0.009 and 0.005 f/mL. (6/7) |
| Area sampling data: | (PCM) In the test room during hose assemble, fiber concentrations were 0.003 and 0.019 f/mL. Distant from the work bench, concentrations were 0.006 and 0.011 f/mL. During cleanup, fiber concentrations were 0.049 f/mL in the test room and 0.048 distant from the work bench. (6/7) |
| Exposure duration: | Hose assembly took 167-198 minutes, and cleanup took 30 minutes. (6/7) |
| Engineering control: | An HVAC unit serves the associated rooms through ceiling mounted supply return registers. (2/7) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Sampling and Analytical Methodology | High | Sampling/analytical methodology is an approved NIOSH method. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | Data are from the U.S. |
| Metric 3: | Applicability | High | Data are for industrial use in textiles, an in-scope occupational scenario. |
| Metric 4: | Temporal Representativeness | Medium | Monitoring data were collected after the most recent PEL and greater than 10 years old. |
| Metric 5: | Sample Size | Medium | Sample distribution characterized by limited statistics (averages, ratios) but discrete samples not provided and distribution not fully characterized. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Medium | Exposure type and sampling data provided, but missing number of workers, exposure frequency, particle size, and PPE. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | High | Uncertainty is addressed in sampling/analytical methodology. Variability is addressed by sampling two times and analyzing with PCM and TEM. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Blake, C. L., Johnson, G. T., Harbison, R. D. (2009). Airborne asbestos exposure during light aircraft brake replacement. Regulatory Toxicology and Pharmacology 54(3):242-246. |
| **HERO ID:** | 2594497 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Personal sampling data: | [PDF Pg. 4]Brake change - Left wheel (average; 8-hr TWA):Left shoulder: 0.024 (f/mL); 0.003 (f/mL)Right Shoulder: <0.011 (f/mL); <0.001 (f/mL)Excursion Level: <0025 (f/mL); N/ABrake change - Right wheel using blowout cleaning (average; 8-hr TWA):Left shoulder: 0.016 (f/mL); 0.002 (f/mL)Right Shoulder: <0.011 (f/mL); <0.001 (f/mL)Excursion Level: 0.037 (f/mL); N/AShop cleaning (average; 8-hr TWA):Left Shoulder: <0.011 (f/mL); <0.001 (f/mL)Right Shoulder: <0.011 (f/mL); <0.001 (f/mL)Excursion Level: <0.069 (f/mL); N/A |
| Area sampling data: | Changing left wheel brake: <0.0036 - 0.0090 (range from 6 samples in f/mL)Changing right wheel brake (w/blowout cleaning): <0.0035-0.0120 (f/mL; range from 6 samples)Shop Cleaning: <0.0035 - 0.0064 (f/mL; range from 6 samples) |
| Comments: | Sampling was performed using PCM according to NIOSH 7400. |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | High | Sampling/analytical methodology is an approved NIOSH/OSHA method. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for Chemical Substances in Construction, Paint, Electrical, and Metal Products, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Medium | Monitoring data were collected after the most recent PEL and greater than 10 years old. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Sample type and exposure type provided but missing exposure duration and frequency. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | High | Uncertainty is addressed in sampling/analytical methodology. Variability addressed by sampling multiple activities and taking area and personal samples. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Boelter, F. W. (2003). Asbestos exposures from gasket removal - Author's reply. AIHA Journal 64(5):595-597. |
| **HERO ID:** | 3584902 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Removal of asbestos containing gaskets and packing in industrial and maritime fittings. (1/3) |
| Physical form: | fibers (1/3) |
| Area sampling data: | One paper reported 8h-TWAs between 1.0-3.6 f/cc. (1/3) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Medium | Sampling method is an approved NIOSH method, but the paper states that it wasn't followed properly. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for demolition of asbestos products, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Medium | Monitoring data were collected after the most recent PEL and greater than 10 years old. |
| | Metric 5: | Sample Size | Medium | Sample distribution characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Exposure type and sampling data provided, but missing number of workers, exposure duration, frequency, PPE, particle size, and engineering controls. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | Uncertainty is addressed by discussing how the NIOSH method may not have been followed. Variability isn't addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Boelter, F. W., Crawford, G. N., Podraza, D. M. (2002). Airborne fiber exposure assessment of dry asbestos-containing gaskets and packings found in intact industrial and maritime fittings. AIHA Journal 63(6):732-740. |
| **HERO ID:** | 3520465 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Products not Described by Other Codes |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | The five different worker activities evaluated included flat blade scraping, hand wire brushing, power wire brushing, making gaskets with a ball-peen hammer, and stem packing removal and replacement (pg 733) |
| Exposure route: | Inhalation (pg 735) |
| Physical form: | Fibrous (pg 733) |
| Personal sampling data: | Personal samples during the testing of ‘‘industrial fittings’’ ranged from 0.005 to 0.052 f/cc. The mean of the personal samples of the five ‘‘industrial’’ cycles was 0.026 f/cc. Standard deviations ranged from 0.001 to 0.008 f/cc (pg 737). |
| Area sampling data: | Room air samples during the testing of industrial fittings ranged from 0.005 to 0.048 f/cc. The mean of the room air samples of the five industrial cycles was 0.023 f/cc. Standard deviations ranged from 0.001 to 0.006 f/cc (pg 737). |
| Exposure duration: | 8 hr/day (pg 735) |
| Engineering control: | The results of this simulation, therefore, represent worst case conditions and are likely higher than those that would be experienced in actual working conditions out of doors or in ventilated spaces if interfering fiber sources could be eliminated from those settings (pg 740). |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Sampling and Analytical Methodology | High | Methodology is an approved OSHA method. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | The data are from the United States. |
| Metric 3: | Applicability | High | The data are for an occupational scenario within the scope of the risk evaluation. |
| Metric 4: | Temporal Representativeness | Low | The data were collected more than 20 years ago. |
| Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Medium | Monitoring data include most critical metadata, but lacks additional metadata such as sample durations and exposure frequency. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | High | The monitoring report addresses variability by sampling multiple worker types and using multiple sample types (area and personal), and uncertainty is addressed through the sampling methodology. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Boelter, F. W., Spencer, J. W., Simmons, C. E. (2007). Heavy equipment maintenance exposure assessment: using a time-activity model to estimate surrogate values for replacement of missing data. Journal of Occupational and Environmental Hygiene 4(7):525-537. |
| **HERO ID:** | 3079629 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Disassembly of a commercial boiler burner flange and gasket removal; work with heavy machinery; maintenance on various pumps, valves, and fittings (p. 3)Industrial/commercial pumps (Ref B): Packing was removed using a packing hook, pick, screwdriver and needle- nosed pliers. Replacement packing was cut with chisel and hammer. Gasketswere removed using a flat blade scraper. Gaskets were made from compressed sheet material using a knife and ball peen hammer. Day 1: 50% of the gaskets and 75% of the packing contained chrysotile asbestos. Day 2: 75% of the packing contained chrysotile asbestos. Day 3: 30% of the gaskets and 93% of the packing contained chrysotile asbestos. One set of packing contained crocidolite asbestos (p. 6)Pump fittings, check valves (Ref G): Day 1: Removed with a flat blade scraper and utility knife. Residue was removed with a power grinder fitted with a twisted wire wheel. Day 2: Gasket residue removedIndustrial and maritime fittings (Ref I): Day 1: Gaskets removed using a flat blade scraper from 5 fittings/8 flanges. Day 2: Gaskets removed using a flat blade scraper then "faced" with hand wire brush from 5 fittings/8 flanges. 50% of gaskets contained asbestos. Day 3: Gaskets removed using a flat blade scraper then "faced" withpowered wire brush from 6 fittings/eight flanges. Day 4: Gaskets made using a scribe, knife, and ball peen hammer for 8 flanges/7 fittings. Day 5: Packing removed using corkscrew packing tool and packing pick from 8 valves. Replacement packing was cut with a knife. 90% of packing contained asbestos. (p. 7)Commercial boiler (Ref K): Burner flange gasket removal using a flat blade scraper. Gasket-related activities covered a partial shift. (p. 6)Heavy Machinery (Ref M): Removal using a flat blade scraper then facing of surfaces with powered abrasive pads or wire brushes. Compressed air and human breath was used occasionally to remove dust (p. 7) |
| Personal sampling data: | National Institute for Occupational Safety and Health Methods7400 and 7402"A total of 782 samples were analyzed by phase contrast microscopy, and 499 samples were analyzed by transmission electron microscopy" (abstract)PCM database consists of 94 full-shift TWA personal, 340 30-minpersonal, and 348 full-shift TWA area measured exposureestimates. The TEM database comprises 70 full-shift TWApersonal, 182 30-min personal, and 247 full-shift TWA areameasured exposure estimates (p. 3)Total fibers (analysis 1, Full shift, Table III): min: 0.0029 f/cc; max: 0.0848 f/ccTotal fibers (analysis 1, 30-min samples, Table III): min: 0.0409 f/cc; max: 0.9396 f/cc |
| Area sampling data: | 348 full-shift TWA area measurements (p. 3)Total fibers(analysis 1, Table III): min: 0.0025 f/cc; max: 0.0879 f/cc |
| Particle size characterization: | The fibers that are counted are those longer than 5 µm, witha length-to-width ratio greater than or equal to 3:1 (p. 8) |
| Exposure duration: | 8-hr workday (i.e., monitoring TWAs ranged from 6.5 to 9 hr,with the typical time period being 7 to 8 hr) (p. 8) |

**EVALUATION**

| Domain | | Metric | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | High | Sampling or analytical methodology is an approved OSHA or NIOSH method or is well described and found to be equivalent to approved OSHA or NIOSH methods. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | The data are from the United States and are representative of the industry being evaluated. |
| | Metric 3: | Applicability | High | The data are for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Low | Metadata on the operations, equipment, and worker activities associated with the data show that the data agree representative of outdated operations, equipment, and activities rather than current operations, equipment, and worker activities. The data were collected more than 20 years ago. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized. |

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| | |
|---|---|
| **Study Citation:** | Boelter, F. W., Spencer, J. W., Simmons, C. E. (2007). Heavy equipment maintenance exposure assessment: using a time-activity model to estimate surrogate values for replacement of missing data. Journal of Occupational and Environmental Hygiene 4(7):525-537. |
| **HERO ID:** | 3079629 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

| | | EVALUATION | |
|---|---|---|---|
| Domain | Metric | Rating | Comments |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Medium | Monitoring data include most critical metadata, such as sample type and exposure type, but lacks additional metadata, such as exposure frequency |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | High | The monitoring study addresses variability in the determinants of exposure for the sampled site or sector. The monitoring study addresses uncertainty in the exposure estimates or uncertainty canbe determined from the sampling and analytical method. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Boelter, F. W., Xia, Y., Persky, J. D. (2016). A Bayesian model and stochastic exposure (dose) estimation for relative exposure risk comparison involving asbestos-containing dropped ceiling panel installation and maintenance tasks. Risk Analysis :1729-1741. |
| **HERO ID:** | 3520468 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Ceiling installers, maintenance workers (2/13) |
| Exposure route: | inhalation (2/13) |
| Physical form: | fibers (2/13) |
| Personal sampling data: | (PCM) Personal 8h TWAs were 0.007 f/cc at site A, 0.022 f/cc at site B, and 0.078 f/cc in a testing chamber. (5/13) |
| Area sampling data: | (PCM) Area samples were 0.11+-0.003 f/cc at site A, 0.016+-0.004 f/cc at site B, and 0.054+-0.007 f/cc in a testing chamber. (5/13) |
| Exposure duration: | 8 hours (6/13) |
| Exposure frequency: | Specialists work 49-147 days/year. Generalists work 2-10 days/year. Maintenance workers work 52-260 days/year. (10/13) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | High | Sampling/analytical methodology is an approved NIOSH method. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for commercial use in construction materials, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | High | Monitoring data were collected after the most recent PEL and no more than 10 years old. |
| | Metric 5: | Sample Size | Medium | Sample distribution characterized by limited statistics (means, ranges, standard deviations, modes) but discrete samples not provided and distribution not fully characterized. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Exposure type and sampling data provided, but missing number of workers, particle size, engineering controls, and PPE. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | High | Uncertainty is addressed in sampling/analytical methodology. Variability is addressed by sampling two sites and a test chamber. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Boelter, F., Simmons, C., Hewett, P. (2011). Exposure data from multi-application, multi-industry maintenance of surfaces and joints sealed with asbestos-containing gaskets and packing. Journal of Occupational and Environmental Hygiene 8(4):194-209. |
| **HERO ID:** | 2576853 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Friction-Related Work Band brake removal Removal of rivets and friction lining from brake band or brake shoe Cutting band with abrasive disc Removal of disc brake assembly Brake replacement and adjustment Rivet replacement of friction lining to bands or shoes Drilling of brake lining Clutch removal, replacement and adjustment (D8 only) Rivet removal from drive and drivenplates (D8 only) Cleaning, scraping compressed air cleaning of drive and driven plates (D8 only) Rivet replacement of friction linings to drive and driven plates (D8 only)Gasket-Related Work Removal of head/exhaust and intake manifold/water manifold gaskets Scraping/power cleaning of engine head, engine block, and manifold surfaces Wiping, cleaning parts Use of compressed air to clean engine parts Replacement of engine parts and gaskets |
| Exposure route: | inhalation |
| Physical form: | inhalable fibers |

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|---|---|
| **Study Citation:** | Boelter, F., Simmons, C., Hewett, P. (2011). Exposure data from multi-application, multi-industry maintenance of surfaces and joints sealed with asbestos-containing gaskets and packing. Journal of Occupational and Environmental Hygiene 8(4):194-209. |
| **HERO ID:** | 2576853 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Personal sampling data: | | | Day 1 TWA full-shift analyzed data >390 minutes min: 0.002 f/cc max: 0.041 f/cc mean: 0.024f/cc SD:0.028Day 1 TWA partial-shift analyzed data <390 minutes mean: 0.007 f/cc Day 1 TWA analyzed plus modeled data minutes min: 0.002 f/cc max: 0.033 f/cc mean: 0.016 f/cc SD: 0.017Day 2 TWA full-shift analyzed data >390 minutes min: 0.005 f/cc max: 0.007f/cc mean: 0.006 f/cc SD: 0.001Day 2 TWA analyzed plus modeled data min: 0.005 f/cc max: 0.007 f/cc mean:0.006 f/cc SD: 0.001Day 3 TWA full-shift analyzed data >390 minutes min: 0.020 f/cc max: 0.028 f/cc mean: 0.024 f/cc SD: 0.006Day 3 TWA partial-shift analyzed data <390 minutes min: 0.015 f/cc max: 0.046 f/cc mean: 0.030f/cc SD: 0.022Day 3 TWA analyzed plus modeled data min: 0.013 f/cc max: 0.036 f/cc mean: 0.024 f/cc SD: 0.010Day 4 TWA full-shift analyzed data >390 minutes mean: 0.005 f/ccDay 4 TWA partial-shift analyzed data <390 minutes min: 0.008 f/cc max: 0.009 f/cc mean: 0.008f/cc SD:0.001Day 4 TWA analyzed plus modeled data min: 0.005 f/cc max: 0.007 f/cc mean: 0.006 f/cc SD: 0.001Day 5 TWA partial-shift analyzed data <390 minutes min: 0.046 f/cc max: 0.055 f/cc mean: 0.052f/cc SD: 0.005Day 5 TWA analyzed plus modeled data min: 0.045 f/cc max: 0.064 f/cc mean:0.053 f/cc SD: 0.010Day 6 TWA full-shift analyzed data >390 minutes min: 0.011 f/cc max: 0.012 f/cc mean: 0.011 f/cc SD: 0.001Day 6 TWA partial-shift analyzed data <390 minutes mean: 0.011 f/ccDay 6 TWA analyzed plus modeled data min: 0.011 f/cc max: 0.012 f/cc mean:0.011 f/cc SD: 0.001Day 7 TWA full-shift analyzed data >390 minutes min: 0.014 f/cc max: 0.022 f/cc mean: 0.017 f/cc SD: 0.004Day 7 TWA analyzed plus modeled data min: 0.014 f/cc max: 0.022 f/cc mean:0.017 f/cc SD: 0.004Day 8 TWA full-shift analyzed data >390 minutes min: 0.010 f/cc max: 0.017f/cc mean: 0.012 f/cc SD: 0.004Day 8 TWA analyzed plus modeled data min: 0.010 f/cc max: 0.017 f/cc mean: 0.012 f/cc SD: 0.004Day 9 TWA full-shift analyzed data >390 minutes min: 0.008 f/cc max: 0.019 f/cc mean: 0.014 f/cc SD: 0.005Day 9 TWA analyzed plus modeled data min: 0.008 f/cc max: 0.019 f/cc mean:0.014 f/cc SD: 0.005Total TWA full-shift analyzed data >390 minutes min: 0.002 f/cc max: 0.041 f/cc mean: 0.014 f/cc SD: 0.009Total TWA partial-shift analyzed data <390 minutes min: 0.008 f/cc max: 0.055f/cc mean: 0.022 f/cc SD: 0.003Total TWA analyzed plus modeled data min: 0.002 f/cc max: 0.064 f/cc mean: 0.018 f/cc SD: 0.005Analysis by NIOSH 7400 Phase Contrast Microsopy (PCM)Friction-Related Work Band brake removal min: 0.043f/cc max: 0.077 f/cc avg: 0.048f/cc SD: 0.010 Removal of rivets and friction lining from brake band or brake shoe min: 0.044 f/cc max: 0.044 f/cc avg: 0.044 f/cc SD: 0.000 Cutting band with abrasive discmin:0.049 f/cc max: 0.561 f/cc avg: 0.305 f/cc SD:0.362 Removal of disc brake assembly min: 0.044 f/cc max: 0.044 f/cc avg: 0.044 f/cc SD: 0.000 Brake replacement and adjustment min: 0.043 f/cc max: 0.104 f/cc avg: 0.047 f/cc SD: 0.012 Rivet replacement of friction lining to bands or shoes min: 0.043 f/cc max: 0.044 f/cc avg: 0.044 f/cc SD: 0.001 Drilling of brake lining avg: 0.038 f/cc Clutch removal, replacement and adjustment (D8 only)min: 0.043 f/cc max: 0.201 f/cc avg: 0.079 f/cc SD: 0.050 Rivet removal from drive and driven plates (D8 only) min: 0.190 f/cc max: 0.230 f/cc avg: 0.210 f/cc SD: 0.028 Cleaning, scraping compressed air cleaning of drive and driven plates (D8 only) min: 0.151 f/cc max: 0.211 f/cc avg: 0.180 f/cc SD: 0.026 Rivet replacement of friction linings to drive and driven plates (D8 only)min:0.048 f/cc max: 0.207f/cc avg: 0.156 f/cc SD: 0.056Gasket-Related Work m Removal of head/exhaust and intake manifold/water manifold gaskets min: 0.044 f/cc max: 0.048 f/cc avg: 0.045 f/cc SD:0.001 Scraping/power cleaning of engine head, engine block, and manifold surfacesmin: 0.045 f/cc max: 0.413 f/cc avg:0.143 f/cc SD: 0.125 Wiping, cleaning parts min: 0.045 f/cc max: 0.199f/cc avg:0.065 f/cc SD: 0.054 Use of compressed air to clean engine parts min: 0.045 f/cc max: 0.199 f/cc avg:0.064 f/cc SD: 0.054 Replacement of engine parts and gasketsmin:0.045 f/cc max: 0.074 f/cc avg:0.050 f/cc SD: 0.010Analysis by NIOSH 7400 (PCM) & 7402 (TEM)Friction-Related Work Band brake removal min: 0.043f/cc max: 0.058 f/cc avg: 0.045 f/cc SD: 0.004 Removal of rivets and friction lining from brake band or brake shoe min: 0.044 f/cc max: 0.044 f/cc avg: 0.044 f/cc SD:0.000 Cutting band with abrasive discmin: 0.049 f/cc max: 0.561f/cc avg: 0.305 f/cc SD:0.362 Removal of disc brake assembly min: 0.044 f/cc max: 0.044 f/cc avg:0.044 f/cc SD:0.000 Brake replacement and adjustment min: 0.043 f/cc max: 0.045 f/cc avg: 0.044 f/cc SD:0.001 Rivet replacement of friction lining to bands or shoes min:0.043 f/cc max:0.044 f/cc avg: 0.044 f/cc SD:0.001 Drilling of brake lining avg: 0.038 f/cc Clutch removal, replacement and adjustment (D8 only) min: 0.043 f/cc max: 0.099 f/cc avg: 0.048 f/cc SD: 0.013 Rivet removal from drive and driven plates (D8 only) min: 0.150”f/cc max: 0.184 f/cc avg: 0.167 f/cc SD: 0.024 Cleaning, scraping compressed air cleaning of drive and driven plates (D8 only) min: 0.150 f/cc max: 0.211f/cc avg: 0.170 f/cc SD: 0.029 Rivet replacement of friction linings to drive and driven plates (D8 only)min:0.044 f/cc max: 0.207 f/cc avg:0.127 f/cc SD: 0.069 Gasket-Related Work Removal of head/exhaust and intake manifold/water manifold gasketsmin: 0.044 f/cc max: 0.045 f/cc avg: 0.044 f/cc SD: 0.000 Scraping/power cleaning of engine head, engine block, and manifold surfacesmin: 0.045 f/cc max: 0.413 f/cc avg: 0.116 f/cc SD: 0.114 Wiping, cleaning parts min: 0.045 f/cc max:0.094 f/cc avg: 0.051 f/cc SD:0.017 Use of compressed air to clean engine parts min: 0.045 f/cc max: 0.094 f/cc avg: 0.051 f/cc SD: 0.017 Replacement of engine parts and gasketsmin:0.045 f/cc max: 0.045”f/cc avg:0.045 f/cc SD: 0.000PCME TWA( asbestos fibers/cc) Day 1 Mechanic #2 D8 – Cable control disassembly. 12E—removed wheels and brake 0.002 f/ccDay 1 Mechanic #3 D8 – Removed and replaced right cable control brake 0.033f/ccDay 1 Mechanic #412 E – Removed and replaced the air filter, exhaust and intake manifolds, valve cover, and engine head 0.007 f/ccDay 2 Mechanic #2D8 – Removed parts to access the track brakes. Assisted with disconnection of the cable control unit from the body of the dozer. 12E –removed and replaced rear brakes 0.005 f/ccDay 2 Mechanic #3D8 – Removed and replaced left cable control brake, disconnected cable control unit from body of D80.007 f/ccDay 2 Mechanic #412E – Removed and replaced rear brakes, cleaned engine head and block, replaced head gasket and engine head, removed radiator connections and gaskets 0.005 f/ccDay 3 Mechanic #112E – Removed and replaced rear brakes, cleaned engine head and block, replaced head gasket and engine head, removed radiator connections and gaskets 0.028 f/cc Day 3 Mechanic #2D8 – Removed the left and right track brake bands, replaced left brake band 0.036 f/ccDay 3 Mechanic #3D8 – Removed and replaced clutch and cable puller linkage0.013 f/ccDay 3 Mechanic #4”12E – Machine fluids replaced, oil filter, crank case breather and air filter parts and gaskets and engine cover replaced. 930 – Removed and replaced the wheels, four brake caliper assemblies, and brake pads 0.020 f/ccDay 4 Mechanic #2”D8 – Track band brake replacement and adjustment. Assisted with the removal of clutch usingoverhead hoist 0.007 f/ccDay 4 Mechanic #3D8 – Removed parts to access the master clutch. Assisted with the removal of clutch using |

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|---|---|
| **Study Citation:** | Boelter, F., Simmons, C., Hewett, P. (2011). Exposure data from multi-application, multi-industry maintenance of surfaces and joints sealed with asbestos-containing gaskets and packing. Journal of Occupational and Environmental Hygiene 8(4):194-209. |
| **HERO ID:** | 2576853 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Area sampling data: | | | Day 1 TWA partial-shift analyzed data <390 minutes; min: 0.004 f/cc max: 0.006 f/cc mean: 0.005 f/cc SD: 0.001Day 1 TWA analyzed plus modeled data; min: 0.006 f/cc max: 0.008 f/cc mean: 0.006f/cc SD:0.001Day 2 TWA full-shift analyzed data >390 minutes; min: 0.005 f/cc max: 0.006 f/cc mean: 0.006 f/cc SD: 0.000Day 2 TWA analyzed plus modeled data; min: 0.005 f/cc max: 0.006 f/cc mean: 0.006f/cc SD:0.000Day 3 TWA full-shift analyzed data >390 minutes; min: 0.005 f/cc max: 0.022 f/cc mean: 0.014 f/cc SD:0.005Day 3 TWA analyzed plus modeled data; min: 0.005 f/cc max: 0.022 f/cc mean: 0.014f/cc SD: 0.005Day 4 TWA partial-shift analyzed data <390 minutes; min: 0.013f/cc max: 0.018 f/cc mean: 0.014 f/cc SD: 0.002Day 4 TWA analyzed plus modeled data; min: 0.007 f/cc max: 0.007 f/cc mean: 0.007f/cc SD: 0.000Day 5 TWA partial-shift analyzed data <390 minutes; min: 0.03f/cc max: 0.04 f/cc mean: 0.036f/cc SD:0.004Day 5 TWA analyzed plus modeled data; min: 0.034 f/cc max: 0.039 f/cc mean: 0.036f/cc SD:0.001Day 6 TWA full-shift analyzed data >390 minutes; min: 0.007 f/cc max: 0.010 f/cc mean:0.008 f/cc SD: 0.001Day 6 TWA partial-shift analyzed data <390 minutes; min: 0.007 f/cc max: 0.010 f/cc mean:0.008 f/cc SD: 0.001Day 6 TWA analyzed plus modeled data; min: 0.007 f/cc max: 0.010 f/cc mean: 0.008f/cc SD:0.001Day 7 TWA full-shift analyzed data >390 minutes; min: 0.009 f/cc max: 0.022 f/cc mean: 0.015 f/cc SD:0.004Day 7 TWA analyzed plus modeled data; min: 0.009 f/cc max: 0.022 f/cc mean: 0.015f/cc SD: 0.004Day 8 TWA full-shift analyzed data >390 minutes; min: 0.009 f/cc max: 0.019 f/cc mean: 0.011 f/cc SD: 0.004Day 8 TWA analyzed plus modeled data; min: 0.009 f/cc max: 0.019 f/cc mean: 0.011f/cc SD: 0.004Day 9 TWA full-shift analyzed data >390 minutes; min: 0.008 f/cc max: 0.017 f/cc mean: 0.011 f/cc SD:0.003Day 9 TWA analyzed plus modeled data; min: 0.008 f/cc max: 0.017 f/cc mean: 0.011f/cc SD:0.003Total TWA full-shift analyzed data >390 minutes; min: 0.005 f/cc max: 0.022 f/cc mean: 0.011 f/cc SD:0.002Total TWA partial-shift analyzed data <390 minutes; min:0.004 f/cc max: 0.040 f/cc mean:0.016 f/cc SD: 0.001Total TWA analyzed plus modeled data; min: 0.005 f/cc max: 0.039 f/cc mean: 0.013f/cc SD: .002 |

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**Study Citation:** Boelter, F., Simmons, C., Hewett, P. (2011). Exposure data from multi-application, multi-industry maintenance of surfaces and joints sealed with asbestos-containing gaskets and packing. Journal of Occupational and Environmental Hygiene 8(4):194-209.
**HERO ID:** 2576853
**Conditions of Use:** Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Exposure duration: | | | Surrogate Estmatesd Value timeDay 1 Mechanic #2D8 – Cable control disassembly. 12E—removed wheels and brake 0 MinutesDay 1 Mechanic #3D8 – Removed and replaced right cable control brake 131 MinutesDay 1 Mechanic #412 E – Removed and replaced the air filter, exhaust and intake manifolds, valve cover, and engine head 123Minutes Day 2 Mechanic #2D8 – Removed parts to access the track brakes. Assisted with disconnection of the cable control unit from the body of the dozer. 12E –removed and replaced rear brakes 0 MinutesDay 2 Mechanic #3D8 – Removed and replaced left cable control brake, disconnected cable control unit from body of D8 0 MinutesDay 2 Mechanic #412E – Removed and replaced rear brakes, cleaned engine head and block, replaced head gasketand engine head, removed radiator connections and gaskets 0 MinutesDay 3 Mechanic #112E – Removed and replaced rear brakes, cleaned engine head and block, replaced head gasket and engine head, removed radiator connections and gaskets 0 MinutesDay 3 Mechanic #2D8 – Removed the left and right track brake bands, replaced left brake band 162 MinutesDay 3 Mechanic #3D8 – Removed and replaced clutch and cable puller linkage 162MinutesDay 3 Mechanic #4”12E – Machine fluids replaced, oil filter, crank case breather and air filter parts and gaskets and engine cover replaced. 930 – Removed and replaced the wheels, four brake caliper assemblies, and brake pads 0 MinutesDay 4 Mechanic #2D8 – Track band brake replacement and adjustment. Assisted with the removal of clutch using overhead hoist 350MinutesDay 4 Mechanic #3D8 – Removed parts to access the master clutch. Assisted with the removal of clutch using overhead hoist223Minutes Day 4 Mechanic #4955 – Removed engine cowling, exhaust manifold, rocker arm assembly, valve cover, engine studs, air intake manifold and air filter, radiator hose connection, water thermostat and the engine head along with associated gaskets0MinutesDay 5 Mechanic #1955 – Removed parts to gain access to the rear brake bands. Disassembled and removed the steering clutch linkages and assisted Mechanic #4 64 MinutesDay 5 Mechanic #3D8 – Removed and replaced clutch drive and driven plate friction linings 155 MinutesDay 5 Mechanic #4 955 – Removed gaskets from the intake manifold, exhaust manifold, valve cover, radiator hose pipe connection, and the oil cooler/water pump. Replaced ferrules, seals, gaskets and engine head 279 MinutesDay 6 Mechanic #1D8 – Assisted with replacement of clutch. 955 – Removed three left side brake band assemblies 0 MinutesDay 6 Mechanic #2955 – Removed band brake; D8 – Removed and replaced clutch and cable puller linkage 0 MinutesDay 6 Mechanic #3D8 – Reinstalled the clutch assembly and clutch linkage 0MinutesDay 6 Mechanic #4955 – Reassembled with gaskets the valve assembly, air intake manifold, exhaust manifold, thermostat, oil cooler surface, radiator pipe connection surfaces, and air filter assemble0 MinutesDay 7 Mechanic #1955 – Removal of left side brake bands, replaced the oil cooler, radiator pipe, gaskets, and radiator fan and fan guard. 0 MinutesDay 7 Mechanic #3D8 – Reassembled the clutch linkage and installed the transmission inter-lock assembly with its original gasket. 955 – Assisted mechanic #1 0 MinutesDay 7 Mechanic #4”D8 – Removed the “pony” engine exhaust pipe, pony engine supply tube, water manifold pipe, exhaust and air intake manifold, and cylinder heads. Removed gaskets and cleaned engine head and flanged surfaces” 0 MinutesDay 8 Mechanic #1955 – Installed right- and left-side brake bands and steering linkages 0MinutesDay 8 Mechanic #2955 – Installed the brake bands on the right and left side. Reinstalled brake and steering linkages; D8 – Assisted with installation of engine head 0 MinutesDay 8 Mechanic #4D8 – Cleaned the exhaust/intake manifolds, front and rear cylinder heads, removed and replaced gaskets0Minutes Day 9 Mechanic #1 955 – Completed steering clutch and brake linkage installation and adjusted brakes. 0 minutesD8 – Assisted Mechanic #4 Mechanic #2”955 – Completed steering clutch and brake linkage installation and adjusted brakes. D8 – Assisted Mechanic #4 955 – Completed steering clutch and brake linkage installation, adjusted brakes; D8 – Assisted Mechanics #1 and 4 with engine assembly and replaced exhaust stack0 MinutesDay 9 Mechanic #3D8 – Drained and replaced oil, re-installed seats, levers, and steering linkages in cab 0 MinutesDay 9 Mechanic #4D8 – Cleaned valve cover surfaces, installed replacement valve cover gaskets. Reinstalled fuel lines, exhaust and water manifold gaskets, and air filter/intake pipe. Cleaned the “pony” engine exhaust pipe flange and replaced gasket. Removed and replaced the fuel filter and gaskets 0 Minutes |
| Comments: | | | very detailed data regard exposed concentration and task durations - though it is odd that many task have zero minutes. |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | High | NIOSH methods 7400 & 7402 |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Appears to be the US. |
| | Metric 3: | Applicability | High | The data are for an occupational scenario ( Heavy duty vehicle mechanics) within the scope of the risk evaluation. |

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|---|---|
| **Study Citation:** | Boelter, F., Simmons, C., Hewett, P. (2011). Exposure data from multi-application, multi-industry maintenance of surfaces and joints sealed with asbestos-containing gaskets and packing. Journal of Occupational and Environmental Hygiene 8(4):194-209. |
| **HERO ID:** | 2576853 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

| | | | EVALUATION | |
|---|---|---|---|---|
| Domain | | Metric | Rating | Comments |
| | Metric 4: | Temporal Representativeness | Medium | 2003 - after PEL (1994) and more 10 and less than 20 years old |
| | Metric 5: | Sample Size | High | Complete statistical distribution of samples provided |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | Monitoring data include all associated metadata, including sample types, exposure types, sample durations, exposure durations worker activities. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | High | The monitoring study addresses variability in the determinants of exposure for the sampled locations and different work activities. it was assumed that uncertainty was considered in the NIOSH methods used. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Bolstad-Johnson, D. M., Burgess, J. L., Crutchfield, C. D., Storment, S., Gerkin, R., Wilson, J. R. (2000). Characterization of firefighter exposures during fire overhaul. American Industrial Hygiene Association Journal 61(5):636-641. |
| **HERO ID:** | 16335 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Firefighters during fire overhaul (practice of practice of searching a fire scene to detect hidden fires or smoldering areas that may rekindle and to also safeguard signs of arson) |
| Area sampling data: | Table 6 (Page 6) provides asbestos data samples:AsbestosNumber of samples - 46;Number of samples above LOD - 15;Ave sample conc. - 0.073 f/ccStd. Dev. - 0.063Min - 0Max - 0.2 f/cc |
| Personal protective equipment: | Respirator, protective clothing. |
| Comments: | Area sampling methodology is provided on Page 2. |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Medium | Does not state it is a NIOSH method but references NIOSH and OSHA many times throughout the source. Area sampling methodology is likely equivalent to a NIOSH method. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Medium | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for firefighting which is in-scope for Chemical Substances in Construction, Paint, Electrical, and Metal Products. |
| | Metric 4: | Temporal Representativeness | Low | Monitoring data are greater than 20 years old. |
| | Metric 5: | Sample Size | Medium | Sample distribution characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Low | Includes worker activity and PPE. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | Does not address variability or uncertainty in the data. |

## Overall Quality Determination Low

| | |
|---|---|
| **Study Citation:** | Borcherding, C. H. (1976). Health hazard evaluation report no. HHE 75-192-330, Pittsburgh Plate Glass Ind., Mt, Zion, Illinois. |
| **HERO ID:** | 3970512 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Area sampling data: | [PDF Pg. 10]Emptying baghouse - top: 1.95; 1.90 (fibers/cc)Emptying baghouse - bottom: 11.90 (fibers/cc)Nailing: 2.80 (fibers/cc)Pressing: 1.92 (fibers/cc)Lathe: 0.91 (fibers/cc)Teardown: 3.92; 0.50 (fibers/cc)Grooving: 0.63; 1.54; 0.64; 0.69 (fibers/cc |
| Number of workers: | Four employees, per shift., work in the roll fabrication room. [PDF Pg. 4] |
| Engineering control: | Mechanical exhaust ventilation was provided at the nailing machine; press, for assembly and disassembly of rolls; the lathe and mill; as well as a seldom-used bandsaw and three floor sweeps for clean-up and box vacuuming. [PDF Pg. 4] |
| Comments: | The phase-contrast microscopic counting method of analysis at 400-500 magnification was utilized in the analysis of the collected samples for fibrous asbestos. [PDF Pg. 6] |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | High | Sampling/analytical methodology is an approved NIOSH method. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for Chemical Substances in Construction, Paint, Electrical, and Metal Products, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Monitoring data are greater than 20 years old. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Low | Sample type provided but no other metadata. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | High | Uncertainty is addressed in sampling/analytical methodology. Variability addressed by sampling during multiple operations at the facility. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Bozzelli, J. W., Russell, J. F. (1982). Airborne asbestos levels in several school buildings before and after bulk asbestos removal. International Journal of Environmental Studies 20(1):27-30. |
| **HERO ID:** | 3584009 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | BULK ASBESTOS REMOVAL |
| Exposure route: | inhalation |
| Physical form: | Asbestos fiber |
| Area sampling data: | Air sample asbestos conc.Classroom: 2.3 - 9.2 (ng/M3)Corridor: 2.9-38.9 (ng/M3) |
| Comments: | TABLE I: Asbestos concentrations before and after removal |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | High | Sampling or analytical methodology is an approved OSHA or NIOSH method . |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | The data are from the United States |
| | Metric 3: | Applicability | High | The data are for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Low | More than 20 years old |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Monitoring data include most critical metadata, such as sample type and exposure type, but lacks additional metadata, such as sample durations, exposure durations, exposure frequency, and/orworker activities. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | The monitoring study provides only limited discussion of theuncertainty in the exposure estimates. |

## Overall Quality Determination High

**Study Citation:** Bragg, G. M. (1987). Asbestos in the environment- an industry viewpoint. Environmental Technology Letters 8(6):289-296.
**HERO ID:** 3647211
**Conditions of Use:** Other:

**EXTRACTION**

| Parameter | Data |
|---|---|
| Exposure route: | inhalation (6/9) |
| Physical form: | dust (2/9) |
| Area sampling data: | At one company, milling, drying, crushing ore, and mining had area sample results of 1.2, 0.7, 1.0, and 0.4 f/cc, respectively. At a second company, milling, drying, crushing ore, and mining had area sample results of 0.7, 0.7, 0.7, and 0.3 f/cc, respectively. At a third company, milling, drying, crushing ore, and mining had area sample results of 0.1, 0.3, 0.4, and 0.2 f/cc, respectively (6/9). |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Sampling and Analytical Methodology | Low | Sampling methodology not specified. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | Medium | Data are from Canada, an OECD country. |
| Metric 3: | Applicability | Uninformative | Data are for mining and milling for manufacture of asbestos products. Such operations have ceased in the United States and are not under investigation in this risk evaluation. |
| Metric 4: | Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| Metric 5: | Sample Size | Medium | It is unclear whether provided area concentrations are averages or discrete data. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Medium | Exposure type and sampling data provided, but missing worker information, particle size, exposure duration, frequency, engineering controls, and PPE. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Medium | Uncertainty isn't addressed. Variability is addressed by gathering data from 3 different mills. |

## Overall Quality Determination Uninformative

| | |
|---|---|
| **Study Citation:** | Bragg, G. M. (2001). Fiber release during the handling of products containing chrysotile asbestos using modern control technology. Canadian Mineralogist SI 5:111-114. |
| **HERO ID:** | 6874310 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Cutting and snapping of asbestos pipe. [PDF Pg. 3] |
| Physical form: | Fibers (solid). [PDF Pg. 1] |
| Area sampling data: | [PDF Pg. 3]Asbestos SheetSelf Threading screws: 0.033 (f/mL)Punching: 0.036 (f/mL)Drilling: 0.031 (f/mL)Hand Saw: 0.015 (f/mL)Asbestos PipeSnap Cutting: 0.02 (f/mL)Hack Saw: 0.01 (f/mL)Manual Lathe: 0.02 (f/mL) |
| Engineering control: | Process enclosure, local exhaust ventilation, and wetting of asbestos. [PDF Pg. 3] |
| Comments: | Data collected using phase contrast microscopy. |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Sampling and Analytical Methodology | High | Sampling/analytical methodology is equivalent to an approved OSHA/NIOSH method. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | Medium | Data are from Canada, an OECD country. |
| | Metric 3: Applicability | High | Data are for Chemical Substances in Construction, Paint, Electrical, and Metal Products, an in-scope occupational scenario. |
| | Metric 4: Temporal Representativeness | Low | Monitoring data are greater than 20 years old. |
| | Metric 5: Sample Size | Medium | Sample distribution characterized by limited statistics (mean) but discrete samples not provided and distribution not fully characterized. |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | Low | Sample type provided but no other metadata. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | High | Uncertainty is addressed in sampling/analytical methodology. Variability addressed by sampling multiple worker activities. |

## Overall Quality Determination Medium

**Study Citation:** Bragg, G. M. (1988). The basics of asbestos dust control.
**HERO ID:** 6904663
**Conditions of Use:** Other:

**EXTRACTION**

| Parameter | Data |
|---|---|
| Worker activity description: | upstream, out of scope:cement plants: warehousing (resulting from torn or damaged bags), debagging, sawing, drilling, machining (including the cutting off of couplings), and reworking (pg 10); coupling lathe (pg 38); Figure 27 (pg 40)friction product plants: warehousing, debagging, mixing, dry pressing, grinding and drilling. (pg 10); Figure 28 (pg 40) |
| Area sampling data: | upstream, out of scope: Figure 4 (pg 15) has sampling results for asbestos cement plant from 1969-1983, ranges from 0 to 104 f/mlFigure 25 (pg 38): asbestos cement plant: coupling lathe sampling over 10 days, 0.04 to 0.5 f/ml, mean of 0.182 f/cc, geo. SD of 2.06 f/ccFigure 26 (pg 39): f/ml levels over 14 years in asbestos cement plant, <0.2 to ~8 f/mlFigure 27 (pg 40): averages and ranges for 14 process steps in asbestos cement plant, 0.005-2.2 f/mlFigure 28 (pg 40): averages and ranges for "well-controlled" friction products plant, 0.02-1.25 f/ml |
| Personal protective equipment: | respirators and clothing (pg 13)above PEL: negative-pressure respirators fitted with replaceable filters; "exceptionally high dust levels": positive-pressure respirators which have air supplied by battery-powered pumps or other sources (pg 22)head covering and coverall (pg 23) |
| Engineering control: | upstream, out of scope:asbestos cement plant: wetting, local ventilation and good housekeeping (that is, keeping the area clean by wet sweeping or vacuuming), low speed tools (pg 10); exhaust hood on debagging station (pg 14); pg 15 has exposure level reductions at a plant that enacted controls (only new type is enclosure); high velocity/low volume collection system (pg 35); friction products plant: local exhaust, good housekeeping and wet machining (pg 10)textile plants: wet processing, specialized tools, enclosures, ventilation (pg 11) |
| Comments: | The accepted method of determining fibre levels in the air is by the use of the phase contrast microscope (PCM) (pg 37) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Sampling and Analytical Methodology | Low | Sampling/analytical methodology is not specified. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | Medium | Data are from Canada, an OECD country. |
| Metric 3: | Applicability | Uninformative | Data are for upstream uses (MFG of asbestos products), which is out of scope for the legacy asbestos risk evaluation. |
| Metric 4: | Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| Metric 5: | Sample Size | Medium | Sample distribution characterized by limited statistics (ranges, means) but discrete samples not provided and distribution not fully characterized. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Low | Sample type provided but no other metadata. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Medium | Variability is addressed by sampling sites with different control technologies over different times, but uncertainty is not addressed. |

## Overall Quality Determination Uninformative

| | |
|---|---|
| **Study Citation:** | Breysse, P. N., Cherrie, J. W., Addison, J., Dodgson, J. (1989). Evaluation of airborne asbestos concentrations using TEM and SEM during residential water tank removal. Annals of Occupational Hygiene 33(2):243–256. |
| **HERO ID:** | 3583449 |
| **Conditions of Use:** | Disposal |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Tank removal involved draining the tank and disconnecting the existing plumbing, and then lifting it from its platform and placing it inside a plastic bag. It was then removed from the loft. Disconnection of the existing plumbing frequently necessitated disturbing the insulation. Once the tank was removed, a new one was installed [PDF Pg. 1] |
| Exposure route: | Inhalation |
| Area sampling data: | Summary of total Chrysotile fibers by TEM method (Document also includes fiber counts at certain magnification settings on PDF Pg. 5-6). (f/ml) (95% CI, range also given)Sample 9: 1.045 (0.864-1.255)Sample 11: 1.629 (1.343-1.957)Sample 27: 1.144 (0.933-1.500)Sample 29: 3.400 (2.88-4.00)Sample 31: 0.909 (0.741-1.105) |
| Exposure duration: | Tank removal and replacement takes 20-40 minutes. [PDF Pg. 2] |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Sampling and Analytical Methodology | High | Sampling/analytical methodology is equivalent to an approved [OSHA/NIOSH] method. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | Medium | Data are from the United Kingdom, an OECD country. |
| | Metric 3: Applicability | High | Data is for disposal, an in-scope occupational scenario. |
| | Metric 4: Temporal Representativeness | Low | Monitoring data are greater than 20 years old. |
| | Metric 5: Sample Size | Medium | Sample distribution characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | Medium | All metadata provided. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | High | Uncertainty is addressed in sampling/analytical methodology but variability is not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Breysse, P. N., Williams, D. L., Herbstman, J. B., Symons, J. M., Chillrud, S. N., Ross, J., Henshaw, S., Rees, K., Watson, M., Geyh, A. S. (2005). Asbestos exposures to truck drivers during World Trade Center cleanup operations. Journal of Occupational and Environmental Hygiene 2(8):400-405. |
| **HERO ID:** | 3079959 |
| **Conditions of Use:** | Disposal |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Trucks lined up just off site waiting to collect a load. While waiting to advance in line, truck drivers spent varying amounts of timesitting in their trucks, walking along the street, and walking onto the site in proximity to the pile. Once they reached the front of the line, the trucks were directed onto the site alongside of or directly into the debris. Later in the cleanup effort, trucks were driven into the excavation pit where they waited for a load. If the wait was more than a few minutes, the drivers routinely got out of the trucks and walked around the edges of the pile or pit. Since each load was carefully inspected for evidence and human remains prior to leaving the site, truck drivers typically spent extended periods of time on site waiting to receive a load. Early in the cleanup effort,loaded trucks were driven directly to a landfill where theywere emptied of their contents. They were then driven backto the site to be reloaded. In early October, the process waschanged. Loaded trucks were driven to a nearby pier wheretheir loads were emptied onto a platform. The debris wasthen transferred onto a barge for transport to the landfill andthe trucks were returned to the site for another load. (p. 3) |
| Exposure route: | inhalation (p.2) |
| Personal sampling data: | Median AHERA airborne asbestos personal air sampling results for each of the three sampling periods were similar, ranging from 0.012 to 0.017 s/cm3. The highest individual sample was 0.10 s/cm3collected during the week of 10/01/01. However, the collection period for this sample was only 3.33 hours due to pump failure...Personal airborne fiber exposures assessed using PCM weremeasured during the two October sampling periods (TableII). A total of 33 samples were analyzed using PCM. Medianairborne fiber concentrations ranged from 0.01 to 0.04 f/cm3.Only one sample exceeded the OSHA asbestos PEL of 0.1 f/cm3.The sample concentration equaled 0.11 f/cm3 and was collected over 580 min. (p. 5) |
| Area sampling data: | A total of 50 samples were collected and 5 were too overloaded with particulate matter to be analyzed. The airborne concentrations were highest in the last sampling period of October 2001, (median area concentration of 0.03 s/cm3), followed by the first week in October 2001, (median area concentration of 0.005 s/cm3). The majority (79%) of area air samples collected in April were below the limit of detection. All structures observed during area air sampling were chrysotile. (p. 5) |
| Particle size characterization: | Of the asbestos structures detected, all but one were chrysotile, and very few (4%) were >5 µm in length. (p. 5) |
| Exposure duration: | Truck drivers worked 12-hour shifts at the site (6 a.m. to6 p.m. and/or 6 p.m. to 6 a.m.) 7 days a week. (p. 3) |
| Exposure frequency: | Truck drivers worked 12-hour shifts at the site (6 a.m. to6 p.m. and/or 6 p.m. to 6 a.m.) 7 days a week. (p. 3) |
| Number of workers: | During the first week of October 2001, the minimum daily average number of truck drivers was 135. (p. 2) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Sampling and Analytical Methodology | High | Sampling/analytical methodology is an approved [NIOSH/OSHA] method. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | Data are from the U.S. |
| Metric 3: | Applicability | Medium | Data are for truck drivers removing debris from the WTC, which is similar to the in-scope occupational scenario of debris removal following demolition of a building with asbestos. |
| Metric 4: | Temporal Representativeness | Low | Monitoring data are greater than 20 years old. |
| Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |

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**Study Citation:** Breysse, P. N., Williams, D. L., Herbstman, J. B., Symons, J. M., Chillrud, S. N., Ross, J., Henshaw, S., Rees, K., Watson, M., Geyh, A. S. (2005). Asbestos exposures to truck drivers during World Trade Center cleanup operations. Journal of Occupational and Environmental Hygiene 2(8):400-405.
**HERO ID:** 3079959
**Conditions of Use:** Disposal

| | | EVALUATION | |
|---|---|---|---|
| Domain | Metric | Rating | Comments |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | High | All metadata provided. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Medium | Uncertainty is addressed in sampling/analytical methodology. Variability addressed by described changes to the process and evolution of the work practices. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Brorby, G. P., Sheehan, P. J., Berman, D. W., Bogen, K. T., Holm, S. E. (2013). Exposures from chrysotile-containing joint compound: evaluation of new model relating respirable dust to fiber concentrations. Risk Analysis 33(1):161-176. |
| **HERO ID:** | 2563214 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Sanding joint compounds or sweeping settled dust generated during such sanding. (2/16) |
| Physical form: | fibers (7/16) |
| Area sampling data: | (PCM) During one cited study, mean asbestos concentrations during sanding were 5.3 and 10 f/cm3. During another, mean concentrations during sanding were 0.3-2.7 f/cm3. During the last cited study, mean concentrations during sanding wee 4.3-11.5 f/cm3. (7/16) |
| Exposure duration: | Sanding took 3-240 minutes (7/16) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | High | Sampling/analytical methodology is an approved NIOSH method. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for commercial use in construction materials, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | High | Monitoring data were collected after the most recent PEL and no more than 10 years old. |
| | Metric 5: | Sample Size | Medium | Sample distribution characterized by limited statistics (minimum, maximum, mean, median) but discrete samples not provided and distribution not fully characterized. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Exposure type and sampling data provided, but missing number of workers, exposure frequency, particle size, engineering controls and PPE. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | High | Uncertainty is addressed in sampling/analytical methodology. Variability is addressed by comparing literature values to a developed model. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Brown, R. C., Hoskins, J. A. (1992). Review : Contamination of Indoor Air with Mineral Fibres. Indoor and Built Environment 1(2):61-68. |
| **HERO ID:** | 28305 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Demolition of various parts of buildings |
| Exposure route: | inhalation |
| Area sampling data: | 2 fibers/liter - demolition of a heater with asbestos fibers damaged and left exposed.12 fibers/liter - site with trowelled asbestos with a large swath damaged and exposed. |
| Comments: | Paper is an overview of the industry and pulls a couple datapoints from other studies. Data in this particular document is not described well enough to be used, but cited sources may be much more useful. |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Sampling and Analytical Methodology | Low | Sampling/analytical methodology is not specified. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | Medium | Data are from the UK, an OECD country. |
| | Metric 3: Applicability | High | Data are for demolition of asbestos-containing buildings, an in-scope occupational scenario. |
| | Metric 4: Temporal Representativeness | Medium | Monitoring data are greater than 10 years old but no more than 20 years old. |
| | Metric 5: Sample Size | Low | Sample distribution is described qualitatively. |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | Uninformative | Sample type and exposure type not provided. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Uninformative

| | |
|---|---|
| **Study Citation:** | Brown, S. K. (1987). Asbestos exposure during renovation and demolition of asbestos-cement clad buildings. American Industrial Hygiene Association Journal 48(5):478-486. |
| **HERO ID:** | 1057177 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Sheet cleaning: roofs at Sites I and 2 with areas 30 and 45 m2, respectively, were cleaned with high pressure water jets in trials taking several hours. These were commercial contracts where operators stood in upright positions on roofing and used water jet guns with extension lances to strip the weathered layer from sheeting. (3/10) |
| Exposure route: | inhalation (2/10) |
| Physical form: | fibers (3/10) |
| Personal sampling data: | (PCM) Two samples during AC roof cleaning had concentrations of 0.08 and 0.10 f/mL. (6/10) |
| Particle size characterization: | All fibers had a length to width ratio of 3 or greater, a length greater than 5 um, and a width less than 3 um. (4/10) 40-60% of fibers counted were less than 0.5 um in diameter, and of these, 60-90% were long fibers with aspect ratios of 40 or greater. (8/10) |
| Exposure duration: | 5.3 hours (6/10) |
| Engineering control: | Outdoor wind speed 1.5 - 6.3 m/sec (Table IV) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Sampling and Analytical Methodology | High | Sampling/analytical methodology is equivalent to an approved [OSHA/NIOSH] method. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | Medium | Data are from Australia, an OECD country. |
| Metric 3: | Applicability | High | Data are for commercial use in construction materials, an in-scope occupational scenario. |
| Metric 4: | Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Medium | Exposure type and sampling data provided, but missing number of workers, exposure frequency, engineering controls and PPE. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | High | Uncertainty is addressed in sampling/analytical methodology. Variability is addressed by sampling at 7 different locations. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Brown, S. K. (1987). Asbestos exposure during renovation and demolition of asbestos-cement clad buildings. American Industrial Hygiene Association Journal 48(5):478-486. |
| **HERO ID:** | 1057177 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Building demolition: several large (90 m x 36 m) wool storage warehouses were demolished at Site 8. The first of these (8. I) was demolished by removing wall sheets and structural bracing and then collapsing the structure with roofing sheets intact. The roofing sheets sustained little damage and subsequently were removed by several workers who formed a chain across the roof and passed and dragged the sheets to each other and finally to two men stacking them on a platform up to chest height. Other warehouses were demolished by removing all cladding from the standing structure with workers confined to platforms adjacent to wall sheets or in scissor lifts set at a height such that roofing was at chest level. Work conditions were more confined in these trials and involved closer contact with weathered sheeting. Handling of roofing sheets was visibly dusty - particularly as they were stacked in the tray of the scissor lift. (4/10) Asbestos concentrations during building demolition were measured only for the period of sheet handling, and they are presented in Table VII. Sheet handling was continuous and much more vigorous than for roof replacement work. Generally,sheeting was removed at a rate of 100 m2/man-hr in demolition work as compared to 5 to 10 m2/ man-hr for the roof replacement process. Building demolition appeared to create considerably more visible dust emission and short sampling periods (30 to 60 min), were employed to limit particulate contamination on filters and to allow comparative trials on the same day. (7/10) |
| Exposure route: | inhalation (2/10) |
| Physical form: | fibers (3/10) |
| Personal sampling data: | (PCM) Personal samples during AC warehouse demolition ranged from ND-1.1 f/mL with TWAs from 0.02-0.60 f/mL. (8/10) |
| Particle size characterization: | All fibers had a length to width ratio of 3 or greater, a length greater than 5 um, and a width less than 3 um. (4/10) 40-60% of fibers counted were less than 0.5 um in diameter, and of these, 60-90% were long fibers with aspect ratios of 40 or greater. (8/10) |
| Exposure duration: | 2-6 hours (4/10) |
| Engineering control: | Before demolition, asbestos cement sheets were coated with lignin sulphonate liquor or diluted acrylic resin. (4/10) Outdoor wind speed varied from 1.3 - 6.4 m/sec. |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | High | Sampling/analytical methodology is equivalent to an approved [OSHA/NIOSH] method. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Medium | Data are from Australia, an OECD country. |
| | Metric 3: | Applicability | High | Data are for demolition of asbestos products, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| | Metric 5: | Sample Size | Medium | Sample distribution characterized by limited statistics (ranges, averages) but discrete samples not provided and distribution not fully characterized. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Exposure type and sampling data provided, but missing number of workers, exposure frequency, and PPE. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | High | Uncertainty is addressed in sampling/analytical methodology. Variability is addressed by sampling at 3 demolition sites. |

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| | |
|---|---|
| **Study Citation:** | Brown, S. K. (1987). Asbestos exposure during renovation and demolition of asbestos-cement clad buildings. American Industrial Hygiene Association Journal 48(5):478-486. |
| **HERO ID:** | 1057177 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

| | | **EVALUATION** | |
|---|---|---|---|
| Domain | Metric | Rating | Comments |
| **Overall Quality Determination** | | **Medium** | |

| | |
|---|---|
| **Study Citation:** | Brown, S. K. (1987). Asbestos exposure during renovation and demolition of asbestos-cement clad buildings. American Industrial Hygiene Association Journal 48(5):478-486. |
| **HERO ID:** | 1057177 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Sheet painting: these were simulated trials in which badly weathered roofing (Sites 5 and 8) and lightly weathered walls (Site 8) were painted with a diluted acrylic coating (28% by weight solids content) by either roller or airless spray. Generally, areas of 50 to 400 m2 were coated in 1.5 to 4 hr. Operators worked from timber supports laid on roofing surfaces that were moved (sometimes by dragging) as work proceeded. (3/10) |
| Exposure route: | inhalation (2/10) |
| Physical form: | fibers (3/10) |
| Personal sampling data: | During AC roof painting, concentrations ranged from 0.01-0.22 f/mL. |
| Particle size characterization: | All fibers had a length to width ratio of 3 or greater, a length greater than 5 um, and a width less than 3 um. (4/10) 40-60% of fibers counted were less than 0.5 um in diameter, and of these, 60-90% were long fibers with aspect ratios of 40 or greater. (8/10) |
| Exposure duration: | Sampling period 0.4 - 3.4 hr (Table V) |
| Engineering control: | Wind speed 1.7 - 4.3 m/sec (Table V) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Sampling and Analytical Methodology | High | Sampling/analytical methodology is equivalent to an approved [OSHA/NIOSH] method. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | Medium | Data are from Australia, an OECD country. |
| Metric 3: | Applicability | High | Data are for commercial use in construction materials, an in-scope occupational scenario. |
| Metric 4: | Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Medium | Exposure type and sampling data provided, but missing number of workers, exposure frequency, engineering controls and PPE. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | High | Uncertainty is addressed in sampling/analytical methodology. Variability is addressed by sampling at 7 different locations. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Brown, S. K. (1987). Asbestos exposure during renovation and demolition of asbestos-cement clad buildings. American Industrial Hygiene Association Journal 48(5):478-486. |
| **HERO ID:** | 1057177 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Roof replacement: old and badly weathered AC roofing was replaced by steel roofing on large commercial buildings (Sites 3 to 5, 7) or housing (Site 6) as normal building maintenance procedures. Roof replacement usually was carried out by two to six men, according to a sequence whereby small sections (20 to 40 m2) were repetitively unfastened, removed and replaced by new roofing. Sheets were removed whole and carried individually to the edge of roofs where they were either stacked (Sites 3, 5, 7), dropped directly into a bin atground level (Site 4), or passed and stacked into the tray of a truck (Site 6). After removal of large areas of roofing, the stacked sheets either were lifted from the building by crane (Site 5) or dropped individually into a dump bin at ground level (Sites 3, 7). Trials wereconducted for 2 to 6 hr during which 50 to 100 m2 of roofing was replaced. (3/10) |
| Exposure route: | inhalation (2/10) |
| Physical form: | fibers (3/10) |
| Personal sampling data: | TWA ranged from 0.03 to 0.21 f/mL |
| Particle size characterization: | All fibers had a length to width ratio of 3 or greater, a length greater than 5 um, and a width less than 3 um. (4/10) 40-60% of fibers counted were less than 0.5 um in diameter, and of these, 60-90% were long fibers with aspect ratios of 40 or greater. (8/10) |
| Exposure duration: | 2 to 6 hr/day |
| Number of workers: | 2 to 6 workers for roof replacement |
| Engineering control: | Wind speed ranged from 0.6 to 4.4 m/sec |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Sampling and Analytical Methodology | High | Sampling/analytical methodology is equivalent to an approved [OSHA/NIOSH] method. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | Medium | Data are from Australia, an OECD country. |
| Metric 3: | Applicability | High | Data are for commercial use in construction materials, an in-scope occupational scenario. |
| Metric 4: | Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| Metric 5: | Sample Size | Medium | Distribution of samples is characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Medium | Exposure type and sampling data provided, but missing number of workers, exposure frequency, engineering controls and PPE. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | High | Uncertainty is addressed in sampling/analytical methodology. Variability is addressed by sampling at 7 different locations. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Brown, S. K. (1988). Asbestos exposure to workers demolishing asbestos cement clad buildings. 1-2:344-350. |
| **HERO ID:** | 6864456 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | exposures during demolition by removal of whole sheets. |
| Exposure route: | inhalation |
| Physical form: | Fiber |
| Personal sampling data: | Asbestos concentrations while replacing AC roofing. Asbestos conc. (f/ml)Replacing dry roofing- 0.03-0.24Replacing part-painted roofing - 0.03Replacing dry roofing- 0.04 - 0.27Replacing acrylic-sealed roofing- 0.03 - 0.08Removing dry roofing - 0.07 - 0.32Removing dry roofing with careful handling and wetting as stacked - ND- 0.07Removing acrylic sealed roofing - 0.04 - 0.26 Asbestos concentrations while removing AC roofing and wall cladding for building demolition. Asbestos conc. (f/ml)Roof sheets removed from collapsed building- dry 0.10-0.47- wet 0.05-0.06- acrylic-sealed 0.11-0. 32Roof sheets removed at platform- dry 0.30 - 0.53- wet 0.10 - 0.13Roof sheets removed at platform- dry 0.34 - 1.1- wet 0.29 - 0.68- acrylic-sealed 0.41- 0.76Wall sheets removed at platform- dry 0.04 - 0.12- acrylic-sealed ND- 0.05(P. 6, 7/9) |
| Personal protective equipment: | protective clothing and respirators for workers |
| Engineering control: | prewetting or sealing of sheets, no breakage of sheets or use of power tools for cutting |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Sampling and Analytical Methodology | Medium | Sampling or analytical methodology is not equivalent to an approved OSHA or NIOSH method and EPA review of information indicates the methodology is acceptable. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | Medium | The data are from an OECD country other than the U.S. |
| Metric 3: | Applicability | High | The data are for an occupational scenario within the scope of the risk evaluation. |
| Metric 4: | Temporal Representativeness | Low | Data is more than 20 years old. |
| Metric 5: | Sample Size | Medium | Distribution of samples is characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Medium | Monitoring data include most critical metadata, such as sample type and exposure type, but lacks additional metadata, such as sample durations, exposure durations, and exposure frequency. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Medium | The monitoring study does not address uncertainty. Variability is addressed by including monitoring results from different activities. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Brownlee, J. A., Lucas, J. H., Walls, K. J., Murphy, J. J., Dinardo, C. (1988). Achieving a transmission electron microscopy clearance criterion at asbestos abatement sites in New Jersery. |
| **HERO ID:** | 6904406 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Removal of spray and trowel-applied fireproofing and thermal insulation from classrooms, offices, and cafeterias. (3/14) |
| Physical form: | fibers (7/14) |
| Area sampling data: | Out of 598 samples, 573 (95.8%) were <0.01 f/cm3. 25 (4.2%) showed concentrations >0.01 f/cm3. The arithmetic mean was 0.0019 f/cm3 for the samples <0.01 f/cm3 and 0.0304 f/cm3 for those >0.01 f/cm3. (7/14) |
| Personal protective equipment: | Inspectors wore an outer protective garment with zippered overall with hood and draw string, elastic cuffs, and closure boots. Respiratory protection consisted of a powered air purifying respirator. (5/14) |
| Engineering control: | A thorough visual inspection was performed after ACM removal to make sure no material remained. (4/14) After cleaning before wet mopping, a leaf blower should be used to stir up and dislodge finer particles from crevices. Negative-air filtration units should be on during removal and cleaning. (13/14) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Sampling and Analytical Methodology | High | Sampling/analytical methodology is equivalent to an approved [OSHA/NIOSH] method. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | Data are from the U.S. |
| Metric 3: | Applicability | High | Data are for removal of asbestos products, an in-scope occupational scenario. |
| Metric 4: | Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| Metric 5: | Sample Size | Medium | Sample distribution characterized by limited statistics (mean, standard deviation, range, median, variance) but discrete samples not provided and distribution not fully characterized. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Medium | Exposure type and sampling data provided, but missing number of workers, exposure duration, and exposure frequency. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Medium | The monitoring study provides only limited discussion of the variability and uncertainty in monitoring data. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Brune, D., Beltesbrekke, H. (1981). Levels of methylmethacrylate, formaldehyde, and asbestos in dental workroom air. European Journal of Oral Sciences 89(1):113-116. |
| **HERO ID:** | 30507 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Furnishing, Cleaning, Treatment Care Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Dismantling a mold containing a Pennwalk liner in a laboratory [PDF Pg. 2]. |
| Exposure route: | Inhalation [PDF Pg. 2]. |
| Area sampling data: | 21-27 fibers/cm^3 [PDF Pg. 3]. |
| Engineering control: | In the present laboratory no access to local ventilation was available. With a good local ventilation system the asbestos fiber content would most likely be reduced to levels lower than two fibers/cm^3 even during the dismantling procedure. Efficiencies of local ventilation for purifying polluted dental workroom air may attain values close to 99%. [PDF Pg. 3] |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Sampling and Analytical Methodology | High | Sampling/analytical methodology is equivalent to an approved OSHA/NIOSH method. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | Medium | Data are from Norway, an OECD country. |
| | Metric 3: Applicability | Uninformative | Data are for denture manufacturing in the 1980s. The COU is not in scope for the asbestos legacy risk evaluation. |
| | Metric 4: Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| | Metric 5: Sample Size | Low | Sample distribution is characterized by no statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | Medium | Sample type and exposure type provided but missing exposure frequency and duration. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Uninformative

| | |
|---|---|
| **Study Citation:** | Bryant, C. J. (1987). Health hazard evaluation report no. HETA-86-434-1833, Federal Office Building, Evansville, Indiana. |
| **HERO ID:** | 3970468 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Federal employee office workers - Specific concern with exposure by janitor staff. |
| Exposure route: | inhalation |
| Physical form: | inhalable fibers |
| Area sampling data: | TEM NIOSH publication 77-204Social Security, Top of Filing Cabinets 0.005 f/cm3Air Sampling Non DetectsSocial Security, Top of Bookcase Close to Main Entrance NDSocial Security, Top of Bookcase Northwest Corner NDSocial Security, Computer Room 101-C Across from Rm. 101-C NDSocial Security, Break Room Top of Filing Cabinet NDSocial Security, Annex Top of Coat Rack NDSenator Quayle and Lugar°s Office (Secretaries Office) NDCongressman McCloskey°s Office (Bookcase - Secretarial Area) NDArmy Recruiting Station, Rm. 108 Top of Coat rack NDHearing and Appeals, Rm. #246 Top of Filing Cabinet (Entrance) NDHearing and Appeals, Rm. 246 Top of Filing Cabinet ND IRS, Rm. 216, Top of Filing Cabinet NDIRS, Rm. 226, Top of Forms Cabinet NDIRS, Hallway Outside Rm. 216 ND Department of Agriculture, Rm. 272 Top of Coat Rack NDDepartment of Agriculture, Rm. 271 Top of Filing Cabinet ND First Floor Lobby, Between Elevators on Shelf NDU.S. District Court, Rm. 304 Clerk of Courts NDU.S. District Court Room, Rm. 301 NDReception Area to Judges Chamber Rm. 310 NDCourt Security Office, Rm. 333 Top of Coat Rack ND U.S. Marshall°s Office, Rm. 332 Top of Filing Cabinet NDU.S. Bankruptcy Clerks Office Rm. 352, Top of Bookcase NDHallway Outside Rm. 352 on Emergency Light ND U.S. Bankruptcy Court, Judge°s Bench NDU.S. Bankruptcy Court, Law Library Top of Bookcases ND |
| Exposure duration: | up to 10 hours per day |
| Exposure frequency: | 40 hours per week. |
| Personal protective equipment: | require the maintenance operator to wear a respirator approved by NIOSH-MSHA for asbestos. Respirator use should conform to the OSHA requirements for general industry as described in 29CFR 1910.134. It also may be prudent to require the maintenance operator to wear a disposable hood and smock during the maintenance activity.(d)gently remove the ceiling tile(s) to a position above adjacent unmoved tiles and perform the maintenance activity in such a manner as to minimize unnecessary vibration and air movement. |
| Engineering control: | ensure that the air pressure in the office space is positive, with respect to the area above the suspended ceiling, using a smoke test kit. |
| Comments: | Though sampling results indicated that asbestos exposure was limited, surface sampling suggested that higher exposures likely occurred in the past. |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Sampling and Analytical Methodology | High | NIOSH study |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | USA |
| Metric 3: | Applicability | High | The data are for an occupational scenario (Federal office worker) within the scope of the risk evaluation. |
| Metric 4: | Temporal Representativeness | Low | 1986 - prior to most recent PEL and more than 20 years old. |
| Metric 5: | Sample Size | Low | Most of the sampling results were non-detects, the one value did not include any supporting statistics. Surface sampling indicated that higher exposure likely occurred in the past. |
| Domain 3: Accessibility/ Clarity | | | |

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| | |
|---|---|
| **Study Citation:** | Bryant, C. J. (1987). Health hazard evaluation report no. HETA-86-434-1833, Federal Office Building, Evansville, Indiana. |
| **HERO ID:** | 3970468 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

| | | | EVALUATION | |
|---|---|---|---|---|
| Domain | | Metric | Rating | Comments |
| | Metric 6: | Metadata Completeness | High | Monitoring data include all associated metadata, including sample types, exposure types, sample durations, exposure durations worker activities, and exposure frequency. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | There was no discussion of variability as most of the sampling results were non-detects. Though surface sampling indicated that higher exposure likely occurred in the past. It was assumed that uncertainty was considered in using the Zumwalde-Dement procedure NIOSH publication 77-204. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Burdett, G. (1998). A comparison of historic asbestos measurements using a thermal precipitator with the membrane filter-phase contrast microscopy method. Annals of Occupational Hygiene 42(1):21-31. |
| **HERO ID:** | 3583038 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Furnishing, Cleaning, Treatment Care Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | samples taken by asbestos flyer spinning frames at factory (pg 2) |
| Physical form: | fibers |
| Personal sampling data: | discrete data provided with time of sampling, particulate concentration, and fiber concentration; fibre concentrations ranged 159 to 404 fibers/mL (pg 2) |
| Area sampling data: | discrete data provided with time of sampling, particulate concentration, and fiber concentration; fibre concentrations ranged 191 to 294 fibers/mL (pg 2) |
| Particle size characterization: | Provides fiber length and width distributions for fibers in graph form as well as median lengths and widths and longest fiber size; geometric mean length for various methods showed textile-grade crocidolite fiber lengths ranging from 1.67 to 9.4 microns (pgs 3, 7, 8) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Medium | Sampling/analytical methodology is not an approved OSHA/NIOSH method but is an acceptable methodology. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Medium | Data are from England, an OECD country. |
| | Metric 3: | Applicability | High | Data are for asbestos textile fiber spinning, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided for fiber concentrations). |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Sample type and exposure type provided but missing associated worker activities. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | High | Uncertainty is addressed in sampling/analytical methodology. Variability addressed by comparing across different methods. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Burdett, G. J., Dewberry, K., Staff, J. (2016). Airborne Asbestos Exposures from Warm Air Heating Systems in Schools. Annals of Occupational Hygiene 60(1):27-39. |
| **HERO ID:** | 3367384 |
| **Conditions of Use:** | Consumer Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | The aim of this study was to investigate the concentrations of airborne asbestos that can be released into classrooms of schools that have amosite-containing asbestos insulation board (AIB) in the ceiling plenum or other spaces, particularly where there is forced recirculation of air as part of a warm air heating system. Air samples were collected in three or more classrooms at each of three schools, two of which were of CLASP (Consortium of Local Authorities Special Programme) system-built design, during periods when the schools were unoccupied. Two conditions were sampled: (i) the start-up and running of the heating systems with no disturbance (the background) and (ii) running of the heating systems during simulated disturbance. The simulated disturbance was designed to exceed the level of disturbance to the AIB that would routinely take place in an occupied classroom. A total of 60 or more direct impacts that vibrated and/or flexed the encapsulated or enclosed AIB materials were applied over the sampling period. The impacts were carried out at the start of the sampling and repeated at hourly intervals but did not break or damage the AIB. |
| Exposure route: | Inhalation |
| Physical form: | Fibers |
| Area sampling data: | The PCM fibre concentrations were all below the LOQ but analytical TEM showed that few of the fibres counted in the background samples were asbestos. The background TEM air concentrations for individual samples from all three schools with warm air heating systems for asbestos fibres were at or below the AS (0.0001 f ml−1). A more vigorous disturbance in School C, by directly striking the AIB panels on heater cupboards and under the windows ~100 times in each classroom over a 2-h sampling period, released airborne PCME amosite fibres with short-term concentrations of up to 0.0043 f ml−1 with a pooled average of 0.0019 f ml−1 for the four classrooms giving measurable releases. The level of disturbance used was considered to replicate a peak exposure event from disturbances which did not damage the AIB. |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Sampling and Analytical Methodology | High | Sampling or analytical methodology is an approved OSHA or NIOSH method or is well described and found to be equivalent to approved OSHA or NIOSH methods. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | Medium | The data are from an OECD country other than the U.S. |
| Metric 3: | Applicability | Uninformative | Asbestos exposure in the absence of work being conducted on asbestos-containing materials is outside the scope of the occupational exposure assessment for asbestos legacy risk evaluation. |
| Metric 4: | Temporal Representativeness | High | The operations, equipment, and worker activities associated with the data are expected to be representative of current operations, equipment, and activities. The monitoring data were collected after the most recent permissible exposure limit (PEL) establishment or update or are generally, no more than 10 years old. |
| Metric 5: | Sample Size | Medium | Distribution of samples is characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Medium | Monitoring data include most critical metadata, such as sample type and exposure type, but lacks additional metadata. |

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|---|---|
| **Study Citation:** | Burdett, G. J., Dewberry, K., Staff, J. (2016). Airborne Asbestos Exposures from Warm Air Heating Systems in Schools. Annals of Occupational Hygiene 60(1):27-39. |
| **HERO ID:** | 3367384 |
| **Conditions of Use:** | Consumer Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

| | | EVALUATION | |
|---|---|---|---|
| Domain | Metric | Rating | Comments |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Medium | Variability is addressed by conducting studies at multiple locations, but discussion of uncertainty is limited. |

## Overall Quality Determination — Uninformative

**Study Citation:** Burdett, G. J., Jaffrey, S. A. M.,T (1986). Airborne asbestos concentrations in buildings. Annals of Occupational Hygiene 30(2):185-199.
**HERO ID:** 274
**Conditions of Use:** Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products

**EXTRACTION**

| Parameter | Data |
|---|---|
| Area sampling data: | Non-domestic buildings containing asbestos [PDF Pg. 12]Site 1: 8 (fibers/L) (chrysotile)Site 2: 11 (fibers/L) (amosite and crocidolite)Site 3: 7 (fibers/L) (chrysotile)Site 4: 2 (fibers/L) (amosite and chrysotile)Site 5: <1 (fibers/L) (amosite)Site 6: <1 (fibers/L) (amosite)Site 7: 40 (fibers/L) (amosite and chrysotile)Site 8: <2 (fibers/L) (amosite)Site 9: <5 (fibers/L) (amosite and chrysotile)Site 10: <5 (fibers/L) (chrysotile)Site 11: <3 (fibers/L) (chrysotile)Site 12: <8 (fibers/L) (amosite and chrysotile)Buildings with warm air heaters containing asbestos [PDF Pg. 13]Site 16: <4 (fibers/L) (chrysotile)Site 17: <3 (fibers/L) (amosite)Site 18: <2 (fibers/L) (chrysotile)Site 19: <1 (fibers/L) (amosite and chrysotile)Site 20: <5 (fibers/L) (amosite and chrysotile)Site 21: 2 (fibers/L) (chrysotile)Site 22: <4 (fibers/L) (chrysotile)Site 23: <5 (fibers/L) (amosite and chrysotile)Site 24: <10 (fibers/L) (Nondetect)Site 25: <1 (fibers/L) (amosite)Site 26: <15 (fibers/L) (nondetect)Site 27: <10 (fibers/L) (amosite and chrysotile)Site 28: <10 (fibers/L) (nondetect)Site 29: <5 (fibers/L) (nondetect)Site 30: <10 (fibers/L) (amosite and chrysotile)Site 31: <10 (fibers/L) (amosite)Site 32: <10 (fibers/L) (amosite and chrysotile)Site 33: <10 (fibers/L) (amosite)Site 34: <10 (fibers/L) (amosite and chrysotile)Site 35: <10 (fibers/L) (nondetect)Site 36: <10 (fibers/L) (chrysotile)Site 37: <10 (fibers/L) (nondetect)Site 38: <10 (fibers/L) (nondetect)Site 39: <5 (fibers/L) (amosite)Building/electric warm air heaters without asbestos materials [PDF Pg. 13]Site 40: <3 (fibers/L) (nondetect)Site 41: <0.5 (fibers/L) (nondetect)Site 42: <10 (fibers/L) (nondetect)Site 43: <15 (fibers/L) (chrysotile) |
| Comments: | All fiber samples collected using PCM and TEM methods; asbestos only fiber samples collected using TEM. |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Sampling and Analytical Methodology | Medium | Sampling/analytical methodology is equivalent to an approved OSHA/NIOSH method. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | Medium | Data are from the United Kingdom, an OECD country. |
| Metric 3: | Applicability | Uninformative | Data are for background exposures in offices, residents, schools, and some occupational settings like factories and laboratories. However, such exposures are considered occupational microclimates, which are considered under general population exposure. |
| Metric 4: | Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| Metric 5: | Sample Size | Medium | Sample distribution characterized by limited statistics (mean) but discrete samples not provided and distribution not fully characterized. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Low | Sample type provided but no other metadata. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | High | Uncertainty is addressed in sampling/analytical methodology. Variability addressed by sampling multiple sites and types of sites. |

## Overall Quality Determination Uninformative

| | |
|---|---|
| **Study Citation:** | Burdett, G. J., Jaffrey, S. A., Rood, A. P. (1989). Airborne asbestos fibre levels in buildings: a summary of UK measurements. IARC Scientific Publication occupational Exposure to Mineral Fibres(90):277-290. |
| **HERO ID:** | 745036 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | A sprayed crocidolite insulation was being removed from thewalls and ceiling of a large unoccupied industrial building prior to demolition. The building was divided into 3 equal areas by studwork and polythene sheets, the removal taking place in the center section. |
| Exposure route: | Inhalation |
| Physical form: | Fibers |
| Area sampling data: | West End: 5.1 - 10.2 f/mL, Center: 0.4 - 95 f/mL, East End: 0.012 - 0.22 f/mL |
| Particle size characterization: | Fiber is defined as a particle with length $>$ 5 microns, width $<$ 3 microns, and an aspect ratio $>$ 3:1. Transmission Electron Microscopy (TEM) is the analytical method used to characterize particle sizes. |
| Engineering control: | Air filtration system was used to create negative pressure in working environment. |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | High | Sampling or analytical methodology is an approved OSHA or NIOSH method or is well described and found to be equivalent to approved OSHA or NIOSH methods. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Medium | The data are from an OECD country other than the U.S. |
| | Metric 3: | Applicability | High | The data are for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Low | Data are more than 20 years old. |
| | Metric 5: | Sample Size | Medium | Distribution of samples is characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Monitoring data include most critical metadata, such as sample type and exposure type, but lacks additional metadata, such as sample durations, exposure durations, exposure frequency, and/orworker activities. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | Describes uncertainty due to containment leakage, but variability is not characterized. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Burdett, G. J., Jaffrey, S. A., Rood, A. P. (1989). Airborne asbestos fibre levels in buildings: a summary of UK measurements. IARC Scientific Publication occupational Exposure to Mineral Fibres(90):277-290. |
| **HERO ID:** | 745036 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Asbestos removal from 6-floor teaching block was conducted in 2 phases. Phase I saw the removal of asbestos from the top 3 floors during an Easter vacation, refurbishment being carried out at intervals during the following 26 weeks. Phase 2 saw the removal of asbestos from the lower 3 floors during the summer vacation, some 12 weeks later. Refurbishment took place over the following 9 weeks. Buildings contained sprayed trowelled amosite insulation behind a false ceiling of non-asbestos perforated tiles. |
| Area sampling data: | Although no samples were taken inside the enclosure during the dry removal of the asbestos, airborne concentrations of theorder of 1-50 f/ml were likely. A single sample (0.29 f/ml), taken in the stairwell adjacent to an enclosure, demonstrated that some leakage was occurring. Samples taken after the removal had been completed and the areas cleaned and vacated, gave measurable concentrations of amosite fibres. The levels recorded in both phases of removal decayed with time, although in phase I the refurbishment activities initially generated higher airborne concentrations. Samples taken 9 weeks after reoccupation, during normal activities, gave average amosite concentrations of 0.0004 f/ ml in both phase I and phase 2 areas, slightly above the levels found before any asbestos was removed. |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Sampling and Analytical Methodology | High | Sampling or analytical methodology is an approved OSHA or NIOSH method or is well described and found to be equivalent to approved OSHA or NIOSH methods. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | Medium | The data are from an OECD country other than the U.S. |
| | Metric 3: Applicability | High | The data are for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: Temporal Representativeness | Low | Data are more than 20 years old. |
| | Metric 5: Sample Size | Medium | Distribution of samples is characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | Medium | Monitoring data include most critical metadata, such as sample type and exposure type, but lacks additional metadata, such as sample durations, exposure durations, exposure frequency, and/orworker activities. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Medium | Describes uncertainty due to containment leakage, but variability is not characterized. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Burdett, G. J., Jaffrey, S. A., Rood, A. P. (1989). Airborne asbestos fibre levels in buildings: a summary of UK measurements. IARC Scientific Publication occupational Exposure to Mineral Fibres(90):277-290. |
| **HERO ID:** | 745036 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | The building was of steel frame and concrete panel construction and all the steel members had a covering of about 30 mm of amosite-based insulation. Activities included maintenance, dry removal, and surface stripping. |
| Area sampling data: | Only one sample was taken inside an enclosure during stripping and was very heavily loaded, with an estimated fibre concentration of 10-30 f/ml. As found at other sites, there was measurable leakage from the plastic enclosures during asbestos removal. It was also found that outdoor samples taken close to the building in an approximately downwind position gave increased levels when the ground floor and the first floor were being stripped.As the building was left vacant for some months without refurbishment, the effect of disturbing the floor dust was also monitored. The vinyl floor coverings had been removed during the final cleaning of the building,leaving an unsealed concrete surface. In the course of a detailed visual inspection, several areas were located where traces of amosite material were suspected. In the first exercise, dust on shelves and a small floor area where contamination was expected was moderately disturbed with a hand brush for less than I min. On a separate visit, dust was vigorously disturbed by heavy sweeping with a broom for 5 min in suspect areas. |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | High | Sampling or analytical methodology is an approved OSHA or NIOSH method or is well described and found to be equivalent to approved OSHA or NIOSH methods. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Medium | The data are from an OECD country other than the U.S. |
| | Metric 3: | Applicability | High | The data are for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Low | Data are more than 20 years old. |
| | Metric 5: | Sample Size | Medium | Distribution of samples is characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Monitoring data include most critical metadata, such as sample type and exposure type, but lacks additional metadata, such as sample durations, exposure durations, exposure frequency, and/orworker activities. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | Describes uncertainty due to containment leakage, but variability is not characterized. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Burdett, G., Bard, D. (2007). Exposure of UK industrial plumbers to asbestos, Part I: Monitoring of exposure using personal passive samplers. Annals of Occupational Hygiene 51(2):121-130. |
| **HERO ID:** | 1079837 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Industrial plumbers (2/10) |
| Physical form: | fibers (4/10) |
| Personal sampling data: | In round 1 of sampling, 0.080 f/mL were detected (0.069 f/mL chrysotile and 0.011 f/mL amphibole). In round 1 of sampling, 1.84 s/mL were detected (1.83 s/mL chrysotile and 0.01 s/mL amphibole). In round 2 of sampling, 0.011 f/mL were detected (0.006 f/mL chrysotile and 0.004 f//mL amphibole). In round 1 of sampling, 0.066 s/mL were detected (0.062 s/mL chrysotile and 0.004 s/mL amphibole).(6/10) |
| Particle size characterization: | Particles >5 um long and with an aspect ratio of >3:1 with widths between 0.2 and 3 um, & > 5 um long asbestos structures (4/10) |
| Number of workers: | 800 plumbers were registered in the U.K. (3/10) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Sampling and Analytical Methodology | High | Sampling/analytical methodology is equivalent to an approved [OSHA/NIOSH] method. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | Medium | Data are from the U.K., an OECD country. |
| Metric 3: | Applicability | High | The data are for an occupational scenario within the scope of the risk evaluation. |
| Metric 4: | Temporal Representativeness | Medium | Monitoring data were collected after the most recent PEL and greater than 10 years old. |
| Metric 5: | Sample Size | Medium | Sample distribution characterized by limited statistics (averages, ratios) but discrete samples not provided and distribution not fully characterized. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Medium | Exposure type and sampling data provided, but missing exposure duration, frequency, engineering controls, and PPE. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Medium | Uncertainty is not addressed. Variability is addressed by conducting two rounds of sampling. |

## Overall Quality Determination Medium

**Study Citation:** Burdett, G., Cottrell, S., Taylor, C. (2009). Airborne fibre and asbestos concentrations in system built schools. Journal of Physics: Conference Series, vol. 151 :012023.
**HERO ID:** 6867336
**Conditions of Use:** Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products

**EXTRACTION**

| Parameter | Data |
|---|---|
| Worker activity description: | Cleaning and maintenance workers seal columns insulated with asbestos board and carry out maintenance and cleaning work in the ceiling voids. (2/20) |
| Exposure route: | inhalation (7/20) |
| Physical form: | fibers (7/20) |
| Personal sampling data: | Three school cleaners who wore personal samplers during normal cleaning activities in a school that was considered to have a potential problem had measured PCM concentrations of 0.003, 0.011 and 0.014 f/ml giving an average of <0.01 f/ml. (12/20) |
| Area sampling data: | (PCM) 12 samples were taken during sealing of columns, which resulted in a mean of 0.004 f/mL. Twenty PCM analyses of samples collected by persons inspecting columns and ceiling areas gave mean and median concentrations of 0.004 and 0.002 f/ml respectively. (11/20) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | High | Sampling/analytical methodology is equivalent to an approved [OSHA/NIOSH] method. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Medium | Data are from the U.K., an OECD country. |
| | Metric 3: | Applicability | High | Data are for commercial use of chemical substances in construction products, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Medium | Monitoring data were collected after the most recent PEL and greater than 10 years old. |
| | Metric 5: | Sample Size | Medium | Sample distribution characterized by limited statistics (mean, ranges, minimum, maximum) but discrete samples not provided and distribution not fully characterized. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Sample type and exposure type provided, but missing exposure duration, frequency, number of workers, particle size, PPE, and engineering controls. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | High | Uncertainty is addressed in sampling/analytical methodology. Variability is addressed by sampling during different worker activities, and during non-working periods. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Burlington Indus Inc, (1980). Asbestos monitoring results with cover letters. |
| **HERO ID:** | 4158311 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | removal of insulation from boiler (p. 5) |
| Exposure route: | Inhalation |
| Physical form: | Fiber |
| Personal sampling data: | 2 personal samples0.05, one illegible(barely legible, p. 7) |
| Area sampling data: | 14 area samplesrange between ND - 1.87 f/cc with some results illegible |
| Personal protective equipment: | Protective clothing and respirator |
| Engineering control: | Wetting of the insulation |
| Comments: | Document is difficult to read, some of the sample results are illegible |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | High | Sampling or analytical methodology is an approved OSHA or NIOSH method or is well described and found to be equivalent to approved OSHA or NIOSH methods. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | The data are from the United States and are representative of the industry being evaluated. |
| | Metric 3: | Applicability | Low | The data are for an occupational scenario within the scope of the risk evaluation but document is difficult to read and some of the sample results are illegible. |
| | Metric 4: | Temporal Representativeness | Low | Metadata on the operations, equipment, and worker activities associated with the data show that the data agree representative of outdated operations, equipment, and activities rather than current operations, equipment, and worker activities. The data were collected more than 20 years ago. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Monitoring data include most critical metadata, such as sample type and exposure type, but lacks additional metadata, such as exposure durations and exposure frequency |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | Variability is addressed by including personal and area samples but uncertainty is not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Burton, N. C., Buchta, T. M. (1993). Health hazard evaluation report no. HETA 91-215-2293, Internal Revenue Services Appeals Office, Omaha, Nebraska. |
| **HERO ID:** | 3647825 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | The cleaning staff dusts the furniture and vacuums the floors of the office area in the late morning (approximately 11:00 a.m.). Cleaning of the carpeting on the walls of the two conference rooms is not done on a regular basis. [PDF Pg. 3] |
| Physical form: | Fibers (solid) [PDF Pg. 7] |
| Area sampling data: | No detectable levels of asbestos fibers in the office areas at the analytical limit of detection of 0.004 fibers per cubic centimeter of air [according to NIOSH analytical method 74001] (1992 data). [PDF Pg. 7] |
| Number of workers: | 22 Employees were at the office during the visit. [PDF Pg. 3] |
| Engineering control: | Constant volume ventilation systems service the Appeals Office. Two separate heating, ventilating, and air-conditioning (HVAC) systems (30,000 cubic foot per minute [cfm] exhaust and supply fans for each system) service the perimeter offices. One system supplies the north and east perimeters and the other supplies the south and west perimeters. These units are located on the 10th floor. The minimum outside air supply is set at 10%. The HVAC systems are inspected weekly and the individual perimeter units on the floors are cleaned annually. The two thermostats located in the office area are pre-set by maintenance staff. The central office area is serviced by a separate recirculating HVAC system located on the third floor. Supply air is provided by an open air plenum powered by two 50,000 cfm fans on the tenth floor. Air is exhausted through an open plenum which is serviced by two 50,000 cfm fans housed on the tenth floor. The exhaust plenum is on a raised portion of the roof and approximately 100 feet away from the outside air intake. Particulate filters (35% efficiency rating) in the outside air intake are on a roller system and are changed once a week. Cooling and heating for all systems are provided by heating and cooling coils.[PDF Pg. 3] |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Sampling and Analytical Methodology | High | Sampling/analytical methodology is an approved NIOSH method. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | High | Data are from the U.S. |
| | Metric 3: Applicability | High | Data are for Chemical Substances in Construction, Paint, Electrical, and Metal Products, an in-scope occupational scenario. |
| | Metric 4: Temporal Representativeness | Low | Monitoring data are greater than 20 years old. |
| | Metric 5: Sample Size | Low | Sample distribution is described qualitatively. |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | Low | Sample type provided but no other metadata. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Medium | Uncertainty is addressed in sampling/analytical methodology but variability is not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Burton, N. C., Shults, R. A. (1995). Health hazard evaluation report no. HETA 91-0040-2510, Kraft General Foods, Inc., Maxwell House Coffee, Co., Houston, Texas. |
| **HERO ID:** | 3970501 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Comments: | This health hazard evaluation is for a facility that has already removed asbestos from the site, and therefore it is no longer present and not part of the study. |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | High | Sampling/analytical methodology is an approved NIOSH method. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | Uninformative | Data are for a facility without asbestos, which is not in-scope or similar to an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Medium | Monitoring data were collected prior to the most recent PEL. |
| | Metric 5: | Sample Size | Low | Sample distribution is characterized by no statistics. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Uninformative | Sample type and exposure type not provided. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Uninformative

| | |
|---|---|
| **Study Citation:** | Butler, C., McCleery, R. E., Kefer, M., Harper, M., Lee, E. G., Wallingford, K. (2014). Health hazard evaluation report no. HHE 2012-0077-3223, Evaluation of Employee Exposures to Libby Amphibole Asbestos During Fores Management Activities in the Kootenai National Forest. |
| **HERO ID:** | 3970511 |
| **Conditions of Use:** | Other: |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Land management activities, including civil engineering, trail and road maintenance, forest biology, fuels and timber management, hydrology, and wildland fire suppression. (9/42) |
| Exposure route: | inhalation (9/42) |
| Physical form: | dust (9/42) |
| Personal sampling data: | (PCM) During sawing and clearing activities, full-shift TWAs were 0.021-0.043 f/cc at a trail head and 0.010-0.026 f/cc at the fire cache. During sample analysis in the hydrology lab, sample concentrations were 0.007-0.035 f/cc. During fireline construction, full-shift TWAs were 0.017-0.079 f/cc. At the ranger station, full-shift TWAs were 0.007-0.027 f/cc. During trail maintenance, full-shift TWAs were 0.009-0.022 f/cc. During timber stand assessments, full-shift TWAs were 0.013-0.098 f/cc. During other activities, full-shift TWAs were 0.021-0.023 f/cc. (Appendix A) |
| Exposure duration: | 8-10 hours/day (9/42) |
| Number of workers: | 40 park rangers. In the summer, up to 100 additional seasonal employees may be hired. (9/42) |
| Personal protective equipment: | PPE worn by any park ranger included fire protective clothes (for fire reduction workers), hardhats, hearing protection, safety glasses, and safety shoes. Fuel reduction, road maintenance, and trail maintenance workers wore full facepiece or half-mask air purifying respirators with P100 particulate filters. (15/42) |
| Engineering control: | For fire suppression workers and firefighters, aviation resources were first relied on to suppress fires. If ground based firefighting was necessary, mitigation measures included avoiding smoke, minimizing the disturbance of duff, and minimizing use of chainsaws. (17/42) The federal agency attempts to schedule forest management work during environmental conditions that minimize dust exposures. (18/42) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | High | Sampling/analytical methodology is an approved NIOSH method. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | Uninformative | Data are for park rangers and forest management activities near a vermiculite mine, which isn't in scope. |
| | Metric 4: | Temporal Representativeness | High | Monitoring data were collected after the most recent PEL and no more than 10 years old. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Exposure type and sampling data provided, but missing, exposure frequency and particle size. |
| Domain 4: Variability and Uncertainty | | | | |

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|---|---|
| **Study Citation:** | Butler, C., McCleery, R. E., Kefer, M., Harper, M., Lee, E. G., Wallingford, K. (2014). Health hazard evaluation report no. HHE 2012-0077-3223, Evaluation of Employee Exposures to Libby Amphibole Asbestos During Fores Management Activities in the Kootenai National Forest. |
| **HERO ID:** | 3970511 |
| **Conditions of Use:** | Other: |

| | | | EVALUATION | |
|---|---|---|---|---|
| Domain | | Metric | Rating | Comments |
| | Metric 7: | Metadata Completeness | High | Uncertainty is addressed in sampling/analytical methodology. Variability is addressed by sampling different jobs in different areas of the forest. |

## Overall Quality Determination Uninformative

| | |
|---|---|
| **Study Citation:** | Butler, C., McCleery, R. E., Kiefer, M., Harper, M., Lee, E. G., Wallingford, K. (2014). Health hazard evaluation report: Evaluation of employee exposures to Libby amphibole asbestos during forest management activities in the Kootenai National Forest. :1-35. |
| **HERO ID:** | 7605003 |
| **Conditions of Use:** | Other: |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Most of the work done by ranger station employees involves land management activities, including civil engineering, trail and road maintenance, forest biology, fuels and timber management, hydrology, and wildland fire suppression. [PDF Pg. 9] |
| Exposure route: | Inhalation [PDF Pg. 35] |
| Personal sampling data: | Full-Shift TWA (8/13/2012)[PDF Pg. 23] Swamper: 0.021 - 0.043 (f/cc)Sawyer: 0.033 - 0.041 (f/cc)Full-Shift TWA (8/16/2012)[PDF Pg. 24] Swamper: 0.011-0.026 (f/cc)Sawyer: 0.010-0.021 (f/cc)Full-Shift TWA for activities in hydrology lab [PDF Pg. 25] Laboratorian: 0.010-0.033 (f/cc)Full-Shift TWA during fireline construction (8/14/2012)[PDF Pg. 26] Employees 1-7: 0.017-0.079 (f/cc)Full-Shift TWA (8/14/2012)[PDF Pg. 27] Office Employee (technical services building): 0.016 (f/cc)Maintenance and Lawn Care: 0.027 (f/cc)Office Employee (Main building): 0.007 (f/cc)Full-Shift TWA during trail maintenance (8/14/2012)[PDF Pg. 28] Swamper: 0.010 - 0.016 (f/cc)Sawyer: 0.009 - 0.022 (f/cc)Full-Shift TWA during timber stand assessment (8/15/2012)[PDF Pg. 29] Timber supervisor: 0.098 (f/cc)Senior Firefighter: 0.018 (f/cc)Forestry Technicians 1 and 2: 0.017 - 0.028 (f/cc)NIOSH Observer: 0.013 (f/cc)Full-Shift TWA (8/16/2012-8/16/2012)[PDF Pg. 30]Civil Engineering Technician: 0.023 (f/cc)Road Raking and Maintenance: 0.021 (f/cc)Full-Shift TWA (8/16/2012)[PDF Pg. 24] Fuel Reduction: 0.048-0.084 (f/cc)Trail Maintenance: 0.016-0.027 (f/cc)Fire Cache Fuel Reduction and Cleanup: 0.013-0.018 (f/cc)Hydrology: 0.010-0.017 (f/cc)Fireline Construction: 0.051-0.17 (f/cc)Timber Stand Assessment: 0.017 - 0.033 (f/cc)Civil Engineer Technician: 0.023 (f/cc)Road Maintenance: 0.011 (f/cc) |
| Exposure duration: | Work shifts are typically 8–10 hours per day. [PDF Pg. 9] |
| Number of workers: | Approximately 40 full-time, permanent federal employees are employed at the ranger station. In the summer, up to 100 additional seasonal employees may be hired. [PDF Pg. 9] |
| Comments: | Sample collected with PCM method. Gave concentrations in range - full sampling data available in PDF Pg. 23-31. |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | High | Sampling/analytical methodology is an approved NIOSH/OSHA method. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | Low | Data are for residual exposures to park rangers working close to an old vermiculite mine. |
| | Metric 4: | Temporal Representativeness | High | Monitoring data are no more than 10 years old. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | All metadata provided. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | High | Uncertainty is addressed in sampling/analytical methodology. Variability addressed by sampling multiple worker activities on multiple dates. |

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|---|---|
| **Study Citation:** | Butler, C., McCleery, R. E., Kiefer, M., Harper, M., Lee, E. G., Wallingford, K. (2014). Health hazard evaluation report: Evaluation of employee exposures to Libby amphibole asbestos during forest management activities in the Kootenai National Forest. :1-35. |
| **HERO ID:** | 7605003 |
| **Conditions of Use:** | Other: |

| | | EVALUATION | |
|---|---|---|---|
| Domain | Metric | Rating | Comments |
| **Overall Quality Determination** | | **High** | |

| | |
|---|---|
| **Study Citation:** | Camilucci, L., De Simone, P., Fanizza, C., Paglietti, F., Mazzali, M. (2001). The Biancavilla case. :190-194. |
| **HERO ID:** | 6878206 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Exposure route: | Inhalation |
| Physical form: | Solid |
| Area sampling data: | Table 1<0.4 f/L - 4.8 f/L (SEM and PCOM techniques) |
| Comments: | Naturally-occurring asbestos is the primary source of pollution (out of scope) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Medium | Sampling or analytical methodology is not equivalent to an approved OSHA or NIOSH method and EPA review of information indicates the methodology is acceptable. Differences in methods are not expected to lead to lower quality data. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Medium | The data are from an OECD country. other than the U.S., and locality-specific factors (e.g., potential differences in regulatory occupational exposure limits, industry/ process technologies) may impact exposures relative to the U.S. |
| | Metric 3: | Applicability | Uninformative | The data are from an occupational scenario that does not applyto any occupational scenario within the scope of the risk evaluation (exposure to asbestos due to proximity to naturally-occurring asbestos). |
| | Metric 4: | Temporal Representativeness | Low | Metadata on the operations, equipment, and worker activities associated with the data show that the data agree representative of outdated operations, equipment, and activities rather than current operations, equipment, and worker activities. The data were collected more than 20 years ago. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Monitoring data include most critical metadata, such as sample type and exposure type, but lacks additional metadata, such as sample durations, exposure durations, exposure frequency, and/orworker activities. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | The monitoring study provides only limited discussion of the variability in the determinants of exposure for the sampled site or sector. The monitoring study provides only limited discussion of the uncertainty in the exposure estimates. |

## Overall Quality Determination Uninformative

| | |
|---|---|
| **Study Citation:** | Campopiano, A., Casciardi, S., Fioravanti, F., Ramires, D. (2004). Airborne asbestos levels in school buildings in Italy. Journal of Occupational and Environmental Hygiene 1(4):256-261. |
| **HERO ID:** | 3520506 |
| **Conditions of Use:** | Consumer Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Exposure source is floor tiles, and cement ceilings. (3/7) |
| Exposure route: | inhalation (2/7) |
| Physical form: | fibers (2/7) |
| Area sampling data: | (PCM) Maximum airborne asbestos fiber concentrations in schools were 0.4 f/L in 1992 and 1993, 2.2 f/L in 1994, 0.4 f/L in 1995, 1.6 f/L in 1996, 0.4 f/L in 1997, 1.0 f/L in 1998, 0.4 f/L in 1999-2001, and 0.7 f/L in 2002. (5/7) |
| Particle size characterization: | Fibers greater than 5 um in length and less than 3 um in diameter, with an aspect ratio of 3:1 or greater. (3/7) |
| Engineering control: | If ACM is severely damaged, abatement methods must be carried out, including removal, encapsulation, or enclosure. (6/7) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Sampling and Analytical Methodology | High | Sampling/analytical methodology is equivalent to an approved [OSHA/NIOSH] method. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | Medium | Data are from Italy, an OECD country. |
| Metric 3: | Applicability | Low | Data are for consumer use of construction materials in schools, which is similar to commercial use of construction materials, an in-scope occupational scenario. |
| Metric 4: | Temporal Representativeness | Medium | Monitoring data were collected after the most recent PEL and greater than 10 years old. |
| Metric 5: | Sample Size | Medium | Sample distribution characterized by limited statistics (maximums) but discrete samples not provided and distribution not fully characterized. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Medium | Exposure type and sampling data provided, but missing number of workers, exposure duration, frequency, and PPE. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | High | Uncertainty is addressed in sampling/analytical methodology. Variability is addressed by sampling over 10 years at 59 schools. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Campopiano, A., Ramires, D., Zakrzewska, A. M., Ferri, R., D'annibale, A., Pizzutelli, G. (2009). Risk assessment of the decay of asbestos cement roofs. Annals of Occupational Hygiene 53(6):627-638. |
| **HERO ID:** | 2593678 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Physical form: | fiber dust |
| Area sampling data: | The concentrations of airborne asbestos fibres measured in the areas adjacent to the 20 buildings in which extensive asbestos cement roofing was found. Among these, 2 roofs were public buildings, 11 industrial buildings, and 7 industrial disused sites, which showed roofing in visibly advanced states of degradation. The pull-up test applied to public and industrial buildings judged the roofs as very poor. The air samplings were performed at a height of ~1.5 m from the ground and at a distance of ~3–4 m from the building. The mean wind velocity was always very slow of ~1–2 m s1. Building Type# Investigated# Air samplingCmean (fl^1 ) lamda_L (fl^1 ) lamda_U (fl^1 )Farms5130.40.11.0Industrial sheds4100.40.11.0Repairshops240.40.11.0Industrial disused sites7300.60.21.4Public buildings260.00.00.4 |
| Particle size characterization: | All sample analysis was focused on respirable dimensioned fibers: All the fibres detected in the observation areas and which were of a respirable dimension (diameter $<$ 3 um, length $>$ 5 um, length:diameter ratio $>$ 3) were analysed by EDS. |
| Comments: | Table 4. Mean airborne asbestos fibres concentrationmeasured in adjacent areas to buildings with asbestos cementroofs |

**EVALUATION**

| Domain | | Metric | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Medium | Sampling/analytical methodology is equivalent to an approved NIOSH method. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Medium | Data are from Italy, an OECD country. |
| | Metric 3: | Applicability | Low | Data are for a non-occupational scenario: area releases from Asbestos concrete roofs, which is similar to the the in-scope occupational scenario Industrial/Commercial Use: Chemical Substances in Construction, Paint, Electrical, and Metal Products |
| | Metric 4: | Temporal Representativeness | Medium | Monitoring data were collected after the most recent PEL and greater than 10 years old. |
| | Metric 5: | Sample Size | Low | Sample distribution is characterized by no statistics. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Low | Sample type provided but no other metadata. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination — Low

| | |
|---|---|
| **Study Citation:** | Caplan, P. E. (1985). Preliminary Survey Report: Control Technology For Asbestos Removal Industry, Report No. CT-147-16a, Veterans Administration Hospital, Denver, Colorado. NIOSH(CT-147-16a):147-16. |
| **HERO ID:** | 3101588 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | the asbestos removal/renovation project at the hospital |
| Physical form: | Fiber |
| Area sampling data: | Typical samples, collected for 26 hours, have shown levels of lessthan 0.005 f/cc during removal operations. Other samples collected in the ”controlled areas” by Major have not exceeded the OSHA PEL of 2 f/cc. [PDF Pg. 13] |
| Personal protective equipment: | All workers in the ”controlled area” wore contamination control disposal coveralls and half-face mask respirators with high efficiency dust cartridges. As mentioned in the Major Training Manual, failure to wear respiratory protection in the ”controlled area” is grounds for immediate dismissal from employment. This safety precaution was well monitored. [PDF Pg. 12] |
| Engineering control: | The HEPA exhaust system, located in the ”controlled area” was apparently effective in maintaining a negative pressure in the control area and, thereby, preventing external contamination. The 9-1/2 inch exhaust duct (0.5 square feet) was removing approximately 500 cubic feet of air per minute (cfm) from the work area. However, its effectiveness could have been improved by locating replacement air inlets closer to the potential dust sources.A water proof, portable fluorescent work drop light, manufactured by KB Industries of Angola, New York was demonstrated. Since most removal operations involve copious quantities of water on both work surfaces and workers, stray electric currents are a constant hazard. Positive ground faults interrupters properly grounded equipment and water-proof devices are essential for safe operations.The three module, mobile Detox unit, developed by Bill Major, (Evergreen Industries) permits excellent personal hygiene practices by removal personnel. It appeared to be well designed and extremely functional. It is noted that an additional modual section on the clean dressing room end would have improved utility by providing space to store street clothing. [PDF Pg. 13] |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Sampling and Analytical Methodology | Low | Sampling/analytical methodology is not specified. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | High | Data are from the U.S. |
| | Metric 3: Applicability | High | Data are for Chemical Substances in Construction, Paint, Electrical, and Metal Products, an in-scope occupational scenario. |
| | Metric 4: Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| | Metric 5: Sample Size | Low | Sample distribution is characterized by no statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | Low | Sample type provided but no other metadata. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Low

| | |
|---|---|
| **Study Citation:** | Caplan, P. E. (1985). Preliminary Survey Report: Control Technology For Asbestos Removal Industry, Report No. CT-147-15a, Gateway High School, Aurora, Colorado. NIOSH(CT-147-15a):147-15. |
| **HERO ID:** | 3101592 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Walls washed down, workers scraped off asbestos sprayed onto the ceiling and overhead beams and collected it in plastic bags. |
| Exposure route: | Inhalation |
| Physical form: | Fibers |
| Area sampling data: | Background readings before removal activites: 0.002-0.006 f/cc (PCM). |
| Personal protective equipment: | Half-face respirators with high-efficiency dust filters , coveralls, booties, and head covers. |
| Engineering control: | Portable decontamination unit set up outside the building with shower, air lock, and dressing facility. Plastic barriers set up to isolate the equipment room from the rest of the building. |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Low | Sampling or analytical methodology is not specified. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | The data are from the United States. |
| | Metric 3: | Applicability | Medium | The data are for an occupational scenario that is similar to an occupational scenario within the scope of the risk evaluation, in terms of the type of industry, operations, and work activities. The data in the study was only for background asbestos monitoring, not during/after removal. |
| | Metric 4: | Temporal Representativeness | Low | The data were collected before the most recent PEL update. |
| | Metric 5: | Sample Size | Medium | Distribution of samples is characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Monitoring data include most critical metadata, such as sample type and exposure type, but lacks additional metadata, such as sample durations, exposure durations, exposure frequency, and/orworker activities. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | The monitoring study does not address variability or uncertainty. |

## Overall Quality Determination Low

| | |
|---|---|
| **Study Citation:** | Castleman, B. (2003). "Controlled use" of asbestos. International Journal of Occupational and Environmental Health 9(3):294-298. |
| **HERO ID:** | 3520515 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Saw operators and saw operators' helpers |
| Personal sampling data: | "The Asbestos Cement Pipe Producers Association in the United States released reports in 1977 showing that abrasive disc saws, commonly used in construction work involving A-C pipe, created exposures measured at 26-109 f/cc in saw operators and 10-49 f/cc among saw operators' helpers." (pg 3)"Japanese scientists reported quite high exposures from field cutting of A-C pipe more than ten years later. Exposures from repair work on A-C pipes using high-speed disc cutters inside and outside holes dug in the ground to gain access to the pipes were recorded as: 49-170 f/cc (mean value 92) inside the hole, and 1.7-15 f/cc outside." (pg 3) |
| Engineering control: | "At a government-industry conference in 1976, a Johns-Manville official reported that use of power saws on A-C sheets could cause exposures over 250 f/cc; with well-designed and properly operated local exhaust ventilation, he said, this could be reduced to 0.8 f/cc" (pg 3) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Low | Sampling or analytical methodology is not specified. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Medium | Data from United States and Japan. |
| | Metric 3: | Applicability | High | The data are for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Low | The data were collected before the most recent PEL establishment or update or are more than 20 years old if no PEL is established. |
| | Metric 5: | Sample Size | Low | Distribution of samples is qualitative or characterized by no statistics. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Monitoring data include most critical metadata, such as sample type and exposure type, but lacks additional metadata, such as sample durations, exposure durations, exposure frequency, and/orworker activities. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | The monitoring study does not address variability or uncertainty. |

## Overall Quality Determination Low

| | |
|---|---|
| **Study Citation:** | CDC, (2002). Occupational exposures to air contaminants at the World Trade Center disaster site – New York, September-October, 2001. MMWR. Morbidity and Mortality Weekly Report 51(21):453-456. |
| **HERO ID:** | 34850 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Worker activity included torch cutter. Other worker activities in clearing debris not included. |
| Personal sampling data: | States personal breathing zone samples were taken but does not differentiate which samples were those. |
| Area sampling data: | 26 out of 29 bulk samples of undisturbed settled material had <1% asbestos (by mass) while the other 3 samples had 1%-3% asbestos (by mass).2 out of 3 samples of fire proofing material were <1% asbestos358 of 804 air samples (45%) had fibers. Excluding 30 minute samples, 25 samples had concentrations that exceeded the REL of 0.1 fibers/cm^3 of air.No 30 minute sample exceeded the OSHA short term excursion limit of 1.0 f/cc.25 samples were greater than 0.1 f/cc (range: 0.1-0.5 f/cc). |
| Comments: | Source is of occupational exposure at the World Trade Center Disaster Site. |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | High | Sampling and analytical methodology is likely equivalent to NIOSH method because the samples were taken by NIOSH. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data is for United States. |
| | Metric 3: | Applicability | Medium | Due to the severity and rarity of the incident, applicability of the data is limited. |
| | Metric 4: | Temporal Representativeness | Low | Data is just over 20 years old. |
| | Metric 5: | Sample Size | Low | Not characterized by statistics. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Low | Seems to provide area sampling data only. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | Does not address variability or uncertainty. |

## Overall Quality Determination Low

| | |
|---|---|
| **Study Citation:** | CDC, (2002). Work-related lung disease surveillance report. |
| **HERO ID:** | 3978123 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Exposure route: | Inhalation [PDF Pg. 5] |
| Physical form: | Fiber (solid) [PDF Pg. 298] |
| Personal sampling data: | Construction Industry Geometric Mean Exposures [PDF Pg. 17]1979 (97 samples): 0.024 (f/cc)1980 (172 samples): 0.020 (f/cc)1981 (112 samples): 0.017 (f/cc)1982 (168 samples): 0.042 (f/cc)1983 (383 samples): 0.032 (f/cc)1984 (629 samples): 0.023 (f/cc)1985 (474 samples): 0.026 (f/cc)1986 (279 samples): 0.007 (f/cc)1987 (254 samples): 0.006 (f/cc)1988 (254 samples): 0.007 (f/cc)1989 (266 samples): 0.007 (f/cc)1990 (175 samples): 0.005 (f/cc)1991 (214 samples): 0.003 (f/cc)1992 (200 samples): 0.003 (f/cc)1993 (144 samples): 0.004 (f/cc)1994 (82 samples): 0.002 (f/cc)1995 (45 samples): 0.001 (f/cc)1996 (75 samples): 0.001 (f/cc)1997 (52 samples): 0.001 (f/cc)1998 (35 samples): 0.002 (f/cc)1999 (31 samples): 0.003 (f/cc) |
| Comments: | NIOSH 7400 |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | High | Sampling/analytical methodology is an approved NIOSH/OSHA method. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for Chemical Substances in Construction, Paint, Electrical, and Metal Products, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Monitoring data are greater than 20 years old. |
| | Metric 5: | Sample Size | Medium | Sample distribution characterized by limited statistics (geometric mean) but discrete samples not provided and distribution not fully characterized. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Sample type and exposure type provided but missing exposure duration, exposure frequency, and worker activity. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | High | Uncertainty is addressed in sampling/analytical methodology. Variability addressed by sampling over multiple years. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Cecchetti, G., Fruttero, A., Conti, M. E. (2005). Asbestos reclamation at a disused industrial plant, Bagnoli (Naples, Italy). Journal of Hazardous Materials 122(1-2):65-73. |
| **HERO ID:** | 3581705 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | asbestos reclamation work (pg 65) |
| Personal sampling data: | Results of monitoring (ff/L +/- SD) are as follows: 3.01+/-3.91 in January 1999, 2.06+/-1.69 in April 1999, 1.58+/-1.75 in September 1999, 2.52+/-3.10 in October 1999, 7.09+/-24.05 in November 1999, 1.86+/-1.91 in December 1999, 2.74+/-3.01 in January 2000, 2.55+/-1.32 in February 2000 (pg 71) |
| Area sampling data: | Results of monitoring (ff/L +/- SD) are as follows: 1.23+/-1.61 in January 1999, 1.50+/-1.81 in April 1999, 1.20+/-1.11 in September 1999, 1.06+/-1.18 in October 1999, 3.38+/-0.89 in November 1999, 1.72+/-1.07 in December 1999, 1.13+/-0.76 in January 2000, 1.10+/-0.85 in February 2000 (pg 71) |
| Exposure duration: | The duration of the sampling was normally 8 h or, in some cases, fraction of this period, whenever it was necessary to obtain different information on same phase of reclamation. (pg 71) |
| Personal protective equipment: | In all phases of reclamation, workers were equipped with respiratory masks, particularly demi-mask with P3 filters and Tyveks clothing. (pg 71) |
| Engineering control: | Each yard, both confined and open, was controlled by monitoring the possible dispersion of fibers in the environment (inside the plant) and the exposure of those who worked during the reclamation phase. (pg 71) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | High | Methodology is well described and found to be equivalent to approved OSHA or NIOSH methods. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Medium | The data are from an OECD country other than the U.S. |
| | Metric 3: | Applicability | High | The data are for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Low | Data is more than 20 years old. |
| | Metric 5: | Sample Size | Medium | Mean and standard deviation provided but individual data points not given. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Monitoring data include most critical metadata, such as sample type and exposure type, but lacks additional metadata, such as exposure frequency, and/or worker activities. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | Variability is addressed by including both personal and area samples but uncertainty is not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Celanese Chemical Company Inc, (1979). Monitoring results from asbestos clean-up procedures (Aug 06, 1979). |
| **HERO ID:** | 4158167 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Cleanup of asbestos after a spill at a plant. (2/2) |
| Physical form: | fibers (2/2) |
| Personal sampling data: | Highest personal sample was 1.2 f/cc. (2/2) |
| Area sampling data: | The highest area sample was 0.8 f/cc. (2/2) |
| Exposure duration: | 50-70 minutes (2/2) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Sampling and Analytical Methodology | Low | Sampling methodology is not specified. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | Data are from the U.S. |
| Metric 3: | Applicability | High | The data are for an occupational scenario within the scope of the risk evaluation. |
| Metric 4: | Temporal Representativeness | Low | Monitoring data is more than 20 years old. |
| Metric 5: | Sample Size | Medium | Sample distribution characterized by limited statistics (maximums) but discrete samples not provided and distribution not fully characterized. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Medium | Exposure type and sampling data provided, but missing number of workers, exposure frequency, particle size, engineering controls, and PPE. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Medium | Variability addressed by including personal and area samples but uncertainty is not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Celanese Chemical Company Inc, (1979). Interpretive statement asbestos monitoring. |
| **HERO ID:** | 4158172 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Tearing out of asbestos insulation (4/6) |
| Exposure route: | inhalation (4/6) |
| Physical form: | Fiber (4/6) |
| Personal sampling data: | Four personal samples were <0.70, <3.01, <1.51, and <0.81 f/cc (5/6). |
| Exposure duration: | Less than 15 minutes/day (4/6) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Sampling and Analytical Methodology | Low | Sampling methodology is not specified. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | Data are from the U.S. |
| Metric 3: | Applicability | High | Data are for demolition of asbestos products, an in-scope occupational scenario. |
| Metric 4: | Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Medium | Exposure type and sampling data provided, but missing number of workers, exposure frequency, engineering controls, PPE, and particle size. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Cely-García, M. F., Curriero, F. C., Sánchez-Silva, M., Breysse, P. N., Giraldo, M., Méndez, L., Torres-Duque, C., Durán, M., González-García, M., Parada, P., Ramos-Bonilla, J. P. (2016). Estimation of personal exposure to asbestos of brake repair workers. Journal of Exposure Science and Environmental Epidemiology 27(4):417-426. |
| **HERO ID:** | 3520524 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Riveters, who are the workers who perform manipulation activities of brake products (i.e., drilling, countersinking, riveting, beveling, grinding, and cutting). (1/10) |
| Exposure route: | inhalation (3/10) |
| Physical form: | fibers (3/10) |
| Personal sampling data: | (PCM-eq) Forty three samples were for 13 riveters that worked in 9 passenger vehicles BRS, and had a mean of 0.151 f/cm3 , a median of 0.048 f/cm3 , a SD of 0.191 f/cm3 and a range from 0.00 to 0.61 f/cm3 . Sixty samples were for 15 riveters that worked in 9 heavy duty vehicles BRS, and had a mean of 0.042 f/cm3 , a median of 0.021 f/cm3 and SD of 0.057 f/cm3 , and a range from 0.00 to 0.31 f/cm3. (3/10) |
| Exposure duration: | 8 hours (2/10) |

**EVALUATION**

| Domain | | Metric | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | High | Sampling/analytical methodology is an approved NIOSH method. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Medium | Data are from Colombia, an OECD country. |
| | Metric 3: | Applicability | High | The data are for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | High | Monitoring data were collected after the most recent PEL and no more than 10 years old. |
| | Metric 5: | Sample Size | Medium | Sample distribution characterized by limited statistics (means, medians, standard deviations, ranges) but discrete samples not provided and distribution not fully characterized. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Exposure type and sampling data provided, but missing number of workers, exposure frequency, particle size, engineering controls, and PPE. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | High | Uncertainty is addressed in sampling/analytical methodology. Variability is addressed by a monte carlo and crystal ball analysis. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Cely-García, M. F., Torres-Duque, C. A., Durán, M., Parada, P., Sarmiento, O. L., Breysse, P. N., Ramos-Bonilla, J. P. (2015). Personal exposure to asbestos and respiratory health of heavy vehicle brake mechanics. Journal of Exposure Science and Environmental Epidemiology 25(1):26-36. |
| **HERO ID:** | 3078032 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | See Personal Sampling Data |
| Exposure route: | Inhalation |
| Physical form: | friable brake components, dust, fibers |

**Continued on next page . . .**

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**Study Citation:** Cely-García, M. F., Torres-Duque, C. A., Durán, M., Parada, P., Sarmiento, O. L., Breysse, P. N., Ramos-Bonilla, J. P. (2015). Personal exposure to asbestos and respiratory health of heavy vehicle brake mechanics. Journal of Exposure Science and Environmental Epidemiology 25(1):26-36.

**HERO ID:** 3078032

**Conditions of Use:** Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Personal sampling data: | US OSHA Standard (0.1 f/cm3 for 8 h TWA)Colombian Standard (0.083 f/cm3 for 9 h TWA)Worker–daySampling windows used (total sampling windows)Actual sampling time(min)PCME TWA only using actual sampling time (f/cm3)Timeassumed with0f/cm^{3} to complete8h TWA(min)PCME concentration for8-hrTWA (f/cm^{3} )Timeassumed with0f/cm^{3} to complete9h TWA(min)PCME concentration for9-hrTWA (f/cm^{3} )R1–day15(5)540(540)0.10700.118^{a}00.107R1–day27(8)283(497)0.180^{b}1970.106^{c}2570.094^{c}R1–day3^{d}8(10)365(537)0.206^{b}1150.157^{c}1750.139^{c}R1–da sampling time(min)PCME TWA for actual sampling time(f/cm^{3} )PCME concentration for 8h TWA (f/cm^{3} )PCME concentration for 9h TWA (f/cm^{3} )Sampling time including time of overloaded sample(min)"PCME TWA for new sampling time(f/cm^{3} )""PCMEconcentration for8hTWA (f/cm^{3} )""PCMEconcentration for9hTWA (f/cm^{3} )"R1–day22830.1800.1060.0944970.1800.1800.166R1–day33650.2060.1570.1394230.2060.1820.161R1–day53250.1730.1170.1044400.1730.1590.141R3–day11520.0460.0150.01 sampleSampling time(min)Chrysotile fiberscounted (TEMf/Fratio)TEMasbestos concentration (f/cm^{3} )PCMEasbestos concentration (f/cm^{3} )PCMETWA30min asbestosconcentration (f/cm^{3} )ActivitiesR1–day1–a3117(1)0.2970.3890.389Manipulationactivities^{a} of4asbestos-containingblocks.R1–day1–b^{b}33127(1)2.0840.6450.645"Completemanipulation^{c} of2small^{d} brakelinings^{e} andbevelingof2asbestos-containing blocks."R1–day1–c3013(1)0.2330.4350.435"Manipulationactivities^{a} of4asbestos-containingblocks.Workershookhisclothes afterperformingmanipulationactivities."R1–day2–a3214(0.93)0.2290.0770.077Manipulationactivities^{a} of4asbestos-containinglinings.R1–day2–b^{b}3253(1)1.4230.0430.043Manipulationactivities^{a} of4non-asbestos-containingblocks.R1–day2–c3055(1)0.9910.4380.438"Manipulationactivities of4small^{d} asbestos-containinglinings.Workerblewthedustfrom thecountersinkingmachine."R1–day2–d3013(1)0.2380.3650.365Manipulationactivities^{a} of4small^{d} non-asbestos-containinglinings.R1–day2–e3016(1)0.2930.2600.260"Riveting8previouslyholednon-asbestos-containingblocks.Workersweptpartofthe manipulationarea."R1–day2–f1012(1)0.6400.6880.229"Cleaningactivitiesofthemanipulationarea(dry conditions)."R1–day3–a394(1)0.0550.1360.136"Manipulationactivities^{a} ofbrakepads^{e} .Cutting brakepads^{e} withemerydisc.Unriveting4 linings^{e} ."R1–day3–b2726(1)0.5170.2650.239"Completemanipulation^{c} of4asbestos-containingand4non-asbestos-containing blocks."R1–day3–c3434(1)0.5190.3130.313"Manipulationactivities^{a} of4non-asbestos-containinglinings.Workerblewthedustfrom thecountersinkingmachine.Completemanipulation^{c} of2small^{d} linings^{e} ."R1–day3–d2916(0.94)0.2970.2800.271"Cleaningofthemanipulationarea(dry conditions)."R1–day4–a3144(1)0.7630.3890.389"Completemanipulation^{c} of2asbestos-and non-asbestos-containinglinings."R1–day4–b2269(1)1.6990.8230.604Completemanipulation^{c} of2small^{d} non -asbestos-containinglinings.R1–day4–c3147(0.98)0.8350.5820.582"Completemanipulation^{c} of4small^{d} asbestos-containinglinings.Completemanipulation^{c} of2 non-asbestos-containingpads."R1–day4–d2937(1)0.7070.2100.203"Cleaningofthemanipulationarea(dry conditions)."R1–day5–a3046(1)0.8200.4330.433Completemanipulation^{c} of2small^{d} non-asbestos-containinglinings.R1–day5–b3045(1)0.7810.4110.411Completemanipulation^{c} of2small^{d} non-asbestos-containinglinings.R1–day6–a^{g}336(1)0.0980.0190.019"Bevelingandgrinding4non-asbestos- containinglinings.Completemanipulation^{c} of4 small^{d} non-asbestos-containinglinings."R2–day2–a2911(0.92)0.2200.0890.086"Rivetingblocks.Manipulationactivities^{a} of2 asbestos-containinglinings."R2–day2–b3214(1)0.2540.0960.096Manipulationactivities^{a} of4small^{d} asbestos-containinglinings.R3–day1–a292(1)0.0370.0590.057Manipula of2non-asbestos-containinglinings.R3–day2–a3114(1)0.2530.1260.126"Manipulationactivities^{a} ofasbestos-containing linings."R3–day2–b3230(1)0.5160.2550.255Manipulationactivities^{a} of2asbestos-containinglinings.R3–day2–c^{f}34————"Installationofbrakeliningsinvehicle'sbrake system."R3–day4–a3030(1)0.5110.2090.209"Manipulationactivities^{a} of2asbestos-containinglinings.Workerblewthedustfrom thecountersinkingmachine."R3–day4–b^{f}29————"Completemanipulation^{c} of2non-asbestos-containinglinings.Workerusedtheelectric circularsawoutsidethemanipulation-area."R3–day5–a292(1)0.0380.0560.054Manipulationactivities^{a} oflinings.^{e}R3–day6–a3231(1)0.4940.1820.182"Manipulationactivities^{a} of4asbestos-containingblocks.Workerblewthedustfrom thecountersinkingandrivetingmachine."R4–day1–a3338(1)0.6120.2380.238Manipulationactivities^{a} of4asbestos-containinglinings.R4–day1–b3324(1)0.3880.2190.219Manipulationactivities^{a} of2asbestos-containinglinings.R4–day2–a3170(0.99)1.2150.4590.459Workerusedelectriccircularsav containingblocks.R4–day2–b2419(1)0.4250.2510.201Manipulationactivities^{a} of2asbestos-containinglinings.R4–day2–c3124(1)0.4280.2220.222Manipulationactivities^{a} of4asbestos-containinglinings.R4–day3–a3019(1)0.3520.1410.141Manipulationactivities^{a} of4non-asbestos-containinglinings.R4–day4–a3419(1)0.2970.1120.112Manipulationact of4asbestos-containingblocks.R4–day4–b3526(1)0.4100.2360.236"Cleaningactivitiesofbrakesystem.Unriveting oldlinings^{e} ."R4–day4–c3032(1)0.5650.2870.287Manipulationactivities^{a} of4asbestos-containingblocks.R4–day4–d3020(1)0.3430.0720.072Manipulationactivities^{a} of4asbestos-containingblocks.R4–day4–e^{f}29————"Brakemechanic'sactivities.Unrivetingold linings.^{e}"R4–day4–f300(0)o0.0180.0000.000"Manipulationactivities^{a} of2asbestos-containinglinings.Workerdrilledtheedgesto gettheropersizeoftheselinings."R4–day5–a309(1)0.1680.1810.181Manipulationactivities^{a} of2asbestos-containinglinings.R4–day5–b3025(1)0.4470.1510.151Manipulationactivities^{a} of2asbestos-containinglinings.TypeofsampleTypeofworkerPCMEasbestosconcentration )nMeanSDMedianMinMax8-hTWApersonalsamples^{a}R160.1140.0470.1180.0280.157R230.0070.0040.0050.0040.012R350.0170.0140.0130.0030.041R450.0520.0290.0630.021 termpersonalsamples^{b}R1200.3240.1790.3390.0190.645R220.0910.0070.0910.0860.096R360.1470.0820.1540.0540.255R4130.1940.1110.2010.0000.4598hTWApersonalsamples |

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|---|---|
| **Study Citation:** | Cely-García, M. F., Torres-Duque, C. A., Durán, M., Parada, P., Sarmiento, O. L., Breysse, P. N., Ramos-Bonilla, J. P. (2015). Personal exposure to asbestos and respiratory health of heavy vehicle brake mechanics. Journal of Exposure Science and Environmental Epidemiology 25(1):26-36. |
| **HERO ID:** | 3078032 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| | | **EVALUATION** | |

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| | | **EVALUATION** | |
| Domain 1: Reliability | | | |
| | Metric 1: Sampling and Analytical Methodology | High | Sampling/analytical methodology is an approved OSHA method. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | Medium | Data are from Colombia, an OECD country. |
| | Metric 3: Applicability | High | Data are for Industrial/Commercial Use: Chemical Substances in Construction, Paint, Electrical, and Metal Products, an in-scope occupational scenario. |
| | Metric 4: Temporal Representativeness | High | Monitoring data were collected after the most recent PEL and no more than 10 years old. |
| | Metric 5: Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | High | All metadata provided. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Medium | Uncertainty is addressed in sampling/analytical methodology but variability is not addressed. |
| **Overall Quality Determination** | | **High** | |

| | |
|---|---|
| **Study Citation:** | CH2M Hill, (1983). Remedial investigation/feasibility study Mountain View Mobile Home Estates Globe, Arizona. |
| **HERO ID:** | 4158117 |
| **Conditions of Use:** | Other: |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Workers at a remediation site (7/70) |
| Exposure route: | inhalation (12/70) |
| Physical form: | fibers (7/70) |
| Personal sampling data: | Analysis of air sampling filters yielded a range of 0.03-0.8 f/cc. (7/70). Sampling times ranged from 18-min to 9.7-hr. |
| Engineering control: | Proposed cleanup methods include site abandonment, asbestos removal side-wide, or a site rehabilitation with a soil cap. (30/70) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Sampling and Analytical Methodology | Low | Sampling methodology not specified. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | Data are from the U.S. |
| Metric 3: | Applicability | High | The data are for an occupational scenario within the scope of the risk evaluation. |
| Metric 4: | Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Medium | Exposure type and sampling data provided, but missing number of workers, exposure frequency, PPE, and worker activity details. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Medium | The monitoring report addresses variability through collection of data from several workers, but measurement uncertainty is not characterized. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Chadwick, D. A., Buchan, R. M., Beaulieu, H. J. (1985). Airborne asbestos in Colorado public schools. Environmental Research 36(1):1-13. |
| **HERO ID:** | 3625598 |
| **Conditions of Use:** | Consumer Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | People in Colorado public schools where sprayed-on asbestos materials were present. (1/13) |
| Physical form: | fibers (8/13) |
| Area sampling data: | (SEM) The concentrations by sample location ranged from less than detectable to 0.059 f/cc and for facility averages from less than reportable to 0.025 f/cc. (8/13) (TEM) The range of concentrations for building sample locations minus the ambient level was from less than the ambient concentration to 0.739 asbestos f/cc. For the average of the building sample locations minus the ambient measurement, the concentration range was 0.001 to 0.379 asbestos f/cc. (10/13) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | High | Sampling or analytical methodology is an approved OSHA or NIOSH method or is well described and found to be equivalent to approved OSHA or NIOSH methods. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | Low | Data are for school and office workers exposures, which may be similar to commercial use of construction products. |
| | Metric 4: | Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Exposure type and sampling data provided, but missing number of workers, exposure duration and frequency, PPE, engineering controls. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | High | Uncertainty is addressed in sampling/analytical methodology. Variability is addressed by sampling multiple facilities. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Cherrie, J. W., Schneider, T. (1999). Validation of a new method for structured subjective assessment of past concentrations. Annals of Occupational Hygiene 43(4):235-245. |
| **HERO ID:** | 3087079 |
| **Conditions of Use:** | Other: |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Warehouse worker |
| Exposure route: | Inhalation |
| Physical form: | Fibers |
| Area sampling data: | 0.01-19.4 f/ml for warehouse worker caring out routine tasks in a contaminated space. |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Low | Sampling or analytical methodology is not specified. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Report was from the UK, but the data were from a warehouse in the US |
| | Metric 3: | Applicability | Low | No asbestos removal or disturbance activities were taking place to lead to exposure, so the source has low applicability to the legacy asbestos occupational exposure assessment. |
| | Metric 4: | Temporal Representativeness | Low | Data are more than 20 years old. |
| | Metric 5: | Sample Size | Medium | Distribution of samples is characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Low | No metadata were provided. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | Report addresses measurement uncertainty in the summary of results from the validity studies, however variability is not addressed. |

## Overall Quality Determination — Low

| | |
|---|---|
| **Study Citation:** | Cherrie, J., Addison, J., Dodgson, J. (1989). Comparative studies of airborne asbestos in occupational and non-occupational environments using optical and electron microscope techniques. 90:304-309. |
| **HERO ID:** | 3657321 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Remedial work on asbestos insultation. (2/6) |
| Exposure route: | inhalation (2/6) |
| Physical form: | dust (2/6) |
| Area sampling data: | Using PCM, the fiber density range was 3-39 fiber/mm2 for asbestos clearance, and 12-160 fiber/mm2 inside a building with spray insulation. Using SEM, the density was 3.3+-2.6 fiber/mm2 for clearance and 0.6+-3.8 fiber/mm2 for the building samples. (5/6) |
| Particle size characterization: | Fibers were split into two groups: those with a length less than 5um, and those longer. The geometric mean ratio of SEM asbestos fiber density, longer than 5 um, to that found with PCM was 0.4. (4/6) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Medium | Sampling/analytical methodology is not an approved OSHA/NIOSH method but is an acceptable methodology. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Medium | Data are from the U.K., an OECD country. |
| | Metric 3: | Applicability | High | Data are for commercial use of chemical substances in construction products, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| | Metric 5: | Sample Size | Medium | Sample distribution characterized by limited statistics (mean, standard deviations, ratios) but discrete samples not provided and distribution not fully characterized. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Sample type and exposure type provided but missing number of workers, exposure duration and frequency, engineering controls, and PPE. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | High | Uncertainty is addressed in sampling/analytical methodology. Variability addressed by sampling at two sites with different degrees of exposure. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Chesson, J., Hatfield, J., Schultz, B., Dutrow, E., Blake, J. (1990). Airborne asbestos in public buildings. Environmental Research 51(1):100-107. |
| **HERO ID:** | 3095922 |
| **Conditions of Use:** | Consumer Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | ambient levels in office/government/school buildings |
| Area sampling data: | summarized four other studies for ambient asbestos levels in buildings, included range, median, mean, and number of samples for each study in units of structures per cubic centimeter; range ND to 0.0031 s/cm3 for GSA buildings, ND to 0.2020 s/cm3 for Canadian schools, 0.0049 to 0.0122 s/cm3 for multistory office buildings, and 0.0005 to 0.0130 s/cm3 for non-school buildings in the UK |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Medium | Sampling/analytical methodology is not an approved OSHA/NIOSH method but is an acceptable methodology. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Some data are from the U.S. |
| | Metric 3: | Applicability | Low | Data are for non-occupational scenario or ambient levels in buildings, which is similar to the the in-scope occupational scenario related to construction. |
| | Metric 4: | Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| | Metric 5: | Sample Size | Medium | Sample distribution characterized by limited statistics (range, mean, median, number of samples), but discrete samples not provided and distribution not fully characterized. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Low | Sample type provided but no other metadata. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | Variability addressed by different building types, but uncertainty is not addressed. |

## Overall Quality Determination — Low

| | |
|---|---|
| **Study Citation:** | Choi, S., Suk, M. H., Paik, N. W. (2010). Asbestos-containing materials and airborne asbestos levels in industrial buildings in Korea. Journal of University of Occupational and Environmental Health 32(1):31-43. |
| **HERO ID:** | 2586932 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Area sampling data: | [PDF Pg. 7]Friable-fair damage condition: 0.0003-0.0072 (f/cm^3)Friable-good condition damage: 0.003-0.0071 (f/cm^3)Non-friable-fair condition damage: 0.0001-0.0062 (f/cm^3)Non-friable-good condition damage: 0.002-0.006 (f/cm^3) |
| Comments: | Results analyzed by PCM methods. Document does not contain asbestos concentrations. |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | High | Sampling/analytical methodology is an approved NIOSH/OSHA method. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Medium | Data are from Korea, an OECD country. |
| | Metric 3: | Applicability | High | Data are for Chemical Substances in Construction, Paint, Electrical, and Metal Products., an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Medium | Monitoring data were collected after the most recent PEL and greater than 10 years old. (2010) |
| | Metric 5: | Sample Size | Medium | Sample distribution characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Low | Sample type provided but no other metadata. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | High | Uncertainty is addressed in sampling/analytical methodology. Variability addressed by testing multiple damage conditions and friable conditions. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Chrostek, W. J. (1984). Health Hazard Evaluation Report No. HETA-84-029-1427, Jewish Family And Childrens Agency, Ardmore, Pennsylvania. NIOSH(HETA-89-029-1427):89-029. |
| **HERO ID:** | 3658724 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | employees and social workers at a Jewish Family and Children's Agency exposed to asbestos from the ceiling. (4/7) |
| Exposure route: | Inhalation (4/7) |
| Physical form: | fibers (4/7) |
| Area sampling data: | (PCM) Area samples were all below the limit of detection of 0.01 f/cc. (7/7) |
| Particle size characterization: | Particles with an aspect ratio of 3:1 or greater were included in the study. (5/7) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | High | Sampling/analytical methodology is an approved NIOSH method. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for commercial use of chemical substances in construction products, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Sample type and exposure type provided, but missing exposure duration, frequency, particle size, engineering controls, PPE, and number of workers. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | High | Uncertainty is addressed in sampling/analytical methodology. Variability is addressed by sampling at multiple locations around the office. |

## Overall Quality Determination High

**Study Citation:** Clayton Environmental Consultants, (1979). Asbestos survey report for Johns-Manville Corp conducted at American Motors Facility.
**HERO ID:** 4158200
**Conditions of Use:** Other:

**EXTRACTION**

| Parameter | Data |
|---|---|
| Worker activity description: | Removal of asbestos containing insulation from overhead pipe. The insulating was removed by first cutting the material into cylindrical sections, then each section was cut in half and the two halves were carefully removed and placed into large plastic bags. (5/17) |
| Exposure route: | inhalation (5/17) |
| Physical form: | fibers (5/17) |
| Personal sampling data: | (PCM) Personal samples were 0.31 f/cc for the leader/pipe insulation remover, 1.62 and 11.86 f/cc for another pipe insulation remover, and overloaded for the last pipe insulating remover. (9/17) |
| Particle size characterization: | Fibers greater than 5 um in length (9/17) |
| Exposure duration: | Removal took 0.25-2.25 hours (9/17) |
| Personal protective equipment: | Workers wore disposable protective clothing and NIOSH approved disposable dust masks. (5/17) |
| Engineering control: | The insulation was dampened before, during, and after the removal. (5/17) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Sampling and Analytical Methodology | High | Sampling/analytical methodology is equivalent to an approved [OSHA/NIOSH] method. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | Data are from the U.S. |
| Metric 3: | Applicability | High | Data are for demolition of asbestos products, an in-scope occupational scenario. |
| Metric 4: | Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Medium | Exposure type and sampling data provided, but missing number of workers and exposure frequency. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Medium | Uncertainty is addressed in sampling/analytical methodology. Variability isn't addressed. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Confidential, (1986). Submission of health and safety data on acetonitrile. |
| **HERO ID:** | 3121119 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| Parameter | Data |
|---|---|
| Worker activity description: | Prep and assembly (12/146), shipping and receiving (13/146), furnace operators (16/146), finishing, laminators (26/146), test lab operators (37/146), tech men (47/146), finish and repair employees, small rubber part fabricators (48/146), laggers (102/146), chief of plant protection (103/146), cell builders, production technician (104/146), preweighed compounding (111/146), mill operators (112/146), pipefitters, pipe coverers, electricians (113/146), calendar operators (124/146), and marine product builders (143/146). |
| Exposure route: | inhalation (16/146) |
| Physical form: | fibers (12/146) |
| Personal sampling data: | Personal monitoring results at unspecified plants were 0.02-0.06 f/cc for prep and assembly (12/146), 0.02-0.48 f/cc for shipping and receiving (13/146), 0.11-0.45 f/cc for furnace operators (one outlier of 999.99 f.cc) (16/146), 0.15 f/cc for misc. finishing, 0.05-0.12 f/cc for laminator helpers, 0.09-0.10 f/cc for heavy duty finishing, 0.08-0.09 f/cc for laminator operators (26/146), 0.01 for test lab operators (37/146), 0.02-0.80 f/cc for tech men (47/146), 0.06-0.34 f/cc for finish and repair workers, 0-0.06 f/cc for small rubber part fabricators (48/146), 0.01-0.03 f/cc for laggers (102/146), 0.01 f/cc for the chief of plant protection, 0.01 f/cc for cell builders, 0.01 f/cc for production technicians (104/146), 0.14-0.39 f/cc for preweighed compounding (111/146), 0.00-0.87 f/cc for mill operators (112/146), 0.09-0.40 f/cc for pipefitters, 0.00-0.58 f/cc for pipe coverers, 0.16-0.68 f/cc for electricians (113/146), 0.00-0.23 f/cc for calendar operators (124/146), and 0.03-0.81 f/cc for marine product builders (143/146). |
| Exposure duration: | Exposure durations were 15 minutes to 6.5 hours. (12/146) |
| Personal protective equipment: | Furnace operators, tech men, finish and repair employees, chief of plant protection, mill operators, pipefitters and coverers, electricians, and calendar operators wore disposable particulate respirators. (16/146) Rubber part fabricators preweighed compounders, and marine product builders wore half mask air purifying respirators. (48/146). Laggers wore a full mask, hood, suit, or helmet with air. (102/146) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Sampling and Analytical Methodology | Low | Sampling methodology not specified. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | High | Data are from the U.S. |
| | Metric 3: Applicability | Medium | The plant specifics aren't given, but worker titles include pipefitters, electricians, and other in-scope titles, so industrial use in construction material is assumed. |
| | Metric 4: Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| | Metric 5: Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | Medium | Exposure type and sampling data provided, but missing number of workers, exposure frequency, engineering controls, and particle size. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Medium | Variability is addressed by sampling different job titles. Uncertainty isn't addressed, |

**Continued on next page . . .**

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| | |
|---|---|
| **Study Citation:** | Confidential, (1986). Submission of health and safety data on acetonitrile. |
| **HERO ID:** | 3121119 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| **Overall Quality Determination** | | **Medium** | |

| | |
|---|---|
| **Study Citation:** | Confidential, (1986). Airborne asbestos monitoring results with cover letter dated 111886 (sanitized). |
| **HERO ID:** | 4158382 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Two laborers were assigned the task of cleaning up some old piping material that was made of Transite (bonded asbestos). This involved moving the piping to a storage location for future disposal. The clean-up involved sweeping dust and wet mopping the floor. |
| Exposure route: | Inhalation |
| Physical form: | Fibers |
| Personal sampling data: | Both personal samples were <0.01 f/mL. |
| Personal protective equipment: | Employees wore coveralls and respirators. |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Sampling and Analytical Methodology | Low | Sampling methodology not specified. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | Data are from the U.S. |
| Metric 3: | Applicability | High | The data are for an occupational scenario within the scope of the risk evaluation. |
| Metric 4: | Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Medium | Exposure type and sampling data provided, but missing additional metadata such as number of workers, exposure duration and frequency, and particle size. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Corn, M. (1994). Airborne concentrations of asbestos in non-occupational environments. Annals of Occupational Hygiene 38(4):495-502. |
| **HERO ID:** | 7 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Ceiling removal/installation; electrical/plumbing work; HVAC work; miscellaneous work; removal/encapsulation; run cable. |
| Personal sampling data: | 8-hr TWA samples in (fibers/cm^3) [PDF Pg. 6]Personal SamplesCeiling removal/installation: 1.49*10^-2Electrical/plumbing work: 6.19*10^-2HVAC Work: 2.02*10^-2Miscellaneous Work: 8.18*10^-3Removal/encapsulation: 6.14*10^-2Run Cable: 1.67*10^-2 |
| Area sampling data: | 8-hr TWA samples in (fibers/cm^3) [PDF Pg. 6]Area inside work areaCeiling removal/installation: 1.12*10^-2Electrical/plumbing work: 3.08*10^-2HVAC Work: 6.82*10^-3Miscellaneous Work: 1.08*10^-2Removal/encapsulation: 1.09*10^-2Run Cable: 8.04*10^-3 |
| Comments: | Sampling was done using the TEM method for chrysotile and amphibole asbestos. |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Sampling and Analytical Methodology | High | Sampling/analytical methodology is an approved NIOSH method. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | Data are from the U.S. |
| Metric 3: | Applicability | High | Data are for commercial use in construction, paint, electrical, and metal products, an in-scope occupational scenario. |
| Metric 4: | Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| Metric 5: | Sample Size | Medium | Sample distribution characterized by limited statistics (mean) but discrete samples not provided and distribution not fully characterized. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Low | Sample type provided but no other metadata. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | High | Uncertainty is addressed in sampling/analytical methodology. Variability addressed by sampling breathing zones during multiple worker activities and multiple areas of the site. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Corn, M., Crump, K., Farrar, D. B., Lee, R. J., Mcfee, D. R. (1991). Airborne concentrations of asbestos in 71 school buildings. Regulatory Toxicology and Pharmacology 13(1):99-114. |
| **HERO ID:** | 3714772 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Source of exposure is plaster ceilings and fireproofing. (10/16) |
| Exposure route: | inhalation (2/16) |
| Physical form: | fibers (2/16) |
| Area sampling data: | (TEM) The average concentration of asbestos structures in indoor samples was 0.020 structure/cm3 for total structures and 0.00023 structure/cm3 for structures longer than 5 pm (Table 1). The corresponding average concentrations for outdoor samples were 0.002 and 0.0 structure/cm3 (no structures longer than 5 pm were found in outdoor samples). |
| Particle size characterization: | Most of the fibers were very thin (94% less than 0.2 pm in diameter) and short (76% less than 1 um long), and most (95%) were chrysotile. The amphibole fibers present tended to be somewhat longer and thicker than the chrysotile fibers. (11/16) |
| Comments: | TABLE2: COMPARISON OF ASBESTOS CONCENTRATION MEASUREMENTS ACROSS LEVELSOF EXPLANATORY VARIABLES |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Sampling and Analytical Methodology | High | Sampling/analytical methodology is an approved NIOSH method. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | Data are from the U.S. |
| Metric 3: | Applicability | High | Data are for commercial use of chemical substances in construction products, an in-scope occupational scenario. |
| Metric 4: | Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| Metric 5: | Sample Size | Medium | Sample distribution characterized by limited statistics (mean, percentiles) but discrete samples not provided and distribution not fully characterized. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Medium | Sample type and exposure type provided but missing number of workers, exposure duration and frequency, engineering controls, and PPE. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | High | Uncertainty is addressed in sampling/analytical methodology. Variability addressed by collecting 5 samples at each site, and sampling at 71 different sites. |

## Overall Quality Determination High

**Study Citation:** Cornwell, R. (1983). Health hazard evaluation report no. HETA 83-176-1310 Easton Elementary School, Morgantown, West Virginia.
**HERO ID:** 3970498
**Conditions of Use:** Other:

**EXTRACTION**

| Parameter | Data |
|---|---|
| Worker activity description: | Maintenance workers removing damaged pipe insulation. (5/9) |
| Exposure route: | inhalation (4/9) |
| Physical form: | fibers (5/9) |
| Personal sampling data: | (PCM) Most of the samples collected during pipe insulation removal were less than 0.1 f/cc. Two personal samples contained concentrations of 0.18 and 0.50 f/cc. (5/9) |
| Area sampling data: | (PCM) Most of the samples collected during pipe insulation removal were less than 0.1 f/cc. One area sample contained 0.18 f/cc. (5/9) |
| Particle size characterization: | Fibers had an aspect ratio of 3:1 and were greater than 5um in length. (5/9) |
| Personal protective equipment: | Whenever asbestos containing material must be handled, an approved respirator must be worn (9/9) |
| Engineering control: | EPA recommends covering equipment and hard to clean surfaces with PVC or polyethylene sheets, Windows, doors, and ventilation systems should be sealed. The area should be sealed off with a PVC or polyethylene sheet. Overlap joinings and heat the seal or tape it. Access to the work zone must be through an air lock. The ventilation system should remain off until the work is completed. (8/9) Spray the ACM with water before it is disturbed. |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Sampling and Analytical Methodology | High | Sampling/analytical methodology is an approved NIOSH method. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | Data are from the U.S. |
| Metric 3: | Applicability | High | Data are for demolition of asbestos products, an in-scope occupational scenario. |
| Metric 4: | Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| Metric 5: | Sample Size | Medium | Sample distribution characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Medium | Exposure type and sampling data provided, but missing number of workers, exposure duration, and frequency. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Medium | Uncertainty is addressed in sampling/analytical methodology. Variability isn't addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Costello, R. (1984). Health Hazard Evaluation Report No. HETA-82-305-1541, Fountain Avenue Landfill, Brooklyn, New York. NIOSH(HETA-82-305-1541):82-305. |
| **HERO ID:** | 3658389 |
| **Conditions of Use:** | Disposal |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | scale clerks, attendants, heavy equipment operators (page 6/38) |
| Exposure route: | inhalation (page 3/38) |
| Personal sampling data: | Asbestos was detected in 2 out of 14 samples at concentrations of 0.01 f/cc. (page 10/38) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Sampling and Analytical Methodology | High | Paper is a NIOSH HHE, so assumed NIOSH methods were used. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | High | The data are from the United States and are representative of the industry being evaluated. |
| | Metric 3: Applicability | High | Data are for the disposal OES, which is in scope. |
| | Metric 4: Temporal Representativeness | Low | Data are over 20 years old. |
| | Metric 5: Sample Size | High | Statistical distribution of samples is fully characterized (discreet data provided). |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | Medium | Monitoring data include most critical metadata, such as sample type and exposure type, but lacks additional metadata, such as exposure duration, exposure frequency, number of workers, PPE, and engineering controls. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Low | The monitoring study does not address variability or uncertainty. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Courtice, M. N., Wang, X., Lin, S., Yu, I. T., Berman, D. W., Yano, E. (2016). Exposure-response estimate for lung cancer and asbestosis in a predominantly chrysotile-exposed Chinese factory cohort. American Journal of Industrial Medicine 59(5):369-378. |
| **HERO ID:** | 3520560 |
| **Conditions of Use:** | Other: |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Raw materials workers, carders, spinners, weavers, rubber workers, cement workers, maintenance workers, administration workers, and rear service workers. (2/10) |
| Exposure route: | inhalation (3/10) |
| Physical form: | dust and fiber (3/10) |
| Personal sampling data: | Historic fiber and dust measurements (personal and area combines) in 1994 were 4.9 mg/m3 for raw materials, 6.4 mg/m3 for carding and spinning, 1.9 mg/m3 for weaving, and 34.0 mg/m3 for rubber and cement manufacture. (3/10) |
| Area sampling data: | Geometric paired area samples for fibers were 5.0 f/mL for raw materials, 7.8 f/mL for carding and spinning, 0.5 f/mL for weaving, and 0.6 f/mL for rubber and cement. (4/10) Average airborne fiber estimates for 2004-2008 were 1.3 f/mL for raw materials, 2.5 f/mL for carding and spinning, 0.1 f/mL for weaving, and 0.7 f/mL for rubber and cement. (5/10) |
| Number of workers: | Over a million workers are estimated to be currently exposed to asbestos in China. (1/10) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Medium | Sampling/analytical methodology is not an approved OSHA/NIOSH method but is an acceptable methodology. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Low | Data are from China, a non-OECD country. |
| | Metric 3: | Applicability | Uninformative | Data are for manufacturing of asbestos-containing products, which isn't in scope. |
| | Metric 4: | Temporal Representativeness | Medium | Monitoring data is from both before and after the PEL. |
| | Metric 5: | Sample Size | Medium | Sample distribution characterized by limited statistics (means, ranges) but discrete samples not provided and distribution not fully characterized. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Exposure type and sampling data provided, but missing exposure duration, frequency, PPE, engineering controls, and particle size. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | High | Uncertainty is addressed in sampling/analytical methodology. Variability is addressed by compiling data from over 50 years. |

## Overall Quality Determination Uninformative

| | |
|---|---|
| **Study Citation:** | Crandall, M. S., Fleeger, A. K. (1989). Health hazard evaluation report no. HETA 88-372-1953, Barbados Ministry of Health, Bridgetown, Barbados. |
| **HERO ID:** | 3970543 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | At the hospital, workers did laundry near asbestos insulated steam pipes. (4/37) At the sugar factory, workers were performing maintenance on processing equipment for the next harvest season. This included the removal of lagging (troweled-on insulating covering) from some of the equipment. (11/37) |
| Physical form: | insulation dust (6/37) |
| Area sampling data: | (PCM) There were 10 air samples collected at the Queen Elizabeth Hospital, including one outdoor sample as a control. Four samples showed fiber concentrations above the LOD. One of these was the control sample, which was collected in a large open area between the hospital laundry and the hospital proper. Two samples from the laundry showed fiber concentrations of 0.005 f/cm3 . One was located next to the TULLIS sheet iron and the other next to the AJAX steam irons (northeast side). One sample, collected in the hospital boiler room near the fire pump tank, showed 0.004 f/cm3 . The outdoor air sample fiber concentration was 0.006 f/cm3 . At the Bulkley Sugar Factory, only one of the 10 samples analyzed by PCM showed fiber concentrations above the LOD. This sample was collected in the evaporation area where 0.016 f/cm3 were found. Three of the samples collected at Bulkley were overloaded. There was a lot of activity in the areas where the samples were collected, and it was much dustier than the other survey sites. (11/37) |
| Number of workers: | 35 workers in the hospital laundry room, 98 workers at the sugar factory. (4/37) |
| Engineering control: | NIOSH recommended that all friable asbestos be replaced using enclosures and wet methods, followed by wet cleanup methods. (15/37) |
| Comments: | Table 3- Results of Phase Contrast Microscopy Fiber Analysis of Air Samples.Table 4-Results of Transmission Electron Microscopy Analysis of Air Samples |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Sampling and Analytical Methodology | High | Sampling/analytical methodology is an approved NIOSH method. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | Low | Data are from Barbados, a non-OECD country. |
| Metric 3: | Applicability | High | Data are for commercial use in construction materials, an in-scope occupational scenario. |
| Metric 4: | Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Medium | Sampling data provided, but missing exposure duration, frequency, particle size, and PPE. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | High | Uncertainty is addressed in sampling/analytical methodology. Variability is addressed by sampling at different sites. |

## Overall Quality Determination Medium

**Study Citation:** Cross, A. A. (1976). Effect of changed working techniques on asbestos dust levels in the working environment. IARC Scientific Publication, no. 13 :121-125.
**HERO ID:** 3101581
**Conditions of Use:** Other:

**EXTRACTION**

| Parameter | Data |
|---|---|
| Worker activity description: | Demolition of old plants and stripping of old insulation. (5/8) |
| Exposure route: | inhalation (5/8) |
| Physical form: | dust and fibers (4/8) |
| Personal sampling data: | During lagging removal at a power station, the highest PBZ concentration recorded was 0.1 f/mL. (6/8) |
| Area sampling data: | During lagging removal from a Navy ship, mean concentrations were in the range of 150-400 f/mL with peak concentrations well over 3000 f/mL. (5/8) During another lagging removal at a power station, area samples were 0.01-0.03 f/mL. (6/8) |
| Personal protective equipment: | Even after workplace controls are implemented, protective clothing and equipment are necessary. (6/8) |
| Engineering control: | Methods of lowering workplace asbestos dust concentrations include modification of the product so that it is less likely to emit dust, elimination of the dust producing operation or process, suppression of dust, avoidance of personal exposure by mechanization, enclosure, and exhaust ventilation or dust extraction. (4/8) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Sampling and Analytical Methodology | Low | Sampling methodology not specified. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | Medium | Data are from the U.K., an OECD country. |
| Metric 3: | Applicability | High | Data are for demolition of asbestos products, an in-scope occupational scenario. |
| Metric 4: | Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| Metric 5: | Sample Size | Medium | Sample distribution characterized by limited statistics (means, ranges, maximums) but discrete samples not provided and distribution not fully characterized. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Medium | Exposure type and sampling data provided, but missing number of workers, exposure duration, frequency, and particle size. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Medium | Variability is addressed by comparing monitoring data from different studies. Uncertainty isn't addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Crump, K. S., Farrar, D. B. (1989). Statistical analysis of data on airborne asbestos levels collected in an EPA survey of public buildings. Regulatory Toxicology and Pharmacology 10(1):51-62. |
| **HERO ID:** | 3095858 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Area sampling data: | ”Area sample: mean concentrations and number of samples for all fibers and for fibers specifically >= 5microns given in fibers/cm3 for each building, stratified by whether building had asbestos-containing materials (ACM) present; for buildings with no ACM, mean conc of all fibers ranged 0-0.0050 fibers/cm3; for buildings with ACM in good condition, mean conc of all fibers ranged 0-0.0010 fibers/cm3; and for buildings with damaged ACM, mean conc for all fibers ranged 0-0.0031 fibers/cm3 (on pages 4-5)also provides mean, median, and range of fiber concentrations by asbestos type for grouped buildings by presence of ACM (pg 7)” |

**EVALUATION**

| Domain | | Metric | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Medium | Sampling/analytical methodology is not an approved OSHA/NIOSH method but is an acceptable methodology. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | Low | Data are for non-occupational scenario or ambient levels in buildings, which is similar to the the in-scope occupational scenario related to construction. |
| | Metric 4: | Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| | Metric 5: | Sample Size | Medium | Sample distribution characterized by limited statistics (range, mean, median, number of samples), but discrete samples not provided and distribution not fully characterized. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Low | Sample type provided but no other metadata. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | Variability addressed by by different buildings and types of asbestos, but uncertainty is not addressed. |

## Overall Quality Determination — Low

| | |
|---|---|
| **Study Citation:** | Dahlgren, J., Peckham, T. (2012). Mesothelioma associated with use of drywall joint compound: a case series and review of literature. International Journal of Occupational and Environmental Health 18(4):337-343. |
| **HERO ID:** | 2554713 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | handling, mixing, sanding, and sweeping also demolition or repair of wallboard |
| Exposure route: | inhalation |
| Physical form: | inhalable fibers |
| Personal sampling data: | Rohl et al., 1975 PCM Pole sanding (Peak) mean: 10 f/cc range: 1.2–19.3 f/ccHand sanding mean: 5.3 1.3–16.9 f/ccDry mixing mean: 47.2 f/cc range: 35.4–59.0 f/ccSweeping floor (15 minutes after sweeping) mean: 41.4 f/ccSweeping floor (30 minutes after sweeping) mean: 26.4 f/ccVerma et al., 1980 SEM Application mean: 0.9 f/cc range: 0.4–1.3 f/ccMixing dry powder mean:11.2 f/cc range: 9.0–12.4 f/ccMixing using premix mean: 2.4 f/cc range: 1.2–3.2 f/ccMixing area using premix mean: 2 f/cc range: 1.2–2.7 f/ccHand sanding mean: 11.5 f/cc range: 2.1–24.2 f/ccPole sanding mean: 4.3 f/cc range: 1.2–10.1 f/ccPole sanding mean: 4.9 f/cc range: 1.2–10.0 f/ccPole sanding mean: 4.9 f/cc range: 1.2–10.1 f/ccSweeping mean: 7.7 f/cc range: 4.0–26.5 f/ccSweeping mean: 19.4 f/cc range: 14.5–25.4 f/ccSweeping mean: 15.1 f/cc range: 4.0–26.5 f/ccTotal operations mean: 6.1 f/cc range: 0.3–26.5 f/ccSoule, 1973* PCM Mixing of dry compound mean: 31.4 f/ccSanding of dry compound mean: 39.4 f/ccSanding of ready-mix compound mean: 4.2 f/ccSanding of ready-mix compound mean: 11.1 f/ccMixing of dry compound mean: 7.6 f/ccSanding of dry compound mean: 4.4 f/ccSanding of dry compound mean: 14.8 f/cc Sanding of ready-mix compound mean: 10.8 f/ccSanding of ready-mix compound mean: 9.7 f/cc |
| Area sampling data: | Rohl et al., 1975 PCM Pole sanding background in same room mean: 8.6 f/cc range: 3.5–19.8 f/ccPole sanding background in adjacent room mean: 4.8 f/cc range: 0.7–8.8 f/ccHand sanding background in same room mean: 2.3 f/cc range: 2.1–2.5 f/ccHand sanding background in adjacent room mean: 4.3 f/cc range: 1.5–7.1 f/ccDry mixing background measurements in same room (10–20 ft)mean: 5.8 f/cc range: 0.5–13.1 f/ccDry mixing background measurement in adjacent room (16–33 ft)mean: 2.6 f/cc range: 2.1–3.1 f/ccVerma et al., 1980 SEM Sanding area{ mean: 3.2 f/cc range: 0.3–7.0 f/cc |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Sampling and Analytical Methodology | Medium | Studies predate NIOSH Method 7400 - Optical microscopy was used. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | High | US |
| | Metric 3: Applicability | High | The data are for an occupational scenario (drywall construction work) within the scope of the risk evaluation. |
| | Metric 4: Temporal Representativeness | Low | published in 2012, after the PEL (1994) but the exposure data that the study was based on was from 1973-1980. |
| | Metric 5: Sample Size | Low | mean and range of measurements was provided. uncertainty not discussed |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | Medium | Monitoring data include most critical metadata, such as sample type, exposure type, sample durations, and/or worker activities, but lacks additional metadata, such as exposure durations and exposure frequency. |
| Domain 4: Variability and Uncertainty | | | |

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| | |
|---|---|
| **Study Citation:** | Dahlgren, J., Peckham, T. (2012). Mesothelioma associated with use of drywall joint compound: a case series and review of literature. International Journal of Occupational and Environmental Health 18(4):337-343. |
| **HERO ID:** | 2554713 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

| | | | **EVALUATION** | |
|---|---|---|---|---|
| Domain | | Metric | Rating | Comments |
| | Metric 7: | Metadata Completeness | Medium | Range and mean values were provided for different tasks which can be used to assess variability, but uncertainty was not discussed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Damiran, N., Silbergeld, E. K., Frank, A. L., Lkhasuren, O., Ochir, C., Breysse, P. N. (2015). Exposure to airborne asbestos in thermal power plants in Mongolia. International Journal of Occupational and Environmental Health 21(2):137-141. |
| **HERO ID:** | 3520572 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | workers were performing thermal insulation work - subtasks included removing old insulation; preparing asbestos mixtures for insulation; installing insulation using mixtures of powder asbestos and asbestos-containing cord; installing insulation using mixtures of powder asbestos; disposing of waste from old insulation materials; pipe welding (pg 138) |
| Exposure route: | inhalation |
| Physical form: | Fiber |
| Personal sampling data: | The average personal airborne fiber concentration was 1.03+/-0.68 f/cm3, with a range of 0.09–3.15 f/cm3. (pg 139) |
| Area sampling data: | The overall average PCM fiber concentration in the workplace was 0.96 f/cm3, with a range of <0.05 to 3.15 f/cm3. Area samples were lower, with a mean of 0.49+/-0.51 f/cm3 (range of <0.05–1.48 f/cm3).(pg 139) |
| Exposure duration: | Sample duration were 12 to 81 minutes (pg 140). |
| Number of workers: | 41 workers employed in 4 coal-fired power plants (pg 138) |
| Personal protective equipment: | Workers were not using any protective clothing and respirators (pg 138). The researcher wore disposable protective coveralls (Tyvek) and a powered air-purifying respirator with a high-efficiency particulate air (HEPA) filter during the air sampling procedure (pg 139). |
| Engineering control: | Air conditioning or technical ventilation – with or without filtering were not used (pg 138) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Sampling and Analytical Methodology | High | Sampling or analytical methodology is an approved OSHA or NIOSH method or is well described and found to be equivalent to approved OSHA or NIOSH methods. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | Low | The data are from a non-OECD country. |
| Metric 3: | Applicability | High | The data are for an occupational scenario within the scope of the risk evaluation. |
| Metric 4: | Temporal Representativeness | High | The data are no more than 10 years old. |
| Metric 5: | Sample Size | Medium | Average concentrations provided but individual data points not provided. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Medium | Monitoring data include most critical metadata, such as sample type and exposure type, but lacks additional metadata, such as exposure frequency. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | High | The monitoring study addresses variability and uncertainty. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Damiran, N., Silbergeld, E. K., Frank, A. L., Lkhasuren, O., Ochir, C., Breysse, P. N. (2015). Exposure to airborne asbestos in thermal power plants in Mongolia. International Journal of Occupational and Environmental Health 21(2):137-141. |
| **HERO ID:** | 3520572 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Exposure route: | inhalation |
| Physical form: | Fiber |
| Area sampling data: | As per a study, in 2007, asbestos exposure at Estonian oil shale-fueled power plants during plant renovation (area airborne fiber concentrations) averaged 0.043+/-0.022 f/cm3. |

**EVALUATION**

| Domain | | Metric | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Low | Sampling or analytical methodology is not specified. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Low | The data are from a non-OECD country. |
| | Metric 3: | Applicability | High | The data are for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Medium | The monitoring data were collected after the most recentPEL establishment or update but are generally more than 10 years old. If no PEL is established, the data are more than 10 years but generally, no more than 20 years old. |
| | Metric 5: | Sample Size | Medium | Distribution of samples is characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Monitoring data include most critical metadata, such as sample type and exposure type, but lacks additional metadata, such as exposure frequency and worker activities. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | Variability and uncertainty has not been addressed regarding the study where the monitoring data is taken from. |

## Overall Quality Determination Low

**Study Citation:** Darcey, D. J., Alleman, T. (2004). Occupational and environmental exposure to asbestos. :17-33.
**HERO ID:** 6865356
**Conditions of Use:** Other:

**EXTRACTION**

| Parameter | Data |
|---|---|
| Worker activity description: | Asbestos abatement workers. (3/17) |
| Exposure route: | inhalation (6/17) |
| Physical form: | fibers (7/17) |
| Personal sampling data: | In the removal of pure asbestos lagging, for example, potential exposures of 62 to 159 fibers/ml have been reported. (7/17) |
| Area sampling data: | During encapsulation, concentration of asbestos was 117.2 f/L. During removal of asbestos, concentration was 1736 f/L. (12/17) |
| Personal protective equipment: | HEPA (high-efficiency-particulate air) filter respirator and impermeable disposable clothing (7/17) Also, a gown and gloves are worn. Following each work period, workers are required to discard all outer clothing and shower, to prevent secondary contamination from work clothes. (8/17) |
| Engineering control: | Geographic isolation, soaking of the asbestos source, and personal containment represent the most important strategies for reduction of exposure. (7/17) The site is kept at negative barometric pressure (relative to the surrounding area) by having fans blow air outward through HEPA filters. If possible, asbestos-containing material is covered in plastic bags to encase escaping fragments. Throughout removal, every effort is made to keep the material soaked so that respirable dust is minimized. Waste products are labeled and are handled with special care. Monitoring for airborne asbestos concentration is performed outside the confined asbestos-abatement area. (8/17) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Sampling and Analytical Methodology | Low | Sampling methodology not specified. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | Data are from the U.S. |
| Metric 3: | Applicability | High | Data are for demolition of asbestos products, an in-scope occupational scenario. |
| Metric 4: | Temporal Representativeness | Medium | Monitoring data were collected after the most recent PEL and greater than 10 years old. |
| Metric 5: | Sample Size | Medium | Sample distribution characterized by limited statistics (averages) but discrete samples not provided and distribution not fully characterized. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Medium | Exposure type and sampling data provided, but missing number of workers, exposure duration, frequency, and particle size. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Medium | Variability is addressed by sampling before, during, and after asbestos removal. Uncertainty isn't addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Darcey, D. J., Alleman, T. (2004). Occupational and environmental exposure to asbestos. :17-33. |
| **HERO ID:** | 6865356 |
| **Conditions of Use:** | Consumer Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Exposure route: | inhalation (6/17) |
| Physical form: | fibers (7/17) |
| Area sampling data: | Air in U.S. school rooms was 0.00054 f/cc. Air in U.S. buildings with cementitious asbestos was 0.00026 f/cc. Air in U.S. buildings with friable asbestos was 0.00064 f/cc. (10/17) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Low | Sampling methodology not specified. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | Low | Data are for ambient air in office buildings and schools, which is similar to the in-scope occupational scenario commercial use of construction products. |
| | Metric 4: | Temporal Representativeness | Medium | Monitoring data were collected after the most recent PEL and greater than 10 years old. |
| | Metric 5: | Sample Size | Medium | Sample distribution characterized by limited statistics (median, percentile) but discrete samples not provided and distribution not fully characterized. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Exposure type and sampling data provided, but missing worker information, exposure duration, frequency, particle size, engineering controls, and PPE. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | Variability is addressed by sampling at different building types. Uncertainty isn't addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Dave, S. K., Beckett, W. S. (2005). Occupational asbestos exposure and predictable asbestos-related diseases in India. American Journal of Industrial Medicine 48(2):137-143. |
| **HERO ID:** | 3079949 |
| **Conditions of Use:** | Other: |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | mining of asbestos rock from the ground, which occurs in India in both small cottage industries using hand picks and shovels, and with larger industrial operations using both underground mining techniques and open cast (open pit) mining; processing of the rock into a commercially useful fibrous form, which often is done in milling factories (pg 2) Exposure also occurs in the processing of the rock into a commercially useful fibrous form, done in milling factories, located close to underground or open cast mine. |
| Exposure route: | inhalation |
| Physical form: | solid |
| Area sampling data: | Mill where ore is crushed and processed: 200-400 f/ml (pg 4); later followup in the same region were less than 2 f/ml (pg.4 )<1 f/ml in mines and 20-25 f/ml in some mills (pg 4)1.5-2 f/ml in mills (pg 4) |
| Number of workers: | 400 workers across 45 asbestos mining and milling units (pg 1)Cottage industries or the unorganized sector are defined as workplaces with fewer than 20 employees (pg 2)120 in milling population (pg 4) |
| Personal protective equipment: | small workplaces not regulated by factory inspectorate, thus workplace standards are not enforced (pg 2) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Sampling and Analytical Methodology | Low | Sampling/analytical methodology is not specified. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | Low | Data are from India, a non-OECD country. |
| Metric 3: | Applicability | Low | Data are for mining and milling, which is not in-scope for asbestos legacy uses but may still be informative. |
| Metric 4: | Temporal Representativeness | Low | Available citations for monitoring data ranged from 1991-1996, more than 20 years ago. Report indicates a recent update of PEL within India, but no associated year. |
| Metric 5: | Sample Size | Medium | Sample distribution characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Low | Sample type provided but no other metadata. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Medium | Variability addressed by evaluating different sized sites/facilities within the industry, but uncertainty is not addressed. |

## Overall Quality Determination — Low

| | |
|---|---|
| **Study Citation:** | Dave, S. K., Beckett, W. S. (2005). Occupational asbestos exposure and predictable asbestos-related diseases in India. American Journal of Industrial Medicine 48(2):137-143. |
| **HERO ID:** | 3079949 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | asbestos-composite wallboard cut with powered tools (pg 4) Additional exposure may occur indoor or outdoors with the gradual release of asbestos fibers from deteriorating building materials. (pg. 4)Construction workers who install asbestos-containing materials may be exposed during the cutting and drilling of building materials such as cement pipe or tiles (pg 5)Because the fibers released by these activities are highly durable, can remain airborne for long periods and can be re-suspended in air with the disturbance of settled dust, building construction workers (such as electricians, masons, and carpenters) who do not work directly with the asbestos-containing materials may be exposed sufficiently to cause asbestos disease. (pg 5)the process of removing asbestos-containing materials can lead to further, significant exposure. This may occur in the ship breaking industry, where decommissioned ships insulated with asbestos are torn apart for scrap metal, releasing the asbestos into the work and general environments. In addition, if old asbestos-containing materials remain in place beyond their functional lifetime, they may release hazardous fibers into the breathing air of those working or dwelling within the buildings (pg 5) |
| Area sampling data: | In a survey of four large-scale asbestos cement factories studied by NIOH, two with a predominance of manual operations had mean fiber levels less than 1 f/ml. However, in two other more mechanized industries, fiber levels were over 10 f/ml (pg 5)A study conducted in several small scale asbestos textile industries measured fiber levels 100 times higher than the current PEL (pg 5)study conducted in a large-scale asbestos textile and brake-manufacturing company by the Central Labor Institute found levels 6–8 times the PEL (pg 5)asbestos cement products factory where levels of fibers were 2–3 times higher than the PEL in some work areas (pg 5) |
| Number of workers: | A study conducted in several small scale asbestos textile industries employing a total of nearly 65 workers (pg 5)In a study of asbestos-exposed workers in this [asbestos textile] industry.... 99 workers (pg 5)355 actively working asbestos cement factory workers (pg 5)55 workers in asbestos jointing and packing industry (pg 5)total asbestos industry workers in India: 25,000; 40,000 if including former workers (pg 6) |
| Personal protective equipment: | respiratory protective masks capable of filtering out very small fibers (pg 5) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Sampling and Analytical Methodology | Low | Sampling/analytical methodology is not specified. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | Low | Data are from India, a non-OECD country. |
| | Metric 3: Applicability | High | Data are for construction materials, an in-scope occupational scenario. |
| | Metric 4: Temporal Representativeness | Low | Lack of clarity on data sources of the monitoring data, but assume year of data collection was more than 20 years as NIOH references are 1989-1992. |
| | Metric 5: Sample Size | Medium | Sample distribution characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | Low | Sample type provided but no other metadata. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Medium | Variability addressed by evaluating for sites of various sizes within the industry, but uncertainty is not addressed. |

## Overall Quality Determination Low

| | |
|---|---|
| **Study Citation:** | Davis, D. R. (1995). Release of asbestos fibers during casting ring liner manipulation. Journal of Prosthetic Dentistry 74(3):294-298. |
| **HERO ID:** | 3615540 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Furnishing, Cleaning, Treatment Care Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Ten metal casting rings approximately 28 mm in diameter and 35 mm long (no. 4805, Whip Mix Corp.) were placed approximately 46 cm in front of the investigator.Individual pieces of dry asbestos liner approximately 90 mm long, 38 mm wide, and 0.6 mm thick were torn from rolls and manually adapted to the inside circumference of the ring. The strips were torn to approximately the distance between two measured (90 mm) lines, when all 10 rings were lined, the asbestos liners were removed and placed in a plastic waste bag; disposal of the liners was in contrast to actual laboratory use, where the liner wouldhave been saturated with water instead of subjected to further manipulation. The rings were again lined as before, and the process was repeated for a total time of 30 minutes. The experiment was repeated three times in suc cession to yield three separate BZ samples. |
| Exposure route: | inhalation |
| Physical form: | Inhalable fibers |
| Personal sampling data: | PCM NIOSH Method 7400 & TEM#1 0.092 f/ml of air Confidence Interval 0.065 0.006 TWA F/ml TEM 0.349 Total structure/ml 0.20 Structures/ml >5um#2 0.061 f/ml of air Confidence Interval 0.044 0.004 TWA F/mlTEM 0.175 Total structure/ml 0.025 Structures/ml >5um#3 0.065 f/ml of air Confidence Interval 0.045 0.004 TWA F/mlTEM 0.175 Total structure/ml <0.025 Structures/ml >5um |
| Area sampling data: | PCM NIOSH Method 7400#1 0.005 f/ml of air Confidence Interval 0.005 0.001 TWA F/ml#2 0.005 f/ml of air Confidence Interval 0.006 0.001 TWA F/ml |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | High | NIOSH Method 7400 PCM & TEM |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | US |
| | Metric 3: | Applicability | High | The data are for an occupational scenario (dentistry) within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Medium | 1995 - after most recent PEL (1994) but more than 10 years old. |
| | Metric 5: | Sample Size | High | results from each sampling event were included including actual fiber/cluster counts, concentrations, confidence intervals and TWA. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Monitoring data include most critical metadata, such as sample type and exposure type, sample durations, and worker activities, but lacks additional metadata, such as exposure durations and exposure frequency. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | High | Variability was discussed and it was assumed that uncerttaintiy was concisdered in NIOSH method 7400. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Dement, J. M., Stayner, L. T. (2010). Letter to the editor: "Comparing milled fiber, Quebec ore, and textile factory dust: has another piece of the asbestos puzzle fallen into place?" by D. Wayne Berman. Critical Reviews in Toxicology 40(8):749-51; author reply 752-7. |
| **HERO ID:** | 2582520 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Furnishing, Cleaning, Treatment Care Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Textile weaving and preparation |
| Area sampling data: | Cites a 1938 study (Dressen et al., 1938) that fiber dust was 1% asbestos in the preparation stage for textile process while it was 26% in weaving.A 1966 study found that 18.6% of fibers in preparation were >10 um in length and that 38.7% of fibers in weaving were >10 um. |
| Particle size characterization: | Airborne asbestos fibers are different from textile mills and mines.Cites a 1938 study of a North Carolina asbestos textile plant (Dressen et al., 1938) where fibers ranged from 7.0 um to 16.3 um in length. |
| Comments: | Letter to editor. The letter states that the analytical method was of the ISO direct transfer method for the study that was conducted however this is the letter to the editor and does not provide the actual data in this source. |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Low | The sampling/analytical methodology is not an approved OSHA/NIOSH method but is an acceptable methodology. However, the source is a letter to an editor and does not actually provide the data that was analyzed. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data is for the US. |
| | Metric 3: | Applicability | Medium | The data is for textile manufacturing, which could fit in the in-scope occupational scenario ”industrial use of treatment care products” if the material was used to treat the textiles. |
| | Metric 4: | Temporal Representativeness | Low | The cited data is over 20 years old. The data from the study itself is not presented here. |
| | Metric 5: | Sample Size | Low | Samples are not characterized by statistics. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Low | Metadata only include some particle characterization data. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | Does not address variability or uncertainty. |

## Overall Quality Determination Low

**Study Citation:** DHHS, (1988). Proceedings of the VIIth International Peumoconioses Conference. :3-1581.
**HERO ID:** 3974880
**Conditions of Use:** Other:

**EXTRACTION**

| Parameter | Data |
|---|---|
| Exposure route: | inhalation and ingestion |
| Physical form: | inhalable fibers |
| Personal sampling data: | General exposure at factories that use asbestos in Thailand 5 fibers/ml (adobe page 348) |
| Area sampling data: | General exposure at factories that use asbestos in Thailand 2.5 fibers/ml. Maximum was 58.5 fibers/ml at a brake manufacturer (adobe page 348)Mexican workers using spray asbestos 54 fibers/cc (1982) & India asbestos cement pipe sawing 216-418 fibers/cc (Adobe page 1010)US asbestos sheet cutting on ships 100 fibers/cc and 500 million fibers/L in cistern drinking water which used asbestos cement roofing tiles.( adobe page 1011)JapanIndoorsSawing Mean: 214 f/ml Median: 147 f/ml Range 125-787 f/mlSawing 1.5 to 2 m above work Mean: 245 f/ml Median: 232 f/ml Range 103-630 f/mlDrilling/screwing/nailing/sawing Mean: 11 f/ml Median: 12.3 f/ml Range 1.3-131 f/mlDrilling/screwing/nailing/sawing 1-10 meter above work Mean: 5.4 f/ml Median: 3.0 f/ml Range 0.9-48.1 f/mlDrilling/screwing/nailing Mean: 2.0 f/ml Median: 2.5 f/ml Range 0.3-14.1 f/mlDrilling/screwing/nailing 1-4 meter above work Mean: 1.3 f/ml Median:1.6 f/ml Range 0.1-4.6 f/mlCutting and Filling Range 12.1 f/mlInspecting work site Range 0.04-0.12 f/mlFinishing or cleaning Mean: 0.3 f/ml Median: 0.3 f/ml Range 0.1-0.5 f/mlCenter of Room Range 0.01 f/mlOutdoordSawing Range 0.14 f/mlRoofing Range 0.13 f/mlRoofing 1-2 M above Range 0.05 f/mlNailing Range 0.13 f/mlPlumbing Range 0.05 f/ml(Adobe page 1089)26 CountriesMining/milling, asbestos cement, friction products, textiles and other asbestos products< 0.5 f/ml 79.8% of workers0.5 < 1 f/ml 10.7% of workers1<2 f/ml 7.4 % of workers>2 f/ml 2.1% of workersmine/mills13,499 workers17 sites6 Countries82.6% <1 f/ml16.0% 1-2 f/ml1.4% >2 f/mlasbestos cement17,844 workers167 sites23 Countries95.5% <1 f/ml3.3% 1-2 f/ml1.2% >2 f/mlFriction materials10,190 workers64 sites10 Countries96.8% <1 f/ml2.2% 1-2 f/ml1.0% >2 f/mlTextiles2,303 workers40 sites7 Countries71.1% <1 f/ml13.0% 1-2 f/ml15.9% >2 f/mlOther products1,890 workers71 sites10 Countries87.9% <1 f/ml6.1% 1-2 f/ml6.0% >2 f/ml(Adobe page 1094) |
| Exposure duration: | JapanDuration handling asbestos containing construction materials.0-4 years 258 workers (10/1 %)5-9 years 492 workers (19.7%)10-14 years 705 workers (28.3%)15-19 years 416 workers (16.7%)20-24 years 383 workers (15.4%)25-29 years 124 workers (5%)30-34 years 91 workers (3.6%)35-39 years 24 workers (1.9%) 40-52 years 8 workers (0.3%)(Adobe page 1091)Mean number of days handling asbestos-containing construction material per month in the last year0-1 days per month 47 workers (2.7%)1-2 days per month 710 workers (36.3%)3-4 days per month 399 workers (20.6%)5-6 days per month 279 workers (14.4%)7-10 days per month 314 workers (16.2%)11-15 days per month 116 workers (6.0%)16-30 days per month 76 workers (3.9%)(Adobe Page 1092)Italy - shipyardduration of Asbestos exposure0-4 years 1 men 0 women5-9 years 5 men 0 women10-19 years 1 men 0 women20-29 years 9 men 3 women30-39 years 13 men 3 women40-49 years 11 men 0 women(Adobe page 1478) |
| Number of workers: | JapanCarpenters 2608Plasterer 531Electrician 280Painter 261Plumber 220Navy 209Sheet metal worker 197Interior finish worker 147Steel-frame worker 197Cabinet maker 126Helper 118Tiler 104Others 1466no answer 104total 6500 ( adobe page 1091) |
| Personal protective equipment: | Japan0.8% of workers out of 3710 wear protective masks at all times 6.6% sometimes(adobe page 1092) |
| Engineering control: | Italy Waterproof overalls that are attached to a sack-like helmet and attached to a pump/filter that provides positive pressure. Decontamination consists of boot wash followed by air blast to remove fibers, then water shower to remove remaining fibers.Next air to dry the overalls and helmets (adobe page 1106) |
| Comments: | Massive document (1617 pages) to check on compiled information the Adobe pages of the document was provided. |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Sampling and Analytical Methodology | High | Results from a large number of studies (1617 pages) at a NIOSH-ILO conference in Pittsburgh (1988) |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | Medium | Information compiled comes from several different countries some are OECD members and some are not. |

**Continued on next page . . .**

. . . continued from previous page

**Study Citation:** DHHS, (1988). Proceedings of the VIIth Intervational Peumoconioses Conference. :3-1581.
**HERO ID:** 3974880
**Conditions of Use:** Other:

| Domain | | Metric | EVALUATION Rating | Comments |
|---|---|---|---|---|
| | Metric 3: | Applicability | High | The data are for a range of occupational scenario ( Asbestos processing and product manufacture) within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Low | 1988 - prior to the recent PEL and more than 20 years old |
| | Metric 5: | Sample Size | Medium | Some of the studies included a mean, median and range values. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Low | Monitoring data presented generally include sample type (e.g., personal breathing zone), in some cases sampling duration. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | In some cases range was provided that could be helpful in assessing variance. Their was no discussion of uncertainty. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Dodge, D. G., Beck, B. D. (2016). Historical state of knowledge of the health risks of asbestos posed to seamen on merchant ships. Inhalation Toxicology 28(14):637-657. |
| **HERO ID:** | 3520598 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Seamen on commercial vessels are exposed to ''in-place'' asbestos on by performing intermittent repair and maintenance tasks such as pipe lagging repair, welding, brake operations, valve repair and gasket cutting, and clean-up after repairs. |
| Exposure route: | Inhalation |
| Physical form: | Fibers |
| Personal sampling data: | Pipe lagging repair (n=5, sample duration = 23-24 min, ND - 0.44 f/cc), Welding (n=2, sample duration = 10-16 min, 2.2-5.0 f/cc), Valve repair and gasket cutting (n=1, sample duration = 33 min, 0.23 f/cc), Clean-up after lagging repair (n=2, sample duration = 4 min, 2.4-3.3 f/cc), Clean-up from pipe repair (n=3, sample duration = 4-22 min, 0.24-3.4 f/cc), Engine room personnel (n=36, sample duration = 150 - 240 min, 0.01-0.11 f/cc) |
| Area sampling data: | Pipe lagging repair (n=8, sample duration = 23-360 min, ND - 0.87 f/cc), Welding (n=3, sample duration = 26-120 min, 0.2-0.4 f/cc), Brake operations - anchor winch brake box cleaning (n=1, sample duration = 4 min, 70 f/cc(estimated)), Open brake operation (n=1, sample duration = 4 min, 2.09 f/cc), Valve repair and gasket cutting (n=2, sample duration = 29-360 min, 0.02-0.17 f/cc), Clean-up after lagging repair (n=4, sample duration = 4-120 min, ND-2.6 f/cc), Clean-up from pipe repair (n=3, sample duration = 22 min, 0.11-0.86 f/cc), Background engine-room samples (n=40, sample duration = 6 hr, ND-1.00 f/cc) |
| Comments: | Task specific personal and area monitoring are provided above. However, the report also summarizes asbestos exposure reported in several other studies (Table 6 & Table 7) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Sampling and Analytical Methodology | Medium | Sampling/analytical methodology is not an approved OSHA/NIOSH method but EPA review of information indicates the methodology is acceptable. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | Medium | Data are from Sweden, an OECD country. |
| | Metric 3: Applicability | High | Data are for maintenance and repair work on commercial vessels. |
| | Metric 4: Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| | Metric 5: Sample Size | Medium | Distribution of samples is characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | Medium | Exposure type and sampling data provided, but missing exposure duration and frequency. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | High | Monitoring report addresses variability through multiple sample types (area and personal), and addresses uncertainty by collecting multiple samples. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Dong, H., Saint-Etienne, L., Renier, A., Billon Galland, M. A., Brochard, P., Jaurand, M. C. (1994). Air samples from a building with asbestos-containing material: asbestos content and in vitro toxicity on rat pleural mesothelial cells. Fundamental and Applied Toxicology 22(2):178-185. |
| **HERO ID:** | 3081847 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Area sampling data: | 22 air samples ranging from 0 - 0.027 f/ml (Table 1)Different areas in a university building in Paris10 hr/day, Monday-Friday (p. 2) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Medium | Sampling or analytical methodology is not equivalent to an approved OSHA or NIOSH method and EPA review of information indicates the methodology is acceptable. Differences in methods are not expected to lead to lower quality data. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Medium | The data are from an OECD country other than the U.S., and locality-specific factors (e.g., potential differences in regulatory occupational exposure limits, industry/ process technologies) may impact exposures relative to the U.S. |
| | Metric 3: | Applicability | High | The data are for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Low | Metadata on the operations, equipment, and worker activities associated with the data show that the data agree representative of outdated operations, equipment, and activities rather than current operations, equipment, and worker activities. The data were collected more than 20 years ago. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | Monitoring data include all associated metadata, including sample types, exposure types, sample durations, exposure durations worker activities, and exposure frequency. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | High | The monitoring study addresses variability in the determinants of exposure for the sampled site or sector. The monitoring study addresses uncertainty in the exposure estimates or uncertainty canbe determined from the sampling and analytical method. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Donovan, E. P., Donovan, B. L., Sahmel, J., Scott, P. K., Paustenbach, D. J. (2011). Evaluation of bystander exposures to asbestos in occupational settings: a review of the literature and application of a simple eddy diffusion model. Critical Reviews in Toxicology 41(1):52-74. |
| **HERO ID:** | 2581697 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Blowing dust from brake drumsGrinding used liningsGasket Manipulation. |
| Exposure route: | Activity Number of samplesSample typeSample time (minutes)Point source sample concentration (f/cc)*Bystander sample concentration (f/cc)*Distance from source (ft.)Automobile studies (gaskets)Removal of automobile exhaust6 Area 30-50 0.018 (0.002–0.04) 0.008 (0.0008–0.015) 2-4systems containing asbestosgaskets in four single and twodouble exhaust enginesAutomobile studies (clutches)Handling, unpacking, and 40 Area 30 0.044 (0.000–0.366) 0.0025 (0.000–0.019) 5repacking boxes of automobileclutch discsStacking clutch boxes 2 Area 30 0.2125 (0.180–0.245) 0.010 (0.003–0.016) 5Cleanup 6 Area 30 0.002 (0.000–0.006) 0.000 (0.000–0.000) 5Clothes handling 2 Area 30 0.0015 (0.000–0.005) 0.000 (0.000–0.000) 5Handling, unpacking, and 20 Area 30 0.044 (0.000–0.366) 0.000 (0.000–0.003) 50repacking boxes of automobileclutch discsStacking clutch boxes 1 Area 30 0.2125 (0.180–0.245) 0.000 (0.000–0.000) 50Cleanup 3 Area 30 0.002 (0.000–0.006) 0.000 (0.000–0.000) 50Clothes handling 1 Area 30 0.0015 (0.000–0.005) 0.000 (0.000–0.000) 50Removal of automotive clutches58 Area 26–161 0.047 (0.015–0.13) 0.013 (<0.002–0.03) 5-10Automobile studies (brakes)Filing of brake shoes 4 AreaAssociated worker 0.0356 0.0128 <10 2 Areasamples ranged from 0.0097 >10Hand sanding brake shoes 4 Area30 to 107 min; sample 0.0684 0.0097 <10 1 Areaduration not reported 0.0091 10 2 Area"for individual area samples" 0.0092 >10Arc grinding I 4 Area 0.4358 0.0266 <10 1 Area 0.0828 10 2 Area 0.0389 >10Arc grinding II 4 Area 0.1734 0.0186 <10 1 Area 0.0372 10 2 Area 0.0154 >10Cleaning 4 Area 0.0000 0.0000 <10 1 Area 0.0000 10 2 Area 0.0000 >10Packing and unpacking brake 26 Area 30 0.2974 (0.008–1.190) 0.0166 (0.001–0.076) 5padsPacking and unpacking brake 16 Area 30 0.0646 (0.021–0.193) 0.065 (0.002–0.038) 5shoesCleanup after packing and 2 Area 30 0.004 (0.002–0.006) 0.002 (0.001–0.004) 5unpacking activitiesClothes handling after packing1 Area 30 0.011 (0.007–0.015) 0.010 5 Point source Bystander sample Distance Activity Number of samplesSample typeSample time (minutes) sample concentration (f/cc)*concentration (f/cc)*from source (ft.)ReferencePacking and unpacking brake pads13AreaNR0.2974 (0.008–1.190)0.0082 (0.003–0.017)25–30Packing and unpacking brake shoes5 AreaNR0.0646 (0.021–0.193)0.001 (0.001–0.002)25–30Cleanup after packing and unpacking activities3AreaNR0.004 (0.002–0.006)0.003 (0.001–0.006)25–30Clothes handling after packing and unpacking activities Gasket Studies1AreaNR0.011 (0.007–0.015)0.00225–30Disassembly and assembly of flanges12Area4 h^{a}0.004–0.0050.003 (0.002–0.004)(opposite end ofMangold et al., 2006^{b} 3 x 3 x 3 m enclosure)Cutting gaskets using circular cutter8Area8 h<0.0050.003 (0.002–0.006)5.0-10.0Cutting gaskets using hand shears8Area8 h<0.0050.004 (<0.003–0.006)5.0–10.0Cutting gaskets using ball peen hammer8Area8 h0.0050.006 (0.004–0.007)5.0–10.0Shaping gaskets using scribe8Area8 h<0.0050.003 (0.002–0.004)5.0–10.0Gasket removal8Area8 h<0.0050.002 (<0.001–0.002)5.0–10.0Flange face cleaning using putty knife0Area8 h<0.0050.001 (<0.001–0.002)5.0–10.0Flange face cleaning using hand wire brush8Area8 h0.0070.003 (0.002–0.005)5.0–10.0Flange face cleaning using power wire brush8Area8 h0.0090.001 (<0.001)5.0–10.0Packing removal and installation8Area4.5<0.0110.004 (0.002–0.0065.0–10.0Band sawing sheet gasket material1Area252.2-3.10.75–0.96∼2-3 (60–90cm)Fowler, 2000^{b}1Area63.1–4.91.8–2.3∼2-3 (60–90cm)Scraping and hand wire brushing 24Area15–309.3–24.02.1–8.4∼7 (2.1 m)Longo et al., 2002^{b}large flange assemblies16Area15-3014.9–317.6–15.7∼7 (2.1 m)Gasket removal1Area148^{a}0.00350.00179Blake et al., 2006^{d}1Area151^{a}0.00350.0013151Area148^{a}0.00350.0011181Area151^{a}0.00350.0026191Area148^{a}0.00350.0017301Area151^{a}0.00350.00072^{c}1Area120^{a}1: Disassembly of a medium 2Area29–60<0.028–<0.046<0.021–<0.02210Liukonen and Weir, 2005^{b}duty diesel engine — RemovalDay 2: Disassembly of a medium6Area11–64<0.021–<0.12<0.02–<0.11810duty diesel engine — Removal1Personal11^{e}<0.021–<0.12<0.1132-5of gaskets and cleaning of gasketsurfacesDay 3: Disassembly of a medium2Area38–1920.012–<0.023<0.007–<0.03410duty diesel engine — Cleaning of2Personal38–1920.012-<0.023<0.008–<0.0352-5gasket and other surfaces |
| Personal sampling data: | Point source Bystander sample Distance Activity Number of samplesSample typeSample time (minutes) sample concentration (f/cc)*concentration (f/cc)*from source (ft.)Packing removal and installation1Personal4.5<0.011<0.009NR^{+} |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Sampling and Analytical Methodology | Low | Sampling/analytical methodology is not specified. |

**Continued on next page . . .**

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**Study Citation:** Donovan, E. P., Donovan, B. L., Sahmel, J., Scott, P. K., Paustenbach, D. J. (2011). Evaluation of bystander exposures to asbestos in occupational settings: a review of the literature and application of a simple eddy diffusion model. Critical Reviews in Toxicology 41(1):52-74.
**HERO ID:** 2581697
**Conditions of Use:** Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products

| | | EVALUATION | |
|---|---|---|---|
| Domain | Metric | Rating | Comments |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | Medium | Data are from the U.S. and other OECD Countries |
| Metric 3: | Applicability | Medium | The data are for an occupational scenario that is similar to an occupational scenario within the scope of the risk evaluation, in terms of the type of industry, operations, and work activities. |
| Metric 4: | Temporal Representativeness | High | Data are for Industrial/Commercial Use: Chemical Substances in Construction, Paint, Electrical, and Metal Products, an in-scope occupational scenario. |
| Metric 5: | Sample Size | Medium | Sample distribution characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Medium | Sample type and exposure type provided but missing specific times, jobs, etc. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Low | The monitoring study does not address variability or uncertainty |

## Overall Quality Determination Medium

**Study Citation:** Dow Chemical, (1980). Evaluation of employee exposure to asbestos at the Cell Services Department of Inorganic Chemicals Production, Michigan Division with cover letter dated 120982.
**HERO ID:** 3648049
**Conditions of Use:** Other:

**EXTRACTION**

| Parameter | Data |
|---|---|
| Exposure route: | inhalation |
| Physical form: | inhalable fibers |
| Personal sampling data: | 8/17/78 Utility Man diaphragm pulling 0.36 fibers /cc8/17/78 Overhead crane operator 0.096 fibers /cc8/17/78 Utility Man diaphragm pulling 0.32 fibers /cc8/17/78 Addition of bags of asbestos to bag slitter 2.7 fibers /cc8/17/78 Addition of bags of asbestos to bag slitter 4.0 fibers /cc6/21/78 Utility Man diaphragm pulling 0.15 fibers /cc6/21/78 Utility Man diaphragm pulling 0.11 fibers /cc6/21/78 Addition of bags of asbestos to bag slitter 0.28 fibers /cc8/1/78 Vent from vacuum pump 0.06 fibers /cc8/1/78 Addition of bags of asbestos to bag slitter 0.05 fibers /cc9/7/78 Utility Man diaphragm pulling 0.09 fibers /cc9/7/78 Utility Man diaphragm pulling 0.05 fibers /cc |
| Area sampling data: | 6/21/78 Addition of bags of asbestos to bag slitter 0.039 fibers /cc9/18/78 Cathode wash 0.05 fibers /cc9/18/78 Cathode wash 0.4 fibers /cc |
| Personal protective equipment: | respirator and coveralls |
| Engineering control: | containment, isolation, substitution, local exhaust ventilation, general ventilation and change of operating procedures. |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Sampling and Analytical Methodology | Low | Sampling or analytical methodology is not specified. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | The data are from the United States. |
| Metric 3: | Applicability | Uninformative | The data are for an occupational scenario that is not in-scope of the risk evaluation. |
| Metric 4: | Temporal Representativeness | Low | 1978, prior to the latest PEL (1994) and more than 20 years old |
| Metric 5: | Sample Size | High | TWA, range, and peak values provided |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Medium | Monitoring data include most critical metadata, such as sample type and exposure type, sample durations, but lacks additional metadata, such as exposure durations, exposure frequency, and worker activity details. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | High | Monitoring report addresses variability by sampling multiple workers/areas, and measurement uncertainty is characterized by TWA, range, and peak values. |

## Overall Quality Determination Uninformative

**Study Citation:** Dow Corning, (1984). Industrial hygiene asbestos survey in _____.
**HERO ID:** 4158331
**Conditions of Use:** Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Tearing asbestos paper roll and folding it to use as a support pad. [PDF Pg. 3] |
| Personal sampling data: | [PDF Pg. 5-6] Sample 1: 0.1 fibers/cm^3Sample 2: 0.03 fibers/cm^3 |
| Area sampling data: | [PDF Pg. 5-6]Sample 1 (during and after removal): 0.6 fibers/cm^3Sample 2 (during and after removal): 2 fibers/cm^3 |
| Comments: | Article is a little unclear but looks like it states that no respiratory protection was used for asbestos fibers. [PDF Pg. 4] |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Medium | Sampling/analytical methodology is not an approved OSHA/NIOSH method but is an acceptable methodology. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for Chemical Substances in Construction, Paint, Electrical, and Metal Products, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Monitoring data are greater than 20 years old. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Low | Sample type provided but no other metadata. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | High | Uncertainty is addressed in sampling/analytical methodology. Variability addressed by taking both personal and area samples. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Dow Corning, (1984). Industrial hygiene asbestos survey in _____ with cover letter dated 013183. |
| **HERO ID:** | 4158332 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Furnishing, Cleaning, Treatment Care Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Workers at a Dow plant using asbestos gloves and cloth. (4/8) |
| Physical form: | fibers (6/8) |
| Personal sampling data: | Personal samples during use of asbestos cloth and gloves were <0.02-0.04 f/cc. (6/8) |
| Area sampling data: | Background levels in the production area were <0.02-0.04 f/cc. (6/8) |
| Engineering control: | A replacement for asbestos gloves and cloth should be considered. (5/8) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Sampling and Analytical Methodology | Low | Sampling or analytical methodology is not specified. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | Data are from the U.S. |
| Metric 3: | Applicability | High | Data are for industrial use in textiles, an in-scope occupational scenario. |
| Metric 4: | Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| Metric 5: | Sample Size | Medium | Distribution of samples is characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Low | Monitoring data include sample type (e.g., personal breathing zone) but no other metadata. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Low | The monitoring study does not address variability or uncertainty. |

## Overall Quality Determination Low

| | |
|---|---|
| **Study Citation:** | Dow Corning, (1984). Industrial hygiene survey for airborne asbestos fibers during insulation removal in _____. |
| **HERO ID:** | 4158334 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Insulation removal (2/10) |
| Exposure route: | inhalation (3/10) |
| Physical form: | fibers (3/10) |
| Area sampling data: | The range of airborne asbestos fibers measured during insulation removal was 0.06-1.3 f/cc. (3/10) |
| Personal protective equipment: | All personnel who entered the restricted area were required to wear dust respirators. (4/10) |
| Engineering control: | Before any asbestos insulation was removed, the affected areas on each floor were roped off and warning signs set up. Employees were informed of the insulation removal and were recommended to avoid the areas as much as possible. Finally, all personnel who entered the restricted areas were required to wear dust respirators. (4/10) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Medium | Sampling methodology is equivalent to an approved OSHA/NIOSH method. However, the analytical methodology is unknown. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for removal of insulation containing asbestos, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Exposure type and sampling data provided, but missing number of workers, exposure duration, frequency, and particle size. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | Variability is addressed by collecting data from multiple sampling locations. However, measurement uncertainty is not characterized. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Dow Corning, (1984). Industrial hygiene survey for airborne asbestos fibers during wall heater insulation removal in _____. |
| **HERO ID:** | 4158335 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Removal of asbestos insulation from wall heaters in a hallway. |
| Personal sampling data: | 0.7-6.0 f/ccTWA: 0.8-3.0 f/cc (average: 1.8)82-226 minute samples |
| Personal protective equipment: | Personnel in asbestos work area wear half-face respirators. |
| Engineering control: | Area closed off with plastic sheeting and duct tape.Water spray was used to wet the insulation. |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | High | Sampling or analytical methodology is an approved OSHA or NIOSH method or is well described and found to be equivalent to approved OSHA or NIOSH methods. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | The data are from the United States and are representative of the industry being evaluated. |
| | Metric 3: | Applicability | High | The data are for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Low | The data were collected before the most recent PEL establishment. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | Monitoring data include all associated metadata, including sample types, exposure types, sample durations, and worker activities. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | Monitoring report addresses variability by sampling several employees, but measurement uncertainty is not characterized. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Dow Corning, (1984). Industrial hygiene survey for airborne fibers during asbestos removal from piping in _____ hallway, dated 012680. |
| **HERO ID:** | 4158336 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Removal of asbestos insulation from piping. Two crews were involved in removing the insulation. Each crew started at opposite ends of the hallway with two pipe coverers on scaffolding, and one assisting with moving the scaffold and handling waste bags. The insulation was removed dry and the chunks placed in plastic bags. (4/7) |
| Exposure route: | inhalation (6/7) |
| Physical form: | fibers (6/7) |
| Area sampling data: | During removal, mean concentration was 5.5 f/cc with a range of 2.9-9.2 f/cc. During cleanup, mean concentration was 0.5 f/cc with a range of 0.2-0.9 f/cc. The 8h-TWA was calculated at 0.7 f/cc. (6/7) |
| Exposure duration: | One hour for all removal and a half hour for cleanup (5/7) |
| Personal protective equipment: | Respirators were worn by all personnel in the area during the removal. (2/7) |
| Engineering control: | The doors were taped shut and side hallways were blocked off with plastic sheeting and tape. Plastic sheeting was also used to cover the hallway floor. Properly worded signs for posting and labels for waste containers were used. (2/7) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | High | Sampling/analytical methodology is equivalent to an approved [OSHA/NIOSH] method. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for demolition of asbestos products, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | The data were collected before the most recent PEL establishment or update or are more than 20 years old if no PEL is established. |
| | Metric 5: | Sample Size | Medium | Sample distribution characterized by limited statistics (ranges, means) but discrete samples not provided and distribution not fully characterized. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Exposure type and sampling data provided, but missing number of workers, exposure frequency, and particle size. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | The monitoring study does not address variability or uncertainty. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Drucker, E., Nagin, D., Michaels, D., Lacher, M., Zoloth, S. (1987). Exposure of Sheet-Metal Workers to Asbestos during the Construction and Renovation of Commercial Buildings in New York City. A Case Study in Social Medicine. Annals of the New York Academy of Sciences 502:230-244. |
| **HERO ID:** | 3094680 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Area sampling data: | Sheet-Metal Workers' Exposure to Asbestos: Asbestos fiber ( f ) concentrations as high as 100 f/cc were measured in the spray zone during construction. (P. 3/15)Measurements of air levels during such renovation demonstrate that sheet-metal workers may have the heaviest exposure of any members of the construction crews with 8-hour time-weighted averages of 0.19 f/cc," with past exposure probably significantly higher. |
| Personal protective equipment: | Respirators and protective clothing represent inferior solutions to the asbestos problem and have serious limitations which are well established in the literature of industrial hygiene.The powered air-purifying respirator (PAPR) provides a higher protection factor than the normal air-purifying respirator and is cooler and more comfortable to wear since the positive pressure reduces breathing resistance. (P. 10/15) |
| Engineering control: | The protocol includes wet handling techniques along with the use of a HEPA vacuum (high efficiency particulate absolute) for surface and floor clean-up. (P. 8/15) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Sampling and Analytical Methodology | High | Sampling or analytical methodology is an approved OSHA or NIOSH method. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | High | The data are from the United States. |
| | Metric 3: Applicability | High | The data are for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: Temporal Representativeness | Low | More than 20 years old. |
| | Metric 5: Sample Size | Medium | Distribution of samples is characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | Medium | Monitoring data include most critical metadata, such as sample type and exposure type, but lacks additional metadata, such as sample durations, exposure durations, exposure frequency, and/orworker activities. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Medium | The monitoring study provides only limited discussion of the variability in the determinants of exposure for the sampled site or sector. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Dufresne, A., Dion, C., Frielaender, A., Audet, E., Perrault, G. (2009). Personal and static sample measurements of asbestos fibres during two abatement projects. Bulletin of Environmental Contamination and Toxicology 82(4):440-443. |
| **HERO ID:** | 2596477 |
| **Conditions of Use:** | Other: |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Scraping off insulation, cleaning surfaces with a broom, moving scaffolds, and moving bags of waste. (2/4) |
| Exposure route: | inhalation (2/4) |
| Physical form: | dust and fibers (2/4) |
| Personal sampling data: | (PCM) Worker's breathing zone samples were 20.3+-7.9 f/cc for amosite and 6.3+-2.2 f/cc for chrysotile. (2/4) |
| Area sampling data: | (PCM) Stationary samples were 5.4+-3.5 f/cc for amosite and 2.9+-1.6 f/cc for chrysotile. (3/4) |
| Personal protective equipment: | Workers wore a protective suit, a motorized high efficiency respirator with a HEPA filter, a work helmet, gloves, and safety boots. (2/4) |
| Engineering control: | Workers sprayed water on the insulation before removal to reduce dust emission. (2/4) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | High | Sampling/analytical methodology is an approved NIOSH method. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Medium | Data are from Canada, an OECD country. |
| | Metric 3: | Applicability | High | Data are for demolition of asbestos products, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Medium | Monitoring data were collected after the most recent PEL and greater than 10 years old. |
| | Metric 5: | Sample Size | Medium | Sample distribution characterized by limited statistics (means, standard deviations) but discrete samples not provided and distribution not fully characterized. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Exposure type and sampling data provided, but missing number of workers, particle size, exposure duration, and frequency, |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | Uncertainty is addressed in sampling/analytical methodology. Variability isn't addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Dumortier, P., De Vuyst, P. (2012). Asbestos exposure during uncontrolled removal of sprayed-on asbestos. Annals of Occupational Hygiene 56(1):49-54. |
| **HERO ID:** | 2570018 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Removal of sprayed-on asbestos. |
| Exposure route: | inhalation |
| Physical form: | fibers |
| Personal sampling data: | Concentrations of asbestos fibers and bodies (AB) were extremely elevated when compared to the reference values expected for people of the general population without obvious asbestosexposure (<1 AB per ml of bronchoalveolar lavage fluid (BALF) in light microscopy and ,300 fibers longer than 1 um/ml BALF). (P. 3/6) |
| Particle size characterization: | Diameter (um)GM (GSD) case 1: 0.46 (1.91), case2: 0.46 (1.84)Min–max case 1:0.04–1.4 , case 2: 0.1–1.9 |
| Number of workers: | 2 |
| Personal protective equipment: | To enter the work area, workers should wear personal protection equipment including clean Tyvek type protective suit, singleuse gloves, safety boots, and a respiratory protection equipment consisting in an autonomous or powered respirator with a full face mask with a P3 filter or a full face respirator connected to a positive pressure air adduction line. |
| Engineering control: | Spraying of water mist to reduce fiber emissions. (P. 5/6) |
| Comments: | Table 1. Exposure and asbestos burden in bronchoalveolar lavage fluid (BALF) of two workers exposed without personal protective equipment during removal of sprayed-on asbestos |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Sampling and Analytical Methodology | High | Sampling or analytical methodology is an approved OSHA or NIOSH method. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | Medium | The data are from an OECD country, Belgium. |
| Metric 3: | Applicability | High | The data are for an occupational scenario within the scope of the risk evaluation. |
| Metric 4: | Temporal Representativeness | Medium | More than 10 years but, no more than 20 years old. |
| Metric 5: | Sample Size | Medium | Distribution of samples is characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | High | Monitoring data include most critical metadata. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Medium | The monitoring study provides only limited discussion of the variability in the determinants of exposure for the sampled site or sector. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Dunnigan, J. (2001). Concentrations of asbestos fibers in the general environment resulting from the use of modern, high-density chrysotile-asbestos-based products. Canadian Mineralogist Spec Iss 5:115-118. |
| **HERO ID:** | 786476 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Physical form: | entrained in asbestos-cement roofing tiles |
| Area sampling data: | Releases from asbestos-cement roofing (Germany) <0.0001 fibers/mLReleases from asbestos-cement roofing (Austria) <0.0001 fibers/mLReleases from asbestos-cement roofing (Australia) <0.0002 fibers/mLReleases from asbestos-cement roofing disposal sites (Germany) : Overhead: 0.0005 - 0.003 fibers/mL Vicinity: 0.0001-0.0009 fibers/mL |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Sampling and Analytical Methodology | Low | Sampling/analytical methodology is not specified. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | Medium | Data are from Canada, an OECD country. |
| Metric 3: | Applicability | Low | Data are for general exposure from the environment around aging C/S Roofing tiles., which is similar to the the in-scope occupational scenario in chemical substances in |
| Metric 4: | Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| Metric 5: | Sample Size | Low | Sample distribution is characterized by no statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Uninformative | Sample type and exposure type not provided. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Uninformative

| | |
|---|---|
| **Study Citation:** | DuPont, (1976). A study to measure the amount of asbestos fiber liberated during operating times of gas chromatographs. |
| **HERO ID:** | 4158363 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Workers who handle chromatographs packed with asbestos insulation. (4/11) |
| Exposure route: | inhalation (5/11) |
| Physical form: | fiber (4/11) |
| Area sampling data: | 5 samples taken near gas chromatographs in operation found no asbestos fibers. (8/11) |
| Engineering control: | Engineering controls suggested by manufacturers were sealing the insulation materials thereby preventing the possibility of exposure. (9/11) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | High | Sampling/analytical methodology is equivalent to an approved [OSHA/NIOSH] method. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for commercial use in construction materials, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Exposure type and sampling data provided, but missing number of workers, exposure frequency, PPE, and particle size. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Dusek, C. J., Yetman, J. M. (1993). Control and prevention of asbestos exposure from construction in naturally occurring asbestos. Transportation research record 1424:34-41. |
| **HERO ID:** | 7481806 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Air drill operator, cable layers, pipe layers, surveyors, and inspectors at a construction project. (1/8) |
| Exposure route: | inhalation (2/8) |
| Physical form: | dust (1/8) |
| Personal sampling data: | (PCM and TEM) Personal monitoring showed fiber concentrations of 0.036-0.682 f/cm3. (5/8) |
| Area sampling data: | (PCM and TEM) Area monitoring showed fiber concentrations of 0.04-1.145 f/cm3. (5/8) |
| Personal protective equipment: | Employees in a regulated area must wear personal protection equipment provided by the employer, including properly fitted and tested respirators and clothing. (3/8) |
| Engineering control: | ”Water is the key to controlling the fugitive dust and thus asbestos emissions from construction materials. Application techniques vary from a sophisticated spray system attached directly to the rock-cutting or drilling equipment, to strategically aiming a water hose at a work activity or employing a water truck to spray the entire work area and haul roads. All exposed and excavated material must be kept damp to preventthe release of asbestos fibers into the air. The variable rate fogger nozzles employed in fighting petroleum fires are an excellent tool for this purpose. The fogger nozzle produces a wet mist that knocks down airborne fibers, and water consumption can be controlled by the operator. (3/8)” |
| Comments: | TABLE 2 Air Monitoring Data from Caisson Drills, Air Drills, and Other CompressedAir-Driven Equipment. |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | High | Sampling/analytical methodology is an approved NIOSH method. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for industrial use of chemical substances in construction products, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Sample type and exposure type provided but missing exposure duration, frequency, number of workers, and particle size. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | High | Uncertainty is addressed in sampling/analytical methodology. Variability addressed by sampling different worker activities and areas along with the perimeter of the site. |

## Overall Quality Determination High

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| | |
|---|---|
| **Study Citation:** | Dusek, C. J., Yetman, J. M. (1993). Control and prevention of asbestos exposure from construction in naturally occurring asbestos. Transportation research record 1424:34-41. |
| **HERO ID:** | 7481806 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|

| | |
|---|---|
| **Study Citation:** | Dynamac, (1984). Draft final report industrial hygiene assessment of petroleum refinery turnaround activities: Survey #2 with cover letter dated 092084. |
| **HERO ID:** | 1481400 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Removing valve gaskets and pipe insulation at the VRU depropanizer vessel. Removing insulation from the compressor and CO boiler. |
| Exposure route: | Inhalation |
| Physical form: | Fibers/dust. |
| Personal sampling data: | Removing valve gaskets and pipe insulation: 0.01 fibers/cm^3 [PDF Pg. 22]Removing insulation from compressor: 0.06 fibers/cm^3. |
| Exposure duration: | Removing valve gaskets and pipe insulation: 407 minutes. [PDF Pg. 48]Removing insulation from compressor: 250 minutes. |
| Comments: | Open-face filter cassette. containing a cellulose-ester filter were used with sampling pumps operating at 2 liters per minute. sampling pumps were calibrated with a soapbubble meter prior to sampling. and flow rates were checked periodically with a precision rotameter. The filters were examined for asbestos fibers (NIOSH Method No. P&CAM 239). [PDF Pg. 51] |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Sampling and Analytical Methodology | High | Sampling/analytical methodology is an approved [NIOSH/OSHA] method. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | Data are from the U.S. |
| Metric 3: | Applicability | High | Data are for Chemical Substances in Construction, Paint, Electrical, and Metal Products, an in-scope occupational scenario. |
| Metric 4: | Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Medium | Sample type and exposure type provided but missing exposure frequency. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | High | Uncertainty is addressed in sampling/analytical methodology. Variability addressed by collecting samples for multiple work activities. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Dynamac, (1985). File with FYI-AX-0984-0349: Final report industrial hygiene assessment of petroleum refinery turnaround activities. |
| **HERO ID:** | 1481407 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Activities performed included: Reactor and Regenerator steam cleaning, blinding, opening, catalyst removal, and interior washdown, refractory removal, repair (welding) of steel supports, and installation of new refractories.Fractionator degreased, opened, cleaned and inspect, if needed, repairedFCCU power train (turbine, motor, blower, expander)offsite refurbishmentHeat exchangers and condensers purged, opened, cleaned and inspect, if needed, repairedCO boilerCleaned with high-pressure water lance, if needed, repaired, preheat furnace and cleaned outGas CompressorDisassembled and overhauledPumpspurged, steam cleaned, inspected and refurbished, including repacking and replacing gaskets.Amine towerempties, purged and opened, replaced trays, special stainless steel components added. |
| Exposure route: | inhalation |
| Physical form: | inhalable fibers |
| Personal sampling data: | removal of valve gaskets and pipe insulation at the VRU devaporizer vessels. The gaskets were reported to contain asbestos and replaced with asbestos free gaskets. Also included removal of insulation form compressor and CO boiler. Removal of gasket and pipe insulation 0.01 f/ccRemoval of compressor insulation 0.06 f/cc |
| Exposure duration: | 10 hours per day |
| Exposure frequency: | 6 days per week - not certain how many weeks are needed for a turnaround and how often do they implement a turnaround per year. |
| Number of workers: | 200-250 |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | High | Personal samples for asbestos fibers were taken using Type AA 0.8 micrometer pore size, mixed cellulose-ester filters in three-piece cassettes, each cassette was attached to the workers outer garment within the breathing zone. Air was drawn through each filter by means of a personal sampling pump. The sampling flow rate was about 1.8 liters per minute, as established by calibration with a soap bubble meter before sampling. The flow rate was checked periodically using a precision rotameter during the sampling. Analysis was by phase contrast microscopy NIOSH Method P&CAM 239. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | US |
| | Metric 3: | Applicability | High | The data are for an occupational scenario ( refinery turnaround) within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Low | 1983 - Prior to the PEL and more than 20 years old. |
| | Metric 5: | Sample Size | Low | No statistics were provided |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Monitoring data include most critical metadata, such as worker activities, sample type, exposure type, exposure durations ,and sample durations, but lacks exposure frequency, |
| Domain 4: Variability and Uncertainty | | | | |

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| | |
|---|---|
| **Study Citation:** | Dynamac, (1985). File with FYI-AX-0984-0349: Final report industrial hygiene assessment of petroleum refinery turnaround activities. |
| **HERO ID:** | 1481407 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

| | | EVALUATION | |
|---|---|---|---|
| Domain | Metric | Rating | Comments |
| | Metric 7: Metadata Completeness | Medium | The monitoring study did not address variability or uncertainty. it was assumed that uncertainty was addressed in the NIOSH method P&CAM 239. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Ebihara, I., Hirata, M., Hisanaga, N., Shibata, E., Sakai, K. (1997). Respiratory findings of construction workers exposed to asbestos dust. Advances in Environmental Control Technology Series :93-126. |
| **HERO ID:** | 6925874 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | p. 3 pole sanding, hand sanding, dry mixing, sweepingTable 2 (p. 3-6) contains worker activity descriptions |
| Exposure route: | inhalation (table 2) |
| Physical form: | solid (table 2) |
| Personal sampling data: | p. 270.5 f/ml during sweeping (figure 7) |
| Area sampling data: | Table 2; p. 3-6Activity-based monitoring during construction/demolition work (not sure if this is personal or area monitoring). Location of sampler in relation to the work area is provided. Samples range from 0.0 to 1,319 fibers/cm3. |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Low | Sampling or analytical methodology is not specified. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | The data are from the United States and are representative of the industry being evaluated. |
| | Metric 3: | Applicability | High | The data are for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Medium | Operations, equipment, and worker activities are expected to be reasonably representative of current conditions. The monitoring data were collected after the most recent PEL establishment or update (1986) |
| | Metric 5: | Sample Size | Medium | Distribution of samples is characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Low | Monitoring data include sample type (e.g., personal breathing zone) but no other metadata. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | The monitoring study does not address variability or uncertainty. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | ECHA, (2014). Committee for Risk Assessment (RAC) opinion on an Annex XV dossier proposing restrictions on chrysotile. |
| **HERO ID:** | 3970699 |
| **Conditions of Use:** | Other: |

**EXTRACTION**

| Parameter | Data |
|---|---|
| Worker activity description: | Exposure scenario 1 for workers: Use as reconditioning agent (closed systems)This scenario consists of one Environmental contributing scenario (ECS) and 8 Worker contributing scenarios:ECS1: No titleWCS1: Receival and storage of fibre packages (PROC1)WCS2: Dumping of fibres in mixing vessel (PROC1)WCS3: Formulation of slurry (PROC1)WCS4: Filling of feeding containers (PROC1)WCS5: Feeding slurry to electrolysis cells (PROC1)WCS6: Flushing of feeding lines and (de)coupling of hoses (PROC3)WCS7: Maintenance and cleaning (PROC8b)WCS8: Waste handling (PROC8b)Exposure data is only available for WCS 2, 6 and 8, where there is a possibility of exposure. In WCS2 all 6 measurements were below the level of detection (approximately 100 fibres/m3 ). In WCS 6 the measurements (n=2) were below the level of detection. In WCS 8 all 6 measurements were below the limit of detection. For calculation of the statistics the level of detection as such was used as the result of the measurement. Details of the exposure data are given in annex 1 to the opinion. For the other WCSs minimal (or no) exposure is expected: The asbestos is fully sealed for WCS1. In WCS3 workers are controlling the process from a remote position (control room). Also WCS4 and 5 are fully closed processes. The workers control this from a remote position. For WCS7 the concentration in the room is very low due to local exhaust ventilation and a high level of hygiene. Also the workers are protected by personal protective equipment (PPE) including powered respirator with efficiency of 97.5 %. Exposure scenario 2 for workers: Use in diaphragm cells (closed systems)This scenario consists of one Environmental contributing scenario (ECS) and 7 Worker contributing scenarios:ECS1: No titleWCS1: Receival and storage of electrolysis cells (PROC1)WCS2: Assembly of electrolysis cells (PROC3)WCS3: Installation of electrolysis cells (PROC3)WCS4: Service life of electrolysis cells (PROC1)WCS5: Disconnection of electrolysis cells from production line and intermediate storage in water pit (PROC3)WCS6: Dismantling and cleaning of dismantled parts (PROC8b)WCS7: Waste handling (PROC8b)Exposure data is only available for WCS 2, 6 and 7. In WCS2, 4 out of 6 measurements were below the level of detection (approximately 100 fibres/m3 ). In WCS 6, 4 of 9 measurements for dismantling were below the level of detection. For cleaning of anode/cathode one result was below the level of detection, the other two were at the level of detection. In WCS 7 all 6 measurements were below the level of detection. For calculation of the statistics the level of detection as such was used as the result of the measurement. Details of the exposure data are given in annex 1 to the opinion. For the other WCSs minimal (or no) exposure is expected: The asbestos is fully sealed for WCS1. In WCS3 the asbestos is bound in matrix, and the diaphragm itself is not handled so the probability of exposure is very low. WCS4 is a fully closed process as the cells are fully closed during its service life, and no exposure is foreseen. Also in WCS5 the cells are fully closed, and during storage submerged in water, preventing release of fibres. There is a need for continuation of the restriction and the associated risk management measures already in place in order to minimise risk of possible exposure to chrysotile asbestos for workers in the two companies. Also, a continuation of the restriction will prevent other companies from initiating import and use of chrysotile asbestos, a substance that is known to be carcinogenic to humans. |
| Exposure route: | inhalation |
| Area sampling data: | Year Maximum fibre equivalents, fibres/m32008 -2009 1002010 -2011 1002012 290Title Geometric Mean fibres/m3Dumping of 102fibres inmixingvesselFlushing of 100feedinglines and(de)couplingof hosesWaste 103handlingAssembly of 122electrolysiscellsDisassembly 123Cleaning 100Waste 103handling |
| Exposure duration: | 0.5 hr per day to 8 hrs per day |
| Exposure frequency: | 2 times /week75 days/year |
| Number of workers: | 1-4 |
| Personal protective equipment: | During the activities with a main potential for exposure e.g. cleaning and maintenance, the workers wear disposable protective clothing and a full face mask (in accordance with EN136:1998) with a powered air filtering unit with P3 filter cartridge (fulfilling EN 12941:1998/EN12942:1998). As general personal protective equipment all workers wear safety clothing and protective safety gloves, as well as helmet and safety shoes. For activities in the asbestos handling room, the shower room must be used and the employees wear disposable clothing. |
| Engineering control: | No environmental assessment has been conducted for either of the two exposure scenarios, as there is no release of asbestos to environmental compartments. Release to air is prevented by the use of ventilation and negative pressure as well as the use of HEPA filters before emission. This is confirmed by measurements at the stacks were the air is released in 2010, 2011 and 2013 which all were below the detection limit (<100 fibres/m3). The background level of asbestos in outdoor air in Germany is in the range of 100 – 150 fibres/m3. Used HEPA filters are collected and destroyed at the site. All waste water possibly containing asbestos enters a closed waste water treatment system. The fibres in the waste water are destroyed on-site. |

**EVALUATION**

**Continued on next page . . .**

. . . continued from previous page

**Study Citation:** ECHA, (2014). Committee for Risk Assessment (RAC) opinion on an Annex XV dossier proposing restrictions on chrysotile.
**HERO ID:** 3970699
**Conditions of Use:** Other:

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | High | Sampling/analytical methodology is equivalent to an approved NIOSH method. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Medium | Data are from countries in the EU that are OECD countries (i.e. Germany). |
| | Metric 3: | Applicability | Uninformative | Asbestos use in processing is not in scope for the legacy risk evaluation. |
| | Metric 4: | Temporal Representativeness | High | Monitoring data were collected after the most recent PEL and no more than 10 years old. |
| | Metric 5: | Sample Size | Medium | Sample distribution characterized by limited statistics (90th percentile, mean, STD) but discrete samples not provided and distribution not fully characterized. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | Monitoring data include all associated metadata, including sample types, exposure types, exposure durations worker activities, and exposure frequency. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | Variability addressed by sampling for different worker activities. Uncertainty is not addressed. |

## Overall Quality Determination Uninformative

| | |
|---|---|
| **Study Citation:** | Egilman, D. (2018). The Production of Corporate Research to Manufacture Doubt About the Health Hazards of Products: An Overview of the Exponent Bakelite® Simulation Study. New Solutions: A Journal of Environmental and Occupational Health Policy 28(2):179-201. |
| **HERO ID:** | 6867252 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Packaging, Paper, Plastic, Toys, Hobby Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | dry mix was charged into a two roller mill ( temperature set 1st roller 60F and second roller 100F)worked manually with hot gloves and a spatula, including:SawingSanding GrindingDrilling |
| Exposure route: | inhalation |
| Physical form: | inhalable fibers |
| Personal sampling data: | 1975 J. Myers report max exposure 14 f/cc1972 Bound Brook NJ max exposure 10.2 f/cc1975 Grinding (Faulring) Max 0.7 f/cc (4 % asbestos product) |
| Area sampling data: | 1975 Grinding (Faulring) Max 1.2 f/cc |
| Personal protective equipment: | Respirators |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Low | Sampling or analytical methodology is not specified. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | US |
| | Metric 3: | Applicability | High | The data are for an occupational scenario (manufacture of plastic products that contain asbestos) within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Low | Data comes from 1975 - prior to the most recent PEL and more than 20 years old. |
| | Metric 5: | Sample Size | Low | The distribution of samples is characterized by no statistics. - details may be available from the other studies that the author refrerences. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Monitoring data include sample type (e.g., personal breathing zone) but no other metadata. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | The monitoring study does not address variability or uncertainty. |

## Overall Quality Determination Low

**Study Citation:** Egilman, D., Bird, T. (2016). Short fiber tremolite free chrysotile mesothelioma cohort revealed. American Journal of Industrial Medicine 59(3):196-199.
**HERO ID:** 3520615
**Conditions of Use:** Other:

**EXTRACTION**

| Parameter | Data |
|---|---|
| Worker activity description: | Workers at plastics manufacturing plant |
| Exposure route: | inhalation |
| Physical form: | inhalable fibers |
| Area sampling data: | Dell and Teta reported a sole measurement taken from an industrial hygiene report from 1968 [LaFrance, 1968] of dust levels between 8.7 and 20.1 million particles per cubicfoot (mppcf). Other than the 1968 monitoring, UCC reported results in f/cc. The exposures ranged from 0.3 to 14.1 f/cc; however, all measurements were under 5 f/cc except for 14.1 f/cc when an operator was dumping five bags of phenolic molding compound 5,303 containing 30% Canadian 7RF9. The worker was wearing a respirator at this time and all other samples (of 10 total) taken in different departments were between 0.8 and 5 f/cc [Bradley, 1972; Kleber, 1973]. The samples referenced by Dell and Teta were taken atthe charging station where asbestos bags were dumped into a hopper [LaFrance, 1968]. UCC reported the results as a percentage of the "allowable dose," which was 5 f/cc in 1974.Other similar samples taken by UCC over the next 5 years indicate that the samples were short-term (<15 min), and not time-weighted averages (TWAs) [Cope, 1972; Kleber,1973]. None of the results exceed 5 f/cc TWA.In 1974, UCC tested mixer operators dumping raw asbestos from bags, the charge roll operators shoveling raw mix onto the rolls, and the CBS bag packer [Neal, 1974]. Eight-hour TWA exposures during bag dumping were between 1.3 and 1.6 f/cc [Neal, 1974]. The exposures of the charge role operators were "satisfactory" ranging from 0.7 to 1.1 f/cc "...despite rather frequent shoveling of raw mix onto the rolls during monitoring" [Neal, 1974]. Finally, the CBS bag packer exposure level was "negligible" at 0.3 fibers per milliliter [Neal, 1974]. UCC required workers in this area to wear respirators, although not all complied [Neal, 1974]. |
| Personal protective equipment: | Respirators |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Sampling and Analytical Methodology | Low | Sampling or analytical methodology is not specified. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | The data are from the United States. |
| Metric 3: | Applicability | Uninformative | Processing is not in scope for the legacy risk evaluation. |
| Metric 4: | Temporal Representativeness | Low | The paper was published in 2016 - but the sampling was from 1970s more than 20 years old. |
| Metric 5: | Sample Size | Low | Distribution of samples is qualitative or characterized by no statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Low | Monitoring data include sample type (e.g., personal breathing zone) but no other meta-data. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Low | The monitoring study does not address variability or uncertainty. |

## Overall Quality Determination Uninformative

| | |
|---|---|
| **Study Citation:** | Equitable Environmental Health Inc, (1977). Dust exposures during the cutting and machining of asbestos/cement pipe additional studies prepared by Equitable Envir Health Inc. |
| **HERO ID:** | 4158239 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Unloading pipes, laying pipes in trenches, cutting pipes, machining pipes, hole cutting, tapping operations, and coupling removal. (5/44) |
| Physical form: | fibers and dust (19/44) |
| Personal sampling data: | During cutting, airborn fiber concentrations ranged from ND-109.1 f/mL (abrasive disc cutting). During machining, concentrations ranged from ND-8.91 f/mL (Doty tool machining). During lathing, concentrations ranged from ND-0.24 f/mL. During tapering, concentrations were ND-0.28 f/mL. During hole cutting, tapping, and coupling removal, concentrations were ND-0.33 f/mL. Integrated personal sample counts over successive operations were ND-5.84 f/mL. (22/44) |
| Area sampling data: | During unloading of pipes and laying pipes in the trenches, airborne fiber concentrations were ND-0.03 f/mL. (21/44) |
| Exposure duration: | Most cutting and machining operations take less than 15 minutes (6/44) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Sampling and Analytical Methodology | High | Sampling/analytical methodology is an approved NIOSH method. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | Data are from the U.S. |
| Metric 3: | Applicability | High | Data are for industrial use in construction materials, an in-scope occupational scenario. |
| Metric 4: | Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Medium | Exposure type and sampling data provided, but missing number of workers, exposure frequency, engineering controls, PPE, and particle size. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | High | Uncertainty is addressed in sampling/analytical methodology. Variability is addressed by sampling different jobs and sample types. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Esmen, N. A., Corn, M. (1998). Airborne fiber concentrations during splitting open and boxing bags of asbestos. Toxicology and Industrial Health 14(6):843-856. |
| **HERO ID:** | 3583395 |
| **Conditions of Use:** | Other: |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Opening bags of raw asbestos and sliding the bag into a hopper. (3/14) |
| Area sampling data: | (PCM) Average concentrations of asbestos during bag splitting and boxing was between 0.43-1.9 f/cm3. Average concentrations of asbestos during boxing only was between 0.17-0.83 f/cm3. (9/14) |
| Particle size characterization: | Only fibers longer than 3 um were counted in this study. (8/14) |
| Engineering control: | A general exhaust system provided ventilation at a rate of 28.2 ACH. (5/14) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Sampling and Analytical Methodology | High | Sampling/analytical methodology is equivalent to an approved [OSHA/NIOSH] method. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | Data are from the U.S. |
| Metric 3: | Applicability | Uninformative | Data are for manufacturing of asbestos-containing products, which isn't in scope. |
| Metric 4: | Temporal Representativeness | Medium | Monitoring data were collected after the most recent PEL and greater than 10 years old. |
| Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Medium | Exposure type and sampling data provided, but missing number of workers, exposure duration, frequency, and PPE. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | High | Uncertainty is addressed in sampling/analytical methodology. Variability is addressed by sampling with and without bag opening, and with different techniques. |

## Overall Quality Determination Uninformative

| | |
|---|---|
| **Study Citation:** | Esmen, N. A., Erdal, S. (1990). Human occupational and nonoccupational exposure to fibers. Environmental Health Perspectives 88(0):277-286. |
| **HERO ID:** | 522 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Construction workers handling drywall & insulation, and shipyard workers. (4/10) |
| Exposure route: | inhalation (3/10) |
| Physical form: | fibers (2/10) |
| Personal sampling data: | For drywall taping, exposure levels are 4-8 fibers/mL (SEM). For general insulation work, 0.6-1.8 million particles/ft3 (PCM). For general shipyard operations, 0.1-2000 fibers/mL. For shipyard insulation removal, 200-400 fibers/mL (PCM). For brake repair, 0.04-0.4 fibers/mL (MFPCOM). For mining/milling, 1.7-16.6 fibers/mL(MF). For spackling, 1.2-59 fibers/mL (MFPCOM, TEM). For shipyard insulation removal, 200-400 fibers/mL (MFPCOM).(4/10) |
| Area sampling data: | Area samples were 0-0.022 fibers/mL in offices (SEM), <0.001-0.04 fibers/mL in buildings, and 0.0083 fibers/mL for chrysotile in schools (TEM). (5/10) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Medium | Sampling/analytical methodology is not an approved OSHA/NIOSH method but is an acceptable methodology. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for commercial use of chemical substances in construction products, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| | Metric 5: | Sample Size | Medium | Sample distribution characterized by limited statistics (mean, ranges) but discrete samples not provided and distribution not fully characterized. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Sample type and exposure type provided, but missing exposure duration, frequency, number of workers, particle size, PPE, and engineering controls. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | High | Uncertainty is addressed in sampling/analytical methodology. Variability addressed by compiling literature data and comparing it to area samples. |

## Overall Quality Determination Medium

**Study Citation:** Esswein, E. J., Tubbs, R. L. (1994). Health Hazard Evaluation Report HETA 93-0696-2395, Hardy Road Landfill, Akron, Ohio. (18):27.
**HERO ID:** 3649383
**Conditions of Use:** Disposal

**EXTRACTION**

| Parameter | Data |
|---|---|
| Worker activity description: | "Landfill supervisor, landfill foreman, weigh station attendant, mechanic, laborer, equipment operator. Activities include compacting refuse at the working face or moving soil for cover, mechanics working on equipment used at the working face, and the laborer conducting general operations at the landfill. (3/18)" |
| Exposure route: | inhalation, dermal (4/18) |
| Physical form: | dust (4/18) |
| Personal sampling data: | (TEM) The presence of asbestos was not detected on any of the samples including field blanks and media blanks. (10/18) |
| Number of workers: | 11 workers (3/18) |
| Personal protective equipment: | Respiratory protection consisting of high efficiency particulate air (HEPA) filters should be provided and worn by all employees exposed to the dusts from materials intended for landfill disposal. (13/18) |
| Engineering control: | Where it is possible, workers should stay upwind of dusty operations or dusty site conditions to reduce exposures. On windy days, consideration should be given to organize work operations to minimize generation of dust at the working face. (14/18) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Sampling and Analytical Methodology | High | Sampling/analytical methodology is an approved NIOSH method. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | Data are from the U.S. |
| Metric 3: | Applicability | High | Data are for disposal of ACM, an in-scope occupational scenario. |
| Metric 4: | Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| Metric 5: | Sample Size | Low | Sample distribution only characterizes presence or absence of asbestos materials. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Medium | Exposure type and sampling data provided, but missing exposure duration, frequency, and particle size. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Medium | Uncertainty is addressed in sampling/analytical methodology. Variability isn't addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Evans, W. A. (1979). Health hazard evaluation report no. HHE-79-89-609, Herman Diamond Company, New York, New York. |
| **HERO ID:** | 3970480 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Diamond cutters (2/6) |
| Exposure route: | inhalation (3/6) |
| Physical form: | fibers (3/6) |
| Area sampling data: | Asbestos was ND at 4 locations at the diamond company. (6/6) |
| Particle size characterization: | The paper used to make the paste had fibers with a range of diameters up to 3.0 um. Fibers in settled dust had diameters ranging from approximately 0.05 to 1 um and from l to 40 um in length .(5/6) |
| Exposure duration: | One cutter remarked that he would normally use the asbestos paper paste five times per week for a total time of 10 minutes. (2/6) |
| Number of workers: | 3-4 diamond cutters (2/6) |
| Engineering control: | The shop has a window air conditioner and an exhaust fan to provide general ventilation. (2/6) NIOSH recommended cutting the asbestos paper while wet to prevent fibers from becoming airborne. (5/6) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | High | Sampling/analytical methodology is an approved NIOSH method. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for commercial use in construction materials, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Exposure type and sampling data provided, but missing exposure frequency and PPE. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | Variability is addressed by sampling at multiple work stations at the company. Uncertainty isn't addressed. |

## Overall Quality Determination — High

| | |
|---|---|
| **Study Citation:** | Everatt, R. P., Smolianskiene, G., Tossavainen, A., Cicenas, S., Jankauskas, R. (2009). Occupational characteristics of respiratory cancer patients exposed to asbestos in Lithuania. Journal of Physics: Conference Series 151:012012. |
| **HERO ID:** | 3085526 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Exposure route: | inhalation |
| Physical form: | solid |
| Area sampling data: | Table 3 - Average Exposures (f/cc)Insulator: 0.03Plumber: 0.09Smith-repairer, pressman: 0.04Smith repairer (chemistry): 0.06Operator: < 0.01Work on thermal insulation produced airborne concentrations from 0.30-0.49 f/cm3 (p. 7) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | High | Sampling or analytical methodology is an approved OSHA or NIOSH method or is well described and found to be equivalent to approved OSHA or NIOSH methods (PCM). |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Low | The data are from a non-OECD country, and locality-specific factors (e.g., potentially greater differences in regulatory occupational exposure limits, industry/ process technologies) may impactexposures relative to the U.S., or the country of origin is not specified. |
| | Metric 3: | Applicability | Medium | The data are for an occupational scenario that is similar to an occupational scenario within the scope of the risk evaluation, in terms of the type of industry, operations, and work activities. |
| | Metric 4: | Temporal Representativeness | Medium | Operations, equipment, and worker activities are expected to be reasonably representative of current conditions. The monitoring data were collected after the most recent PEL establishment or update but are generally more than 10 years old. |
| | Metric 5: | Sample Size | Medium | Distribution of samples is characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Monitoring data include most critical metadata, such as sample type and exposure type, but lacks additional metadata, such as sample durations, exposure durations, exposure frequency, and/orworker activities. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | The monitoring study provides only limited discussion of the variability in the determinants of exposure for the sampled site or sector. The monitoring study provides only limited discussion of the uncertainty in the exposure estimates. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Ewing, W. M. (1999). Further observations of settled asbestos dust in buildings. 1342:323-332. |
| **HERO ID:** | 5685 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Exposure route: | Inhalation |
| Physical form: | Dust |
| Area sampling data: | Geometric mean surface concentration was 3.7 million asbestos structures per square centimeter (s/cm^2) in areas with asbestos containing fireproofing (Page 1). Geometric mean surface concentration was 160,000 s/cm^2 from areas having asbestos-containing acoustical plaster. (page 1)Geometric mean surface concentration was 1000 s/cm^2 from areas without friable asbestos-containing surface materials (page 1).Geometric mean for 79 samples collected outside of buildings in a large city was 5100 s/cm^2. Higher levels were found closer to street level. (Page 3).Table 1 (Units - s/cm^2) (page 3).Outside buildings in a large cityRange: <400-140,000; GM: 5100Inside building with no surfacing ACM (Asbestos containing materials)Range: <240-210,000; GM: 1000Areas of building with acoustical plasterRange: <3500-74 million; GM: 160,000Areas of buildings with exposed fireproofingRange: 7000-140 million; GM: 3.6 millionAbove ceiling tiles with fireproofingRange: <3500-220 million; GM: 3.8 millionTable 2 - Asbestos Dust Sampling results from return air ducts in 3 building with structural ACM Fireproofing (Page 5)Range: 1.1 million - 20 million s/cm^2Table 3 - Asbestos Dust Sampling results from supply air ducts/diffusers in 3 buildings with structural ACM Fireproofing (Page 5)"New" supply air ducts (6 years old): Range: 27,000-110,000 s/cm^2Original supply air ducts (25-30 years old): Range 170,000-27 million s/cm^2Supply air diffusers: Range: 79,000-160,000 s/cm^2 |
| Comments: | Sampling and analytical procedure employed is described in ASTM standard method D 5755-95 (page 1). Samples were collected and analyzed as described in ASTM Standard Test Method for Microvacuum Sampling and Indirect Analysis of Dust by Transmission Electron Microscopy for Asbestos Structure Number Concentrations (D 5755-95) or the earlier draft method prepared by the US EPA. More details are provided on page 2.Nearly all asbestos structures were chrysotile. (Page 3).Study states that a surface concentration of 1000 s/cm^2 is considered clean (Page 3). Surface is considered contaminated when concentration is above 100,000 s/cm^2 (Page 8). |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | High | Sampling and analytical methodology is thoroughly described and likely equivalent to an approved OSHA/NIOSH method. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Study and samples were conducted in the US. |
| | Metric 3: | Applicability | Low | Data are for ceiling tiles, air-duct insulation. Study also has asbestos fireproofing. Samples are dust surface samples, and may be applicable to dermal exposure to dusts settled on surfaces during construction or demolition. |
| | Metric 4: | Temporal Representativeness | Low | Monitoring data are greater than 20 years old. |
| | Metric 5: | Sample Size | Medium | Sample distribution characterized with range and geometric mean but discrete samples are not provided and distribution is not fully characterized. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Sample type and exposure type provided as well as number of sites and chemical concentration. |
| Domain 4: Variability and Uncertainty | | | | |

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|---|---|
| **Study Citation:** | Ewing, W. M. (1999). Further observations of settled asbestos dust in buildings. 1342:323-332. |
| **HERO ID:** | 5685 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

| | | | EVALUATION | |
|---|---|---|---|---|
| Domain | | Metric | Rating | Comments |
| | Metric 7: | Metadata Completeness | Medium | Addresses variability by sampling buildings with various levels of asbestos decomposition. Does not address uncertainty. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Eypert-Blaison, C., Romero-Hariot, A., Clerc, F., Vincent, R. (2017). Assessment of occupational exposure to asbestos fibers: Contribution of analytical transmission electron microscopy analysis and comparison with phase-contrast microscopy. Journal of Occupational and Environmental Hygiene 15(3):263-274. |
| **HERO ID:** | 4165916 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | asbestos removal - cutting water pipes with mechanical shovel; cutting/removing insulation and seals; treatment/removal of ”asbestos-containing plaster” (pg 4)Full list of removal activities/techniques in Tables 2-5 (pg 6-9) |
| Exposure route: | inhalation |
| Physical form: | airborne fibers |
| Personal sampling data: | extreme values of more than 250,000 fibers per litre were recorded in the case of serpentine short asbestos fibers; In some cases, the potential exposure exceeded 100 f/L (pg 4)Table 1 (pg 5) presents minimum, means, median, and maximum exposure concentrations by fiber class and nature; 1.47 f/L - 256,072 f/LTables 2-5 present sampling data results (medians, means, maximums etc.) (pg 6-9)Removal of materials which are considered non-friable, such as fiber cement roofing or indoor-outdoor surface coatings, generated high dust levels (greater than 2,000 f/L on average, and, in some cases, up to 8,580 f/L). |
| Particle size characterization: | ”WHO” fibers: longer than 5 um, diameter $<$ 3 um, L:D ratio $>$3, diameter $>$ 0.2 um (pg 1)thin asbestos fibers: L $>$ 5 um; 0.01 um $<$ D $<$ 0.2 um; L/D $>=$ 3 (pg 2)short asbestos fibers: 0.5 um $<$ L $<$ 5 um; 0.01 um $<$ D $<$ 3 um; L/D $>=$ 3 (pg 2) |
| Personal protective equipment: | respirator with assisted ventilation were worn, e.g. TM3P-type devices with an APF of 60, or external air-supply devices with an APF of 250 (pg 4) |
| Engineering control: | enclosed area, negative pressure (pg 3)HEPA vacuums equipped with cyclones and safe bag-changing systems (pg 12) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Sampling and Analytical Methodology | Medium | Sampling/analytical methodology is not an approved OSHA/NIOSH method but is an acceptable methodology. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | Medium | Data are from France, an OECD country. |
| Metric 3: | Applicability | High | Data are for construction materials, an in-scope occupational scenario. |
| Metric 4: | Temporal Representativeness | High | Monitoring data were collected after the most recent PEL and no more than 10 years old. |
| Metric 5: | Sample Size | Medium | Sample distribution characterized by limited statistics (median, max, mean) but discrete samples not provided and distribution not fully characterized. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Medium | Sample type and exposure type provided but missing metadata such as exposure frequency. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Medium | Variability addressed by providing sampling data for different methods of asbestos removal but uncertainty is not addressed. |

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|---|---|
| **Study Citation:** | Eypert-Blaison, C., Romero-Hariot, A., Clerc, F., Vincent, R. (2017). Assessment of occupational exposure to asbestos fibers: Contribution of analytical transmission electron microscopy analysis and comparison with phase-contrast microscopy. Journal of Occupational and Environmental Hygiene 15(3):263-274. |
| **HERO ID:** | 4165916 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

| | | **EVALUATION** | |
|---|---|---|---|
| Domain | Metric | Rating | Comments |
| **Overall Quality Determination** | | **Medium** | |

| | |
|---|---|
| **Study Citation:** | Fannick, N. (1981). Health hazard evaluation report no. HETA-81-042-832, Federal Aviation Administration, New York Air Route Traffic Control Center, Ronkonkoma, New York. |
| **HERO ID:** | 3970477 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | air traffic controllers (asbestos-treated beams in old attic area) (pg 3) |
| Exposure route: | inhalation |
| Physical form: | airborne fibers |
| Area sampling data: | pg 5: <0.007 - <0.013 f/cc |
| Number of workers: | 200 workers in control center during day, 50 at night (pg 3) |
| Personal protective equipment: | approved respirators whenever work is performed in attic area (pg 3) |

**EVALUATION**

| Domain | | Metric | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | High | Sampling/analytical methodology is an approved NIOSH method. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for construction materials, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Low | Sample type provided but no other metadata. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Fannick, N. (1983). Health hazard evaluation report no. HETA 83-03-1293, Russell-zuhl, Inc., New York City, New York. |
| **HERO ID:** | 3970522 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | The storeroom was first occupied by the firm about five years ago. At that time, there were many exposed pipes covered with a white, flaky substance which the firm's president assumes was asbestos. The room was cleaned by the president and two helpers. [PDF Pg. 4] |
| Area sampling data: | Airborne asbestos fibers were not detected on the filtersamples (limit of detection was approximately 0.05 fiber per cubiccentimeter of air). [PDF Pg. 7] |
| Personal protective equipment: | No respirators were worn during cleaning of the storage room. [PDF Pg. 4] |
| Engineering control: | To prevent any asbestos contamination from the damaged overhead pipe covering , it is recommended that the pipe covering be repaired with fibrous glass batting and duct tape. [PDF Pg. 8] |
| Comments: | Exposure duration not given in document. Three samples of airborne dust were collected on 37 millimeter "AA" filters at a nominal flow rate of 1.5 liters per minute for about 4 hours. The samples were analyzed for asbestos content following a standardized NIOSH procedure described in NIOSH ' s P&CAM 239 analytical technique for asbestos fibers. [PDF Pg. 5] |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | High | Sampling/analytical methodology is an approved NIOSH/OSHA method. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for Chemical Substances in Construction, Paint, Electrical, and Metal Products, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Monitoring data are greater than 20 years old. |
| | Metric 5: | Sample Size | Low | Sample distribution is described qualitatively. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Low | Sample type provided but no other metadata. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | Uncertainty is addressed in sampling/analytical methodology, but variability is not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Faulring, G. M., Forgeng, W. D., Kleber, E. J., Rhodes, H. B. (1975). Detection of chrysotile asbestos in airborne dust from thermosetting resin grinding. Journal of Testing and Evaluation 3(6):482-490. |
| **HERO ID:** | 3583314 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Grinding resin plaques to simulate boat yard operations (1/9). |
| Exposure route: | inhalation (1/9) |
| Physical form: | dust (1/9) |
| Personal sampling data: | PBZs were between 0-0.7 f/cc during grinding. (3/9) |
| Area sampling data: | Area samples were between 0-1.2 f/cc during grinding, and 0-0.06 f/cc after. (3/9) |
| Particle size characterization: | particle lengths were between 3-5 um (3/9) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | High | Sampling/analytical methodology is an approved NIOSH method. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for commercial use in construction materials, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Exposure type and sampling data provided, but missing number of workers, exposure duration, frequency, engineering controls, and PPE. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Fergusen, R. P., Knutti, E. B. (1991). Health hazard evaluation report no. HETA-88-391-2156, Morton Salt Company, Weeks Island, Louisiana. |
| **HERO ID:** | 3970474 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Mechanics, pan operators, loader operators, and boiler operators exposed to siding, pipe insulation, and other ACM. (4/38) |
| Exposure route: | inhalation (8/38) |
| Personal sampling data: | (PCM) Personal samples of miners ranged from 0.01-0.04 f/cc. (22/38) |
| Area sampling data: | (PCM) Area samples ranged from 0.003-0.03 f/cc. (22/38) |
| Engineering control: | NIOSH recommended the mine install scrubbers, filters, and catalytical purifiers. (11/38) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | High | Sampling/analytical methodology is an approved NIOSH method. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for industrial use in construction materials, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Exposure type and sampling data provided, but missing number of workers, exposure duration, frequency, particle size, physical form, and PPE. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | High | Uncertainty is addressed in sampling/analytical methodology. Variability is addressed by sampling different jobs on two days. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Ferguson, R. P., Knutti, E. B. (1993). Health Hazard Evaluation Report HETA 88-391-2156, Morton Salt Company, Weeks Island, Louisiana. (Revised April 1993). NIOSH(HETA-88-391-2156):1-36. |
| **HERO ID:** | 3102308 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | locations in salt mill; worker activities included mechanics, boiler operators, evaporators, loader operators, pan operators (pg 22) |
| Personal sampling data: | samples ranged in concentration from 0.01 to 0.04 fibers per cubic centimeter across the included jobs/activities (pg 22) |
| Area sampling data: | samples ranged from 0.003 to 0.03 fibers per cubic centimeter across all locations sampled (pg 22) |
| Number of workers: | approximately 208 workers employed at the salt mill and mine (pg 1) |
| Comments: | Health Hazard Evaluation |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | High | Sampling/analytical methodology is an approved NIOSH method. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | Medium | Data are for exposures during mining operations with asbestos material present, which is similar to the in-scope occupational scenario for use in construction. |
| | Metric 4: | Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | All metadata provided. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | Uncertainty is addressed in sampling/analytical methodology but variability is not addressed. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Finkelstein, M. M. (2015). Asbestos fibres in the lungs of an American mechanic who drilled, riveted, and ground brake linings: A case report and discussion. Annals of Occupational Hygiene 59(4):525-527. |
| **HERO ID:** | 3085859 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Heavy vehicle brake mechanics that drill, rivet, and ground friction products. (1/3) |
| Exposure route: | inhalation (2/3) |
| Personal sampling data: | Among workers sampled, riveters had the highest PCM concentrations, between 0.003-0.157 f/cm3. (1/3) |
| Number of workers: | 10 workers in original study, 1 worker in follow-up (1/3) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Low | Sampling/analytical methodology is not specified. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Medium | Data are from Canada, an OECD country. |
| | Metric 3: | Applicability | High | The data are for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | High | Monitoring data were collected after the most recent PEL and no more than 10 years old. |
| | Metric 5: | Sample Size | Medium | Sample distribution characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Sample type and exposure type provided, but missing physical form, exposure duration and frequency, PPE, engineering control, and particle size. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | Uncertainty is addressed by using control subjects. Variability is not addressed. |

## Overall Quality Determination — Medium

| | |
|---|---|
| **Study Citation:** | Finn, M. B., Hallenbeck, W. H. (1984). Detection of chrysotile asbestos in workers' urine. American Industrial Hygiene Association Journal 45(11):752-759. |
| **HERO ID:** | 3083557 |
| **Conditions of Use:** | Other: |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Workers at a small factory that produces roofing tars and asphalt sealers were exposed when 100 lb bags of chrysotile asbestos were opened and dumped into mixers. (2/9) |
| Exposure route: | inhalation (4/9) |
| Physical form: | fibers (6/9) |
| Personal sampling data: | (PCM) 6 8h TWA personal air samples ranged from 0.0004-0.96 fibers/mL. 15-minute samples ranged from 0.44-21.8 fibers/mL (6/9) |
| Particle size characterization: | In the air samples, mean dimensions of fibers ranged from 0.049 um diameter and 0.61 um length to 0.125 um diameter and 1.70 um length. (7/9) |
| Number of workers: | 6 employees (2/9) |
| Personal protective equipment: | Management required the use of respirators during the dumping operations. (2/9) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Sampling and Analytical Methodology | Medium | Sampling/analytical methodology is not an approved OSHA/NIOSH method but is an acceptable methodology. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | High | Data are from the U.S. |
| | Metric 3: Applicability | Uninformative | Processing chrysotile asbestos for roofing materials is not in scope for the legacy asbestos risk evaluation. |
| | Metric 4: Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| | Metric 5: Sample Size | Medium | Sample distribution characterized by limited statistics (mean, ranges) but discrete samples not provided and distribution not fully characterized. |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | Medium | Sample type and exposure type provided, but missing exposure duration, frequency, and engineering controls. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | High | Uncertainty is addressed in sampling/analytical methodology. Variability addressed by sampling over multiple years. |

## Overall Quality Determination Uninformative

**Study Citation:** First, M. W., Love, D. (1982). Engineering control of asbestos. American Industrial Hygiene Association Journal 43(9):634-639.
**HERO ID:** 3582527
**Conditions of Use:** Other:

**EXTRACTION**

| Parameter | Data |
|---|---|
| Exposure route: | inhalation |
| Physical form: | inhalable fibers |
| Personal sampling data: | Batchmaker3-11-80 0.047 f/cc5-1-80 0.020 f/cc11-10-80 0.02 f/cc11-11-80 0.01 f/cc11-11-80 011-14-80 02-81 0.004 f/ccForeman4-30-80 0.004 f/cc11-14-80 0.004 f/cc11-17-80 0Shipping & Receiving Room worker4-30-80 0.007 f/ccExtruder 2-81 0.003Mixing Room Clean up Crew5-1-80 0.01 f/cc11-10-80 0.04 f/cc11-17-80 02-81 0 |
| Area sampling data: | Outlet of Bag Filter10-25-79 0.086 f/cc10-25-79 0.029 f/cc5-2-80 0.032 f/cc2-81 0.0 f/cc |
| Engineering control: | Asbestos stacked 100 pound pressure packed bags stacked on wooden pallets sealed with transparent shrunk wrapped plastic, making it impossible for broken bags to leak unless the outer film is punctured, but this can be easily repaired with pressure sensitive tape. Broken bags can be resealed and spilt material can be picked up using a central industrial vacuum cleaning system.Fully automated bag opening and empty bag compacting machine receives bag into a hopper from a conveyor and after being centered in the machine by retractable rollers, the bags are cut completely in half lengthwise. the two haves are drawn apart and after the contents have been emptied. The halves are drawn into an automatic bag compactor and ejected into extended plastics tubs that can be tied off an when full and disposed of safely. Exhaust ventilated conveying and transfer systems are designed to eliminate excessive asbestos exposure of plant workers, and effluent air filtration systems were employed to avoid emission of fibers into the environment.During the transfer of the product from the mixer to the transfer tray , flexible hose is needed to connect to exhaust system. To remove fibers from exhaust, filter bags pretreated with asbestos floats ( a grade of short fine diameter asbestos) to provide the highest collection efficiency. Modular vacuum-cleaned HEPA filter unit to clean exhaust air. Automatic pulse jet cleaning, where collected material are deposited into an airtight drum that is close coupled to a automatic air lock at the base of the dust hopper. |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Sampling and Analytical Methodology | High | NIOSH methods were used, though it is not clear which methods is used. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | The data are from the United States. |
| Metric 3: | Applicability | Uninformative | Processing is not in scope for the legacy risk evaluation. |
| Metric 4: | Temporal Representativeness | Low | 1982 - prior to the most recent PEL and more than 20 years old. |
| Metric 5: | Sample Size | High | Statistical summary not provided, but results form each sampling event are provided that can be used to compile statistical summary. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Medium | Monitoring data include most critical metadata, such as sample type and exposure type, but lacks additional metadata, such as sample durations, exposure durations, exposure frequency, and/orworker activities. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Medium | Variability is addressed by including area and personal samples but uncertainty is not addressed. |

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|---|---|
| **Study Citation:** | First, M. W., Love, D. (1982). Engineering control of asbestos. American Industrial Hygiene Association Journal 43(9):634-639. |
| **HERO ID:** | 3582527 |
| **Conditions of Use:** | Other: |

| | | EVALUATION | |
|---|---|---|---|
| Domain | Metric | Rating | Comments |
| **Overall Quality Determination** | | **Uninformative** | |

| | |
|---|---|
| **Study Citation:** | Fischbein, A., Rohl, A. N., Langer, A. M., Selikoff, I. J. (1979). Drywall construction and asbestos exposure. American Industrial Hygiene Association Journal 40(5):402-407. |
| **HERO ID:** | 3084320 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Drywall tapers (3/7) |
| Physical form: | fibers (5/7) |
| Personal sampling data: | (PCM) Personal samples during pole sanding averaged 10.0 f/cc (range of 1.2-19.3 f/cc). Personal samples during hand sanding averaged 5.3 f/cc (range of 1.3-16.9 f/cc). Personal samples during dry mixing averaged 47.2 f/cc (range of 35.4-59.0 f/cc). Personal samples during floor sweeping were 41.4 f/cc and 26.4 f/cc. (5/7) |
| Particle size characterization: | Fibers longer than 5 um. (4/7) |
| Exposure duration: | Drywall tapers spend 5-10% of their time sanding dried spackle, which is roughly 25-50 minutes of an 8 hour day. (3/7) |
| Number of workers: | Local union groups had 3,500 members and it is estimated that 75,000 other construction workers were also employed. (2/7) |
| Engineering control: | Using asbestos-free taping compounds would prevent further exposure. (7/7) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Sampling and Analytical Methodology | High | Sampling/analytical methodology is an approved NIOSH method. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | High | Data are from the U.S. |
| | Metric 3: Applicability | High | Data are for commercial use in construction materials, an in-scope occupational scenario. |
| | Metric 4: Temporal Representativeness | High | Monitoring data were collected prior to the most recent PEL. |
| | Metric 5: Sample Size | Medium | Sample distribution characterized by limited statistics (means, ranges) but discrete samples not provided and distribution not fully characterized. |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | Medium | Exposure type and sampling data provided, but missing exposure frequency and PPE. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Medium | The monitoring study provides only limited discussion of the variability in the determinants of exposure for the sampled site or sector. |

## Overall Quality Determination High

**Study Citation:** Flesch, J. P., Rostand RA (1975). Health hazard evaluation report no. HHE 74-94-253, Armstrong Cork Company, Jackson, Mississippi.
**HERO ID:** 3970503
**Conditions of Use:** Other:

**EXTRACTION**

| Parameter | Data |
|---|---|
| Worker activity description: | Operators were observed to manually or mechanically weigh, convey and formulate the specific batch mix via a series of buckets filled at dump stations. (6/14) |
| Exposure route: | inhalation (11/14) |
| Physical form: | fibers (11/14) |
| Personal sampling data: | (PCM) PBZ measurements were 0.33-0.68 f/cc for the raw material suppliers, 4.98 f/cc during asbestos shredder maintenance, 0.95-1.41 f/cc for the compounders, 0.08-0.18 f/cc for the batch weighers, 0.18-0.66 f/cc for the resin weighers, and 0.19-0.26 f/cc for the assistant resin weighers. (11/14) |
| Exposure duration: | 8 hours (3/14) |
| Exposure frequency: | 5-6 days/week (3/14) |
| Number of workers: | 90 people, 35 of which are involved in production (3/14) |
| Personal protective equipment: | Respiratory protection was worn only during periodic maintenance of the walk-in asbestos shredder. (6/14) |
| Engineering control: | Local exhaust ventilation was applied at the dumping stations. An enclosure was built around the asbestos shredder to limit airborne fibers. (6/14) |
| Comments: | Table 1. Summary of 3rd Floor Operators' Breathing Zone Exposure to Airborne Toxic Substances 2nd &3rd Shifts/December 12, 1974 |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Sampling and Analytical Methodology | High | Sampling/analytical methodology is equivalent to an approved [OSHA/NIOSH] method. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | Data are from the U.S. |
| Metric 3: | Applicability | Uninformative | Data are for manufacturing of asbestos-containing products, which isn't in scope. |
| Metric 4: | Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | High | All metadata provided. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Medium | Variability is addressed by sampling different job descriptions. Uncertainty isn't addressed. |

## Overall Quality Determination Uninformative

| | |
|---|---|
| **Study Citation:** | Fontaine, J. H., Trayer, D. M. (1975). Asbestos control in steam-electric generating plants. American Industrial Hygiene Association Journal 36(2):126-130. |
| **HERO ID:** | 3084646 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Steam plant operators who tear out insulation, cut insulation, and clean up scrap insulation. (3/6) |
| Exposure route: | inhalation (2/6) |
| Physical form: | fiber (2/6) |
| Personal sampling data: | Table I. Asbestos Sampling Data8 hour TWAs ranged from <0.1-5.9 f/cm3. Peak single sample concentrations ranged from 0.0-24.6 f/cm3. |
| Particle size characterization: | Fibers measured were greater than 5 micrometers in length. (3/6) |
| Exposure duration: | 8 hours (3/6) |
| Number of workers: | At each steam electric plant, there are 6 full time insulators and a foreman. (2/6) |
| Personal protective equipment: | The type of respiratory protection used most often by insulators is an air purifying respirator with a replaceable filter. (4/6) |
| Engineering control: | Local exhaust ventilation is used to control airborne asbestos dust produced by cutting block and pipe insulation with a band saw in the steam plant insulation shops. Wetting is also used to suppress dust, and has reduced airborne asbestos by 85%. (3/6) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | High | Sampling/analytical methodology is an approved NIOSH method. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for industrial use of chemical substances in construction products, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | All metadata provided. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | High | Uncertainty is addressed in sampling/analytical methodology. Variability is addressed by sampling on multiple days. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Forbes, D. G., White, G. W. (1981). The identification of bulk asbestos and monitoring of airborne fiber. 2. Monitoring. Journal of the Association of Public Analysts 19:75-82. |
| **HERO ID:** | 6879625 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | asbestos removal (pg 5) |
| Exposure route: | inhalation |
| Physical form: | airborne fibers |
| Area sampling data: | 0.2-10 fibers/ml (pg 5); 7 fibers/ml (pg 6); <0.02 fibers/ml (pg 6) |
| Particle size characterization: | Table 3 (pg 7): > 5 um length; < 3 um diameter; > 3:1 aspect ratio |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Sampling and Analytical Methodology | Medium | Sampling/analytical methodology is not an approved OSHA/NIOSH method but is an acceptable methodology. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | Medium | Data are from the U.K., an OECD country. |
| | Metric 3: Applicability | High | Data are for construction materials, an in-scope occupational scenario. |
| | Metric 4: Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| | Metric 5: Sample Size | Medium | Sample distribution characterized by limited statistics (ranges, means) but discrete samples not provided and distribution not fully characterized. |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | Low | Sample type provided but no other metadata. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | High | Uncertainty is addressed in sampling/analytical methodology. Variability addressed by sampling "clean" and "dirty" filters. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Fowler, D. P. (2000). Exposures to asbestos arising from bandsawing gasket material. Applied Occupational and Environmental Hygiene 15(5):404-408. |
| **HERO ID:** | 3080855 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | bandsawing a gasket sheet with a conventional 16-inch woodworking bandsaw inside a chamber (abstract) |
| Personal sampling data: | 5 samples (7-30 min durations)The personal exposures to fibers longer than 5 micrometers(um) during bandsawing were between 2.2 and 4.9 fibers per milliliter (f/mL) by PCM where the current OSHA eight-hour TWA standard is 0.1 f/mL, and the 30-minute excursion limit is 1.0 f/mL. The personal results by TEM were higher; 22.2–49.3 asbestos structures per milliliter (s/mL) for all asbestos structures and 8.2–17.6 s/mL for those asbestos structures longer than 5 umTable 1, pg. 4/6 |
| Area sampling data: | 4 samples (6-25 min durations)For the PCM analyses, the area sample results werebetween 0.75 and 2.3 f/mL. The TEM area results were 14.3 and22.7 s/mL for total structures, and 5.7 and 7.6 s/mL for thosestructures longer than 5 lm in the two samples that could beanalyzed.Table 1, pg. 4/6 |
| Personal protective equipment: | half-mask respirator with HEPA filter cartridges (p. 3) |
| Engineering control: | The entire chamber was ventilated during all sawing by drawing air into the entry of the clean room with a Nilfisk Model GS 80 HEPA-filtered vacuum cleaner placed at the end of the chamber farthest from the entry. The air flow rate was approximately 0.99–1.13 cubic meters per minute (35– 40 cubic feet per minute), for an air exchange rate of 3.2–3.7 air changes per hour (ACH) (p. 3) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | High | Sampling or analytical methodology is an approved OSHA or NIOSH method or is well described and found to be equivalent to approved OSHA or NIOSH methods (PCM and TEM) |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | The data are from the United States and are representative of the industry being evaluated. |
| | Metric 3: | Applicability | High | The data are for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Low | The monitoring data are more than 20 years old |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | Monitoring data include all associated metadata, including sample types, exposure types, sample durations, exposure durations worker activities, and exposure frequency. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | The monitoring study provides only limited discussion of the variability in the determinants of exposure for the sampled site or sector. The monitoring study provides only limited discussion of the uncertainty in the exposure estimates. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Gaensler, E. A. (1992). Asbestos exposure in buildings. Clinics in Chest Medicine 13(2):231-242. |
| **HERO ID:** | 3082156 |
| **Conditions of Use:** | Consumer Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Exposure route: | inhalation (4/12) |
| Physical form: | fibers, dusts (3/12) |
| Area sampling data: | (TEM) Table 2 presents airborne asbestos concentrations in general buildings. In general administration buildings with damaged ACM, area samples were 0.00008 f/mL over 5 um on average. In schools, 0.00024 f/mL, in a college, 0.00003 f/mL, and in a Maryland public building, 0.00009 f/mL over 5 um. (5/12) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Sampling and Analytical Methodology | Low | Sampling methodology not specified. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | Data are from the U.S. |
| Metric 3: | Applicability | Uninformative | Data are for general inhalation exposure in buildings, which isn't in scope. |
| Metric 4: | Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| Metric 5: | Sample Size | Medium | Sample distribution characterized by limited statistics (means) but discrete samples not provided and distribution not fully characterized. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Medium | Exposure type and sampling data provided, but worker information, exposure duration and frequency, particle size, engineering controls and PPE. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | High | Uncertainty is addressed in by listing problems with extrapolating historical data.. Variability is addressed by using area samples from different locations. |

## Overall Quality Determination — Uninformative

| | |
|---|---|
| **Study Citation:** | Ganor, E., Fischbein, A., Brenner, S., Froom, P. (1992). Extreme airborne asbestos concentrations in a public building. British Journal of Industrial Medicine 49(7):486-488. |
| **HERO ID:** | 3096697 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Asbestos cement plant workers. |
| Exposure route: | Inhalation |
| Area sampling data: | Average concentration of crocidolite asbestos fibers was 4 fibers/cm^3 in a dining room with a range of 3-5 f/cm^3.At an asbestos cement plant the average was 0.14 f/cm^3.Asbestos cement plant dump site: 0.02 f/cm^3Garage brake cleaning: 0.02 f/cm^3Highway: 0.002 f/cm^3. (PDF Page 1)Table 2 provides asbestos concentration found in other reports in public buildings.Those studies provides average concentrations ranging from 0.003 to 0.202 f/cm^3. (PDF page 2). |
| Comments: | Source is for asbestos in a public building and just reference cement asbestos in one table but the study is not about asbestos cement plants. |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Low | Unclear if sampling/analytical methodology is equivalent to an approved OSHA/NIOSH method. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Medium | Data is for the UK, an OECD country. |
| | Metric 3: | Applicability | Low | Unclear if data would be applicable to use of construction materials but it is similar. |
| | Metric 4: | Temporal Representativeness | Low | Data is over 20 years old. |
| | Metric 5: | Sample Size | Medium | Data characterized by an average. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Low | Data provides sample type (area) and exposure route is assumed. No other metadata provided. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | Does not address variability or uncertainty. |

## Overall Quality Determination — Low

| | |
|---|---|
| **Study Citation:** | Garcia, E., Newfang, D., Coyle, J. P., Blake, C. L., Spencer, J. W., Burrelli, L. G., Johnson, G. T., Harbison, R. D. (2018). Evaluation of airborne asbestos exposure from routine handling of asbestos-containing wire gauze pads in the research laboratory. Regulatory Toxicology and Pharmacology 96:135-141. |
| **HERO ID:** | 6869530 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | lab technician - heating and ”direct wire gauze manipulation” (abstract) |
| Exposure route: | inhalation |
| Personal sampling data: | Pg 5:Scenario 1 results presented in Table 3: <0.029-<0.032 f/cc for 30-minute samples, 0.013-0.018 f/cc for 4-hr samples, 0.005-0.012 f/cc for 6-hr samplesScenario 2 results presented in Table 5: <0.027-0.054 f/cc for 30-minute samples, <0.014 f/cc for 60-minute sample, 0.033-0.048 f/cc for 120-min samples |
| Area sampling data: | Pg 5:Scenario 1: ”Six (6)-hour area sampling within the isolation chamber during testing showed an average concentration of 0.0076 f/cc by PCM (Range: 0.0069–0.0085)... The minimum and maximum TEM-adjusted PCM asbestos fiber concentration estimates were < 0.0009 f/cc and 0.0017 f/cc, respectively. Four-hour area samples were not positive for asbestos”Scenario 2: 12 area air samples (3 each for 120 min and 60 min burn tests, 6 for 30 min burn tests), results presented in Table 4: 0.023-0.050 f/cc for 120 min, <0.014-0.028 f/cc for 60 min, <0.030-0.056 for 30 minPg 6:Scenario 3: <0.006 f/cc |
| Number of workers: | 1-2 (lab technician or technician and assistant) (abstract) |
| Personal protective equipment: | tyvek suits, splash goggles, safety glasses (pg 2) |
| Engineering control: | negative pressure HEPA exhaust ventilation; glove box (pg 2) |
| Comments: | ”Both PZB and area air samples were analyzed in accordance with NIOSH Method 7400 by PCM, and Method 7402 by TEM” - pg4 |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | High | Sampling/analytical methodology is an approved NIOSH method. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are for the U.S. |
| | Metric 3: | Applicability | High | Data are for metal products (wire gauze), an in-scope occupational scenario |
| | Metric 4: | Temporal Representativeness | High | Monitoring data were collected after the most recent PEL and no more than 10 years old. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | Sample type and exposure type provided but missing metadata such as exposure frequency. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | High | Uncertainty is addressed in sampling/analytical methodology. Variability addressed by sampling for various use scenarios for wire gauze. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | GE, (1984). Richmond Apparatus Service Shop industrial hygiene survey. |
| **HERO ID:** | 1874216 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Arc chute cleaning and stator insulation removal. [PDF Pg. 5] |
| Personal sampling data: | Arc chute cleaning operations: <0.1 fibers/cm^3 [PDF Pg. 8]Stator insulation removal: 2.0 fibers/cm^3) |
| Area sampling data: | General area sample at adjacent 3F work location during arc chute cleaning: <0.06 fibers/cm^3. [PDF Pg. 8] |
| Exposure duration: | Usually less than 2 hours/day. [PDF Pg. 6] |
| Comments: | To evaluate employee exposures to metals and asbestos, all samples ,are collected on 0.8 micron cellosolve ester filters using MSA Model G pumps. The metal samples were analyzed using Atomic Absorption Spectrophotometry. Fiber counts were determined by the phase contrast microscopic technique. [PDF Pg. 4] PPE recommendations are for hearing loss and not asbestos exposure. |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Sampling and Analytical Methodology | High | Sampling/analytical methodology is equivalent to an approved OSHA/NIOSH method. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | Data are from the U.S. |
| Metric 3: | Applicability | High | Data are for Chemical Substances in Construction, Paint, Electrical, and Metal Products, an in-scope occupational scenario. |
| Metric 4: | Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Medium | Sample type and exposure type provided but missing exposure frequency. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | High | Uncertainty is addressed in sampling/analytical methodology. Variability addressed by sampling multiple worker activities and taking a general area sample. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | GE, (1984). Airborne asbestos samples, B/19. |
| **HERO ID:** | 4158368 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Oven removal. |
| Exposure route: | Inhalation |
| Physical form: | Fibers |
| Area sampling data: | 4 samples around the oven:0.17 f/cc, 0.46 f/cc, 1.28 f/cc, 2.18 f/cc |
| Personal protective equipment: | Coveralls and a Wilson 1400 respirator. |
| Engineering control: | Asbestos wet down with a fire hose before removaloven removal. |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Sampling and Analytical Methodology | High | Sampling or analytical methodology is an approved OSHA or NIOSH method or is well described and found to be equivalent to approved OSHA or NIOSH methods (PCM) |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | The data are from the United States and are representative of the industry being evaluated. |
| Metric 3: | Applicability | High | The data are for an occupational scenario within the scope of the risk evaluation. |
| Metric 4: | Temporal Representativeness | Low | The data were collected more than 20 years ago. |
| Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Low | Monitoring data include sample type (e.g., personal breathing zone) but no other metadata. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Medium | Monitoring report addresses variability by sampling various locations during oven removal, but measurement uncertainty is not characterized. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | GE, (1983). Asbestos survey, ambient levels in Stellite Area. |
| **HERO ID:** | 4158370 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | asbestos found in gasket material on oven doors, lagging on pipes, asbestos gloves during Stellite welding (pg 4) |
| Exposure route: | inhalation |
| Area sampling data: | 2 non-detects, 0.01 f/cc, 0.02 f/cc (pg 6-7) |
| Personal protective equipment: | asbestos gloves (pg 4) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | High | Sampling/analytical methodology is an approved NIOSH method. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for construction materials, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Sample type and exposure type provided but missing metadata such as exposure frequency. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | Monitoring report addresses variability through multiple sample locations, but does not characterize measurement uncertainty. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | GE, (1984). Employee exposure to air contaminants while performing butt welding on a brass ring - building 18, 2nd floor. |
| **HERO ID:** | 4158371 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Exposures to air contaminants during the TIG welding of a brass ring were evaluated in Building 18, 2nd floor. Exposure to asbestos that might result from the use of asbestos-containing gloves. |
| Physical form: | Fiber |
| Personal sampling data: | 0.04 fiber/cc measured with 170-min sample time and 2 LPM flowrate using 0.8 micron millipore filters. Sample analysis was done microscopically. |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Medium | Sampling or analytical methodology is not equivalent to an approved OSHA or NIOSH method and EPA review of information indicates the methodology is acceptable. Differences in methods are not expected to lead to lower quality data. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | The data are from the United States. |
| | Metric 3: | Applicability | High | The data are for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Low | Data are more than 20 years old. |
| | Metric 5: | Sample Size | High | Discrete data measurement provided. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Monitoring data include most critical metadata such as sample type and duration, but lacks additional metadata such as exposure frequency, exposure durations, and number of workers. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | The monitoring study does not address variability or uncertainty. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | GE, (1984). Employee exposure to asbestos during pipe insulation maintenance operations-building 269. |
| **HERO ID:** | 4158372 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Asbestos insulation removal, cleanup and pipe covering. [PDF Pg. 5] |
| Exposure route: | Inhalation |
| Personal sampling data: | [PDF Pg. 7]Pipe Coverer (removing worn asbestos pipe insulation): 1.25; 1.76; 2.83; 0.89; 2.16; 2.20; 0.88; 8.04 (fibers/cc). TWA: 2.02; 2.37 (fibers/cc)Vacuum cleaning and insulating pipes with non-asbestos covering: 0.1; 0.1; 0.1; 0.1; 0.1; 0.1 (fibers/cc). TWA: 0.53; 0.35; 0.27; 0.32 (fibers/cc) |
| Exposure duration: | 8 hours/day [PDF Pg. 5] |
| Personal protective equipment: | Air-supplied respiratory protection [PDF Pg. 5] |
| Comments: | Air samples were collected on cellulose ester filters having a pore size of 0.8 micrometers using Gillian HFS113 pumps. Pump flow rate was set at 2.0 liters per minute and monitored during the sampling period using a Brooks precision rotameter. Fiber counting was performed using the phase contrast microscopy technique in accordance with NIOSH P&CAM 239.Engineering controls not given in the document. |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Sampling and Analytical Methodology | High | Sampling/analytical methodology is an approved NIOSH method. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | Data are from the U.S. |
| Metric 3: | Applicability | High | Data are for Chemical Substances in Construction, Paint, Electrical, and Metal Products, an in-scope occupational scenario. |
| Metric 4: | Temporal Representativeness | Low | Monitoring data are greater than 20 years old. |
| Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | High | All metadata provided. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | High | Uncertainty is addressed in sampling/analytical methodology. Variability addressed by sampling multiple worker activities. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | GE, (1984). Employee exposures to asbestos during removal of asbestos - insulated ductwork - Building 6 - 3rd floor. |
| **HERO ID:** | 4158373 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | removal of asbestos ductworkdisposal of asbestos |
| Personal sampling data: | Sheetmetal worker (asbestos removal): 23.6 f/cc average TWA, 20.4-29.3 f/cc TWAWelder (assisted in disposal): 1.63 f/cc average TWA |
| Exposure duration: | 3 hr task duration (p. 5)sampling over three days, durations from 5-269 minutes |
| Personal protective equipment: | 3M 9920 respirator and disposable clothing |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | High | Sampling or analytical methodology is an approved OSHA or NIOSH method or is well described and found to be equivalent to approved OSHA or NIOSH methods (PCM). |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | The data are from the United States and are representative of the industry being evaluated. |
| | Metric 3: | Applicability | High | The data are for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Low | Metadata on the operations, equipment, and worker activities associated with the data show that the data agree representative of outdated operations, equipment, and activities rather than current operations, equipment, and worker activities. The data were collected more than 20 years ago. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | Monitoring data include all associated metadata, including sample types, exposure types, sample durations, exposure durations worker activities, and exposure frequency. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | High | The monitoring study addresses variability in the determinants of exposure for the sampled site or sector. The monitoring study addresses uncertainty in the exposure estimates or uncertainty can be determined from the sampling and analytical method. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | GE, (1984). Employee exposures to asbestos during storage area cleanup operation - Building 5. |
| **HERO ID:** | 4158374 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Cleanup of asbestos pipe insulation in Building 5 basement storage area. [PDF Pg. 4] |
| Personal sampling data: | [PDF Pg. 6]Utility worker cleaning asbestos pipe insulation from building 5 storage area. Sample 1: 0.7 (f/cc)Sample 2: 0.6 (f/cc)Sample 3: 0.9 (f/cc)8-hr TWA for sample 1 and 2: 0.3 (f/cc)8-hr TWA for sample 3: 0.2 (f/cc) |
| Area sampling data: | 8-hr TWA in storage area (15-minute samples) [PDF Pg. 6]Sample 1: 1.5 (f/cc)Sample 2: 0.8 (f/cc)Sample 3: 1.6 (f/cc)Sample 4: 2.4 (f/cc)Sample 5: 1.2 (f/cc)Sample 6: 0.4 (f/cc)Sample 7: 0.1 (f/cc)Sample 8: 0.7 (f/cc) |
| Exposure duration: | Three samples were taken during asbestos pipe insulation cleaning which were 110 minutes, 105 minutes, and 105 minutes. The short term sampling (ceiling) duration was 15 minutes. [PDF Pg. 6] |
| Comments: | Air samples were collected to evaluate employee exposures to airborne asbestos fibers during the cleanup operation. The samples were collected on (open faced) 0.8 micron type AA filters using MSA pumps calibrated at 2.0 liters per minute. The filter samples were analyzed using a phase contrast microscope. [PDF Pg. 4] |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | High | Sampling/analytical methodology is equivalent to an approved OSHA/NIOSH method. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | The data are for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Sample type and exposure type provided but missing PPE, engineering controls, and exposure frequency. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | Uncertainty is not addressed. Variability addressed by taking both personal and area samples. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | GE, (1983). Industrial hygiene survey of arc chute operations. |
| **HERO ID:** | 4158375 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Arc chute molding, machining, assembly, and materials handling. (5/11) |
| Physical form: | fibers (7/11) |
| Personal sampling data: | Asbestos was ND in all of the personal samples (7/11). |
| Engineering control: | Local exhaust ventilation systems were present. (5/11) It was suggested to eliminate use of brooms and hand brushes, use vacuums, and place the weighing scale inside the asbestos bagging enclosure. (9/11) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Medium | Sampling/analytical methodology is not an approved OSHA/NIOSH method but is an acceptable methodology. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for industrial use in construction materials, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Exposure type and sampling data provided, but missing number of workers, exposure duration, frequency, PPE, and particle size. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | High | Uncertainty is addressed in sampling/analytical methodology. Variability is addressed by sampling in different buildings. |

## Overall Quality Determination — High

| | |
|---|---|
| **Study Citation:** | GE, (1984). Industrial hygiene survey, B/76. |
| **HERO ID:** | 4158376 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Slot armor slitting, sawing, sanding, and lay up (4/8) |
| Physical form: | fibers (5/8) |
| Personal sampling data: | (PCM) During slitting and sawing slot armor, exposures were <0.01 f/cc. During sanding slot armor and slot armor lay up, exposures were <0.02 f/cc. (5/8) |
| Comments: | Samples collected on 0.8 micron cellulose filters using MSA Model G pumps and subsequently analyzed using phase contrast microscopy. |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Medium | Sampling or analytical methodology is not equivalent to an approved OSHA or NIOSH method and EPA review of information indicates the methodology is acceptable. Differences in methods are not expected to lead to lower quality data. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for industrial use in construction materials, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Low | Monitoring data include sample type (e.g., personal breathing zone) but no other metadata. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | GE, (1984). SUO employee exposure to airborne asbestos fibers during pipe lagging removal, Building 2 - basement cafeteria. |
| **HERO ID:** | 4158378 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | pipe lagging removal (pg 4) |
| Personal sampling data: | outside of sampling periods, the exposure concentrations for the balance of the shift is assumed 0.1 f/cc in order to calculate TWAs (pg 5)Table on pg 6-8 has full sampling data; ranges from 0.12->35.61 f/cc |
| Exposure duration: | durations for each exposure activity provided in Table on pg 6-8; ranges from 15-136 minutes |
| Personal protective equipment: | respirators (pg 5) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Sampling and Analytical Methodology | Medium | Sampling/analytical methodology is not an approved OSHA/NIOSH method but is an acceptable methodology. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | Data are from the U.S. |
| Metric 3: | Applicability | High | Data are for construction materials, an in-scope occupational scenario. |
| Metric 4: | Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Medium | Sample type and exposure type provided but missing metadata such as exposure frequency. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | GE, (1981). SUO employee exposures to airborne asbestos during duct covering removal Building 269. |
| **HERO ID:** | 4158379 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | lagging (insulation) removal, removing lagging from pipes and bagging it, vacuuming and cleaning up |
| Exposure route: | inhalation |
| Personal sampling data: | personal samples0.01 - 1.05 f/cc |
| Area sampling data: | area samples0.004 - 1.1 f/cc |
| Exposure duration: | sampling time between 15 - 348 minutes |
| Personal protective equipment: | Respirator, disposable paper coveralls, plastic hood and bootees, cotton gloves. |
| Engineering control: | Tape off work area with red tape to restrict entry, water spray. |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Sampling and Analytical Methodology | Medium | Report states PCM was used and describes the sampling methodology used. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | The data are from the United States and are representative of the industry being evaluated. |
| Metric 3: | Applicability | High | The data are for an occupational scenario within the scope of the risk evaluation. |
| Metric 4: | Temporal Representativeness | Low | The data were collected before the most recent PEL establishment or update or are more than 20 years old if no PEL is established. |
| Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Medium | Monitoring data include most critical metadata, such as sample type and exposure type, but lacks additional metadata, such as exposure frequency. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Medium | The monitoring study provides no discussion of uncertainty but addresses variability by taking multiple samples of the same activity. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | GE, (1980). SUO employee exposures to airborne asbestos fibers at the duct removal & cleaning operation Building 28. |
| **HERO ID:** | 4158380 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Removal of exhaust ducts and cleaning of a dust collector. (4/10) |
| Physical form: | fibers (6/10) |
| Personal sampling data: | All samples were <0.1 f/cc except duct removal and bagging (0.15 f/cc), collector disassembly and removal (2.78 f/cc), vacuuming empty collector (0.92 f/cc), removal of contaminated bags (19.90 and 3.29 f/cc), and vacuuming dust from collector (0.62 f/cc. (6/10) |
| Exposure duration: | 6-56 minutes (7/10) |
| Personal protective equipment: | Approved respirators, paper coveralls, head coverings, shoe coverings, cotton gloves. (9/10) |
| Engineering control: | Tape off are with red tape to restrict entry of all persons not involved in removal. The dust collector should be wet down with water prior to removal. All windows and doors should be kept closed. Bags of material should be labeled and sealed before transport to landfill. (9/10) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Sampling and Analytical Methodology | Medium | Sampling/analytical methodology is not an approved OSHA/NIOSH method but is an acceptable methodology. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | High | Data are from the U.S. |
| | Metric 3: Applicability | High | Data are for removal of asbestos products, an in-scope occupational scenario. |
| | Metric 4: Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| | Metric 5: Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | Medium | Exposure type and sampling data provided, but missing number of workers, exposure frequency, and particle size. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Medium | Monitoring report addresses variability by sampling various personnel, but measurement uncertainty is not characterized. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | GE, (1984). SUO employee exposures to airborne fibers during pipe lagging removal, Building 37 - 5th floor. |
| **HERO ID:** | 4158381 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | removal of asbestos lagging from steam pipes in building 37 on the fifth floor. |
| Exposure route: | inhalation |
| Physical form: | Fibers, Dust |
| Personal sampling data: | 0.17 - 1.58 fibers/cc. (P. 6/7) |
| Personal protective equipment: | Respirators approved for protection against asbestos dust. |
| Comments: | See table. (P. 6/7) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | High | Sampling or analytical methodology is an approved OSHA or NIOSH method |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | The data are from the United States |
| | Metric 3: | Applicability | High | The data are for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Low | more than 20 years old |
| | Metric 5: | Sample Size | Medium | Distribution of samples is characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Monitoring data include most critical metadata, such as sample type and exposure type, but lacks additional metadata, such as sample durations, exposure durations, exposure frequency, and/orworker activities. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | The monitoring study does not address variability or uncertainty. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | General Motors, (1982). Die-cast operations benzo(a)pyrene plating operations asbestos nitrosamines with cover letter. |
| **HERO ID:** | 1231414 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Department 2 Die-cast machines fill liquid zinc reservoirs (solid bars)Department 6 die-cast machines, trim press, loading and unloading parts.Department 6 pot men fill liquid zinc reservoirs (heated zinc) |
| Area sampling data: | Column L-21 NDColumn L-21 (repeat) 0.01 f/ccColumn L-32 0.04 f/ccColumn L-32 (repeat) NDEngineer supervisor office NDEngineer supervisor office (repeat) NDColumn L-26 NDColumn L-26 (repeat) NDColumn K-29 NDColumn K-29 (repeat) NDPowerhouse NW wall NDPowerhouse NW wall (repeat) 0.03 f/ccPowerhouse S wall NDPowerhouse S wall (repeat) NDPowerhouse NW basement NDPowerhouse NW basement (repeat) NDColumn K-7 NDColumn K-7 (repeat) NDDepartment 2 N end NDDepartment 2 N end (repeat) NDDepartment 2 Column D-10 NDDepartment 2 Column D-10 (repeat) NDColumn D-19 NDColumn D-19 (repeat) NDColumn D-17 NDColumn D-17 (repeat) NDColumn E-26 NDColumn E-26 (repeat) NDColumn D-23 NDColumn D-23 (repeat) 0.01 f/ccPowerhouse induction furnace NDPowerhouse induction furnace (repeat) NDSW Power washer NDSW Power washer (repeat) 0.02 f/cc |
| Number of workers: | Department 2 Die-cast machines 3 workersDepartment 6 Die-cast machine operators unknownDepartment 6 Pot men 4 workers |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Medium | Personal sampling pumps were used with opened-face cellulose acetate filters 0.8 micrometer pore size. Analytical method: Phase-contrast micscopy. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | US |
| | Metric 3: | Applicability | High | The data are for an occupational scenario (die-cast operator working in a facility with asbestos) work within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Medium | 1981 - prior to the PEL (1986) and more than 20 years old |
| | Metric 5: | Sample Size | Low | Statistics were not provided - though most of the results were ND |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Monitoring data include most critical metadata, such as sample type, exposure type, sample durations, worker activities but lacks additional metadata, such as exposure durations, exposure and frequency. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | The monitoring study does not address variability or uncertainty. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Gibbs, G. W. (1994). THE ASSESSMENT OF EXPOSURE IN TERMS OF FIBERS. Annals of Occupational Hygiene 38(4):477-487. |
| **HERO ID:** | 3081787 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Area sampling data: | 6 f/ml exposure in the textile industry |
| Comments: | Asbestos exposure during mining and milling |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | High | Sampling or analytical methodology is an approved OSHA or NIOSH method or is well described and found to be equivalent to approved OSHA or NIOSH methods. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | The data are from the United States and are representative of the industry being evaluated. |
| | Metric 3: | Applicability | Uninformative | The data are from an occupational scenario (asbestos mining/milling) that does not apply to any occupational scenario within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Low | Metadata on the operations, equipment, and worker activities associated with the data show that the data agree representative of outdated operations, equipment, and activities rather than current operations, equipment, and worker activities. The data were collected before the most recent PEL update. |
| | Metric 5: | Sample Size | Low | Distribution of samples is qualitative or characterized by no statistics. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Low | Monitoring data include sample type (e.g., personal breathing zone) but no other metadata. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | The monitoring study does not address variability or uncertainty. |

## Overall Quality Determination Uninformative

| | |
|---|---|
| **Study Citation:** | Gibbs, G. W. (1975). Fibre release from asbestos garments. Annals of Occupational Hygiene 18(2):143-149. |
| **HERO ID:** | 3615432 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Furnishing, Cleaning, Treatment Care Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Workers at two ore reduction plants where asbestos safety garments were worn routinely. (1/7) |
| Exposure route: | inhalation (4/7) |
| Physical form: | textiles (1/7) |
| Personal sampling data: | (SEM) At plant 1, personal samples had an average of 2.0 f/cm3 and a range of 0.3-5.0 f/cm3. At plant 2, personal samples had an average of 14.1 f/cm3 and a range of 9.9-26.2 f/cm3. (4/7) |
| Area sampling data: | (SEM) At plant 1, average 8-hour concentrations of asbestos were 0.4 f/cm3 with a range of 0.1-1.1 f/cm3. (4/7) |
| Exposure duration: | At plant 1, daily exposure time ranged from 50-144 mins, with a mean of 103 minutes. (4/7) At plant 2, daily exposure time ranged from 28-39 minuets, with a mean of 35 minutes. (5/7) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Sampling and Analytical Methodology | High | Sampling/analytical methodology is equivalent to an approved [OSHA/NIOSH] method. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | Medium | Data are from Canada, an OECD country. |
| Metric 3: | Applicability | High | Data are for industrial use in textiles, an in-scope occupational scenario. |
| Metric 4: | Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| Metric 5: | Sample Size | Medium | Sample distribution characterized by limited statistics (means, ranges) but discrete samples not provided and distribution not fully characterized. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Medium | Exposure type and sampling data provided, but missing number of workers, exposure frequency, particle size, engineering controls and PPE. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Medium | Variability is addressed by sampling at two plants. Uncertainty isn't addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Gibson, S. M., Ogle, R. B. (1988). Technical and economic assessment for asbestos abatement within Facility 20470, Wright-Patterson Air Force Base, Ohio. |
| **HERO ID:** | 6886475 |
| **Conditions of Use:** | Disposal |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Exposure route: | inhalation |
| Physical form: | ”Under static conditions, ACMs that are well encapsulated do not release asbestos fibers and therefore do not pose a direct threat. When ACMs are disturbed during maintenance, repair, or renovation, they may become airborne”” (pg 10)”The fibers of friable material are slowly released as the material ages” (pg 24)”...it was noted that the low-pressure steam lines were insulated with ACM. Damage to the pipe insulation covering, observed near the heating units, caused friableasbestos to be exposed in the vicinity of the heater” (pg 19) |
| Area sampling data: | Static air samples with minimal activity in the area: ”Analytical results indicated levels that were well below the present occupational exposure limit of 0.2 fiber per cm3 of air in an 8-h work period. However, based on the visual inspection results, employees performing work within the containment shell could be subjected to significant airborne asbestos exposures. For example, activities such as cleaning of floors, equipment maintenance, and climbing to or walking within the catwalk area could produce airborne exposure to asbestos fibers” (pg 22) |
| Comments: | abatement project at Federal facility |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Medium | Sampling/analytical methodology is not an approved OSHA/NIOSH method but is an acceptable methodology. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for abatement industry, which is an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Sample type and exposure type provided but missing discussion of analytical methods and sampling parameters. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Glencross, P. M., Christiani, D. C. (1996). Health hazards of abatement work: Asbestos and lead. New Solutions: A Journal of Environmental and Occupational Health Policy 6(3):23-34. |
| **HERO ID:** | 6908739 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Abatement |
| Exposure route: | Inhalation |
| Physical form: | There are six types of mineral silicate fibers, together referred to as asbestos. Ninety-five percent of the asbestos in the U.S. is chrysotile, a white curly fiber that is easily woven into protective clothing and heat insulation products. Amosite, the second most common, was used in fireboards, friction products, and fire hoses especially during the 1950s and 196Os). Amosite and anthophyllite are rectangular fibers. Crocidolite, a strong, blue, needlelike fiber, was used in asbestos cement and briefly in a cigarette filter. Amosite, anthophyllite and crocidolite are classified with the remaining two fiber types (tremolite and actinolite) as members of the amphibole group. Chrysotile is the only member of its own group; it is a pyroxenes or serpentine asbestos. (pg 1 of 12) |
| Area sampling data: | As indicated in Table 1 (pg 2 of 12), different concentrations (fibers/cc) are as follows: indoor air (depending if asbestos is used in building materials) – 0.0003-0.06; dry sweep of a library floor with asbestos containing ceiling material – 10; removing asbestos-containing ceiling section in a library – 17 – 34. |
| Particle size characterization: | Because asbestos is crystalline, very small fibers can break length-wise and form even smaller diameter fibers (less than .25 microns or 1/100,000ths of an inch). (pg 2 of 12) |
| Personal protective equipment: | protective clothing and respirators (pg 11 of 12) |
| Engineering control: | ventilation (pg 11 of 12) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | High | Sampling or analytical methodology is well described by Sawyer 1977 and found to be equivalent to approved OSHA or NIOSH methods. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | The data are from the United States. |
| | Metric 3: | Applicability | High | The data are for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Low | Monitoring data are greater than 20 years old. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized in referenced study (Sawyer 1977). |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Monitoring data include most critical metadata, such as sample type and exposure type, but lacks additional metadata. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | High | The monitoring study addresses variability by collecting data for various sampling conditions. Measurement uncertainty is captured by the mean, standard deviation, and number of samples for each sampling condition. |

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| | |
|---|---|
| **Study Citation:** | Glencross, P. M., Christiani, D. C. (1996). Health hazards of abatement work: Asbestos and lead. New Solutions: A Journal of Environmental and Occupational Health Policy 6(3):23-34. |
| **HERO ID:** | 6908739 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

| | | EVALUATION | |
|---|---|---|---|
| Domain | Metric | Rating | Comments |
| **Overall Quality Determination** | | **High** | |

| | |
|---|---|
| **Study Citation:** | Godish, D. (1989). Asbestos exposure in schools. Journal of School Health 59(8):362-363. |
| **HERO ID:** | 3615517 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Exposure route: | Inhalation [PDF Pg. 1] |
| Physical form: | Fibers (solid) [PDF Pg. 1] |
| Area sampling data: | Measured median levels of airborne asbestos in schools containing friable ACBM have been reported between 0.002 and 0.004 fibers/ cm. [PDF Pg. 2] |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Low | Sampling/analytical methodology is not specified. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | Low | The monitoring data is for asbestos exposure to children and employees in schools which is not in scope. This exposure might be similar to an in-scope occupational scenario like construction and building materials. |
| | Metric 4: | Temporal Representativeness | Low | Monitoring data are greater than 20 years old. |
| | Metric 5: | Sample Size | Low | Distribution of samples is qualitative or characterized by no statistics. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Sample type and exposure type provided but missing exposure duration and frequency. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | The article discusses that variability is due to a number of factors including the nature and condition of ACBM. Uncertainty is not addressed. |

## Overall Quality Determination — Low

| | |
|---|---|
| **Study Citation:** | Goldade, M. P., O'Brien, W. P. (2014). Use of direct versus indirect preparation data for assessing risk associated with airborne exposures at asbestos-contaminated sites. Journal of Occupational and Environmental Hygiene 11(2):67-76. |
| **HERO ID:** | 2544085 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Exposure route: | inhalation |
| Physical form: | inhalable fibers |
| Personal sampling data: | Total Direct Analysis Total particles: 746 mean: 0.336 structures/cc SD: 0.396 structures/cc Min: 0.04 structures/cc Max: 1.41 Total Indirect Analysis Total particles:1539 mean: 1.16 structures/cc SD: 2.39 structures/cc Min: <0.005 structures/cc Max: 11.9Length ≥5 $\mu$m Fraction Direct Analysis Total particles: 621 mean: 0.284 structures/cc SD: 0.351 structures/cc Min: 0.037 structures/cc Max: 1.21 Length ≥5 $\mu$m Fraction Indirect Analysis Total particles: 829 mean: 0.525 structures/cc SD: 0.955 structures/cc Min: <0.005 structures/cc Max: 4.04Length <5 $\mu$m Fraction Direct Analysis Total particles:125 mean: 0.052 structures/cc SD: 0.057 structures/cc Min: <0.004 structures/cc Max: 0.234 Length <5 $\mu$m Fraction Indirect Analysis Total particles: 710 mean: 0.637 structures/cc SD: 1.54 structures/cc Min: <0.005 structures/cc Max: 7.85 |
| Particle size characterization: | Particle size distribution - see figure 1 |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | High | These breathing zone air samples, representing airborne LAexposure measurements, were analyzed by phase contrast microscopy (PCM); confirmation by transmission electron microscopy (TEM), though not required, was performed on asubset of samples. The goal of the monitoring was to measurebreathing zone concentrations of airborne LA associated withdisturbance of source materials in residential scenarios. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | US |
| | Metric 3: | Applicability | High | The data are for an occupational scenario (contaminate site clean up) within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | High | 2013- After PEL (1994) and less than 10 years old |
| | Metric 5: | Sample Size | High | Results are provided as mean, sd, and range values |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Monitoring data include most critical metadata, such as sample type and exposure type, but lacks additional metadata, such as sample durations, exposure durations, exposure frequency, and/orworker activities. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | High | The monitoring study discussed variability within the data for two different transfer methods, and also addresses uncertainty in the sampling and analytical method. |

## Overall Quality Determination High

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| | |
|---|---|
| **Study Citation:** | Goldade, M. P., O'Brien, W. P. (2014). Use of direct versus indirect preparation data for assessing risk associated with airborne exposures at asbestos-contaminated sites. Journal of Occupational and Environmental Hygiene 11(2):67-76. |
| **HERO ID:** | 2544085 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|

| | |
|---|---|
| **Study Citation:** | Gonzalezfernandez, E., Delaosa, P. D., Martin, F. R. (1987). Comparison of AIA and NIOSH methods on asbestos fiber measurements in the workplace. Annals of Occupational Hygiene 31(3):363-373. |
| **HERO ID:** | 3581197 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | asbestos-cement factory in four different workplaces: mill, loading, and mixing; big pipe turning; small pipe turning; pipe cutting (pg 6) |
| Personal sampling data: | total 88 pairs of samples taken and analyzed using AIA or NIOSH method with NIOSH fiber concentrations ranging 1.03 to 1.94 fibers/mL and fiber density 147 to 236 fibers/square millimeters; provides fiber density, concentrations, number of samples for each workplace type as well as individual sampling data for selected samples (pgs 6, 7, and 9-11) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | High | Sampling/analytical methodology is an approved NIOSH method. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Medium | Data are from Spain, an OECD country. |
| | Metric 3: | Applicability | High | Data are for industrial uses associated with piping, which is included in the industrial use occupational scenario for construction. |
| | Metric 4: | Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Sample type and exposure type provided but missing exposure duration. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | High | Uncertainty is addressed in sampling/analytical methodology. Variability addressed by different workplaces. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Goodman, J. E., Peterson, M. K., Bailey, L. A., Kerper, L. E., Dodge, D. G. (2014). Electricians' chrysotile asbestos exposure from electrical products and risks of mesothelioma and lung cancer. Regulatory Toxicology and Pharmacology 68(1):8-15. |
| **HERO ID:** | 3078075 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | [PDF Pg. 4]Electrical cable pulling activities, electrical installation activities, electrical repair activity, fluorescent lamp replacement. |
| Area sampling data: | [Table 1, PDF Pg. 3] Electricians exposed during renovation of buildings with sprayed-on fireproofing: geometric mean was 0.13 (f/cm^3).Experiment during simulation of operations and maintenance activities in school: arithmetic mean of 0.34 (f/cm^3).Experiment during simulation of eight different repair/maintenance tasks: highest average for simulations was 0.25 (f/cm^3).Air samples collected during normal operation and maintenance of buildings: Mean of 0.0095 (f/cm^3).10 personal air samples of maintenance workers doing electrical and plumbing work: highest TWA was 0.0308 (f/cm^3).Variety of electrical repair tasks in buildings with asbestos being removed: highest TWA was 0.06 (f/cm^3).Various maintenance tasks: highest TWA was 0.06 (f/cm^3).Grinding of resin plaques: 1.2 (f/cm^3).Sawing, sanding, drilling of phenolic molding material: 0.006-0.08 (f/cm^3). |
| Exposure duration: | [Table 1, PDF Pg. 3]Maintenance activities in school: <2.5 hours.Simulation of eight different repair/maintenance tasks: 1-3 hours.Grinding of resin plaques: 4-5 minutes. |
| Comments: | Additional more in-depth sample results given on PDF Pg. 2-4. |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Low | Sampling/analytical methodology is not specified. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for Chemical Substances in Construction, Paint, Electrical, and Metal Products, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Data cited in Table 1 is over 20 years old |
| | Metric 5: | Sample Size | Medium | Sample distribution characterized by limited statistics (mean) but discrete samples not provided and distribution not fully characterized. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Sample type and exposure type provided but missing PPE, engineering controls, and exposure frequency. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | Variability addressed by sampling from multiple authors, but uncertainty is not addressed. |

## Overall Quality Determination — Medium

| | |
|---|---|
| **Study Citation:** | Goung, S. J., Yang, J., Kim, Y. S., Lee, C. M. (2015). A pilot study of indoor air quality in screen golf courses. Environmental Science and Pollution Research 22(9):7176-7182. |
| **HERO ID:** | 2835440 |
| **Conditions of Use:** | Other: |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | General population in lobby and game room of indoor screen golf course |
| Exposure route: | Inhalation |
| Physical form: | Fibers |
| Area sampling data: | 0.002 to 0.005 f/cc |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | High | Sampling or analytical methodology is an approved OSHA or NIOSH method or is well described and found to be equivalent to approved OSHA or NIOSH methods. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Low | The data are from an OECD country other than the U.S. |
| | Metric 3: | Applicability | Uninformative | The data are from an occupational or non-occupational scenario that does not apply to any occupational scenario within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | High | Data from indoor screen golf courses were collected in the last 10 years. |
| | Metric 5: | Sample Size | Medium | Distribution of samples is characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Low | Monitoring data include sample type (e.g., personal breathing zone) but no other metadata pertinent to occupational risk assessment. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | High | Monitoring report accounts for variability by testing multiple locations, and measurement uncertainty is captured through the number of samples for each measurement location. |

## Overall Quality Determination — Uninformative

**Study Citation:** Gościcki, J. W., Indulski, J. A. (1982). The Polish studies on occupational exposure to asbestos and its biological effects. Archivum Immunologiae et Therapiae Experimentalis 30(3-4):169-176.
**HERO ID:** 3100631
**Conditions of Use:** Other:

**EXTRACTION**

| Parameter | Data |
|---|---|
| Worker activity description: | Workers at asbestos product manufacturing plants. (2/8) |
| Physical form: | fibers (2/8) |
| Area sampling data: | Textile production area dust concentrations were 0.4-3.0 mg/m3 and asbestos concentrations were 0.2-5.9 f/cc. Spinning and weaving mills were 4.0-40.0 mg/m3 for dust. Asbestos cement production was 0.3-30.9 mg/m3 for dust and 0.06-2.18 f/cc for asbestos. Asbestos rubber production was 0.6-3.3 mg/m3 for dust and 2 f/cc for asbestos. Friction material production was 0.2-14.4 mg/m3 for dust and 0.45-2.09 f/cc for asbestos. Shipbuilding was 1.86-97.9 mg/m3 for dust. (2/8) |
| Particle size characterization: | The mean geometric size of chrysotile fibers was 14 um in the USSR, 16 um in Canada, 18 um in Africa, 20 um in Italy, and 8 um for crocidolite fibers. (6/8) |
| Number of workers: | 5,000 people in the asbestos cement industry are exposed in Poland. (1/8) |
| Personal protective equipment: | During cleaning, respirators are worn. (2/8) |
| Engineering control: | Ventilation is utilized at asbestos production plants. (3/8) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Sampling and Analytical Methodology | Low | Sampling methodology not specified. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | Medium | Data are from Poland, an OECD country. |
| Metric 3: | Applicability | Uninformative | Data are for asbestos product manufacturing, which isn't in scope. |
| Metric 4: | Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| Metric 5: | Sample Size | Medium | Sample distribution characterized by limited statistics (means, ranges) but discrete samples not provided and distribution not fully characterized. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Medium | Exposure type and sampling data provided, but missing exposure duration and frequency. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Medium | Variability is addressed by sampling at different industries. Uncertainty isn't addressed. |

## Overall Quality Determination Uninformative

**Study Citation:** Grant, M. P. (2019). Evaluation of wildland fire fighters' exposures to asbestos during a prescribed burn.
**HERO ID:** 7598689
**Conditions of Use:** Other:

**EXTRACTION**

| Parameter | Data |
|---|---|
| Worker activity description: | fire fighters' exposures to asbestos during prescribed burns near a former vermiculite mine. |
| Personal sampling data: | The concentration of total fibers for the sample was 0.032 f/cc, which was below the OEL for total fibers of 0.1 f/cc (Table C1). The concentration was also the highest concentration detected among fire fighters during that task (range: not detected–0.032 f/cc). |
| Exposure duration: | 12 hours on the day |
| Number of workers: | 19 employees |
| Engineering control: | Use wet mop-up methods instead of dry mop-up methods. |
| Comments: | Table C1. Personal breathing zone samples for fibers analyzed by phase contrast microscopy for fire fighters during a prescribed burnTable C2. Personal breathing zone samples for fibers analyzed by phase contrast microscopy for decontamination employees during a prescribed burnTable C3. Personal breathing zone samples for asbestos analyzed by transmission electron microscopy (TEM) for fire fighters and decontamination employees during a prescribed burn |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | High | Sampling or analytical methodology is an approved OSHA or NIOSH method |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | The data are from the United States |
| | Metric 3: | Applicability | Medium | The data are for an occupational scenario that is similar to an occupational scenario |
| | Metric 4: | Temporal Representativeness | High | no more than 10 years old |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | Monitoring data include all associated metadata. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | High | The monitoring study addresses variability in the determinants of exposure for the sampled site or sector. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Green, F. H. Y., Harley, R., Vallyathan, V., Althouse, R., Fick, G., Dement, J., Mitha, R., Pooley, F. (1997). Exposure and mineralogical correlates of pulmonary fibrosis in chrysotile asbestos workers. Occupational and Environmental Medicine 54(8):549-559. |
| **HERO ID:** | 7837 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Furnishing, Cleaning, Treatment Care Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Source does not go specifically into worker activities but just states that they work in an asbestos textile factory that deals almost exclusively with chrysotile. |
| Exposure route: | Inhalation |
| Physical form: | Fibers in ambient air; Dust |
| Particle size characterization: | Table 4 provides size distribution of asbestos fibers in lung tissue (Units are um) (Page 6)Chrysotile:Fiber length: Median - 1.5; Quartiles - 0.5-1.5Fiber diameter: Median - 0.06; Quartiles - 0.06-0.06Aspect ratio: Median - 23.1; Quartiles - 7.7-23.1Tremolite:Fiber length: Median - 1.5; Quartiles - 1.5-2.5Fiber diameter: Median - 0.19; Quartiles - 0.13-0.19Aspect ratio: Median - 7.9; Quartiles - 7.8-11.4Crocidolite:Fiber length: Median - 2.5; Quartiles - 1.5-5.0Fiber diameter: Median - 0.32; Quartiles - 0.19-0.32Aspect ratio: Median - 15.2; Quartiles - 6.2-23.1Amosite:Fiber length: Median - 0.5; Quartiles - 0.5-1.5Fiber diameter: Median - 0.07; Quartiles - 0.07-0.07Aspect ratio: Median - 7.7; Quartiles - 7.7-22.0Anthophyllite:Fiber length: Median - 1.5; Quartiles - 1.5-3.5Fiber diameter: Median - 0.19; Quartiles - 0.19-0.25Aspect ratio: Median - 7.8; Quartiles - 7.8-18.4 |
| Exposure duration: | Provides data on cumulative lifetime exposure but not hr/day that workers were exposed.Table 2 provides exposure variables. (Page 5)Years employed:0.1-1.3Lifetime cumulative exposure (fibres>5 um/ml^3 x years employed = fibre-years)2.4Peak exposure (fibres > 5 um/ml^3)5.4Average exposure (fibre-years/years of employment)4.5Years employed - 1.4-8.9Lifetime cumulative exposure - 15.8Peak exposure - 7.0Average exposure - 5.0Years employed - 9.0-27.2Lifetime cumulative exposure - 106.0Peak exposure - 13.6Average exposure - 4.8Years employed - >27.3Lifetime cumulative exposure - 120.3Peak exposure - 9.6Average exposure - 4.0Total Lifetime cumulative exposure - 30.2Total Peak exposure - 7.9Total Average exposure - 4.7 |
| Number of workers: | There were 44 male and 10 female asbestos workers and 22 male and 12 female controls. |
| Comments: | Workers are almost exclusively exposed to chrysotile asbestos. Source was marked for area sampling data but I never saw any sample data for samples taken at the plant. All sampling data was of lung tissue which I chose to add that data in the chemical concentration section. |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Medium | Provides information about the sampling/analytical methodology but never states whether or not it is related to an EPA/NIOSH method. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Study is based on the US. |
| | Metric 3: | Applicability | Medium | Data are for textile industrial manufacturing which is an in-scope occupational scenario. The sampling data however is of the lung tissue of deceased workers and not actual workplace samples. |
| | Metric 4: | Temporal Representativeness | Low | Study was conducted in 1997 which is greater than 20 years old. Samples are also of lungs of asbestos workers from 1940-1975. |
| | Metric 5: | Sample Size | Medium | Sample distribution characterized by a median and quartiles but discrete samples are not provided. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Sample type, exposure type, worker activity, exposure duration,particle size characterization, and concentration data are provided. |

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|---|---|
| **Study Citation:** | Green, F. H. Y., Harley, R., Vallyathan, V., Althouse, R., Fick, G., Dement, J., Mitha, R., Pooley, F. (1997). Exposure and mineralogical correlates of pulmonary fibrosis in chrysotile asbestos workers. Occupational and Environmental Medicine 54(8):549-559. |
| **HERO ID:** | 7837 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Furnishing, Cleaning, Treatment Care Products |

| | | **EVALUATION** | |
|---|---|---|---|
| Domain | Metric | Rating | Comments |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Medium | Addresses variability by looking at workers over many years but does not address uncertainty. |

## Overall Quality Determination — Medium

| | |
|---|---|
| **Study Citation:** | Großdorfer, K. F., Prügger, F. (1979). Asbestosis in Textile Processing. Arhiv za Higijenu Rada i Toksikologiju 30(Suppl 2):841-844. |
| **HERO ID:** | 6891340 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Furnishing, Cleaning, Treatment Care Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Personal sampling data: | [PDF Pg. 2]Between two sewing machines: 11 (f/cm^3)Sewing of plastic asbestos carrying sacks: 5.8 (f/cm^3)Shackout and cutting: 14.8 (f/cm^3) |
| Area sampling data: | [PDF Pg. 1-2]Cleaning of hemp stacks: 3.4 (f/cm^3)Cutting hemp sacks: 2.8 (f/cm^3)Sewing room ambient air: 6.9 (f/cm^3)Sewing of plastic asbestos carrying sack: 3.5 (f/cm^3)Shackout and cutting: 8.4 (f/cm^3) |
| Engineering control: | Suction Fan [PDF Pg. 2] |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Medium | Sampling/analytical methodology is not an approved OSHA/NIOSH method but is an acceptable methodology. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Medium | Data are from Austria, an OECD country. |
| | Metric 3: | Applicability | High | Data are for Chemical Substances in Furnishing, Cleaning, Treatment Care Products, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Monitoring data are greater than 20 years old. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Low | Sample type provided but no other metadata. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | Uncertainty is addressed in sampling/analytical methodology but variability is not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Guidotti, T. L. (1988). Quantitative risk assessment of exposure to airborne asbestos in an office building. Canadian Journal of Public Health 79(4):249-254. |
| **HERO ID:** | 3095120 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | A highly visible asbestos rip-out operation was in progress as part of a renovation of the upper stories; deteriorating ceiling tiles and wall plaster; asbestos in sprayed-on insulation (pg 2) |
| Exposure route: | inhalation |
| Physical form: | airborne fibers |
| Area sampling data: | Fibre counts in the building by light microscopy suggest a baseline of 0.01 f/cc and peaks on the order of 0.1 f/cc during renovation work (pg 1)Sampling of air in office buildings in Ontario and Alberta have generally yielded levels in the range of 0.01 f/cc for fibres of all length, and 0.003 or less for fibres >= 5.0 µm. When the airspace above suspended ceilings has been examined, total counts less than 0.01 f/cc are typical by either optical or electron microscopy. (Optical microscopy is not accurate at such low levels.) If maintenance or renovation work is carried out without special precautions, total fibre counts as high as 0.18 have been recorded,although this total count still represents < 0.02 for fibres > 5.0 µm (pg 2)Baseline levels before and after renovation were 0.01 f/cc and below. During renovation, counts ranged from undetectable to as high as 0.86 on one occasion, probably an unusual incident, and averaged 0.07. During renovation work, airborne asbestos levels in the renovation areas themselves ranged from undetectable to 0.09 f / cc except for two unusually high counts (0.25 and 0.13) that probably represented unusual events. Average counts were 0.0 l. Before and after renovation, counts were consistently 0.01 and below in the renovation areas. (pg 3)The most probable exposure level for an occupant would be 0.01 f/ cc of chrysotile on a time-weighted average. (pg 4) |
| Number of workers: | 2,000 workers in building (pg 1) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Medium | Sampling/analytical methodology is not an approved OSHA/NIOSH method but is an acceptable methodology. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Medium | Data are from Canada, an OECD country. |
| | Metric 3: | Applicability | High | Data are for construction materials, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| | Metric 5: | Sample Size | Medium | Sample distribution characterized by limited statistics (ranges, means, outliers) but discrete samples not provided and distribution not fully characterized. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Low | Sample type provided but no other metadata. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination — Low

| | |
|---|---|
| **Study Citation:** | Guillemin, M. P., Madelaine, P., Litzistorf, G., Buffat, P., Iselin, F. (1989). Asbestos in buildings: The difficulties of a reliable exposure assessment. Aerosol Science and Technology 11(3):221-243. |
| **HERO ID:** | 3583563 |
| **Conditions of Use:** | Consumer Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Materials damaged during maintenance operations or renovations or by the users themselves. (pg 4) |
| Area sampling data: | Provides asbestos fiber concentrations in fibers/L for all sizes of fibers and for fibers >=2.5 micron or >=5 micron; concentrations for all sizes of asbestos fiber ranged from 15.6 to 1,599.47 fibers/L as measured by TEM (pg 11). Provides fiber concentration measured over time throughout the day using graphical representation (pg 14-16). Fiber concentrations, both total and asbestos-specific, also measured by FAM, PCM, and SEM with SEM showing range of 0.064 to 1.432 fibers/L for fibers larger than 2.5 microns across all buildings (pg 17) |
| Particle size characterization: | Provides graphical representation of size distribution of fibers for amosite and chrysotile fibers (pgs 8-10) as well as tabular data for size distributions. Tabular data shows overall fiber length range for buildings with friable asbestos as between 0.165 to 8.911 microns and between 0.8 to 1.208 microns in length for buildings with unknown asbestos sources (pg 11). |
| Comments: | TABLE 4. Airborne Fiber Concentrations Obtained by FAM and by PCMTABLE 5. Fiber Concentrations Obtained by Scanning Electron Microscopy |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Sampling and Analytical Methodology | High | Sampling/analytical methodology includes an approved NIOSH method. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | Medium | Data are from Switzerland, an OECD country. |
| Metric 3: | Applicability | Low | Data are for non-occupational scenario or ambient levels in buildings, which is similar to the the in-scope occupational scenario related to construction. |
| Metric 4: | Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided for fiber concentrations). |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Medium | Sample type and exposure type provided but missing associated exposure durations or sampling duration. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | High | Uncertainty is addressed in sampling/analytical methodology. Variability addressed by comparing across different methods and building types. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Guillemin, M., Litzistorf, G., Madelaine, P., Iselin, F., Buffat, P. (1987). THE INDOOR ASBESTOS PROBLEM FACTS AND QUESTIONS. Experientia, Supplementum 51(ED.):BASEL. |
| **HERO ID:** | 3094662 |
| **Conditions of Use:** | Consumer Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Research lab workers, office workers, and school employees. (3/6) |
| Exposure route: | inhalation (3/6) |
| Physical form: | fibers (3/6) |
| Area sampling data: | (TEM) Area samples (>=2.5 um) in two research labs were 1.95 f/L and 5.97 f/L. Samples in classrooms and schools ranged from 0.19-23.80 f/L. An sample in an office was 3.35 f/L. Two factory samples were 2.66 and 7.05 f/L. A sample in a shopping center was 0.36 f/L. (3/6) |
| Particle size characterization: | Fibers were measured in two categories: fibers >= 5 um and fibers >= 2.5 um. The ratio of 5um to 2.5um fibers ranged from 0 (ND)-0.68. (3/6) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | High | Sampling/analytical methodology is equivalent to an approved [OSHA/NIOSH] method. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Medium | Data are from Switzerland, an OECD country, |
| | Metric 3: | Applicability | Low | Data are for office workers exposures, which is similar to commercial use of construction products. |
| | Metric 4: | Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Exposure type and sampling data provided, but missing number of workers, exposure duration, frequency, engineering controls, and PPE. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | High | Uncertainty is addressed in sampling/analytical methodology. Variability is addressed by sampling at 9 different locations. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Gunter, B. J. (1981). Health hazard evaluation report no. HETA-81-038-801, Hensel Phelps Construction Company, Greeley, Colorado. |
| **HERO ID:** | 3970475 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Carpenters during a hotel construction project, sawing and handling of asbestos sheet board (3/8) |
| Exposure route: | inhalation (4/8) |
| Physical form: | fibers (7/8) |
| Personal sampling data: | (PCM) Personal samples were 140,000 f/m3 and 50,000 f/m3 for carpenters, 320,000 f/m3 for the carpenter apprentice, and 50,000 f/m3 for a laborer. (7/8) |
| Area sampling data: | (PCM) An area sample was 70,000 f/m3. (7/8) |
| Particle size characterization: | Fibers were greater than 5 microns in length. (5/8) |
| Exposure duration: | 8 hours/day (4/8) |
| Number of workers: | 4 workers (4/8) |
| Personal protective equipment: | Respirators were purchased, but workers didn't receive adequate training or have them properly fitted. (5/8) |
| Engineering control: | NIOSH recommends taking long showers at work and leaving the work clothes at the work site. (5/8) |
| Comments: | Table 1: Breathing Zone and General Area Air Concentrations of Asbestos Fibers |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Sampling and Analytical Methodology | High | Sampling/analytical methodology is equivalent to an approved [OSHA/NIOSH] method. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | Data are from the U.S. |
| Metric 3: | Applicability | High | Data are for commercial use in construction materials, an in-scope occupational scenario. |
| Metric 4: | Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | High | All metadata provided. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Medium | Uncertainty is addressed by evaluation criteria and limits of detection. Variability isn't addressed. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Gunter, B. J. (1974). Health hazard evaluation report no. HHE 73-149-140, Federal-Mogul Corporation, Gallipolis, Ohio. |
| **HERO ID:** | 3970507 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Use of an asbestos conveyor belt in an automobile plant (2/5) |
| Physical form: | fibers (2/5) |
| Personal sampling data: | Three samples were 0.04, 0.15, and 0.11 f/cc. One sample was too dirty to read. (4/5) |
| Exposure duration: | 8 hours/day (2/5) |
| Number of workers: | 200 employees (1/5) |
| Personal protective equipment: | Workers should be provided with respirators (3/5) |
| Engineering control: | Exhaust ventilation should be installed (3/5) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | High | Sampling or analytical methodology is an approved OSHA or NIOSH method or is well described and found to be equivalent to approved OSHA or NIOSH methods. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | The data are for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Exposure type and sampling data provided, but missing exposure frequency and particle size. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | The monitoring study does not address variability or uncertainty. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Ha, K., Chung, S., Lee, S., Kang, M., Kim, G., Yoo, S., Eo, S., Jung, K., Kim, C. (2017). Characteristics of airborne asbestos concentrations in Korean preschools. Journal of Environmental Health 80(1):E1-E6. |
| **HERO ID:** | 6885685 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Exposure route: | Inhalation |
| Physical form: | Solid |
| Area sampling data: | Table 2 - PCM91 samples, 0.000 - 0.04 f/cc (mean 0.009 +/- 0.008 f/cc) |
| Comments: | Concentrations of Airborne Fibrous Materials Detected With Phase Contrast Microscopy Analysis |

**EVALUATION**

| Domain | | Metric | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Medium | Sampling or analytical methodology is not equivalent to an approved OSHA or NIOSH method and EPA review of information indicates the methodology is acceptable. Differences in methods are not expected to lead to lower quality data. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Medium | The data are from an OECD country. other than the U.S., and locality-specific factors (e.g., potential differences in regulatory occupational exposure limits, industry/ process technologies) may impact exposures relative to the U.S |
| | Metric 3: | Applicability | High | The data are for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | High | The operations, equipment, and worker activities associated with the data are expected to be representative of current operations, equipment, and activities. The monitoring data were within the last 10 years. |
| | Metric 5: | Sample Size | Medium | Distribution of samples is characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Monitoring data include most critical metadata, such as sample type and exposure type, but lacks additional metadata, such as sample durations, exposure durations, exposure frequency, and/or worker activities. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | High | The monitoring study addresses variability in the determinants of exposure for the sampled site or sector (variability in sampling location ). The monitoring study addresses uncertainty in the exposure estimates. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Hall, R. M., Boudreau, Y. (1999). Health hazard evaluation report no. HETA 98-0124-2743, Yankton Siox Tribe- Marty Indian School, Marty, South Dakota. |
| **HERO ID:** | 3970539 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | The worker used brushes and scraping devices to remove fly ash on the inside walls of the boiler (p. 16) |
| Exposure route: | inhalation |
| Physical form: | solid |
| Area sampling data: | one area air sample was collected at the entrance to the boys dormitory utility tunnel (p. 7)Total fibers on this sample were less than the LOD. The analytical LOD for total fibers is 3000 fibers/filter, which equates to a MDC of 0.006 fibers/cubic centimeter (cc), assuming a sample volume of 540 liters. (p. 12)39–minute area samples collected for total and respirable dust inside the boiler during cleaning activities had concentrations of 15 mg/m3 (TWA = 1.3 mg/m3) and 3 mg/m3 (TWA = 0.25 mg/m3), respectively. (p. 12) |
| Personal protective equipment: | respirator utilized by the worker during boiler cleaningactivities has an APF of 50 (p. 14)a full-face constant flow airline respirator, disposable coveralls, booties, gloves, and hood (p. 15) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Sampling and Analytical Methodology | High | Sampling or analytical methodology is an approved OSHA or NIOSH method or is well described and found to be equivalent to approved OSHA or NIOSH methods. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | High | The data are from the United States and are representative of the industry being evaluated. |
| | Metric 3: Applicability | High | The data are for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: Temporal Representativeness | Low | Metadata on the operations, equipment, and worker activities associated with the data show that the data agree representative of outdated operations, equipment, and activities rather than current operations, equipment, and worker activities (data is more than 20 years old). |
| | Metric 5: Sample Size | Medium | Statistical distribution of samples is fully characterized (only a single sample taken) |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | Medium | Monitoring data include most critical metadata, such as sample type and exposure type, but lacks additional metadata, such as sample durations, exposure durations, and exposure frequency |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Medium | The monitoring study provides limited discussion of variability or uncertainty |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Hall, R. M., Trout, D., Earnest GS, Mueller, C., Nimgade, A. (2002). Health hazard evaluation report no. HETA 2002-0038-2870, 26 Federal Plaza, New York, New York. |
| **HERO ID:** | 3970527 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Exposure route: | inhalation |
| Physical form: | dust |
| Area sampling data: | SAMPLE #LOCATION"PCM^{1} FIBER CONCENTRATION(FIBERS/CC)""TEM^{2} FIBER CONCENTRATION (FIBERS/CC)"ASB-11234^{TH} FLOOR FDA GENERAL OFFICE AREA0.0070.004ASB-114CAFETERIA FLOOR 6 GENERAL AREAND0.011ASB-111"LOBBY OF 26 FEDERAL BUILDING (IN FRONT OF DAYCARE CENTER)"0.0250.028ASB-1063900B-OFFICE OF THE INSPECTOR GENERAL0.0060.007ASB-102PARKING GARAGE NEAR LOADING DOCK"OVERLOADED WITH PARTICULATE (COULD NOT ANALYZE)"ASB-108"CMS-DFM FINANCIAL CONTROLS BRANCH (GENERAL OFFICE AREA)"ND0.006ASB-10344G SOUTH SIDE AIR INTAKE0.0040.004ASB-105"HUD 3500 OFFICE OF ASSISTANT GENERAL COUNSEL"0.0430.04ASB-1133805 FOB CMS GENERAL OFFICE AREA0.0080.009ASB-10744G SOUTH SIDE AIR INTAKE0.0090.02ASB-110"ACF- 41-14 FOB GA GENERAL OFFICE AREA (NORTH SIDE OF GENERAL OFFICE AREA)"ND0.005ASB-101"ACF- 41-14 FOB GENERAL OFFICE AREA (SOUTH SIDE NEAR EXIT)"ND0.01ASB-104ACF- 41-14 FOB NEAR CONFERENCE ROOM AND0.006"ND = NON-D ETECTEDNO ASBESTOS FIBERS WERE IDENTIFIED WITH TEM ANALYSIS^{1} PHASE CO NTRAST MICROSCOPY^{2} TRANSMIS SION ELECTRON MICROSCOPY" |
| Particle size characterization: | nan |
| Comments: | Health Hazard Study was conducted in correlation with dust/debris from the 9/11/2001 World Trade Center attack and subsequent collapse. This scenario does not fall into the current use scenario. |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Sampling and Analytical Methodology | High | Sampling/analytical methodology is an approved NIOSH method. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | High | Data are from the U.S. |
| | Metric 3: Applicability | Uninformative | Data are for accumulated dust/debris from a terrorist attack/building collapse which is not in-scope or similar to an in-scope occupational scenario. |
| | Metric 4: Temporal Representativeness | Medium | Monitoring data were collected after the most recent PEL and greater than 10 years old. |
| | Metric 5: Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | Low | Sample type provided but no other metadata. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Uninformative

| | |
|---|---|
| **Study Citation:** | Harries, P. G. (1971). Asbestos dust concentrations in ship repairing: A practical approach to improving asbestos hygiene in naval dockyards. Annals of Occupational Hygiene 14(3):241-254. |
| **HERO ID:** | 3084877 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Application and removal of asbestos materials asbestos in Naval Dockyards |
| Exposure route: | inhalation |
| Physical form: | Fiber |
| Personal sampling data: | ASBESTOS DUST CONCENTRATIONS IN MISCELLANEOUS PROCESSES ASSOCIATED WITH PIPE LAGGINGSawing calcium silicate sections= Range: 7-152, Mean: 55 fibers/cm^3Removing calcium silicate sections from box = Range: 16-136, Mean: 52Fitting calcium silicate section to pipe= Range: 1-129, mean: 43 fibers/cm^3Cleaning calcium silicate debris= Range: 90-277, Mean: 155 fibers/cm^3Fitting amosite rope= Range: 5-340, Mean: 112 fibers/cm^3Removing asbestos 'plastic mix' from container= Range: 48-70, Mean: 217 fibers/cm^3Mixing asbestos 'plastic mix' with water in bucket= Range: 24-579, Mean: 256 fibers/cm^3Ripping cloth (untreated)= Range: 0.3-16.5, Mean: 7 fibers/cm^3Ripping cloth (contaminated)= Range:5.5-43, Mean: 20 fibers/cm^3Ripping cloth (treated)= Range:>1, Mean: >1 fibers/cm^3Stitching cloth= Range: 0-10, Mean: 3.4 fibers/cm^3Fitting cloth over lagged pipes= Range: 0.3-43, Mean: 22 fibers/cm^3(P. 6/14)ASBESTOS DUST CONCENTRATION DURING REMOVAL OF FtBROUS ASBESTOS ACOUSTIC PANELSRange 48 - 271 fibers/cm^3(P. 7/14)ASBESTOS DUST CONCENTRATIONS IN ASBESTOS MATTRESS SHOPSOld Shop= Range: 0.7, Mean: 1.5 fibers/cm^3New Shop= Range: 0-17, Mean: 3.7 fibers/cm^3(P. 7/14) |
| Area sampling data: | DURING REMOVAL OF SPRAYED CROCIDOLITE ASBESTOSAircraft hanger = Range: 117-484 , Mean: 334 fibers/cm^3Adjacent areas= Range: 19 - 31 , Mean: 56.5 fibers/cm^3Small compartments= Range: 35 - 384, Mean: 219.9 fibers/cm^3Adjacent areas= Range: 43-177, Mean:82.6 fibers/cm^3Sweeping and bagging debris= Range: 213 - 493, Mean: 353.0 fibers/cm^3. (P. 3/14)More data on Area sampling. Please check comments. |
| Engineering control: | These steps included a review of the use of asbestos, and where possible the introduction of substitute materials. |
| Comments: | TABLE 2. ASBESTOS DUST CONCENTRATION ASSOCIATED WITH REMOVAL OF SPRAYED CROCIDOLITE ASBESTOSTABLE 3. ASBESTOS DUST CONCENTRATIONS DURING REMOVAL OF PIPE AND MACHINERY LAGGINGTABLE 4. ASBESTOS DUST CONCENTRATIONS DURING THE APPLICATION OF P1PE AND MACHINERY LAGGINGTABLE 5. ASBESTOS DUST CONCENTRATIONS IN MISCELLANEOUS PROCESSES ASSOCIATED WITH PIPE LAGGINGTABLE 6. ASBESTOS DUST CONCENTRATION DURING REMOVAL OF Fibrous ASBESTOS ACOUSTIC PANELSTABLE 7. ASBESTOS DUST CONCENTRATIONS IN OTHER MISCELLANEOUS PROCESSESTABLE 8. ASBESTOS DUST CONCENTRATIONS IN ASBESTOS MATTRESS SHOPS |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Sampling and Analytical Methodology | High | Sampling or analytical methodology is an approved method. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | Medium | The data are from an OECD country. |
| | Metric 3: Applicability | High | The data are for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: Temporal Representativeness | Low | More than 20 years old. |
| | Metric 5: Sample Size | High | Statistical distribution of samples is fully characterized. |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | High | Data include all associated metadata |

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| | |
|---|---|
| **Study Citation:** | Harries, P. G. (1971). Asbestos dust concentrations in ship repairing: A practical approach to improving asbestos hygiene in naval dockyards. Annals of Occupational Hygiene 14(3):241-254. |
| **HERO ID:** | 3084877 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

| | | EVALUATION | |
|---|---|---|---|
| Domain | Metric | Rating | Comments |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | High | The monitoring study addresses variability in the determinants of exposure for the sampled site or sector. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Harries, P. G. (1968). Asbestos hazards in naval dockyards. Annals of Occupational Hygiene 11(2):135-145. |
| **HERO ID:** | 97 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Furnishing, Cleaning, Treatment Care Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | [PDF Pg. 2]Mattress Making: In each dockyard this is carried out in shops equipped with exhaust ventilation cowls in which the mattresses are filled with amosite fibre. Working conditions are good and dust concentrations are low. Some crocidolite has occasionally been used in the past and the men preferred it lo amosite as it wasless dusty and less spiky than amosite. Wyers ( 1946) has previously commented on the workers dislike of amosite asbestos. |
| Exposure route: | [PDF Pg. 5]Inhalation |
| Physical form: | [PDF Pg. 4]Dust |
| Area sampling data: | [PDF Pg. 5]Application and stitching asbestos cloth: 0.05-0.26 (fibers/cm^3) |
| Comments: | Amosite asbestos was evaluated. [PDF Pg. 5] Fibre counts are carried out using methods recommended by the Asbestosis Research Council ( H OLMES, 1965). |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Sampling and Analytical Methodology | Medium | Sampling/analytical methodology is equivalent to an approved OSHA/NIOSH method. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | Medium | Data are from the United Kingdom, an OECD country. |
| | Metric 3: Applicability | High | Data are for Chemical Substances in Furnishing, Cleaning, Treatment Care Products, an in-scope occupational scenario. |
| | Metric 4: Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| | Metric 5: Sample Size | Medium | Sample distribution characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | Low | Sample type provided but no other metadata. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Medium | Variability addressed by a range of measured concentrations, but uncertainty is not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Harries, P. G. (1968). Asbestos hazards in naval dockyards. Annals of Occupational Hygiene 11(2):135-145. |
| **HERO ID:** | 97 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | [PDF Pg. 3]Lagging: The application a nd removal of heat insulating materials is mainly concentrated in the machinery spaces aboard ships and present practice is to lag all hot faces above I 50°F with calcium silicate sections covered with asbestos cloth. Cutting and fixing sections, rope and cloth docs give rise to localized high dustconcentrations, but the highest dust concentrations occur during removal of old lagging material.Asbestos spraying: This process was extensively used for environmental insulation until 1963 when it was completely discontinued. The existing material is extensively removed during refits and is being replaced by glass fibre. The dust concentrationsduring removing the dry material arc very high.Application of sound insulation: Asbestos boards of various types and thicknesses have been sawn and fitted for sound insulation and removed during subsequent refits. This work is done by joiners, and again the highest dust concentrations occur during removal of the old material. |
| Exposure route: | [PDF Pg. 5]Inhalation |
| Physical form: | [PDF Pg. 4]Dust |
| Area sampling data: | [PDF Pg. 5]Storerooms: 0.1-36 (fibers/cm^3)Application of amosite sections: 9-40 (fibers/cm^3)Application and stitching asbestos cloth: 0.0500.26 (fibers/cm^3)Removal of amosite sections (boiler room): 29-1040 (fibers/cm^3)Removal of blue sprayed asbestos: 112-1906 (fibers/cm^3)Removal of asbestos acoustic board: 48-683 (fibers/cm^3)Bagging asbestos debris: 106-3815 (fibers/cm^3) |
| Comments: | Amosite asbestos was evaluated. |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Sampling and Analytical Methodology | Medium | Sampling/analytical methodology is equivalent to an approved OSHA/NIOSH method. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | Medium | Data are from the United Kingdom, an OECD country. |
| Metric 3: | Applicability | High | Data are for Chemical Substances in Construction, Paint, Electrical, and Metal Products, an in-scope occupational scenario. |
| Metric 4: | Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| Metric 5: | Sample Size | Medium | Sample distribution characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Low | Sample type provided but no other metadata. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Medium | Variability addressed by sampling multiple job activities, but uncertainty is not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Harries, P. G. (1971). A comparison of mass and fibre concentrations of asbestos dust in shipyard insulation processes. Annals of Occupational Hygiene 14(3):235-240. |
| **HERO ID:** | 98 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Physical form: | Asbestos Fibers |
| Area sampling data: | Removal of Sprayed Crocidolite Asbestos [PDF Pg. 3]Range: 23-493 (fibers/cm^3)Mean: 226.27 (fibers/cm^3)Standard Deviation: 146.08 (fibers/cm^3)Removal of Pipe Lagging (Boiler Rooms) [PDF Pg. 4]Range: 24.7-186.4 (fibers/cm^3)Mean: 82.76 (fibers/cm^3)Standard Deviation: 50.64 (fibers/cm^3)Removal of Pipe Lagging (Engine Rooms) [PDF Pg. 4]Range: 7-115 (fibers/cm^3)Mean: 51.6 (fibers/cm^3)Standard Deviation: 40.9 (fibers/cm^3)Removal of Pipe Lagging (Brick Stowage Space) [PDF Pg. 4]Range: 225.6-895.6 (fibers/cm^3)Mean: 419.7 (fibers/cm^3)Standard Deviation: 241.3 (fibers/cm^3)Application of Pipe Lagging (Boiler Rooms) [PDF Pg. 5]Range: 0.13-55 (fibers/cm^3)Mean: 13.77 (fibers/cm^3)Standard Deviation: 16.08 (fibers/cm^3)Application of Pipe Lagging (Engine Rooms) [PDF Pg. 5]Range: 0.1-40 (fibers/cm^3)Mean: 6.95 (fibers/cm^3)Standard Deviation: 11.14 (fibers/cm^3)Application of Pipe Lagging (Accumulator Compartment) [PDF Pg. 5]Range: 0.10-18.70 (fibers/cm^3)Mean: 6.74 (fibers/cm^3)Standard Deviation: 5.44 (fibers/cm^3) |
| Comments: | Study examines crocidolite asbestos by gravimetric sampling. |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Medium | Sampling/analytical methodology is equivalent to an approved OSHA/NIOSH method. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Medium | Data are from the United Kingdom, an OECD country. |
| | Metric 3: | Applicability | High | The data are for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Low | Sample type provided but no other metadata. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | Variability addressed by sampling multiple areas, but uncertainty is not addressed. |

## Overall Quality Determination Medium

**Study Citation:** Harrison, P. T. C., Llewellyn, J. W. (1998). Exposure to asbestos and man-made mineral fibers in buildings and the consequences for health. IAQ Conference :83-93.
**HERO ID:** 7473349
**Conditions of Use:** Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products

**EXTRACTION**

| Parameter | Data |
|---|---|
| Worker activity description: | maintenance work, sawing, drilling, and sanding of asbestos products by hand |
| Exposure route: | inhalation |
| Area sampling data: | Most indoor measurements lie in the range 0.0001 fibers per milliliter (f/mL) to 0.001 f/mL; some are 0.001 f/mL to 0.01 f/mL or, exceptionally, 0.01 f/mL to 0.08 f/mL (pg 4)2.5 ng/m3 - 68 ng/m3 inside (pg 4)The mean asbestos concentration levels for three large data sets (summarized in HEI 1992) indicate that across a broad range of building types and a large number of samples, the mean values are grouped around 0.0005 f/mL (pg 4)Categories of increasing order of airborne asbestos concentration in buildings are: no asbestos present<asbestos materials in good condition present<maintenance work in progress<asbestos material in poor condition. Approximate levels for airborne asbestos corresponding to the above categories in f/mL are: <0.000001/up to 0.001/up to 0.04/up to 0.3. Most indoor air concentrations are below 0.0002 f/mL, which is similar to that for outdoor ambient air (pg 4)Airborne asbestos fiber levels up to 3.2 f/mL have been measured during sawing, drilling, and sanding of asbestos products by hand (pg 6) |
| Particle size characterization: | 1 um - 10 um (pg 7) |
| Exposure duration: | 40 hours a week in offices, shops, factories, and other commercialbuildings (pg 5) |
| Exposure frequency: | 48 weeks per year (pg 5) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Sampling and Analytical Methodology | Low | Sampling/analytical methodology is not specified. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | Medium | Data are from the U.K., an OECD country |
| Metric 3: | Applicability | High | Data are for construction materials, an in-scope occupational scenario. |
| Metric 4: | Temporal Representativeness | Low | Monitoring data are greater than 20 years old. |
| Metric 5: | Sample Size | Medium | Sample distribution characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Medium | Sample type and exposure type provided but missing metadata such as number of workers. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Medium | Variability addressed by presenting data for different exposure activities, but uncertainty is not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Hatfield, J., Stockrahm, J., Todt, F., Ogden, J., Leczynski, B., Price, B., Chesson, J., Russell, J., Ford, P., Thomas, J., Fitzgerald, J., Roat, R., Lee, R., Van Orden, D., Dunmyre, G., Constant, P., McHugh, J., Mayer, D., Spain, W., Ewing, B., Hays, S., Hatfield, R., Claveria, A. (1988). Assessing asbestos exposure in public buildings. |
| **HERO ID:** | 6912224 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Exposure route: | inhalation |
| Physical form: | inhalable fibers |
| Area sampling data: | TEM 8 hour sampling periodCategory 1 (no ACM) Median: 0.00010 s/cc Mean: 0.00099 s/cc SD 0.00198Category 2 (ACM - limited damage) Median: 0.00040 s/cc Mean: 0.00059 s/cc SD 0.00052Category 3 (ACM - exposed) Median: 0.00058 s/cc Mean: 0.00073 s/cc SD 0.00072test results for 7 sites within each building are provided in Appendix G |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | High | EPA study |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | US |
| | Metric 3: | Applicability | High | The data are for an occupational scenario (Federal Buildings) within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Low | 1988 - prior to latest PEL and more than 20 years old. |
| | Metric 5: | Sample Size | High | Extensive statistics are provided to determine significance |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | Monitoring data include all associated metadata, including sample types, exposure types, sample durations, exposure durations worker activities, and exposure frequency. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | High | The monitoring study addresses variability between locations and building classifications. The monitoring study also addresses uncertainty in the exposure estimates based on the QA activities specified in the report. |

## Overall Quality Determination High

**Study Citation:** Hervin, R. L. (1977). Health hazard evaluation report no. HETA-77-102-434, Terminal B, Trans World Airlines, Inc., Kansas City, Missouri.
**HERO ID:** 3970469
**Conditions of Use:** Other:

**EXTRACTION**

| Parameter | Data |
|---|---|
| Worker activity description: | The following workers were monitored: plumber, maintenance mechanic, ramp service operator, lead mechanic, janitor, lead ramp serviceman, and ramp serviceman (table I on page 7). However, specific activities during the monitoring period are not discussed. |
| Personal sampling data: | 11 personal breathing zone samples. All asbestos sample results are listed as <0.05 fibers/cc (table I on page 7) |
| Area sampling data: | 7 air sample obtained from HV-TWI Power Box in the garage, eating area in the garage, main area by the lunch room door in baggage room #2, Center of Room over Conveyor in baggage room #2, Vehicle Repair Area in the garage, Exhaust Duct in the garage, and Outside Ambient Air. results shown in table I on page 7 |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Sampling and Analytical Methodology | High | Sampling/analytical methodology is an approved NIOSH method. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | Data are from the U.S. |
| Metric 3: | Applicability | Low | Data are exposure to insulation which exists on the structural underside of the public service level floor. However, it is not clear if the asbestos disturbance activities occurred during the monitoring period. Data may be considered for background exposure. |
| Metric 4: | Temporal Representativeness | Low | Monitoring data are greater than 20 years old. |
| Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Medium | Sample type and exposure type provided but missing sample duration, worker activities, exposure duration, and exposure frequency. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Medium | Uncertainty is addressed in sampling/analytical methodology, and variability is addressed through multiple sample types (area and personal). |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Hollett, B. A. (1985). Walk-Through Survey Report No. CT-147-14a: Control Technology For Asbestos Removal Industry At Tarrallton Elementary School, Norfolk, Virginia. NIOSH(CT-147-14a):147-14. |
| **HERO ID:** | 3101528 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Physical form: | Fiber |
| Particle size characterization: | Thin long fibers (less than 0.2 um diameter and greater than 5.0 um long), |
| Personal protective equipment: | Disposable coveralls and half face high-efficiency cartridge respirators. |
| Engineering control: | HEPA exhaust ”Negative Air” was also used to control emissions. Wet removal methods were used to reduce fiber emissions. |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Sampling and Analytical Methodology | High | Sampling or analytical methodology is an approved OSHA or NIOSH method. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | The data are from the United States |
| Metric 3: | Applicability | Medium | The data are for an occupational scenario that is similar to an occupational scenario. |
| Metric 4: | Temporal Representativeness | Low | More than 20 years old |
| Metric 5: | Sample Size | Low | Distribution of samples is qualitative or characterized by no statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Medium | No details on metadata. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Medium | The monitoring study provides only limited discussion of the variability in the determinants of exposure for the sampled site or sector. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Hollett, B. A. (1985). Walk-Through Survey Report: Control Technology For Asbestos Removal Industry, Report No. CT-147-11a, Columbus East High School, Columbus, Indiana. NIOSH:147-11. |
| **HERO ID:** | 3101586 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Exposure route: | Inhalation. |
| Physical form: | Fibers, solid. [PDF Pg. 5] |
| Area sampling data: | The average fiber levels per location appeared to be higher(0.03 to 0.117 f/cc) during the day time periods compared to (less than 0.005 to 0.009 f/cc) in night time. The average day timelevels were approximately 0.1 f/cc compared to the first floor concentrations of approximately 0.05 f/cc.[PDF Pg. 5] |
| Personal protective equipment: | The removal workers wore disposable coveralls and half-face cartridge respirators. Walk-through decontamination showers were located at the entrance to the enclosure. [PDF Pg. 7] |
| Engineering control: | HEPA filtration units and containment barrier control method. [PDF Pg. 6] |
| Comments: | PCM methods used. |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | High | Sampling/analytical methodology is an approved NIOSH method. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for Chemical Substances in Construction, Paint, Electrical, and Metal Products, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| | Metric 5: | Sample Size | Medium | Sample distribution characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Sample type and exposure type provided but missing exposure frequency and duration. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | High | Uncertainty is addressed in sampling/analytical methodology. Variability addressed by comparing samples take during the day and at night. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Hollett, B. A., Caplan, P. E., Cooper, T. C., Froehlich, P. A. (1987). In-depth survey report: Control technology for asbestos removal at Bloom Middle School, Cincinnati, Ohio. |
| **HERO ID:** | 3099230 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Workers involved in preparation and removal of asbestos material |
| Personal sampling data: | Personal Air SamplesSequential 2- to 3-hour personal samples were taken daily for each of the four workers In addition to these full shift time-weighted average samples, on the second through the fourth days, five to seven 15-minute, short-term exposure samples were collected daily Worker exposures were measured for the site preparation and removal processes and the other associated activities. Other activities 1ncluded waste collection and disposal, decontamination, and equipment operation and maintenance About 8 to 15 sequential and short-term personal exposure samples were collected for each 5- to 6-hour work shiftWORKERTYPEACTIVITY6/18/20226/19/20226/20/20226/21/20221TWA0.250.30.470.17STREMOVAL0.38STREMOVAL0.77STREMOVAL1.12TWA0.0140.10.330.12STPREPARATION0.03STREMO TWA = Sequential, full-shift time-weighted average.ST= 15 minute short-term |
| Area sampling data: | PCM results for mean levels near the workers was 300,000 f/m^3 during removal and 26,000 f/m^3 during preparation. In-room background sample means during removal operations were 300,000 f/m^3 and 16,000 f/m^3 during preparation. The mean background level in the halls were 55,000 f/m^3 and the ambient level outside the building was 2,000 f/m^3. |
| Particle size characterization: | Pre-removalNonaggressive 65,000 fibers/m^3Aggressive 139,000 fibers/m^3Post-removalNonaggressive 140,000 fibers/m^3Aggressive 294,000 fibers/m^3 |
| Personal protective equipment: | Workers were not required and were not observed to wear protective equipment during the preparation stage, primarily covering the pipes with poly. When removal activity was started in a room, all workers were required to wear disposable coveralls and half face mask cartridge respirators equipped with high efficiency cartridges. |
| Engineering control: | Potential sources of asbestos dust were controlled by enclosing the pipe lagging in plastic sheeting before removing it from the pipes. Plastic glove bags were used to enclose and collect the pipe lagging during removal activities. The pipe lagging was wetted with amended water prior to, during, and after its removal from the pipes. To prevent general contamination of the school building by dust from the removal operations in the study areas, overlapping plastic curtains were placed on all doors to halls or other rooms. Additionally, all ventilation registers and windows were sealed with plastic sheeting and tape, removable furniture and fixtures were also covered with plastic sheeting. |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Sampling and Analytical Methodology | High | Sampling/analytical methodology is an approved NIOSH method. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | Data are from the U.S. |
| Metric 3: | Applicability | High | Data are for Industrial/Commercial Use: Chemical Substances in Construction, Paint, Electrical, and Metal Products, an in-scope occupational scenario. |
| Metric 4: | Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Medium | Monitoring data include most critical metadata, such as sample type and exposure type, but lacks additional metadata, such as exposure frequency. |

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|---|---|
| **Study Citation:** | Hollett, B. A., Caplan, P. E., Cooper, T. C., Froehlich, P. A. (1987). In-depth survey report: Control technology for asbestos removal at Bloom Middle School, Cincinnati, Ohio. |
| **HERO ID:** | 3099230 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

| | | EVALUATION | |
|---|---|---|---|
| Domain | Metric | Rating | Comments |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | High | Uncertainty is addressed in sampling/analytical methodology. Variability addressed by sampling multiple locations. |

## Overall Quality Determination — High

| | |
|---|---|
| **Study Citation:** | Hollett, B. A., Caplan, P. E., Cooper, T. C., Froehlich, P. A. (1987). In-Depth Survey Report: Control Technology for Asbestos Removal at Sands Elementary School, Cincinnati, Ohio, Report No. CT-147-19B. Division of Physical Sciences and Engineering(CT-147-19B):147-19. |
| **HERO ID:** | 3099459 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Preparation - installation of poly barriers separating the work areas. Misted surfaced of lagging and sealed with poly sheeting. Removal - workers loaded glove bags with necessary tools and hung from pipe and b ag zipped to form a seal. Spray tanks were installed. Lagging cut longitudinally along full length of pipe. jacket removed and asbestos block sprayed and pried apart and lowered to the bottom of the bag. hard to clean areas were cleaned with nylon bristle bottle brush. when bag was full, external washed drawn together. Air evacuated with vacuum equipped with HEPA filter. sealed for removal.Decontamination - spilt material removed using HEPA vacuum cleaners, wet mopped and bags of waste removed. |
| Exposure route: | inhalation |
| Physical form: | inhalable fibers |
| Personal sampling data: | All results are f/cc using NIOSH 7400-BRemoval of pipe laggingWorker #1 TWA 0.345 - 0.799; preparation 0.016; removal 0.156-1.0; removal 2.0Worker #2 TWA 0.298-0.560; removal 0.711-0.756Worker #3 TWA 0..343-0.663; Preparation 0.017; Removal 0.467-3.18; removal 0.911-1.27Worker #4 TWA 0.152-0.639; Removal 0.622-2.44; removal 2.78; removal 9.29Lunch room prep for pipe lagging removalworker #1 0.011Worker #2 0.008Worker #3 0.004Worker #4 0.016Pipe lagging removalaverage 0.468-0.604 (P. 25/49)study includes more details - data is not extractable and the print is difficult to read. |
| Area sampling data: | results are in terms of f/cc using PCMsampling site near workers 0.003; mean 0.003 min 0.003 max 0.004 STD 0.00Room 0.007; mean 0.007 min 0.004 max 0.009 std 0.003Hall 0.005; mean 0.005 min 0.002 max 0.009 std 0.003Pipe lagging removal near workers sampling site near workers 0.445-0.800; mean 0.583 min 0.002 max 0.956 STD 0.31Room 0.383-789; mean 0.546 min 0.258 max 0.816 std 0.19Hall 0.001-0.451; mean 0.155 min 0.001 max 0.458 std 0.23 (P. 27/49)The study includes additional data comparing different analytical methods for pre and post removal for different sampling days and locations. |
| Personal protective equipment: | disposable coveralls and half face mask cartridge respirators with high efficiency cartridges. |
| Engineering control: | duset control Wetting to soak or saturate asbestos containing materials prior to and during removal Negative pressure to exhaust contaminated air though a HEPA filter and draw in clean air remote control roomsisolation boothssupplied air cabs |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | High | NIOSH study |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | US |
| | Metric 3: | Applicability | High | The data are for an occupational scenario ( Asbestos removal from a school) within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Low | 1985- prior to the PEL (1994) and more than 20 years old |
| | Metric 5: | Sample Size | High | limited statistics were provided but results for each sampling event was included, so statistics could be easily generated. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Monitoring data include most critical metadata, such as sample type, exposure type, sample durations, worker activities, butlacks additional metadata, such as exposure durations, and exposure frequency. |

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|---|---|
| **Study Citation:** | Hollett, B. A., Caplan, P. E., Cooper, T. C., Froehlich, P. A. (1987). In-Depth Survey Report: Control Technology for Asbestos Removal at Sands Elementary School, Cincinnati, Ohio, Report No. CT-147-19B. Division of Physical Sciences and Engineering(CT-147-19B):147-19. |
| **HERO ID:** | 3099459 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

| | | **EVALUATION** | |
|---|---|---|---|
| Domain | Metric | Rating | Comments |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | High | NIOSH study both variability and uncertainty discussed in report. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Hollett, B. A., Caplan, P. E., Cooper, T. C., Froehlich, P. A. (1987). In-depth survey report: Control technology for asbestos removal at Washburn Elementary School, Cincinnati, Ohio. |
| **HERO ID:** | 3099460 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | removal of asbestos pipe lagging (pg 4); deteriorated acoustical plaster, fireproofing (pg 7)degradation/repair or disturbance of in-place asbestos-containing materials (pg 5); e.g., acoustical plaster, pipe and boiler insulation (pg 7)asbestos sources: acoustical plaster, fireproofing, acoustical ceiling tile, pressed asbestos-board, cement sheeting; asbestos gloves, leggings, pot holders, gaskets (pg 7) |
| Exposure route: | inhalation |
| Physical form: | dust |
| Personal sampling data: | Table 1 (pg 23) presents TWA and ST (both preparation and removal) sample results for 4 workers for 4 separate days:TWA: 0.01-0.354 f/ccST: Preparation: 0.017-0.045 f/cc; removal: 0.178-2.91 f/ccTable 2 (pg 24) also presents personal sampling data:preparation: 0.005-0.054 f/ccremoval: 0.043-0.61 f/ccfull sampling data in appendix |
| Area sampling data: | Table 3A (pg 25) presents PCM and TEM area sampling results:0.006-2.525 f/ccTable 3B (pg 26) presents PCM and TEM area sampling results:0.00-5.018 f/ccTable 4 (pg 27) presents TEM area sampling results:pre-removal: 73,800-119,000 f/ccpost-removal: 217,000-283,000 f/ccTable 5 (pg 28) presents PCM and TEM area sampling results: Pre-removal: 0.001-0.184 f/ccPost-removal: 0.001-0.356 f/ccfull sampling data in appendix |
| Particle size characterization: | Sampling: >5 um length, length:width ratio of >5:1, >0.2 um wide (pg 6) |
| Exposure duration: | 2- or 3-hour samples collected over a full work shift (pg 16)8-hr sampling (pg 17)15-minute, short-term exposure samples; 5- to 6-hr work shift (pg 18) |
| Number of workers: | minimum of two workers (pg 34) |
| Personal protective equipment: | approved respiratory protection and protective clothing (pg 11)disposable coveralls and half face mask cartridge respirators equipped with high efficiency cartridges (pg 19)NIOSH investigators used Racal Air Stream Powered Air Particulate Respirators with high efficiency filters (pg 20) |
| Engineering control: | glove bag (pg 4)wetting, negative pressure w/ HEPA filters, isolation, local ventilation, secondary containment (plastic barriers & negative air) (pg 5)4 air changes per hour (pg 11)dilution ventilation, dust suppression, recirculation, housekeeping, remote control rooms, isolation booths, supplied-air cabs (pg 19) |
| Comments: | PCM NIOSH method 7400 (pg 6) |

**EVALUATION**

| Domain | | Metric | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | High | Sampling/analytical methodology is an approved [NIOSH/OSHA] method. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for construction materials, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Sample type and exposure type provided but missing metadata such as exposure frequency. |
| Domain 4: Variability and Uncertainty | | | | |

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|---|---|
| **Study Citation:** | Hollett, B. A., Caplan, P. E., Cooper, T. C., Froehlich, P. A. (1987). In-depth survey report: Control technology for asbestos removal at Washburn Elementary School, Cincinnati, Ohio. |
| **HERO ID:** | 3099460 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

| | | **EVALUATION** | |
|---|---|---|---|
| Domain | Metric | Rating | Comments |
| | Metric 7: Metadata Completeness | High | Uncertainty is addressed in sampling/analytical methodology. Variability addressed by multiple days of sampling. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Hollett, B. A., Caplan, P. E., Cooper, T. C., Froehlich, P. A. (1987). In-Depth Survey Report: Control Technology for Asbestos Removal at Winton Place Elementary School, Cincinnati, Ohio, Report No. CT-147-19D. Division of Physical Sciences and Engineering(CT-147-19D):147-19. |
| **HERO ID:** | 3099463 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Preparation and removal of asbestos-containing pipe-lagging. |
| Personal sampling data: | (Worker #1) [PDF Pg. 22]July 15TWA sample: 0.011 f/cm^3Short-Term preparation: 0.015 f/cm^3Short-term removal: 0.022 f/cm^3July 16TWA sample: 0.015 f/cm^3Short-term removal: 0.016 f/cm^3July 17TWA sample: 0.009 f/cm^3Short-term removal: 0.016 f/cm^3Short-term removal: 0.017 f/cm^3(Worker #2)July 15 TWA sample: 0.01 f/cm^3Short-Term preparation: 0.006 f/cm^3Short-Term removal: 0.032 f/cm^3July 16TWA sample: 0.013 f/cm^3Short-Term removal: 0.065 f/cm^3July 17TWA sample: 0.005 f/cm^3Short-Term removal: 0.034 f/cm^3(Worker #3)July 15 TWA sample: 0.04 f/cm^3Short-Term preparation: 0.002 f/cm^3Short-Term removal: 0.035 f/cm^3July 16Short-Term removal: 0.086 f/cm^3Short-Term removal: 0.020 f/cm^3July 17TWA Sample: 0.008 f/cm^3Short-Term removal: 0.017 f/cm^3Short-Term removal: 0.016 f/cm^3(Worker #4)July 15TWA sample: 0.013 f/cm^3Short-Term preparation: 0.016 f/cm^3Short-term removal: 0.036 f/cm^3July 17TWA sample: 0.010 f/cm^3Short-term removal: 0.044 f/cm^3 |
| Area sampling data: | Girls room July 15 preparation activities [PDF Pg. 25]Average (near workers): 0.006 f/cm^3Average (room background): 0.008 f/cm^3Average (hall background): 0.001 f/cm^3Girls Room July 15 Removal ActivitiesAverage (near workers): 0.007 f/cm^3Average (room background): 0.007 f/cm^3Average (hall background): 0.002 f/cm^3Girls Room and Room #14 July 16 Removal ActivitiesAverage (near workers): 0.013 f/cm^3Average (room background): 0.032 f/cm^3Average (hall background): 0.002 f/cm^3Boys Room July 17 Removal ActivitiesAverage (near workers): 0.004 f/cm^3Average (room background): 0.006 f/cm^3Average (hall background): 0.002 f/cm^3 |
| Personal protective equipment: | Contractor personnel wore disposable coveralls in the work area during removal activities. In addition, each employee was fitted with a half-face cartridge respirator equipped with high efficiency filters which they wore during removal activities. [PDF Pg. 30] |
| Engineering control: | Safe-T-Strip® and Disposalene® glove bags were used during this survey; six were used in the girls room during the first day, six were used in room 14 during the second day, and on the third day eight were used in the boys room. [PDF Pg. 29] |
| Comments: | Area samples taken with PCM method. Pipe lagging contained chrysotile asbestos. Waste treatment methods are described by process description and pollution control is described by engineering controls. |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | High | Sampling/analytical methodology is an approved NIOSH method. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | The data are for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| | Metric 5: | Sample Size | Medium | Sample distribution characterized by limited statistics (min, max, mean) but discrete samples not provided and distribution not fully characterized. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | All metadata provided. |
| Domain 4: Variability and Uncertainty | | | | |

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|---|---|
| **Study Citation:** | Hollett, B. A., Caplan, P. E., Cooper, T. C., Froehlich, P. A. (1987). In-Depth Survey Report: Control Technology for Asbestos Removal at Winton Place Elementary School, Cincinnati, Ohio, Report No. CT-147-19D. Division of Physical Sciences and Engineering(CT-147-19D):147-19. |
| **HERO ID:** | 3099463 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

| | | **EVALUATION** | |
|---|---|---|---|
| Domain | Metric | Rating | Comments |
| | Metric 7: Metadata Completeness | High | Uncertainty is addressed in sampling/analytical methodology. Variability addressed by sampling multiple worker activities and areas. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Hollett, B. A., Froehlich, P. A., Caplan, P. E., Cooper, T. C., Shulman, S. A. (1990). An Evaluation of Glove Bag Containment in Asbestos Removal. NIOSH(IA):88-22. |
| **HERO ID:** | 3646359 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | The worker seals the bag around the material to be removed and then manipulated various tools within the bag by means of the gloves sealed into the side of the bag to remove the lagging. The debris falls to the bottom of the bag, where it is contained for final disposal as asbestos waste. (16/136) |
| Exposure route: | inhalation (39/136) |
| Physical form: | fibers (34/136) |
| Personal sampling data: | (PCM) Of 45 daily TWA exposure, 3 (7%) were in excess of 626,000 f/m3, 17 (38%) were in excess of 313,000 f/m3, and 27 (60%) were in excess of 200,000 f/m3. Only 13 (29%) were less than 100,000 f/m3. (47/136) Fiber concentrations during preparation activities averaged 20,000 f/m3 and removal activities averaged about 350,000 f/m3. Of the 70 short term 15-min samples, 15 (21%) exceeded 1,000,000 f/m3. The highest exposure exceeded 9,000,000 f/m3. (54/136) |
| Area sampling data: | (PCM) Average proximate area samples were 4,000-710,000 f/m3. (53/136) |
| Exposure duration: | 5-6 hour shifts (39/136) |
| Personal protective equipment: | The workers wore disposable coveralls and half-face cartridge respirator with HEPA filter. (66/136) |
| Engineering control: | Glove bags are large plastic bags which contain long gloves sealed into the body. The worker seals the bag around the material to be removed and then manipulated various tools within the bag by means of the gloves sealed into the side of the bag to remove the lagging. The debris falls to the bottom of the bag, where it is contained for final disposal as asbestos waste. (16/136) In addition to glove bags, the removal area is sealed off with plastic sheets, the ACM is wetted. During removal, negative pressure ventilation is provided through HEPA filters at four air changes per hour. (33/136) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Sampling and Analytical Methodology | High | Sampling/analytical methodology is an approved NIOSH method. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | Data are from the U.S. |
| Metric 3: | Applicability | High | Data are for demolition of asbestos products, an in-scope occupational scenario. |
| Metric 4: | Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Medium | Exposure type and sampling data provided, but missing number of workers, exposure frequency, and particle size. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | High | Uncertainty is addressed in sampling/analytical methodology. Variability is addressed by sampling removal at four sites. |

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|---|---|
| **Study Citation:** | Hollett, B. A., Froehlich, P. A., Caplan, P. E., Cooper, T. C., Shulman, S. A. (1990). An Evaluation of Glove Bag Containment in Asbestos Removal. NIOSH(IA):88-22. |
| **HERO ID:** | 3646359 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

| | | **EVALUATION** | |
|---|---|---|---|
| Domain | Metric | Rating | Comments |
| **Overall Quality Determination** | | **High** | |

| | |
|---|---|
| **Study Citation:** | Hollins, D. M., Paustenbach, D. J., Clark, K., Mangold, C. A. (2009). A visual historical review of exposure to asbestos at Puget sound naval shipyard (1962-1972). Journal of Toxicology and Environmental Health, Part B: Critical Reviews 12(2):124-156. |
| **HERO ID:** | 2595959 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| Parameter | Data |
|---|---|
| Worker activity description: | cutting asbestos felt (pg 7)making sleeves for very hot piping around boilers using raw amosite asbestos (pg 7)asbestos sewing room: workers fabricated numerous products, such as valve boots, boiler pads, jacket covers, and other amosite-containing materials (pg 7)fabricating a removable and replaceable cover or pad, which involved cutting and sewing asbestos cloth together with wire or asbestos cord, inserting insulating material padding (asbestos felt or fiberglass), and sewing shut (pg 8)cutting half-rounds [asbestos insulation] with band saw (pg 8)Insulators/pipe coverers/laggers: (1) cutting and shaping insulation materials; (2) mixing of mineral wool, asbestos, fibrous glass, and cements; (3) installing or fitting insulation block or sections of pipe covering sewing or using wire or glue; (4) spraying asbestos-containing insulation materials; (5) coating insulation materials with cements, resins, cloth, or sealers; (6) removing or tearing out damaged materials while insulating or re-insulating; and (7) cleaning up torn-out insulation and debris; tools include: handsaws, knives, and spatulas (pg 10-11)clean up using sweeping -> portable vacuum (pg 26) |
| Exposure route: | inhalation |
| Physical form: | dust (pg 7) |
| Personal sampling data: | British Naval Shipyards: 0 to 17 fibers/cc in the breathing zone of those working in sewing or mattress shops; average exposures in New England shipyard sewing and fabrication areas that averaged 3.0 mppcf (18 fibers/cc) (pg 8)Breathing zone concentrations collected during the application of pipe and machinery lagging in shipboard machinery spaces (i.e., boiler and engine rooms) ranged from 0.04 to 68 fibers/cc (pg 11) |
| Area sampling data: | cutting insulating felt on a table could generate considerable dust, and was known to produce airborne dust concentrations averaging 4.8 and 7.2 million particles per cubic foot (mppcf) [approximately 28.8 and 43.2 fibers per cubic centimeter (fibers/cc), using a conversion factor of 1 mppcf to 6 fibers/cc] (pg 7)In British Naval shipyards, asbestos dust concentrations reportedly ranged from 0 to 126 fibers/cc in the general environment (pg 8)respirable airborne dust concentrations from band saw cutting of asbestos board exceeding 0.2 mppcf with local exhaust ventilation and 10 mppcf without local exhaust ventilation (1.2 fibers/cc and 60 fibers/cc, respectively) (pg 9)average fiber concentrations of 20 fibers/cc during shipyard pre-fabrication activities lasing 0.5-2 h (pg 9)applying insulation for 0.5–2 h during marine construction was likely to result in airborne asbestos concentrations averaging 4.2fibers/cc; area airborne fiber concentrations collected during the application of pipe and machinery lagging in shipboard machinery spaces (i.e., boiler and engine rooms) ranged from 0.1 to 61 fibers/cc (pg 11)asbestos cement mixing: 14.2 fibers/cc in U.S. shipyards (0.5-2 h sampling), >100 fibers/cc for short-term; 256 fibers/cc reported at British Naval shipyard; early sampling data for cement mixing reported average of 57.3 mppcf (about 344 fibers/cc) (pg 19)average fiber concentrations during the mixing and application of cement were found to decrease from 4.6 fibers/cc with poor ventilation to 2.5 fibers/cc with good ventilation (pg 24)cleaning (with vacuum): 0.2 fibers/cc (0.5-2 hr sampling) for U.S. shipyards; 0.6-1.2 fibers/cc on Australian vessels; 155 fibers/cc for British naval yard (pg 26) |
| Exposure duration: | 0.5-2 hours for pre-fabrication activities/applying insulation/cement mixing at U.S. shipyards/vacuum cleaning at U.S. shipyards (pg 9/11/18)Insulators/pipe coverers/laggers: handled asbestos 50% of their worktime (pg 11) |
| Personal protective equipment: | during the period circa 1940–1960, respiratory protection devices were not routinely used (pg 5)from period 1940-70, workers did not wear coveralls (pg 8)respiratory protection (dust mask) used during cutting asbestos insulation with band saw, no coveralls (pg 8-9)Modern practice: HEPA respirator and protective coveralls (pg 9)respiratory protection while sawing half rounds (pg 12)coveralls during application of pipe insulation (pg 12)MSA Dustfoe 66 respirator [hanging around pipe coverer's neck] (pg 12) |
| Engineering control: | replaced amosite blankets with high-density fiberglass (pg 5, 28)LEV (pg 7)"elephant trunk" or flexible duct exhaust system in vicinity of insulators [but positioned incorrectly] (pg 13)down-draft ventilated work tables (pg 18; more detail pg 25-26)changing from insulators using dry asbestos cement to premixed cement; cutting of asbestos materials before bringing them to work area (pg 24-25) changing from cleaning via sweeping to vacuuming (pg 26) |

**EVALUATION**

| Domain | | Metric | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Low | Sampling/analytical methodology is not specified. |

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|---|---|
| **Study Citation:** | Hollins, D. M., Paustenbach, D. J., Clark, K., Mangold, C. A. (2009). A visual historical review of exposure to asbestos at Puget sound naval shipyard (1962-1972). Journal of Toxicology and Environmental Health, Part B: Critical Reviews 12(2):124-156. |
| **HERO ID:** | 2595959 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

| | | EVALUATION | |
|---|---|---|---|
| Domain | Metric | Rating | Comments |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | Data are from the U.S. |
| Metric 3: | Applicability | High | Data are for construction materials, an in-scope occupational scenario. |
| Metric 4: | Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| Metric 5: | Sample Size | Medium | Sample distribution characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Medium | Sample type and exposure type provided but missing metadata such as exposure frequency. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Medium | Variability addressed by providing sampling data for different types of asbestos and activities, but uncertainty is not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Hollins, D., Burns, A., Unice, K., Paustenbach, D. J. (2019). An analysis of workplace exposures to asbestos at three steel mills located in the United States (1972-1982). Toxicology and Industrial Health 35(11-12):726-737. |
| **HERO ID:** | 6868702 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Relining of open hearth furnaces, stoves, and blast furnaces by steel mill bricklayers and bricklayer helpers. Task descriptions are provided in Table 4 (p. 8)Refractories are heat-resistant materials that provide linings forhigh-temperature furnaces, ladles, troughs, hot metal mixers, and similar retention or storage vessels. Repair and replacement of refractories. The major types of refractories included pre-shaped objects (such as brick and block) and unformed products (such as plastics, ramming mixes, dry vibratables, castables, gunning mixes, cements, and mortars) (p. 2) |
| Exposure route: | inhalation |
| Physical form: | solid |
| Personal sampling data: | ”Over 75% of the samples (n = 106) were collected for 50 min or less, four samples were collected for 227 to 306 min, and sample durations were not reported for the remaining 28 samples. Average airborne fiber concentrations measured during relining activities of open hearth furnaces, stoves, and blast furnaces were 0.21 f/cc, 0.72 f/cc and 0.13 f/cc phase-contrast microscopy (PCM), respectively. Measured airborne fiber concentrations of four time-weighted average (TWA) samples (>227 min) averaged 0.045 f/cc. Estimated 8-h TWAs concentrations averaged 0.34 f/cc for bricklayers and 0.2 f/cc bricklayer helpers” (abstract)134 short-term samples: 93 samples (30 minutes or fewer), 8 samples (37-50 min), 27 task samples (unreported)TWA samples (34-306 min) |
| Exposure duration: | 8 hr TWA |
| Exposure frequency: | ”The life of a refractory lining can range from approximately 400 to 600 heats””A furnace campaign (the length of time that a furnace operates once it is fully heated) may last several years (typically 6–7 years, up to 10 years), after which time the furnace is shut down and is relined, generally by refractory masons and assistants” (p. 3) |
| Personal protective equipment: | ”For heat protection, workers typically would wear woven asbestos-containing heat-protective clothing (also referred to as proximity clothing), such as aprons, whole body suits, gloves, and hoods” (p. 3) |

**EVALUATION**

| Domain | | Metric | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Medium | Sampling or analytical methodology is not equivalent to an approved OSHA or NIOSH method and EPA review of information indicates the methodology is acceptable. Differences in methods are not expected to lead to lower quality data. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | The data are from the United States and are representative of the industry being evaluated. |
| | Metric 3: | Applicability | High | The data are for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Low | Metadata on the operations, equipment, and worker activities associated with the data show that the data agree representative of outdated operations, equipment, and activities rather than current operations, equipment, and worker activities. The data are more than 20 years old (1972-1982). |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized. |
| Domain 3: Accessibility/ Clarity | | | | |

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|---|---|
| **Study Citation:** | Hollins, D., Burns, A., Unice, K., Paustenbach, D. J. (2019). An analysis of workplace exposures to asbestos at three steel mills located in the United States (1972-1982). Toxicology and Industrial Health 35(11-12):726-737. |
| **HERO ID:** | 6868702 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

| | | | EVALUATION | |
|---|---|---|---|---|
| Domain | | Metric | Rating | Comments |
| | Metric 6: | Metadata Completeness | Medium | Monitoring data include most critical metadata, such as sample type and exposure type, but lacks additional metadata on exposure frequency |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | The monitoring study provides only limited discussion of the variability in the determinants of exposure for the sampled site or sector. The monitoring study provides only limited discussion of the uncertainty in the exposure estimates |

## Overall Quality Determination Medium

**Study Citation:** Holm, L., Holmberg, B. (1987). Exposures to carcinogens and consequences of listing of carcinogens in the swedish working environment. Regulatory Toxicology and Pharmacology 7(2):185-199.
**HERO ID:** 1010084
**Conditions of Use:** Other:

**EXTRACTION**

| Parameter | Data |
|---|---|
| Area sampling data: | Mechanical Workshop- Handling brake linings <0.1-0.3 f/ml (1978-81) 0.1-0.4 f/ml (1982-85) Workshop - Handling brake linings 0.07-1.3 f/ml (1978-81) Workshop – Presses 0.05-0.07 f/ml (1978-81) Workshop – Presses 0.01 f/ml (1978-81)Garage – cars <0.01-0.08 f/ml (1978-81) <0.1-0.2 f/ml (1982-85)Garage – cars 0.1-0.3 f/ml (1978-81) 0.2-0.3 f/ml (1982-85)Garage – Buses 0.2-0.6 f/ml (1978-81) 0.1-0.3(1982) 0.1-0.2 (1983-1985)Railway workshop 0.1-0.2 f/ml (1978-81) <0.1-0.2 (locomotive) f/ml (1982-85)Railway workshop <0.1-0.6 f/ml (1978-81) 0.4-0.6 (cars) f/ml (1982-85)Glassworks 0.02-0.2 f/ml (1978-81) 0.01-0.5 (float glass) f/ml (1982-85)Garbage station 0.1 f/ml (1978-81)Office 0.005-0.02 f/ml (1978-81) <0.1 f/ml (1982-85) department store 0.005 f/ml (1982-85) ATC-tower <0.1 f/ml (1982-85) Chlorine-alkali plant <0.1 f/ml (1978-81) <0.01-0.04 f/ml (1982-85)Foundry (automated) <0.01-0.5 f/ml (1978-81)Brake lining plant 0.01-2.2(1978) < 0.1-0.3 (1982)School (With asbestos/concrete ceiling) <0.1 f/ml (1982-85)School - restaurant 0.02 f/ml (1982-85) Ventilation room-filter cleaning 0.08-0.1 f/ml (1982-85)Machine room – Escalator 0.1-0.2 f/ml (1982-85) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Low | Sampling or analytical methodology is not specified. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Medium | Sweden - OECD member country |
| | Metric 3: | Applicability | High | The data are for an occupational scenario (exposure from working with materials that contain asbestos) within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Medium | 1986 - at the time of the PEL but more than 20 years old |
| | Metric 5: | Sample Size | Low | Distribution of samples did not include statistics, but for most cases range values were provided. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Low | Monitoring data include sample type (e.g., personal breathing zone) but no other meta-data. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | The monitoring study included range data that could be useful to evaluate variability but the study did not not address uncertainty |

## Overall Quality Determination Low

| | |
|---|---|
| **Study Citation:** | Horner, R. (1990). Removal of vinyl asbestos floor tile. US Department of Agriculture. Forest Service. Engineering Field Notes (Print) 22:31-33. |
| **HERO ID:** | 6865657 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Floor tile removal |
| Exposure route: | inhalation |
| Personal sampling data: | 0.01 f/cc |
| Area sampling data: | Adjacent areas-during work <0.01 f/ccWork area-during work <0.01 f/ccFinal aggressive samples-after completion <0.01 f/cc |
| Number of workers: | 3 |
| Personal protective equipment: | protective clothing, and half-mask respirators |
| Engineering control: | Water, wetting agent |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Sampling and Analytical Methodology | Low | Sampling or analytical methodology is not specified. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | The data are from the United States. |
| Metric 3: | Applicability | High | The data are for an occupational scenario within the scope of the risk evaluation. |
| Metric 4: | Temporal Representativeness | Low | Report is more than 20 years old. |
| Metric 5: | Sample Size | Medium | Distribution of samples is characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Medium | Monitoring data include most critical metadata, such as sample type and exposure type, but lacks additional metadata, such as sample durations, exposure durations, and exposure frequency. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Medium | Variability is addressed by taking personal and area samples but uncertainty is not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Hughes, J. M. (1994). Human evidence: Lung cancer mortality risk from chrysotile exposure. Annals of Occupational Hygiene 38(4):555-560. |
| **HERO ID:** | 3081779 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | production workers, maintenance and repair workers in buildings with ACM (p. 2) |
| Exposure route: | inhalation (p.1) |
| Physical form: | chrysotile (p. 2) |
| Area sampling data: | One study: 0.00020 f/ml in public buildings containing ACM (p. 2)Another study: Maintenance and repair workers in buildings with ACM, after accounting for the frequency and duration of these types of activities, have average annual exposure levels ranging from a median value of 0.002 to 0.02 f/ml per year at the 90th percentile. Production workers exposure levels ranged from 0.10 to 0.20 f/ml. (p. 2) |
| Exposure duration: | asbestos workers - 40 hr/week (p. 2) |
| Exposure frequency: | 48-50 weeks/yr (p. 2) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Sampling and Analytical Methodology | Low | Sampling or analytical methodology is not specified. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | Medium | The data are from an OECD country. other than the U.S. |
| Metric 3: | Applicability | High | The data are for an occupational scenario within the scope of the risk evaluation. |
| Metric 4: | Temporal Representativeness | Low | The data were collected before the most recent PEL establishment or update or are more than 20 years old if no PEL is established. |
| Metric 5: | Sample Size | Medium | Distribution of samples is characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Medium | Monitoring data include most critical metadata, such as sample type and exposure type, but lacks additional metadata, such as sample durations, and/or worker activities. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Medium | Variability is addressed by including multiple sources of data but uncertainty is not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Hughes, J. M., Weill, H., Hammad, Y. Y. (1987). Mortality of workers employed in two asbestos cement manufacturing plants. Occupational and Environmental Medicine 44(3):161-174. |
| **HERO ID:** | 281 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Pipe production/manufacturing using asbestos cement |
| Exposure route: | Inhalation |
| Physical form: | Dust, air |
| Area sampling data: | Estimated total average exposure was 7.6 mppcf.Table 3 (page 4) provides average concentration during years of asbestos exposure in million particles per cubic foot (mppcf).Plant 1:1942-1945: 8.9 mppcf w/ mean years employed of 5.7 years1946-1949: 9.6 mppcf w/ mean years employed of 3.6 years1950-1959: 6.8 mppcf w/ mean years employed of 2.9 years1960-1969: 1.3 mppcf w/ mean years employed of 2.5 yearsTotal: 7.8 mppcf w/ mean years employed of 3.6Plant 2:1937-1941: 6.4 mppcf w/ mean years employed of 5.5 years1942-1945: 9.0 mppcf w/ mean years employed of 2.1 years1946-1949: 7.4 mppcf w/ mean years employed of 5.2 years1950-1959: 8.7 mppcf w/ mean years employed of 2.8 years1960-1969: 3.9 mppcf w/ mean years employed of 2.0 yearsTotal: 7.5 mppcf w/ mean years employed of 3.9 years.Table 10 (Page 9) provides average concentration (mppcf) of chrysotile and crocidolite in Plant 2 employees separated by years of employment:Chrysotile only<0.25 years: 8.9 mppcf0.25-1 years: 7.9 mppcf1-5 years: 7.3 mppcf5-15 years: 6.2 mppcf>15 years: 6.4 mppcfCombined: 8.0 mppcfChrysotile and Crocidolite (pipe production area)<0.25 years: 9.3 mppcf0.25-1 years: 8.8 mppcf1-5 years: 8.3 mppcf5-15 years: 6.6 mppcf>15 years: 5.9 mppcfCombined: 7.5 mppcf |
| Particle size characterization: | 1 fibre/mL = 1 mppcf |
| Exposure duration: | Workers had a mean of overall employment of 3.8 years. |
| Number of workers: | 6931 employees of two asbestos cement product manufacturing plant (Page 2). |
| Comments: | Chrysotile was the primary fibre in both plants. Plant 1 had small amounts of amosite and crocidolite irregularly. Plant 2 used crocidolite. |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Low | Sampling was conducted by industry, insurance company, and government personnel but does not specify the identities of either three of these organizations. States sampling was done using a midget impinger recorded in mppcf. Analytical methodology is not specified. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Samples are taken in the US. |
| | Metric 3: | Applicability | High | The data are for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Low | Samples were taken over 20 years ago. |
| | Metric 5: | Sample Size | Medium | Concentrations are only provided with a mean. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Provides what the plant producing but never specifies specific job roles of employees. Also provides exposure type, physical form, number of workers, and some information about exposure duration. |
| Domain 4: Variability and Uncertainty | | | | |

**Continued on next page . . .**

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| | |
|---|---|
| **Study Citation:** | Hughes, J. M., Weill, H., Hammad, Y. Y. (1987). Mortality of workers employed in two asbestos cement manufacturing plants. Occupational and Environmental Medicine 44(3):161-174. |
| **HERO ID:** | 281 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

| | | | EVALUATION | |
|---|---|---|---|---|
| Domain | | Metric | Rating | Comments |
| | Metric 7: | Metadata Completeness | Medium | Addresses variability by providing sampling data over multiple years. Does not address uncertainty. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Hwang, J., Taylor, R., Cann, C., Norris, P., Golla, V. (2019). Evaluation of accumulated polycyclic aromatic hydrocarbons and asbestiform fibers on firefighter vehicles: Pilot study. Fire Technology 55(6):2195-2213. |
| **HERO ID:** | 6894395 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Firefighter response. |
| Exposure route: | Dermal and Inhalation [PDF Pg. 1] |
| Physical form: | Fibers (solid) [PDF Pg. 1] |
| Dermal exposure data: | nan |
| Exposure frequency: | Summary of runs/year for different truck types (full table given on PDF Pg. 10]Fire Engine-Pumper: 45-300Full Size Car: 450Pickup Truck: 0-500 |
| Personal protective equipment: | The key personal protective equipment (PPE) for firefighters is turnout gear, the main function of which is to protect on-duty firefighters from hazardous occupational conditions, including chemical and particle-toxicants. [PDF Pg. 2] |
| Comments: | The American Society for Testing and Materials (ASTM) D6480 [41] technique was adopted to analyze the asbestiform wipe samples [PDF Pg. 7] Data are for wipe samples from the surface of vehicles used for firefighting. |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Sampling and Analytical Methodology | High | Sampling/analytical methodology is equivalent to an approved OSHA/NIOSH method. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | Data are from the U.S. |
| Metric 3: | Applicability | Medium | Data are for asbestos concentrations on the surfaces of vehicles used in firefighting activities. May be useful for informing exposure during disaster relief work. |
| Metric 4: | Temporal Representativeness | High | Monitoring data are no more than 10 years old. |
| Metric 5: | Sample Size | Medium | Distribution of samples is characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | High | Monitoring data include all associated metadata, including sample types, exposure types, sample durations, exposure durations worker activities, and exposure frequency. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | High | Uncertainty is addressed in sampling/analytical methodology. Variability addressed by sampling different types of vehicles used by firefighters. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Hwang, S. H., Roh, J., Park, C., Kim, J., Lee, B. H., Park, W. M. (2018). Reducing the risk of particulate matter containing asbestos using a high-efficiency, low-differential pressure system. Aerosol Science and Technology 52(9):1005-1011. |
| **HERO ID:** | 6859869 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Exposure route: | Inhalation |
| Physical form: | Solid |
| Area sampling data: | Asbestos concentrations before control:Demolition Site A: 0.038 f/ccDemolition Site B: 0.027 f/ccSchool classroom: 0.007 f/ccOffice: 0.006 f/ccAfter controlDemolition Site A: 0.004 f/ccDemolition Site B: 0.006 f/ccSchool classroom: 0.004 f/ccOffice: 0.003 f/ccPCM Chrysotile |
| Engineering control: | Melt-blown (MB) filter mediaasbestos removal efficiency of the grade H13 MB filter was 99.974% |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | High | Sampling or analytical methodology is an approved OSHA or NIOSH method or is well described and found to be equivalent to approved OSHA or NIOSH methods. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Medium | The data are from an OECD country. other than the U.S., and locality-specific factors (e.g., potential differences in regulatory occupational exposure limits, industry/ process technologies) may impact exposures relative to the U.S. |
| | Metric 3: | Applicability | High | The data are for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | High | The operations, equipment, and worker activities associated with the data are expected to be representative of current operations, equipment, and activities. The monitoring data were collected after the most recent permissible exposure limit (PEL) establishment or update and are generally no more than 10 years old. Metadata on the operations, equipment, and worker activities associated with the data show that the data should be representative of current operations, equipment, and activities |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Monitoring data include most critical metadata, such as sample type and exposure type, but lacks additional metadata, such as exposure durations, exposure frequency, and/or worker activities. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | The monitoring study does not address variability. Uncertainty canbe determined from the sampling and analytical method. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Hyland, R. A., Yates, D. H., Benke, G., Sim, M., Johnson, A. R. (2010). Occupational exposure to asbestos in New South Wales, Australia (1970-1989): development of an asbestos task exposure matrix. Occupational and Environmental Medicine 67(3):201-206. |
| **HERO ID:** | 2587028 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Exposure route: | dust, airborne fibers |
| Personal sampling data: | Data are for handling/grinding brakes and clutches (deemed similar to current use, which may include removal of exisiting brakes/clutches):All units fibers/ml, sampling data from Australian Dust Disease Board Mean 0.05 percentile 0.95 percentile Total N Handling 1970-79 2.1 0.1 4.6 24 1980-89 0.8 0.1 8.3 27 Lit. Data 5.9 0.6 12.6 7 Grinding: 1970-79 1.6 0.1 8.5 42 1980-89 0.9 0.1 4.6 24 Lit. Data 10.7 1.0 43.5 10Table 2, pg. 3/7 |
| Comments: | Worker activities and area sampling data are/were not relevant to current legacy assessment of existing asbestos materials. |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Sampling and Analytical Methodology | Medium | Sampling/analytical methodology is equivalent to an approved OSHA method. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | Medium | Data are from Australia, an OECD country. |
| | Metric 3: Applicability | Medium | Data are for installing/removing/working with asbestos brakes and clutches, which is similar to the in-scope occupational scenario Industrial/Commercial Use: Chemical Substances in Construction, Paint, Electrical, and Metal Products |
| | Metric 4: Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| | Metric 5: Sample Size | Medium | Sample distribution characterized by limited statistics (mean, 5 and 95 percentile, and number of samples) but discrete samples not provided and distribution not fully characterized. |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | Medium | Sample type and exposure type provided but missing time, activity, year, controls, etc. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Medium | Uncertainty is addressed in sampling/analytical methodology but variability is not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | IARC, (2010). Painting, firefighting, and shiftwork. 98:804-804 pages. |
| **HERO ID:** | 1104469 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Swedish study of 10 paint factories – Charging operations, tinting, handling of bags, compressing empty bags, floor cleaning and emptying air-cleaner filters |
| Exposure route: | inhalation |
| Physical form: | inhalable fibers |
| Personal sampling data: | Sweden (1977) paint manufacture sampling during charging operations, 5 min–8h 0.31-5 f/m3 |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Low | Sampling or analytical methodology is not specified. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Medium | OECD member countries |
| | Metric 3: | Applicability | High | The data are for an occupational scenario (paint manufacture) within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Medium | 2010 - more than 10 and less than 20 years |
| | Metric 5: | Sample Size | Low | Distribution of samples is qualitative or characterized by no statistics. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Low | Monitoring data include sample type (e.g., personal breathing zone) but no other metadata. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | The monitoring study does not address variability or uncertainty. |

## Overall Quality Determination — Low

**Study Citation:** IARC, (2010). Painting, firefighting, and shiftwork. 98:804-804 pages.
**HERO ID:** 1104469
**Conditions of Use:** Other:

**EXTRACTION**

| Parameter | Data |
|---|---|
| Worker activity description: | A municipal fire department is composed of 1st line firefighters (pump, ladder, and rescue crews, and operations chiefs) and 2nd line firefighters (drivers and division chiefs). |
| Exposure route: | inhalation |
| Physical form: | inhalable fibers |
| Personal sampling data: | UK Breathing zone samples from firefighters of both new and old helmets with unlined asbestos cloth covers were analyzed and had fiber concentrations of 2.30 f/cm3 and 1.38 f/cm3, respectively. |
| Area sampling data: | Municipal fire 2.7 f/cm2 (mean); Fire Training 0-2.3 f/cm2 from helmets and fumes of fire fighters. |
| Exposure duration: | Estimated time spent inside structural fires broken down by tasks for two fire departments in Arizona, USA. The results were: entry/ventilation 5.7 ± 11.7 hour/yr (Phoenix), and 3.5 ± 3.7 hour/yr (Tucson); rescue 5.0 ± 8.0 hour/yr (Phoenix), and 2.1 ± 2.7 hour/yr (Tucson); knockdown (extinction) 5.6 ± 8.9 hour/yr(Phoenix), and 4.5 ± 4.4 hour/yr (Tucson); overhaul 15.0 ± 3.7 hour/yr (Phoenix), and 20.8 ± 76.8 hour/yr (Tucson); and, support/standby 16.3 ± 28.6 hour/yr (Phoenix), and 19.1 ± 76.7 hour/yr (Tucson). Total firefighter activity at fires in Phoenix and Tucson was a mean of 47.6 hour/yr and 50.0 hour/yr, respectively.In a study among firefighters in Washington, DC, (n = 43), at the time of the survey, an average of 9.2 days had elapsed since the last fire. Also, 0.33 fires had been fought in the previous 24 hours, 1.33 in the previous week, 5.91 in the previous month, and 57.1 fires in the previous yearApproximately 90% of municipal structural fires are either extinguished within 5–10 minutes, or abandoned and fought from the outside. This results in an average duration of heavy physical activity at fires of approximately 10 minutes. Knockdown of large fires may last much longer. During overhaul, any remaining small fires are extinguished. The environment during overhaul is not as hot or as smoky as during knockdown, but it still contains products of combustion from small fires or smoldering material. Exposure can differ widely between the twophases of firefighting. The determination of when overhaul begins varies from one fire department to another, and is often left to the judgement of individual firefighters or group leaders. firefighters work 10 to 24 hour shifts for 188 days per year |
| Personal protective equipment: | firefighters helmets/SCUBA equipment |

**EVALUATION**

| Domain | | Metric | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Low | Sampling or analytical methodology is not specified. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Medium | US and OECD members |
| | Metric 3: | Applicability | High | The data are for an occupational scenario (firefighting) within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Medium | 2010 - more than 10 and less than 20 years |
| | Metric 5: | Sample Size | Low | No statistics provided |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Low | Monitoring data include sample type (e.g., personal breathing zone) but no other metadata. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | The monitoring study does not address variability or uncertainty. |

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| | |
|---|---|
| **Study Citation:** | IARC, (2010). Painting, firefighting, and shiftwork. 98:804-804 pages. |
| **HERO ID:** | 1104469 |
| **Conditions of Use:** | Other: |

| | | **EVALUATION** | |
|---|---|---|---|
| Domain | Metric | Rating | Comments |
| **Overall Quality Determination** | | **Low** | |

| | |
|---|---|
| **Study Citation:** | IARC, (2012). ARC Monographs on the evaluation of carcinogenic risks to humans: Asbestos (Chrysotile, amosite, crocidolite, tremolite, actinolite, and anthophyllite). |
| **HERO ID:** | 3970851 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Personal sampling data: | study of TWA asbestos exposure for maintenance workers in buildings with ACM.1227 samples0.009 f/mL for telecommunication switch work0.037 f/mL for above-ceiling maintenance work0.51 f/mL for ork in utility spaces (p. 9)p. 10Williams et al study. (1):8h TWA exposuresInsulators (50th percentile): 9 f/mL, 8 f/mL 2 f/mL, 0.3 f/mL Williams et al study. (2):Insulator activities ranged from 2-10 f/mL (task based)p. 11Table 1.3: Insulation works in Germany ranged between 0.2 - 18 f/mL between the years of 1950-1990Madl et al:Peak concentrations reached during gasket removal and flange face cleaning with hand tools (0.14 f/mL) and packing removal and installation (0.4 f/mL) |
| Area sampling data: | asbestos removal in the shipping industry (320 f/mL) removal of asbestos insulation (300 f/mL) (uncertain if these measurements are personal or area) (p. 10) |
| Number of workers: | OSHA estimated in 1990 that about 568,000 workers in production and services industries and 114,000 in construction industries may have been exposed to asbestos in the workplace (p.7)up to 1.3 million construction workers potentially exposed (p. 7)1.4 million workers potentially exposed to talc(p. 15) |

**EVALUATION**

| Domain | | Metric | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Medium | Sampling or analytical methodology is not specified in this report but can be assumed to be PCM. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | The data are from the United States and are representative of the industry being evaluated. |
| | Metric 3: | Applicability | High | The data are for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Medium | Operations, equipment, and worker activities are expected to be reasonably representative of current conditions. The monitoring data were collected after the most recent PEL establishment or update but are generally more than 10 years old |
| | Metric 5: | Sample Size | Low | Distribution of samples is qualitative or characterized by no statistics. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Low | Monitoring data include sample type (e.g., personal breathing zone) but no other metadata. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | The monitoring study does not address variability or uncertainty. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | IPCS, (1986). Asbestos and other natural mineral fibres. Environmental Health Criteria :194. |
| **HERO ID:** | 81716 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Exposure route: | inhalation and ingesting |
| Physical form: | airborne fibers and contaminated water |
| Personal sampling data: | Table 8. Asbestos levels in different manufacturing industries in the United Kingdom, 1972-78——————————————————————Asbestos cement 86.5% < 0.5 fibers/ml 95.0% < 1.0 fibers/ml 98.5% < 2.0 fibers/mlMillboard/paper 87.0% < 0.5 fibers/ml 98.2 % < 1.0 fibers/ml 99.6% < 2.0 fibers/mlFriction materials 71.0% < 0.5 fibers/ml 85.5 % < 1.0 fibers/ml 95.0% < 2.0 fibers/mlTextiles 58.5% < 0.5 fibers/ml 80.7 % < 1.0 fibers/ml 95.0Insulation board 54.0% < 0.5 fibers/ml 72.5 % < 1.0 fibers/ml 88.6% < 2.0 fibers/ml |
| Area sampling data: | Table 9. Asbestos fiber concentrations in 1984 in variousbranches of the asbestos industry in France——————————————————————Asbestos cement 93.5% < 0.5 fibers/ml 3.9% 0.5-1 fibers/ml 2.1% 1-2 fibers/ml 0.3% > 2 fibers/mlFriction materials 62.8% < 0.5 fibers/ml 21.2% 0.5-1 fibers/ml 13.8% 1-2 fibers/ml 2.0% > 2 fibers/mlTextile 65.3% < 0.5 fibers/ml 20.1% 0.5-1 fibers/ml 13.7% 1-2 fibers/ml 0.8% > 2 fibers/mlOthers 73.2%% < 0.5 fibers/ml 25.0% 0.5-1 fibers/ml 0% 1-2 fibers/ml 0 1.7% > 2 fibers/ml—————————————————————— TotalPercentage 73.9% < 0.5 fibers/ml 15.6% 0.5-1 fibers/ml 9.1 % 1-2 fibers/ml 1.2% > 2 fibers/ml |
| Particle size characterization: | The article points out that converting mass measurements to fiber counts is particularly challenging and varies significantly within industry groups. The report did provide a complex table i for fibers per ng for different size categories (cylindrical fiber shape, density) and diameter/ length ratios. (Table 3) Unfortunately the table can not be easily reproduced in this form format. |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Sampling and Analytical Methodology | Low | Sampling or analytical methodology is not specified. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | Medium | UK and France OECD Member countries |
| Metric 3: | Applicability | High | The data are for an occupational scenario ( processing of asbestos and product manufacture) within the scope of the risk evaluation. |
| Metric 4: | Temporal Representativeness | Medium | 1986 - at the time of the PEL but more than 20 years old |
| Metric 5: | Sample Size | Low | Distribution of samples is characterized by no statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Low | Monitoring data include sample type (e.g., personal breathing zone) but no other metadata. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Low | The monitoring study does not address variability or uncertainty. |
| **Overall Quality Determination** | | **Low** | |

| | |
|---|---|
| **Study Citation:** | IT Corporation, (1993). Asbestos release during building demolition activities. |
| **HERO ID:** | 3970150 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Building demolition |
| Exposure route: | inhalation |
| Physical form: | fiber, dust |
| Personal sampling data: | Asbestos Release during Demolition and Disposal Aurora Elementary School. personal samples: 0.003- 0.040 asbestos structures/cc. (P. 7/8) |
| Area sampling data: | Asbestos Release During Demolition and Disposal, Santa Cruz and Watsonville, CA: range 0.003 - 0.060 asbestos structures/cc. (P. 4/8)Asbestos Release During implosion Demolition: 0.003 - 0.11 asbestos structures/cc. (P. 6/8)Asbestos Release During Fort Bliss Demolition Activity: 0.003 - 0.014 asbestos structures/cc. (P. 6/8)Asbestos Release during Demolition and Disposal Aurora Elementary School: < 0.001 - 0.002 asbestos structures/cc. (P. 7/8)Asbestos Release during Demolition and Disposal, Fort Wainwright school: 0.0 - 0.002 asbestos structures/cc. (P. 7/8) |
| Particle size characterization: | Particle size varies from 0 to >5 microns. Fig. 1 - Fig. 5. |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | High | Sampling or analytical methodology is an approved OSHA or NIOSH method or is well described and found to be equivalent to approved OSHA or NIOSH methods. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | The data are from the United States. |
| | Metric 3: | Applicability | High | The data are for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Low | More than 20 years old. |
| | Metric 5: | Sample Size | Medium | Range and Mean provided but individual data points not provided. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Monitoring data include most critical metadata, such as sample type and exposure type, but lacks additional metadata, such as sample durations, exposure durations, and exposure frequency. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | Variability is addressed by including data from different locations but uncertainty is not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Jacobs, N. F. B., Towle, K. M., Finley, B. L., Gaffney, S. H. (2019). An updated evaluation of potential health hazards associated with exposures to asbestos-containing drywall accessory products. Critical Reviews in Toxicology 49(5):430-444. |
| **HERO ID:** | 6874464 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Mixing (pre-mix), application, cleaning, and sanding. [PDF Pg. 9] |
| Area sampling data: | Lower Bound Fiber concentrations (fibers >5 um/cc) [PDF Pg. 9]Mixing (pre-mix): 2.3Application: 0.9Sanding: 1.5Cleaning: 15.5Other: 0Upper Bound fiber concentrations (fibers >5 um/cc) [PDF Pg. 9]Mixing (dry-mix): 12.2Application: 0.9Sanding: 11.5Cleaning: 15.5Other: 0Texture Work (8-hr TWA) (Fibers >5 um/cc) [PDF Pg. 9]Lower Bound: 23.9Upper Bond: 34.0 |
| Exposure duration: | Lower Bound Exposure Durations (hours/40 hour work week) [PDF Pg. 9]Mixing (pre-mix): 0.25Application: 11.2Sanding: 2.7Cleaning: 1Other: 24.85Upper Bound Exposure Durations (hours/40 hour work week) [PDF Pg. 9]Mixing (dry-mix): 2Application: 27Sanding: 10Cleaning: 1Other: 0 |
| Comments: | Samples analyzed via PCM method. |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | High | Sampling or analytical methodology is an approved OSHA or NIOSH method or is well described and found to be equivalent to approved OSHA or NIOSH methods. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for Chemical Substances in Construction, Paint, Electrical, and Metal Products, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Medium | Some monitoring data are no more than 10 years old. Some monitoring data are older than 20 years old. |
| | Metric 5: | Sample Size | Medium | Sample distribution characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Monitoring data include most critical metadata, such as sample type and exposure type, but lacks additional metadata, such as exposure frequency. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | High | Uncertainty is addressed in sampling/analytical methodology. Variability addressed by sampling for multiple worker activities. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Jankovic, J., Reger, R. (1989). Health hazard evaluation report no. MHETA-87-017-1949, United Rubber Workers' International Union, Akron, Ohio. |
| **HERO ID:** | 3970473 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | This process involves the feeding of brass clad steel wire, from hundreds of spools, to be fashioned into steel belts. Each of these spools contains two brake pads to prevent overspin. Each plant employed some hand mixing of raw materials, but this involved very few workers. [PDF Pg. 5]. |
| Physical form: | Fibers in insulation material (solid) [PDF Pg. 5]. |
| Area sampling data: | mean of 39 samples: 0.4 (f/cm^3) [PDF Pg. 6]. |
| Number of workers: | Three plants employing 1,500 to 2,000 workers each [PDF Pg. 5]. |

**EVALUATION**

| Domain | | Metric | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Low | Sampling/analytical methodology is not specified. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for Chemical Substances in Construction, Paint, Electrical, and Metal Products, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| | Metric 5: | Sample Size | Medium | Sample distribution characterized by limited statistics (mean) but discrete samples not provided and distribution not fully characterized. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Low | Sample type provided but no other metadata. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Low

| | |
|---|---|
| **Study Citation:** | Japanese Ministry of Environment, (2011). Summary of countermeasures against asbestos in Japan. |
| **HERO ID:** | 3980937 |
| **Conditions of Use:** | Disposal |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Removal of asbestos containing spray of materials, heat insulation materials, and molded products such as slates and acoustic boards. (54/87) |
| Exposure route: | inhalation (51/87) |
| Physical form: | fibers (6/87) |
| Area sampling data: | Area samples at an asbestos waste disposal site improved from 0.47 fiber/L in 1995 to 0.06 fiber/L in 2009. (21/87) |
| Particle size characterization: | Asbestiform minerals are readily spilt into bundles of fine fibers 1-2$\mu$m in diameter. (6/87) |
| Personal protective equipment: | Filtering respirators and supplied-air respirators. (52/87) Eye protectors, gloves, shoe covers, protective garments. (55/87) |
| Engineering control: | Installation of security zones and negative pressure/dust-collecting exhaust ventilation equipment, and the use of wetting agents. (19/87) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | High | Sampling/analytical methodology is equivalent to an approved [OSHA/NIOSH] method. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Medium | Data are from Japan, an OECD country. |
| | Metric 3: | Applicability | High | Data are for asbestos removal, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Medium | Monitoring data were collected after the most recent PEL and greater than 10 years old. |
| | Metric 5: | Sample Size | Medium | Sample distribution characterized by limited statistics (geometric means) but discrete samples not provided and distribution not fully characterized. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Exposure type and sampling data provided, but missing number of workers, exposure duration, and frequency. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Medium

**Study Citation:** Kahal, E. J. (1984). Innovative approach to asbestos removal.
**HERO ID:** 6914180
**Conditions of Use:** Other:

**EXTRACTION**

| Parameter | Data |
|---|---|
| Worker activity description: | Replacing old insulation and cutting or drilling into transite wallboards. (3/14) |
| Exposure route: | inhalation (6/14) |
| Physical form: | fibers (14/14) |
| Personal sampling data: | (PCM) Personal samples collected during worst-case conditions during insulation removal were ND-1.5 f/cc. (14/14) |
| Personal protective equipment: | Respirators are custom-fit and used by employees. (6/14) Disposable coveralls are required for most asbestos operations. Boots and gloves may also be required. (7/14) |
| Engineering control: | Existing asbestos steam linings are enclosed with aluminum. (4/14) All entrances or access ways to asbestos work locations have posted warning signs and are barricaded to prevent non-asbestos workers from unwittingly entering an asbestos work location. (7/14) Applying mist to insulation, mechanical ventilation, and vacuums with HEPA filters are implemented. Asbestos waste is placed in a bag and labeled. Plastic huts are used to protect nearby employees. (8/14) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | High | Sampling/analytical methodology is equivalent to an approved [OSHA/NIOSH] method. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for demolition of asbestos products, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| | Metric 5: | Sample Size | Medium | Sample distribution characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Exposure type and sampling data provided, but missing number of workers, exposure duration, frequency, and particle size. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Kaiser, E. A. (1993). Health hazard evaluation report no. HETA-91-349-2311, Rhode Island Department of Education, Providence, Rhode Island. |
| **HERO ID:** | 3970476 |
| **Conditions of Use:** | Consumer Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Source of exposure is asbestos containing materials (ACMs) around boilers, furnaces, and steam pipes along perimeter walls and the basement ceiling. In many areas this asbestos is friable. (4/33) |
| Exposure route: | inhalation (13/33) |
| Physical form: | fiber bundles (17/33) |
| Area sampling data: | Two of five area samples contained airborne asbestos. (17/33) |
| Particle size characterization: | The results of the TEM analysis performed on filters indicated that chrysotile bundles or clusters (1.5 µm x 5.5 µm and 3.5 µm x 4 µm) were detected on two (2) of the five (5) air samples. (17/33) |
| Exposure duration: | Up to 10 hours per day (7/33) |
| Comments: | There are other engineering data present, which is why this study was included even though it is general building inhalation exposure. |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Sampling and Analytical Methodology | High | Sampling/analytical methodology is an approved NIOSH method. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | Data are from the U.S. |
| Metric 3: | Applicability | Low | Data are for consumer use of construction materials, which is similar to commercial use of construction materials, an in-scope occupational scenario. |
| Metric 4: | Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| Metric 5: | Sample Size | Low | Sample distribution is described qualitatively. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Medium | Exposure type and sampling data provided, but missing number of workers, exposure frequency, engineering controls and PPE. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Medium | Uncertainty is addressed in sampling/analytical methodology. Variability is not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Kakooei, H., Normohammadi, M. (2014). Asbestos exposure among construction workers during demolition of old houses in Tehran, Iran. Industrial Health 52(1):71-77. |
| **HERO ID:** | 3531012 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Demolition of old houses. |
| Exposure route: | inhalation |
| Physical form: | Fiber |
| Personal sampling data: | Personal monitoring of asbestos fiber levels indicated a range from 0.01 to 0.15 PCM f/ml (0.02–0.42 SEM f/ml). |
| Area sampling data: | The highest and lowest GM (GSD) concentrations of asbestos 0.31 (0.082) SEM f/ml and 0.13 (0.145) SEM f/ml). (P.3/7) |
| Particle size characterization: | >5 $\mu$m in length and >0.2 $\mu$m in diameter. (P. 4/7) |
| Exposure duration: | 240– 360 min. (P. 3/7) |
| Number of workers: | The number of workers per demolition practices were approximately 3–5 persons. (P. 2/7) |
| Comments: | Table 1. Airborne asbestos fiber concentrations by regionTable 2. Airborne asbestos fiber concentrations by site of demolition |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | High | Sampling or analytical methodology is an approved OSHA or NIOSH method. The National Institute for Occupational Safety and Health(NIOSH) method 7400. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Low | The data are from a non-OECD country, Iran. |
| | Metric 3: | Applicability | High | The data are for an occupational scenario within the scope of the risk evaluation. Demolition. |
| | Metric 4: | Temporal Representativeness | Medium | Data from 2011. More than 10 years old. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Monitoring data include most critical metadata, such as sample type and exposure type, but lacks additional metadata, such as exposure durations, exposure frequency, and/orworker activities. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | High | The monitoring study addresses variability in the determinants of exposure for the sampled site or sector. |

## Overall Quality Determination **High**

**Study Citation:** Kakooei, H., Sameti, M., Kakooei, A. A. (2007). Asbestos exposure during routine brake lining manufacture. Industrial Health 45(6):787-792.
**HERO ID:** 3531014
**Conditions of Use:** Other:

**EXTRACTION**

| Parameter | Data |
|---|---|
| Worker activity description: | Workers at a brake lining manufacturing plant (1/6) |
| Physical form: | dust (2/6) |
| Personal sampling data: | (PCM) The maximum personal asbestos fiber concentration were 1.85 (1.84–1.91) f/cc which belonged to mixing process. (3/6) |
| Area sampling data: | (PCM) The average of total dust particle concentration in the processes and operation is measured at 9.6 mg/m3 (range: 2.08- 16.32 mg/m3), of which approximately 100% consists of thoracic particles($\leq$10 µm). (3/6) |
| Particle size characterization: | According to the counted particles, the count mode and geometric mean diameter of the particles are 1.5 µm and 6.02µm, respectively. The count mean diameter or the arithmetic mean of the number distribution also was, 8.4 µm. (4/6) |
| Exposure duration: | 1-2 hours (3/6) |
| Number of workers: | 3000 workers(2/6) |
| Engineering control: | The side windows were left fully open to facilitate natural ventilation. (4/6) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Sampling and Analytical Methodology | High | Sampling/analytical methodology is an approved OSHA method. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | Low | Data are from Iran, a non-OECD country. |
| Metric 3: | Applicability | Uninformative | Data are for manufacturing of asbestos-containing products, which is not in-scope for the legacy asbestos risk evaluation. |
| Metric 4: | Temporal Representativeness | Medium | Monitoring data were collected after the most recent PEL and greater than 10 years old. |
| Metric 5: | Sample Size | Medium | Sample distribution characterized by limited statistics (means, standard deviations) but discrete samples not provided and distribution not fully characterized. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Medium | Exposure type and sampling data provided, but missing exposure frequency, and PPE. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | High | Uncertainty is addressed in sampling/analytical methodology. Variability is addressed by sampling multiple jobs and process steps. |

## Overall Quality Determination Uninformative

| | |
|---|---|
| **Study Citation:** | Kam, J. K. (1989). Demolition worker hazard: The effect of short-term, low-level combined exposures. Journal of Environmental Health 52(3):162-163. |
| **HERO ID:** | 3097739 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Demolition activities, which involved tearing down a three-story building that was approximately 40 years old. (2/3) |
| Exposure route: | inhalation (2/3) |
| Physical form: | dust (2/3) |
| Personal sampling data: | (PCM) Worker exposures ranged from 0-0.10 f/cc. (3/3) |
| Particle size characterization: | Fibers longer than 5 microns are deemed more hazardous than shorter fibers. (3/3) |
| Number of workers: | 23 workers (2/3) |
| Personal protective equipment: | Dust masks were available, but none of the workers wore them. (2/3) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | High | Sampling/analytical methodology is an approved NIOSH method. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Low | Data are from China, a non-OECD country. |
| | Metric 3: | Applicability | High | The data are for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Sample type and exposure type provided, but missing exposure duration, frequency, and engineering controls. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | High | Uncertainty is addressed in sampling/analytical methodology. Variability is addressed by sampling during multiple days. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Kangur, M. (2007). Occupational exposure to asbestos during renovation of oil-shale fuelled power plants in Estonia. International Journal of Occupational Safety and Ergonomics 13(3):341-346. |
| **HERO ID:** | 3531019 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Renovation of Estonia's biggest solid oil-shale fueled electric power plants. (4/7) |
| Exposure route: | inhalation (4/7) |
| Physical form: | fibers (4/7) |
| Area sampling data: | The mean concentrations of airborne fibers in the working environment of the boiler-house and the turbine hall in plant 1 during normal working activities was 0.024 ± 0.009 fibers/cm, during the renovation period 0.038 ± 0.016 fibers/cm3 ; whereas the respective average concentrations in plant 2 were 0.017 ± 0.005 fibers/cm3 , and 0.024 ± 0.014 fibers/cm. (5/7) |
| Number of workers: | 1,000 workers participated in the renovation. (4/7) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Sampling and Analytical Methodology | High | Sampling/analytical methodology is equivalent to an approved [OSHA/NIOSH] method. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | Medium | Data are from Estonia, an OECD country. |
| Metric 3: | Applicability | High | Data are for commercial use in construction materials, an in-scope occupational scenario. |
| Metric 4: | Temporal Representativeness | Medium | Monitoring data were collected after the most recent PEL and greater than 10 years old. |
| Metric 5: | Sample Size | Medium | Sample distribution characterized by limited statistics (means, standard deviations, ranges) but discrete samples not provided and distribution not fully characterized. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Medium | Exposure type and sampling data provided, but missing exposure duration, frequency, particle size, engineering controls and PPE. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Medium | Variability is addressed by sampling at two plants. Uncertainty isn't addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Karadagli, F. (2011). Comparative Assessment of Asbestos-Containing and Alternative Materials in Turkish Industrial Facilities. Indoor and Built Environment 20(4):471-478. |
| **HERO ID:** | 3086691 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Area sampling data: | Airborne fiber concentrations and worker exposure to fibers in the newer building were assessed to be insignificant. (pg 476) High levels of fiber concentrations were observed in places, where brake pads were cleaned with compressed air, wire brushes, or a similar method. One study reported that airborne fiber concentrations did not exceed the regulatory limits (0.1 fiber/cm3 air for 8 h TWA) in repair shops during brake maintenance of most vehicles. Another study found fiber concentrations of up to 125 fibers/cm3 of air during cleaning of brakes from buses and trucks with compressed air, while this number was 8.2 fibers/cm3 during maintenance of passenger cars. Overall, average concentrations were between 0.1 and 0.2 fibers/cm3 for an 8 h TWA for truck and bus maintenance, and less than 0.05 fiber/cm3 for passenger cars. . Overall, average concentrations were between 0.1 and 0.2 fibres/cm3 for an 8 h TWA for truck and bus maintenance, and less than 0.05 fibre/cm3 for passenger cars. |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Sampling and Analytical Methodology | Low | Sampling or analytical methodology is not specified. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | Medium | The data are from an OECD country other than the U.S. |
| | Metric 3: Applicability | High | The data are for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: Temporal Representativeness | Low | Most of the monitoring data is more than 20 years old. |
| | Metric 5: Sample Size | Low | Distribution of samples is qualitative or characterized by no statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | Medium | Monitoring data include most critical metadata, such as sample type and exposure type, but lacks additional metadata, such as sample durations, exposure durations, exposure frequency, and/orworker activities. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Medium | Variability is addressed by citing multiple studies but uncertainty is not addressed. |

## Overall Quality Determination — Low

| | |
|---|---|
| **Study Citation:** | Kauffer, E., Vigneron, J. C., Fabriès, J. C., Billon-Galland, M. A., Brochard, P. (1996). The use of a new static device based on the collection of the thoracic fraction for the assessment of the airborne concentration of asbestos fibres by transmission electron microscopy. Annals of Occupational Hygiene 40(3):311-319. |
| **HERO ID:** | 3081453 |
| **Conditions of Use:** | Consumer Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Physical form: | fibers (7/9) |
| Area sampling data: | Area sampling was conducted in an asbestos contaminated building. Fiber concentrations ranged from 0.08-1.65 f/L with a mean of 0.55 f/L using traditional aerosol sampling. With a CATHIA sampling head described in the paper, concentrations ranged from 0.15-0.99 f/L with a mean of 0.41 f/L. (7/9) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Medium | Sampling/analytical methodology is not an approved OSHA/NIOSH method but is an acceptable methodology. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Medium | Data are from France, an OECD country. |
| | Metric 3: | Applicability | Low | Data are for consumer use in construction materials, which is similar to the in-scope occupational scenario commercial use of construction materials. |
| | Metric 4: | Temporal Representativeness | Medium | Monitoring data were collected after the most recent PEL and greater than 10 years old. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Physical form and sampling data provided, but missing worker information, exposure duration and frequency, particle size, PPE, and engineering controls. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | Uncertainty isn't addressed. Variability is addressed by collecting samples with different sets of equipment. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Kauffer, E., Vincent, R. (2007). Occupational exposure to mineral fibres: Analysis of results stored on colchic database. Annals of Occupational Hygiene 51(2):131-142. |
| **HERO ID:** | 1848342 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Industry (no. of samples)Metallurgy (605)Building - civil engineering (499)Transport indsutries (226)Services (29)Chemical Industries (320)Wood (302)Shops other than food (209)Service Activities I (87)Service Activities II (43) |
| Exposure route: | inhalation |
| Physical form: | fibers in air |
| Personal sampling data: | 1986 - 1996: 1,719 personal samples: mean conc. 2.5 fibers/ml1997-2005: 601 personal samples: mean conc. 0.60 fibers/mlAverage sample duration: 41.8% <30 min, 19.5% 30-60min, 29.1% 60-120 min., 9.5% 120-480 min, 0.2% > 480 min.1986-1996:Industry (no. of samples)MeanMedianMin. MaxMetallurgy (511) 1.9 0.33 0.01 160Building - civil engineering (243) 9.2 0.85 0.01 370Transport indsutries (117) 0.55 0.15 0.02 9.1Services (17) 0.10 0.07 0.03 0.3Chemical Industries (295) 0.79 0.34 0.01 9.5Wood (288) 1.3 0.34 0.015 27Shops other than food (173) 1.9 0.34 0.01 88Service Activities I (49) 1.1 0.23 0.015 18Service Activities II (26)0.16 0.048 0.004 0.891997 - 2004Industry (no. of samples) MeanMedianMin. MaxMetallurgy (94) 0.29 0.055 0.003 12 Building and civil engineering (256) 1.1 0.063 0.004 83 Transport industries (109) 0.43 0.06 0.005 22 Services (12) 0.15 0.17 0.025 0.22 Chemical industries (25) 0.22 0.1 0.009 2.9 Wood (14) 0.067 0.0340.01 0.19 Shops other than food shops (36) 0.068 0.058 0.009 0.21 Service activities 1 (38) 0.052 0.027 0.007 0.54 Service activities 2 (17) 0.29 0.055 0.019 2.3 1986-1996:Industry (no. of samples) MeanMedian Min.MaxRepair, maintenance, general inspection (207) 0.47 0.14 0.007 9.1 Common services, specific pollution premises (18) 0.88 0.07 0.004 4.1 Inspection, cleaning, repair (1) (27) 0.31 0.17 0.03 1.5 Building finishings + maintenance (65) 1.1 0.19 0.01 18 Other building + civil engng. work (1) (16) 1.2 0.26 0.015 7.21997 - 2004Industry (no. of samples) MeanMedian Min.MaxDemolition work (85) 0.24 0.06 0.009 2 Other building + civil engng. work (144) 0.47 0.08 0.007 22 Repair, maintenance, general inspection (101) 0.31 0.055 0.003 12 |
| Area sampling data: | 1986 - 1996: 1,491 personal samples: mean conc. 1.9 fibers/ml1997-2005: 601 personal samples: mean conc. 0.16 fibers/mlAverage sample duration: 33.3% <30 min, 13.1% 30-60min, 32.7% 60-120 min., 20.6% 120-480 min, 0.3% > 480 min. |
| Personal protective equipment: | mean conc. w/PPE mean conc. w/out PPE mean overall #sample f/mL #sample f/mL #sample f/mLAsbestos (1986–1996) 407 5.0 518 0.76 925 2.6Asbestos (1997–2004) 398 0.86 142 0.071 540 0.65 |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Low | Sampling/analytical methodology is not specified. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Medium | Data are from France, an OECD Country. |
| | Metric 3: | Applicability | Medium | Data are for mixed uses (unclear), which include demolition, maintenance, and construction, which is similar to the in-scope occupational scenario demolition. |
| | Metric 4: | Temporal Representativeness | Medium | Monitoring data were collected after the most recent PEL and greater than 10 years old. Note, some data is from before the most recent PEL as well. |
| | Metric 5: | Sample Size | Medium | Sample distribution characterized by limited statistics (min, max, mean, median) but discrete samples not provided and distribution not fully characterized. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Sample type and exposure type provided but missing length of time for each sample, |

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|---|---|
| **Study Citation:** | Kauffer, E., Vincent, R. (2007). Occupational exposure to mineral fibres: Analysis of results stored on colchic database. Annals of Occupational Hygiene 51(2):131-142. |
| **HERO ID:** | 1848342 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

| | | **EVALUATION** | |
|---|---|---|---|
| Domain | Metric | Rating | Comments |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Low

| | |
|---|---|
| **Study Citation:** | Kazimierczak, E. (1994). The asbestos containing materials in Polish building - some observations on the air pollution. WIT Transactions on Ecology and the Environment, vol. 4 :553-558. |
| **HERO ID:** | 6875063 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Exposure route: | Inhalation [PDF Pg. 1] |
| Area sampling data: | [PDF Pg. 6]Outside buildings with a-c demolished sheets: 0.0026 (f/cc)Inside buildings with ACM: 0.0002-0.0004 (f/cc)Inside buildings after ACM shortly repaired: 0.0017 (f/cc) |
| Comments: | Fibre concentrations at work places by phase contrast light microscopy based on RTM-1 AIA method. [PDF Pg. 4] |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Sampling and Analytical Methodology | Medium | Sampling/analytical methodology is not an approved OSHA/NIOSH method but is an acceptable methodology. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | Medium | Data are from Poland, an OECD country. |
| | Metric 3: Applicability | High | Data are for Chemical Substances in Construction, Paint, Electrical, and Metal Products, an in-scope occupational scenario. |
| | Metric 4: Temporal Representativeness | Low | Monitoring data are greater than 20 years old. |
| | Metric 5: Sample Size | Medium | Sample distribution characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | Medium | Sample type and exposure type provided but missing worker activity, exposure duration, and exposure frequency. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | High | Uncertainty is addressed in sampling/analytical methodology. Variability addressed by samples collected at multiple sites. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Keyes, D. L., Chesson, J., Ewing, W. M., Faas, J. C., Hatfield, R. L., Hays, S. M., Longo, W. E., Millette, , J. R. (1991). EXPOSURE TO AIRBORNE ASBESTOS ASSOCIATED WITH SIMULATED CABLE INSTALLATION ABOVE A SUSPENDED CEILING. American Industrial Hygiene Association Journal 52(11):479-484. |
| **HERO ID:** | 3581248 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Installing electrical or computer cables above a suspended ceiling with asbestos fireproofing. (2/7) |
| Physical form: | fiber (2/7) |
| Personal sampling data: | (TEM) During cable installation near asbestos fireproofing, personal samples were 10.5+-11.6 and 124.8+-85.6 s/cm3. (5/7) PCM analyzed personal samples were 0.13 f/cm3 and 0.34 f/cm3. (5/7) |
| Area sampling data: | (TEM) Before installation, samples were 0.052+-0.030 and 0.158+-0.094 s/cm3. During cable installation near asbestos fireproofing, area samples were 28.9+-12.6 and 100.2+-91.2 s/cm3. After installation, samples were 8.4+-7.0 and 17.0+-13.5 s/cm3.(5/7) |
| Exposure duration: | 8 hours (3/7) |
| Engineering control: | Doors and wall openings were covered with plastic sheets and duct tape, and the HVAC system was shut down. (3/7) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | High | Sampling or analytical methodology is an approved OSHA or NIOSH method or is well described and found to be equivalent to approved OSHA or NIOSH methods. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for commercial use in construction materials, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | The data were collected before the most recent PEL establishment or update or are more than 20 years old if no PEL is established. |
| | Metric 5: | Sample Size | Medium | Sample distribution characterized by limited statistics (means, standard deviations) but discrete samples not provided and distribution not fully characterized. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Exposure type and sampling data provided, but missing exposure frequency, PPE, and particle size. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | High | Uncertainty is addressed in sampling/analytical methodology. Variability is addressed by sampling two scenarios of exposure. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Kim, Y., Zhang, Y. L., Park, W. J., Chad, G. W., Hong, W. H. (2020). Quantifying asbestos fibers in post-disaster situations: Preventive strategies for damage control. International Journal of Disaster Risk Reduction 48(2212-4209):1563-1563. |
| **HERO ID:** | 6913550 |
| **Conditions of Use:** | Other: |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Firefighters and disaster cleanup workers (2/8) |
| Exposure route: | inhalation (1/8) |
| Physical form: | dust (1/8) |
| Area sampling data: | "For uncoated asbestos cement roofing, the analysis result shows that the maximum and minimum asbestos concentrations were 0.162 f/cc (at 0 h) and 0.119 f/cc (after 36 h), respectively. For water-coated cement roofing, the analysis result shows thatthe maximum and minimum asbestos concentrations were 0.127 f/cc (after 36 h) and 0.002 f/cc (after 0–3 h), respectively. (3/8)" |
| Engineering control: | Methods of suppressing the scattering of asbestos fibers in a post disaster situation consist of spraying the damaged building with an asbestos stabilizer or simply with water. (2/8) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Sampling and Analytical Methodology | High | Sampling/analytical methodology is an approved NIOSH method. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | Medium | Data are from Korea, an OECD country. |
| Metric 3: | Applicability | High | Data are for demolition of asbestos products, an in-scope occupational scenario. |
| Metric 4: | Temporal Representativeness | High | Monitoring data were collected after the most recent PEL and no more than 10 years old. |
| Metric 5: | Sample Size | Medium | Sample distribution characterized by limited statistics (minimums, maximums) but discrete samples not provided and distribution not fully characterized. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Medium | Exposure type and sampling data provided, but missing number of workers, exposure duration, frequency, PPE, and particle size. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | High | Uncertainty is addressed in sampling/analytical methodology. Variability is addressed by testing coated and uncoated asbestos roofing. |

## Overall Quality Determination High

**Study Citation:** Kingsley, I. (1976). Health hazard evaluation report no. HHE 76-40-341, 919 Third Garage Company, New York, New York.
**HERO ID:** 3970497
**Conditions of Use:** Other:

**EXTRACTION**

| Parameter | Data |
|---|---|
| Worker activity description: | Parking garage attendants exposed to sprayed-on asbestos insulation. However, no asbestos disturbing activity was taking place. |
| Exposure route: | Inhalation |
| Physical form: | Fibers |
| Personal sampling data: | All personal samples were <0.01 f/cc except two samples that were 0.03 and 0.06 f/cc. |
| Area sampling data: | Two area samples were <0.01 f/cc. |
| Exposure duration: | 11 hours/day |
| Exposure frequency: | 365 days/year |
| Engineering control: | There is a general mechanical ventilation system consisting of several overhead and wall exhaust grilles on each garage level. Ducts lead from these grilles to either a floor or wall opening in the fan room which serves as a plenum and contains a 5 ft. square open inlet backward curved fan. At the cellar level, make-up air is obtained through the ramp and through openings in the false ceiling. On the subcellar level, make-up air enters only through the ramp. |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | High | Sampling/analytical methodology is equivalent to an approved [OSHA/NIOSH] method. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | Low | Monitoring data are for exposure to asbestos containing materials in the absence of asbestos disturbing activities. Data are most useful for determining background exposure. |
| | Metric 4: | Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Exposure type and sampling data provided, but missing number of workers, PPE, and particle size. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | High | Monitoring report addresses variability by sampling multiple attendants, and measurement uncertainty is achieved by taking multiple samples for each attendant. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Kinsey, J. S., Keen, R. C., Mumford, C. J. (1977). A preliminary survey of the hazards to operators engaged in the disposal of asbestos waste. Annals of Occupational Hygiene 20(1):85–89. |
| **HERO ID:** | 3615457 |
| **Conditions of Use:** | Disposal |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Area sampling data: | Provides number of samples, average sample time, average fiber concentration for each of the sites; fiber concentrations ranged from 0.02 to 2.00 fibers/cm3 (pg 4) |
| Exposure duration: | ”exposure times were short if these procedures were followed and, indeed, in the case of the largest amount of material buried at any one time, which was approximately 50 tonnes, the total time taken to completely bury the material was approximately one hour.” (pg 3) ... provides time worked by driver and average time of sample for each site where sampling occurred (pg 4) |
| Number of workers: | ”the two major sites in the country are taking about half the asbestos waste produced. In these two sites only two machine operators are employed, together with about 10 full-time drivers per site” (pg 2); operators exposed are listed for each site where sampling occurred, ranged from 3 to 6 operators (pg 4) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Low | Sampling/analytical methodology is not specified. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Medium | Data are from Great Britain, an OECD country. |
| | Metric 3: | Applicability | High | Data are for asbestos disposal, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| | Metric 5: | Sample Size | Medium | Sample distribution characterized by limited statistics (number of samples, averages), but discrete samples not provided and distribution not fully characterized. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Sample type and exposure type provided but missing associated occupational activities and sampling locations. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | Variability addressed by collecting samples from different sites, but uncertainty is not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Kirshner, M., Bleach, K. (1994). Environmental and occupational remediation subsequent to the World Trade Center bombing. Environment International 20(2):253-261. |
| **HERO ID:** | 3582387 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Cleanup and reconstruction crews after the bombing of the World Trade Center exposed to asbestos fireproofing and insulation debris. Debris removal occurred over a 4 week period after the incident. The waste was generally characterized as concrete, cinder block, cement, drywall, or other building materials. |
| Exposure route: | inhalation (6/9) |
| Physical form: | fibers (6/9) |
| Personal sampling data: | ”During cleanup, all personal air monitoring results werebelow detection limits for asbestos. (7/9)” |
| Area sampling data: | ”(PCM) 8 hours after the blast, all measurements showed results below the level of detection of 8 fibers/L. (6/9)” |
| Number of workers: | Cleanup required 900 employees (7/9) |
| Personal protective equipment: | Port Authority provided fit testing and half-face respirators with high efficiency filters on an as-needed basis. (6/9) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Sampling and Analytical Methodology | Low | Sampling methodology not specified. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | High | Data are from the U.S. |
| | Metric 3: Applicability | High | Data are for cleanup of debris potentially containing asbestos, an in-scope occupational scenario. |
| | Metric 4: Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| | Metric 5: Sample Size | Medium | Sample distribution characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | Medium | Exposure type and sampling data provided, but missing exposure duration, frequency, particle size, and engineering controls. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Kleinfeld, M., Messite, J., Langer, A. M. (1973). A study of workers exposed to asbestiform minerals in commercial talc manufacture. Environmental Research 6(2):132-143. |
| **HERO ID:** | 29981 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Mining Drilling Dragline loading Tramming & mucking Primary crushing Hoist loadingMilling Secondary crushing Grinding (Wheeler mills) Grinding (Hardinge mills) Bagging Palletizing Bulk Loading Rail Car/Truck Loading |
| Exposure route: | inhalation |
| Physical form: | airborne fibers |
| Area sampling data: | Mine (fibers > 5 um/ml) Drilling 8 um/ml (1970) comparative plant (1969) 371 um/ml Dragline loading 16 um/ml (1970) Tramming & mucking 22 um/ml (1970) comparative plant (1969) 62 um/ml Primary crushing 260 um/ml (1970) Hoist loading 29 um/ml (1970) Mill (fibers > 5 um/ml) Secondary crushing 13 um/ml (1970) comparative plant (1969) 112 um/ml Grinding (Wheeler mills) 30 um/ml (1970) comparative plant (1969) 84 um/ml Grinding (Hardinge mills) 33 um/ml (1970) Bagging 30 um/ml (1970) comparative plant (1969) 135 um/ml Palletizing 27 um/ml (1970) Bulk Loading 8 um/ml (1970) Rail Car/Truck Loading comparative plant (1969) 198 um/ml |
| Exposure duration: | The article provides exposure in terms of years of exposure (mean=16.2 range 11- 22) - not hrs/day. |
| Number of workers: | 39 |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Medium | Sampling method noted but not claiming that a specifically a NIOSH method was used. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | US |
| | Metric 3: | Applicability | High | The data are for an occupational scenario (Talc mining and milling) within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Low | 1973 - Prior to PEL and more than 20 years old |
| | Metric 5: | Sample Size | Medium | Distribution of samples is characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Monitoring data include most critical metadata, such as sample type and exposure type, but lacks additional metadata, such as sample durations, exposure durations, exposure frequency. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | The distribution of samples is characterized by different values for different operations at two different plants. Nothing about uncertainty was presented. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Knight, K. L., Bloor, D. M., Miller, F. (1985). Use of a cowl in asbestos air sampling. Annals of Occupational Hygiene 29(2):289-291. |
| **HERO ID:** | 3083505 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Asbestos cement factory workers. Samples taken from the work environment of a man engaged in transferring baled chrysotile asbestos into a rod mill. (PDF Page 1) |
| Personal sampling data: | Table 1 on PDF Page 2 provides fibre densities from personal air sampling. The individual samples are provided and the standardized fiber density ranges from: 82-584 fibers/mm^2 with an average of 306 fibers/mm^2 |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | High | The sampling/analytical methodology is the European Reference Method. The methodology is likely equivalent to an approved OSHA/NIOSH methodology. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Medium | Data is from the UK, an OECD country. |
| | Metric 3: | Applicability | High | Data is for industrial/commercial use of construction materials which is an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Data is over 20 years old. |
| | Metric 5: | Sample Size | High | Sample distribution is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Low | Sample type provided but no other significant metadata. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | Does not address variability or uncertainty. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Kominsky, J. R., Freyberg, D. W., Brackett, K. A. (1993). Evaluation of Three Cleaning Methods for Removing Asbestos from Carpet: Determination of Airborne Asbestos Concentrations Associated with Each Method. (23):90. |
| **HERO ID:** | 3649689 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Furnishing, Cleaning, Treatment Care Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Dry vacuuming using cleaners with and without HEPA filter vs. wet cleaning with hot-water extraction cleaner (abstract) |
| Personal sampling data: | Max: 0.333 f/cm3 (1-hr sample) (pg 3) |
| Area sampling data: | Table 1 (pg 4): Before cleaning: 0.025-0.163 s/cm3After cleaning:conventional vacuum: 0.03-0.065 s/cm3HEPA vacuum: 0.043-0.168 s/cm3hot-water extraction: 0.066-0.109 s/cm3 |
| Exposure duration: | 60 min (pg 2) |
| Engineering control: | HEPA-filtered dry vacuum: air flow capacity of 87 ft3/min (pg 2)Hot-water extraction cleaner: air flow capacity of 95 ft3/min (pg 2)Conventional vacuum: air flow capacity of 110 ft3/min (pg 2) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | High | EPA monitoring. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for furnishings (carpet), an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| | Metric 5: | Sample Size | Medium | Sample distribution characterized by limited statistics (mean, min, max) but discrete samples not provided and distribution not fully characterized. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Sample type and exposure type provided but missing metadata such as exposure frequency. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | Variability addressed by evaluating multiple carpet cleaning types, but uncertainty is not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Kominsky, J. R., Freyberg, R. W. (1991). Asbestos Fiber Reentrainment during Dry Vacuuming and Wet Cleaning of Asbestos-Contaminated Carpet. (11):56. |
| **HERO ID:** | 3649688 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Furnishing, Cleaning, Treatment Care Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Dry and wet vacuuming of carpet containing asbestos. |
| Exposure route: | Inhalation |
| Physical form: | Fibers |
| Area sampling data: | Note -THESE ARE SPIKED SAMPLES to test the two methods of floor cleaning and may or may not represent actual occupational exposure. The intent of the study is to determine if re-entrainment during vacuuming is significant - and it is:100 Million structures / ft^2Before cleaninghot water extraction Average 0.0673 s/cm3 SD 0.0874 s/cm3Dry vacuum Average 0.0571 s/cm3 SD 0.0315 s/cm3During Cleaninghot water extraction Average 0.639 s/cm3 SD 0.0911 s/cm3Dry vacuum Average 0.2531 s/cm3 SD 0.1655 s/cm31 Billion structures / ft^2Before cleaninghot water extraction Average 0.0761 s/cm3 SD 0.0471 s/cm3Dry vacuum Average 0.1424 s/cm3 SD 0.1235 s/cm3During Cleaninghot water extraction Average 0.1577 s/cm3 SD 0.0690 s/cm3Dry vacuum Average 0.2248 s/cm3 SD 0.1499 s/cm3 |
| Engineering control: | Two 500 ft2 rooms constructed with HEPA filtration systems in place. Decontamination facilities were also utilized. |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | High | Sampling and analytical methodology are approved EPA methods. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | The data are from the United States. |
| | Metric 3: | Applicability | High | The data are for an occupational scenario (carpet cleaning) within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Low | Data more than 20 years old. |
| | Metric 5: | Sample Size | High | Comprehensive statistical approach used; results provided in terms of average concentrations and SD. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Monitoring data include most critical metadata such as sample type, exposure type, and sample durations, but lacks additional metadata such as occupational exposure durations, exposure frequency, and worker activity details. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | High | The monitoring report addresses variability by sampling in various locations with different vacuums, and uncertainty is addressed by the statistical distribution of results (mean, SD). |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Kominsky, J. R., Freyberg, R. W., Chesson, J., Cain, W. C., Powers, T. J., Wilmoth, R. C. (1990). Evaluation of two cleaning methods for the removal of asbestos fibers from carpet. American Industrial Hygiene Association Journal 51(9):500-504. |
| **HERO ID:** | 3582814 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Furnishing, Cleaning, Treatment Care Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Cleaning of carpets with HEPA-filtered vacuum and hot water extraction cleaner. [PDF Pg. 1] |
| Exposure route: | Inhalation |
| Physical form: | Fibers |
| Area sampling data: | (concentrations after cleaning as a proportion to before cleaning)Low Contamination Loading (9.3E4 s/m^2) [PDF Pg.5]Wet clean: 0.29Dry vacuum: 1.19High Contamination Loading (9.3E7 s/m^2)Wet clean: 0.33Dry vacuum: 0.84 |
| Exposure duration: | 65 minutes per activity. [PDF Pg. 3] |
| Engineering control: | HEPA-filtered dry vacuum. [PDF Pg. 1] |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | High | Sampling/analytical methodology is equivalent to an approved OSHA/NIOSH method. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for furnishing, cleaning, and treatment care products, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Medium | Monitoring data are greater than 10 years old but no more than 20 years old. |
| | Metric 5: | Sample Size | Medium | Sample distribution characterized by limited statistics (mean) but discrete samples not provided and distribution not fully characterized. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | All metadata provided. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | High | Uncertainty is addressed in sampling/analytical methodology. Variability addressed by performing multiple tests for 2 cleaning methods. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Kominsky, J. R., Freyberg, R. W., Powers, T. J., Wilmoth, R. C. (1989). Statistical evaluation of airborne asbestos measured before, during and after abatement. |
| **HERO ID:** | 6900979 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Cleaning of carpet contaminated with asbestos [PDF PG. 1] |
| Area sampling data: | Pre-Abatement Phase Perimeter [PDF Pg. 13]Site 1: 0.0052 (s/cm^3)Site 2: 0.0030 (s/cm^3)Site 3: 0.0008 (s/cm^3)Pre-Abatement Phase Work Area [PDF Pg. 13]Site 1: 0.0091 (s/cm^3)Site 2: 0.0367 (s/cm^3)Site 3: 0.0001 (s/cm^3)During Abatement Phase Perimeter [PDF Pg. 13]Site 1: 0.0089 (s/cm^3)Site 2: 0.0304 (s/cm^3)Site 3: 0.0129 (s/cm^3)Post-Abatement Phase Perimeter [PDF Pg. 13]Site 1: 0.0057 (s/cm^3)Site 2: 0.2410 (s/cm^3)Site 3: 0.0028 (s/cm^3)Post-Abatement Phase Area [PDF Pg. 13]Site 1: 0.0056 (s/cm^3)Site 2: 0.3082 (s/cm^3)Site 3: 0.0023 (s/cm^3) |
| Comments: | The air samples were collected on 25-mm, 0.4-um pore-size, Nuclepore polycarbonate filters. Each 25-mm filter was mounted on a 5-um pore-size, mixed cellulose ester, backup diffusing filter and cellulose support pad and was contained in a three-piece cassette with a 50-mm conductive cowl and face cap. The filter assembly was attached to an electric-powered vacuum pump operating at a flow rate of 8 to 12 liters per minute to achieve a minimum air volume of approximately 3000 liters.The polycarbonate membrane filters were analyzed by transmission electron microscopy (TEM). The filters were prepared and analyzed for asbestos fibers by TEM in accordance with the Yamate Revised Method. 3 A TEM Level II analysis was performed on all polycarbonate samples collected in this study. [PDF Pg. 9] |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | High | Sampling/analytical methodology is equivalent to an approved OSHA/NIOSH method. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for Chemical Substances in Construction, Paint, Electrical, and Metal Products, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Monitoring data are greater than 20 years old. |
| | Metric 5: | Sample Size | Medium | Sample distribution characterized by limited statistics (mean) but discrete samples not provided and distribution not fully characterized. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Low | Sample type provided but no other metadata. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | High | Uncertainty is addressed in sampling/analytical methodology. Variability addressed by collecting samples at the perimeter of the work area and in the work area and sampling at multiple sites. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Koppers Indus Hygiene Sec, (1981). Industrial hygiene survey of the Garwood, New Jersey plant with cover memo. |
| **HERO ID:** | 1481349 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Removal of insulation containing asbestos. [PDF Pg. 6] |
| Personal sampling data: | [PDF Pg. 9]Operator A: 0.045, 0.053, 0.17 fibers/cm^3.Adding 7 bags of asbestos to batch: 0.65, 0.19 (fibers/cm^3) |
| Area sampling data: | [PDF Pg. 9]#53 mixer platform: <0.01, 0.57, 0.54, <0.10 (fibers/cm^3) |
| Personal protective equipment: | The use of adequate respiratory protection, worn and fitted properly should be enforced during demolition procedures where asbestos exposures are anticipated to occur. [PDF Pg. 5]Special clothing is to be provided to workers exposed to airborneasbestos in concentrations exceeding 10 fibers >5 $\mu$m/cc as a ceiling exposure.The use of hard hats and protective eyewear in the production areas of this plant should be monitored to insure good safety practice.Full-face dust respirators containing high efficiency particulate filters should be worn by workers performing the operations described in Table No. 5. |
| Comments: | Open-face collection on HCE filters (Koppers Company. Inc •• "Procedure for Determination of Worker Exposure to Airborne Asbestos Fibers.") Koppers Research Analytical Department No. P-3D02. Phase Contrast Microscopy. [PDF Pg. 9] |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Sampling and Analytical Methodology | High | Sampling/analytical methodology is equivalent to an approved OSHA/NIOSH method. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | Data are from the U.S. |
| Metric 3: | Applicability | High | Data are for Chemical Substances in Construction, Paint, Electrical, and Metal Products, an in-scope occupational scenario. |
| Metric 4: | Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Medium | Sample type and exposure type provided but missing exposure frequency and duration. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | High | Uncertainty is addressed in sampling/analytical methodology. Variability addressed by samples collected at multiple times and during multiple worker activities. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Koppers, (1982). Status report of industrial hygiene monitoring at the Fontana, California plant. |
| **HERO ID:** | 1481351 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Area sampling data: | *Note*: Additional results reported, showed them in a range here [PDF PG. 41].Coatings plant operator: 0.14-1.6 (fibers/cm^3). On shredder housing next to opening: 0.11-0.17 (f/cm^3)On platform next to shredder: 0.12-0.21 (f/cm^3)Coatings plant helper (shredding asbestos): 0.1-2.1 (f/cm^3)On shredder housing: <0.1-1.1 (f/cm^3) |
| Comments: | Asbestos monitoring was conducted during the production of Roof Resaturant 410. Research Department Analytical Method No P-3002 was used (comparable to NIOSH Method P and CAM 239). |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | High | Sampling/analytical methodology is equivalent to an approved OSHA/NIOSH method. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for Chemical Substances in Construction, Paint, Electrical, and Metal Products, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Low | Sample type provided but no other metadata. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | High | Uncertainty is addressed in sampling/analytical methodology. Variability addressed by sampling multiple areas of the plant at multiple times. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Koppers, (1981). Status report of industrial hygiene monitoring at the Follansbee, West Virginia plant with cover letter. |
| **HERO ID:** | 1481376 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Painters and insulators. |
| Area sampling data: | Painter/Insulator 1: 0.06 fibers/cm^3 [PDF Pg. 50]Painter/Insulator 2: 0.04 fibers/cm^3) |
| Comments: | The analytical method (analysis) used to count the fibers of diameter and length for health significance as required by OSHA 29 CFR 1910.1001 is Koppers Company, Inc., Research Department, Physics and. Physical Chemistry Group, Method No. P-3002 (12/4/79), "Asbestos Test Method." |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | High | Sampling/analytical methodology is equivalent to an approved OSHA/NIOSH method. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for Chemical substances in construction, paint, electrical, and metal products, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Sample type and exposure type provided but missing exposure frequency and exposure duration. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | High | Uncertainty is addressed in sampling/analytical methodology. Variability addressed by sampling two workers separately for the same job activity. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Koppers, (1981). Industrial hygiene survey report for the Irving, Texas Plant. |
| **HERO ID:** | 2859225 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Exposure route: | Inhalation [PDF Pg. 9 talks about respiratory protection]. |
| Physical form: | Fibers < 5 microns |
| Personal sampling data: | [PDF Pg. 15]Sandmill operator, operating high speed dispersion mixer: 0.028, 0.013, 0.11, 0.20 (fibers/cm^3)Sandmill operator, operating high speed dispersion mixer (TWA): 0.064, 0.14 (fibers/cm^3)Adding 90 lbs of asbestos to batch: 1.4, 0.28(fibers/cm^3) |
| Area sampling data: | [PDF Pg. 15] Sandmill area, 5 1/2 ft above floor: 0.05, 0.018, 0.017, ND (fibers/cm^3)Sandmill area, 5 1/2 ft above floor (TWA): 0.034, 0.053 (fibers/cm^3)Asbestos addition to batch: 0.28, 1.1 (fibers/cm^3) |
| Personal protective equipment: | The operator handling asbestos wore an MSA Model GMA-H respirator with NIOSH approval TC-23C-l55 [PDF Pg. 5]. |
| Engineering control: | Horseshoe-shaped exhaust hoods are used to ventilate the Cowles mixers and were measured at an airflow of 200 fpm. [PDF Pg. 10] |
| Comments: | Samples taken using Koppers Analytical Research Department method No. P-3002. |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Sampling and Analytical Methodology | High | Sampling/analytical methodology is equivalent to an approved OSHA/NIOSH method. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | Data are from the U.S. |
| Metric 3: | Applicability | High | Data are for Chemical Substances in Construction, Paint, Electrical, and Metal Products, an in-scope occupational scenario. |
| Metric 4: | Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Medium | Sample type and exposure type provided but missing exposure frequency and duration. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | High | Uncertainty is addressed in sampling/analytical methodology. Variability addressed by sampling multiple activities and taking area and personal samples. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Koppers, (1980). Status report of industrial hygiene monitoring at the Wickliffe, Ohio plant building materials/Industrial Products Division Organic Materials Group. |
| **HERO ID:** | 4158319 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Hydroshield operator, assistant operator, truck driver, utility person. (10/30) |
| Exposure route: | inhalation (24/30) |
| Physical form: | fibers (24/30) |
| Personal sampling data: | Personal samples ranged from 0.1-17 f/cc. (24/30) The mean concentration was 7.5 f/cc. (10/30) |
| Exposure duration: | 8 hours (10/30) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | High | Sampling/analytical methodology is an approved OSHA method. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for industrial use in construction materials, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Exposure type and sampling data provided, but missing number of workers, exposure frequency, particle size, engineering controls, and PPE. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | High | Uncertainty is addressed in sampling/analytical methodology. Variability is addressed by sampling over multiple days. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Korhonen, K., Liukkonen, T., Ahrens, W., Astrakianakis, G., Boffetta, P., Burdorf, A., Heederik, D., Kauppinen, T., Kogevinas, M., Osvoll, P., Rix, B. A., Saalo, A., Sunyer, J., Szadkowska-Stanczyk, I., Teschke, K., Westberg, H., Widerkiewicz, K. (2004). Occupational exposure to chemical agents in the paper industry. International Archives of Occupational and Environmental Health 77(7):451-460. |
| **HERO ID:** | 1321973 |
| **Conditions of Use:** | Other: |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Area sampling data: | Pulping, refining, etc. of stockmean: 1.5 f/cm3 median: 1.2 f/cm3 Min: 0 Max: 7.1 f/cm3Newsprint and uncoated paper machinemean: 0.04 f/cm3 median: 0 Min: 0 Max: 0.11 f/cm3Fine and coated paper machinemean: 0.02 f/cm3 median: 0.007 f/cm3 Min: 0 Max: 0.06 f/cm3Soft/tissue-paper machinemean: 1.5 f/cm3 median: 0.7 f/cm3 Min: 0 Max: 7.3 f/cm3Paper/paperboard machine from more than one of the above categoriesmean: 0.07 f/cm3 median: 0.04 f/cm3 Min: 0 Max: 0.5 f/cm3Calendering or on-machine coatingmean: 0.04 f/cm3 median: 0 Min: 0 Max: 0.2 f/cm3Winding, cutting, grading, etcmean: 0.39 f/cm3 median: 0 Min: 0 Max: 10.5 f/cm3Unspecified departmentmean: 0.06 f/cm3 median: 0.009 f/cm3 Min: 0 Max: 0.22 f/cm3 |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Sampling and Analytical Methodology | Low | Sampling or analytical methodology is not specified. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | Medium | OECD member countries |
| Metric 3: | Applicability | High | The data are for an occupational scenario ( pulp and paper) within the scope of the risk evaluation. |
| Metric 4: | Temporal Representativeness | Medium | 2004 - After PEL (1986) more than 10 years old, but less than 20. |
| Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized ( mean, median, and range. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Low | Monitoring data include sample type but no other metadata. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Medium | As mean, median, and range were provided, it would be possible to assess variability but not uncertainty. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Kottek, M., Kilpatrick, D. J. (2016). Estimating Occupational Exposure to Asbestos in Australia. Annals of Occupational Hygiene 60(4):531-532. |
| **HERO ID:** | 3531038 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Boilermakers and pipe fitters (2/2) |
| Personal sampling data: | They recorded short-term personal exposures of 83 f ml−1, which is not meaningfully different to the 8-h TWA exposure of 86 f ml−1which they recorded for the entire operation. |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Low | Sampling or analytical methodology is not specified. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Medium | Data are from Australia, an OECD country. |
| | Metric 3: | Applicability | High | The data are for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | High | Monitoring data were collected after the most recent PEL and no more than 10 years old. |
| | Metric 5: | Sample Size | Low | Distribution of samples is qualitative or characterized by no statistics. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Exposure type and sampling data provided, but missing number of workers, exposure duration, frequency, particle size, engineering controls, and PPE. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | The monitoring study does not address variability or uncertainty. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Kramkowski, R. S., Daniels, W. J. (1984). Health Hazard Evaluation Report No. HETA-83-450-1468, George Rogers Clark National Historical Park, Vincennes, Indiana. NIOSH(HETA-83-450-1468):83-450. |
| **HERO ID:** | 3652542 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Maintenance personnel at a historical park with asbestos insulation on heating pipes. (5/14) |
| Exposure route: | inhalation (7/14) |
| Physical form: | fibers (7/14) |
| Area sampling data: | (PCM) No asbestos was detected on 5 area samples. (8/14) |
| Exposure duration: | 5 to 10 minutes per day (5/14) |
| Personal protective equipment: | An approved respirator must be worn when removing asbestos. (13/14) |
| Engineering control: | During removal, equipment should be covered with plastic sheets. Windows and doors should d be sealed. Access to the work zone must be through an air lock system. Spraying the asbestos with water is required. Asbestos should be bagged and labeled, and all surfaces should be washed down after stripping. (12/14) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | High | Sampling/analytical methodology is an approved NIOSH method. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for commercial use in construction materials, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Exposure type and sampling data provided, but missing number of workers, exposure frequency, and particle size. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | Uncertainty is addressed in sampling/analytical methodology. Variability is not addressed. |

## Overall Quality Determination — High

| | |
|---|---|
| **Study Citation:** | Kronoveter, K. (1983). Health Hazard Evaluation Report No. HETA-83-358-1362, George H. Fallon Federal Office Building, Baltimore, Maryland. NIOSH(HETA-83-358-1362):83-358. |
| **HERO ID:** | 3652533 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Personal sampling data: | [PDF Pg. 9]8/10/1981: five samples ranged 0.008-0.08 (f/cm^3) |
| Area sampling data: | [PDF Pg. 9]10/1/1973: three samples ranged 0.002-0.008 (f/cm^3)12/12/1980: four samples ranged <0.001 - 0.001 (f/cm^3)8/12/1981: five samples ranged 0.005-0.03 (f/cm^3)10/15/1982: six air samples ranged 0.001-0.006 (f/cm^3)04/11/1983: seven samples ranged 0.01-0.06 (f/cm^3) |
| Comments: | The samples were analyzed by phase contrast microscopy using the proposed revised NIOSH Method P&CAM 239, which is not specific for asbestos fibers. Additionally, four of the eight air samples wereexamined by transmission electron microscopy for small asbestos fibers which would not be visible by the phase contrast microscopy. technique. [PDF Pg. 5] Worker activity description not given. |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Sampling and Analytical Methodology | High | Sampling/analytical methodology is an approved NIOSH/OSHA method. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | High | Data are from the U.S. |
| | Metric 3: Applicability | High | Data are for Chemical Substances in Construction, Paint, Electrical, and Metal Products, an in-scope occupational scenario. |
| | Metric 4: Temporal Representativeness | Low | Monitoring data are greater than 20 years old. |
| | Metric 5: Sample Size | Medium | Sample distribution characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | Low | Sample type provided but no other metadata. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | High | Uncertainty is addressed in sampling/analytical methodology. Variability addressed by taking both personal and area samples on multiple dates. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Labar, G. (1989). Upjohn's prescription for controlling asbestos. Occupational Hazards 51(9):55. |
| **HERO ID:** | 6896049 |
| **Conditions of Use:** | Consumer Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Workers in a production facility, labs and other buildings owned by Upjohn Co. |
| Exposure route: | inhalation (2/5) |
| Physical form: | fibers (2/5) |
| Area sampling data: | Recent building surveys have found asbestos to be present in ambient air at or below 0.01 f/cc. (2/5) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Low | Sampling methodology is not specified. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | Low | Monitoring data applies to ambient air at industrial buildings which may be similar to occupational exposure from construction and building materials. |
| | Metric 4: | Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| | Metric 5: | Sample Size | Low | Distribution of samples is qualitative or characterized by no statistics. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Exposure type and sampling data provided, but missing number of workers, exposure duration, frequency, particle size, engineering controls, and PPE. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination **Low**

| | |
|---|---|
| **Study Citation:** | Lamontagne, A. D., Van Dyke, M. V., Martyny, J. W., Ruttenber, A. J. (2001). Cleanup worker exposures to hazardous chemicals at a former nuclear weapons plant: piloting of an exposure surveillance system. Applied Occupational and Environmental Hygiene 16(2):284-290. |
| **HERO ID:** | 1279240 |
| **Conditions of Use:** | Disposal |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Cleanup Use of hand tools for size reduction, disassembly, etc. Use of powered tools for size reduction, disassembly, etc. Hot cutting or welding Decon: Wet methods Decon: Mechanical methods (e.g. dry wiping, sweeping) HEPA Vacuuming Abrasive methods (e.g. sanding, grinding, CO2 blasting) Draining of pipe, tank, or other containers Coating removal (paint, adhesives, etc.) Asbestos removal/abatement (including clearances samples) On-site transport of waste materials Materials consolidation Sorting, packaging, or repackaging waste materials Demolition of buildings or other large structures Environmental remediation Application of fixtures to surfaces to contain contaminants Polymer Macro-Encapsulation Miscellaneous—not covered by current coding choicesWaste management Waste treatment (e.g. thermal desorption, vitrification) Waste storage operations Handling wet combustibles(high solvent content) Leak/spill response or follow-up (environmental or indoors) Miscellaneous—not covered by current coding choicesAssessment of Contamination Collection of samples or use of Direct Reading Instrument (e.g., Geiger Counter, Organic Vapor Meter)Observation Observation of any work type or task group Facility Maintenance Housekeeping (e.g. mopping, sweeping, trash removal) Ventilation system maintenance General maintenance of equipment or building Miscellaneous—not covered by current coding choices |
| Exposure route: | inhalation |
| Physical form: | inhalable fibers |
| Personal sampling data: | TWA Median 0.065 f/cc (range 0.020-0.26 f/cc) TWA-8 Median 0.0082 f/cc (range 0.0020-0.057 f/cc) |
| Number of workers: | 1715 RFETS employees. |
| Personal protective equipment: | respirators were worn for 89 % of the samples |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | High | Used NIOSH methods ( not specified) |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | US |
| | Metric 3: | Applicability | High | The data are for an occupational scenario (Nuclear weapons processing plant clean up) within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Medium | 1995-1998 after PEL but more than 20 years old. |
| | Metric 5: | Sample Size | Medium | median value and range provided. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Monitoring data include most critical metadata, such as sample type, exposure type, sample durations, and worker activities, but lacks additional metadata, such as exposure durations and exposure frequency. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | High | Range data are provided to evaluate variability, it is assumed that uncertainty is addressed in implementing the NIOSH method. |

**Continued on next page . . .**

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| | |
|---|---|
| **Study Citation:** | Lamontagne, A. D., Van Dyke, M. V., Martyny, J. W., Ruttenber, A. J. (2001). Cleanup worker exposures to hazardous chemicals at a former nuclear weapons plant: piloting of an exposure surveillance system. Applied Occupational and Environmental Hygiene 16(2):284-290. |
| **HERO ID:** | 1279240 |
| **Conditions of Use:** | Disposal |

| | | EVALUATION | |
|---|---|---|---|
| Domain | Metric | Rating | Comments |
| **Overall Quality Determination** | | **High** | |

| | |
|---|---|
| **Study Citation:** | Landrigan, P. J., Diliberti, J. H., Graef, J. W., Jackson, R. I., Nathenson, G. (1987). American Academy of Pediatrics Committee on Environmental Hazards: Asbestos exposure in schools. Pediatrics 79(2):301-305. |
| **HERO ID:** | 3083143 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Area sampling data: | Levels in schools may exceed outdoor ambient levels by a factor of approximately 100, although at least 3 to 4 orders of magnitude lower than historic workplace levels. |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Sampling and Analytical Methodology | Low | Sampling or analytical methodology is not specified. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | The data are from the United States and are representative of the industry being evaluated. |
| Metric 3: | Applicability | High | The data are for an occupational scenario within the scope of the risk evaluation. |
| Metric 4: | Temporal Representativeness | Low | more than 20 years old. |
| Metric 5: | Sample Size | Medium | range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Uninformative | Monitoring data does not provide the actual concentration or comparison concentration(ambient levels). The study also does not provide a citation for the referred air concentration levels. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Low | The monitoring study does not address variability or uncertainty. |

## Overall Quality Determination Uninformative

| | |
|---|---|
| **Study Citation:** | Landrigan, P. J., Lioy, P. J., Thurston, G., Berkowitz, G., Chen, L. C., Chillrud, S. N., Gavett, S. H., Georgopoulos, P. G., Geyh, A. S., Levin, S., Perera, F., Rappaport, S. M., Small, C. (2004). Health and environmental consequences of the world trade center disaster. Environmental Health Perspectives 112(6):731-739. |
| **HERO ID:** | 56631 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Firefighters, police, paramedics, other first responders, and construction workers and volunteers who worked initially in rescue and recovery after 9/11. (1/9) |
| Exposure route: | inhalation (3/9) |
| Physical form: | fibers in settled dust (4/9) |
| Personal sampling data: | There were no 8-hr time-weighted average asbestos exposures to workers above the OSHA standard, which uses the PCM measurement technique of 0.1 fiber/cm3. (4/9) |
| Area sampling data: | (TEM) Twenty-two of the air samples analyzed by the U.S. EPA were found to contain asbestos at levels above the clearance standard of 70 fibers/mm2. (4/9) |
| Number of workers: | 10,116 firefighters |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Sampling and Analytical Methodology | High | Sampling/analytical methodology is equivalent to an approved [OSHA/NIOSH] method. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | Data are from the U.S. |
| Metric 3: | Applicability | High | Data are for cleanup and disposal of asbestos material, an in-scope occupational scenario. |
| Metric 4: | Temporal Representativeness | Medium | Monitoring data were collected after the most recent PEL and greater than 10 years old. |
| Metric 5: | Sample Size | Medium | Sample distribution characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Medium | Sample type and exposure type provided, but missing exposure duration, frequency, number of workers, particle size, PPE, and engineering controls. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Medium | Uncertainty is addressed in sampling/analytical methodology. Variability is not addressed. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Lange, J. H. (1999). A statistical evaluation of asbestos air concentrations. Indoor and Built Environment 8(5):293-303. |
| **HERO ID:** | 3091882 |
| **Conditions of Use:** | Disposal |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Abatement of sprayed-on ceiling ACM in a public housing building. [PDF Pg. 2] |
| Personal sampling data: | Personal Exposure Summary (f/cm^3) [PDF Pg. 4]# Samples: 39Mean Conc: 0.024Standard Deviation: 0.015Geometric Mean: 0.021Geometric Standard Deviation: 1.73Range of Conc: 0.007-0.081Individual Worker DataWorker A# Samples: 6Mean Conc: 0.021Standard Deviation: 0.009Geometric Mean: 0.018Geometric Standard Deviation: 1.71Range of Conc: 0.014-0.032Worker B# Samples: 6Mean Conc: 0.025Standard Deviation: 0.008Geometric Mean: 0.024Geometric Standard Deviation: 1.39Range of Conc: 0.009-0.032Worker C# Samples: 5Mean Conc: 0.025Standard Deviation: 0.020Geometric Mean: 0.021Geometric Standard Deviation: 2.05Range of Conc: 0.011-0.056Worker D# Samples: 4Mean Conc: 0.021Standard Deviation: 0.008Geometric Mean: 0.020Geometric Standard Deviation: 1.38Range of Conc: 0.014-0.033Worker E# Samples: 3Mean Conc: 0.023Standard Deviation: 0.016Geometric Mean: 0.020Geometric Standard Deviation: 1.93Range of Conc: 0.042 |
| Area sampling data: | Area Exposure Summary (f/cm^#)# Samples: 39Mean Conc: 0.005Standard Deviation: 0.003Geometric Mean: 0.005Geometric Standard Deviation: 1.67Range of Conc: 0.002-0.013 |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Sampling and Analytical Methodology | High | Sampling/analytical methodology is an approved NIOSH method [7400]. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | High | Data are from the U.S. |
| | Metric 3: Applicability | High | Data are for disposal, an in-scope, occupational scenario. |
| | Metric 4: Temporal Representativeness | Low | Monitoring data are greater than 20 years old. |
| | Metric 5: Sample Size | Medium | Sample distribution characterized by limited statistics (range, standard deviation, mean) but discrete samples not provided and distribution not fully characterized. |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | Medium | Sample type and exposure type provided but missing exposure frequency and exposure duration. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | High | Uncertainty is addressed in sampling/analytical methodology. Variability addressed by sampling multiple workers. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Lange, J. H. (2005). Asbestos-containing floor tile and mastic abatement: Is there enough exposure to cause asbestos-related disease?. Indoor and Built Environment 14(1):83-88. |
| **HERO ID:** | 3091895 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Removal of floor tiles and mastic. (2/6) |
| Exposure route: | inhalation (2/6) |
| Physical form: | fibers (2/6) |
| Personal sampling data: | (PCM) 7 studies of floor tile removal were summarized in this report. The first study reported personal sample concentrations of 0.02 f/cc. The second through seventh studies reported mean concentrations of 0.015, 0.012, <0.005-0.02, 0.008-0.016, 0.005, and 0.003 f/cc, respectively, (3/6) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Medium | Sampling methodology isn't specified in this report, but are provided in the studies the report cites. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for demolition of asbestos products, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Most of the sources used for obtaining the monitoring data are more than 20 years old. |
| | Metric 5: | Sample Size | Medium | Sample distribution characterized by limited statistics (means, ranges) but discrete samples not provided and distribution not fully characterized. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Exposure type and sampling data provided, but missing number of workers, exposure duration, frequency, particle size, engineering controls, and PPE. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | High | Uncertainty is addressed in the discussion section. Variability is addressed by including results from 7 studies. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Lange, J. H. (2002). Impact of asbestos concentrations in floor tiles on exposure during removal. International Journal of Environmental Health Research 12(4):293-300. |
| **HERO ID:** | 3531070 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Abatement practices consisted of scraping and lifting tile using ice scrappers (manual removal), with little if any water applied. Some floor tile that was well adhered had to be removed by pounding with hammers. A full containment was established in both schools with a multi-stage (three) decontamination station (EPA 1987). [PDF Pg. 3] |
| Personal sampling data: | [PDF Pg. 5] 8-hr TWA samplesSchool 1Worker A: 0.033;0.008; 0.033 (f/cc)Worker B: 0.015 (f/cc)Worker C: 0.014; 0.012; 0.020 (f/cc)School 2Worker A: 0.016 (f/cc)Worker B: 0.028 (f/cc)Worker C: 0.005 (f/cc) |
| Exposure frequency: | Time of actual removal for each area was 3–5 days [PDF Pg. 4]. |
| Number of workers: | 3-8 workers/day for the abatement job |
| Engineering control: | Negative pressure was employed using High Efficiency Particulate Air filtered negative air machines (at least four air exchanges per hour) (EPA 1987). [PDF Pg. 3] |
| Comments: | Filters were analyzed using the NIOSH 7400 method employing phase contrast microscopy (NIOSH 1977). [PDF Pg. 4] |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | High | Sampling/analytical methodology is an approved NIOSH/OSHA method. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for Chemical Substances in Construction, Paint, Electrical, and Metal Products, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Monitoring data are greater than 20 years old. (2002) |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | Monitoring data include all associated metadata, including sample types, exposure types, sample durations, exposure durations worker activities, and exposure frequency. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | High | Uncertainty is addressed in sampling/analytical methodology. Variability addressed by sampling at two schools. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Lange, J. H. (2005). Airborne exposure during asbestos abatement of floor tile, wall plaster, and pipe insulation. Bulletin of Environmental Contamination and Toxicology 74(1):70-72. |
| **HERO ID:** | 3531075 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Workers involved in removal of floor tile, pipe insulation and wall plaster (pg 70) |
| Exposure route: | Inhalation |
| Physical form: | Fiber |
| Personal sampling data: | As indicated in Table 1 on pg 72, for floor tiles: AM & GM = 0.010 f/cc; for plaster: AM = <0.003 f/cc; and pipe personal: AM = 0.017 f/cc. All values are TWA. |
| Area sampling data: | As indicated in Table 1 on pg 72, for plaster area: AM = 0.011 and GM = 0.010 f/cc. All values are TLA. |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Medium | Sampling or analytical methodology is not equivalent to an approved OSHA or NIOSH method and EPA review of information indicates the methodology is acceptable. Differences in methods are not expected to lead to lower quality data. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | The data are from the United States. |
| | Metric 3: | Applicability | High | The data are for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Low | Although the article is from 2004 but the monitoring data was collected in 2001. |
| | Metric 5: | Sample Size | Medium | Range and mean provided but each monitoring result was not provided. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Monitoring data include most critical metadata, such as sample type and exposure type, but lacks additional metadata, such as sample durations, exposure durations, and exposure frequency. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | Variability is addressed by including both area and personal samples but uncertainty is not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Lange, J. H. (2001). Occupational exposure during removal of windows with lead-based paint and asbestos caulking. Bulletin of Environmental Contamination and Toxicology 66(2):146-149. |
| **HERO ID:** | 82307 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Abatement was conducted by physically removing the window with its frame. This required under some conditions cutting part of the frame and/or window into sections. |
| Exposure route: | inhalation |
| Physical form: | fibers |
| Personal sampling data: | 7+ samples, range <0.0028-0.0394 f/cc, arithmetic mean 0.01 f/cc |
| Area sampling data: | Door/frame removal: 5.7 mg/m^3 |
| Number of workers: | 3-4 people on site per day |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Sampling and Analytical Methodology | High | Sampling or analytical methodology is an approved OSHA or NIOSH method or is well described and found to be equivalent to approved OSHA or NIOSH methods. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | High | The data are from the United States and are representative of the industry being evaluated. |
| | Metric 3: Applicability | High | The data are for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: Temporal Representativeness | Low | The data were collected before the most recent PEL establishment or update or are more than 20 years old if no PEL is established. |
| | Metric 5: Sample Size | Medium | Distribution of samples is characterized by a range but individual data values are not given. |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | Medium | Monitoring data include most critical metadata, such as sample type and exposure type, but lacks additional metadata, such as sample durations, and exposure durations. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Medium | Variability is addressed by including both personal and area sample but uncertainty is not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Lange, J. H., Kuhn, B. D., Thomulka, K. W., Sites, S. L. M. (2000). A study of area and personal airborne asbestos samples during abatement in a crawl space. Indoor and Built Environment 9(3-4):192-200. |
| **HERO ID:** | 3541601 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Worker involved in abatement activities in crawl space. The type of abatement work involved removal of friable pipe insulation, contaminated dirt, encapsulation, and cleanup of asbestos-containing material (pg 193). |
| Exposure route: | inhalation (pg 193) |
| Personal sampling data: | In Building 1, asbestos concentration was 0.07 +/- 0.04 f/cm3 TWA. In Building 2, asbestos concentration was 0.08 +/- 0.10 f/cm3 TWA (n=13) and 0.05 +/- 0.03 f/cm3 TWA (n=12+) . (pg 194) |
| Area sampling data: | In Building 1, asbestos concentration was 0.03 +/- 0.02 f/cm3 TWA. In Building 2, asbestos concentration was 0.03 +/- 0.04 f/cm3 TWA (n=13) and 0.02 +/- 0.02 f/cm3 TWA (n=12+) . (pg 194) |
| Exposure duration: | 8 hours (pg 193) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | High | Sampling or analytical methodology is an approved OSHA method |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | The data are from the United States. |
| | Metric 3: | Applicability | High | The data are for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Low | The data were collected more than 20 years ago. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Monitoring data include most critical metadata, but lacks additional metadata such as exposure frequency. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | High | Monitoring report addresses variability by collecting measurements from different locations, as well as multiple sampling types (area and personal). Measurement uncertainty is addressed through the number of samples collected of each type. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Lange, J. H., Lange, P. R., Reinhard, T. K., Thomulka, K. W. (1996). A study of personal and area airborne asbestos concentrations during asbestos abatement: A statistical evaluation of fibre concentration data. Annals of Occupational Hygiene 40(4):449-466. |
| **HERO ID:** | 3091819 |
| **Conditions of Use:** | Disposal |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | removal of boiler/pipe insulation in crawl space, ceiling tile, transite, floor tile/mastic; mastic removal with air filter blast track (shot-blast) machine; asbestos abatement may involve removal, encapsulation, enclosure, or operations and maintenance |
| Physical form: | ”fibres may also dry out during their travel, resulting in re-entrainment into the air, at least to a partial degree; as these fibres began to dry out, they may fracture resulting in anumerically larger fibre concentration. (pg 12 of PDF)” |
| Personal sampling data: | Personal samples: data stratified by different abatement measures with number of samples, mean, geometric mean, range, and sample distribution provided for each; overall range for personal samples was 0.005 f/cm3 (fibers per cubic centimeter) to 0.957 f/cm3 (pg 7 of PDF) |
| Area sampling data: | Area samples: data stratified by different abatement measures with number of samples, mean, geometric mean, range, and sample distribution provided for each; overall range for area samples was 0.005 f/cm3 (fibers per cubic centimeter) to 1.542 f/cm3 (pg 7 of PDF) |
| Engineering control: | Containments for the work area inside buildings (pipe/boiler, floor tile and mastic) consisted of critical barriers on the windows, ventilation system intakes and exhausts, electric plugs, light switches, light fixtures and related items |
| Comments: | Exposures during asbestos abatement activities (e.g., asbestos removal) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | High | Sampling/analytical methodology is an approved NIOSH method. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for asbestos present in the demolition/abatement industries, which is an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Medium | Monitoring data were collected after the most recent PEL and greater than 10 years old. |
| | Metric 5: | Sample Size | Medium | Sample distribution characterized by limited statistics (range, mean, geometric mean, stadard deviation, number of samples), but discrete samples not provided and distribution not fully characterized. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | All metadata provided. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | High | Uncertainty is addressed in sampling/analytical methodology. Variability addressed by comparison of area and personal samples and sampling verious locations/tasks. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Lange, J. H., Sites, S. L., Mastrangelo, G., Thomulka, K. W. (2008). Exposure to airborne asbestos during abatement of ceiling material, window caulking, floor tile and roofing material. Bulletin of Environmental Contamination and Toxicology 80(1):10-13. |
| **HERO ID:** | 2604770 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Abatement of plaster, floor tiles, caulking, and roofing. (2/4) |
| Exposure route: | inhalation (2/4) |
| Physical form: | fibers (2/4) |
| Personal sampling data: | Personal samples (including excursion samples) were: For floor tile abatement in project A: Personal: <0.01 f/cc (<0.01-<0.02 f/cc), Excursion: <0.08 f/cc (<0.08 f/cc)For floor tile abatement in project B: Personal: <0.01 f/cc (<0.01-<0.02 f/cc), Excursion: <0.08 f/cc (<0.08 f/cc)For roofing abatement: Personal: <0.01 f/cc (<0.01 f/cc), Excursion: <0.08 f/cc (<0.08 f/cc)For window caulking abatement: Personal: <0.01 f/cc (<0.01 f/cc), Excursion: <0.08 f/cc (<0.08 f/cc)For plaster abatement: Personal: 0.02 f/cc (<0.01-0.05 f/cc), Excursion: 0.09 f/cc (<0.08–0.24 f/cc) |
| Area sampling data: | AM and (ranges) for Area samples: For floor tile abatement in project A: Background: <0.01 f/cc (<0.01 f/cc), Perimeter: <0.01 f/cc (<0.01–<0.03 f/cc)For floor tile abatement in project B: Background: <0.01 f/cc (<0.01 f/cc), Perimeter: <0.01 f/cc (<0.01–<0.02 f/cc)For roofing abatement: Perimeter: <0.01 f/cc (<0.01–<0.02 f/cc)For window caulking abatement: Perimeter: <0.01 f/cc (<0.01–<0.02 f/cc)For plaster abatement: Perimeter: <0.01 f/cc (<0.01–<0.02 f/cc) |
| Personal protective equipment: | During these activities workers were required to wear respirators (3/4) |
| Engineering control: | Plaster and floor tile/mastic (FT/mastic) abatement involved establishment of critical barriers and full enclosure with a decontamination chamber (three stages and negative air filtration – NAF). Caulking removal did not include removal of windows; although, had a critical barrier enclosure around the window with no NAF. Wet methods were employed for plaster only. (2/4) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | High | Sampling/analytical methodology is equivalent to an approved [OSHA/NIOSH] method. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for commercial abatement of construction materials, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Medium | Monitoring data were collected after the most recent PEL and greater than 10 years old. |
| | Metric 5: | Sample Size | Medium | Sample distribution characterized by limited statistics (means, standard deviations, ranges) but discrete samples not provided and distribution not fully characterized. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Exposure type and sampling data provided, but number of workers, exposure duration, frequency, and particle size not provided. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | Uncertainty is not addressed. Variability is addressed by sampling three different projects. |

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| | |
|---|---|
| **Study Citation:** | Lange, J. H., Sites, S. L., Mastrangelo, G., Thomulka, K. W. (2008). Exposure to airborne asbestos during abatement of ceiling material, window caulking, floor tile and roofing material. Bulletin of Environmental Contamination and Toxicology 80(1):10-13. |
| **HERO ID:** | 2604770 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

| | | **EVALUATION** | |
|---|---|---|---|
| Domain | Metric | Rating | Comments |
| **Overall Quality Determination** | | **High** | |

| | |
|---|---|
| **Study Citation:** | Lange, J. H., Sites, S. L., Mastrangelo, G., Thomulka, K. W. (2006). Exposure to airborne asbestos during abatement of ceiling material, window caulking, floor tile, and roofing material. Bulletin of Environmental Contamination and Toxicology 77(5):718-722. |
| **HERO ID:** | 3531082 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | asbestos abatement |
| Exposure route: | inhalation |
| Physical form: | airborne fibers |
| Personal sampling data: | Table (pg 4): presents means and ranges for sampling data: <0.01-0.24 f/cc |
| Area sampling data: | background levels: <0.01 f/cc (pg 3)Table (pg 4): presents means and ranges for sampling data: <0.01-<0.03 f/cc |
| Personal protective equipment: | respirators (pg 3) |
| Engineering control: | critical barriers and full enclosure with a decontamination chamber (three stage and negative air filtration); wet methods (pg 2) |

**EVALUATION**

| Domain | | Metric | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Medium | Sampling/analytical methodology is not an approved OSHA/NIOSH method but is an acceptable methodology. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for construction materials, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Medium | Monitoring data were collected after the most recent PEL and greater than 10 years old. |
| | Metric 5: | Sample Size | Medium | Sample distribution characterized by limited statistics (means, ranges, SD) but discrete samples not provided and distribution not fully characterized. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Low | Sample type provided but no other metadata. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | The monitoring study provides only limited discussion of the variability in the determinants of exposure for the sampled site or sector. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Lange, J. H., Thomulka, K. W. (2000). Air sampling during asbestos abatement of floor tile and mastic. Bulletin of Environmental Contamination and Toxicology 64(4):497-501. |
| **HERO ID:** | 3080795 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Exposure measurements, area and personal samples, were collected during asbestos abatement of floor tile and mastic in a three story dormitory type building (25,000 square feet-abated) in Pennsylvania, USA.Floor tile abatement (removal) was performed using scrape and lift and mastic by chemical solvent. Little water was used for abatement of floor tile. |
| Exposure route: | inhalation |
| Physical form: | fibers/dust |
| Personal sampling data: | Type of Sampletot Sample T (min) Sample Conc. (f/cc) 8 hr TWA Conc. (f/cc)Personal2310.0340.017Personal2170.0250.011Personal1960.0940.021Personal570.036<0.01Personal19 MeanGeo MeanStd. Dev.Geo. Std. Dev.Personal110.0290.0180.0262.8110+0.0220.0150.0172.54 |
| Area sampling data: | Type of Sampletot Sample T (min) Sample Conc. (f/cc)8 hour TWA Conc. (f/cc)Area1000.026<0.01Area860.018<0.01Area1520.008<0.01Area3930.007<0.01Area1180.02<0.01A MeanGeo MeanStd. Dev.Geo. Std. Dev.Area140.0140.0070.0173.1413+0.010.0060.0082.73 |
| Engineering control: | Engineering controls consisted of employment of negative air machines with an exchange rate of at least four changes per hour. Polyethylene barriers (6 mil) and a three stage decontamination station were employed. |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Sampling and Analytical Methodology | High | Sampling or analytical methodology is an approved OSHA or NIOSH method or is well described and found to be equivalent to approved OSHA or NIOSH methods. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | High | Data are from the U.S. |
| | Metric 3: Applicability | High | Data are for Industrial/Commercial Use: Chemical Substances in Construction, Paint, Electrical, and Metal Products, an in-scope occupational scenario. |
| | Metric 4: Temporal Representativeness | Low | The data were collected before the most recent PEL establishment or update or are more than 20 years old if no PEL is established. |
| | Metric 5: Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | Medium | Monitoring data include most critical metadata, such as sample type and exposure type, but lacks additional metadata, such as exposure durations and exposure frequency. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Medium | Variability is addressed by including personal and area samples but uncertainty is not addressed. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Lange, J. H., Thomulka, K. W. (2000). An evaluation of personal airborne asbestos exposure measurements during abatement of dry wall and floor tile/mastic. International Journal of Environmental Health Research 10(1):5-19. |
| **HERO ID:** | 3091821 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Floor tile was abated by a lift and scrape technique. Little if any wetting was used for removal of the floor tile. Mastic was abated by shot blasting (US Filter Blastrac Track, Oklahoma, OK) and chemical methods All areas were abated by shot blasting except edges and locations where the machine could not be employed. Dry wall was abated by wet techniques and physical destruction methods (p. 2) |
| Personal sampling data: | Exposure concentrations for dry wall and floor tile/mastic abatement were 0.85 f/cm3-TWA (time-weighted average) and 0.04 f/cm3-TWA for arithmetic means and 0.72 f/cm3-TWA and 0.03 f/cm3-TWA for geometric means, respectively.Table 149 dry wall samples, range 0.12-2.03 (mean: 0.76, 0.85)23 FT/Mastic samples, range 0.01-0.08 (mean 0.04)See Table 1, pg. 4/15 |
| Exposure duration: | Each shift was 8 h in length with one shift per day. |
| Number of workers: | The number of workers per shift was approximately four. |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | High | Sampling or analytical methodology is an approved OSHA or NIOSH method or is well described and found to be equivalent to approved OSHA or NIOSH methods. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | The data are from the United States and are representative of the industry being evaluated. |
| | Metric 3: | Applicability | High | The data are for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Low | Data are more than 20 years old. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | Monitoring data include all associated metadata, including sample types, exposure types, sample durations, exposure durations worker activities, and exposure frequency. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | High | The monitoring study addresses variability in the determinants of exposure for the sampled site or sector. The monitoring study addresses uncertainty in the exposure estimates or uncertainty canbe determined from the sampling and analytical method. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Lange, J. H., Thomulka, K. W. (2000). Area and personal airborne exposure during abatement of asbestos-containing roofing material. Bulletin of Environmental Contamination and Toxicology 64(5):673-678. |
| **HERO ID:** | 3531083 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Exposure to asbestos during abatement of roofing materials |
| Personal sampling data: | Exposure concentration personal samples ranged from0.0047 to 0.0752 f/cc. (P. 3/6) |
| Area sampling data: | Exposure concentration for area samples ranged from<0.0006 to 0.0162 f/cc. (P. 3/6) |
| Personal protective equipment: | The most commonly referenced requirement involving personal protection is employment of a respirator (Lange et al. 1996). |
| Engineering control: | Water from a hose was used to wet the roof before abatement andwhen cuts were undertaken. |
| Comments: | Table 1. Summary statistics for area and personal sample concentrations,in f/cc (non-TWA), for abatement of roofing material. |

**EVALUATION**

| Domain | | Metric | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | High | Sampling or analytical methodology is an approved OSHA or NIOSH method or is well described and found to be equivalent to approved OSHA or NIOSH methods. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | The data are from the United States and are representative of the industry being evaluated. |
| | Metric 3: | Applicability | High | The data are for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Low | Report is more than 20 years old. |
| | Metric 5: | Sample Size | Medium | Mean, standard deviation, and range given but individual data points not provided. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Monitoring data include most critical metadata, such as sample type and exposure type, but lacks additional metadata, such as sample durations, exposure durations, and exposure frequency. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | Personal and area samples included to address variability but uncertainty is not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Lange, J. H., Thomulka, K. W. (2001). Personal exposure to asbestos during removal of asbestos-containing window caulking and floor tile/pipe insulation. Fresenius Environmental Bulletin 10(8):688-691. |
| **HERO ID:** | 3585971 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Removal of window caulking by scraping with a putty knife. Removal of pipe insulation and floor tiling. [PDF Pg. 2] |
| Exposure route: | Inhalation |
| Physical form: | Fibers |
| Personal sampling data: | Units in (f/cc) [PDF Pg. 2]Window Caulking# samples: 9Arithmetic mean: 0.008Geometric mean: 0.006Range: <0.002 - 0.013Window Caulking# samples: 4Arithmetic mean: 0.05Geometric mean: 0.03Range: <0.004-0.08Floor tile/pipe insulation# samples: 10Arithmetic mean: 0.024Geometric mean: 0.01Range: <0.002-0.13Floor tile/pipe insulation# samples: 1Arithmetic mean: 0.005Geometric mean: NDRange: ND |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Sampling and Analytical Methodology | High | Sampling/analytical methodology is an approved NIOSH/OSHA method. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | High | Data are from the U.S. |
| | Metric 3: Applicability | High | Data are for construction, paint, electrical, and metal products, an in-scope occupational scenario. |
| | Metric 4: Temporal Representativeness | Low | Monitoring data are greater than 20 years old. |
| | Metric 5: Sample Size | Medium | Sample distribution characterized by limited statistics (min, max, mean) but discrete samples not provided and distribution not fully characterized. |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | Medium | Sample type and exposure type provided but missing exposure frequency and duration. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | High | Uncertainty is addressed in sampling/analytical methodology. Variability addressed by sampling multiple worker activities. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Lange, J. H., Thomulka, K. W. (2002). Airborne exposure concentrations during asbestos abatement of ceiling and wall plaster. Bulletin of Environmental Contamination and Toxicology 69(5):712-718. |
| **HERO ID:** | 3585972 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Abatement workers removing ACM (plaster) from a school building. (1/7) |
| Exposure route: | inhalation (2/7) |
| Personal sampling data: | (PCM) Personal sampling had a mean of 0.007+-0.007 f/cc and a range of <0.006-0.031 f/cc. (3/7) |
| Area sampling data: | (PCM) Area samples had a mean of 0.013+-0.019 f/cc and range of 0.0009-0.069 f/cc. (3/7) |
| Personal protective equipment: | Respirator |
| Engineering control: | NAMs and HEPA filters were employed to achieve at least 4 air exchanges per hour. (2/7) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | High | Sampling or analytical methodology is an approved OSHA or NIOSH method or is well described and found to be equivalent to approved OSHA or NIOSH methods. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for asbestos abatement, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | The data were collected before the most recent PEL establishment or update or are more than 20 years old if no PEL is established. |
| | Metric 5: | Sample Size | Medium | Sample distribution characterized by limited statistics (mean, standard deviations, ranges, confidence intervals) but discrete samples not provided and distribution not fully characterized. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Sample type and exposure type provided, but missing physical form, exposure duration and frequency, and particle size. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | High | Uncertainty is addressed in sampling/analytical methodology. Variability addressed by using multiple sampling/analysis methods. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Lange, J. H., Thomulka, K. W. (2000). Occupational exposure to airborne asbestos during abatement of asbestos-containing pipe and boiler insulation. Fresenius Environmental Bulletin 9(7-8):477-482. |
| **HERO ID:** | 3586137 |
| **Conditions of Use:** | Disposal |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Abatement of boiler and pipe insulation in an electric power plant.[PDF Pg. 1] |
| Exposure route: | Inhalation. |
| Personal sampling data: | Summary of Personal Air Sampling (f/cc) [PDF Pg. 3]Number of samples: 101Arithmetic Mean: 0.03Geometric Mean: 0.02Standard Deviation: 0.01Geometric Standard Deviation: 1.6Range: <0.01 - 0.08 |
| Comments: | Throughput and chemical concentration are not discussed. |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Sampling and Analytical Methodology | High | Sampling/analytical methodology is an approved NIOSH method (NIOSH 7400). |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | High | Data are from the U.S. |
| | Metric 3: Applicability | High | Data are for disposal, an in-scope occupational scenario. |
| | Metric 4: Temporal Representativeness | Low | Monitoring data are greater than 20 years old. |
| | Metric 5: Sample Size | Medium | Sample distribution characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | Medium | Sample type and exposure type provided but missing exposure duration and frequency. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Medium | Uncertainty is addressed in sampling/analytical methodology but variability is not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Lange, J. H., Thomulka, K. W., Lee, R. H., Van Orden, D. R. (2002). Surface and passive monitoring for asbestos in an industrial facility. Indoor and Built Environment 11(6):327-333. |
| **HERO ID:** | 3541655 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Area sampling data: | Surface concentrations ranged from the limit of detection (25 structures/mm^2) to 363,400 structures/mm^2 (PDF Page 1).Table 1 on PDF Page 3 provides a summary of the statistics found for sampling in control rooms. Units are in structures/mm^2. Values in parentheses represent the number of structures greater than 5 um in length.Control Room ACountertop:Sample1 - 147,075 (215)Sample2 - 144,980 (240)Sample3 - 14,445 (<25)Sample4 - 1,555 (240)Sample5 - 770 (215)AM - 61,765SD - 77,115GM - 12,991GSD - 11.7Wall:Sample1 - 630 (<25)Sample2 - 12,115 (<25)Sample3 - 25 (<25)Sample4 - 555 (215)Sample5 - 25 (<25)AM - 2,670SD - 5,288GM - 305GSD - 13.4Floor:Sample1 - 6,345 (265)Sample2 - 15,265 (120)Sample3 - 2,490 (70)Sample4 - 385 (25)Sample5 - 134 (5)AM - 4,924SD - 6,293GM - 1,656GSD - 7.1Control Room BCountertop:Sample1 - 4,285 (<25)Sample2 - 1,960 (120)Sample3 - 8,725 (70)Sample4 - 13,925 (525)Sample5 - 21,210 (70)AM - 10,021SD - 7,746GM - 7,347GSD - 2.6Wall:Sample1 - 6,865 (<25)Sample2 - 475 (25)Sample3 - 25 (<25)Sample4 - N/ASample5 - N/AAM - 2,455SD - 3,826GM - 433GSD - 16.5Floor:Sample1 - 363,400 (9,300)Sample2 - 625 (25)Sample3 - 14,070 (240)Sample4 - 97,000 (215)Sample5 - 156,410 (240)AM - 126,301SD - 146,945GM - 34,407GSD - 12.6Table 2 on PDF Page 4 provides a summary of statistics for sampling in hallways adjacent to the control rooms.First HallwayFloor:Sample1 - 5,140 (70)Sample2 - 3,590 (120)Sample3 - 80,925 (70)Sample4 - 70 (<25)Sample5 - N/AAM - 22,431.5SD - 39,053.5GM - 3,213GSD - 17.8Hall:Sample1 - 920 (145)Sample2 - <25 (<25)Sample3 - 14,165 (25)Sample4 - <25 (<25)Sample5 - <25 (<25)AM - 3,025SD - 6,240GM - 121GSD - 25.7Second HallwayFloor:Sample1 - 560 (<25)Sample2 - 335 (25)Sample3 - 6,925 (70)Sample4 - 6,070 (<25)Sample5 - N/AAM - 3,472.5SD - 3,512GM - 1,673GSD - 4.8Hall:Sample1 - <25 (<25)Sample2 - 190 (<25)Sample3 - 9,350 (25)Sample4 - 23,745 (70)Sample5 - N/AAM - 8,324SD - 11,167GM - 852GSD - 33.2 |
| Particle size characterization: | Most asbestos structures were smaller than 5 um in length (PDF Page 1) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | High | Sampling/analytical methodology is likely equivalent to an approved OSHA/NIOSH method. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for industrial use in metal production, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Monitoring data are greater than 20 years old. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Low | Sample type provided but no other metadata. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | Variability is addressed by sampling in abated and non-abated areas of an industrial facility to provide a range of data points. Uncertainty is not addressed. |

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|---|---|
| **Study Citation:** | Lange, J. H., Thomulka, K. W., Lee, R. H., Van Orden, D. R. (2002). Surface and passive monitoring for asbestos in an industrial facility. Indoor and Built Environment 11(6):327-333. |
| **HERO ID:** | 3541655 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

| | | **EVALUATION** | |
|---|---|---|---|
| Domain | Metric | Rating | Comments |
| **Overall Quality Determination** | | **Medium** | |

| | |
|---|---|
| **Study Citation:** | Lange, J. H., Thomulka, K. W., Lee, R. J., Dunmyre, G. R. (1995). Evaluation of lift and passive sampling methods during asbestos abatement activities. Bulletin of Environmental Contamination and Toxicology 55(3):325-331. |
| **HERO ID:** | 3585973 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Exposure route: | inhalation |
| Physical form: | inhalable fibers |
| Area sampling data: | 0.001 to 0.031 f/cc ( PCM - NIOSH 7400) |
| Particle size characterization: | Lift sample concentration, in s/0.2 mm 2, for before and after abatement from various locations.Kitchen - metal main serving countertop Before <5um: 117 >5um: 5 Total: 117 After <5um: 94 >5um: <5 Total: 95 Kitchen - metal main serving countertop Before <5um: 5 >5um: <5 Total: 5 After <5um: 41 >5um: <5 Total: 41 Kitchen - metal main serving countertop Before <5um: 5 >5um: <5 Total: 5 After <5um: 165 >5um: <5 Total: 165 Kitchen - metal preparation sink area Before <5um: <5 >5um: <5 Total: <5 After <5um: 41 >5um: <5 Total:41 Kitchen - metal preparation sink area Before <5um: 76 >5um: <5 Total: <5 After <5um: 864 >5um: <5 Total: 864 Kitchen - top of alarm Before <5um: 73 >5um: <5 Total: 73 After <5um: 20 >5um: <5 Total: 20 Kitchen - metal table beside sterilizer Before <5um: <5 >5um: <5 Total: <5 After <5um: 229 >5um: <5 Total: 229 Boiler Room - top of small gas heater Before <5um: 68 >5um: 5 Total: 73 After <5um: 144 >5um: 5 Total: 149 Boiler Room - top of small gas heater Before <5um: 81 >5um: <5 Total: 81 After <5um: 991 >5um: <5 Total: 991 Boiler Room - top of small gas heater Before <5um: 5 >5um: <5 Total: 5 After <5um:458 >5um:10 Total: 468Gym - top of storage cabinet Before <5um: 36 >5um: <5 Total: 36 After <5um: NS >5um: NS Total:NSGym - top of storage cabinet Before <5um: <5 >5um: <5 Total: <5 After <5um: NS >5um: NS Total:NSGym - top of storage cabinet Before <5um: <5 >5um: <5 Total: <5 After <5um: NS >5um: NS Total:NSLocker - top of storage cabinetBefore <5um: 10 >5um: <5 Total: 10 After <5um: <5 >5um: <5 Total:<5Locker - top of storage cabinet Before <5um: NS >5um: NS Total: NS After <5um: <5 >5um: <5 Total:<5Wood Shelf - from an open closet Before <5um: NS >5um: NS Total: NS After <5um: 51 >5um: <5 Total: 51Cabinet heater - top of a wall heater Before <5um: NS >5um: NS Total: NS After <5um: 763 >5um: <5 Total: 763Cabinet heater - top of a wall heaterBefore <5um: NS >5um: NS Total: NS After <5um: 5 >5um:<5 Total 5Cabinet heater - top of a wall heaterBefore <5um: NS >5um: NS Total: NS After <5um: 648 >5um: <5 Total: 648Cabinet heater - top of a wall heater Before <5um: NS >5um: NS Total: NSAfter <5um: 61 >5um: <5 Total 61 |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | High | PCM using NIOSH Method 7400 |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | US |
| | Metric 3: | Applicability | High | The data are for an occupational scenario (Remediation at a school) within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Medium | 1994 - after recent PEL and more than 10 years old |
| | Metric 5: | Sample Size | High | Range and significance provided. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Low | Monitoring data include sample type but no other metadata. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | High | Assumed that uncertainty was addresses in the NIOSH Method 7400. range was provided which could be used to assess variability. |

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|---|---|
| **Study Citation:** | Lange, J. H., Thomulka, K. W., Lee, R. J., Dunmyre, G. R. (1995). Evaluation of lift and passive sampling methods during asbestos abatement activities. Bulletin of Environmental Contamination and Toxicology 55(3):325-331. |
| **HERO ID:** | 3585973 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

| | | EVALUATION | |
|---|---|---|---|
| Domain | Metric | Rating | Comments |
| **Overall Quality Determination** | | **High** | |

| | |
|---|---|
| **Study Citation:** | Lange, J. H., Thomulka, K. W., Sites, S. L. (2002). Comparison of asbestos exposure in a containment system with and without employment of glovebags. Bulletin of Environmental Contamination and Toxicology 69(6):843-846. |
| **HERO ID:** | 3531085 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Worker exposure during asbestos abatement of pipes and boiler insulation. |
| Personal sampling data: | Without glovebag: 53 samples, arithmetic mean (f/cc): 0.023; geometric mean (f/cc): 0.006; standard deviation (f/cc): 0.018; geometric standard deviation (f/cc): 1.9With glovebag: 13 samples, arithmetic mean (f/cc): 0.006; geometric mean (f/cc): 0.016; standard deviation (f/cc): 0.003; geometric standard deviation (f/cc) 2.9(p. 3) |
| Engineering control: | glovebags |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | High | Sampling or analytical methodology is an approved OSHA or NIOSH method or is well described and found to be equivalent to approved OSHA or NIOSH methods. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | The data are from the United States and are representative of the industry being evaluated. |
| | Metric 3: | Applicability | High | The data are for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Medium | Operations, equipment, and worker activities are expected to be reasonably representative of current conditions. The monitoring data are more than 10 years but generally, no more than 20 years old. |
| | Metric 5: | Sample Size | Medium | Distribution of samples is characterized by a range with uncertain statistics |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Monitoring data include most critical metadata, such as sample type and exposure type, but lacks additional metadata, such as sample durations, exposure durations, and exposure frequency. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | High | Uncertainty is addressed by discussing the limitation of the PCM method. Variability is addressed by taking samples with and without glovebags. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Lange, J. H., Thomulka, K. W., Sites, S. L. M. (2003). Airborne concentrations of asbestos during removal of pipe/boiler insulation using glovebags with and without containments. Fresenius Environmental Bulletin 12(5):431-435. |
| **HERO ID:** | 3586138 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | pipe/boiler insulation and tile abatement (abstract)quantity of asbestos removed: 2,000 linear feet of insulation and 1,100 sq ft of floor tile (project 1), 1,900 linear feet of insulation (project 2) (pg 2) |
| Exposure route: | inhalation |
| Physical form: | solid fibers |
| Personal sampling data: | EL samples <0.045 f/cc except for 1 sample (glovebag alone) which was 0.049 (pg 2)Table on pg 4 presents arithmetic means, geometric means, ranges and standard deviations for the various projects with different controls; range: 0.002-0.09 f/cc |
| Exposure duration: | 6 days for project 1, 10 days for project 2 (pg 2)Personal samples were collected as task-length averages (TLA) and excursion limits (EL). TLA samples were determined for only the time period of sampling (1-3 hours) and not adjusted to 8-hr TWA. EL samples collected for 30 minutes. (pg 2) |
| Personal protective equipment: | respirators |
| Engineering control: | glovebags (alone); glovebags used inside two different containment systems (critical barriers and full containment with critical barriers) (abstract)Project 1 employed glovebags alone and glovebags with critical polyethylene plastic barriers covering windows, doors, and other openings but not walls and related structures. (pg 2)Project 2 employed glovebags alone and both critical barriers and full containment. Full containment consisted of polyethylene plastic covering all surfaces in work area, including walls and doors. (pg 2)Both projects consisted of negative pressure system using negative air machines with HEPA filtration (NAM). Floor tile removed under full containment and NAM. All projects employed wet methods for removal as well as had three stage decontamination chambers (pg 2) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Sampling and Analytical Methodology | High | Sampling/analytical methodology is an approved NIOSH method. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | High | Data are from the U.S. |
| | Metric 3: Applicability | High | Data are for construction materials, an in-scope occupational scenario. |
| | Metric 4: Temporal Representativeness | Medium | Monitoring data were collected after the most recent PEL and greater than 10 years old. |
| | Metric 5: Sample Size | Medium | Sample distribution characterized by limited statistics (means, SD, ranges) but discrete samples not provided and distribution not fully characterized. |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | Medium | Sample type and exposure type provided but missing metadata such as exposure frequency. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Medium | Variability is addressed by evaluating exposure with different controls, but uncertainty is not addressed. |

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| | |
|---|---|
| **Study Citation:** | Lange, J. H., Thomulka, K. W., Sites, S. L. M. (2003). Airborne concentrations of asbestos during removal of pipe/boiler insulation using glovebags with and without containments. Fresenius Environmental Bulletin 12(5):431-435. |
| **HERO ID:** | 3586138 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

| | | EVALUATION | |
|---|---|---|---|
| Domain | Metric | Rating | Comments |
| **Overall Quality Determination** | | **High** | |

| | |
|---|---|
| **Study Citation:** | Lange, J. H., Thomulka, K. W., Sites, S. L., Priolo, G., Mastrangelo, G. (2006). Personal airborne asbestos exposure levels associated with various types of abatement. Bulletin of Environmental Contamination and Toxicology 76(3):389-391. |
| **HERO ID:** | 3531086 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Exposure route: | Inhalation |
| Physical form: | Fibers |
| Personal sampling data: | All results are provided as f/ccFT/Mastic Mean: 0.004; Geometric mean: 0.004; SD: 0.003; GSD: 1.5; Range: <0.005-0.015.Pipe insul Mean: 0.014; Geometric mean: 0.010; SD: 0.012; GSD: 2.5; Range: <0.005-0.053.Ceiling tile Mean: 0.005; Geometric mean: 0.005; SD: 0.002; GSD: 1.5; Range: <0.003-0.011.Pipe/boiler insul Mean: 0.010; Geometric mean: 0.009; SD: 0.003; GSD: 1.4; Range: <0.003-0.015.FT/fitting/caulking Mean: 0.006; Geometric mean: 0.005; SD: 0.004; GSD: 2.0; Range: <0.006-0.008.Window caulking Mean: 0.003; Geometric mean: 0.003; SD: 0.007; GSD: 1.3; Range: <0.004-0.007.Roofing Mean: 0.003; Geometric mean: 0.003; SD: 0.008; GSD: 1.3; Range: <0.004-0.007.FT/Mastic Mean: 0.006; Geometric mean: 0.006; SD: 0+ ; GSD: 1.0; Range: 0.006+.Transite pipe Mean: 0.005; Geometric mean: 0.004; SD: 0.002; GSD: 1.8; Range: 0.002-0.006.Mastic Mean: 0.006; Geometric mean: 0.006; SD: 0.0+ ; GSD: 1.0; Range: 0.006+. |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | High | Sampling or analytical methodology is an approved OSHA or NIOSH method or is well described and found to be equivalent to approved OSHA or NIOSH methods. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | The data are from the United States. |
| | Metric 3: | Applicability | High | The data are for an occupational scenario (asbestos abatement at schools) within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Medium | Paper published in 2006 - Sampling performed in 2005. After PEL and more than 10 years old |
| | Metric 5: | Sample Size | High | Results provided as measures of central tendency, arithmetic and geometric means, standard and geometric deviations and ranges. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Monitoring data include most critical metadata such as sample type and exposure type, but lacks additional metadata such as sample durations, exposure durations, exposure frequency, andworker activity details. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | High | The monitoring report addresses variability through sampling multiple worker activities, and measurement uncertainty is captured in the arithmetic and geometric mean and SD. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Lange, J. H., Thomulka, K. W., Sites, S. S., Priolo, G., Buja, A., Mastrangelo, G. (2005). Personal exposure during abatement of various asbestos-containing materials in the same work area. Bulletin of Environmental Contamination and Toxicology 74(6):1034-1036. |
| **HERO ID:** | 3531087 |
| **Conditions of Use:** | Disposal |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Asbestos abatement workers with floor tile, mastic, and window caulking. (1/3) |
| Exposure route: | inhalation (1/3) |
| Physical form: | fibers (3/3) |
| Personal sampling data: | Over 5 studies, asbestos exposure ranged from <0.005-0.065 f/cc. (3/3) |
| Personal protective equipment: | Respirators were employed and were effective at maintaining exposure levels below the PEL. (2/3) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | High | Sampling/analytical methodology is an approved NIOSH method. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for asbestos abatement, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Medium | Monitoring data were collected after the most recent PEL and greater than 10 years old. |
| | Metric 5: | Sample Size | Medium | Sample distribution characterized by limited statistics (mean, ranges, standard deviations) but discrete samples not provided and distribution not fully characterized. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Sample type and exposure type provided, but missing exposure duration, frequency, particle size, number of workers, and engineering controls. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | High | Uncertainty is addressed in sampling/analytical methodology. Variability is addressed by sampling at 5 sites. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Lange, J. H., Wang, M., Buja, A., Mastrangelo, G. (2005). Area and personal exposure measurements during asbestos abatement of a crawl space and boiler room. Bulletin of Environmental Contamination and Toxicology 74(2):388-390. |
| **HERO ID:** | 3531088 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Removal of pipe insulation and boiler insulation. (1/3) |
| Exposure route: | inhalation (3/3) |
| Physical form: | fibers (3/3) |
| Personal sampling data: | (PCM) Personal samples taken during removal were 0.03+-0.11 f/cc with a range of <0.01-0.55 f/cc. (3/3) |
| Area sampling data: | (PCM) Area samples taken during removal were 0.03+-0.15 f/cc with a range of <0.01-0.75 f/cc. (3/3) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | High | Sampling/analytical methodology is equivalent to an approved [OSHA/NIOSH] method. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | The data are for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| | Metric 5: | Sample Size | Medium | Sample distribution characterized by limited statistics (means, ranges, standard deviations) but discrete samples not provided and distribution not fully characterized. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Exposure type and sampling data provided, but missing number of workers, exposure duration, frequency, particle size, engineering controls, and PPE. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | Variability is addressed by including personal and area samples but uncertainty is not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Lange, J., Mastrangelo, G., Cegolon, L. (2011). Asbestos abatement workers versus asbestos workers: exposure and health-effects differ. International Journal of Occupational Medicine and Environmental Health 24(4):418-9; author reply 420-1. |
| **HERO ID:** | 3078752 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Personal sampling data: | asbestos abatement workers: 0.001 to 0.080 f/cc |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Sampling and Analytical Methodology | Low | Sampling/analytical methodology is not specified. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | Medium | Data are from Poland, an OECD country. |
| | Metric 3: Applicability | High | Data are for Industrial/Commercial Use: Chemical Substances in Construction, Paint, Electrical, and Metal Products, an in-scope occupational scenario. |
| | Metric 4: Temporal Representativeness | Medium | Cited study of data is 2006, which is more than 10 years old but generally no more than 20 years old. |
| | Metric 5: Sample Size | Medium | Sample distribution is characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | Uninformative | Sample type and exposure type not provided. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Uninformative

| | |
|---|---|
| **Study Citation:** | Larsen, L. B. (1974). Health hazard evaluation report no. HHE 73-135-138, Kaiser Permanente Cement Company, Lucerne Valley, California. |
| **HERO ID:** | 3970529 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | loading, blending, and bagging of the cement. (2/17) |
| Exposure route: | inhalation |
| Physical form: | solid |
| Personal sampling data: | Table 21.4 - 5.6 f/cc |
| Area sampling data: | Table 2 0.6 - 3.4 f/cc |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Sampling and Analytical Methodology | High | Sampling or analytical methodology is an approved OSHA or NIOSH method or is welldescribed and found to be equivalent to approved OSHA or NIOSH methods. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | High | The data are from the United States and are representative of the industry being evaluated. |
| | Metric 3: Applicability | Uninformative | The report is for processing of asbestos cement - out of scope for this assessment |
| | Metric 4: Temporal Representativeness | Low | Data are more than 20 years old |
| | Metric 5: Sample Size | High | Statistical distribution of samples is fully characterized |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | Medium | Monitoring data include most critical metadata, such as sample type and exposure type, but lacks additional metadata, such as exposure durations and exposure frequency. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Medium | The monitoring study provides only limited discussion of the variability in the determinants of exposure for the sampled site or sector. The monitoring study provides only limited discussion of the uncertainty in the exposure estimates. |

## Overall Quality Determination Uninformative

| | |
|---|---|
| **Study Citation:** | Latif, M. T., Baharudin, N. H., Velayutham, P., Awang, N., Hamdan, H., Mohamad, R., Mokhtar, M. B. (2011). Composition of heavy metals and airborne fibers in the indoor environment of a building during renovation. Environmental Monitoring and Assessment 181(1-4):479-489. |
| **HERO ID:** | 1256097 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | The main renovation actions included demolition, blowing, cutting, sand-blasting, supporting, epoxy painting, the installation of a new steel grid and sheets of concrete, cementing or adding of gypsum and finally, painting. |
| Area sampling data: | Asbestos: 0.0038 +/- 0.0011 f/ccAirborne Fibers:Station 1 0.0022 +/- 0.0002 f/ccStation 2 0.0037 +/- 0.0016 f/ccStation 3 0.0029 +/- 0.0006 f/ccStation 4 0.0030 +/- 0.0006 f/ccStation 5 0.0038 +/- 0.0011 f/cc |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | High | These air samplers were calibrated using a cyclone jar before and after the sampling period (NIOSH 0600). The determination of airborne fiber on the membrane filter was undertaken through the use of a microscope with a phase contrast (NIOSH 7400). Phase contrast microscopy accurately assessed the level of exposure for fibers 5 $\mu$m in length and >0.25 $\mu$m in diameter. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Low | Malaysia - non OECD member |
| | Metric 3: | Applicability | High | The data are for an occupational scenario (building renovation) within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Medium | 2010 - after PEL (1986) and more than 10 years old. |
| | Metric 5: | Sample Size | Medium | Distribution of samples is characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Low | Monitoring data include sample type but no other metadata. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | The monitoring study does not address variability or uncertainty. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Lazaridis, M., Lazaridis, M. (2011). Indoor Air Pollution. 19:255-304. |
| **HERO ID:** | 2331208 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Exposure route: | inhalation |
| Physical form: | inhalable fibers |
| Area sampling data: | Indoor areas Buildings without asbestos materials ~300 fibers/m3Buildings with asbestos materials 700–10.000 fibers/m3 |
| Particle size characterization: | Their size ranges between 1 and 12 mm. The diameter is between 0. and 15 mm (700 times thinner than the width of human hair). In fact the asbestos fibers consist from a pack of parallel thinner fibers which have diameters close to 20–25 nm |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Low | Sampling or analytical methodology is not specified. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Low | unknown |
| | Metric 3: | Applicability | Low | not apparent what the occupational scenario is - just indoors |
| | Metric 4: | Temporal Representativeness | Medium | not certain when the research was implemented - there are references for 1999- so After the PEL (1994) and more than 20 years old |
| | Metric 5: | Sample Size | Low | Distribution of samples is qualitative or characterized by no statistics. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Low | Monitoring data did not include any metadata. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | The monitoring study does not address variability or uncertainty. |

## Overall Quality Determination Low

| | |
|---|---|
| **Study Citation:** | Lee, J. G., Lee, K. H., Choi, H., Moon, H. L., Byeon, S. H. (2012). Total dust and asbestos concentrations during asbestos-containing materials abatement in Korea. International Journal of Environmental Research 6(4):849-852. |
| **HERO ID:** | 2635206 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | abatement of two asbestos-containing materials (ACM): baumlite board (cement flat board) and ceiling textile. |
| Exposure route: | inhalation |
| Physical form: | Dust, fiber |
| Personal sampling data: | Baumlite board: non-TWA range 0.014 - 0.082 fiber/cc 8-hr TWA range 0.002 - 0.009 fiber/ccCeiling textile non-TWA range 0.014 - 0.114 fibers/cc 8-hr TWA range 0.003 - 0.014 fiber/cc |
| Area sampling data: | Baumlite board: non-TWA range 0.029 - 0.036 fiber/cc 8-hr TWA range 0.003 - 0.004 fiber/ccCeiling textile non-TWA range 0.031 - 0.106 fibers/cc 8-hr TWA range 0.004 - 0.013 fiber/cc |
| Comments: | Table 1. Total dust and asbestos concentrations during asbestos-containing materials (ACM) abatement |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Sampling and Analytical Methodology | High | Sampling or analytical methodology is an approved OSHA or NIOSH method. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | Medium | The data are from an OECD country. other than the U.S. |
| Metric 3: | Applicability | High | The data are for an occupational scenario within the scope of the risk evaluation. |
| Metric 4: | Temporal Representativeness | Medium | More than 10 years but, no more than 20 years old. |
| Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Medium | Monitoring data include most critical metadata, such as sample type and exposure type, but lacks additional metadata, such as sample durations, exposure durations, exposure frequency, and/orworker activities. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | High | The monitoring study addresses variability in the determinants of exposure for the sampled site or sector. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Lee, K. H., Yoon, H. S., Choi, S. J., Kang, D. (2009). Asbestos exposure and malignant mesothelioma in Korea. Asian Pacific Journal of Cancer Prevention 10(4):707-710. |
| **HERO ID:** | 3079147 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Handling and eliminating of asbestos containing materials, such as in construction, ship demolition, and car servicing. (2/4) |
| Physical form: | fibers (2/4) |
| Area sampling data: | For employees handling metal products, bond products, plastic products, and air planes, asbestos concentrations were 0.04+-0.09 f/cc. For employees working with electric appliances, steel, car manufacturing, train/car repair, construction, and ship building, asbestos concentrations were 0.07+-0.26 f/cc. (2/4) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Low | Sampling methodology not specified. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Medium | Data are from Korea, an OECD country. |
| | Metric 3: | Applicability | High | Data are for commercial and industrial use in construction materials, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Medium | Monitoring data were collected after the most recent PEL and greater than 10 years old. |
| | Metric 5: | Sample Size | Medium | Sample distribution characterized by limited statistics (means, standard deviations) but discrete samples not provided and distribution not fully characterized. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Exposure type and sampling data provided, but missing number of workers, exposure duration, frequency, particle size, engineering controls, and PPE. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | Variability is addressed by comparing area concentrations in different occupations. Uncertainty isn't addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Lee, S. A. (1981). Health hazard evaluation report no. HETA 81-293-983, Bulk Mail Center, Pittsburgh, Pennsylvania. |
| **HERO ID:** | 3970517 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Personal sampling data: | [PDF Pg. 11]Mail Handler (11 samples): NDWelder (1 sample): NDAssistant Welder (1 sample): NDClerk (9 samples): ND |
| Area sampling data: | [PDF Pg. 11]Area near brake shoe (2 samples): ND |
| Number of workers: | 650 clerks. [PDF Pg. 4] |
| Comments: | Samples were analyzed by phase contrast microscopy according to NIOSH Method P&CAM 239. [PDF Pg. 4] |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | High | Sampling/analytical methodology is an approved NIOSH/OSHA method. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for Chemical Substances in Construction, Paint, Electrical, and Metal Products, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Monitoring data are greater than 20 years old. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | All metadata provided. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | High | Uncertainty is addressed in sampling/analytical methodology. Variability addressed by sampling multiple worker activities. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Lewis FA (1980). Health hazard evaluation report no. HHE 79-141-711, Fischer % Porter Company, Warminster, Pennsylvania. |
| **HERO ID:** | 3970518 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Q-hut potting and coating operations. (1/11) |
| Exposure route: | inhalation (11/11) |
| Physical form: | fibers (5/11) |
| Area sampling data: | Three area samples taken near the Q-hut were all less than or equal to 0.1 f/cc. (11/11) |
| Exposure duration: | 8 hours (3/11) |
| Personal protective equipment: | NIOSH recommended protective gloves, coveralls, goggles, booties, and head covering. (7/11) |
| Engineering control: | Each rotator in the potting room has local exhaust ventilation located below and behind the rollers. (2/11) |
| Comments: | Through structural vibration employee work movement, disturbing air currents, and natural aging/drying out of the insulation, asbestos material can fall out into the work environment. |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Sampling and Analytical Methodology | High | Sampling/analytical methodology is an approved NIOSH method. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | Data are from the U.S. |
| Metric 3: | Applicability | High | Data are for commercial use of chemical substances in construction products, an in-scope occupational scenario. |
| Metric 4: | Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| Metric 5: | Sample Size | Medium | Statistical distribution of samples is characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Medium | Sample type and exposure type provided, but missing exposure frequency, particle size, and number of workers. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Medium | Uncertainty is addressed in sampling/analytical methodology. Variability is not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Lewis, F. A. (1980). Health Hazard Evaluation Determination, Report No. HHE-79-141-711, Fischer and Porter Company, Warminster, Pennsylvania. NIOSH:79-141. |
| **HERO ID:** | 3653519 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Encapsulation of instrumentation and wires on water pipes. [PDF Pg. 2-3] |
| Exposure route: | Inhalation. |
| Physical form: | Fibers (solid) |
| Area sampling data: | [PDF Pg. 11]Q-hut center area: 0.1 (fibers/cm^3)Q-hut work table: <0.1 (fibers/cm^3)Potting room/oven top: <0.1 (fibers/cm^3) |
| Exposure duration: | [PDF Pg. 11]390 minute sampling time. |
| Number of workers: | 21 [PDF Pg. 2] |
| Personal protective equipment: | NIOSH recommends the use of protective gloves, coveralls, goggles, booties and head covering. [PDF Pg. 6] |
| Engineering control: | Local exhaust ventilation. [PDF Pg. 2] |
| Comments: | Asbestos analyzed by PCM method (P&CAM #239) [PDF Pg. 3] |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | High | Sampling/analytical methodology is an approved NIOSH method. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for Chemical Substances in Construction, Paint, Electrical, and Metal Products, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Monitoring data are greater than 20 years old. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Sample type and exposure type provided but missing exposure frequency. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | Uncertainty is addressed in sampling/analytical methodology. Variability addressed by sampling multiple areas. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Lewis, N. J., Curtis, M. F. (1990). Occupational health and hygiene following a fire in a warehouse with an asbestos cement roof. Journal of the Society of Occupational Medicine 40(2):53-54. |
| **HERO ID:** | 3096039 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | brushing, vacuuming and picking up fragments by hand |
| Physical form: | solid |
| Personal sampling data: | Environmental monitoring after the fire< 0.01 f/ml (4 samples)> 0.01 f/ml (4 samples)max sample of 0.4 f/ccInside the warehouse< 0.01 f/ml (22 samples)> 0.01 f/ml (0 samples) |
| Area sampling data: | Environmental monitoring after the fire< 0.01 f/ml (83 samples)> 0.01 f/ml (3 samples)Inside the warehouse< 0.01 f/ml (34 samples)> 0.01 f/ml (7 samples) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Sampling and Analytical Methodology | Low | Sampling or analytical methodology is not specified. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | Medium | Report is from U.K. |
| | Metric 3: Applicability | High | The data are for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: Temporal Representativeness | Low | The data are more than 20 years old. |
| | Metric 5: Sample Size | Medium | Distribution of samples is characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | Medium | Monitoring data include most critical metadata, such as sample type and exposure type, but lacks additional metadata, such as sample durations, exposure durations, and exposure frequency. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Medium | Variability is addressed by taking samples at different locations but uncertainty is not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Lioy, P. J., Gochfeld, M. (2002). Lessons learned on environmental, occupational, and residential exposures from the attack on the World Trade Center. American Journal of Industrial Medicine 42(6):560-565. |
| **HERO ID:** | 6916367 |
| **Conditions of Use:** | Other: |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Emergency responders, rescuers, construction workers (1/6) |
| Exposure route: | inhalation (4/6) |
| Physical form: | dust (3/6) |
| Area sampling data: | By May 2002 after the September 11 attacks, there were many reoccupied buildings, which had not been adequately cleaned. Asbestos was widely reported in the media, as ranging from non-detectable to >3% by mass in dust samples. (3/6) |
| Personal protective equipment: | Within one week, abundant respirators were on hand in the supply depot, and we observed a wide variety of twin cartridge and canister respirators with and without full-face masks. However, no instructions were provided to help WTC workers select the correct respirator, nor was fit testing conducted until day 3. Many workers did not use the respirators. (4/6) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Sampling and Analytical Methodology | Low | Sampling methodology not specified. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | Data are from the U.S. |
| Metric 3: | Applicability | High | Data are for demolition of asbestos products, an in-scope occupational scenario. |
| Metric 4: | Temporal Representativeness | Medium | Monitoring data were collected after the most recent PEL and greater than 10 years old. |
| Metric 5: | Sample Size | Medium | Sample distribution characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Medium | Exposure type and sampling data provided, but missing number of workers, exposure duration, frequency, engineering controls, and particle size. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Lippy, B. E. (2002). Safety and health of heavy equipment operators at Ground Zero. American Journal of Industrial Medicine 42(6):539-542. |
| **HERO ID:** | 3080441 |
| **Conditions of Use:** | Disposal |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Heavy equipment operators cleaning up debris from 9/11. (1/4) |
| Exposure route: | inhalation (3/4) |
| Physical form: | dust (2/4) |
| Area sampling data: | (TEM) Sixty percent of the samples collected by the IUOE inside heavy equipment cabs were greater than the EPA clearance criteria of 0.01 structures/cm3 of air. (3/4) |
| Exposure duration: | 12 hours (1/4) |
| Number of workers: | 7,000 firefighters (1/4) |
| Personal protective equipment: | 130,000 respirators were given out to cleanup equipment operators. (1/4) However, less than half of the operators wore respirators. (2/4) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | High | Sampling/analytical methodology is an approved EPA method. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for disposal of asbestos wastes after 9/11, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Medium | Monitoring data were collected after the most recent PEL and greater than 10 years old. |
| | Metric 5: | Sample Size | Medium | Sample distribution characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Exposure type and sampling data provided, but missing exposure frequency, particle size, and engineering controls. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | Variability is addressed by comparing measurements to other literature sources. Uncertainty isn't addressed. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Liukonen, L. R., Weir, F. W. (2005). Asbestos exposure from gaskets during disassembly of a medium duty diesel engine. Regulatory Toxicology and Pharmacology 41(2):113-121. |
| **HERO ID:** | 3531131 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Diesel engine disassembly and cleaning of engine surfaces where the used gasket materials may have adhered. (2/9) |
| Exposure route: | inhalation (1/9) |
| Physical form: | fibers (8/9) |
| Personal sampling data: | (PCM) Personal samples ranged from <0.021-<0.120 f/cm3. (8/9) |
| Area sampling data: | (PCM) Area samples ranged from <0.007-<0.118 f/cm3. (8/9) |
| Engineering control: | A 42 in. diameter floor fan located near the doorway at the end of the shop directed a flow of outside air into the work environment. (2/9) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | High | Sampling/analytical methodology is an approved NIOSH method. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for commercial use of chemical substances in metal products, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Medium | Monitoring data were collected after the most recent PEL and greater than 10 years old. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Sample type and exposure type provided, but missing exposure duration, frequency, number of workers, particle size, and PPE. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | Uncertainty is addressed in sampling/analytical methodology. Variability addressed by sampling across 3 days. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Lucas, C. (1981). Health hazard evaluation report no. HETA 81-209-891, Pilgrim Glass Company, Ceredo West Virginia. |
| **HERO ID:** | 3970486 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | plate press line in hot metal shop - gatherer, presser, two carry-in people, a foreman's helper, and a separator:"The gatherer uses a long-handled rod to extract about 4 lbs of molten glass from the continuous tank furnace and drops it on to a press. The presser forms the plate. Next carry-in person #1 transfers the plate to a carbon holder using a scoop. Carry-in #2, using asbestos gloves, stacks the plates in columns of 3 with 4 small irregular shaped pieces of 1/4 inch asbestos mill board separating each plate. Carry-in #2 removes his gloves to transfer the column of 3 plates to the hot end of the #2 lehr using a long-handled paddle. The lehr is a temperature controlled enclosed conveyor belt used to slow the cooling of newly formed glassware. This slow cool process prevents the glass from cracking. The lehr's inlet temperature of 9000F drops 500F for every 6 feet the belt moves. Resident time in the lehr is 2 hour and 45 minutes. At the cold end of the lehr (800F) a separator removes and prepares the plate for shipping. The small 2 to 5 inch irregular shaped pieces of asbestos mill board are dropped into a 3 foot sauare cardboard box. When the box is full it is returned to the beginning of the plate press line to be reused in the plate stacking process. These asbestos pieces are used until they deteriorate or are lost. About once a month the foreman's helper must break new pieces of asbestos mill board by hand. He performs this task outside in open air. The mill board is received in 42 x 48 inch sheets. (pg 4)"dry sweeping to clean hot metal shop increases airborne asbestos (pg 5) |
| Physical form: | airborne fibers |
| Personal sampling data: | 0.02-1.13 fibers/cc (pg 3); 0.01-1.13 fibers/cc (pg 6)Full sampling results in Table 1 (pg 9) |
| Particle size characterization: | >5 um in length (pg 3) |
| Exposure duration: | 8-hour shift (pg 4) |
| Number of workers: | 7 (pg 3); 6 (pg 4) |
| Personal protective equipment: | asbestos gloves (pg 4) |
| Engineering control: | In the roof of the Hot Metal Shop there were four 42-inch general exhaust fans each with capacity ratings of 14,780 CFM. One was not in operation during the survey. Two garage sized doors and three standard sized doors are open to the outside in the Hot Metal Shop. Also there is an air intake port outside the building that supplies a manifold which circles the continuous tank furnace. The manifold delivers air primarily for cooling purposes. This along with the open doors and exhaust fans insure that air changes in the building are frequent. A floor fan is used to provide air movement on the plate press line. This probably increases asbestos exposures by blowing free fibers into the air that workers breath. (pg 5) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Sampling and Analytical Methodology | High | Sampling/analytical methodology is an approved NIOSH/OSHA method. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | Data are from the U.S. |
| Metric 3: | Applicability | High | Data are for construction materials, an in-scope occupational scenario. |
| Metric 4: | Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Medium | Sample type and exposure type provided but missing metadata such as exposure frequency. |

**Continued on next page . . .**

. . . continued from previous page

**Study Citation:** Lucas, C. (1981). Health hazard evaluation report no. HETA 81-209-891, Pilgrim Glass Company, Ceredo West Virginia.
**HERO ID:** 3970486
**Conditions of Use:** Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products

| | | EVALUATION | |
|---|---|---|---|
| Domain | Metric | Rating | Comments |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Medium | The monitoring study provides only limited discussion of the variability in the determinants of exposure for the sampled site or sector. Uncertainty are not addressed. |

## Overall Quality Determination — High

| | |
|---|---|
| **Study Citation:** | Lumley, K. P. (1971). Asbestos dust levels inside firefighting helmets with chrysotile asbestos covers. Annals of Occupational Hygiene 14(3):285-286. |
| **HERO ID:** | 3625784 |
| **Conditions of Use:** | Other: |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Personal sampling data: | New helmet with unlined asbestos cloth cover: 2.3 f/cm3Old helmet with unlined asbestos cloth cover: 1.38 f/cm3Helmet with aluminised asbestos cover: 0 f/cm3 |
| Exposure duration: | 25 min (pg 1) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Medium | Sampling/analytical methodology is not an approved OSHA/NIOSH method but is an acceptable methodology. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Medium | Data are from the UK, an OECD country |
| | Metric 3: | Applicability | Medium | Data are for firefighting, which is similar to the in-scope occupational scenario construction materials. |
| | Metric 4: | Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Sample type and exposure type provided but missing other metadata. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | Variability addressed by sampling for different types of helmets, but uncertainty is not addressed. |

## Overall Quality Determination — Medium

| | |
|---|---|
| **Study Citation:** | Lumley, K. P., Harries, P. G., O'Kelly, F. J. (1971). Buildings insulated with sprayed asbestos: A potential hazard. Annals of Occupational Hygiene 14(3):255-257. |
| **HERO ID:** | 3084876 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | asbestos removal; disturbed/damaged asbestos insulation (pg 1) |
| Exposure route: | inhalation |
| Physical form: | dust |
| Area sampling data: | A crocidolite dust concentration of 25 fibres/cm3 was obtained when the floor below this insulation was cleaned with a brush. (pg 2)Crocidolite: Table 1 (pg 4): 0.01-52.6 f/cm3Amosite: Table 2 (pg 4): 1.7-7.6 f/cm3 |
| Number of workers: | 50 people engaged in packing foodstuffs and handling stores in storehouses (pg 2) |
| Engineering control: | sealing insulation (pg 1) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Medium | Sampling/analytical methodology is not an approved OSHA/NIOSH method but is an acceptable methodology. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Medium | Data are from the U.K., an OECD country |
| | Metric 3: | Applicability | High | Data are for construction materials, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| | Metric 5: | Sample Size | Medium | Sample distribution characterized by limited statistics (ranges, means) but discrete samples not provided and distribution not fully characterized. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Monitoring data include most critical metadata, such as sample type and exposure type, but lacks additional metadata, such as sample durations, exposure durations, and exposure frequency. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | Variability is addressed by sampling for 2 types of asbestos, but uncertainty is not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Lundgren, D. A., Vanderpool, R. W., Liu, B. Y. H. (1991). Asbestos fiber concentrations resulting from the installation, maintenance and removal of vinyl-asbestos floor tile. Particle & Particle Systems Characterization 8(3):233-236. |
| **HERO ID:** | 3582228 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Maintenance involved chemical stripping of the existing floor polish, cleaning of the floor tile surface, and then polishing and buffing of the tile surface. |
| Exposure route: | Inhalation. |
| Physical form: | Fibers (solid). |
| Personal sampling data: | Tile Installation (f/cc) [PDF Pg. 3]Sample #1: 0.089Sample #2: 0.092Tile Removal (f/cc)Cold Removal Worker #1 (2 samples): 0.074; 0.049Cold Removal Worker #2 (2 samples): 0.082; 0.139Hot Removal Worker #1 (2 samples): 0.054; 0.049Hot Removal Worker #2 (2 samples): 0.033; 0.076 |
| Area sampling data: | Tile Maintenance Test [PDF Pg. 3]Background sample #1: 0.000 (f/cc)Background Sample #2: 0.001 (f/cc)Maintenance Test Sample #1: 0.034 (f/cc)Maintenance Test Sample #2: 0.046 (f/cc)Tile Installation (f/cc)Sample #1: 0.130Sample #2: 0.120Tile Removal (f/cc)Indoor Background Sample #1: 0.0001Indoor Background Sample #2: 0.0007Hot&Cold Removal Sample #1: 0.057Hot&Cold Removal Sample #2: 0.041 |
| Exposure duration: | Installation of the tiles was completed in 80 minutes. [PDF Pg. 2]Cold removal of the 9 ft. by 36 ft. flooring area was accomplished by two workers in 30 minutes. Hot removal of this test section was accomplished in 45 minutes by the same two workers. |
| Number of workers: | One worker performed tile installation. Two workers performed tile removal. [PDF Pg. 1-2] |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Sampling and Analytical Methodology | High | Sampling/analytical methodology is equivalent to an approved [OSHA/NIOSH] method. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | Data are from the U.S. |
| Metric 3: | Applicability | High | Data are for construction, paint, electrical, and metal products, an in-scope occupational scenario. |
| Metric 4: | Temporal Representativeness | Low | Monitoring data are greater than 20 years old. |
| Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | High | All metadata provided. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | High | Uncertainty is addressed in sampling/analytical methodology. Variability addressed by testing multiple worker activities and taking multiple samples per activity. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Madl, A. K., Devlin, K. D., Perez, A. L., Hollins, D. M., Cowan, D. M., Scott, P. K., White, K., Cheng, T. J., Henshaw, J. L. (2015). Airborne asbestos exposures associated with gasket and packing replacement: a simulation study of flange and valve repair work and an assessment of exposure variables. Regulatory Toxicology and Pharmacology 71(1):35-51. |
| **HERO ID:** | 3015760 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | A mechanic performed flange gasket replacement or complete valve overhaul on a steel work bench. (4/17) |
| Exposure route: | inhalation (8/17) |
| Physical form: | fibers and dust (6/17) |
| Personal sampling data: | With PCM, personal samples during removal, installation, and replacement of flanges and gaskets averaged between 0.116-0.323 f/cc with a range of 0.083-0.599 f/cc. With TEM, they averaged between 0.146-0.388 f/cc with a range of 0.008-1.185 f/cc. (11/17) During valve replacement, with PCM, personal samples averaged between 0.104-0.294 f/cc with a range of 0.062-0.606 f/cc. With TEM, personal samples averaged between 0.05-0.389 f/cc with a range of 0.014-0.679 f/cc. (12/17) |
| Particle size characterization: | Fibers were defined as >5 um in length and >= 0.25 um in diameter and having at least a 3:1 aspect ratio (4/17) |
| Exposure duration: | It was assumed that gasket and packing work could comprise 30 min to 3 h of an average 8 h workday. (9/17) |
| Personal protective equipment: | The mechanic wore coveralls (4/17) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Sampling and Analytical Methodology | High | Sampling/analytical methodology is an approved NIOSH method. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | Data are from the U.S. |
| Metric 3: | Applicability | High | Data are for commercial use in packing and gaskets, an in-scope occupational scenario. |
| Metric 4: | Temporal Representativeness | High | Monitoring data were collected after the most recent PEL and no more than 10 years old. |
| Metric 5: | Sample Size | Medium | Sample distribution characterized by limited statistics (average, standard deviation, range) but discrete samples not provided and distribution not fully characterized. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Medium | Exposure type and sampling data provided, but missing exposure frequency, and engineering controls. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | High | Uncertainty is addressed in sampling/analytical methodology. Variability is addressed by sampling over 5 days. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Madl, A. K., Gaffney, S. H., Balzer, J. L., Paustenbach, D. J. (2009). Airborne asbestos concentrations associated with heavy equipment brake removal. Annals of Occupational Hygiene 53(8):839-857. |
| **HERO ID:** | 2591959 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Heavy Equipment Brake Removal |
| Exposure route: | inhalation |
| Physical form: | fiber |
| Personal sampling data: | Average 8-h TWA was estimated to be 0.009 f/cc for a mechanic and 0.006 f/cc for a bystander. (P. 13/19) |
| Area sampling data: | The average/airborne chrysotile concentrations as measuredby PCM, TEM, and PCME were 0.053, 0.087, and 0.024 f/cc, respectively, for the Stockton mechanic and 0.338, 0.012, and 0.010 f/cc measured by PCM, TEM, and PCME, respectively, for the Big Rock mechanic (Table 2). (P. 9/19)The average airborne asbestos concentrations measured on the volunteer (handling the clothes) were 0.231, 0.011, and 0.036 f/cc when measured by PCM, TEM, and PCME, respectively. Likewise, at the bystander location, average asbestos concentrations of 0.093, 0.012, and 0.010 f/cc were measured using PCM, TEM, and PCME, respectively (sampling times were 30 min in duration andcollected during the anticipated peak times of exposure). (P. 13/19) |
| Particle size characterization: | Within the worker samples, there were 261 total asbestos fibers counted using the ISO methodology. Of these, only 36% were free fibers or bundles, 18% were free fibers or bundles with diameter,0.7 um (length . 5 um) and only 2% were free fibers or bundles with diameter ,0.7 um and length .20 lm. The remaining fibers were either in clusters (3%) or attached to a matrix (61%). Only 3% of the fibers, however, were part of a cluster that may be respirable (,10 um in width), and 36%of fibers were part of a matrix that may be respirable. |
| Comments: | Table 2. Summary of air sampling results: brake removal and clothes handling by PCM, TEM, and PCME (30 min) by worker, bystander, remote, and background, as well as location. |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Sampling and Analytical Methodology | High | Sampling or analytical methodology is an approved OSHA or NIOSH method. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | High | The data are from the United States. |
| | Metric 3: Applicability | High | The data are for an occupational scenario within the scope of the risk evaluation. Braking and gear-changing (clutch) components in a variety of industrial and commercial machinery. |
| | Metric 4: Temporal Representativeness | Medium | More than 10 years but generally, no more than 20 years old. |
| | Metric 5: Sample Size | High | Statistical distribution of samples is fully characterized. |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | High | Monitoring data include all associated metadata, including sample types, exposure types, sample durations, exposure durations worker activities, and exposure frequency. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | High | The monitoring study addresses variability in the determinants of exposure for the sampled site or sector. |

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| | |
|---|---|
| **Study Citation:** | Madl, A. K., Gaffney, S. H., Balzer, J. L., Paustenbach, D. J. (2009). Airborne asbestos concentrations associated with heavy equipment brake removal. Annals of Occupational Hygiene 53(8):839-857. |
| **HERO ID:** | 2591959 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

| | | EVALUATION | |
|---|---|---|---|
| Domain | Metric | Rating | Comments |
| **Overall Quality Determination** | | **High** | |

| | |
|---|---|
| **Study Citation:** | Madl, A. K., Hollins, D. M., Devlin, K. D., Donovan, E. P., Dopart, P. J., Scott, P. K., Perez, A. L. (2014). Airborne asbestos exposures associated with gasket and packing replacement: a simulation study and meta-analysis. Regulatory Toxicology and Pharmacology 69(3):304-319. |
| **HERO ID:** | 3077980 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Removal and installation of asbestos-containing packing and gaskets contained within vintage valves (2/16) |
| Exposure route: | inhalation (2/16) |
| Physical form: | fibers (2/16) |
| Personal sampling data: | Table 1 presents asbestos concentrations for short term (30 min) samples, using PCM, and TEM. During all valve work, personal sampling concentrations for the main workers were 0.059+-0.033 f/cc for PCM and 0.014+-0.018 f/cc for TEM. (5/16) Table 3 presents asbestos concentrations for long term (60 min) samples, using PCM, and TEM. During all valve work, personal sampling concentrations were 0.069+-0.031 f/cc for PCM and 0.013+-0.016 f/cc for TEM. (7/16) |
| Area sampling data: | Table 4 presents area asbestos concentrations during valve work. Concentrations were 0.0019+-0.0012 f/cc for PCM, and 0.0005+-0.0003 f/cc for TEM. (8/16) |
| Exposure duration: | In general, the mechanics took approximately 15–40 min to replace the packing material and approximately 10–30 min to replace the gasket, thus resulting in a total duration of approximately 30–60 min for a complete valve overhaul. (2/16) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Sampling and Analytical Methodology | High | Sampling/analytical methodology is an approved NIOSH method. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | Data are from the U.S. |
| Metric 3: | Applicability | High | Data are for industrial use in metal products, an in-scope occupational scenario. |
| Metric 4: | Temporal Representativeness | High | Monitoring data were collected after the most recent PEL and no more than 10 years old. |
| Metric 5: | Sample Size | Medium | Sample distribution characterized by limited statistics (mean, ranges, maximums, minimums, standard deviations) but discrete samples not provided and distribution not fully characterized. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Medium | Exposure type and sampling data provided, but missing number of workers, exposure frequency, particle size, engineering controls and PPE. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | High | Uncertainty is addressed in sampling/analytical methodology. Variability is addressed by comparing PCM to TEM results, and comparing against literature. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Mangold, C., Clark, K., Madl, A., Paustenbach, D. (2006). An exposure study of bystanders and workers during the installation and removal of asbestos gaskets and packing. Journal of Occupational and Environmental Hygiene 3(2):87-98. |
| **HERO ID:** | 3531143 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Gasket Install/Removal: Disassembly, flange cleaning, gasket cutting/shaping, gasket install, reassemblyValve Packing Removal/Replacement: Exterior cleaning, disassembly, old packing removed, new packing measured, cut and installed, reassembly of valve. |
| Exposure route: | inhalation |
| Physical form: | Solid Gasket: The new gaskets were made from Garlock gasket material (Style #900/7735, Garlock Sealing Technologies, Inc., Palmyra, NT), containing about 70% Chrysotile asbestos. |
| Personal sampling data: | Study IAsbestos Concentrations by PCM (f/cc)GasketType"1st4-hour TWA""2nd4-hour TWA""8-hour TWA""Std. Dev."Spiralwoundmetalencased0.0050.0030.0040.001Braided0.0050.0060.0050.001Encapsulatedsheet0.0050.0050.0050Study IIAirborne Concentnrations of Asbestos for Workers During the Performance of Various Gasket Activities8-HourAsbestosConcentrationbyPCM(f/cc)BreathingZoneSiten (8 hr sample)8-hourTWAStd.Dev.Storage of gasket material0NANAHand-punching50.060.01Hand operated mechanical 50.020.02Machinepunch50.110.04Hand shaping table (knives,scissors,scribes)50.040.02Machine shearing50.090.04Nibbler machine50.140.05Flange opened no scraping (gasketinstallation)30.030.02Flange opened, scraping with knife30.030.01Study IIIBreathingZoneValve SourceStudySiteValves per DaynAverageMin.–Max.Std.Dev.USSGypsyOnboardship4200.0300.01–0.080.021OffshoreIBuilding(onland)6100.0230.01–0.050.013No.ofContentofActivitieGasketsActivityPerfor |
| Area sampling data: | Study IAsbestos Concentrations by PCM (f/cc)GasketType"1st4-hour TWA""2nd4-hour TWA""8-hour TWA""Std. Dev."Spiralwoundmetalencased0.0020.0020.0020.000Braided0.0030.0040.0040.001Encapsulatedsheet0.0030.0040.0040.001Study IIAirborne Concentnrations of Asbestos for Workers During the Performance of Various Gasket Activities8-HourAsbestosConcentrationbyPCM(f/cc)ONU Exposure EstimationSiten (8 hr sample)8-hourTWAStd.Dev.Storage of gasket material50.020.01Hand-punching50.040.03Hand operated mechanical punch50.020.00Machinepunch50.090.07Hand shaping table (knives,scissors,scribes)50.030.03Machine shearing50.070.03Nibbler machine50.110.05Flange opened no scraping (gasketinstallation)30.030.00Flange opened, scraping with knife30.020.01Study IIIBackgroundValve SourceStudySiteValves per DaynAverageMin.–Max.Std.Dev.USSGypsyOnboardship450.0040.002–0.0050.001OffshoreIBuilding(onland)690.0030.002–0.0040.001Study IVNo.ofContentofArea/BystanderArea/BystanderActivitiesGasketsActivityPerformed(%)BackgroundnAverageMin.–Max.Std.Dev.nAverageMin.–Max.Std.Dev.Circularcutter1670–8 VAsbestos Concentration by PCM (f/cc)Asbestos Concentration by TEM (f/cc)Breathing ZoneAreaAreaBackgroundConcentrationActivitybyTEMWorkerBystandernAverageMin.–Max.Std.Dev.nAverageMin.–Max.Std.Dev.Packing removal0.002<0.011<0.00980.0040.002-0.0060.00180.0080.002–0.0120.003 |
| Exposure frequency: | 8 hours |
| Personal protective equipment: | Plastic-impregnated protective clothing (Tyvec) |
| Comments: | Note that the work was supported by Garlock, inc. the gasket maker on the project who has been involved in litigation regarding asbestos. (i.e. may be biased) |

**EVALUATION**

| Domain | | Metric | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Medium | Sampling/analytical methodology is equivalent to an approved NIOSH method in early studies and is an approved NIOSH method in later studies. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for Industrial/Commercial Use: Chemical Substances in Construction, Paint, Electrical, and Metal Products, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |

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| | |
|---|---|
| **Study Citation:** | Mangold, C., Clark, K., Madl, A., Paustenbach, D. (2006). An exposure study of bystanders and workers during the installation and removal of asbestos gaskets and packing. Journal of Occupational and Environmental Hygiene 3(2):87-98. |
| **HERO ID:** | 3531143 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

| | | | **EVALUATION** | |
|---|---|---|---|---|
| Domain | | Metric | Rating | Comments |
| | Metric 5: | Sample Size | Medium | Sample distribution characterized by limited statistics (n, min, max, std dev) but discrete samples not provided and distribution not fully characterized. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | All metadata provided. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | High | Uncertainty is addressed in sampling/analytical methodology. Variability addressed by samples collected at multiple vessels, locations, and formats. |

## Overall Quality Determination High

**Study Citation:** Manville Serv Corp, (1983). OSHA industrial hygiene survey results - Manville plant [878211543].
**HERO ID:** 1480904
**Conditions of Use:** Other:

**EXTRACTION**

| Parameter | Data |
|---|---|
| Worker activity description: | Worker titles and names are given with no context to the industry or operations. |
| Personal sampling data: | Values from N.D. - 0.9 fibers/cm3 |
| Area sampling data: | One data point at 1.3 fibers/cm3 |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Sampling and Analytical Methodology | Low | Sampling or analytical methodology is not specified. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | The data are from the United States. |
| Metric 3: | Applicability | Uninformative | The condition of use is unknown for the monitoring data. |
| Metric 4: | Temporal Representativeness | Low | Data is more than 20 years old. |
| Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Uninformative | Monitoring data do not include any needed metadata to understand what the data represent and are not usable in the risk evaluation. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Low | The monitoring study does not address variability or uncertainty. |

## Overall Quality Determination Uninformative

**Study Citation:** Manville Serv Corp, (1982). Analysis of asbestos containing material.
**HERO ID:** 4158178
**Conditions of Use:** Other:

**EXTRACTION**

| Parameter | Data |
|---|---|
| Area sampling data: | 100+ samples ranging from 0.00 - 1.7 f/cc from various sampling campaigns in different industrial facilities |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Low | Sampling or analytical methodology is not specified. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | The data are from the United States. |
| | Metric 3: | Applicability | Uninformative | The condition of use for the data is unspecified. |
| | Metric 4: | Temporal Representativeness | Low | Metadata on the operations, equipment, and worker activities associated with the data show that the data agree representative of outdated operations, equipment, and activities rather than current operations, equipment, and worker activities. The data were collected more than 20 years ago. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Low | Monitoring data include sample type (e.g., personal breathing zone) but no other metadata. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | The monitoring study does not address variability or uncertainty. |

## Overall Quality Determination Uninformative

| | |
|---|---|
| **Study Citation:** | Manville Serv Corp, (1981). Analysis of filter sample for fiber count by phase contrast microscopy (P+CAM 239) prepared by Biospherics Inc. |
| **HERO ID:** | 4158179 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Area sampling data: | Airborne asbestos fiber count: (0.72 fibers/cm^3) [PDF Pg. 4] |
| Comments: | Method used was PCM (P&CAM) [PDF Pg. 4] |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | High | Sampling/analytical methodology is equivalent to an approved OSHA/NIOSH method. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for Chemical Substances in Construction, Paint, Electrical, and Metal Products, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Monitoring data are greater than 20 years old. |
| | Metric 5: | Sample Size | Low | Sample distribution is characterized by no statistics. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Low | Sample type provided but no other metadata. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Medium

**Study Citation:** Manville Serv Corp, (1981). Analytical results for fiber-on-filter counts and bulk asbestos prepared by Biospherics Inc.
**HERO ID:** 4158180
**Conditions of Use:** Other:

**EXTRACTION**

| Parameter | Data |
|---|---|
| Physical form: | fibers (5/6) |
| Area sampling data: | (PCM) Area samples were 1.44 f/cc and <0.05 f/cc. (5/6) |
| Comments: | The area sampling data are total fibers in air and are not specific to asbestos. |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | High | Sampling or analytical methodology is an approved OSHA or NIOSH method or is well described and found to be equivalent to approved OSHA or NIOSH methods. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | Low | The condition of use isn't specified. Only sample results are given. |
| | Metric 4: | Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Physical form and sampling data provided, but missing worker information, exposure duration, frequency, particle size, engineering controls, and PPE. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | The monitoring study does not address variability or uncertainty. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Manville Serv Corp, (1982). Asbestos baghouse collector sampling [878211133]. |
| **HERO ID:** | 4158181 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Area sampling data: | An area sample near the asphalt preformed collector measured 0.1 f/cc. (4/5) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Low | Sampling methodology is not specified. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for industrial use in construction materials, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Low | Monitoring data include sample type (e.g., personal breathing zone) but no other metadata. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Medium

**Study Citation:** Manville Serv Corp, (1981). Asbestos baghouse collector sampling - Nashua Plant [878212080].
**HERO ID:** 4158183
**Conditions of Use:** Other:

**EXTRACTION**

| Parameter | Data |
|---|---|
| Area sampling data: | Baghouse collector samples< 0.1, < 0.1, 2.8 f/cc |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Low | Sampling or analytical methodology is not specified. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | The data are from the United States. |
| | Metric 3: | Applicability | Uninformative | Occupational scenario unknown. |
| | Metric 4: | Temporal Representativeness | Low | The data were collected more than 20 years ago. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Low | Monitoring data include sample type but no additional metadata. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | The monitoring study does not address variability or uncertainty. |

## Overall Quality Determination Uninformative

| | |
|---|---|
| **Study Citation:** | Manville Serv Corp, (1982). Asbestos baghouse collector sampling Billerica Plant - June 7, 1982 [878210944]. |
| **HERO ID:** | 4158184 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Baghouse collector |
| Exposure route: | inhalation |
| Physical form: | Fibers |
| Area sampling data: | 0.5 - 11 f/cc (14 samples) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Low | Sampling or analytical methodology is not specified. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | The data are from the United States and are representative of the industry being evaluated. |
| | Metric 3: | Applicability | Uninformative | The data are from an occupational or non-occupationalscenario that is out of scope of the risk evaluation. The activities in the facility are not specified but it is likely that asbestos is being processed/used on site since asbestos dust collectors are present. |
| | Metric 4: | Temporal Representativeness | Low | Metadata on the operations, equipment, and worker activities associated with the data show that the data agree representative of outdated operations, equipment, and activities rather than current operations, equipment, and worker activities. The data were collected more than 20 years ago. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Low | Monitoring data include sample type (e.g., personal breathing zone) but no other metadata. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | The monitoring study does not address variability or uncertainty. |

## Overall Quality Determination Uninformative

**Study Citation:** Manville Serv Corp, (1981). Asbestos baghouse collector sampling Manville Plant [878211131].
**HERO ID:** 4158185
**Conditions of Use:** Other:

**EXTRACTION**

| Parameter | Data |
|---|---|
| Physical form: | fibers (4/6) |
| Area sampling data: | In the A building, asbestos concentrations were <0.1-0.2 f/cc. In the B building, concentrations were <0.1-0.1 f/cc. In building G, concentration was 0.2 f/cc. (4/6) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Sampling and Analytical Methodology | Low | Sampling methodology not specified. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | Data are from the U.S. |
| Metric 3: | Applicability | Uninformative | Condition of use isn't specified, only sampling results given. |
| Metric 4: | Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Medium | Exposure type and sampling data provided, but missing worker information, exposure duration, frequency, particle size, engineering controls, and PPE. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Medium | Variability is addressed by sampling at different buildings at the facility. Uncertainty isn't addressed. |

## Overall Quality Determination Uninformative

**Study Citation:** Manville Serv Corp, (1980). Asbestos baghouse collector sampling Manville Plant [878211136].
**HERO ID:** 4158186
**Conditions of Use:** Other:

**EXTRACTION**

| Parameter | Data |
|---|---|
| Area sampling data: | full results pg 4-5: <0.1-1.6 f/cc |
| Engineering control: | baghouse (pg 4) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Low | Sampling/analytical methodology is not specified. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | Uninformative | Data are for an unknown, industrial OES. |
| | Metric 4: | Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Low | Sample type provided but no other metadata. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Uninformative

| | |
|---|---|
| **Study Citation:** | Manville Serv Corp, (1981). Asbestos baghouse collector sampling Nashua Plant [878212078]. |
| **HERO ID:** | 4158187 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Area sampling data: | Samples from baghouse collectors: <0.1 - 0.1 f/cc (5 samples) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Low | Sampling or analytical methodology is not specified. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | The data are from the United States and are representative of the industry being evaluated. |
| | Metric 3: | Applicability | Uninformative | The report is for asbestos processing (out of scope) |
| | Metric 4: | Temporal Representativeness | Low | Metadata on the operations, equipment, and worker activities associated with the data show that the data agree representative of outdated operations, equipment, and activities rather than current operations, equipment, and worker activities. The data were collected more than 20 years ago |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Low | Monitoring data include sample type (e.g., personal breathing zone) but no other metadata. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | The monitoring study does not address variability or uncertainty. |

## Overall Quality Determination Uninformative

| | |
|---|---|
| **Study Citation:** | Manville Serv Corp, (1982). Asbestos baghouse collector sampling Nashua Plant - October 11, 1982 [878212081]. |
| **HERO ID:** | 4158188 |
| **Conditions of Use:** | Other: |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Physical form: | fibers (4/5) |
| Area sampling data: | Area samples at an unknown plant were <0.1-0.3 f/cc. (4/5) |

**EVALUATION**

| Domain | | Metric | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Low | Sampling methodology not specified. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | Uninformative | The condition of use is unknown. |
| | Metric 4: | Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Exposure type and sampling data provided, but missing worker information, exposure duration, frequency, particle size, engineering controls, and PPE. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Uninformative

**Study Citation:** Manville Serv Corp, (1980). Asbestos baghouse collector update [878211137].
**HERO ID:** 4158189
**Conditions of Use:** Other:

**EXTRACTION**

| Parameter | Data |
|---|---|
| Area sampling data: | 1.6 f/cc; 0.4 f/cc (pg 4) |
| Engineering control: | baghouse (pg 4) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Low | Sampling/analytical methodology is not specified. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | Uninformative | Data are for an unspecified use. |
| | Metric 4: | Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Low | Sample type provided but no other metadata. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Uninformative

| | |
|---|---|
| **Study Citation:** | Manville Serv Corp, (1981). Asbestos fiber sampling - January 20-21, 1981 Pipe Division - Green Cove Springs. |
| **HERO ID:** | 4158193 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Physical form: | Fiber (solid) [PDF Pg. 4] |
| Area sampling data: | [PDF Pg. 4]West entrance to PVC Dept.: <0.001 (fibers/cm^3)Between Pipe Machine & Willows: <0.01 (fibers/cm^3)Maintenance Cage: 0.0 (fibers/cm^3)UPL Area: 0.0 (fibers/cm^3)Shipping & Receiving Storage: 0.0 (fibers/cm^3) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Low | Sampling/analytical methodology is not specified. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for Chemical Substances in Construction, Paint, Electrical, and Metal Products, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Monitoring data are greater than 20 years old. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Low | Sample type provided but no other metadata. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | Variability addressed by sampling at five different locations. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Manville Serv Corp, (1981). Asbestos fiber sampling - January 20-21, 1981 Pipe Division - Green Cove Springs Plant. |
| **HERO ID:** | 4158194 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Physical form: | fiber (4/5) |
| Area sampling data: | In the West entrance to the PVC department, concentrations were 0.003 f/cc. Between the pipe machine and willows, concentrations were 0.003 f/cc. In the maintenance cage, UPL area, and shipping and receiving storage area, concentrations were 0.0 f/cc (4/5) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Low | Sampling methodology is not specified. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for industrial use in construction materials, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Exposure type and sampling data provided, but missing worker activity, number of workers, exposure duration, frequency, particle size, engineering controls, and PPE. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Manville Serv Corp, (1978). Asbestos monitoring at Detroit Edison. |
| **HERO ID:** | 4158197 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Insulation removal/repair by the maintenance team |
| Exposure route: | Inhalation |
| Physical form: | Fiber |
| Personal sampling data: | 4 personal samples (60 minutes)0.6, 0.6, 0.1 f/cc1 inconclusive sample |
| Area sampling data: | 2 personal samples (60 minutes)0.1 f/cc1 inconclusive sample |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Low | Sampling or analytical methodology is not specified. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | The data are from the United States and are representative of the industry being evaluated. |
| | Metric 3: | Applicability | High | The data are for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Low | Metadata on the operations, equipment, and worker activities associated with the data show that the data agree representative of outdated operations, equipment, and activities rather than current operations, equipment, and worker activities. The data were collected before the most recent PEL establishment or update or are more than 20 years old if no PEL is established. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Monitoring data include most critical metadata, such as sample type and exposure type, but lacks additional metadata, such as exposure durations and exposure frequency. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | Variability is addressed by including both personal and area samples but uncertainty is not addressed. |

## Overall Quality Determination Medium

**Study Citation:** Manville Serv Corp, (1981). Asbestos samples at the Willows - Service Sheet Department Industrial Specialties Division - November 20, 1981.
**HERO ID:** 4158198
**Conditions of Use:** Other:

**EXTRACTION**

| Parameter | Data |
|---|---|
| Worker activity description: | Mixer operators (4/7) |
| Exposure route: | inhalation (4/7) |
| Physical form: | fibers (4/7) |
| Personal sampling data: | Personal samples for the mixer operators ranged from <0.1 f/cc to 1.3 f/cc. (4.7) |
| Area sampling data: | Area samples prior to shaking down the dust house were <0.1-0.5 f/cc. Area samples during the dust house shake down were <0.1-14.7 f/cc. (6/7) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Sampling and Analytical Methodology | Low | Sampling methodology not specified. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | High | Data are from the U.S. |
| | Metric 3: Applicability | Uninformative | Data appear to be from asbestos mixing during sheet manufacturing, which isn't in scope. |
| | Metric 4: Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| | Metric 5: Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | Medium | Exposure type and sampling data provided, but missing number of workers, exposure duration, frequency, particle size, engineering controls, and PPE. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Medium | Variability is addressed by sampling at 4 sites during 3 different days. Uncertainty isn't addressed. |

## Overall Quality Determination Uninformative

| | |
|---|---|
| **Study Citation:** | Manville Serv Corp, (1980). Asbstos baghouse collector sampling - Manville Plant [878211136]. |
| **HERO ID:** | 4158201 |
| **Conditions of Use:** | Other: |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Area sampling data: | <0.1-1.6 f/cc (pg 2-3) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Low | Sampling/analytical methodology is not specified. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | Low | Data are for asbestos product MFG, a non-legacy use, but still may be informative for other COU. |
| | Metric 4: | Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Low | Sample type provided but no other metadata. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Low

| | |
|---|---|
| **Study Citation:** | Manville Serv Corp, (1979). Atmosphere filtering monitoring form [878211282]. |
| **HERO ID:** | 4158203 |
| **Conditions of Use:** | Other: |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Physical form: | fibers (4/7) |
| Personal sampling data: | A personal sample of a worker in the boiler room of the U.S.S. Manley was 12.0 f/cc. (5/7) |
| Area sampling data: | Area samples in the boiler room of the U.S.S. Manley were 8.0 and 9.0 f/cc. (4/7) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Sampling and Analytical Methodology | Low | Sampling methodology not specified. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | Data are from the U.S. |
| Metric 3: | Applicability | Uninformative | Condition of use not specified. |
| Metric 4: | Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Low | Exposure type and sampling data provided, but missing most critical metadata such as number of workers, exposure duration, frequency, engineering controls, PPE, and particle size. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Uninformative

| | |
|---|---|
| **Study Citation:** | Manville Serv Corp, (1980). Atmospheric filtering monitoring report [878210731]. |
| **HERO ID:** | 4158228 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Removal of asbestos on the U.S.S. Montgomery. (4/8) |
| Exposure route: | inhalation (4/8) |
| Physical form: | fibers (4/8) |
| Personal sampling data: | Personal sampling data: 1.1 f/cc. (4/8) |
| Area sampling data: | Area sample taken during asbestos removal had concentration of 0.80 f/cc. Area sample taken after cleanup of demolished material had a concentration of 0.09 f/cc. Certificate sampling result of analysis were 0.88 f/cc. |
| Engineering control: | The removal area was secured from other parts of the ship. (7/8) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Sampling and Analytical Methodology | Low | Sampling or analytical methodology is not specified. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | Data are from the U.S. |
| Metric 3: | Applicability | High | Data are for demolition of asbestos products, an in-scope occupational scenario. |
| Metric 4: | Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Medium | Exposure type and sampling data provided, but missing number of workers, exposure frequency, particle size, and PPE. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Medium | Variability is addressed by including personal and area samples but uncertainty is not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Manville Serv Corp, (1980). Atmospheric filtering monitoring report [878210732]. |
| **HERO ID:** | 4158229 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Removal of asbestos and after cleaning in the aux mechanical room on the U.S.S Montgomery (pg 5) |
| Exposure route: | inhalation |
| Personal sampling data: | removing asbestos: 1.2 f/cc (pg 5) |
| Area sampling data: | 0.001 f/cc (pg 4)removing asbestos: 1.0 f/cc (pg 6)after cleaning: 0.07 f/cc (pg 7) |
| Engineering control: | secured area (pg 5) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Low | Sampling/analytical methodology is not specified. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | The data are for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Low | The data were collected before the most recent PEL establishment or update or are more than 20 years old if no PEL is established. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Monitoring data include most critical metadata, such as sample type and exposure type, but lacks additional metadata, such as sample durations, exposure durations, and exposure frequency. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | Variability addressed by sampling during removal and after cleaning, but uncertainty is not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Manville Serv Corp, (1980). CAL/OSHA industrial hygiene survey at Pittsburg Plant November 27, 1979. |
| **HERO ID:** | 4158232 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Personal sampling data: | two samples4.20 mg/m312.26 mg/m3 (p. 7) |
| Area sampling data: | 21 area samples range between 0.00 - 0.03 f/cc0.13 - 1.39 mg/m3 |

**EVALUATION**

| Domain | | Metric | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | High | Sampling or analytical methodology is an approved OSHA or NIOSH method or is well described and found to be equivalent to approved OSHA or NIOSH methods. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | The data are from the United States and are representative of the industry being evaluated. |
| | Metric 3: | Applicability | Medium | The data are for an occupational scenario that is similar to an occupational scenario within the scope of the risk evaluation, in terms of the type of industry, operations, and work activities. |
| | Metric 4: | Temporal Representativeness | Low | Metadata on the operations, equipment, and worker activities associated with the data show that the data agree representative of outdated operations, equipment, and activities rather than current operations, equipment, and worker activities. The data were collected more than 20 years ago. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Monitoring data include most critical metadata, such as sample type and exposure type, but lacks additional metadata, such as sample durations, and worker activities. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | The monitoring study provides only limited discussion of the variability in the determinants of exposure for the sampled site or sector. The monitoring study provides only limited discussion of the uncertainty in the exposure estimates. |

## Overall Quality Determination Medium

**Study Citation:** Manville Serv Corp, (1981). Certification for airborne concentration of asbestos dust based on the analysis taken.
**HERO ID:** 4158235
**Conditions of Use:** Other:

**EXTRACTION**

| Parameter | Data |
|---|---|
| Area sampling data: | 0.09 fibers (assumed per cm3) (pg 4) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Low | Sampling/analytical methodology is not specified. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | Uninformative | Condition of use is unspecified for monitoring data. |
| | Metric 4: | Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Low | Sample type provided but no other metadata. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Uninformative

| | |
|---|---|
| **Study Citation:** | Manville Serv Corp, (1980). Dust sampling - Laurinburg Plant Tour. |
| **HERO ID:** | 4158240 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Personal sampling data: | Two samples: 0.2 F/cc and 0.06 F/cc (p. 4) |
| Exposure duration: | 67 minutes (sample duration) (p. 4) |
| Comments: | samples taken during mixing of asbestos fibers during processing of asbestos products, this is out of scope for the risk evaluation |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Low | Sampling or analytical methodology is not specified |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | The data are from the United States and are representative of the industry being evaluated. |
| | Metric 3: | Applicability | Uninformative | Samples taken during mixing of asbestos fibers during processing of asbestos products, this is out of scope for the risk evaluation |
| | Metric 4: | Temporal Representativeness | Low | Metadata on the operations, equipment, and worker activities associated with the data show that the data agree representative of outdated operations, equipment, and activities rather than current operations, equipment, and worker activities. The data are more than 20 years old. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Monitoring data include most critical metadata, such as sample type and exposure type, but lacks additional metadata, such as exposure durations, exposure frequency, and/orworker activities. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | The monitoring study does not address variability or uncertainty. |

## Overall Quality Determination Uninformative

| | |
|---|---|
| **Study Citation:** | Manville Serv Corp, (1980). Fiber sampling truck shop personnel. |
| **HERO ID:** | 4158244 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Replacing a hydraulic pump under a dump truck |
| Physical form: | Solid |
| Personal sampling data: | Pump removal: 0.4 F/cc (83 min)Pump and bracket install: 1.98 F/cc (27 min) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Medium | Sampling or analytical methodology is not specified but can be assumed to be PCM. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | The data are from the United States and are representative of the industry being evaluated. |
| | Metric 3: | Applicability | High | The data are for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Low | Metadata on the operations, equipment, and worker activities associated with the data show that the data agree representative of outdated operations, equipment, and activities rather than current operations, equipment, and worker activities. The data were collected more than 20 years ago. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Monitoring data include most critical metadata, such as sample type and exposure type, but lacks additional metadata, such as exposure frequency. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | The monitoring study provides only limited discussion of the variability in the determinants of exposure for the sampled site or sector. The monitoring study provides only limited discussion of the uncertainty in the exposure estimates. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Manville Serv Corp, (1979). Florida power and light job survey [878211105]. |
| **HERO ID:** | 4158248 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | J-spray Insulation was removed from 700 deg F ducting and dropped ten feet to floor. |
| Exposure route: | Inhalation |
| Physical form: | Fibers |
| Personal sampling data: | 60 minute personal samples0.3, 0.7, 0.6, 0.3, 0.1 f/ccOne sample had a concentration ”excessively beyond analytical technique” |
| Area sampling data: | 9 area samples taken (15 minutes)1.2, 0.0, 0.1, 0.0, 0.8, 0.8, 1.0Two samples had concentrations ”excessively beyond analytical technique” |
| Engineering control: | Area roped off with ”Caution” sign. |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Sampling and Analytical Methodology | Low | Sampling or analytical methodology is not specified. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | The data are from the United States. |
| Metric 3: | Applicability | High | The data are for an occupational scenario within the scope of the risk evaluation. |
| Metric 4: | Temporal Representativeness | Low | The data were collected more than 20 years ago. |
| Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Medium | Monitoring data include most critical metadata, such as sample type and exposure type, but lacks additional metadata, such as exposure durations or exposure frequency. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | High | Monitoring report addresses variability through multiple sample types (area and personal), and measurement uncertainty is captured by collecting multiple samples of each type. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Manville Serv Corp, (1979). Florida power and light job survey [878211106]. |
| **HERO ID:** | 4158249 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Removing and bagging 2 inch thermobestos from piping and equipment. [PDF Pg. 4] |
| Exposure route: | Inhalation |
| Physical form: | Fiber |
| Personal sampling data: | [PDF Pg. 4] Sample 1: 0.1 fibers/ccSample 2: 0.5 fibers/ccSample 3: 0.3 fibers/cc Sample 4: 0.4 fibers/ccSample 5: 0.3 fibers/ccSample 6: 0.1 fibers/cc |
| Personal protective equipment: | The operators were wearing throwaway coveralls and government approved respirators. [PDF Pg. 4] |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Sampling and Analytical Methodology | Low | Sampling/analytical methodology is not specified. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | Data are from the U.S. |
| Metric 3: | Applicability | High | Data are for Chemical Substances in Construction, Paint, Electrical, and Metal Products, an in-scope occupational scenario. |
| Metric 4: | Temporal Representativeness | Low | Monitoring data are greater than 20 years old. |
| Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Medium | Sample type and exposure type provided but missing sample methods, exposure duration, and exposure frequency. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Manville Serv Corp, (1978). Florida power and light job survey [878211550]. |
| **HERO ID:** | 4158250 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Workers on spider stages, insulation removed from hot duct and dropped to the ground. Walls were then scraped clean with an ice scraper-like tool. Area with dropped asbestos was roped off, asbestos was allowed to cool, and then it was collected in a dump cart. Area swept clean |
| Personal sampling data: | task-based samples taken during the removal process (p. 5)0.0-1.6 f/cc (10 samples) durations ranged between 15-60 minutes |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Sampling and Analytical Methodology | Low | Sampling or analytical methodology is not specified. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | High | The data are from the United States. |
| | Metric 3: Applicability | High | The data are for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: Temporal Representativeness | Low | The data were collected before the most recent PEL update. |
| | Metric 5: Sample Size | High | Statistical distribution of samples is fully characterized. |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | Medium | Monitoring data include most critical metadata, such as sample type and exposure type, but lacks additional metadata, such as sample durations, exposure durations, exposure frequency, and/orworker activities. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Medium | The monitoring study provides only limited discussion of the variability in the determinants of exposure for the sampled site or sector. The monitoring study provides only limited discussion of the uncertainty in the exposure estimates. |

## Overall Quality Determination Medium

**Study Citation:** Manville Serv Corp, (1982). Impinger studies in nonindustriall areas.
**HERO ID:** 4158252
**Conditions of Use:** Other:

**EXTRACTION**

| Parameter | Data |
|---|---|
| Exposure route: | inhalation |
| Physical form: | airborne particles (presumably fibers) |
| Area sampling data: | 0.9-2.3 mppcf (pg 6; Appendix I table) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Low | Sampling or analytical methodology is not specified. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | Low | Data are general public indoor air samples, which is similar to the in-scope occupational scenario construction materials. |
| | Metric 4: | Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Low | Sample type provided but no other metadata. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | The monitoring report addresses variability through multiple sampling locations, but uncertainty is not well characterized. |

## Overall Quality Determination Low

| | |
|---|---|
| **Study Citation:** | Manville Serv Corp, (1983). Industrial hygiene monitoring. |
| **HERO ID:** | 4158253 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Removal of asbestos containing material. |
| Exposure route: | Inhalation |
| Physical form: | Fibers |
| Personal sampling data: | Employee 1: 3.93, 4.76 (fibers/ml)Employee 2: 1.76, 2.68 (fibers/ml) |
| Comments: | Samples were analyzed with PCM method [PDF Pg. 4]. Asbestos content of the removed substances was 8.82% amosite asbestos [PDF Pg. 4] |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Medium | Sampling or analytical methodology is not equivalent to an approved OSHA or NIOSH method and EPA review of information indicates the methodology is acceptable. Differences in methods are not expected to lead to lower quality data. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for Chemical Substances in Construction, Paint, Electrical, and Metal Products, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Monitoring data are greater than 20 years old. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Low | Sample type provided but no other metadata. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | High | Uncertainty is addressed in sampling/analytical methodology. Variability addressed by sampling two employees. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Manville Serv Corp, (1981). Industrial hygiene survey - March 24 1981 production and engineering service - Manville Plant. |
| **HERO ID:** | 4158254 |
| **Conditions of Use:** | Disposal |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | salvage department - outside truck driver; dozer operator - landfill site (pg 4) |
| Area sampling data: | <0.1 f/cc (pg 4) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Low | Sampling/analytical methodology is not specified. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for construction materials, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| | Metric 5: | Sample Size | Medium | Sample distribution characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Low | Sample type and associated metadata not provided. Only air monitoring results and worker activity described. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Low

| | |
|---|---|
| **Study Citation:** | Manville Serv Corp, (1980). Marinite fabrication follow-up - Corona Plant. |
| **HERO ID:** | 4158258 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Sawing thermal insulating boards |
| Personal sampling data: | Saw operator: 0.2 f/cc (13 mins)Helper: 1.3 f/cc (13 min) |
| Area sampling data: | 0.1 f/cc (13 min) |
| Comments: | Fabrication of marinite boards (asbestos-containing thermal insulating boards) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | High | Sampling or analytical methodology is an approved OSHA or NIOSH method or is well described and found to be equivalent to approved OSHA or NIOSH methods. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | The data are from the United States and are representative of the industry being evaluated. |
| | Metric 3: | Applicability | Medium | The data are for an occupational scenario that is similar to an occupational scenario within the scope of the risk evaluation, in terms of the type of industry, operations, and work activities. |
| | Metric 4: | Temporal Representativeness | Low | Metadata on the operations, equipment, and worker activities associated with the data show that the data agree representative of outdated operations, equipment, and activities rather than current operations, equipment, and worker activities. The data were collected before the most recent PEL update. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Monitoring data include most critical metadata, such as sample type and exposure type, but lacks additional metadata, such as exposure durations, exposure frequency, and/or worker activities. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | The monitoring study provides only limited discussion of the variability in the determinants of exposure for the sampled site or sector. The monitoring study provides only limited discussion of the uncertainty in the exposure estimates. |

## Overall Quality Determination Medium

**Study Citation:** Manville Serv Corp, (1980). Marrero - asbestos point removal.
**HERO ID:** 4158259
**Conditions of Use:** Other:

**EXTRACTION**

| Parameter | Data |
|---|---|
| Worker activity description: | Two foremen, two bulldozer operators, two power shovel operators, one laborer. Removal of material involved pulling the bulk material from point and pushing it into two pits dug on either side of the point. |
| Area sampling data: | Five samples from different locations near asbestos removals ranged from 0.0 - <0.1 f/cc. |
| Exposure duration: | Project lasted three weeks. |
| Personal protective equipment: | Respirators worn by three employees. |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Sampling and Analytical Methodology | Medium | Sampling or analytical methodology is not equivalent to an approved OSHA or NIOSH method and EPA review of information indicates the methodology is acceptable. Differences in methods are not expected to lead to lower quality data. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | The data are from the United States. |
| Metric 3: | Applicability | Uninformative | The data are from an occupational scenario that does not apply to any occupational scenario within the scope of the risk evaluation. |
| Metric 4: | Temporal Representativeness | Low | The data were collected before the most recent PEL update. |
| Metric 5: | Sample Size | Medium | Distribution of samples is characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Medium | Monitoring data include most critical metadata, such as sample type and exposure type, but lacks additional metadata, such as sample durations, exposure durations, exposure frequency, and/or worker activities. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Medium | The monitoring study provides only limited discussion of the variability in the determinants of exposure for the sampled site or sector. The monitoring study provides only limited discussion of the uncertainty in the exposure estimates. |

## Overall Quality Determination Uninformative

| | |
|---|---|
| **Study Citation:** | Manville Serv Corp, (1982). Martin Marrietta Corporation - Office Facilities phase I Littleton Systems Center Southpark - Littleton Colorado. |
| **HERO ID:** | 4158260 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Removing insulation from a steam line. [PDF Pg. 4] |
| Exposure route: | Inhalation [PDF Pg. 5] |
| Physical form: | Dust (solid) [PDF Pg. 4] |
| Personal sampling data: | [PDF Pg. 5]Sample 1: 1.8 (fibers/cc)Sample 2: 1.8 (fibers/cc)Sample 3: 1.4 (fibers/cc)Sample 4: 1.8 (fibers/cc) |
| Personal protective equipment: | Throw-away full coveralls and respirators [PDF Pg. 4] |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Low | Sampling/analytical methodology is not specified. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for Chemical Substances in Construction, Paint, Electrical, and Metal Products, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Monitoring data are greater than 20 years old. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Sample type and exposure type provided but missing exposure frequency and duration. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Manville Serv Corp, (1979). Monitoring the atmosphere filtering [878212086]. |
| **HERO ID:** | 4158264 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | asbestos removal (pg 5-7) |
| Exposure route: | inhalation |
| Physical form: | airborne fibers |
| Personal sampling data: | 0.4-2 fibers/cc |
| Area sampling data: | 0 (pg 4)0.7-2 fibers/cc (pg 5)0.01-2 fibers/cc (pg 7) |
| Exposure duration: | 1 hr sampling (pg 5-6); 30 min sampling (pg 7) |

**EVALUATION**

| Domain | | Metric | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Low | Sampling/analytical methodology is not specified. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for construction materials, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| | Metric 5: | Sample Size | Medium | Sample distribution characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Sample type and exposure type provided but missing metadata such as exposure frequency. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Manville Serv Corp, (1980). Monitoring the atmospheric filtering [878210965]. |
| **HERO ID:** | 4158278 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Asbestos removal (4/7) |
| Exposure route: | inhalation (4/7) |
| Physical form: | fibers (4/7) |
| Personal sampling data: | A personal sample of a worker removing asbestos from the HMS Bulwark was 0.003 f/cc. (4/7) |
| Area sampling data: | Area samples during asbestos removal on the HMS Bulwark were 0.007 and 0.004 f/cc. (5/7) |
| Engineering control: | The asbestos removal area was secured from other parts of the ship. (4/7) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Sampling and Analytical Methodology | Low | Sampling instruments and methods are reported in codes with no way to determine their meanings. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | Data are from the U.S. |
| Metric 3: | Applicability | High | Data are for removal of asbestos products, an in-scope occupational scenario. |
| Metric 4: | Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Low | Exposure type and sampling data provided, but missing number of workers, exposure duration, frequency, particle size, and PPE. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Medium

**Study Citation:** Manville Serv Corp, (1984). OSHA industrial hygiene survey results - Manville Plant [878211543].
**HERO ID:** 4158284
**Conditions of Use:** Other:

**EXTRACTION**

| Parameter | Data |
|---|---|
| Worker activity description: | Pg 3-4: Day Mixer - Asbestos Feed OperatorPutty Shop Mixer Operator #2 UCL OperatorSouth Mono Lathe OperatorNorth Mono Lathe Operator#22 Lathe OperatorNorth Mono Lathe OperatorSouth Mono Lathe OperatorRadiall Drill OperatorEast K&C Lathe #1UPL #2 InspectorUPL #2 AreaUPL #1 InspectorZagar Drill OperatorMarble Dust Loader |
| Personal sampling data: | 0.05-1.3 f/cc (pg 3-4) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Sampling and Analytical Methodology | Low | Sampling/analytical methodology is not specified. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | High | Data are from the U.S. |
| | Metric 3: Applicability | Uninformative | Condition of use is unknown. |
| | Metric 4: Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| | Metric 5: Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | Low | Sample type provided but no other metadata. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Low | variability and uncertainty are not addressed. |

## Overall Quality Determination Uninformative

| | |
|---|---|
| **Study Citation:** | Manville Serv Corp, (1982). Quantitation of airborne asbestos fibers according to the USPHS/NIOSH membrane filter method prepared by Testwell Craig Labs of Albany Inc. |
| **HERO ID:** | 4158287 |
| **Conditions of Use:** | Other: |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Physical form: | airborne fibers |
| Area sampling data: | Pg 5 table: <0.0003 - 0.0013 f/cm3Pg 7 table: <0.0005 - 0.0053 f/cm3 |
| Comments: | USPSH/NIOSH Membrane Filter Method |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | High | Sampling/analytical methodology is an approved NIOSH method. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | Low | COU is unknown |
| | Metric 4: | Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Low | Sample type provided but no other metadata. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Medium

**Study Citation:** Manville Serv Corp, (1979). Results of the nine asbestos samples [878211551].
**HERO ID:** 4158288
**Conditions of Use:** Other:

**EXTRACTION**

| Parameter | Data |
|---|---|
| Area sampling data: | Uncertain if samples are area or personal9 samples, 60 min durations0.1 f/cc, 0.1 f/cc, 0.2 f/cc, 0.4 f/cc, 0.9 f/cc, 0.3 f/cc, 0.1 f/cc, 0.2 f/cc, 0.1 f/cc |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Sampling and Analytical Methodology | Low | Sampling or analytical methodology is not specified. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | The data are from the United States and are representative of the industry being evaluated. |
| Metric 3: | Applicability | Low | It is uncertain what the occupational scenario is for this monitoring data. |
| Metric 4: | Temporal Representativeness | Low | Data collected more than 20 years ago. |
| Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Uninformative | Monitoring data do not include any needed metadata to understand what the data represent and are not usable in the risk evaluation. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Low | The monitoring study does not address variability or uncertainty. |

## Overall Quality Determination Uninformative

**Study Citation:** Manville Serv Corp, (1979). Results of the nine asbestos samples [878211552].
**HERO ID:** 4158289
**Conditions of Use:** Other:

**EXTRACTION**

| Parameter | Data |
|---|---|
| Area sampling data: | Nine 90 minute samples (source does not say area or personal)0.8, 0.9, 0.4, 0.5, 0.3, 0.6, 0.1, 0.3, 0.2 f/cc |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Low | Sampling or analytical methodology is not specified. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | The data are from the United States. |
| | Metric 3: | Applicability | Uninformative | Condition of use is unknown. |
| | Metric 4: | Temporal Representativeness | Low | The data were collected before the most recent PEL update. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Low | Monitoring data do not include any needed metadata to understand what the data represent and are not usable in the risk evaluation. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | The monitoring study does not address variability or uncertainty. |

## Overall Quality Determination Uninformative

| | |
|---|---|
| **Study Citation:** | Manville Serv Corp, (1983). Routine and special industrial hygiene and environmental surveys. |
| **HERO ID:** | 4158290 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Job titles include foreman, Asbestos fiber clean up, Forklift operators, warehouse/dock workers, maintenance, mixers, saw operators, grinder, etc. Maintenance workers, cleaners, asbestos removal, truck driver samples assumed to be in scope and were recorded |
| Personal sampling data: | samples ranged from 0.0 - 6.2 (p. 40)18.9 f/cc (maintainer, p. 59) |
| Area sampling data: | unclear which area samples are in scoperange from 0.0 - 11.7 (p. 60) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Low | Sampling or analytical methodology is not specified. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | The data are from the United States and are representative of the industry being evaluated. |
| | Metric 3: | Applicability | Low | The data are for a non-occupational scenario that is similar to an occupational scenario within the scope of the risk evaluation. The source states that it's unclear if the data is from worker monitoring or if they were collected in a controlled environment. |
| | Metric 4: | Temporal Representativeness | Low | Metadata on the operations, equipment, and worker activities associated with the data show that the data agree representative of outdated operations, equipment, and activities rather than current operations, equipment, and worker activities. The data were collected before the most recent PEL establishment. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Low | Monitoring data include sample type (e.g., personal breathing zone) but no other metadata. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | The monitoring study does not address variability or uncertainty. |

## Overall Quality Determination Low

| | |
|---|---|
| **Study Citation:** | Manville Serv Corp, (1981). Special asbestos fiber samples - R & D Center asbestos fiber section - June 9, 1981. |
| **HERO ID:** | 4158292 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Cutting 3/4" asbestos-cement corrugated sheets and changing the saw blades |
| Exposure route: | Inhalation |
| Physical form: | Fibers |
| Personal sampling data: | 4 samples (f/cc)Cutting corrugated sheet0.20.2Changing blades (15 min)0.00.3 |
| Area sampling data: | 2 samples (f/cc)Cutting corrugated sheet0.0Changing blades (15 min)0.4 |
| Engineering control: | Dust collection system attached to the corrugated sheet saw. |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Sampling and Analytical Methodology | Low | Sampling or analytical methodology is not specified. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | High | The data are from the United States. |
| | Metric 3: Applicability | High | The data are for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: Temporal Representativeness | Low | Metadata on the operations, equipment, and worker activities associated with the data show that the data agree representative of outdated operations, equipment, and activities rather than current operations, equipment, and worker activities. The data collected are more than 20 years old. |
| | Metric 5: Sample Size | High | Statistical distribution of samples is fully characterized. |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | Low | Monitoring data include sample type (e.g., personal breathing zone) but no other metadata. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Medium | The monitoring study provides only limited discussion of the variability in the determinants of exposure for the sampled site or sector. The monitoring study does not discuss uncertainty in the exposure estimates. |

## Overall Quality Determination Medium

**Study Citation:** Manville Serv Corp, (1980). Special asbestos samples - Station D-102 WE area - batch mixer - Waukegan Plant - flexboard - April 10, 1980.
**HERO ID:** 4158293
**Conditions of Use:** Other:

**EXTRACTION**

| Parameter | Data |
|---|---|
| Physical form: | fibers (4/5) |
| Area sampling data: | An area sample was taken 4 feet East of the screw conveyor. The sample results were 3.3 and 2.9 f/cc with a TWA of 3.1 f/cc. (4/5) |
| Engineering control: | A canopy exhaust hood is present with a capture velocity of 140-180 feet per minute, but needs to be closer to the conveyor. (4/5) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Low | Sampling methodology not specified. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | Uninformative | Data appear to be from asbestos board manufacturing, which isn't in scope. |
| | Metric 4: | Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Exposure type and sampling data provided, but missing worker information, exposure duration, frequency, PPE, and particle size. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Uninformative

| | |
|---|---|
| **Study Citation:** | Manville Serv Corp, (1982). Special asbetos sampling unloading asbestos paper from railcars Waukegan Roofing - J-M Division September 29,1982. |
| **HERO ID:** | 4158294 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Packaging, Paper, Plastic, Toys, Hobby Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | unloading asbestos paper from railcars (pg 4) |
| Personal sampling data: | 0.3 f/cc; 0.2 f/cc (pg 4) |
| Exposure duration: | three hours (pg 4) |
| Personal protective equipment: | respirators (pg 4) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Low | Sampling/analytical methodology is not specified. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for asbestos paper, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Sample type and exposure type provided but missing metadata such as exposure frequency. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Manville Serv Corp, (1980). Special dust sampling disc sander operation - Nashua Plant. |
| **HERO ID:** | 4158295 |
| **Conditions of Use:** | Other: |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | disc sander operator (pg 4) |
| Exposure route: | inhalation |
| Physical form: | airborne fibers |
| Personal sampling data: | 3.2 and 3.5 f/cc for a TWA of 3.4 f/cc (pg 4) |
| Personal protective equipment: | 8710 disposable respirator (pg 4) |
| Engineering control: | ”inadequate design of ventilation control equipment. At present, a small diameter hose, resting on the work table near the operator, is used. Although the suction contained within the collection system seems to be acceptable, the need for a funnel-type or similar shape receptacle appears necessary” (pg 4) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Sampling and Analytical Methodology | Low | Sampling/analytical methodology is not specified. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | High | Data are from the U.S. |
| | Metric 3: Applicability | Low | OES not specified-appears to be upstream use which is out-of-scope but may still be informative. |
| | Metric 4: Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| | Metric 5: Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | Medium | Sample type and exposure type provided but missing additional metadata. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Low

**Study Citation:** Manville Serv Corp, (1980). Special dust sampling in carding department.
**HERO ID:** 4158296
**Conditions of Use:** Other:

**EXTRACTION**

| Parameter | Data |
|---|---|
| Worker activity description: | carding department of textile plant:card operator, grinder repairman, sweeper operator, section man, waste serviceman (pg 4-5) |
| Personal sampling data: | 0.1-0.4 F/cc (pg 4-5) |
| Area sampling data: | 0.1-0.5 F/cc (pg 4-5) |
| Engineering control: | central vacuum system (pg 4) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Low | Sampling/analytical methodology is not specified. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | Low | Data are for textile production, a non-legacy use. Could potentially be useful as analog data for legacy asbestos textiles. |
| | Metric 4: | Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Low | Sample type and worker title, but no other metadata provided. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Low

| | |
|---|---|
| **Study Citation:** | Manville Serv Corp, (1980). Special dust survey - June 25, 1980 production and engineering service Manville Plant. |
| **HERO ID:** | 4158297 |
| **Conditions of Use:** | Disposal |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Truck drivers and bulldozer operators at a landfill. (4/5) |
| Exposure route: | inhalation (4/5) |
| Physical form: | dust (4/5) |
| Personal sampling data: | For the truck driver in the salvage department, concentrations were 0.1 and <0.1 f/cc. For the bulldozer operator, concentrations were 0.6 and <0.1 f/cc. (4/5) |
| Engineering control: | Air conditioning unit in dozer was inoperable and had to be operated with doors open. |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Low | Sampling methodology not specified. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for disposal of asbestos products, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Low | Monitoring data include sample type (e.g., personal breathing zone) but no other metadata. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Medium

**Study Citation:** Manville Serv Corp, (1980). Special dust survey - September 29 1980 production and engineering services Manville Plant.
**HERO ID:** 4158299
**Conditions of Use:** Disposal

**EXTRACTION**

| Parameter | Data |
|---|---|
| Worker activity description: | A bulldozer operator to a landfill. (4/5) |
| Exposure route: | inhalation (4/5) |
| Physical form: | fibers (4/5) |
| Area sampling data: | Three samples near the bulldozer at the landfill site were 0.2, 0.6, and <0.1 f/cc. (4/5) |
| Engineering control: | An air conditioning unit on the bulldozer was operating. (4/5) |

**EVALUATION**

| Domain | | Metric | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Low | Sampling methodology not specified. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for disposal of asbestos products, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Exposure type and sampling data provided, but missing number of workers, exposure duration, frequency, particle size, and PPE. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Manville Serv Corp, (1980). Special dust survey - September 8 1980 production And engineering services Manville Plant. |
| **HERO ID:** | 4158300 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Cutting 1/4" transite asbestos sheets |
| Exposure route: | Inhalation |
| Physical form: | Fibers |
| Area sampling data: | 0.1 fibers/cm3 - 0.3 fibers/cm3 |
| Personal protective equipment: | Respirator |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Low | Sampling or analytical methodology is not specified. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | The data are from the United States. |
| | Metric 3: | Applicability | Medium | The data are for an cutting transite sheets, which is a type of asbestos containing material that may still exist in old buildings. Data may be useful for determining exposure in demolition or renovation. |
| | Metric 4: | Temporal Representativeness | Low | Data is more than 20 years old. |
| | Metric 5: | Sample Size | High | Discrete data measurements are provided. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Low | Monitoring data include sample type (e.g., personal breathing zone) but no other metadata. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | The monitoring study does not address variability or uncertainty. |

## Overall Quality Determination — Low

| | |
|---|---|
| **Study Citation:** | Manville Serv Corp, (1981). Special retesting of asbestos dust Station D-20BT White Area Winder Operator. |
| **HERO ID:** | 4158301 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Winder operator (4/5) |
| Exposure route: | Inhalation |
| Physical form: | Fibers (4/5) |
| Personal sampling data: | A personal sample was taken for a winder operator that exceeded the TLv at 4.8 f/cc. While using a respirator, the personal sample was 0.4 f/cc. (4/5) |
| Personal protective equipment: | Wearing a disposable 7170 respirator decreased breathing zone concentrations from 4.8 f/cc to 0.4 f/cc. (4/5) |
| Engineering control: | The ventilation system was newly installed. Also, the overhead guidewheel will not be used with non coated asbestos products. (4/5) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Low | Sampling methodology not specified. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | Low | Data are for a ”winder” of some type. Without more specific information, this may or may not be in scope. |
| | Metric 4: | Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Exposure type and sampling data provided, but missing number of workers, exposure duration, frequency, and particle size. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | The monitoring study does not address variability or uncertainty. |

## Overall Quality Determination — Low

| | |
|---|---|
| **Study Citation:** | Manville Serv Corp, (1980). State inspection of Laurinburg Plant. |
| **HERO ID:** | 4158303 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Area sampling data: | 4 areas tested, 9 samples ranging from 0.0 - <0.1 F/cc (1 hour samples) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Low | Sampling or analytical methodology is not specified. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | The data are from the United States. |
| | Metric 3: | Applicability | Medium | The data are for an occupational scenario that is similar to an occupational scenario within the scope of the risk evaluation. Asbestos was in the vicinity of the work area but it is unclear if asbestos was in place or if it was being used in the area. |
| | Metric 4: | Temporal Representativeness | Low | Metadata on the operations, equipment, and worker activities associated with the data show that the data agree representative of outdated operations, equipment, and activities rather than current operations, equipment, and worker activities. The data were collected more than 20 years old ago. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Monitoring data include most critical metadata, such as sample type and exposure type, but lacks additional metadata, such as exposure durations, and exposure frequency. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | The monitoring study does not address variability or uncertainty. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Manville Serv Corp, (1980). Study on exposure to asbestos fibres in working conditions at the Locomotive Deposit Workshop of the National Railways. |
| **HERO ID:** | 4158304 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Sanding of chimneys, reconditioning of rheostate resistances, insulation of the diesel motor effluent line, board cutting, cord preparation, bearing setting, substitution of brake pellets, taping of cables, sanding tops of rheostats, stripping of resistance blocks, disassembling conveyors and cooling panels, and rheostat disassembling (9/14) |
| Physical form: | fibers (4/14) |
| Personal sampling data: | Concentration of asbestos during railway processing were N.D.-4.4 f/cc. Median values were N.D.-2.7 f/cc. (11/14) |
| Exposure duration: | 10 minutes to 2 hours, 30 minutes on average (12/14) |
| Number of workers: | 2000 workers (4/14) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Medium | Sampling/analytical methodology is not an approved OSHA/NIOSH method but is an acceptable methodology. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Medium | Data are from Italy, an OECD country. |
| | Metric 3: | Applicability | High | Data are for industrial use in construction materials, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| | Metric 5: | Sample Size | Medium | Sample distribution characterized by limited statistics (medians, standard deviations, ranges) but discrete samples not provided and distribution not fully characterized. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Exposure type and sampling data provided, but missing exposure frequency, PPE, engineering controls, and particle size. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | High | Uncertainty is addressed in sampling/analytical methodology. Variability is addressed by sampling multiple jobs and process steps. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Manville Serv Corp, (1980). Texas Power and Light Valley Station job survey. |
| **HERO ID:** | 4158306 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Removing two layers of to inch thick asbestos containing material from a turbine. [PDF Pg. 4] |
| Personal sampling data: | Operators engages in asbestos removal:Sample 1: 0.6 (fibers/cm^3)Sample 2: 0.4 (fibers/cm^3) |
| Area sampling data: | Downwind on removal operation:Sample 3: 1.7 (fibers/cm^3)Sample 4: 1.1 (fibers/cm^3) |
| Exposure duration: | Duration of sampling the activity was 60 minutes [PDF Pg. 5] |
| Personal protective equipment: | Respirator and disposable type whole body coveralls. [PDF Pg. 4] |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Low | Sampling/analytical methodology is not specified. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for Chemical Substances in Construction, Paint, Electrical, and Metal Products, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Monitoring data are greater than 20 years old. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Low | Sample type provided but no other metadata. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | High | Monitoring report addresses variability through multiple sample types (area and personal), and measurement uncertainty is addressed through multiple samples of each type. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Manville Serv Corp, (1987). Summary of industrial hygiene monitoring data representing studies taken at four Manville Corp manufacturing locations relative to five chemicals with cover letter dated 070887. |
| **HERO ID:** | 4158385 |
| **Conditions of Use:** | Other: |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Physical form: | fibers (4/13) |
| Personal sampling data: | Both personal and area samples combined gave annual averages of 7.48 f/cc in 1979 and 0.90 f/cc in 1981. (4/13) |
| Area sampling data: | Both personal and area samples combined gave annual averages of 7.48 f/cc in 1979 and 0.90 f/cc in 1981. (4/13) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Sampling and Analytical Methodology | Low | Sampling methodology not specified. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | Data are from the U.S. |
| Metric 3: | Applicability | Uninformative | Monitoring data is from four manufacturing facilities and the condition of use is not specified. Data is not useable for risk evaluation purposes. |
| Metric 4: | Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| Metric 5: | Sample Size | Medium | Distribution of samples is characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Medium | Exposure type and sampling data provided, but missing worker information, exposure duration, frequency, engineering controls, PPE, and particle size. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | High | Monitoring report addresses variability through multiple sampling types (area and personal), and uncertainty is addressed by the number of samples taken for each sample type. |

## Overall Quality Determination Uninformative

**Study Citation:** Manville Serv Corp, (1973). Asbestos baghouse collector sampling [878211134].
**HERO ID:** 5913541
**Conditions of Use:** Other:

**EXTRACTION**

| Parameter | Data |
|---|---|
| Physical form: | fibers (4/6) |
| Area sampling data: | Near the baghouse collector, concentration of asbestos was 0.1 f/cc. (4/6) |
| Engineering control: | A baghouse is used to reduce airborne asbestos. (4/6) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Low | Sampling methodology not specified. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | Low | Condition of use isn't specified, only sampling results given. |
| | Metric 4: | Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Low | Monitoring data include area monitoring data, but no other metadata is provided. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Low

| | |
|---|---|
| **Study Citation:** | Manville Serv Corp, (1980). Monitoring the atmospheric filtering [878211011]. |
| **HERO ID:** | 5913552 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Removal of asbestos-containing material from Boiler Room of HMS Bulwark. |
| Personal sampling data: | 1.0 fibers/cc measured during asbestos removal with sampling time of 6.5 hours. |
| Area sampling data: | 1.2 fibers/cc measured during asbestos removal with sampling time of 6.5 hours.0.05 fibers/cc measured dafter asbestos removal with sampling time of 30-min. |
| Engineering control: | Secured area |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Low | Sampling/analytical methodology is not specified. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | The data are from the United States. |
| | Metric 3: | Applicability | High | Data are for Chemical Substances in Construction, Paint, Electrical, and Metal Products, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Monitoring data are greater than 20 years old. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Monitoring data include sample type and exposure type, but study lacks additional metadata such as exposure durations, exposure frequency, and/or worker activity details. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | Variability addressed by collecting both personal and area samples, but uncertainty is not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Manville Serv Corp, (1979). Florida power and light job survey [878211553]. |
| **HERO ID:** | 5913558 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | removing asbestos insultation (pg 4)Area samples: below pressurizer, below access duct to pressurizer cubicle, below ladder to the top of pressurizer (pg 5) |
| Exposure route: | inhalation |
| Physical form: | airborne fibers |
| Personal sampling data: | 0.1 - 0.7 f/cc (pg 4) |
| Area sampling data: | 0-1.2 f/cc (pg 5) |
| Particle size characterization: | Tables 1-2 (pg 11-12) |
| Exposure duration: | 60 min personal samples (pg 4); 15 minute area samples (pg 5) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Sampling and Analytical Methodology | Low | Sampling/analytical methodology is not specified. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | Data are from the U.S. |
| Metric 3: | Applicability | High | Data are for construction materials, an in-scope occupational scenario. |
| Metric 4: | Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| Metric 5: | Sample Size | Medium | Sample distribution characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Medium | Sample type and exposure type provided but missing metadata such as exposure frequency. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | High | Monitoring report address variability through multiple sampling types (area and personal), and measurement uncertainty is addressed by multiple samples of each type. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Manville Serv Corp, (1980). Atmospheric filtering monitoring report [878210733]. |
| **HERO ID:** | 5913590 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Asbestos removal |
| Personal sampling data: | 0.95 f/cc2 hr sampleMax fiber count: 2 f/cc |
| Area sampling data: | 3 samples0.09 (30 min), 0.7 (2 hr),0.07 (30 min) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | High | Sampling or analytical methodology is an approved OSHA or NIOSH method or is well described and found to be equivalent to approved OSHA or NIOSH methods (PCM) |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | The data are from the United States and are representative of the industry being evaluated |
| | Metric 3: | Applicability | High | The data are for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Low | Metadata on the operations, equipment, and worker activities associated with the data show that the data agree representative of outdated operations, equipment, and activities rather than current operations, equipment, and worker activities. The data were collected more than 20 years ago. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Monitoring data include most critical metadata, such as sample type and exposure type, but lacks additional metadata, such as, exposure durations, exposure frequency, and/or worker activities. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | The monitoring study provides only limited discussion of the variability in the determinants of exposure for the sampled site or sector. The monitoring study provides only limited discussion of the uncertainty in the exposure estimates. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Manville Serv Corp, (1980). Florida power and light job survey [878211102]. |
| **HERO ID:** | 9562188 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Removal of thermal asbestos blocks from a hot air duct. Insulation was picked up and placed on plywood, cooled with water, placed in plastic bags and sealed. (p. 4) |
| Personal sampling data: | 6 samples, 60 minute duration0.3 f/cc, 0.5 f/cc, 0.1 f/cc, 0.7 f/cc, 0.3 f/cc, 0.1 f/cc |
| Personal protective equipment: | coveralls and respirators |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Medium | Sampling or analytical methodology is not equivalent to an approved OSHA or NIOSH method and EPA review of information indicates the methodology is acceptable. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | The data are from the United States and are representative of the industry being evaluated. |
| | Metric 3: | Applicability | High | The data are for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Low | The data were collected before the most recent PEL establishment or update or are more than 20 years old if no PEL is established. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Monitoring data include most critical metadata, such as sample type and exposure type, but lacks additional metadata, such as exposure duration. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | The monitoring study does not address variability or uncertainty. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Manville Serv Corp, (1980). Florida power and light job survey [878211103]. |
| **HERO ID:** | 9562189 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Removal of asbestos-containing materials. Specifically, the operator was removing 18-in x 36-in sections of AC insulation from the north side of the Burner Wind Box and inserting it into plastic bags. The operator put the insulation into the bags and secured them. The insulation had been put on in two layers, the inside layer was 2.5-in thick. The operators worked off 12-ft scaffold and removed the chicken wire from the air heater. The operators removed the J-Spray insulation by hand from the air heater wall. In sections the insulation was hammered off the side of the wall and inserted into bags. |
| Exposure route: | Inhalation |
| Physical form: | Fibers |
| Personal sampling data: | 15 min samples: 0, 0, 0.18, 0.19, 0.3 fibers/cc |
| Engineering control: | The ACM was sprayed with water to keep the dust to a minimum. The insulation was placed into plastic bags and secured at the top and caution labels were attached to each bag. |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Sampling and Analytical Methodology | Low | Sampling/analytical methodology is not specified. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | Data are from the U.S. |
| Metric 3: | Applicability | High | Data are for building materials, an in-scope occupational scenario. |
| Metric 4: | Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Medium | Sample type and exposure type provided but missing additional metadata such as exposure frequency. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Medium | The monitoring report addresses variability through sampling in multiple locations, but measurement uncertainty is not characterized. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Manville Serv Corp, (1979). Florida power and light job survey [878211104]. |
| **HERO ID:** | 9562202 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Removing asbestos during renovation operation. (4/6) |
| Physical form: | Fibers |
| Personal sampling data: | Personal samples were 0.1-0.9 f/cc. (5/6) |
| Engineering control: | Insulation was sprayed with water to keep dust to a minimum. The insulation was placed into plastic bags and secured at the top. Caution labels were attached to each bag. (4/6) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Low | Sampling or analytical methodology is not specified. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for demolition of asbestos products, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | The data were collected before the most recent PEL establishment or update or are more than 20 years old if no PEL is established. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Exposure type and sampling data provided, but missing number of workers, exposure duration, frequency, particle size, and PPE. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Manville Serv Corp, (1980). Florida power and light job survey [878211547]. |
| **HERO ID:** | 9562294 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Removal of asbestos containing insulation, inserting it into plastic bags and securing them. (4/6) |
| Exposure route: | inhalation (4/6) |
| Physical form: | dust (4/6) |
| Personal sampling data: | Five personal samples during insulation removal were 0.30 f/cc, 0.18 f/cc, 0.00 f/cc, 0.00 f/cc, and 0.19 f/cc. (5/6) |
| Engineering control: | The ACM was sprayed with water to keep dust to a minimum, and put into plastic bags after removal. (4/6) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Low | Sampling methodology is not specified. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | The data are for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Low | The data were collected before the most recent PEL establishment or update or are more than 20 years old if no PEL is established. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Exposure type and sampling data provided, but missing number of workers, exposure duration, frequency, PPE, and particle size. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Manville Serv Corp, (1980). Florida power and light job survey [878211548]. |
| **HERO ID:** | 9562302 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | The operators were working on the fourth level floor and were removing thermobestos block from the top of the hot air duct. The operators started the job by picking up the hot insulation and placing it on a six by eight foot piece of plywood. The material had to be cooled down with a stream of water. The thermobestos was inserted into plastic bags which were secured with tape. The bags had the "Caution Asbestos" warning printed on the front. The job cycle included the arc welding of pins to a wire system and installing two layers of 2"x24"x48" Delta board over the system. Wire mesh was cut and installed over the insulation. The job was difficult due to the excessive heat the operators were exposed to. |
| Exposure route: | Inhalation |
| Personal sampling data: | Sampling duration was 60-min for each sample. Measurements in fibers/cc. Sample 1: 0.3Sample 2: 0.5Sample 3: 0.1Sample 4: 0.7Sample 5: 0.3Sample 6: 0.1 |
| Personal protective equipment: | The operators were wearing throw-away coveralls and government approved respirators. |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Sampling and Analytical Methodology | Low | Sampling/analytical methodology is not specified. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | High | Data are from the U.S. |
| | Metric 3: Applicability | High | Data are for Chemical Substances in Construction, Paint, Electrical, and Metal Products, an in-scope occupational scenario. |
| | Metric 4: Temporal Representativeness | Low | Monitoring data are greater than 20 years old. |
| | Metric 5: Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | Medium | Sample type and exposure type provided but missing exposure frequency, exposure duration, and number of workers. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Medium | The monitoring report addresses variability through the sampling of various workers, but measurement uncertainty is not characterized. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Manville Serv Corp, (1980). Monitoring the atmospheric filtering [878211010]. |
| **HERO ID:** | 9598515 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Removal of asbestos containing materials from Boiler Room on HMS Bulwark. |
| Exposure route: | Inhalation |
| Physical form: | Fibers |
| Personal sampling data: | 0.09 fibers/cm3 measured during asbestos removal with 5.5-hr sampling time and 2 LPM flowrate. |
| Area sampling data: | 0.005 fibers/cm3 measured during asbestos removal with 5.5-hr sampling time and 2 LPM flowrate.0.07 fibers/cm3 measured after asbestos removal with 30-min sampling time and 2 LPM flowrate. |
| Engineering control: | Area secured during asbestos removal. |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Low | Sampling or analytical methodology is not specified. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Medium | Data measurements are from HMS Bulwark, which was a naval ship from the UK (an OECD country other than the US). |
| | Metric 3: | Applicability | High | The data are for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Low | Data are more than 20 years old. |
| | Metric 5: | Sample Size | High | Discrete data measurements provided. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Monitoring data include most critical metadata, such as sample type and exposure type, but lacks additional metadata such as exposure durations, exposure frequency, and worker activity details. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | Monitoring report addresses variability through multiple sample types (area and personal), but does not characterize measurement uncertainty. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Marr, W. T. (1964). Asbestos exposure during naval vessel overhaul. American Industrial Hygiene Association Journal 25:264-268. |
| **HERO ID:** | 3085090 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Activity/process provided for shipboard insulation jobs; included forming asbestos pads, installing asbestos cloth and pads on equipment, and sawing of blocks and pipe sections and removal of old insulation (pg 3 and 4) |
| Exposure route: | inhalation |
| Physical form: | Dust |
| Area sampling data: | Units in million particles per cubic foot (mppcf). Range from 0.2 to 10 mppcf for 2-5micron particles; 0.1 to 3 mppcf for 5-10micron particles; and trace to 8 mppcf for 3-60 micron particles... Provided ranges broken down by asbestos subtype and worker activity |
| Exposure duration: | Percentage of time working with asbestos instalation/removal for shipboard insulation jobs: 38% of time to installing magnesia and amosite asbestos blocks and pipe sections, 42% of time to installing calcium silicate and amosite asbestos blocks and pipe sections, and remaining time to installation and removal of those types and other asbestos forms (pg 3)average 15 years of exposure |
| Number of workers: | 60 to 80 employees at Naval Shipyard |
| Engineering control: | General exhaust ventilation or portable exhaust fans; use of damp/wetted material to avoid dust creation |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Sampling and Analytical Methodology | Low | Sampling/analytical methodology is not specified. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | Data are from the U.S. |
| Metric 3: | Applicability | High | Data are for installation and removal of asbestos materials for machinery/equipment, an in-scope occupational scenario. |
| Metric 4: | Temporal Representativeness | Low | Monitoring data are greater than 20 years old. |
| Metric 5: | Sample Size | Medium | Sample distribution characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Medium | Sample type and exposure type provided but missing date or timing of collection, location, methods. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Medium | Variability addressed by different compositions of asbestos and particle sizes, but uncertainty is not addressed. |

## Overall Quality Determination Medium

**Study Citation:** Marr, W. T. (1964). Asbestos exposure during naval vessel overhaul. American Industrial Hygiene Association Journal 25:264-268.
**HERO ID:** 3085090
**Conditions of Use:** Disposal

**EXTRACTION**

| Parameter | Data |
|---|---|
| Worker activity description: | Activity/process provided for shipboard insulation jobs; included removal of old insulation (pg 4) |
| Exposure route: | inhalation |
| Physical form: | Dust |
| Area sampling data: | Units in million particles per cubic foot (mppcf). Range from 0.2 to 10 mppcf for 2-5micron particles; 0.1 to 3 mppcf for 5-10micron particles; and trace to 8 mppcf for 3-60 micron particles... Provided ranges broken down by asbestos subtype and worker activity |
| Exposure duration: | Percentage of time working with asbestos instalation/removal for shipboard insulation jobs: 38% of time to installing magnesia and amosite asbestos blocks and pipe sections, 42% of time to installing calcium silicate and amosite asbestos blocks and pipe sections, and remaining time to installation and removal of those types and other asbestos forms (pg 3)average 15 years of exposure |
| Number of workers: | 60 to 80 employees at Naval Shipyard |
| Engineering control: | General exhaust ventilation or portable exhaust fans; use of damp/wetted material to avoid dust creation |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Low | Sampling/analytical methodology is not specified. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for installation and removal of asbestos materials for machinery/equipment, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Monitoring data are greater than 20 years old. |
| | Metric 5: | Sample Size | Medium | Sample distribution characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Sample type and exposure type provided but missing date or timing of collection, location, methods. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | Variability addressed by different compositions of asbestos and particle sizes, but uncertainty is not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Massey, D. G., Fournier-Massey, G. (1987). Asbestos removal from buildings: A review. Hawaii Medical Journal 46(5):153-154, 157. |
| **HERO ID:** | 3617589 |
| **Conditions of Use:** | Consumer Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Exposure route: | inhalation (2/3) |
| Physical form: | fibers (2/3) |
| Area sampling data: | One source reported that public schools of Ontario, Canada had levels below 0.04 f/cc. (2/3) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Medium | Sampling/analytical methodology is not an approved OSHA/NIOSH method but is an acceptable methodology. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Medium | The data are from an OECD country. other than the U.S. |
| | Metric 3: | Applicability | Low | Data are for consumer use of construction materials in schools, which is similar to commercial use of construction materials, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| | Metric 5: | Sample Size | Medium | Sample distribution characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Low | Monitoring data include sample type (e.g., personal breathing zone) but no other metadata. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination — Low

| | |
|---|---|
| **Study Citation:** | Massey, D. G., Fournier-Massey, G. (1987). Asbestos removal from buildings: A review. Hawaii Medical Journal 46(5):153-154, 157. |
| **HERO ID:** | 3617589 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Rip-out of asbestos materials. (2/3) |
| Exposure route: | inhalation (2/3) |
| Physical form: | fibers (2/3) |
| Area sampling data: | "The airborne level of fibers during removal averaged 16.4 f/cc with dry methods, but remained under 2 f/cc with wet removal. In another study, airborne fiber levels from the time of initial erection of barriers to final clearing rose to 37 f/cc. Dry removal resulted in a mean level of 38.9 f/cc, untreated water removal 28.6 f/cc and EPA-amended water methodology 1 f/cc. Bagging of the debris resulted in a higher airborne contamination (3.8 f/cc)(2/3)" |
| Engineering control: | Excellent maintenance of existing asbestos-containing building materials is the most appropriate action. Encapsulation with sealants such as latex paint, or complete occlusion of trouble spots may be necessary. Protecting easily-damaged areas with sheet metal is the rule in the shipbuilding trade. The use of bonding agents by injection can stabilize areas prior to repair and painting. These techniques are also valuable in buying time until asbestos can be removed in a well-planned maneuver. (3/3) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Medium | Sampling/analytical methodology is not an approved OSHA/NIOSH method but is an acceptable methodology. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for demolition of asbestos products, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| | Metric 5: | Sample Size | Medium | Sample distribution characterized by limited statistics (average, maximum) but discrete samples not provided and distribution not fully characterized. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Exposure type and sampling data provided, but missing number of workers, exposure duration, frequency, PPE, and particle size. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | Variability is addressed by citing multiple studies. Uncertainty isn't addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Mccoy, M. J., Lewis, R. C., Mowat, F. S. (2021). Airborne concentrations of chrysotile asbestos during operation of industrial crane controls and maintenance of associated arc chutes. Toxicology and Industrial Health 37(3):124-133. |
| **HERO ID:** | 7460196 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | The first simulation activity involved the operators opening the control panel doors, placing the crane units under power, and running the components under traverse and hoistingdrive loads. [PDF Pg. 3]The second activity was designed to simulate maintenance activities involving arc chutes that were sanded with varying grits of sandpaper or scraped with a pocketknife, with the resultant dust being removed using forceful exhalation by mouth. [PDF Pg. 3] |
| Personal sampling data: | [PDF Pg. 6]Operation: 0.009; 0.009; 0.012; 0.023 [fibers/cm^3)Maintenance (Task 1): <0.013; 0.021 (fibers/cm^3)Maintenance (Task 2): 0.013; 0.022 (fiber/cm^3)Table 3. |
| Area sampling data: | [PDF Pg. 6]Operation: 0.11 (fibers/cm^3)Maintenance (task 2): 0.30; 0.35 (fibers/cm^3)Maintenance (task 1+2): 0.013; 0.014 (fibers/cm^3)Table 3. |
| Exposure duration: | Durations of the first simulated activity ranged from 9-12 seconds (shown in Table 1). [PDF Pg. 4]Durations of the second simulated activity ranged from 35-75 seconds (Shown in Table 2). [PDF Pg. 4] |
| Comments: | PCM (NIOSH 7400) [PDF Pg. 6] |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | High | Sampling/analytical methodology is an approved NIOSH method. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for Chemical Substances in Construction, Paint, Electrical, and Metal Products, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | High | Monitoring data are no more than 10 years old. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | All metadata provided. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | High | Uncertainty is addressed in sampling/analytical methodology. Variability addressed by multiple samples and both area and personal sampling. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Mckinnery, W. N., Jr, Moore, R. W. (1992). Evaluation of airborne asbestos fiber levels during removal and installation of valve gaskets and packing. AIHA Journal 53(8):531-532. |
| **HERO ID:** | 28518 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Replacing an asbestos gasket and packing material (and installation of new asbestos gasket and packing material) in a pipe valve that would be found in a building/industrial operation. |
| Exposure route: | inhalation |
| Personal sampling data: | PCM Analysis: (unit = fibers/cc)Gasket Removal and Installation:Location: \| No. Samples \| Min. Fib/cc \| Max. Fib/cc \| Geo. Mean Fib/ccPersonal - R: \| 23 \| 0.05 \| 0.44 \| 0.16 PErsonal - In \| 12 \| 0.13 \| 0.29 \| 0.20 Packing Removal and Installation:Location: \| No. Samples \| Min. Fib/cc \| Max. Fib/cc \| Geo. Mean Fib/ccPersonal - R: \| 21 \| 0.05 \| 1.01 \| 0.29 Personal - In \| 18 \| 0.04 \| 0.52 \| 0.10 TEM Analysis: (unit = structures/cc)Gasket Removal and Installation: Location: \| No. Samples \| Min. st/cc \| Max. st/cc \| Geo. Mean st/ccPersonal - R: \| 26 \| 0.86 \| 18.45 \| 4.58 PErsonal - In \| 12 \| 0.40 \| 74.32 \| 2.97 Packing Removal and Installation:Location: \| No. Samples \| Min. st/cc \| Max. st/cc \| Geo. Mean st/ccPersonal - R: \| 7 \| 0.52 \| 19.57 \| 4.37 Personal - In \| 6 \| 0.07 \| 4.05 \| 0.42 R = Removal, IN = InstallationAverage gasket removal time: 32 min. Average gasket installation time: 31 min.Average Packing removal time: 46 min.Average Packing installation time: 26 min. |
| Area sampling data: | PCM Analysis: R = Removal, IN = InstallationGasket Removal and Installation:Location: \| No. Samples \| Min. Fib/cc \| Max. Fib/cc \| Geo. Mean Fib/ccCenter - R: \| 23 \| 0.09 \| 0.59 \| 0.19 Center - In \| 12 \| 0.11 \| 0.35 \| 0.19 Northeast - R \| 13 \| 0.03 \| 0.32 \| 0.08 Northeast - IN \| 6 \| 0.13 \| 0.19 \| 0.16 Southwest - R \| 13 \| 0.00 \| 0.17 \| 0.05 Soutwest - IN \| 6 \| 0.11 \| 0.18 \| 0.14 Packing Removal and Installation:Location: \| No. Samples \| Min. Fib/cc \| Max. Fib/cc \| Geo. Mean Fib/ccCenter - R: \| 14 \| 0.05 \| 0.60 \| 0.25 Center - In \| 12 \| 0.03 \| 0.75 \| 0.09 Northeast - R \| 14 \| 0.04 \| 0.48 \| 0.22 Northeast - IN \| 12 \| 0.03 \| 0.43 \| 0.09 Southwest - R \| 14 \| 0.04 \| 0.34 \| 0.19 Soutwest - IN \| 12 \| 0.03 \| 0.46 \| 0.09 TEM Analysis: (unit = structures/cc)Gasket Removal and Installation: Location: \| No. Samples \| Min. st/cc \| Max. st/cc \| Geo. Mean st/ccCenter - R: \| 23 \| 0.29 \| 28.22 \| 3.32 Center - In \| 12 \| 0.86 \| 3.52 \| 1.05 Northeast - R \| 13 \| 0.69 \| 15.36 \| 3.92 Northeast - IN \| 6 \| 0.93 \| 3.23 \| 1.73 Southwest - R \| 6 \| 0.52 \| 12.74 \| 2.74 Soutwest - IN \| 6 \| 0.91 \| 3.53 \| 1.66 Packing Removal and Installation:Location: \| No. Samples \| Min. st/cc \| Max. st/cc \| Geo. Mean st/ccCenter - R: \| 7 \| 0.39 \| 18.86 \| 5.38 Center - In \| 6 \| 0.03 \| 10.88 \| 0.38 R = Removal, IN = InstallationAverage gasket removal time: 32 min. Average gasket installation time: 31 min.Average Packing removal time: 46 min.Average Packing installation time: 26 min. |
| Particle size characterization: | Dataset looked at # of fibers, not gross size of fibers. |
| Personal protective equipment: | PPE observed in this study is not relevant, as this was an isolated study done to mimic conditions seen in the workplace (this was not a workplace setting, but a controlled experiment. Workers were wearing SCBA. |
| Comments: | Study is NOT a workplace study, but a lab study designed to mimic workplace conditions. |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | High | Sampling/analytical methodology is an approved NIOSH method. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | Medium | Data are for a lab study that mimics exposures from replacing asbestos containing gaskets and packing from pipe valves, which is similar to the in-scope occupational scenario: Chemical Substances in Construction, Paint, Electrical, and Metal Products |
| | Metric 4: | Temporal Representativeness | Medium | Monitoring data are greater than 10 years old but no more than 20 years old. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized : # of samples, min, max, mean, and STD provided. |
| Domain 3: Accessibility/ Clarity | | | | |

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| | |
|---|---|
| **Study Citation:** | Mckinnery, W. N., Jr, Moore, R. W. (1992). Evaluation of airborne asbestos fiber levels during removal and installation of valve gaskets and packing. AIHA Journal 53(8):531-532. |
| **HERO ID:** | 28518 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

| | | | EVALUATION | |
|---|---|---|---|---|
| Domain | | Metric | Rating | Comments |
| | Metric 6: | Metadata Completeness | Medium | Sample type and exposure type provided but missing characterization of the length of time for each sample (only an average given). |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | Variability addressed by comparing PCM Vs. TEM microscopy results, but uncertainty is not addressed. |

## Overall Quality Determination — High

| | |
|---|---|
| **Study Citation:** | McManus, K. P. (1981). Health hazard evaluation report no. HETA 81-309-936, US Air Force Recruiting Station, Bridgeport, Connecticut. |
| **HERO ID:** | 3970484 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Custodians dusting bookshelves. [PDF Pg. 5] |
| Physical form: | Fiber (solid) [PDF Pg. 5] |
| Area sampling data: | In a university library with a deteriorating sprayed asbestos ceiling , custodians were continuously dusting over a mile of shelving and generating an average of 4.0 f/cm3 contamination level for themselves and 0.3 f/cm3 for nearby library users. [PDF Pg. 5][PDF Pg. 5] US Airforce Recruiting Office AreaRear left (285 liters): <4500 (fibers/filter)Rear right (330 liters): <4500 (fibers/filter)Front left (285 liters): <4500 (fibers/filter)Front right (225 liters): <4500 (fibers/filter) |
| Engineering control: | Ventilation system [PDF Pg. 3]. |
| Comments: | Samples were collected on AA filters and analyzed according to NIOSH Method P&CAM 2394 utilizing Phase Contrast Microscopy. The limit of detection has been determined to be 0.03 fibers per field or 4500 fibers per filter. [PDF Pg. 4] |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Sampling and Analytical Methodology | High | Sampling/analytical methodology is an approved NIOSH method. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | Data are from the U.S. |
| Metric 3: | Applicability | High | Data are for Chemical Substances in Construction, Paint, Electrical, and Metal Products, an in-scope occupational scenario. |
| Metric 4: | Temporal Representativeness | Low | Monitoring data are greater than 20 years old. |
| Metric 5: | Sample Size | Low | Sample distribution is characterized by no statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Low | Sample type provided but no other metadata. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | High | Uncertainty is addressed in sampling/analytical methodology. Variability addressed by sampling multiple areas of the building. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | McManus, K. P. (1986). Health hazard evaluation report no. HETA 85-021-1654, Portsmouth Naval Shipyard, Portsmouth, New Hampshire. |
| **HERO ID:** | 3970525 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | The insulation shop uses talc and cement to make pipe insulation for Navy ships. Employees also perform rip-puts and pipe covering on the ships. (5/15) |
| Exposure route: | inhalation (3/15) |
| Physical form: | dust (3/15) |
| Area sampling data: | (PCM) Area samples in the insulation shop were <0.0017-0.005 f/cc. (9/15) |
| Particle size characterization: | (TEM) Sample No. 4913 (Lunchroom) contained one amosite fiber, 1.88 microns in length and 0.56 microns in diameter, within the area of the sample analyzed. Sample No. 4914 (Band Saw) contained one tremolite fiber, 10.31 microns in length and 0.31 microns in diameter. Sample No. 410128 (Pad Room) contained one chrysotile fiber, 1.19 microns in length and 0.06 microns in diameter. Sample No. 410134 (Storage Room) contained two chrysotile fibers and one amosite fiber, ranging from 1.38 to 2.50 microns in length and 0.06 microns in diameter. (10/15) |
| Number of workers: | 100 employees work in the insulation shop of the ship (5/15) |
| Personal protective equipment: | Air-supplied respirators are used during all insulation rip-outs. (5/15) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Sampling and Analytical Methodology | High | Sampling/analytical methodology is an approved NIOSH method. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | Data are from the U.S. |
| Metric 3: | Applicability | High | Data are for industrial use in construction materials, an in-scope occupational scenario. |
| Metric 4: | Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Medium | Exposure type and sampling data provided, but missing exposure duration, frequency, and engineering controls. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | High | Uncertainty is addressed in sampling/analytical methodology. Variability is addressed by sampling different locations around the shop. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Mead Corp, (1981). Asbestos concentrations in gasket storage area prepared by Liberty Mutual. |
| **HERO ID:** | 4158120 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | handling asbestos gaskets (pg 4) |
| Personal sampling data: | non detect (pg 6) |
| Area sampling data: | non detect (pg 6) |
| Exposure duration: | sampling durations provided on pg 6; 74 minutes-118 minutes |
| Number of workers: | 2 (pg 4) |
| Engineering control: | fans (pg 5) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Sampling and Analytical Methodology | Low | Sampling/analytical methodology is not specified. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | High | Data are from the U.S. |
| | Metric 3: Applicability | High | Data are for construction materials, an in-scope occupational scenario. |
| | Metric 4: Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| | Metric 5: Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | Low | Sample type provided but no other metadata. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Mead Corp, (1982). Asbestos monitoring with attachments [878210179]. |
| **HERO ID:** | 4158123 |
| **Conditions of Use:** | Other: |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Exposure route: | inhalation (3/6) |
| Physical form: | fibers (4/6) |
| Area sampling data: | (PCM) Concentrations were ND for all area samples. |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | High | Sampling/analytical methodology is an approved NIOSH method. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | Low | Condition of use isn't specified, only sampling results given. |
| | Metric 4: | Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Low | Monitoring data include sample type (e.g., personal breathing zone) but no other metadata. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | Uncertainty is not addressed. Variability is addressed by sampling on multiple days at multiple locations at the plant. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Mead Corp, (1980). Asbestos survey in gasket storage area [878210175]. |
| **HERO ID:** | 4158124 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Employees unloading, placing and removing from shelves, and wrapping asbestos-containing gaskets. (4/7) |
| Exposure route: | inhalation (5/7) |
| Physical form: | fibers (6/7) |
| Personal sampling data: | Personal samples taken on workers in the gasket storage area were ND, ND, less than 0.1 f/cc and less than 0.08 f/cc. (6/7) |
| Area sampling data: | Area samples on shelves were all ND. (6/7) |
| Number of workers: | 2 employees (4/7) |
| Personal protective equipment: | The employees wear a single-use mask approved by NIOSH for protection against asbestos. (5/7) |
| Engineering control: | A large air supply fan in the east wall and a large exhaust fan in the west wall produced laminar flow of air. (5/7) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Medium | Sampling/analytical methodology is not an approved OSHA/NIOSH method but is an acceptable methodology. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | The data are for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Exposure type and sampling data provided, but missing exposure duration and frequency, and particle size. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | Variability is addressed by including personal and area samples. Uncertainty is not addressed. |

## Overall Quality Determination Medium

**Study Citation:** Mead Corp, (1981). Asbestos survey in gasket storage area prepared by Leberty Mutual.
**HERO ID:** 4158125
**Conditions of Use:** Other:

**EXTRACTION**

| Parameter | Data |
|---|---|
| Worker activity description: | gasket handling (pg 6) |
| Exposure route: | inhalation |
| Physical form: | dust |
| Area sampling data: | gasket storage: not detected (pg 7) |
| Exposure duration: | ~50 minute sampling (pg 7) |
| Number of workers: | 1-2 workers handle gaskets at a time, >12 employees who work in warehouse (pg 6) |

**EVALUATION**

| Domain | | Metric | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Medium | Sampling/analytical methodology is not an approved OSHA/NIOSH method but is an acceptable methodology. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | Uninformative | Industrial use of sheet gaskets containing asbestos was covered in the first part of the asbestos risk evaluation and is not in-scope for the asbestos legacy assessment. |
| | Metric 4: | Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Sample type and exposure type provided but missing metadata such as exposure frequency. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Uninformative

| | |
|---|---|
| **Study Citation:** | Mead Corp, (1980). Asbestos survey in gasket storage area [878210176]. |
| **HERO ID:** | 9551177 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Unloading of gaskets received from manufacturers, placing gaskets onto storage shelves, removing gaskets from shelves, and wrapping gaskets to fill customers' orders. [PDF Pg. 5] |
| Personal sampling data: | [PDF Pg. 6]On one of two employees working in Casket Storage Area: nondetectOn second employee working in Casket Storage Area, included loading of gaskets and placing onto shelves: <0.1 f/cm^3)Second sample on first employee: nondetectSecond sample on second employee: (<0.08 f/cm^3) |
| Area sampling data: | [PDF Pg. 6]On shelf in row 1 of Gasket Storage Area : nondetectSample 2: nondetectOn shelf in middle of row 4 of Gasket Storage Area: nondetectSample 2: nondetect. |
| Personal protective equipment: | Single-use masks approved by NIOSH were used during gasket handling [PDF Pg. 5]. |
| Engineering control: | A large air supply fan in the east wall and a large exhaust fan in the west wall were used to product laminar flow of air [PDF Pg. 5] |
| Comments: | Sampled using PCM methods. |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | High | Sampling/analytical methodology is equivalent to an approved OSHA/NIOSH method. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for Chemical Substances in Construction, Paint, Electrical, and Metal Products, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Sample type and exposure type provided but missing exposure duration and frequency. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | High | Uncertainty is addressed in sampling/analytical methodology. Variability addressed by sampling workers and multiple locations. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Mehlman, M. A. (1991). Dangerous and cancer-causing properties of products and chemicals in the oil-refining and petrochemical industries. Part IX: Asbestos exposure and analysis of exposures. Annals of the New York Academy of Sciences, vol. 643, no. 1 :368-389. |
| **HERO ID:** | 3082300 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Installation, repair, and maintenance of asbestos-containing materials such as pipe insulation, ceiling and floor tiles, heat exchangers, diesel units, valves, gaskets, and more. (2/23) |
| Exposure route: | inhalation (2/23) |
| Physical form: | airborne dust containing fibers (5/23) |
| Area sampling data: | The fiber level near or at oil refining plants have been found to be between 2,000,000 to 3,000,000 fibers per cubic meter (f/m3)(pg. 2/23) |
| Particle size characterization: | In reference samples, 46% of amosite was >1 um, 6% was > 5um, and 1% was >10 um. For anthophylite, 46% was >1 um, 5% was > 5um, and 1% was >10 um. For Crocidolite, 36% was >1 um, 3% was > 5um, and 0.7% was >10 um. For chrysotile, 36-44% was >1 um, 3-6% was > 5um, and 1-3% was >10 um. (4/23) |
| Number of workers: | 15,742 in Louisiana and the Texas gulf coast (5/23) The petroleum refining industry employed 99,000 workers in 1977. The whole petrochemical industry employed 624,400 workers in 1978. (7/23) It is estimated that 90% of these workers have had contact with asbestos. (18/23) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Sampling and Analytical Methodology | Low | Sampling methodology not specified. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | Data are from the U.S. |
| Metric 3: | Applicability | High | Data are for industrial use in construction materials, an in-scope occupational scenario. |
| Metric 4: | Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| Metric 5: | Sample Size | Medium | Sample distribution characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Medium | Exposure type and sampling data provided, but missing exposure duration, frequency, engineering controls, and PPE. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Medium | Variability is addressed by comparing statistics from the refining industry to the whole petroleum industry, and by providing ranges of measurements. Uncertainty isn't addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Missouri Department of Health Bureau of Environmental Epidemiology, (1992). Exposure of custodial employees to airborne asbestos. |
| **HERO ID:** | 3970149 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Custodial activities included stripping vinyl asbestos tiles, buffing tiles, vacuuming, dust mopping, dry broom sweeping, and hand dusting. (3/22) |
| Exposure route: | inhalation (3/22) |
| Physical form: | dust (3/22) |
| Personal sampling data: | (TEM) The mean 8-hr TWA for all personal samples was 0.0009+-0.0043 s/cc. (7/22) |
| Area sampling data: | (TEM) The mean total concentration value for all area samples was 0.0033+-0.0147 s/cc. (7/22) |
| Particle size characterization: | The arithmetic mean value for length of all structures was 2.45+-1.94u with a range of 0.5-9.5u. The arithmetic mean width was 0.14+-0.18u with a range of 0.1-1.75u. (16/22) |
| Exposure duration: | 8 hours (3/22) |
| Number of workers: | 8 custodians (3/22) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | High | Sampling/analytical methodology is an approved NIOSH method. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for commercial use of chemical substances in construction products, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| | Metric 5: | Sample Size | Medium | Sample distribution characterized by limited statistics (mean, standard deviations, ranges) but discrete samples not provided and distribution not fully characterized. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Sample type and exposure type provided, but missing exposure frequency, PPE, and engineering control. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | High | Uncertainty is addressed in sampling/analytical methodology. Variability addressed by sampling at six sites. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Mlynarek, S. P., Van Orden, D. R. (2012). Asbestos exposure from the overhaul of a Pratt & Whitney R2800 engine. Regulatory Toxicology and Pharmacology 64(2):189-194. |
| **HERO ID:** | 2561011 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Engine Overhaul:Engine Disassembly, scraping, gasket removal, sandblasting, painting, reassembly.Cylinder Change:This job consists of removing any wiring, intake or exhaust tubes, air foils, and anything else that would interfere with the cylinder removal, removing the valve rocker arm covers, removing the push rods, and removing the cylinder itself. A replacement cylinder is then installed, followed by reassembly of the above components. The gaskets on the rocker arm cover-cylinder face are changed, and also the gaskets on the push rods, intake/exhaust tubes, and any other gaskets encountered. Clutch Rebuild:The job consisted of disassembly and separation of the high and low ratio sections of both clutches and removal of the facings from each of the four sections. New facings were then installed and the clutch was reassembled. The clutch disassembly was done during the first week. The components were left on a table in the facility away from the overhaul area. Installation of the new facings and reassembly of the clutch was done during of the second week of this project.Ignition System Rebuild:A complete engine overhaul would include inspection and rebuilding of the ignition system including the magneto, two distributors, the air pumps within the distributors, and all subcomponents.pgs 2-3/6 |
| Physical form: | airborne fibers |
| Personal sampling data: | Summary of task-based air samples, phase contrast microscopy f/ml. % distr.Location Number Avg sample time, Median detect limit Geo mean conc Mean conc Std devi 10 25 50 75 90Disassembly Worker 59 188 min 0.0067 (15)b 0.0151 0.0247 0.0272 0.0049 0.0078 0.0155 0.0283 0.0695 Bystander 10 248 min 0.0056 (1) 0.0233 0.0276 0.0144 0.0097 0.0182 0.0284 0.0310 0.0486 Indoor 49 254 min 0.0010 (5) 0.0045 0.0056 0.0040 0.0018 0.0031 0.0043 0.0069 0.0130 Outdoor 18 305 min 0.0009 (3) 0.0014 0.0016 0.0008 0.0006 0.0013 0.0015 0.0019 0.0027 Re-assembly Worker 47 222 min 0.0056 (5) 0.0166 0.0198 0.0145 0.0085 0.0109 0.0163 0.0225 0.0370 Bystander 10 365 min 0.0042 (0) 0.0230 0.0250 0.0107 0.0115 0.0169 0.0273 0.0305 0.0399 Indoor 30 284 min 0.0009 (0) 0.0040 0.0046 0.0026 0.0020 0.0026 0.0041 0.0058 0.0083 Outdoor 10 291 min 0.0009 (8) – 0.0009 0.0007 0.0002 0.0003 0.0008 0.0011 0.0020Summary of task-based personal air samples for selected operations, phase contrast microscopy f/mlLocation NumberAverage sample time,(min)Median detection limitGeo mean conc. Mean conc. RangeClutchrebuild 3 196 0.0065(0)^{a} 0.0156 0.0157 0.0129–0.0179Cylinderchange2 146 0.0133(0) 0.0113 0.01410.0057–0.0226Ignitionsystem2 224 0.0062(0) 0.0181 0.01810.0176–0.0187Cutgasket 1 54 0.0247(0) 0.0427 0.0427Tabls 2 and 3, pg. 5/6 |
| Engineering control: | Sandblasting occurs in a hood in a separate room. |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | High | Sampling/analytical methodology is an approved NIOSH method. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for ”Industrial Uses: Chemical Substances in Construction, Paint, Electrical, and Metal Products”, which is similar to the in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Medium | The study itself is 10 years old, data contained in study is generally between 10 and 20 years old |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data not provided, but distribution fully characterized, with percentile distribution, std deviation, etc.). |
| Domain 3: Accessibility/ Clarity | | | | |

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| | |
|---|---|
| **Study Citation:** | Mlynarek, S. P., Van Orden, D. R. (2012). Asbestos exposure from the overhaul of a Pratt & Whitney R2800 engine. Regulatory Toxicology and Pharmacology 64(2):189-194. |
| **HERO ID:** | 2561011 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

| | | | EVALUATION | |
|---|---|---|---|---|
| Domain | | Metric | Rating | Comments |
| | Metric 6: | Metadata Completeness | High | All metadata provided. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | High | Uncertainty is addressed in sampling/analytical methodology. Variability addressed by sampling across all different tasks and procedures during the engine rebuild.. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Mlynarek, S. P., Van Orden, D. R. (2012). Assessment of potential asbestos exposures from jet engine overhaul work. Regulatory Toxicology and Pharmacology 63(1):78-83. |
| **HERO ID:** | 2565742 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | The overhaul was performed in accordance with accepted industry standards, and with the guidelines published in the Pratt & Whitney engine manuals. The exception was that upon completion of the overhaul, the engine was not returned to flight readiness. While all engine components were reassembled, some time-consuming procedures normally part of an overhaul, principally installation of safety wiring, disassembling and weighing each individual blade from each compressor and turbine section, rebalancing each compressor and turbine section, testing the integrity of parts, rebalancing moving parts, torqueing of bolts, alignment testing of bearings, and balancing of compressor and turbine vane assemblies were not performed. This had no effect on the assessment of airborne asbestos exposure since no asbestos-containing part removal, replacement, or disturbance is associated with these activities. Overhaul The overhaul took place over a three week period. During the first week of the project, the mechanics disassembled the JT3D engine. The disassembly work took approximately 6–7 business days. No work was done during the intervening weekend. The disassembly was conducted in accordance with the procedures set forth in the Pratt & Whitney engine manuals (Pratt and Whitney, 1997), and accepted industry standards. Weeks two and three of the project were spent reassembling the engine. Reassembly proceeded in reverse from disassembly, and was conducted in accordance with the procedures set forth in the Pratt & Whitney engine manuals, and accepted industry standards. Original replacement parts were used whenever possible. During the period of time between disassembly and reassembly, no work was performed on the engine or any of its components, except that all the appropriate large, metal pieces were cleaned. Cleaning of these components is a normal part of an overhaul, and presents no opportunity for asbestos exposure. Accordingly, no air sampling was performed during this period of time. Gear box rebuild Once removed from the engine, the gear box for most jet engine types, including the JT3D, is typically rebuilt in a separate area, concurrent with the remainder of the engine rebuild. The gear box for this engine was rebuilt in this fashion. It was taken to a separate room, described earlier, and a mechanic whose specialty is this type of work performed the rebuild. The gear box rebuild was done in one day. On the same day, and in the same room, some minor components of the engine such as the fuel control, the fuel pump, and the fuel oil cooler, were rebuilt as well. Separate personal air samples were collected during the rebuild of the gear box and other components from the mechanics that performed the work. Area air samples were collected in proximity to this work in conjunction with the overhaul, as were samples from the two outdoor locations. (P. 3/6) |
| Exposure route: | inhalation |
| Physical form: | solid fiber particulate |
| Personal sampling data: | Percentile distributionLocationNumberAvg sample t, minMedian detect limitGeo mean conc.Mean concentrationStandard deviation1025507590DisassemblyWorker 28 194 0.0071(10) 0.0073 0.0099 0.0069 0.00160.00480.00920.01290.0184Bystander13226 0.0062(2)0.0118 0.0131 0.0056 0.00580.00880.01250.01760.0209AssemblyWorker 53 236 0.0053(20)0.0067 0.0081 0.0058 0.00350.00480.0070.0090.0144Bystander17 2820.0048(4)0.0079 0.0136 0.0139 0.00170.00480.00780.01890.0323 (# of samples below detection limit) |
| Area sampling data: | Percentile distributionLocationNumberAvg sample t, minMedian detect limitGeo mean conc.Mean concentrationStandard deviation1025507590DisassemblyIndoor52238 0.0012(4) 0.0029 0.0031 0.0013 0.00170.00230.0030.00380.0048Outdoor26232 0.0012(14) 0.0010 0.0013 0.0007 0.00030.00080.00120.00180.0025AssemblyIndoor74288 0.0009(4) 0.0021 0.0027 0.0027 0.00110.00150.0020.00270.0046Outdoor33290 0.0009(9) 0.0011 0.0013 0.0006 0.00060.00080.00130.00170.0021 (# of samples below detection limit)A total of 425 bulk samples were collected, 420 were collected from the overhaul work and 5 from the facility or its contents. Ofthe 420 analyses of samples associated with the overhaul work, 403 of these were of Pratt & Whitney engine parts, and 17 of thesewere from parts designated as Quick Engine Change (QEC). These QEC parts are not Pratt & Whitney products.Of the Pratt & Whitney parts, 37 (9%) were positive for the presence of asbestos. In all cases the type of asbestos was chrysotile,and the percent asbestos present in these samples ranged from 30% to 90%.Of the QEC parts, 5 (33%) were positive for the presence of asbestos. In all cases the type of asbestos was chrysotile, and thepercent asbestos present in these samples ranged from 40% to 90% |
| Engineering control: | No dedicated LEV. Large overhead doors and ceiling fans were employed. |
| Comments: | Table 1Summary of task-based air samples, phase contrast microscopy f/ml. |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|

**Continued on next page . . .**

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| | |
|---|---|
| **Study Citation:** | Mlynarek, S. P., Van Orden, D. R. (2012). Assessment of potential asbestos exposures from jet engine overhaul work. Regulatory Toxicology and Pharmacology 63(1):78-83. |
| **HERO ID:** | 2565742 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

| | | EVALUATION | | |
|---|---|---|---|---|
| Domain | | Metric | Rating | Comments |
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | High | Sampling/analytical methodology is an approved NIOSH method. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for Industrial/Commercial Uses: Chemical Substances in Construction, Paint, Electrical, and Metal Products, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | High | Monitoring data were collected after the most recent PEL and no more than 10 years old. |
| | Metric 5: | Sample Size | Medium | Sample distribution characterized by limited statistics (percentile distribution, std deviaiton, min, max, mean) but discrete samples not provided and distribution not fully characterized. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Sample type and exposure type provided but only average sample time is provided. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | Uncertainty is addressed in sampling/analytical methodology but variability is not addressed. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Moorcroft, J. S., Duggan, M. J. (1984). Rate of decline of asbestos fiber concentration in room air. Annals of Occupational Hygiene 28(4):453-457. |
| **HERO ID:** | 3584219 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Removal and dusting of light fittings, wiping of walls, cupboard tops and benches, etc., brushing of radiators and sweeping of the floor. [PDF Pg. 2] |
| Exposure route: | Inhalation |
| Physical form: | Fiber (solid). |
| Area sampling data: | Results of fiber count during three periods: Period 1: no dust disturbance; Period 2: dust disturbance with the worker activities described (period during dust disturbance); Period 3: no dust disturbance (period after disturbing the dust). Results given in f/ml air for multiple rooms:Test 1Period 1: 0.002; 0.003Period 2: 003; 0.009; 0.003; 0.003; 0.004Period 3: 0.002; 0.002; 0.002; 0.002Test 2Period 1: -Period 2: 0.67; 0.27; 0.43; 0.50Period 3: 0.05; 0.05; 0.04; 0.02Test 3Period 1: 0.002Period 2: 0.03; 0.04; 0.01; 0.03Period 3: 0.002; 0.002; 0.003; 0.002Test 4Period 1: 0.004; 0.002Period 2: 0.003; 0.002; 0.006; 0.01Period 3: 0.002; 0.002Test 5Period 1: 0.003; 0.002Period 2: 0.002; 0.002; 0.006; 0.01Period 3: 0.002; 0.002; 0.002; 0.003Test 6Period 1: 0.002; 0.002; 0.002Period 2: 0.03; 0.03; 0.03Period 3: 0.01; 0.01; 0.02Test 7Period 1: 0.001Period 2: 0.08; 0.20; 0.09; 0.03Period 3: 0.02; 0.02; 0.02Test 8Period 1: 0.002; 0.002; 0.002Period 2: 0.002; 0.003; 0.01; 0.005Period 3: 0.002; 0.003; 0.006; 0.003 |
| Engineering control: | Polyethylene air lock to seal the area. [PDF Pg. 2] |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | High | Sampling/analytical methodology is equivalent to an approved OSHA/NIOSH method. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Medium | Data are from Britain, an OECD country. |
| | Metric 3: | Applicability | High | Data are for construction, paint, electrical, and metal products, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Monitoring data are greater than 20 years old. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Sample type and exposure type provided but missing exposure duration. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | High | Uncertainty is addressed in sampling/analytical methodology. Variability addressed by collecting samples in multiple rooms and during both dust disturbing, and non-disturbing activities. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Moseley, C. L. (1980). Health hazard evaluation report no. HHE-79-136-668, Shoreham Nuclear Power Plant, Shoreham, Long Island, New York. |
| **HERO ID:** | 3970482 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Personal sampling data: | 1 sample (pipefitter) (p. 1)0.16 f/cc |
| Area sampling data: | 2 area samples (non-detect) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | High | Sampling or analytical methodology is an approved OSHA or NIOSH method or is well described and found to be equivalent to approved OSHA or NIOSH methods. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | The data are from the United States and are representative of the industry being evaluated. |
| | Metric 3: | Applicability | High | The data are for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Low | Metadata on the operations, equipment, and worker activities associated with the data show that the data agree representative of outdated operations, equipment, and activities rather than current operations, equipment, and worker activities. The data were collected more than 20 years ago. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Monitoring data include most critical metadata, such as sample type and exposure type, but lacks additional metadata, such as sample durations, exposure durations, exposure frequency, and/orworker activities. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | The monitoring study provides only limited discussion of the variability in the determinants of exposure for the sampled site or sector. The monitoring study provides only limited discussion of the uncertainty in the exposure estimates. |

## Overall Quality Determination **High**

| | |
|---|---|
| **Study Citation:** | Moss, C. E., Hurell, J. J., Jr (1994). Health hazard evaluation report no. HETA 92-0319-2459, Howard University, Washington, D.C.. |
| **HERO ID:** | 3970516 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | School of Engineering staff and students. [PDF Pg. 6] |
| Exposure route: | Inhalation [PDF Pg. 19] |
| Physical form: | Fibers (solid) [PDF Pg. 19] |
| Area sampling data: | Sampling did not detect airborne asbestos. [PDF Pg. 18 |
| Engineering control: | Additionally, the heating equipment room (G-014) was equipped with a wall exhaust fan that vented directly outdoors, without filtration, to an adjacent sidewalk area. [PDF Pg. 18] |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | High | Sampling/analytical methodology is an approved NIOSH/OSHA method. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for Chemical Substances in Construction, Paint, Electrical, and Metal Products, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Monitoring data are greater than 20 years old. |
| | Metric 5: | Sample Size | Low | Sample distribution is characterized by no statistics. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Sample type and exposure type provided but missing exposure duration and frequency. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | Uncertainty is addressed in sampling/analytical methodology but variability is not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Mowat, F., Bono, M., Lee, R. J., Tamburello, S., Paustenbach, D. (2005). Occupational exposure to airborne asbestos from phenolic molding material (Bakelite) during sanding, drilling, and related activities. Journal of Occupational and Environmental Hygiene 2(10):497-507. |
| **HERO ID:** | 3531218 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Sawing, sanding, drilling of the molding material, and cleanup of dust generated from these activities. (3/12) |
| Exposure route: | inhalation (4/12) |
| Physical form: | fibers (3/12) |
| Personal sampling data: | (PCM) During band sawing, personal sampling for asbestos concentrations averaged 0.13 f/cc with a range of <0.04-0.21 f/cc. During belt sanding, concentrations averaged 0.04 f/cc with a range of <0.03-0.05 f/cc. During drill press operation, concentrations averaged <0.01 f/cc. During sweep cleanup, concentrations averaged 0.02 f/cc with a range of <0.01-0.08 f/cc. (7/12) 8h-TWAs were estimated as 0.01 to 0.08 f/mL in four different scenarios. (10/12) |
| Area sampling data: | (PCM) During band sawing, area asbestos concentrations averaged 0.08 f/cc with a range of <0.03-0.32 f/cc. During belt sanding, concentrations averaged 0.04 f/cc with a range of <0.02-0.08 f/cc. During drill press operation, concentrations averaged 0.01 f/cc with a range of <0.003-0.02 f/cc. During sweep cleanup, concentrations averaged 0.01 f/cc with a range of <0.003-0.03 f/cc. (7/12) |
| Exposure duration: | 8 hours/day (5/12) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Sampling and Analytical Methodology | High | Sampling/analytical methodology is an approved NIOSH method. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | Data are from the U.S. |
| Metric 3: | Applicability | High | Data are for industrial use in construction materials, an in-scope occupational scenario. |
| Metric 4: | Temporal Representativeness | Medium | Monitoring data were collected after the most recent PEL and greater than 10 years old. |
| Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Medium | Exposure type and sampling data provided, but missing number of workers, exposure frequency, particle size, engineering controls, and PPE. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | High | Uncertainty is addressed in sampling/analytical methodology. Variability is addressed by sampling different activities and replicating samples four times. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Mowat, F., Weidling, R., Sheehan, P. (2007). Simulation tests to assess occupational exposure to airborne asbestos from asphalt-based roofing products. Annals of Occupational Hygiene 51(5):451-462. |
| **HERO ID:** | 3531219 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | See area sampling box for chronologically ordered activities, installation through repair/replacement/demolition. |
| Area sampling data: | 1970s: spraying of asphalt-based roof coatings were reported to range from 0.003 to 0.3 f/cc; spraying asphalt cutback (0.003–0.15 f/cc; sample duration, 342–432 min) and spraying asphalt emulsion (0.01–0.3 f/cc; sample duration not provided) (pg 2)1986-1991: removal of asbestos-containing roof flashings, mastics, coatings and cements yielded low asbestos fiber concentrations (range, 0.004–0.027 f/cc; mean, 0.024 f/cc); no samples exceeded 0.1 f/cc (pg 2)1982: 0.1 to 0.6 f/cc during tear-out and replacementof roofing materials (pg 2)1987: demolition in old Australian buildings ranged from 0.02 to 0.60 f/cc (pg 2)1987: Exposures of <0.1 to 0.22 f/cc were measured when the roof surface was painted or cleaned with a water jet for several hours. During roof replacement (including unfastening, removal and disposal of roof sheets), concentrations ranged from below the limit of detection to 0.32 f/cc, with estimated TWAs ranging from 0.03 to 0.21 f/cc (pg 10) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Low | Sampling/analytical methodology is not specified. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Medium | Data are from various OECD countries. |
| | Metric 3: | Applicability | High | Data are for construction materials, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| | Metric 5: | Sample Size | Medium | Sample distribution characterized by limited statistics (ranges, means) but discrete samples not provided and distribution not fully characterized. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Sample type and exposure type provided but missing metadata such as exposure frequency. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | Variability addressed by providing data for various activities, but uncertainty is not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Mowat, F., Weidling, R., Sheehan, P. (2007). Simulation tests to assess occupational exposure to airborne asbestos from asphalt-based roofing products. Annals of Occupational Hygiene 51(5):451-462. |
| **HERO ID:** | 3531219 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | roof repair; application of asbestos-containing fibered roof coatings and plastic cements followed by scraping/sanding (wet and hand) either shortly after or after roof substrates were cured (simulating product that had been on rooftop for several months); product removal from tools and clothing (abstract). See also narrative from pg. 3-4 for more details. |
| Personal sampling data: | PCM total (including non-asbestos) fiber concentrations ranged from <0.005 to 0.032 f/cc; TEM asbestos fiber concentrations ranged from <0.0021 to 0.056 f/cc; Calculated 8-h time-weighted averages (TWAs) ranged from 0.0003 to 0.002 f/cc (abstract)Means, SD, mins, and maximums for each activity/product tested presented in Table 3 (pg 7; same range as abstract above)Table 4 (pg 8) presents TEM asbestos fiber counts and calculated PCM-equivalent concentrations (0-0.027 f/cc) |
| Area sampling data: | 0.0002 f/cc (abstract)total (including non-asbestos) fiber concentration ranges provided on pg 7 for each activity (<0.002-0.009 f/cc)Table 5 (pg 10) presents PCM total fiber (<0.002-0.008 f/cc) and TEM (<0.0007-0.0008 f/cc) asbestos fiber concentrations |
| Exposure duration: | 30 minute sampling for personal samples (pg 4&6); 2 hr sampling for area samples (pg 6); 8-hr TWAs calculated (pg 6) |
| Comments: | OSHA/NIOSH testing procedures (pg 4); The personal samples collected during sampling were analyzed for fiber concentrations by PCM using NIOSH Method 7400, and for asbestos concentrations by TEM using NIOSH Method 7402 (pg 6) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | High | Sampling/analytical methodology is an approved NIOSH method. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for construction materials, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Medium | Monitoring data were collected after the most recent PEL and greater than 10 years old. |
| | Metric 5: | Sample Size | Medium | Sample distribution characterized by limited statistics (means, ranges) but discrete samples not provided and distribution not fully characterized. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Sample type and exposure type provided but missing metadata such as exposure frequency. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | Variability addressed by sampling for various activities, but uncertainty is not addressed. |

## Overall Quality Determination High

**Study Citation:** MSHA, (2022). Mine Data Retrieval System (MSHA): Asbestos.
**HERO ID:** 10259534
**Conditions of Use:** Other:

**EXTRACTION**

| Parameter | Data |
|---|---|
| Worker activity description: | Skip Dumper, Toploader, Tipple Operator, Utility Worker, Dry Screening, Lab Technician, Mill Operator, Office Worker at Mine (ONU) |
| Personal sampling data: | Skip Dumper, Toploader, Tipple Operator at active Vermiculite mine: 0 - 0.02 f/ccUtility Worker at active Vermiculite mine: 0 - 0.02 f/ccBagging Operator at active Vermiculite mine: 0.01 - 0.05 f/ccDry Screen Plant Operator at active Vermiculite mine: 0 - 0.02 f/ccLab Technician at active Vermiculite mine: 0.01 - 0.02 f/cc |
| Number of workers: | MILL OPERATION/PREPARATION PLANT 2021Quarter: 20211, Quarterly Hours: 20992, Avg Employee Count: 39Quarter: 20212, Quarterly Hours: 21921, Avg Employee Count: 41Quarter: 20213, Quarterly Hours: 19630, Avg Employee Count: 32Quarter: 20213, Quarterly Hours: 21736, Avg Employee Count: 41Quarter: 20214, Quarterly Hours: 20633, Avg Employee Count: 36Quarter: 20214, Quarterly Hours: 22843, Avg Employee Count: 43OFFICE WORKERS AT MINE SITE 2021Quarter: 20211, Quarterly Hours: 3840, Avg Employee Count: 6Quarter: 20212, Quarterly Hours: 3120, Avg Employee Count: 6Quarter: 20213, Quarterly Hours: 586, Avg Employee Count: 1Quarter: 20213, Quarterly Hours: 2880, Avg Employee Count: 6Quarter: 20214, Quarterly Hours: 585, Avg Employee Count: 1Quarter: 20214, Quarterly Hours: 4160, Avg Employee Count: 8 |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Low | Sampling or analytical methodology is not specified. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | The data are from the United States and are representative of the industry being evaluated. |
| | Metric 3: | Applicability | High | The data are for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | High | Data were collected in the past 10 years. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Low | Monitoring data does not include metadata such as worker activity details, exposure frequency, and sampling duration. Also, it is unclear as to the type of monitoring data (area vs personal). |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | Variability is addressed through collection of data for multiple worker activities. However, measurement uncertainty is not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | MSSM, (1982). Disability compensation for asbestos associated disease in the United States. :710. |
| **HERO ID:** | 6895826 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Products not Described by Other Codes |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Exposure route: | inhalation |
| Physical form: | inhalable fibers |
| Area sampling data: | Asbestos productsHenderson & Enterline 30 f/mlNicholson et al 25 f/ml (1945-1965)Port Allegany, PA & Tyler Tx average 25 f/ml (NIOSH 1968-1971)Primary manufacture 0.5 - 4.0 f/ml (1975) Textile ( controlled) 1.5 f/ml1975 fiber concentrations (asbestos information association)OSHA submittal Asbestos paper Range:0.1 -2.8 f/ml Typical: 0.75-1.9 f/mlGaskets and packing 0.1 -2.5 f/ml Reinforced plastics 0.2 -3.0 f/ml Typical: 0.75-2.0 f/mlAsbestos textiles 0.25-15 f/ml Typical: 1.0 -4.0 f/mlAsbestos information association 1975Asbestos paper 1.0-3.5 f/mlGasket and packing 0.2-5.0 f/mlAsbestos-reinforced plastic 0.5-.0 f/mlAsbestos textiles 0.5-5.0 f/mlMining/milling (Adobe page 230)representative: 15/f/mlChrysotile textile plant (adobe page 204)average concentration 5-10 f/mlfiber preparation 10-80f/mlUS textile plant subsequent to 1935 less than 10 f/mlBritish 1933-1955 30-45 f/mlAsbestos products (Adobe page 233)UK Newhouse and Berry 5-10 f/ml for low exposure, 20 f/ml and higher for sever exposure. |
| Number of workers: | 1975 number of employees exposed to asbestos materialsAsbestos paper 158,400Gaskets and packings 12,000Reinforced plastics 8,400Asbestos textiles 6,000Miscellaneous 8,400 |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | High | US Department of Labor |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | US - some data are from UK which is an OECD member |
| | Metric 3: | Applicability | High | The data are for an occupational scenario (asbestos containing product manufacture) within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Low | 1982 - prior to the latest PEL and more than 20 years old |
| | Metric 5: | Sample Size | Medium | Range and typical estimates provided |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Low | Monitoring data include sample type (e.g., personal breathing zone) but no other meta-data |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | Range data were provided that can be useful to assess variability, uncertainty was not discussed |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | MSSM, (1982). Disability compensation for asbestos associated disease in the United States. :710. |
| **HERO ID:** | 6895826 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Exposure route: | inhalation |
| Physical form: | inhalable fibers |
| Personal sampling data: | Asbestos insulation products factory (PCM)Plant 8 April 1967 (adobe page 169)Mixing/feeding median: 115 >5u range: 21-176 >5uBuilder median: 73 >5u range: 24-204 >5uSaw operator median: 33 >5u range: 17-42 >5uPacker median: 24 >5u range: 8-30 >5uMaterial handler range: 26 >5uTotal median: 49 >5u range: 8-176 >5uPlant 1 April 1967Glass block selector range: 0-0.1 >5uCoating machine operator range: 0 >5uPress operator range: 0 >5uSealing machine operator range: 0.1 >5uSpray pointer range: 0 >5uTotal median: 115 >5u range: 21–176 >5uPlant 2 April 1967Mold filler median: 0.7 >5u range: 0.2-0.8 >5uBand saw median: 2.5 >5u range: 1.0-4.0 >5uBox builder range: 0.8 >5uPacker median: 1.7 >5u range: 0.4-4.0 >5uCutter range: 0.3-2.5 >5uStacker range: 0.7 >5uWeigher range: 0.7 >5uTotal median: 1 >5u range: 0.2-4.0 >5uPlant 6Mixer range: 0 >5uHot wire range: 0.2-1.2 >5uSaw range: 0.8-1.2 >5uTotal range: 0-1.2 >5uPlant 8 November 1970Mixing/feeding range: 21-35 >5uBuilder median: 15 >5u range: 0.1-79 >5uSaw operator median: range: 4-29 >5uPacker median: 13 >5u range: 1-32 >5uMiscellaneous median: 16 >5u range: 1-60 >5uTotal median: 15 >5u range: 0.1-79 >5uPlant 2 November 1970median: 0.3 > 5u range: 0-1.5Plant 8 October 1971Mixing/feeding median: 45 >5u range: 25-74 >5uBuilder median: 19.5 >5u range: 2-69 >5uSaw operator median: 14.7 >5u range: 1-31 >5uPacker median: 8.7 >5u range: 3-38 >5uMiscellaneous median: 3.5 >5u range: 1-40 >5uTotal median: 14.7 >5u range: 1-74 >5u |
| Area sampling data: | 1975 fiber concentrations (asbestos information association)OSHA submittal Asbestos paper Range:0.1 -2.8 f/ml Typical: 0.75-1.9 f/mlAsbestos cement pipe 0.25-4.5 f/ml Typical: 0.5 -2.2 f/mlFloor tile 0.25-4.3 f/ml Typical: 0.5-1.75 f/mlFriction products 0.1 -22 f/ml Typical: 1.0 -3.3 f/mlPaints, coatings, and sealants 0.25-8 f/ml Typical: 1.0 -2.5 f/mlAsbestos cement sheet 0.25-8.7 f/ml Typical: 1.0 -3.0 f/mlGaskets and packing 0.1 -2.5 f/ml Reinforced plastics 0.2 -3.0 f/ml Typical: 0.75-2.0 f/mlAsbestos textiles 0.25-15 f/ml Typical: 1.0 -4.0 f/mlAsbestos information association 1975Asbestos paper 1.0-3.5 f/mlFriction products 2.5-6.5 f/mlAsbestos cement sheet 1. 0-6.0 f/mlGasket and packing 0.2-5.0 f/mlAsbestos-reinforced plastic 0.5-.0 f/mlAsbestos textiles 0.5-5.0 f/mlConstruction spray insulation 10 ft from nozzle 70 f/ml 25 ft from nozzle 3 f/mlDry wall tapping (NYC) Hand sanding 5.3 f/mlDry mixing 47.2 f/ml Range 0.9-19.6 f/ml3-20 ft from taping 2.3-8.6 f/mladjacent rooms 2.6-4.8 f/ml (15-25 ft from taping)Average insulation workers (adobe page 80/239)fibers > 5 PCM construction 2.7-6.3 marine 2.9-8.9 f/mlvisible fiber count konimeter marine 8.0-40 f/mlAverage asbestos dust in insulation work (1968-1971) (Adobe page 225) 3-6 f/mlNaval dockyard (Britain) 8.9 f/mlPeak exposure50-100 f/ml (2 to 5 minutes)1968-1970 (adobe page 226)Insulators industrial/commercial construction10-15 f/mlMarine construction 15-20 f/mlEstimated average concentration (adobe pager 138)Primary manufacture 20-40Insulation work 15Ship building and repair 2Adobe page 254Schools 9-1950 ng/m3up to 800 ng/m3 for building with asbestos fire proofing(conversion factor provided 1000ng/m3 = 0.03 f/ml) |
| Number of workers: | Estimated that there are 21 million workers , survivors of over 27.5 million workers in primary and secondary manufacturing industries, shipyards, construction work and a number of other industries and occupations who in the past 40 years were significantly exposed to asbestos form 1940-1979 (adobe page 95).17,800 asbestos insulation workers in US & CAN 1967-1976Shipyards 4.5 million men and women were employed in shipyards during WWII, after 1945 the number declined to 200,000. Bureau of Labor Statistics spring 1978 (adobe page 89)Insulation workers in construction 31,900 19,100 employed in industry elsewhere ( maintenance)Union estimate 38,9001975 number of employees exposed to asbestos materialsAsbestos cement sheets 19,200 |

**EVALUATION**

| Domain | | Metric | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | High | US Department of labor study |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Predominately the US though some UK data were included (UK is an OECD member) |
| | Metric 3: | Applicability | High | The data are for an occupational scenario (Construction) within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Low | 1982 - prior to the recent PEL and more than 20 years old. |
| | Metric 5: | Sample Size | High | median and range values provided. |

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**Study Citation:** MSSM, (1982). Disability compensation for asbestos associated disease in the United States. :710.
**HERO ID:** 6895826
**Conditions of Use:** Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products

| | | EVALUATION | |
|---|---|---|---|
| Domain | Metric | Rating | Comments |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Low | Monitoring data include sample type (e.g., personal breathing zone) but no other metadata. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Medium | Range and median values were provided that can help assess variability, but nothing about uncertainty. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Mukerjee, S., Mukerjee, D., Powers, T. J., Wassermann, O. (1991). Strategy to reduce risk of asbestos in the United States. Journal of Clean Technology and Environmental Sciences 1(3-4):193-207. |
| **HERO ID:** | 3586006 |
| **Conditions of Use:** | Other: |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Asbestos abatement from government buildings, private nonresidential buildings, and apartments. (3/16) |
| Exposure route: | inhalation (3/16) |
| Physical form: | fibers (8/16) |
| Area sampling data: | (TEM) 20 abatement sites had area concentrations of 0.003-0.3 asbestos structures/cc. (11/16) |
| Exposure frequency: | 5 days/week (4/16) |
| Personal protective equipment: | Respirators (8/16) |
| Engineering control: | All visible asbestos containing material has been removed, the substrate has been brushed and wet-wiped, a sealant has been applied to the substrate and to plastic sheeting covering the floors and walls, and all plastic sheeting has been removed. (7/16) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Sampling and Analytical Methodology | Medium | Sampling methodology is said to be an AHERA method, but isn't detailed. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | High | Data are from the U.S. |
| | Metric 3: Applicability | High | Data are for demolition of asbestos products, an in-scope occupational scenario. |
| | Metric 4: Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| | Metric 5: Sample Size | Medium | Distribution is characterized by a graph with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | Medium | Exposure type and sampling data provided, but missing number of workers, exposure duration, and particle size, |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Medium | Variability is addressed by sampling at 20 sites. Uncertainty isn't addressed. |

## Overall Quality Determination — Medium

| | |
|---|---|
| **Study Citation:** | Murbach, D., Chapman, P., Madl, A., Paustenbach, D. (2006). Evaluation of background exposures to airborne asbestos on maritime shipping vessels (1972-1992). Epidemiology 17(6):S462-S462. |
| **HERO ID:** | 3586150 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Exposure route: | inhalation |
| Physical form: | inhalable fibers |
| Area sampling data: | PCMAverage value 0.008 f/cc 95th percentile 0.05 f/ccTEMAverage value 0.006 f/cc 95th percentile 0.003 f/ccCrew areasRange 0.00017 to 0.124 f/ccEngine Room/machine shop0.00015 to 0.39 f/cc |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Sampling and Analytical Methodology | Medium | Analytical method described, but sampling methodology is not provided. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | High | Data are from US shipping vessels. |
| | Metric 3: Applicability | High | The data are for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: Temporal Representativeness | Medium | The data are more than 10 years but generally, no more than 20 years old. |
| | Metric 5: Sample Size | Medium | Distribution of samples is characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | Medium | Monitoring data include most critical metadata, but lacks additional metadata such as sample durations, exposure durations, exposure frequency, and worker activity details. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Low | Uncertainty is vaguely characterized, and variability is not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Murphy, R. L. H., Ferris, B. G., Jr, Burgess, W. A., Worcester, J., Gaensler, E. A. (1971). Effects of low concentrations of asbestos: clinical, environmental, radiologic and epidemiologic observations in shipyard pipe coverers and controls. New England Journal of Medicine 285(23):1271-1278. |
| **HERO ID:** | 144 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Shipyard pipe coverers. Pipe coverers prepared and applied insulating materials to machinery and pipes. Most common procedure was wiring contoured asbestos cement blocks to pipes. Shop work included layout, band-saw cutting, pattern cutting, sewing, asbestos cement mixing and fabrication of pads. Asbestos in fibrous form was also stuffed into jackets and sewn around small pipes. (Pages 1 and 2). |
| Exposure route: | Inhalation |
| Physical form: | Airborne dust and fiber. |
| Area sampling data: | Table 1 (page 2). Average concentration is expressed in millions of particles per cubic foot of air (mppcf).(A) Midget Impinger 1965 data:Cutting room - 5.7 mppcfSewing & fabrication bench - 3.0 mppcfBand-saw cutting - 10.0 mppcfMixing mud - 0.8 mppcfAboard ship (various) - 7.2 mppcfWeighted average - 5.2 mppcf(B) Konimeter 1945, 1965 and 1966 dataSewing and fabrication:1945 - 2 samples; range - 10.6-12.3 mppcf; avg - 11.4 mppcf; % fiber - 0.5-0.81965 - 12 samples; range - 14.2-30.2 mppcf; avg - 23.4 mppcf; % fiber - 0.1-2.71966 - 10 samples; range - 12.9-32.8 mppcf; avg - 23.1 mppcf; % fiber - 0.1-3.8Aboard Ship:1945 - 15 samples; range - 25.3-89.0 mppcf; avg - 49.2 mppcf; % fiber - 0.2-2.41965 - 12 samples; range - 8.2-61.7 mppcf; avg - 21.4 mppcf; % fiber - 0.1-0.71966 - 10 samples; range - 18.3-35.7 mppcf; avg - 25.9 mppcf; % fiber - 0.1-0.7 |
| Number of workers: | Total of 587 workers: 101 pipe coverers and 486 shiplifters and pipefitters. (End of page 2 into page 3) |
| Personal protective equipment: | Operations when pattern cutting required one worker who wore a respirator. Does not mention what type of respirator. (Page 2) |
| Engineering control: | Ventilation was provided by portable blowers but they were not always used (page 2) |
| Comments: | Amosite was called for most frequently because of its low thermal conductivity, light weight and strength. Chrysotile was used to a lesser extent, and crocidolite was never used. (page 2) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Medium | Sampling and analytical methodology is the ”Method of Kotze” (Page 2). Could not find data stating that it was not an approved methodology. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data is from the United States. |
| | Metric 3: | Applicability | High | The data is for exposure to asbestos from cement used and from asbestos in fibrous form. |
| | Metric 4: | Temporal Representativeness | Low | Data is from sampling dated from 1945 to 1966 which is over 20 years old. |
| | Metric 5: | Sample Size | Medium | Distribution is characterized by average concentrations, a range, % fiber, and number of samples. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Monitoring data includes sample type, exposure type, physical form, worker activity, number of workers, and some PPE and engineering controls. Lacks sample duration, exposure duration, and exposure frequency. |
| Domain 4: Variability and Uncertainty | | | | |

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| | |
|---|---|
| **Study Citation:** | Murphy, R. L. H., Ferris, B. G., Jr, Burgess, W. A., Worcester, J., Gaensler, E. A. (1971). Effects of low concentrations of asbestos: clinical, environmental, radiologic and epidemiologic observations in shipyard pipe coverers and controls. New England Journal of Medicine 285(23):1271-1278. |
| **HERO ID:** | 144 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

| | | **EVALUATION** | |
|---|---|---|---|
| Domain | Metric | Rating | Comments |
| | Metric 7: Metadata Completeness | Medium | Variability is addressed by sampling across different years along with multiple samples in different site locations. Uncertainty is not addressed. |

## Overall Quality Determination — Medium

| | |
|---|---|
| **Study Citation:** | Nam, I. S., Oh, H. J., Kim, J. M., Yang, J. H., Kim, J. S., Sohn, J. R. (2015). Comparison of risk assessment criteria and distribution of asbestos-containing materials in school building. International Journal of Environmental Research 9(4):1341-1350. |
| **HERO ID:** | 3584319 |
| **Conditions of Use:** | Consumer Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Teachers and faculty in Korean elementary schools that contain asbestos materials. (2/10) |
| Exposure route: | inhalation (1/10) |
| Physical form: | fibers (1/10) |
| Area sampling data: | (PCM) Area samples in 8 areas around schools were 0.003, 0.021, 0.002, 0.003, 0.008, 0.008, 0.002, and 0.003 f/cc. (7/10) |
| Particle size characterization: | Asbestos particles of about 0.1 ~ 10 μm poly filamentous structure have a length and structure that is easily deposited in the lungs through the respiratory tract. In particular, they can be particles more than 8 μm length, with a diameter particle size of less than 0.25 μmare primarily related to the incidence of respiratory diseases (1/10) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Sampling and Analytical Methodology | High | Sampling/analytical methodology is an approved EPA method. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | Medium | Data are from Korea, an OECD country. |
| | Metric 3: Applicability | Low | Data are for school and office workers exposures, which is similar to commercial use of construction products. |
| | Metric 4: Temporal Representativeness | High | Monitoring data were collected after the most recent PEL and no more than 10 years old. |
| | Metric 5: Sample Size | Medium | Sample distribution characterized by limited statistics (averages, sample counts) but discrete samples not provided and distribution not fully characterized. |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | Medium | Exposure type and sampling data provided, but missing number of workers, exposure duration and frequency, PPE, and engineering controls. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | High | Uncertainty is addressed in sampling/analytical methodology. Variability is addressed by sampling multiple facilities. |

## Overall Quality Determination Medium

**Study Citation:** (1977). IARC monographs on the evaluation of the carcinogenic risk of chemicals to man: asbestos. 14:1-106.
**HERO ID:** 3084507
**Conditions of Use:** Other:

**EXTRACTION**

| Parameter | Data |
|---|---|
| Area sampling data: | "A comparison of asbestos concentrations in air under different circumstances as measured by electron microscopy is as follows: near asbestos spraying, 10-1000 ng/m3; during a milling operation, 10-5000 ng/m3; in other occupational exposures, 1000->100,000 ng/m3"Table 11 (pg 34) presents fiber concentration ranges for various industries |

**EVALUATION**

| Domain | | Metric | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Low | Sampling/analytical methodology is not specified. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for various in-scope occupational scenarios. |
| | Metric 4: | Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| | Metric 5: | Sample Size | Medium | Sample distribution characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Low | Sample type provided but no other metadata. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Low

**Study Citation:** (2015). New reports from the NIOSH health hazard evaluation program. International Journal of Occupational and Environmental Health 21(2):180-181.
**HERO ID:** 3520372
**Conditions of Use:** Other:

**EXTRACTION**

| Parameter | Data |
|---|---|
| Worker activity description: | Forest management and fire suppression activities in an area surrounding a former vermiculite mine. Most of the work involves land management activities, including civil engineering, trail and road maintenance, forest biology, fuels and timber management, hydrology, and wildland fire suppression.(1/2) |
| Exposure route: | inhalation (1/2) |
| Physical form: | fibers (1/2) |
| Personal sampling data: | "Of the 27 personal air samples evaluated by TEM, which included the six air samples exceeding 0.1 f/cc, six contained mineral fibers. Five of six contained richterite (one of the fibers that compose Libby amphibole), and one contained chrysotile (a serpentine form of asbestos).(1/2)" |
| Exposure duration: | Work shifts are typically 8–10 hours per day. (1/2) |
| Number of workers: | The site has approximately 40 full-time employees, and up to 100 additional employees in the summer (1/2) |
| Personal protective equipment: | Employees wore respirators during trail maintenance and fuel reduction activities and completed a 3-stage decontamination (1/2) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Sampling and Analytical Methodology | Low | Sampling methodology is not specified. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | Data are from the U.S. |
| Metric 3: | Applicability | Uninformative | Data are for forest management activities, which isn't in scope. |
| Metric 4: | Temporal Representativeness | High | Monitoring data were collected after the most recent PEL and no more than 10 years old. |
| Metric 5: | Sample Size | Low | Sample distribution only characterizes presence or absence of asbestos materials. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Medium | Exposure type and sampling data provided, but missing exposure frequency, engineering controls, and particle size. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Uninformative

| | |
|---|---|
| **Study Citation:** | (1983). Results of air samples taken during health hazard evaluation with attached data sheets. |
| **HERO ID:** | 3656436 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Personal sampling data: | [PDF Pg. 5]Asbestos handler: 0.11, 0.14, 0.10 (fibers/cm^3) |
| Area sampling data: | [PDF Pg. 5]3 ft to right of asbestos charging station, shoulder height: 0.02, 0.01, 0.04 (f/cm^3) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Low | Sampling/analytical methodology is not specified. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for Chemical Substances in Construction, Paint, Electrical, and Metal Products, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Monitoring data are greater than 20 years old. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Low | Sample type provided but no other metadata. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | Variability addressed by area and personal sampling, but uncertainty is not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Nash, J. L. (2002). Cleaning up after 9/11: Respirators, power, and politics. Occupational Hazards 64(5):40-43. |
| **HERO ID:** | 6881758 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Exposure route: | inhalation (pg 3) |
| Physical form: | dust/debris (pg 3) |
| Area sampling data: | ”60 percent of our [asbestos] samples were greater than theEPA clearance level [.02 f/cc]” (pg 3)”OSHA had conducted more than 1,000 asbestos samples, and results ranged from ”none detected” to .037” (pg 4)”Sampling done by private organizations in some buildings found concentrations of asbestos in dust that far exceeded EPA’s 1 percent definitional threshold for material containing asbestos” (pg 5) |
| Personal protective equipment: | Four months after the catastrophe, there were reports that half the workers at Ground Zero, perhaps the most hazardous work site in the nation, still were not wearing respirators. (pg 2)half-face, negative-pressure respirators with P-100, organic vapor/acid gas cartridges (pg 8)pg 9 provides various estimates for % of workers complying with respirator requirements, 20-80% |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Sampling and Analytical Methodology | Medium | Sampling/analytical methodology is not specified, however, some sampling was conducted by OSHA |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | Data are from the U.S. |
| Metric 3: | Applicability | High | Data are for construction materials, an in-scope occupational scenario. |
| Metric 4: | Temporal Representativeness | Medium | Monitoring data were collected after the most recent PEL and greater than 10 years old. |
| Metric 5: | Sample Size | Medium | Sample distribution characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Low | Sample type provided but no other metadata. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Medium | Variability is addressed by sampling in and outside of buildings near ground zero but uncertainty is not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Nasirzadeh, N., Mohammadian, Y., Fakhri, Y. (2020). Concentration and cancer risk assessment of asbestos in Middle East countries: A systematic review-meta-analysis. International Journal of Environmental Analytical Chemistry :1-15. |
| **HERO ID:** | 7461088 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Measurements are from ”workplace” without further description of worker activities. |
| Personal sampling data: | Table 1Total of 777 personal samples taken at workplacesaverages: 0.02 - 31.0 f/cc |
| Area sampling data: | Table 1Total of 329 environmental samples taken at workplacesaverages: 0.029 - 0.25 f/cc |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | High | Sampling or analytical methodology is an approved OSHA or NIOSH method or is well described and found to be equivalent to approved OSHA or NIOSH methods. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Low | The data are from a non-OECD country. |
| | Metric 3: | Applicability | Low | The occupational scenario for the monitoring data is not provided in the source, just that the exposure occurs in a ”workplace” |
| | Metric 4: | Temporal Representativeness | High | The monitoring data are no more than 10 years old. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Low | Monitoring data include sample type (e.g., personal breathing zone) but no other meta-data. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | High | Variability is addressed by sampling several different workplaces, as well as multiple sample types (area and personal), and uncertainty is addressed with 95% confidence interval of measurements. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Nicholson, W. J., Rohl, A. N., Weisman, I., Selikoff, I. J. (1980). Environmental asbestos concentrations in the United States. IARC Scientific Publications IARC Scientific Publication No(30):823-827. |
| **HERO ID:** | 159 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Exposure route: | Inhalation |
| Physical form: | ambient air/dust |
| Area sampling data: | Table 1 (page 2). Analysis of 187 quarterly composite samples from 1969-1970. 61 samples (32.6%) - less than 1 ng/m^3.119 samples (63.6%) - less than 2 ng/m^3.164 samples (87.7%) - less than 5 ng/m^3.176 samples (94.2%) - less than 10 ng/m^3.184 samples (98.5%) - less than 20 ng/m^3.185 samples (99.0%) - less than 50 ng/m^3.187 samples (100.0%) - less than 100 ng/m^3.Analysis of New York City samples.0 samples (0.0%) - less than 1 ng/m^3.1 sample (4.5%) - less than 2 ng/m^3.4 samples (18.1%) - less than 5 ng/m^3.8 samples (36.4%) - less than 10 ng/m^3.16 samples (72.7%) - less than 20 ng/m^3.21 samples (95.4%) - less than 50 ng/m^3.22 samples (100.0%) - less than 100 ng/m^3. |
| Exposure duration: | 24 hour samples from US Cities data. 6- to 8-hour samples from New York City (Page 2) |
| Comments: | Measurements were made of Chrysotile concentrations (Page 1). This form is for ambient concentration of asbestos in US cities most likely due to construction activities and automobile braking (page 2). |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | High | Sampling methodology is based on another research article titled "Asbestos in the Environment" by Nicholson, W.J. & Pundsack, F.L. and published in Biological Effects of Asbestos (International Agency for Research on Cancer Scientific Publications No. 8) so the sampling and analytical methodology are likely approved or equivalent. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Samples are based on US cities. |
| | Metric 3: | Applicability | Medium | Data are for a similar occupational exposure within scope which includes ambient outdoor concentrations due to construction/car vehicles /machinery in US cities. Does not actually sample at the sites but the concentrations can be attributed to that COU. |
| | Metric 4: | Temporal Representativeness | Low | Samples are from 1969-1970 so they are over 20 years old. |
| | Metric 5: | Sample Size | Medium | Monitoring data includes the number of samples and percentage of samples that fall under a certain concentration. Does not provide the individual data points. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Monitoring data includes number of sites, exposure route, physical form, and exposure duration. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | Addresses variability by sampling across multiple cities. Does not address uncertainty. |

## Overall Quality Determination Medium

**Continued on next page . . .**

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| | |
|---|---|
| **Study Citation:** | Nicholson, W. J., Rohl, A. N., Weisman, I., Selikoff, I. J. (1980). Environmental asbestos concentrations in the United States. IARC Scientific Publications IARC Scientific Publication No(30):823-827. |
| **HERO ID:** | 159 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|

| | |
|---|---|
| **Study Citation:** | Nicholson, W. J., Rohl, A. N., Weisman, I., Selikoff, I. J. (1980). Environmental asbestos concentrations in the United States. IARC Scientific Publications IARC Scientific Publication No(30):823-827. |
| **HERO ID:** | 159 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Exposure route: | inhalation. |
| Physical form: | ambient air/dust |
| Area sampling data: | Table 2 (Page 3).Buildings with friable fireproofing material in return air plenums.4 samples (12.5%) - less than 1 ng/m^35 samples (15.6%) - less than 5 ng/m^38 samples (25.0%) - less than 10 ng/m^315 samples (46.9%) - less than 20 ng/m^326 samples (81.3%) - less than 50 ng/m^330 samples (93.9%) - less than 200 ng/m^331 samples (96.9%) - less than 500 ng/m^332 samples (100%) - less than 1000 ng/m^3 |
| Exposure duration: | 4-to-8 hour samples. |
| Comments: | Measurements were made of Chrysotile concentrations (Page 1). This form is for ambient concentration of asbestos of fireproofing material in air duct system which would fall under the COU loose-fill insulation including air duct installation (Page 3). |

**EVALUATION**

| Domain | | Metric | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | High | Sampling methodology is based on another research article titled ”Asbestos in the Environment” by Nicholson, W.J. & Pundsack, F.L. and published in Biological Effects of Asbestos (International Agency for Research on Cancer Scientific Publications No. 8) so the sampling and analytical methodology are likely approved or equivalent. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Samples are based on US buildings. |
| | Metric 3: | Applicability | Medium | Data are for an occupational exposure similar to one in scope which includes ambient indoor and concentrations associated fireproofing material within the air duct insulation. |
| | Metric 4: | Temporal Representativeness | Low | Samples are from 1969-1970 so they are over 20 years old. |
| | Metric 5: | Sample Size | Medium | Monitoring data includes the number of samples and percentage of samples that fall under a certain concentration. Does not provide the individual data points. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Monitoring data includes exposure route, physical form, and exposure duration. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | Does not address variability or uncertainty. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Nicholson, W. J., Rohl, A. N., Weisman, I., Selikoff, I. J. (1980). Environmental asbestos concentrations in the United States. IARC Scientific Publications IARC Scientific Publication No(30):823-827. |
| **HERO ID:** | 159 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Asbestos mine and mill employees. Employed in California and Newfoundland. |
| Exposure route: | Inhalation |
| Physical form: | Ambient air/dust. |
| Area sampling data: | Table 2 (Page 3).Houses of asbestos mine and mill employees0 samples (0.0%) - less than 50 ng/m^34 samples (30.8%) - less than 100 ng/m^38 samples (61.5%) - less than 200 ng/m^310 samples (76.9%) - less than 500 ng/m^312 samples (92.3%) - less than 2000 ng/m^313 samples (100.0%) - less than 5000 ng/m^3Three samples not in the table were taken in houses of non-miners in Newfoundland were 32, 45, and 65 ng/m^3. |
| Comments: | Measurements were made of Chrysotile concentrations (Page 1). This form is for ambient air/dust concentrations of asbestos in mining/milling worker homes (Page 3). |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | High | Sampling methodology is based on another research article titled ”Asbestos in the Environment” by Nicholson, W.J. & Pundsack, F.L. and published in Biological Effects of Asbestos (International Agency for Research on Cancer Scientific Publications No. 8) so the sampling and analytical methodology are likely approved or equivalent. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Samples are based on US and Canada workers. |
| | Metric 3: | Applicability | Medium | Data are for an occupational exposure within scope but takes measurements of concentrations at the workers home. Could be assumed that these concentrations are at the same level or higher at their place of employment. The COU is for braking and gear-changing components in mining and milling. |
| | Metric 4: | Temporal Representativeness | Low | Samples are from 1969-1970 so they are over 20 years old. |
| | Metric 5: | Sample Size | Medium | Monitoring data includes the number of samples and percentage of samples that fall under a certain concentration. Does not provide the individual data points. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Monitoring data includes number of sites, exposure route, physical form, and exposure duration. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | Does not address variability or uncertainty. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Nicholson, W. J., Rohl, A. N., Weisman, I., Selikoff, I. J. (1980). Environmental asbestos concentrations in the United States. IARC Scientific Publications IARC Scientific Publication No(30):823-827. |
| **HERO ID:** | 159 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Construction workers sprayed asbestos onto the steelwork of the lower floors of the first tower of the world trade center. (Page 3) |
| Exposure route: | Inhalation |
| Physical form: | Ambient air |
| Area sampling data: | Table 2 (Page 3).Ambient air within 0.5 miles of asbestos spray sites.0 samples (0.0%) - less than 5 ng/m^33 samples (17.6%) - less than 10 ng/m^38 samples (47.1%) - less than 20 ng/m^314 samples (82.3%) - less than 50 ng/m^316 samples (94.1%) - less than 200 ng/m^317 samples (100.0%) - less than 500 ng/m^3Ambient asbestos concentrations were approximately 100 times higher than normal ambient air. |
| Engineering control: | Used tarpaulins to contain the spray of asbestos. Often were torn, loosely secured or ineffective. |
| Comments: | Measurements were made of Chrysotile concentrations (Page 1). This form is for ambient air concentrations of asbestos at the world trade center construction site (Page 3). |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | High | Sampling methodology is based on another research article titled ”Asbestos in the Environment” by Nicholson, W.J. & Pundsack, F.L. and published in Biological Effects of Asbestos (International Agency for Research on Cancer Scientific Publications No. 8) so the sampling and analytical methodology are likely approved or equivalent. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Samples are based on construction in the US. |
| | Metric 3: | Applicability | High | Data are for an occupational exposure within scope which includes construction and spraying asbestos onto steel framing likely as a sealant. |
| | Metric 4: | Temporal Representativeness | Low | Samples are from 1969-1970 so they are over 20 years old. |
| | Metric 5: | Sample Size | Medium | Monitoring data includes the number of samples and percentage of samples that fall under a certain concentration. Does not provide the individual data points. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Monitoring data includes worker activity, exposure route, physical form, and exposure duration. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | Does not address variability or uncertainty. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Nicholson, W. J., Rohl, A. N., Weisman, I., Selikoff, I. J. (1980). Environmental asbestos concentrations in the United States. IARC Scientific Publications IARC Scientific Publication No(30):823-827. |
| **HERO ID:** | 159 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Exposure route: | Inhalation |
| Physical form: | Ambient air/dust. |
| Area sampling data: | Samples ranged from 9 to 1950 ng/m^3 with an average of 217 ng/m^3. Outside air samples at three of the schools varied from 3 to 30 ng/m^3, with an average of 14 ng/m^3. In all samples but two (which measured 320 ng/m^3), no asbestos was visible on the floor of the area sampled. (Page 2)Table 2 (Page 3).Public schools with damaged asbestos surfaces.0 samples (0.0%) - less than 5 ng/m^3.1 sample (3.7%) - less than 10 ng/m^3.1 sample (3.7%) - less than 20 ng/m^3.6 samples (22.2%) - less than 50 ng/m^3.12 samples (44.4%) - less than 100 ng/m^3.19 samples (70.4%) - less than 200 ng/m^3.25 samples (92.6%) - less than 500 ng/m^3.26 samples (96.3%) - less than 1000 ng/m^3.27 samples (100.0%) - less than 2000 ng/m^3. |
| Exposure duration: | 4-to-8 hour samples. |
| Comments: | Measurements were made of Chrysotile concentrations (Page 1). This form is for public schools with damaged asbestos surfaces (page 2). These schools were selected on the basis of visible damage, these results cannot be considered typical of all schools with asbestos surfaces but instead illustrate the extensive contamination that can occur. |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | High | Sampling methodology is based on another research article titled "Asbestos in the Environment" by Nicholson, W.J. & Pundsack, F.L. and published in Biological Effects of Asbestos (International Agency for Research on Cancer Scientific Publications No. 8) so the sampling and analytical methodology are likely approved or equivalent. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Samples are based on US schools. |
| | Metric 3: | Applicability | Low | Data are for similar occupational exposure within scope which includes ambient indoor and some outdoor concentrations associated with roofing/flooring materials. This location is at a public school after asbestos material has been damaged. Could potentially be used to predict ambient air concentrations in buildings with asbestos damage. |
| | Metric 4: | Temporal Representativeness | Low | Samples are from 1969-1970 so they are over 20 years old. |
| | Metric 5: | Sample Size | Medium | Monitoring data includes the number of samples and percentage of samples that fall under a certain concentration. Does not provide the individual data points. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Monitoring data includes number of sites, exposure route, physical form, and exposure duration. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | Does not address variability and uncertainty. |

## Overall Quality Determination Medium

**Study Citation:** NICNAS, (1999). Chrysotile asbestos: priority exisiting chemical no. 9.
**HERO ID:** 3978350
**Conditions of Use:** Other:

**EXTRACTION**

| Parameter | Data |
|---|---|
| Exposure route: | inhalation |
| Physical form: | inhalable fibers |
| Personal sampling data: | Gasket production1991 Industrial cutting shop personal below limit of detection1991 Handcut area personal below limit of detection1991 Stores personal below limit of detection1991 Spiral Wound area personal below limit of detection1995 Handcut area personal < 0.05 f/ml1995 Press personal <0.05 f/mlCAF production1991 assembling spiral wound gaskets Range: <0.05 f/ml 4 samples < 0.05 f/ml1992 Raw material prep Range <0.05-0.3 f/ml 16 samples <0.05 f/ml 14 samples >0.05-<0.1 f/ml 7 samples >0.1- <0.2 f/ml 10 samples >0.2 f/ml1993 Raw material prep Range <0.05-0.27 f/ml 16 samples <0.05 f/ml 22 samples >0.05-<0.1 f/ml 6 samples >0.1- <0.2 f/ml 3 samples >0.2 f/ml1994 Raw material prep Range <0.05-0.38 f/ml 6 samples <0.05 f/ml 5 samples >0.05-<0.1 f/ml 13 samples >0.1- <0.2 f/ml 15 samples >0.2 f/ml1995 Raw material prep Range <0.01-0.08 f/ml 5 samples <0.05 f/ml 17 samples >0.05-<0.1 f/ml 6 samples >0.1- <0.2 f/ml 10 samples >0.2 -<0.5 1 samples >0.5 f/ml1996 Raw material prep Range <0.05-0.3 f/ml 15 samples <0.05 f/ml 5 samples >0.05-<0.1 f/ml 7 samples >0.1- <0.2 f/ml 12 samples >0.2 f/mlProcessing asbestos gasketsA. handling CAF gaskets < 0.01 f/mlB. cutting gaskets 0.08 f/mlC. (i) scraping gaskets 0.07 f/ml (ii) cutting gaskets 0.07 f/ml (iii) cleaning up 0.1 f/mlD. removal and replacement of gaskets < 0.01 f/mlGasket cutting and stamping 1989, 1991, 1993 & 1995 <0.05 f/mlSheet cutting, sawing & drilling <0.08 f/mlInternational study sheet cutting < 0.02 f/ml TWAInternational study gasket removal and instillation dry removal up to 1.4 f/ml and wet removal 0.06 f/mlRemoval of Gaskets ( other studies)USA removal from old valves Mean: 0.16 f/ml Range 0.05-0.44 f/ml PCMUSA removal from old valves Mean: 4.58 f/ml Range 0.86-18.45 f/ml TEMUSA installation in old valves Mean: 0.20 f/ml Range 0.13-0.29 f/ml PCMUSA installation in old valves Mean: 2.97 f/ml Range 0.40-74.32 f/ml TEMNetherlands gasket easily removed Range: 0.04-0.24 f/ml PCMNetherlands gasket easily removed Range: <0.0008 f/ml TEMNetherlands removal of remaining gasket Range: below detection - 0.02 f/ml PCMNetherlands removal of remaining gasket Range: below detection - 0.004 f/ml TEMUSA Refinery cutting gaskets 7 samples 330-490 min 0.001- 0.017 f/ml 4 samples 30-55 min 0.33-0.49 f/ml 3 samples 19-55 min 11-0.33 f/ml 1 samples 25 min 1.4 f/mlUSA Refinery replacing sheet gasket 2 samples 15-30 min <0.06 f/mlUSA Storage gaskets 480 min 0.37-0.58 f/ml |
| Area sampling data: | Gasket production1989 Spiral wound gasket area 0.04 f/ml1991 Industrial cutting shop static < 0.01, 0.01 f/ml1991 Hand cut area static < 0.01 f/ml1991 Spiral Wound area static 0.01 f/ml1993 Cutting shop 0.04 f/ml1995 Press static 0.01 f/ml1995 Small guillotine static < 0.01f/ml1995 Packing area static < 0.01 f/mlCAF production1991 assembling spiral wound gaskets Range: <0.01- 0.02 f/ml 4 samples < 0.05 f/ml1995 calender/trimer Range: <0.01- 0.05 f/ml 22 samples < 0.01 f/ml 1 sample >0.01-<0.05 f/ml1996 calender/trimer Range: <0.01- 0.01 f/ml 22 samples < 0.01 f/ml 1 sample >0.01 f/ml1995 guillotine Range: <0.01-0.02 f/ml 19 samples < 0.01 f/ml 2 sample >0.01-<0.05 f/ml1996 guillotine Range: <0.01- 0.01 f/ml 22 samples < 0.01 f/mlProcessing Gasket3 locations 2-3 m from cutting area <0.01 f/mlnear cutting area <0.01 f/mlGasket cutting and stamping 1989, 1991, 1993 & 1995 <0.05 f/mlSheet cutting, sawing & drilling <0.01 f/ml |
| Exposure duration: | Gasket manufacture (Max exposure /employee (h/d/year)CAF productionRaw material preparation 4 h/231 days/yearCalendering 4 h/231 days/yearFinishing 4 h/231 days/yearStores 1 h/231 days/yearGasket cutting 3 h/231 days/yearMaintenance personnel 1 h/231 days/yearLaboratory staff 0.75 h/231 days/yearGasket productionGasket cutting 6 h/231 days/yearSpiral wounding 6 h/231 days/yearStores 3 h/231 days/year |
| Personal protective equipment: | Personal protective equipmentIn general, the use of personal protective equipment (PPE) as a control measure should be limited to situations where other control measures are not practicable or where it is used in conjunction with other measures to increase protection.PPE used by chrysotile product manufacturers in Australia include: • respiratory protection (e.g. half-face mask respirators with class M cartridges or 3M 8710 respirators); • safety glasses or goggles in designated eye protection areas or on designated machines (e.g. grinders); • cotton overalls; and • gloves for handling of materials.In most gasket workshops, overalls were worn by all employees. All brake bonding shops and one service garage reported that respiratory protection was used during times of potential exposure to asbestos. During site visits it was observed that a 3M 8710 mask was used during cutting and grinding of brake linings (in brake bonding) and during the changing of brake linings (service garage).NSW WorkCover has published a guidance document on the use of personal protective equipment (NSW WorkCover, 1996). Personal protective equipment should be selected according to manufacturers/suppliers recommendations, usually available in the MSDS.Gasket manufacture: workers wear cotton overalls, half face mask respirators (with class M cartridges) and leather gloves when handling chrysotile or conducting equipment maintenance operations.Epoxy resin manufacture: At the time of the survey, 17 workers were employed at the site, around half of which were engaged on the factory floor and storage areas. Workers wear 3M 8710 respirators when handling and weighing asbestos. Gloves are worn by all factory floor workers. |

**Continued on next page . . .**

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**Study Citation:** NICNAS, (1999). Chrysotile asbestos: priority exisiting chemical no. 9.
**HERO ID:** 3978350
**Conditions of Use:** Other:

| Domain | Metric | EVALUATION Rating | Comments |
|---|---|---|---|
| Engineering control: | Engineering controlsEngineering controls are plant construction or processes which minimise exposure to hazardous substances such as ventilation, enclosure (closed process) and automation.The three manufacturers of chrysotile products in Australia have various engineering controls in place at their manufacturing sites. These controls include:• dust extraction systems which operate during different stages of the manufacturing process;• automated process for the opening and removal of the woven polyethylene bag which contains the raw chrysotile and disposal of the bag;• mixing vessels enclosed and operated under negative pressure;• automated decanting of asbestos mixes and machining of final product• localised automated dust extraction; and• centrally ducted vacuum systems. | | |

| Domain | Metric | EVALUATION Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Sampling and Analytical Methodology | High | Australian National Industrial Chemicals Notification and Assessment Scheme. Differentiates PCM and TEM sampling |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | Medium | Australia - OECD member |
| | Metric 3: Applicability | Uninformative | The data are for an occupational scenario (gasket manufacture) that is not within scope of the legacy asbestos risk evaluation. |
| | Metric 4: Temporal Representativeness | Low | 1999 more than 20 years old |
| | Metric 5: Sample Size | Medium | sometimes range values are provided |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | Medium | Monitoring data include most critical metadata, such as sample type, exposure type, sample durations, and exposure durations but lacks additional metadata, such as exposure frequency, andworker activities. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Medium | Some range data are provided and results from different studies that can be useful in assessing variance. With regard to sampling, uncertainty is not discussed. |

## Overall Quality Determination Uninformative

| | |
|---|---|
| **Study Citation:** | NICNAS, (1999). Chrysotile asbestos: priority exisiting chemical no. 9. |
| **HERO ID:** | 3978350 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Automobile brake servicing which includes the following: blowing out dust from drum brakes, dry brushing drum brakes, hand grinding of drum brake linings, machine grinding brake linings, brake bonding. |
| Exposure route: | Inhalation |
| Physical form: | Fibers |
| Personal sampling data: | Exposures are characterized in Table 11, Table 12, and Table 16, ranging from <0.001 - 125 fibers/mL. Sampling times range from 1-min to 8-hr. |
| Area sampling data: | Exposures are characterized in Table 11, Table 12, and Table 16, ranging from <0.001 - 2.55 fibers/mL. Sampling times range from 0.25-hr to 4-hr. |
| Exposure duration: | Table 10 provides exposure durations for brake servicingBrake changes and clutch repair: 0.5 - 6 hr/dayBrake bonding: 5hr/week |
| Exposure frequency: | Table 10 provides exposure durations for brake servicingBrake changes and clutch repair: 1 - 3 days/weekBrake bonding: 5hr/week |
| Personal protective equipment: | Table 10 provides some information about PPE, such as the use of disposable masks during brake servicing. |
| Engineering control: | Table 10 provides general engineering control information, such as ventilation conditions and use of aerosol brake cleaner for dust suppression. |
| Comments: | Several bulk samples of brake dust contained < 1% asbestos. |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Sampling and Analytical Methodology | Medium | Several asbestos monitoring studies were considered in the NICNAS assessment. Most studies considered use NIOSH or OSHA approved methods, and some use equivalent methods where differences are not expected to lead to lower quality data. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | Medium | Most data are from the United States, but some data are from OECD countries other than the United States. |
| | Metric 3: Applicability | High | The data are for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: Temporal Representativeness | Low | Data was collected more than 20 years ago. |
| | Metric 5: Sample Size | Medium | Distribution of samples is characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | Medium | Monitoring data include most critical metadata such as sample type and exposure type, but lacks additional metadata such as detailed worker activities. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | High | Assessment addresses variability by collecting multiple sample types (area and personal), and uncertainty is captured by the sampling methodology. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | NIOSH, (1973). Health hazard evaluation report no. HHE 72-91-37, Mobi Oil Corporation, Augusta, Kansas. |
| **HERO ID:** | 3970537 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | ”Insulators at an oil refinery who are responsible for themaintenance, repair, and upkeep of insulation throughout the plant (5/19)” |
| Exposure route: | inhalation (4/19) |
| Physical form: | dust (1/19) |
| Personal sampling data: | (PCM) Personal samples for insulators during indoor cutting operations ranged from 0.6-3.3 f/cc.(13/19) Personal samples for insulators during outdoor insulation operations ranged from 0.2-1.5 f/cc.(14/19)Estimated 8-hour TWAs for the four insulators were 0.3, 0.4, 0.4, and 0.6 f/cc. (15/19) |
| Area sampling data: | (PCM) Area samples in the area above the cutting tables were 0.1-0.9 f/cc. (13/19) Area samples outdoors while stripping were 0.0 and 0.9 f/cc. (14/19) |
| Particle size characterization: | Fibers longer than 5 micrometers in length. (13/19) |
| Exposure duration: | 1 hour/day spent directly working with insulation indoors (6/19) |
| Number of workers: | 4 insulators (5/19) |
| Personal protective equipment: | These workers wear respirators and disposable paper coveralls during operations which may involve airborne asbestos. (5/19) |
| Engineering control: | A ventilated hood is used for cutting insulation, and an exhaust system is present in the insulators’ tool building. (6/19) |
| Comments: | Table I-III |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Sampling and Analytical Methodology | High | Sampling/analytical methodology is equivalent to an approved [OSHA/NIOSH] method. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | High | Data are from the U.S. |
| | Metric 3: Applicability | High | Data are for industrial use in construction materials, an in-scope occupational scenario. |
| | Metric 4: Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| | Metric 5: Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | High | All metadata provided. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Medium | Variability is addressed by sampling indoors and outdoors. Uncertainty isn’t addressed. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | NIOSH, (1980). Health hazard evaluation determination report no HE 79-141-711 Fischer and Porter Company Warminster Pennsylvania. |
| **HERO ID:** | 4158116 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Employee exposure from the following source. ”Asbestos-type” insulation coats the ceilings and walls of the Q-hut interior structure. Through structural vibration employee work movement, disturbing air currents, and natural aging/drying out of the insulation, asbestos material can fallout into the work environment. |
| Exposure route: | Inhalation |
| Physical form: | Fiber |
| Area sampling data: | [PDF Pg. 12]Q-hut Center Area: 0.1 (fibers/cc)Q-hut work table: <0.1 (fibers/cc)Potting room/oven top: <0.1 (fibers/cc) |
| Personal protective equipment: | Protective gloves, coveralls, goggles. booties and head covering should be used during mixing, pouring, grinding, ”palmering” and clean-up operations. [PDF Pg. 7] |
| Engineering control: | Ventilation Units |
| Comments: | Area air samp1es for asbestos fibers were collected on a 0.8 M AA filters using a three-piece cassette and a portable air sampling pump at a flow rate of 1.5 liters per minute. The air samples were analyzed for asbestos according - to NIOSH Method P&CAM #239 utilizing phase contrast microscopy, and the bulk samples were analyzed using prolonged light microscopy and dispersion staining techniques. |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Sampling and Analytical Methodology | High | Sampling/analytical methodology is an approved NIOSH method. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | Data are from the U.S. |
| Metric 3: | Applicability | Low | Employee exposure is not directly related to asbestos removal operations. Exposure to employees is from ”friable” asbestos insulation on the walls and ceilings escaping to the work area. |
| Metric 4: | Temporal Representativeness | Low | Monitoring data are greater than 20 years old. |
| Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Medium | Monitoring data include most critical metadata, such as sample type and exposure type, but lacks additional metadata, such as sample durations, exposure durations, and exposure frequency. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Medium | Variability addressed by sampling multiple areas of the facility but uncertainty is not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Nokso-Koivisto, P., Pukkala, E. (1994). Past exposure to asbestos and combustion products and incidence of cancer among Finnish locomotive drivers. Occupational and Environmental Medicine 51(5):330-334. |
| **HERO ID:** | 3081842 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | The outer covers of the boilers of two engines were dismantled.Asbestos layers were loosened and torn away and collected in separate containers |
| Personal sampling data: | 8 personal samplesThe average number of fibres > 5 microns was 5.0 (2.5-7.5)/cm3 |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Low | Sampling or analytical methodology is not specified. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Medium | The data are from an OECD country. other than the U.S. (Finland) |
| | Metric 3: | Applicability | High | The data are for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Low | Metadata on the operations, equipment, and worker activities associated with the data show that the data agree representative of outdated operations, equipment, and activities rather than current operations, equipment, and worker activities. The data were collected more than 20 years ago. |
| | Metric 5: | Sample Size | Medium | Distribution of samples is characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Monitoring data include most critical metadata, such as sample type and exposure type, but lacks additional metadata, such as exposure frequency. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | The monitoring study does not address variability or uncertainty. |

## Overall Quality Determination Low

| | |
|---|---|
| **Study Citation:** | Nolan, R. P., Langer, A. M. (2001). Concentration and type of asbestos fibers in air inside buildings. Canadian Mineralogist, special issue 5 :39-51. |
| **HERO ID:** | 6874316 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | sampling activities |
| Exposure route: | inhalation |
| Physical form: | solid fibers |
| Personal sampling data: | 17 personal samples (TEM)mean value: <0.00084 f/ccTable 2 |
| Area sampling data: | 117 area samples (TEM)mean value: <0.00082 f/ccTable 2Table 5: fireproofing fell from the ceiling and asbestos concentration reached a max of 0.00864 f/cc |

**EVALUATION**

| Domain | | Metric | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Medium | Sampling or analytical methodology is not equivalent to an approved OSHA or NIOSH method and EPA review of information indicates the methodology is acceptable. Differences in methods are not expected to lead to lower quality data. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | The data are from the United States and are representative of the industry being evaluated. |
| | Metric 3: | Applicability | High | The data are for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Low | Metadata on the operations, equipment, and worker activities associated with the data show that the data agree representative of outdated operations, equipment, and activities rather than current operations, equipment, and worker activities. The data are more than 20 years old. |
| | Metric 5: | Sample Size | Medium | Distribution of samples is characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | Monitoring data include all associated metadata, including sample types, exposure types, sample durations, exposure durations worker activities, and exposure frequency. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | High | The monitoring study addresses variability in the determinants of exposure for the sampled site or sector. The monitoring study addresses uncertainty in the exposure estimates. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Novick, L. F., Rice, C., Freedman, M. A., Jillson, D. (1981). ASBESTOS IN VERMONT SCHOOLS - FINDINGS OF A STATEWIDE ON-SITE INVESTIGATION. American Journal of Public Health 71(7):744-746. |
| **HERO ID:** | 3583553 |
| **Conditions of Use:** | Consumer Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Source of exposure was pipe lagging in 183 schools, boiler covers in 104 schools, suspended ceilings in 34 schools, spray-on ceilings in 21 schools, non suspended ceilings in 2 schools, and other sources in 114 schools. (1/3) |
| Area sampling data: | Area sampling confirmed the presence of Amosite in 36 samples, chrysotile in 142 samples, crocidolite in 3 samples, and hardboard asbestos in 29 samples. No exposure concentrations were given. (2/3) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | High | Report mentions that sampling method is equivalent to an EPA method. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | Low | Data are for consumer use of construction materials in schools, which is similar to commercial use of construction materials, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| | Metric 5: | Sample Size | Low | Sample distribution only characterizes presence or absence of asbestos materials. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Exposure type and sampling data provided, but missing number of workers, exposure duration, frequency, particle size, engineering controls, and PPE. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | Variability is addressed by sampling at 336 schools. Limited uncertainty is addressed by considering various locations. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Nuodex Inc, (1980). Asbestos sampling- Fords M-1 reactor area with cover letters. |
| **HERO ID:** | 4158327 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Exposure route: | Inhalation [PDF Pg. 7] |
| Physical form: | Fibers (solid) [PDF Pg. 7] |
| Area sampling data: | [PDF Pg. 7]Top Reactor Platform (2 samples) (8/6/1980): <0.01; 0.03 (fibers/cc)Top Reactor Platform (2 samples) (8/7/1980): <0.01; <0.01 (fibers/cc) |
| Comments: | All samples were collected on a 37 mm 0.8 micron CEF open-faced filter at 2.0 LPH using a Gilian HFS113UT Pump. Analyzed by NIOSH method P&CAM 239. [PDF Pg. 7] No personal sampling data given in the document. |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | High | Sampling/analytical methodology is an approved NIOSH/OSHA method. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for Chemical Substances in Construction, Paint, Electrical, and Metal Products, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Monitoring data are greater than 20 years old. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Sample type and exposure type provided but missing exposure frequency and duration. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | High | Uncertainty is addressed in sampling/analytical methodology. Variability addressed by sampling at the facility on multiple days. |

## Overall Quality Determination High

**Study Citation:** Oberta, A. F. (2005). Operations and maintenance-living with asbestos. ASTM International Manual Series :87-97.
**HERO ID:** 6881657
**Conditions of Use:** Other:

**EXTRACTION**

| Parameter | Data |
|---|---|
| Worker activity description: | Removal of asbestos tile and insulation from buildings. (8/11) |
| Exposure route: | inhalation (3/11) |
| Physical form: | fibers (8/11) |
| Personal sampling data: | (PCM) Long term samples were 0.0022-0.0344 f/cc during removal and 0.0037-0.028 f/cc during hole drilling in tiles. Short term samples were 0.0123-0.2777 f/cc during removal and 0.0204-0.098 f/cc during hole drilling. (8/11) |
| Exposure duration: | 8 hours (8/11) |
| Personal protective equipment: | Respiratory protection and protective clothing are required when debris is present. |
| Engineering control: | A globe bag is used when repairing or removing small amounts of insulation. Debris should be wet to avoid fibers becoming airborne. Negative pressure can be used for extra precaution. Instead, wrapping damaged pipe insulation with plastic is an important step. If cleaning up debris, sealing off an area with barrier tape may be necessary. (3/11) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Medium | Sampling/analytical methodology is not specified as an approved OSHA/NIOSH method but is an acceptable methodology. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for demolition of asbestos products, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Medium | Monitoring data were collected after the most recent PEL and greater than 10 years old. |
| | Metric 5: | Sample Size | Medium | Sample distribution characterized by limited statistics (ranges, averages, confidence limit) but discrete samples not provided and distribution not fully characterized. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Exposure type and sampling data provided, but missing number of workers, exposure frequency, and particle size. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | High | Uncertainty is addressed in analytical methodology. Variability is addressed by comparing short term and long term samples. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Oberta, A. F., Fischer, K. E. (1999). Negative exposure assessments for asbestos floor tile work practices. American Society for Testing and Materials Special Technical Publication, no. 1342 :193-208. |
| **HERO ID:** | 6874239 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | [PDF Pg. 9]Removal of asbestos floor tile; hole drilling and punching for analysis. |
| Personal sampling data: | [PDF Pg. 9]Long-term SamplesIntact removal with water (8 samples): 0.0067-0.0292 (f/cc)Intact removal with encapsulant (6 samples): 0.0022-0.0175 (f/cc)Intact removal with heat gun (6 samples): 0.0086-0.0344 (f/cc)Hole drilling with water (10 samples): 0.005-0.028 (f/cc)Hole drilling with encapsulant (8 samples): 0.0053-0.0114 (f/cc)Hole drilling with vacuum shroud (4 samples): 0.0037-0.0146 (f/cc)Hole punching with water (10 samples): 0.0053-0.022 (f/cc)Hole punching with encapsulant (8 samples): 0.0041-0.0131 (f/cc)Short-Term SamplesIntact removal with water (12 samples): 0.0218-0.2777 (f/cc)Intact removal with encapsulant (12 samples): 0.0123-0.0513 (f/cc)Intact removal with heat gun (12 samples): 0.0245-0.0327 (f/cc)Hole drilling with water (10 samples): 0.0327-0.0694 (f/cc)Hole drilling with encapsulant (16 samples): 0.0237-0.098 (f/cc)Hole drilling with vacuum shroud (4 samples): 0.0204-0.0245 (f/cc)Hole punching with water (12 samples): 0.0204-0.049 (f/cc)Hole punching with encapsulant (14 samples): 0.0245-0.0327 (f/cc) |
| Area sampling data: | [PDF Pg. 12]PCM Area SamplesIntact removal with water (3 samples): 0.0023-0.0056 (f/cc)Intact removal with encapsulant (2 samples): 0.0025-0.044 (f/cc)Intact removal with heat gun (2 samples): 0.0009-0.0033 (f/cc)Hole drilling with water (3 samples): 0.0013-0.0058 (f/cc)Hole drilling with encapsulant (3 samples): 0.0013-0.0046 (f/cc)Hole drilling with vacuum shroud (1 sample): 0.0041 (f/cc)Hole punching with water (3 samples): 0.0026-0.0036 (f/cc)Hole punching with encapsulant (3 samples): 0.0009-0.0037 (f/cc)TEM Area SamplesIntact removal with water (3 samples): 0.0041-0.0150 (f/cc)Intact removal with encapsulant (2 samples): 0.0041-0.0189 (f/cc)Intact removal with heat gun (2 samples): 0.0026-0.0046 (f/cc)Hole drilling with water (3 samples): 0.0042-0.0289 (f/cc)Hole drilling with encapsulant (3 samples): 0.0041-0.0139 (f/cc)Hole drilling with vacuum shroud (1 sample): 0.0046 (f/cc)Hole punching with water (3 samples): 0.0050-0.0344 (f/cc)Hole punching with encapsulant (3 samples): 0.0026-0.0045 (f/cc) |
| Comments: | Personal samples were analyzed with PCM method [PDF Pg. 10]. Area samples were analyzed with PCM and TEM methods [PDF Pg. 12]. |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Sampling and Analytical Methodology | Medium | Sampling/analytical methodology is equivalent to an approved OSHA/NIOSH method. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | Data are from the U.S. |
| Metric 3: | Applicability | High | Data are for Chemical Substances in Construction, Paint, Electrical, and Metal Products, an in-scope occupational scenario. |
| Metric 4: | Temporal Representativeness | Low | Monitoring data are greater than 20 years old. |
| Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Low | Sample type provided but no other metadata. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | High | Uncertainty is addressed in sampling/analytical methodology. Variability addressed by sampling multiple activities. |

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|---|---|
| **Study Citation:** | Oberta, A. F., Fischer, K. E. (1999). Negative exposure assessments for asbestos floor tile work practices. American Society for Testing and Materials Special Technical Publication, no. 1342 :193-208. |
| **HERO ID:** | 6874239 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

| | | EVALUATION | |
|---|---|---|---|
| Domain | Metric | Rating | Comments |
| **Overall Quality Determination** | | **Medium** | |

| | |
|---|---|
| **Study Citation:** | Obminski, A. (2020). Asbestos in building and its destruction. Construction and Building Materials 249(Elsevier):118685. |
| **HERO ID:** | 6884598 |
| **Conditions of Use:** | Consumer Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Source of exposure is asbestos wall panels and insulation. (6/14) |
| Exposure route: | inhalation (4/14) |
| Physical form: | dust (5/14) |
| Area sampling data: | (PCM) In buildings with sturdy construction and asbestos cement panels, area samples were <300+-90, 360+-90, <300, 400-600, and <300 f/m3. In buildings with non-sturdy construction and non-friable materials, area samples were 800, 1200, 500, and 390-790 f/m3. (5/14) In buildings with un-sturdy construction containing friable materials, area concentrations were 550, <300, 310+-60, 800+-300, 2000-2700, <300, 300, and 700+-300 f/m3. (6/14) |
| Particle size characterization: | the length L > 5 mm, the diameter Ø < 3 mm, L: Ø < 3 : 1 (4/14) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Sampling and Analytical Methodology | High | Sampling/analytical methodology is an approved NIOSH method. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | Medium | Data are from Poland, an OECD country. |
| | Metric 3: Applicability | Low | Data are for ambient air in buildings, which is similar to the in-scope occupational scenario commercial use of construction products. |
| | Metric 4: Temporal Representativeness | High | Monitoring data were collected after the most recent PEL and no more than 10 years old. |
| | Metric 5: Sample Size | Medium | Sample distribution characterized by limited statistics (averages, ranges, maximums) but discrete samples not provided and distribution not fully characterized. |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | Medium | Exposure type and sampling data provided, but missing number of workers, exposure duration, frequency, engineering controls, and PPE. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | High | Uncertainty is addressed in a paragraph regarding measurement uncertainty. Variability is addressed by sampling many asbestos handling operations. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Obminski, A. (2020). Asbestos in building and its destruction. Construction and Building Materials 249(Elsevier):118685. |
| **HERO ID:** | 6884598 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Cutting asbestos insulation, installing insulation, removing asbestos boards and roofing, handling corrugated sheets. (7/14) |
| Exposure route: | inhalation (4/14) |
| Physical form: | dust (5/14) |
| Area sampling data: | (PCM) Concentration of respirable fibers ranged from 140-200,000 f/m3. Table 7 has more detailed results from multiple studies. (7/14) |
| Particle size characterization: | the length L > 5 mm, the diameter Ø < 3 mm, L: Ø < 3 : 1 (4/14) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | High | Sampling/analytical methodology is an approved NIOSH method. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Medium | Data are from Poland, an OECD country. |
| | Metric 3: | Applicability | High | Data are for commercial use in construction materials, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | High | Monitoring data were collected after the most recent PEL and no more than 10 years old. |
| | Metric 5: | Sample Size | Medium | Sample distribution characterized by limited statistics (averages, ranges, maximums, minimums, standard deviations) but discrete samples not provided and distribution not fully characterized. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Exposure type and sampling data provided, but missing number of workers, exposure duration, frequency, engineering controls, and PPE. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | High | Uncertainty is addressed in a paragraph regarding measurement uncertainty. Variability is addressed by sampling many asbestos handling operations. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Oehlert, G. W., Lee, R. J., Vanorden, D. (1995). STATISTICAL-ANALYSIS OF ASBESTOS FIBER COUNTS. Environmetrics 6(2):115-126. |
| **HERO ID:** | 3583209 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Physical form: | Fiber |
| Area sampling data: | Arithmetic means (Table IV)All fibers (f/cc)Commercial (28 buildings) - 0.00162Public (32 buildings) - 0.00536School (177 buildings) - 0.03991University (78 buildings) - 0.00864Fibers greater than or equal to 5 umCommercial (28 buildings) - 0.00003Public (32 buildings) - 0.00016School (177 buildings) - 0.00018University (78 buildings) - 0.00018 |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | High | Sampling or analytical methodology is an approved OSHA or NIOSH method or is well described and found to be equivalent to approved OSHA or NIOSH methods. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | The data are from the United States and are representative of the industry being evaluated. |
| | Metric 3: | Applicability | High | The data are for an occupational scenario within the scope of the risk evaluation. (Asbestos removal) |
| | Metric 4: | Temporal Representativeness | Low | Metadata on the operations, equipment, and worker activities associated with the data show that the data agree representative of outdated operations, equipment, and activities rather than current operations, equipment, and worker activities. The data were collected more than 20 years ago. |
| | Metric 5: | Sample Size | Medium | Distribution of samples is characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Monitoring data include most critical metadata, such as sample type and exposure type, but lacks additional metadata, such as sample durations, exposure durations, exposure frequency, and/orworker activities. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | The monitoring study provides only limited discussion of the variability in the determinants of exposure for the sampled site or sector. The monitoring study provides only limited discussion of the uncertainty in the exposure estimates. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Ohlson, C. G., Klaesson, B., Hogstedt, C. (1984). Mortality among asbestos-exposed workers in a railroad workshop. Scandinavian Journal of Work, Environment and Health 10(5):283-291. |
| **HERO ID:** | 3083565 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Padding steam engines with insulation material. Placing mineral wool containing asbestos around a steam boiler. The steam boilers were maintenanced every 6 years and broken up after 25 years of service. Insulation would be loosed and some asbestos torn out and spread around. After being disposed, asbestos was brushed away with long steel brushes.Passenger coaches were spray-insulated with crocidolite between 1961-1971. Heating equipment was insulated with yarns of chrysotile wound around the pipes. Same with the exhaust pipes. Dust came from dismantling old and dry asbestos. Water tanks were insulated with crocidolite. Ventilation pipes contained amosite and amosite mixed with chrysotile was used in air conditioning equipment.Punching of gaskets from sheets of asbestos, changing of break lines in electric engines, and insulating with asbestos powder in the casing and insulation of the electrical works of the engines. |
| Exposure route: | Inhalation, dermal (from dust settling) |
| Physical form: | Dust |
| Area sampling data: | Estimates of exposures were not actually calculated but scores from (0) - no asbestos exposure; (1) irregular exposure of low intensity; (2) regular, low exposure; (3) medium exposure; and (4) heavy exposure. Expected ranges for these exposures were: (1) was 0.5-1 fiber/mL; (2) was 1-5 fiber/mL; (3) was 5-10 fiber/mL; and (4) was 10-20 fiber/mL. Workers in insulating steam engines were scored a (4). Average workshop exposure was scored in 3-5 fiber/mL which falls in exposure (2). Passenger coaches were scored a (4). |
| Number of workers: | 1,650 workers in 1949. Decreased to 620 employees in 1980. A total of 5,000 men had been employed here between 1902-1980. |
| Comments: | Source is for exposure among railroad workshop workers. Asbestos exposure is from crocidolite, chrysotile, and amosite over the years. |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Low | Sampling/analytical methodology is not specified. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Medium | Data are from Sweden, an OECD country. |
| | Metric 3: | Applicability | High | Data are for industrial/commercial use of construction/metal materials. |
| | Metric 4: | Temporal Representativeness | Low | Data are greater than 20 years old. |
| | Metric 5: | Sample Size | Low | Sample distribution is characterized by no statistics. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Sample type and exposure type provided but missing exposure duration, exposure frequency, personal sampling data. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | Does not address variability or uncertainty. |

## Overall Quality Determination — Low

| | |
|---|---|
| **Study Citation:** | Okawa, M. T. (1972). Health hazard evaluation report no. HHE 72-24, Filtering Materials Corporation, Richmond, California. |
| **HERO ID:** | 3970513 |
| **Conditions of Use:** | Other: |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Fiberizer operator, fiberizer helper, die cutter, inspector, batchmaker, tail off, brander, chemist, mechanic, shipper, extractor operator |
| Exposure route: | inhalation |
| Personal sampling data: | 28 personal samples. report provides job title, sampling duration, and fibers/cc in table 1 on page 7 |
| Area sampling data: | 2 area samples in the Fiberizer area resulting in 1.29 and 0.06 fibers/cc (all results on page 7) |
| Particle size characterization: | nan |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Sampling and Analytical Methodology | High | Sampling/analytical methodology is an approved NIOSH method. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | High | Data are from the U.S. |
| | Metric 3: Applicability | Uninformative | Data are for manufacture of filter materials, which is not in-scope for the legacy asbestos risk evaluation. |
| | Metric 4: Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. (1972) |
| | Metric 5: Sample Size | High | Statistical distribution of samples is fully characterized. |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | High | Monitoring data include all associated metadata, including sample types, exposure types, sample durations, exposure durations worker activities, and exposure frequency. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | High | Uncertainty is addressed in sampling/analytical methodology. Variability addressed by samples collected near multiple workers on multiple visits to the same site. |

## Overall Quality Determination Uninformative

| | |
|---|---|
| **Study Citation:** | Olin Chemicals, (1993). Industrial hygiene survey at Olin Chemical Plant. |
| **HERO ID:** | 4158386 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | operators near the EDC, PC, and power house (page 3 and 7) |
| Area sampling data: | 11 area samples. sample collection location and result provided in table II on page 7 |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Low | Sampling/analytical methodology is not specified. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for Chemical Substances in Construction, Paint, Electrical, and Metal Products (specifically insulation), an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Monitoring data are greater than 20 years old.(1987) |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Sample type and exposure type provided but missing sample duration, worker activities, exposure duration, and exposure frequency |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | Uncertainty is addressed in sampling/analytical methodology but variability is not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Olin, (1977). Asbestos fiber in air sampling results, cell renewal room operations, with cover letter. |
| **HERO ID:** | 3653801 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Depositors, depositor helper, and utility man. (3/4) |
| Exposure route: | inhalation (3/4) |
| Physical form: | fibers (3/4) |
| Personal sampling data: | For the depositor, personal samples were 0.09 and 0.14 f/cc. For the depositor helper, samples were 0.12 and 0.14 f/cc. For the utility man, samples were 0.10 and 0.23 f/cc. (3/4) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Sampling and Analytical Methodology | High | Sampling/analytical methodology is an approved OSHA method. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | High | Data are from the U.S. |
| | Metric 3: Applicability | Low | Data may apply to the industrial use of asbestos in Electrical batteries and accumulators. |
| | Metric 4: Temporal Representativeness | Low | The data were collected before the most recent PEL establishment or update or are more than 20 years old if no PEL is established. |
| | Metric 5: Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | Medium | Exposure type and sampling data provided, but missing number of workers, exposure duration, frequency, particle size, engineering controls, and PPE. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Medium | Variability is addressed by sampling different job descriptions. Uncertainty isn't addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Olin, (1979). Environmental hygiene survey to evaluate employee exposure. |
| **HERO ID:** | 4158323 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Employees at a shooting range. Source of exposure is asbestos-containing ceiling material. (2/3) |
| Exposure route: | inhalation (2/3) |
| Physical form: | fibers (2/3) |
| Personal sampling data: | One personal sample was 0.45 f/cc. (2/3) |
| Area sampling data: | One area sample at the shooting range was 0.83 f/cc. (2/3) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Low | Sampling methodology not specified. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for commercial use in construction materials, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Exposure type and sampling data provided, but missing number of workers, exposure duration, frequency, particle size, engineering controls, and PPE. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Oliver, L. C. (1998). Asbestos in building: Management and related health effects. Journal of Clean Technology, Environmental Toxicology, and Occupational Medicine 7(4):433-443. |
| **HERO ID:** | 3092160 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | shipyard workers, insulators, sheet metal workers, pipe fitters (pg 2)Table 1: quiet fallout, dry dusting, installation of track light, cleaning books in a library, library user, removal of ceiling section; cable installation; custodians/maintenance (pg 4)asbestos abatement; sweeping and dusting, patching or removing pipe and/or boiler insulation, boiler maintenance (pg 6) |
| Exposure route: | inhalation |
| Physical form: | airborne fibers |
| Area sampling data: | Table 1, pg 4, presents "low level" asbestos exposures in buildings for different conditions/activities; results range from 0.02-17.7 f/cm3simulated computer cable installation increases average airborne asbestos levels 500-fold; 95- to 140-fold increases post-installation following routine cleaning (pg 4) |
| Number of workers: | 121 custodians; 711 lab, maintenance, and grounds personnel in a large Boston University; 226 school custodians (pg 7)457 maintenance employees in Wisconsin school system; 673 school district employees in CA; 1,117 NY and NJ insulators; 383 PA railroad workers; 314 New England sheet metal workers (pg 8) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Low | Sampling/analytical methodology is not specified. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for construction materials, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| | Metric 5: | Sample Size | Medium | Sample distribution characterized by limited statistics (assumed means) but discrete samples not provided and distribution not fully characterized. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Low | Sample type provided but no other metadata. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Low

| | |
|---|---|
| **Study Citation:** | OSHA, (1988). Occupational exposure to asbestos, tremolite, anthophyllite and actinolite: Section 2: II. Regulatory and legal authority background. |
| **HERO ID:** | 3978236 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Asbestos removalAsbestos product instillation-drilling - sawing pipe and sheetAutomotive brake repairManufacture of asbestos paperWorking with asbestos gasketsMaintenance |
| Exposure route: | inhalation |
| Physical form: | inhalable fibers |
| Personal sampling data: | short term exposure (15 minutes) : asbestos-cement pipe cutting and machining during instillation; 0.75 f/cc and 8-hr TWA exposure under 0.1 f/ccsites with small amount of cutting the 0.2 f/cc TWA can be attained without use of shrouded tools. Automotive brake repair: use of compressed air to clean brake linings would likely exceed the TWA PEL. Brushing the asbestos residue form affected parts can sometimes exceed the 1 f/cc excursion limit but still comply with the 0.2 f/cc PEL Asbestos paper manufacture: dry mechanical operations TWA 0.14 f/ccAsbestos cement sheet installation using a shrouded circular saw and drill on flat asbestos cement sheet for 40 minutes provided an exposure level of 0.1 f/cc. Additional 1979 studying using shrouded circular saw, saber and drill for under 30 minutes resulted in max exposure of 0.15 f/cc.Installation of asbestos sheet gaskets: measurement data for an average of 37 minutes provided a maximum value of 0.39 f/cc for 28 minutes.Small abatement projects measured levels over a day work ranged form 0.1 to 0.57 f/cc with a geometric mean value of 0.09 f/ccMaintenance workers 0.02-1.4 f/cc |
| Exposure duration: | Asbestos-cement pipe cutting and machining during instillation; 15 minutesAsbestos cement sheet installation 40 minutes Additional 1979 studying using shrouded circular saw, saber and drill for under 30 minutes Installation of asbestos sheet gaskets: measurement data for an average of 37 minutes Small abatement projects measured levels over a day |
| Number of workers: | 35,800 (having 8-hr TWA below 0.2 f/cc but short term exposures exceeding he excursion limit. |
| Personal protective equipment: | compliance with new limit will require use of respirators is needed for ship repair, confined spaces, nuclear power plants and building asbestos removal projects. |
| Engineering control: | shrouded tools |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Sampling and Analytical Methodology | High | OSHA study |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | US |
| Metric 3: | Applicability | High | The data are for an occupational scenario ( wide range of occupational activities) all are within the scope of the risk evaluation. |
| Metric 4: | Temporal Representativeness | Low | 1988 - prior to the most recent PEL and more than 20 years old. |
| Metric 5: | Sample Size | Low | Distribution of samples is not characterized by statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Medium | Monitoring data include sample type (e.g., personal breathing zone) and duration associated with peak exposure event, but no other metadata. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Low | The monitoring study does not address variability or uncertainty. |

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|---|---|
| **Study Citation:** | OSHA, (1988). Occupational exposure to asbestos, tremolite, anthophyllite and actinolite: Section 2: II. Regulatory and legal authority background. |
| **HERO ID:** | 3978236 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

| | | EVALUATION | |
|---|---|---|---|
| Domain | Metric | Rating | Comments |
| **Overall Quality Determination** | | **Medium** | |

| | |
|---|---|
| **Study Citation:** | Paik, N. W., Walcott, R. J., Brogan, P. A. (1983). Worker exposure to asbestos during removal of sprayed material and renovation activity in buildings containing sprayed material. American Industrial Hygiene Association Journal 44(6):428-432. |
| **HERO ID:** | 3582179 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Removal of fireproofing insulation materials on ceilings. |
| Exposure route: | inhalation |
| Physical form: | dust |
| Personal sampling data: | During removal of sprayed materials when wet: average - 2 fibers/cm^3During removal of sprayed materials when dry average - 16.4 fibers/cm^3Table 3 (PDF page 3) and Table 5 (PDF Page 5) present the distribution of airborne asbestos fiber concentrations by job titles during renovation of office buildings.Carpenter - Ranged from <0.05 to>2.0 fibers/cm^3. GM - 0.13 fibers/cm^3. 84th percentile - 0.45 fibers/cm^3. GSD - 3.46Electrician - Ranged from <0.05 to>2.0 fibers/cm^3. GM - 0.13 fibers/cm^3. 84th percentile - 0.77 fibers/cm^3. GSD - 3.23Sheet-metal worker - Ranged from <0.05 to >2.0 fibers/cm^3. GM - 0.19 fibers/cm^3. 84th percentile - 0.77 fibers/cm^3. GSD - 4.05Painter - Ranged from <0.05 to 0.3 fibers/cm^3. GM - 0.08 fibers/cm^3. 84th Percentile - 0.19. GSD - 2.38.Table 4 (PDF Page 3) and Table 6 (PDF Page 5) presents the distribution of airborne asbestos fiber concentrations by removal methods during removal of sprayed fireproofing material from office buildings.Dry - Ranged from <0.1 to 200 fibers/cm^3. GM - 16.4 fibers/cm^3. 84th percentile - 51.8 fibers/cm^3. GSD - 3.16Wet - Ranged from <0.1 to 10.0 fibers/cm^3. GM - 0.5 fibers/cm^3. 84th percentile - 1.0 fibers/cm^3. GSD - 2.0 |
| Area sampling data: | The samples characterized in the chemical concentration tab are the area samples that were taken. |
| Comments: | Source is for worker exposure to asbestos during removal of fireproofing insulation during renovations. |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | High | Sampling/analytical methodology is an approved NIOSH/OSHA method. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for commercial use of construction materials, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Monitoring data are greater than 20 years old. |
| | Metric 5: | Sample Size | Medium | Sample distribution characterized by limited statistics ([state statistics, e.g., min, max, mean]) but discrete samples not provided and distribution not fully characterized. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Sample type and exposure type provided but missing particle size, PPE, exposure durations/frequency, engineering controls. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | Variability addressed by taking multiple samples across different removal methods and worker occupations, but uncertainty is not addressed. |

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|---|---|
| **Study Citation:** | Paik, N. W., Walcott, R. J., Brogan, P. A. (1983). Worker exposure to asbestos during removal of sprayed material and renovation activity in buildings containing sprayed material. American Industrial Hygiene Association Journal 44(6):428-432. |
| **HERO ID:** | 3582179 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

| | | EVALUATION | |
|---|---|---|---|
| Domain | Metric | Rating | Comments |
| **Overall Quality Determination** | | **Medium** | |

| | |
|---|---|
| **Study Citation:** | Panahi, D., Kakooei, H., Marioryad, H., Mehrdad, R., Golhosseini, M. (2011). Evaluation of exposure to the airborne asbestos in an asbestos cement sheet manufacturing industry in Iran. Environmental Monitoring and Assessment 178(1-4):449-454. |
| **HERO ID:** | 2581637 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Provides information about the process but not specific worker activities. Can assume workers are unloading material, feeding material, mixing, molding, cutting, drilling, and loading. (page 2 of 6) |
| Exposure route: | Inhalation |
| Physical form: | fibers (page 1 of 6) |
| Personal sampling data: | 45 PBZ samples were taken. 15.5% exceeded the TLV established by the American Conference of Governmental Industrial Hygienists (ACGIH) which is 0.1 fibers/mL (f/mL).PBZ levels indicated a range from 0.2+/- 0.01 to 0.16 +/- 0.03 f/mL. Geometrical mean was 0.05 +/- 1.36 f/mL. Table 1 (page 3) provides PBZ by process:1) feeding of raw materials (7 samples). Geometric mean (GM): 0.1645 +/- 1.02 f/mL; Arithmetic mean (AM): 0.1674 +/- 0.03 f/mL; Range: 0.124-0.211; 4 samples (57.1%) exceeded 0.1 f/mL2) mixing (7 samples). GM 0.0208 +/- 1.02 f/mL; AM: 0.0211 +/- 0.01 f/mL; Range: 0.016-0.026 f/mL; 0 samples exceeded 0.1 f/mL3) molding of sheet (8 samples); GM: 0.0464 +/- 1.17 f/mL; AM: 0.0545 +/- 0.02 f/mL; Range: 0.012-0.088 f/mL; 0 samples exceeded 0.1 f/mL 4) unloading car (7 samples); GM: 0.0481 +/- 1.01 f/mL; AM: 0.0481 +/- 0.01 f/mL; Range: 0.043-0.053 f/mL; 0 samples exceeded 0.1 f/mL5) Cutting & Drilling (9 samples); GM: 0.0776 +/- 1.23 f/mL; AM: 0.0775 +/- 0.06 f/mL; Range: 0.035-0.243 f/mL; 3 samples (33.3%) exceeded 0.1 f/mL6) Sheet storage (7 samples); GM: 0.0264 +/- 1.11 f/mL; AM: 0.0264 +/- 0.01 f/mL; Range: 0.014-0.051 f/mL; 0 samples exceeded 0.1 f/mL7) Total (45 samples); GM: 0.0522 +/- 1.36 f/mL; AM: 0.0708 +/- 0.05 f/mL; Range: 0.012-0.243 f/mL; 7 samples (15.5%) exceeded 0.1 f/mL |
| Particle size characterization: | Diameter of chrysotile fibers: 0.2-0.5 umDiameter of amphibole fibers: 0.7-1.0 um (page 5 of 6) |
| Exposure duration: | Samples taken for 60 minutes. (page 3 of 6) |
| Number of workers: | Cites a source from 2000 (Goldberg et al), that about 20-40% of all adult persons held a job that could entail some occupational exposure to asbestos. (page 2 of 6)At the specific factory in Iran that was sampled, there were 120 workers. Mean age was 41 years old (range: 29-56 years). Mean employment was 15 years (range: 7-17 years). (page 2 of 6) |
| Comments: | Analyzed by NIOSH method 7400. |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | High | Sampling/analytical methodology is an approved NIOSH method. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Low | Data are from Iran, a non-OECD country. |
| | Metric 3: | Applicability | High | Data are for industrial use of asbestos in cement manufacturing. |
| | Metric 4: | Temporal Representativeness | Medium | Data and sources of information are greater than 10 years old but not more than 20 years old. |
| | Metric 5: | Sample Size | Medium | Sample distribution characterized by limited statistics (range, means, standard deviations) but discrete samples not provided. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Monitoring data include sample duration, type of sample, worker activity/process description but lacks exposure frequency. |

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|---|---|
| **Study Citation:** | Panahi, D., Kakooei, H., Marioryad, H., Mehrdad, R., Golhosseini, M. (2011). Evaluation of exposure to the airborne asbestos in an asbestos cement sheet manufacturing industry in Iran. Environmental Monitoring and Assessment 178(1-4):449-454. |
| **HERO ID:** | 2581637 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

| | | **EVALUATION** | |
|---|---|---|---|
| Domain | Metric | Rating | Comments |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Medium | Addresses variability by sampling at different steps of the process, Does not address uncertainty. |

## Overall Quality Determination — Medium

| | |
|---|---|
| **Study Citation:** | Park, D. (2008). Trends in occupational asbestos exposure and asbestos consumption over recent decades in Korea (vol 14, pg 18, 2008). International Journal of Occupational and Environmental Health 14(2):93-93. |
| **HERO ID:** | 3581867 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Ship operation and heavy machine manufacturing. (6/8) |
| Physical form: | fibers (4/8) |
| Personal sampling data: | (PCM) In ship-repair operations for removing asbestos, asbestos exposure concentrations were reported to range from 0.01 to 4.00 f/cc (5/8) For heavy machine manufacturing, occupational health journals report concentrations of 0.01-11.4 f/cc. (Table 2, pg. 6/8) |
| Area sampling data: | (PCM) Average asbestos exposure levels from 1995 to 2006 ranged from 0.02-0.92 f/cc. (4/8) In the secondary asbestos industry, mean concentrations were 0.05+-0.22 f/cc with a range of 0.001-3.29 f/cc. (Table 1, pg. 5/8) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Sampling and Analytical Methodology | High | Sampling/analytical methodology is an approved NIOSH method. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | Medium | Data are from Korea, an OECD country. |
| | Metric 3: Applicability | High | Data are for industrial use in construction materials, an in-scope occupational scenario. |
| | Metric 4: Temporal Representativeness | Medium | Monitoring data is from both before and after the PEL. |
| | Metric 5: Sample Size | Medium | Sample distribution characterized by limited statistics (means, standard deviations, ranges) but discrete samples not provided and distribution not fully characterized. |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | Medium | Exposure type and sampling data provided, but missing number of workers, exposure duration, frequency, PPE, engineering controls, and particle size. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | High | Uncertainty is addressed in sampling/analytical methodology. Variability is addressed by comparing data to literature and taking surveys. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Park, D., Choi, S., Ryu, K., Park, J., Paik, N. (2008). Trends in occupational asbestos exposure and asbestos consumption over recent decades in Korea. International Journal of Occupational and Environmental Health 14(1):18-24. |
| **HERO ID:** | 3079461 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Exposure route: | inhalation (3/8) |
| Physical form: | fibers (5/8) |
| Personal sampling data: | Table 1 shows exposures by industry type. In secondary asbestos industries, mean exposures were 0.05+-0.22 f/cc with a range of 0.001-3.29 f/cc. In ship operation, mean exposures were 0.13+-0.31 f/cc with a range of 0.001-2.68 f/cc. (5/8) |
| Area sampling data: | (PCM) Table 2 shows more exposure data from journals. For secondary asbestos industries, concentrations ranged from 0.01-11.4 f/cc. (6/8) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Sampling and Analytical Methodology | High | Sampling/analytical methodology is an approved NIOSH method. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | Medium | Data are from Korea, an OECD country. |
| Metric 3: | Applicability | High | Data are for industrial use in construction materials, an in-scope occupational scenario. |
| Metric 4: | Temporal Representativeness | Medium | Monitoring data were collected after the most recent PEL and greater than 10 years old. |
| Metric 5: | Sample Size | Medium | Sample distribution characterized by limited statistics (means, standard deviations, ranges) but discrete samples not provided and distribution not fully characterized. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Medium | Exposure type and sampling data provided, but missing worker activity, number of workers, exposure duration and frequency, particle size, engineering controls and PPE. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | High | Uncertainty is addressed in sampling/analytical methodology. Variability is addressed by comparing exposure levels between time periods and industries. |

## Overall Quality Determination — High

| | |
|---|---|
| **Study Citation:** | Parrish, R. G., Hartle, R., Groth, D. (1985). Health hazard evaluation report no. HETA 83-044-1596, General Lectric Plant, Evendale, Ohio. |
| **HERO ID:** | 3970521 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | The electricians moved the insulation material with their hands or shovels when packing it around the engine parts. [PDF Pg. 5]Plumbers and pipe fitters, air conditioning repair and maintenance workers, office workers, millwrights, sheet metal workers, maintenance workers, masons and carpenters, machinists. [PDF Pg. 11] |
| Exposure route: | Inhalation |
| Physical form: | Dust (solid) [PDF Pg. 5] |
| Area sampling data: | Although no asbestos was detected in the settled dust samples. this does not rule out the historical use of asbestos in the heat treatment process. [PDF Pg. 10] |
| Number of workers: | 30 to 35 electricians have worked on the process. [PDF Pg. 5] |
| Comments: | Settled dust samples were collected from relatively inaccesible locations at all areas within the facility where the heat treatment process had been located. These samples were analyzed for asbestos by polarized light microscopy and dispersion staining techniques in hopes of gaining information on fiber types and size. Samples of the current materials were also obtained and analyzed for asbestos. [PDF Pg. 5] |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | High | Sampling/analytical methodology is an approved NIOSH/OSHA]method. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for Chemical Substances in Construction, Paint, Electrical, and Metal Products, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Monitoring data are greater than 20 years old. |
| | Metric 5: | Sample Size | Low | Sample distribution is characterized by no statistics. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Sample type and exposure type provided but missing exposure duration and frequency. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | Uncertainty is addressed in sampling/analytical methodology but variability is not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Paustenbach, D. J., Sage, A., Bono, M., Mowat, F. (2004). Occupational exposure to airborne asbestos from coatings, mastics, and adhesives. Journal of Exposure Analysis and Environmental Epidemiology 14(3):234-244. |
| **HERO ID:** | 3531298 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | (1) product application, (2) spill cleanup, (3) product sanding, (4) product removal, and (5) post-removal sweep cleaning of a work area (p. 3)More information provided in Table 2:Sanding: The surface of a board covered with a fully dried coat of each test product was sanded by hand (using first a coarse, 60-grit sandpaper and then a finer, 120-grit sandpaper).Removal: Styrofoam boardscoated with fully dried test product were cut into narrow strips (0.25– 1.5 in wide) using a utility knife, fine-toothed saw, and wallboard saw. The cut pieces were removed by hand or by scraping with a putty knife.Sweep cleaning: A hand-held bench brush was used to remove debris-coated with test product (remaining from the removal test) and from the table on which the testing had been performed. A broom and dustpan were used to clean the debris from the floor of the testing area. All debris was placed in a garbage can. |
| Personal sampling data: | Personal (n = 172) air samplesSanding: 0.04 f/ml (1 h) (Table 6)Worst case 8-hour calculated TWA is 0.03 fibers/ml (p. 9)Results of air sampling conducted during typical work simulations involving asbestos-containing outdoor weatherproofing coatings manufactured by Mobil Oil indicated that airborne asbestos fiber concentrations ranged from 0.024 to 0.088 structures/cm3 during application, and o0.01 structures/ml during removal (Mobil Oil Corporation, 1992) (p. 10)Studies conducted by the National Roofing Contractors Association(NRCA) (1994) indicate that removal of asbestos-containingroof flashings and associated mastics, coatings, and cementsalso yielded low asbestos fiber concentrations, ranging from0.004 to 0.027 fibers/cm3 (p. 10)Lange and Thomulka (2000a) reported exposure concentrations during an asbestos abatement project conducted in 1997 involving a 20-day removal of floor tiles and mastic (asbestos concentrations ranging from 3 to 7%) in a three-story dormitory building. These authors calculated 8-h TWAs ranging from o0.01 to 0.021 fibers/ml based on personal samples of airborne asbestos taken during removal of floor tile and mastic. (p. 10) |
| Area sampling data: | area (n = 280) air samplesSanding: 0.005 - 0.008 (1 h) f/mlSweeping: 0.003 f/ml (1 h) (Table 6) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | High | Sampling or analytical methodology is an approved OSHA or NIOSH method or is well described and found to be equivalent to approved OSHA or NIOSH methods. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | The data are from the United States and are representative of the industry being evaluated. |
| | Metric 3: | Applicability | High | The data are for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Medium | Operations, equipment, and worker activities are expected to be reasonably representative of current conditions. The monitoring data were collected after the most recent PEL update but are more than 10 years old. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | Monitoring data include all associated metadata, including sample types, exposure types, sample durations, exposure durations worker activities, and exposure frequency. |
| Domain 4: Variability and Uncertainty | | | | |

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| | |
|---|---|
| **Study Citation:** | Paustenbach, D. J., Sage, A., Bono, M., Mowat, F. (2004). Occupational exposure to airborne asbestos from coatings, mastics, and adhesives. Journal of Exposure Analysis and Environmental Epidemiology 14(3):234-244. |
| **HERO ID:** | 3531298 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

| | | **EVALUATION** | |
|---|---|---|---|
| Domain | Metric | Rating | Comments |
| | Metric 7: Metadata Completeness | High | The monitoring study addresses variability in the determinants of exposure for the sampled site or sector. The monitoring study addresses uncertainty in the exposure estimates or uncertainty canbe determined from the sampling and analytical method. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Perkins, R. A., Hargesheimer, J., Fourie, W. (2007). Asbestos release from whole-building demolition of buildings with asbestos-containing material. Journal of Occupational and Environmental Hygiene 4(12):889-894. |
| **HERO ID:** | 1079550 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | whole-building demolitions |
| Physical form: | Fiber |
| Personal sampling data: | Breathing zone of worker- 0.043-0.045 f/ccCovering loaded trucks - 0.087-0.141 f/cc (P. 5/7) |
| Area sampling data: | Building ANear adjacent building 0.032 f/cc (PCM), <0.0039 s/cc (TEM)Adjoining building roof 0.012 f/cc (PCM), <0.0039 s/cc (TEM)Adjacent building 0.026 f/cc (PCM), <0.009 s/cc (TEM) (P. 5/7) |
| Exposure duration: | 6-hr working day |
| Comments: | TABLE III. Comparison of PCM and TEM Results in Building ATABLE IV. Air Monitoring Results for Block B |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Sampling and Analytical Methodology | High | Sampling or analytical methodology is an approved OSHA or NIOSH method. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | The data are from the United States. |
| Metric 3: | Applicability | High | The data are for an occupational scenario within the scope of the risk evaluation. |
| Metric 4: | Temporal Representativeness | Medium | More than 10 years but, no more than 20 years old. |
| Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | High | Monitoring data include all associated metadata. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Medium | The monitoring study provides only limited discussion of the variability in the determinants of exposure for the sampled site or sector. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Perkins, R. A., Hargesheimer, J., Vaara, L. (2008). Evaluation of public and worker exposure due to naturally occurring asbestos in gravel discovered during a road construction project. Journal of Occupational and Environmental Hygiene 5(9):609-616. |
| **HERO ID:** | 2564341 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | The D10 bulldozer daily operation generally consisted of four phases: (1) start-up, (2) ripping, (3) pushing material, and (4) shutdown, which included cleaning the tracks. The backhoe picked up the gravel to be removed from MS 105 and loaded it into trucks.The backhoe daily operation consisted of two different work phases: (1) start-up, and (2) loading. |
| Exposure route: | inhalation |
| Physical form: | inhalable fibers |
| Personal sampling data: | Grader operator highest: 0.594 f/cc samples over 0.1: mean 0.276 f/cc SD 0.218 f/cc samples over LOD: mean 0.051 f/cc SD 0.081 f/ccWater truck driver highest: 0.186 f/cc samples over 0.1: mean 0.157 f/cc SD 0.034 f/cc samples over LOD: mean 0.037 f/cc SD 0.040 f/ccCulvert crew highest: 0.167 f/cc samples over 0.1: mean 0.167 f/cc samples over LOD: mean 0.031 f/cc SD 0.026 f/ccBelly dump operator highest: 0.131 f/cc samples over 0.1: mean 0.12 f/cc SD 0.013 f/cc samples over LOD: mean 0.037 f/cc SD 0.036 f/cc Grade checker highest: 0.18 (ST) f/cc samples over 0.1: mean 0.136f/cc SD 0.038 f/cc samples over LOD: mean 0.056 f/cc SD 0.043 f/ccDOT inspectors highest: 0.37 (ST) 0.15 (TWA) f/cc samples over 0.1: mean 0.26 f/cc SD 0.155 f/cc samples over LOD: mean 0.0385 f/cc SD 0.010 f/ccLab technicians and engineers highest: 0.037 samples over 0.1: NA samples over LOD: mean 0.025 f/cc SD 0.01 f/ccFlaggers highest: 0.036 samples over 0.1: NA samples over LOD: mean 0.20 f/cc SD 0.0085 f/ccPilot car drivers highest: 0.039 samples over 0.1: NA samples over LOD: mean0.020 f/cc SD 0.010 f/ccRoad roller operators highest: 0.089 (ST) samples over 0.1: NA samples over LOD: mean 0.027 f/cc SD 0.017 f/ccSurvey crew highest: 0.055 f/cc samples over 0.1: NA samples over LOD: mean 0.030 f/cc SD 0.14 f/ccMiscellaneous equipment operators highest: 0.071f/cc samples over 0.1: NA samples over LOD: mean 0.027 f/cc SD 0.014 f/ccMiscellaneous teamsters highest: 0.049 f/cc samples over 0.1: NA samples over LOD: mean 0.024 f/cc SD 0.0185 f/ccRoad workersTWA (Average sampling time was 4.1 hr, with SD of 1.2 hr)Above LOD, below 0.1 f/cc mean: 0.028 f/cc SD: 0.016 f/ccAbove 0.1 f/cc mean: 0.18 f/cc 0.12 f/cc SD: 0.594 f/ccST (Average sampling time was 39.5 m, with SD of 17 m)Above LOD, below 0.1 f/cc mean: 0.07 f/cc SD: 0.03 f/ccAbove 0.1 f/cc mean: 0.18 f/cc 0.08 f/cc SD: 0.369 f/ccD-10 BulldozerStart-up PCM 0.189 f/cc (NIOSH 7400) TEM 0.104 f/cc (NIOSH 7402) Break ground PCM 0.13 f/cc (NIOSH 7400) TEM 0.101 f/cc (NIOSH 7402) Push gravel PCM 0.011 f/cc (NIOSH 7400)Shutdown PCM <0.272 f/cc (NIOSH 7400) TEM <0.089 f/cc (NIOSH 7402) BackhoeStart-up PCM <0.082 f/cc (NIOSH 7400)Loading PCM <0.072 f/cc (NIOSH 7400)Motorists with Windows Open in Dusty ConditionsMotorists highest 0.134 (ST) Samples over 0.1 f/cc Mean 0.131 f/cc SD 0.004 f/cc Samples over LOD: mean 0.049 f/cc SD 0.016 f/cc |
| Area sampling data: | Workers in Location of Highest Area Air Monitoring SamplesAll workers, highest: 0.071 Samples over 0.1 f/cc NA Samples over LOD Mean: 0.033 f/cc SD: 0.021 f/ccD-10 BulldozerStart-up, area sample in cab 0.204 f/cc (NIOSH 7400) 0.101 f/cc (NIOSH 7402) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Sampling and Analytical Methodology | High | NIOSH method 7400 & 7402 |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | US |
| Metric 3: | Applicability | High | The data are for an occupational scenario (road construction) within the scope of the risk evaluation. |
| Metric 4: | Temporal Representativeness | Medium | Published in 2008 from sampling performed in 2000, which was after the PEL (1994) but more than 20 years old. |
| Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized including a summary of samples below LOD, TWA values, Short term mean, SD and highest value. |

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| | |
|---|---|
| **Study Citation:** | Perkins, R. A., Hargesheimer, J., Vaara, L. (2008). Evaluation of public and worker exposure due to naturally occurring asbestos in gravel discovered during a road construction project. Journal of Occupational and Environmental Hygiene 5(9):609-616. |
| **HERO ID:** | 2564341 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

| | | EVALUATION | |
|---|---|---|---|
| Domain | Metric | Rating | Comments |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Medium | Monitoring data include most critical metadata, such as sample type, exposure type, sample durations, and worker activities, but lacks additional metadata, such as exposure duration and exposure frequency. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | High | The monitoring study addresses variability in the determinants of exposure for the sampled site or sector by including SD values and highest value. As the monitoring study used NIOSH methods which it is assumed considered uncertainty in the exposure estimates. |

## Overall Quality Determination — High

| | |
|---|---|
| **Study Citation:** | Peters, S., Vermeulen, R., Portengen, L., Olsson, A., Kendzia, B., Vincent, R., Savary, B., Lavoué, J., Cavallo, D., Cattaneo, A., Mirabelli, D., Plato, N., Fevotte, J., Pesch, B., Brüning, T., Straif, K., Kromhout, H. (2016). SYN-JEM: A Quantitative Job-Exposure Matrix for Five Lung Carcinogens. Annals of Occupational Hygiene 60(7):795-811. |
| **HERO ID:** | 3531308 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | HVAC technicians, building insulator, ship joiner, chemistry technician, and metal shipwright (9/17) |
| Exposure route: | inhalation (13/17) |
| Physical form: | fibers (9/17) |
| Area sampling data: | (PCM) In 2000, mean exposure for HVAC technicians was 0.029 f/mL, building insulators was 0.016 f/mL, ship joiner was 0.016 f/mL, chemistry technician was 0.012 f/mL, and metal shipwright was 0.012 f/mL. Mean exposure for low exposed jobs was 0.004 f/mL and for high exposure jobs was 0.005 f/mL. (9/17) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | High | Sampling/analytical methodology is equivalent to an approved [OSHA/NIOSH] method. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Medium | Data are for many different countries, all of which are OECD countries. |
| | Metric 3: | Applicability | High | The data are for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Low | The data were collected before the most recent PEL establishment or update or are more than 20 years old if no PEL is established. |
| | Metric 5: | Sample Size | Medium | Sample distribution characterized by limited statistics (means, ratios, confidence intervals) but discrete samples not provided and distribution not fully characterized. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Exposure type and sampling data provided, but missing number of workers, exposure duration, frequency, engineering controls, PPE, and particle size. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | High | Uncertainty is addressed in sampling/analytical methodology. Variability is addressed by compiling data from over 40 years. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Peters, S., Vermeulen, R., Portengen, L., Olsson, A., Kendzia, B., Vincent, R., Savary, B., Lavoué, J., Cavallo, D., Cattaneo, A., Mirabelli, D., Plato, N., Fevotte, J., Pesch, B., Brüning, T., Straif, K., Kromhout, H. (2016). SYN-JEM: A Quantitative Job-Exposure Matrix for Five Lung Carcinogens. Annals of Occupational Hygiene 60(7):795-811. |
| **HERO ID:** | 3531308 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Furnishing, Cleaning, Treatment Care Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Spinner, threader, loom threader (9/17) |
| Exposure route: | inhalation (13/17) |
| Physical form: | fibers (9/17) |
| Area sampling data: | (PCM) In 1980, mean exposure for spinners and threaders was 0.407 f/mL, and loom threaders was 0.229 f/mL. Mean exposure for low exposed jobs was 0.061 f/mL and for high exposure jobs was 0.074 f/mL.(9/17) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | High | Sampling/analytical methodology is equivalent to an approved [OSHA/NIOSH] method. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Medium | Data are for many different countries, all of which are OECD countries. |
| | Metric 3: | Applicability | High | Data are for commercial use in furnishing, cleaning, and treatment products, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | The data were collected before the most recent PEL establishment or update or are more than 20 years old if no PEL is established. |
| | Metric 5: | Sample Size | Medium | Sample distribution characterized by limited statistics (means, ratios, confidence intervals) but discrete samples not provided and distribution not fully characterized. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Exposure type and sampling data provided, but missing number of workers, exposure duration, frequency, engineering controls, PPE, and particle size. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | High | Uncertainty is addressed in sampling/analytical methodology. Variability is addressed by compiling data from over 40 years. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Phanprasit, W., Sujirarat, D., Musigapong, P., Sripaiboonkij, P., Chaikittiporn, C. (2012). Asbestos Exposure among Mitering Workers. Safety and Health at Work 3(3):235-240. |
| **HERO ID:** | 3531313 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Workers involved in roof-tile mitering using high-speed motor saw with fiber blade and a hand saw (pg 236) |
| Exposure route: | inhalation |
| Physical form: | fibers |
| Personal sampling data: | The fiber concentration levels of all personal samples taken for 30 minutes from a high-speed motor saw exceeded the OSHA 30 minutes excursion standard of 1 fibers/cc, with the median of 4.11 fibers/cc and the range in between 1.33-12.41 fibers/cc. During the tests using hand saws, only one sample was over the excursion standard, showing the median of 0.13 fibers/cc and the range of 0.01-5.00 fibers/cc (pg 237-238). Had the test been carried out for eight hours continuously, for example, the fiber concentration levels from the use of a high-speed motor saw could be as high as 4.11 fibers/cc for personal samples, far exceeding the time-weighted average standard of 0.1 fibers/cc (pg 238) |
| Area sampling data: | All area samples from the 2 cutting tools showed a median of 0.59 fibers/cc with the range of 0.14-3.32 fibers/cc (pg 238). Had the test been carried out for eight hours continuously, for example, the fiber concentration levels from the use of a high-speed motor saw could be as high as 0.59 fibers/cc for area samples, far exceeding the time-weighted average standard of 0.1 fibers/cc (pg 238) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Sampling and Analytical Methodology | High | Methodology is an approved NIOSH method. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | Low | The data are from a non-OECD country. |
| Metric 3: | Applicability | High | The data are for an occupational scenario within the scope of the risk evaluation. |
| Metric 4: | Temporal Representativeness | Medium | The data are more than 10 years but generally, no more than 20 years old. |
| Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Medium | Monitoring data include most critical metadata, such as sample type and exposure type, but lacks additional metadata, such as sample durations, exposure durations and exposure frequency. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Medium | Variability is addressed by including personal and area samples but uncertainty is not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Phanprasit, W., Sujirarat, D., Musigapong, P., Sripaiboonkij, P., Chaikittiporn, C. (2012). Asbestos Exposure among Mitering Workers. Safety and Health at Work 3(3):235-240. |
| **HERO ID:** | 3531313 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Workers in AC roof tile factories and workers removing asbestosroof-tile. |
| Area sampling data: | Recent studies in four AC roof tile factories in Thailand [9]and one in India [10] indicated that the average fiber concentration levels in these two studies were relatively low at 0.078 (0.19) fibers/cc and 0.04-0.07 fibers/cc respectively, while the asbestos roof-tile removal generated 0.1-0.4 fibers/cc approximately [11]. |

**EVALUATION**

| Domain | | Metric | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Low | Sampling or analytical methodology is not specified. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Low | The data are from a non-OECD country. |
| | Metric 3: | Applicability | High | The data are for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Medium | The data are more than 10 years but generally, no more than 20 years old. |
| | Metric 5: | Sample Size | Low | Distribution of samples is qualitative or characterized by no statistics. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Monitoring data include most critical metadata, such as sample type and exposure type, but lacks additional metadata, such as sample durations, exposure durations, exposure frequency, and/orworker activities. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | The monitoring study does not address variability or uncertainty. |

## Overall Quality Determination Low

| | |
|---|---|
| **Study Citation:** | Phelka, A. D., Finley, B. L. (2012). Potential health hazards associated with exposures to asbestos-containing drywall accessory products: A state-of-the-science assessment. Critical Reviews in Toxicology 42(1):1-27. |
| **HERO ID:** | 2569844 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | [PDF Pg. 16-17]Mixing, application, sanding, and cleanup of joint compounds. |
| Personal sampling data: | [PDF Pg. 16-17] (Results were summarized here)Drill mixing: 1.2-21.1 (f/cm^3)Hand Mixing: 0.6-138.8 (f/cm^3)Mixing: 0.91-59 (f/cm^3)Application: 0.1-1.6 (f/cm^3)Sanding: 0.4-44.7 (f/cm^3)Pole Sanding: 0.3-19.3 (f/cm^3)Hand Sanding: 13-24.2 (f/cm^3)Sweep Floor: 1.4-41.4 (f/cm^3)Wipe Drywall/Sweep Floor: 1.05-3.4 (f/cm^3)Sanding and Cleanup: 0.038-0.19 (f/cm^3) |
| Area sampling data: | [PDF Pg. 16-17] (Results were summarized here)Drill Mixing: 1.2 (f/cm^3)Hand Mixing: 0.07-138.8 (f/cm^3)Mixing: 0.7-2.7 (f/cm^3)Application: 0.05-0.13 (f/cm^3)Sanding: 0.08-45.3 (f/cm^3)Touch Sanding: 0.4-0.6 (f/cm^3)Hand Sanding: 0.3-1.8 (f/cm^3)Wipe Drywall/Sweep Floor: 0.10-1.4 (f/cm^3Sanding and Cleanup: 0.04-0.27 (f/cm^3) |
| Comments: | PCM method used. |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | High | Sampling/analytical methodology is equivalent to an approved OSHA/NIOSH method. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for Chemical Substances in Construction, Paint, Electrical, and Metal Products, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | High | Monitoring data were collected after the most recent PEL and no more than 10 years old. (2012) |
| | Metric 5: | Sample Size | Medium | Sample distribution characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Sample type and exposure type provided but missing exposure duration and frequency. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | High | Uncertainty is addressed in sampling/analytical methodology. Variability addressed by sampling multiple work activities. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Piacitelli, L. (1983). Health hazard evaluation report no. HETA 83-106-1311, West Virginia Geological and Economic Survey, Morgantown, West Virginia. |
| **HERO ID:** | 3970500 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Area sampling data: | One air sample collected in the boiler room was 0. 14 fibers/cc. [PDF Pg. 5] |
| Comments: | Six air samples were collected on 37 mm AA cellulose filters in open face cassettes using sampling pumps calibrated at l CFM. The samples were counted per NIOSH analytical method, P&CAM 239 . (1) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | High | Sampling/analytical methodology is an approved NIOSH/OSHA method. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for Chemical Substances in Construction, Paint, Electrical, and Metal Products, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Monitoring data are greater than 20 years old. |
| | Metric 5: | Sample Size | Low | Sample distribution is characterized by no statistics. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Low | Sample type provided but no other metadata. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | The monitoring study does not address variability or uncertainty. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Pierce, J. S., Jiang, G. C. T., Finley, B. L. (2008). A state of the science review of the potential health hazards associated with asbestos in shielded metal arc welding rods in the United States. Toxicological and Environmental Chemistry 90(5):917-956. |
| **HERO ID:** | 6915862 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Exposure route: | inhalation (pg 24) |
| Physical form: | fibers (pg 24) |
| Personal sampling data: | personal asbestos exposures during welding operations ranged from 2.2 to 5.0 f/cc (pg 26)In an additional unpublished investigation, 34 samples were collected during the following activities: background, handling welding rods, welding with four types of asbestos-containing electrodes, and the broom sweeping of dust and debris following welding operations. Using TEM, no asbestos fibers were detected in any of the personal or area samples (Millette 1994a, 1994b). (pg 26) |
| Area sampling data: | In addition, ‘‘worst-case’’ use simulation studies, specifically intended to generate airborne flux particles, reported that airborne asbestos concentrations were either undetectable or very low. The airborne concentrations generated were always below the current OSHA permissible exposure limit (0.1 f/cc TWA) (pg 2)Dust concentrations near the welding activities with coated electrodes ranged from 0.36 to 27.6 millions of particles per cubic foot (mppcf) (pg 8)background levels before and after welding operations ranged from 0.2 to 0.4 f/cc (pg 26) |
| Particle size characterization: | The vast majority of the chrysotile fibers (>98%) contained in the cationic fiber were reportedly <5 mm in length, with an average fiber length of 2.5 mm (pg 11) |
| Exposure duration: | 10 and 16 min sampling durations (pg 25); 26 min sample and 2 120 min samples (pg 26) |
| Number of workers: | By the early 1940s, there were over 100,000 workers employed in the United States as welders and burners, and by the middle of that decade this figure more than tripled (Dreessen et al. 1947). In 2005, the American Welding Society reported that in 2005 there were nearly 576,000 welders employed in the United States (pg 3)455 electric welders (pg 10)632 insulation workers (pg 11)various number of workers data in Tables II and III (pg 17-21) |
| Comments: | contains number of workers data (pg 9) for textile MFG, which is out of scope (upstream of use)NIOSH Physical and Chemical Analytical Method 239 (P&CAM 239) (pg 26) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Sampling and Analytical Methodology | High | Sampling/analytical methodology is an approved NIOSH/OSHA method. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | High | Data are from the U.S. |
| | Metric 3: Applicability | High | Data are for welding/building materials, an in-scope occupational scenario. |
| | Metric 4: Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| | Metric 5: Sample Size | Medium | Sample distribution characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | Medium | Sample type and exposure type provided but missing metadata such as exposure frequency. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Medium | Variability addressed by providing sampling data for different sites/time periods but uncertainty is not addressed. |

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| | |
|---|---|
| **Study Citation:** | Pierce, J. S., Jiang, G. C. T., Finley, B. L. (2008). A state of the science review of the potential health hazards associated with asbestos in shielded metal arc welding rods in the United States. Toxicological and Environmental Chemistry 90(5):917-956. |
| **HERO ID:** | 6915862 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

| | | **EVALUATION** | |
|---|---|---|---|
| Domain | Metric | Rating | Comments |
| **Overall Quality Determination** | | **Medium** | |

| | |
|---|---|
| **Study Citation:** | Pinchin, D. (2004). Potential hazards and liabilities of asbestos in vermiculite insulation: Warnings for the homeowner, building manager, contractor and real estate industry. Environmental Science & Engineering 16(6):28-30. |
| **HERO ID:** | 6901721 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Insulation installers and removers (3/3) |
| Physical form: | Lightweight, silvery grey or blonde granular layered material. (1/3) |
| Area sampling data: | Installation of attic insulation resulted in 10-28 f/cc (optical microscope). Removal of vermiculite insulation without precautions resulted in 3-174 f/cc (optical/electron microscope). (3/3) |
| Particle size characterization: | Vermiculite insulation has particle sizes of 2-10 mm. (2/3) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Low | Sampling methodology not specified. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Medium | Data are from Canada, an OECD country. |
| | Metric 3: | Applicability | High | Data are for commercial use in construction materials, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Medium | Monitoring data were collected after the most recent PEL and greater than 10 years old. |
| | Metric 5: | Sample Size | Medium | Sample distribution characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Exposure type and sampling data provided, but missing number of workers, exposure duration and frequency, engineering controls, and PPE. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | Variability is addressed by sampling different insulation handling activities with different microscopes. Uncertainty isn't addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Pira, E., Donato, F., Maida, L., Discalzi, G. (2018). Exposure to asbestos: past, present and future. Journal of Thoracic Disease 10(S2):S237-S245. |
| **HERO ID:** | 6859559 |
| **Conditions of Use:** | Consumer Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Physical form: | airborne dust (3/9) |
| Area sampling data: | In buildings with friable asbestos, concentrations are usually less than 1000 F/m3, but in some cases reach 10,000 F/m3. (7/9) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Low | Sampling methodology is not specified. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Medium | Data are from Italy, an OECD country. |
| | Metric 3: | Applicability | Low | Data are for general population exposure in buildings, which isn't in scope, but may be similar to industrial/commercial use in construction and building materials. |
| | Metric 4: | Temporal Representativeness | High | Report is less than 10 years old. |
| | Metric 5: | Sample Size | Medium | Sample distribution characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Low | Monitoring data include sample type (e.g., personal breathing zone) but no other metadata. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | The monitoring study does not address variability or uncertainty. |

## Overall Quality Determination — Low

| | |
|---|---|
| **Study Citation:** | Prentice, J., Gonsalves, B. (1985). REPRODUCIBILITY OF DUST DISTURBANCE TECHNIQUES DURING CLEARANCE SAMPLING AFTER ASBESTOS REMOVAL. Annals of Occupational Hygiene 29(3):435-437. |
| **HERO ID:** | 3581622 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Clearance sampling was performed on five separate occasions in a small area contaminated by amosite. Surfaces that harbor dust were struck with a clipboard to simulate future work in the area. |
| Exposure route: | inhalation |
| Physical form: | Dust |
| Area sampling data: | Table 1 (PDF Page 3) provides the calculated fibers/mL0.09 +/- 0.020.10 +/- 0.030.11 +/- 0.030.10 +/- 0.020.10 +/- 0.02 |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Medium | Sampling/analytical methodology is not an approved OSHA/NIOSH method but is an acceptable methodology. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Medium | Data are from the UK, an OECD country. |
| | Metric 3: | Applicability | Medium | Data are for simulated renovations of a building, which is similar to the an in-scope scenario. |
| | Metric 4: | Temporal Representativeness | Low | Monitoring data are greater than 20 years old. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Sample type and exposure type provided but missing personal breathing zone data, particle size, exposure duration/frequency PPE, engineering controls. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | The monitoring report addresses uncertainty by taking five separate measurements, but variability is not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Price, B., Crump, K. S., Baird, E. C., III (1992). Airborne asbestos levels in buildings - Maintenance worker and occupant exposures. Journal of Exposure Analysis and Environmental Epidemiology 2(3):357-374. |
| **HERO ID:** | 3581626 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Maintenance activities [PDF Pg. 2]Repair or maintenance of boilers, air handling units, heat exchangers, and tanks; repair or replacement of pipe insulation including some removal of ACM; valve or gasket replacement; installation of connections or extensions for telecommunications and computer networks or other electrical systems; adjustment and repair of HV AC systems; repair or replacement of lighting fixtures; and replacement of ceiling tiles. |
| Exposure route: | Inhalation. |
| Area sampling data: | Air monitoring data for small scale, short duration activities (Summary, additional information can be found on PDF Pg. 5-8) (given in min, max, average; f/cc)Utility Spaces (840 observations): 0.001, 21.4, 0.051Above Ceilings (139 observations): 0.002, 0.433, 0.037Other (229 observations): 0.001, 2.97, 0.027NYNEX(19 observations): 0.004, 0.017, 0.009 |
| Exposure duration: | Potential Exposure Hours Per Year25th percentile: 10.750th percentile: 27.375th percentile: 64.490th percentile: 332 |
| Engineering control: | Glovebags were used in 62% of all jobs and 81 % of jobs in utility area. Amended water was used in over 60% of the jobs: HEPA vacuums were used in 64% of the jobs. Negative air pressure was rarely used. Enclosures were used in a small number of jobs. [PDF PG. 4] |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Medium | Sampling/analytical methodology is equivalent to an approved OSHA/NIOSH method. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for construction, paint, electrical, and metal products, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Monitoring data are greater than 20 years old. |
| | Metric 5: | Sample Size | Medium | Sample distribution characterized by limited statistics min, max, mean) but discrete samples not provided and distribution not fully characterized. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | All metadata provided. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | High | Uncertainty is addressed in sampling/analytical methodology. Variability addressed by sampling multiple areas of work. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Price, B., Ware, A. (2007). Mesothelioma: Risk apportionment among asbestos exposure sources (vol 25, pg 937, 2005). Risk Analysis 27(3):787-787. |
| **HERO ID:** | 3582367 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Installation, maintenance, and repair of asbestos-containing products, notably insulation and other construction materials. (1/7) |
| Physical form: | fiber (5/7) |
| Personal sampling data: | Average annual 8-hour daily exposure was estimated at 0.85 f/cc for home repair and remodeling, and 1.72 f/cc for insulation repair and replacement. (5/7) |
| Exposure duration: | 8 hours/day (5/7) |
| Exposure frequency: | 240 days/year (5/7) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Sampling and Analytical Methodology | Low | Sampling methodology not specified. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | Data are from the U.S. |
| Metric 3: | Applicability | High | Data are for commercial use in construction materials, an in-scope occupational scenario. |
| Metric 4: | Temporal Representativeness | Medium | Monitoring data were collected after the most recent PEL and greater than 10 years old. |
| Metric 5: | Sample Size | Medium | Sample distribution characterized by limited statistics (averages) but discrete samples not provided and distribution not fully characterized. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Medium | Exposure type and sampling data provided, but number of workers, particle size, engineering controls, and PPE not provided. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Medium | Variability addressed by including 2 activities but uncertainty is not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Pryor, P. (1986). Health hazard evaluation report no. HETA 84-257-1650, Denver Water Department, Denver Colorado. |
| **HERO ID:** | 3970524 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Cement Asbestos pipe cutting. |
| Exposure route: | Inhalation |
| Physical form: | inhalable fibers |
| Personal sampling data: | Asbestos Samples Without Water Suppression Cutter Operator 3.36 f/ccCutter Operator 3.54 f/ccAssistant 2.45 f/ccAssistant 2.27 f/ccAsbestos Samples With Water Suppression Cutter Operator 0.76 f/ccCutter Operator 0.60 f/ccAssistant 0.76 f/ccAssistant 0.43 f/cc1985 |
| Area sampling data: | Asbestos Samples Without Water Suppression Area 3 2.18 f/ccArea 4 1.90 f/ccAsbestos Samples With Water Suppression Area 1 0.17 f/ccArea 2 0.59 f/ccArea 3 0.60 f/ccArea 4 0.21 f/cc1985 |
| Exposure duration: | up to 10 hours per day |
| Exposure frequency: | 40 hours per week |
| Personal protective equipment: | Respirators are necessary when the exposures exceed either standards or evaluation criteria. Respirators should not be considered a primary control and should only be used in conjunction with the engineering controls described earlier. For the asbestos exposures evaluated in this study, three types of respirators are approved . the first is a HIOSH/MSHA approved negative pressure-type respirator (half or full face) with a highefficiency pre-filter for asbestos levels below the current OSHA Standard. It should be noted that HIOSH currently recommends against the single-use, disposable type respirators while working around asbestos.The last two respirators include the approved NIOSH/KSHA, powered-air purifying respirator and the NIOSH/MSHA type-C supplied-air respirator. These two respirators are intended for use during emergencies or during exposure to asbestos levels which exceed the current OSHA Standard. the reader is referred to OSHA 1910 . 1001 for further information on this regulation.When reviewing the respirators described above, it becomes apparent that the half or full-face respirator is the better choice. However, these can only be used if the dust suppression system is used routinely.It should be also understood that under OSHA 1910.134, if it has been determined that respirators must be worn, a complete program of selection, maintenance, and fit testing of the respirators are required. |
| Engineering control: | Engineering controls are the preferred method for decreasing potential exposures to toxic substances and should be used whenpossible. Therefore, it is recommended that the company requirethe use of the water suppression system regardless of the time ofyear. |

**EVALUATION**

| Domain | | Metric | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | High | NIOSH study PCM Method 7400 |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | US |
| | Metric 3: | Applicability | High | The data are for an occupational scenario ( Cement pipe cutting) within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Low | 1985 - prior to the recent PEL and more than 20 years old |
| | Metric 5: | Sample Size | High | Statistics were not provided but results from individual personal and area samples were provided which could be used to develop summary statistics. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Monitoring data include most critical metadata, such as sample type, exposure type, sample durations, and worker activities, but lacks additional metadata, such as exposure durations and frequency. |

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| | |
|---|---|
| **Study Citation:** | Pryor, P. (1986). Health hazard evaluation report no. HETA 84-257-1650, Denver Water Department, Denver Colorado. |
| **HERO ID:** | 3970524 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

| | | EVALUATION | |
|---|---|---|---|
| Domain | Metric | Rating | Comments |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | High | Results from individual personal and area samples were provided which could be used to assess variability between jobs and locations. It is assumed that uncertainty was addressed in NIOSH method 7400. |

## Overall Quality Determination — High

| | |
|---|---|
| **Study Citation:** | Quinn, M. M., Kriebel, D., Buiatti, E., Paci, E., Sini, S., Vannucchi, G., Zappa, M. (1987). An asbestos hazard in the reprocessed textile industry. American Journal of Industrial Medicine 11(3):255-266. |
| **HERO ID:** | 3083182 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Products not Described by Other Codes |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Workers were employed in the reprocessed textile industry. Workers were exposed to asbestos while handling the bags which were contaminated with chrysotile, amosite, and crocidolite (pg 255). |
| Exposure route: | Inhalation (pg 260) |
| Physical form: | chrysotile, amosite, and crocidolite fibers (pg 255) |
| Personal sampling data: | The sample from the press operator's breathing zone had a total fiber concentration of 0.8 fibers/cc (pg 262). |
| Personal protective equipment: | No respiratory or other personal protective equipment was worn. |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Sampling and Analytical Methodology | High | Methodology is an approved NIOSH method. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | Medium | The data are from an OECD country. other than the U.S. |
| | Metric 3: Applicability | High | The data are for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: Temporal Representativeness | Low | Data is more than 20 years old. |
| | Metric 5: Sample Size | Low | Distribution of samples is characterized by no statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | Low | Monitoring data include sample type but no other metadata. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Low | The monitoring study does not address variability or uncertainty. |

## Overall Quality Determination — Low

| | |
|---|---|
| **Study Citation:** | Racine, W. P. (2010). Emissions concerns during renovation in the healthcare setting: asbestos abatement of floor tile and mastic in medical facilities. Journal of Environmental Management 91(7):1429-1436. |
| **HERO ID:** | 2586623 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Removal of asbestos containing materials. [PDF Pg. 1] |
| Exposure route: | Inhalation [PDF Pg. 1] |
| Physical form: | Dust (solid) [PDF Pg. 1] |
| Personal sampling data: | [PDF PG. 5]Chemical Stripping: 0.004-0.015, mean: 0.0087 (fibers/cm^3)Wet Grinding: 0.007-0.024, mean: 0.0124 (fibers/cm^3) |
| Area sampling data: | [PDF PG. 5]Chemical Stripping: 0.002-0.006, mean: 0.0037 (fibers/cm^3)Wet Grinding: 0.002-0.009, mean: 0.0052 (fibers/cm^3) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Sampling and Analytical Methodology | High | Sampling/analytical methodology is an approved NIOSH/OSHA method. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | Data are from the U.S. |
| Metric 3: | Applicability | High | Data are for Chemical Substances in Construction, Paint, Electrical, and Metal Products, an in-scope occupational scenario. |
| Metric 4: | Temporal Representativeness | Medium | Monitoring data were collected after the most recent PEL and greater than 10 years old. |
| Metric 5: | Sample Size | Medium | Sample distribution characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Medium | Sample type and exposure type provided but missing exposure duration and frequency. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | High | Uncertainty is addressed in sampling/analytical methodology. Variability addressed by sampling during 2 methods of use and personal and area sampling. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Ramos, H. (1974). Health hazard evaluation report no. HETA-74-45-150, TrimTex Division of William E. Wright Company, Williamsport, Pennsylvania. |
| **HERO ID:** | 3970478 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Furnishing, Cleaning, Treatment Care Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Personal sampling data: | [PDF Pg. 4]Braiding room: 0.03 (fibers/cc)Spooling Room: 0.04 (fibers/cc) |
| Area sampling data: | [PDF Pg. 4]Braiding room (4 samples): 0.02; 0.02; 0.02; 0.04 (fibers/cc)Spooling Room: 0.06 (fibers/cc) |
| Comments: | The air samples were collected on AA Millipore filters at a flow rate of one liter per minutes and asbestos fibers in length greater than 5 micrometers were counted utilizing phase contrast microscopy. [PDF Pg. 2] |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Sampling and Analytical Methodology | High | Sampling/analytical methodology is equivalent to an approved OSHA/NIOSH method. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | Data are from the U.S. |
| Metric 3: | Applicability | Uninformative | The data are from an occupational scenario that does not apply to any occupational scenario within the scope of the risk evaluation. |
| Metric 4: | Temporal Representativeness | Low | Monitoring data are greater than 20 years old. |
| Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Low | Sample type provided but no other metadata. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | High | Uncertainty is addressed in sampling/analytical methodology. Variability addressed by sampling multiple operations. |

## Overall Quality Determination Uninformative

| | |
|---|---|
| **Study Citation:** | Reitze, W. B., Nicholson, W. J., Holaday, D. A., Selikoff, I. J. (1972). Application of sprayed inorganic fiber containing asbestos: occupational health hazards. American Industrial Hygiene Association Journal 33(3):178-191. |
| **HERO ID:** | 3084810 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | ”workmen actually engaged in applying the material, is relatively small in numbers. This group, however, is the most heavily exposed.”; worker handling the nozzle; worker emptying the bags into the hopper (pg 5) ... ”Pipe fitters, welders, electricians, plumbers, carpenters, and others may be on the construction site during or shortly after mineral fibers have been sprayed” (pg 6) ... ”The two most important sources for workman exposure during spray operations are (1) material that becomes airborne during the spray operation (overspray), both that which remains at the job site and that which blows into the surrounding air, and (2) material that remains on the site because of poor housekeeping.” (pg 9) |
| Personal sampling data: | fiber counts per cubic centimeter provided from other studies: spraying of thermal insulation at power house turbine ranged from 5 to 100 f/cc across three measured workmen; spraying of fireproofing in multistory building ranged from 20 to 99 f/cc across two measured workmen.... ” large spread in counts can be attributed to differences in asbestos content of material, work proficiency, and the ever-changing conditions on construction sites[.] These dust levels are much higher than those at asbestos work sites in other trades” (pg 5) |
| Area sampling data: | ”On-site samples taken at various distances from the nozzle show fiber counts ranging from 70 f/cc 10 feet from the nozzle to 3 f/cc 25 feet away. Counts taken 30 minutes after completion of spray still ranged from 1 to 4 f/cc, and 60 minutes after, from 0.25 to 0.76 f/cc. Again, these counts vary because of changes in on-site ventilation”; area samples provided for spatiotemporal variation of spray application (pg 6 and 7) |
| Number of workers: | In the United States, more than 3,000,000 men are regularly employed in the building trade |
| Personal protective equipment: | ”because of the high fiber counts, 100 f/cc, a conventional filter-type respirator will not provide adequate protection for the worker handling the spray nozzle or for other workers in the enclosure. In such areas, some type of supplied air respirator must be used” (pg 13) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Low | Sampling/analytical methodology is not specified. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for asbestos use in the construction industry, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Sample type and exposure type provided but missing sampling procedures and locations. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | Variability addressed by spatial differences in fiber concentrations and change in concentration following spraying, but uncertainty is not addressed. |

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| | |
|---|---|
| **Study Citation:** | Reitze, W. B., Nicholson, W. J., Holaday, D. A., Selikoff, I. J. (1972). Application of sprayed inorganic fiber containing asbestos: occupational health hazards. American Industrial Hygiene Association Journal 33(3):178-191. |
| **HERO ID:** | 3084810 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

| | | **EVALUATION** | |
|---|---|---|---|
| Domain | Metric | Rating | Comments |
| **Overall Quality Determination** | | **Medium** | |

| | |
|---|---|
| **Study Citation:** | Remington, D. (1989). Report on asbestos: Putting it into perspective. Canadian Occupational Safety 27(3):12-15. |
| **HERO ID:** | 6907423 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Renovation of asbestos-containing buildings (3/4) |
| Exposure route: | inhalation (1/4) |
| Physical form: | fiber bundles (1/4) |
| Area sampling data: | During the period renovation was in progress, 116 measurements of airborne asbestos by optical microscopy were made in areas outside that being renovated. During renovation, counts ranged from undetectable to as high as 0.86 f/cc on one unusual occasion, and averaged 0.07 f/cc. In the renovation areas themselves, airborne asbestos levels ranged from undetectable to 0.09 f/cc except for two unusually high counts of 0.25 and 0.13 f/cc that probably represented unusual events. Average counts were 0.01 f/cc. Before and after renovation, counts were consistently 0.01 and below in the renovation areas. (3/4) |
| Personal protective equipment: | Respirators and protective clothing. A half-face mask is specified for Type 1 or Type 2 asbestos removal. A powered air-purifying respirator system is needed for Type 3 removal of amosite or crocidolite or power cutting of any type of asbestos fiber. (2/4) |
| Engineering control: | To prevent dust release, asbestos cement products should not be cut, sanded or drilled with power tools, and joint compounds made prior to 1978 should not be dry sanded. (1/4) When vacuuming asbestos products, only vacuum cleaners equipped with H.E.P.A. (High Efficiency Particulate Air) filters are the most reliable guarantee that the exhausted air is essentially free of asbestos fiber emissions. (4/4) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Low | Sampling methodology not specified. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Medium | Data are from Canada, an OECD country. |
| | Metric 3: | Applicability | High | Data are for commercial use in construction materials, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| | Metric 5: | Sample Size | Medium | Sample distribution characterized by limited statistics (range, maximum, average) but discrete samples not provided and distribution not fully characterized. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Exposure type and sampling data provided, but missing number of workers, exposure duration and frequency, and particle size, |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | Variability is addressed by obtaining baseline measurements. Uncertainty isn't addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Reynolds, S. J., Kreiger, R. A., Bohn, J. A., Fish, D., Marxhausen, T., McJilton, C. (1994). Factors affecting airborne concentrations of asbestos in a commercial building. American Industrial Hygiene Association Journal 55(9):823-828. |
| **HERO ID:** | 3097354 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Renovation and maintenance of buildings [PDF Pg. 3] Cable installation above an ACM ceiling. [PDF Pg. 3] |
| Exposure route: | Inhalation |
| Physical form: | Fibers (solid) |
| Area sampling data: | General air sampling results in various locations for 6-day sampling in structures/cubic centimeter:3rd floor constructionDay 1: -Day 2: NDDay 3: 0.007; 0.002; 0.005Day 4: NDDay 5: 0.004Day 6: 0.002Geometric Mean: 0.0025Geometric Standard Deviation: 2.162nd floor (no construction)Day 1: -Day 2: ND; ND; NDDay 3: NDDay 4: NDDay 5: ND Day 6: ND; ND; NDGeometric Mean: 0.0010Geometric Standard Deviation: 0.00Mail room (suspended ceiling)Day 1: -Day 2: NDDay 3: 0.002Day 4: NDDay 5: NDDay 6: NDGeometric Mean: 0.0011Geometric Standard Deviation: 1.36Dock (no suspended ceiling)Day 1: -Day 2: NDDay 3: 0.008Day 4: 0.002; ND; 0.002Day 5: ND; ND; NDDay 6: 0.002Geometric Mean: 0.0016Geometric Standard Deviation: 2.00Roof (control sample)Day 1: NDDay 2: 0.002Day 3: NDDay 4: NDDay 5: NDDay 6: NDGeometric Mean: 0.0011Geometric Standard Deviation: 1.33Supply Air Shaft (control sample)Day 1: NDDay 2: NDDay 3: NDDay 4: NDDay 5: NDDay 6: NDGeometric Mean: 0.001Geometric Standard Deviation: 0.00Return Air Shaft (control sample)Day 1: NDDay 2: NDDay 3: NDDay 4: NDDay 5: NDDay 6: 0.002Geometric Mean: 0.0011Geometric Standard Deviation: 1.33Elevator/Mechanical Room (control sample)Day 1: 0.002Day 2: NDDay 3: NDDay 4: NDDay 5: NDDay 6: NDGeometric Mean: 0.0011Geometric Standard Deviation: 1.33Garage (control sample)Day 1: NDDay 2: 0.002Day 3: NDDay 4: NDDay 5: NDDay 6: 0.002Geometric Mean: 0.0013Geometric Standard Deviation: 1.43 |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | High | Sampling/analytical methodology is equivalent to an approved [OSHA/NIOSH] method. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for construction, paint, electrical, and metal products, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Medium | Monitoring data are greater than 10 years old but no more than 20 years old. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Sample type and exposure type provided but missing exposure duration and frequency. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | High | Uncertainty is addressed in sampling/analytical methodology. Variability addressed by sampling multiple areas on multiple days. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Rickards, A. L. (1994). Levels of workplace exposure. Annals of Occupational Hygiene 38(4):469-75, 409. |
| **HERO ID:** | 3081788 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Products not Described by Other Codes |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Carding, weaving (cloth), weaving (brake lining) (page 5 of 8) |
| Personal sampling data: | Figure 2 on page 6 of 81991worker exposure concentration (C)84.4% of workers: C <= 0.5 f/cc9.4%: 0.5< C <=1 f/cc4.2%: 1< C <= 2 f/cc2.1%: C => 2 f/cc1992worker exposure concentration (C)89.1% of workers: C <= 0.5 f/cc6.3%: 0.5< C <=1 f/cc3.9%: 1< C <= 2 f/cc0.8%: C => 2 f/cc |
| Comments: | Asbestos textile processingSamples for workers in the Asbestos International Association (AIA) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | High | Sampling or analytical methodology is an approved OSHA or NIOSH method or is well described and found to be equivalent to approved OSHA or NIOSH methods. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | The data are from the United States and are representative of the industry being evaluated. |
| | Metric 3: | Applicability | Low | The occupational exposure scenario is not described for the data provided. |
| | Metric 4: | Temporal Representativeness | Low | Metadata on the operations, equipment, and worker activities associated with the data show that the data agree representative of outdated operations, equipment, and activities rather than current operations, equipment, and worker activities. The data were collected more than 20 years ago. |
| | Metric 5: | Sample Size | Low | Distribution of samples is qualitative or characterized by no statistics. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Low | Monitoring data include sample type (e.g., personal breathing zone) but no other metadata. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | The monitoring study provides only limited discussion of the variability in the determinants of exposure for the sampled site or sector. The monitoring study provides only limited discussion of the uncertainty in the exposure estimates. |

## Overall Quality Determination Low

| | |
|---|---|
| **Study Citation:** | Roach, S. A. (1965). Measurement of airborne asbestos dust by instruments measuring different parameters. Annals of the New York Academy of Sciences 132(1):306-315. |
| **HERO ID:** | 3085075 |
| **Conditions of Use:** | Other: |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | filling sacks at bagging machine (pg 1-2) |
| Exposure route: | inhalation |
| Area sampling data: | Dust exposure for bagging machine operator presented graphically on pg 2."the [bagging machine] operator was nowhere exposed to a concentration higher than 2 mppcf" (pg 3)>>5 mppcf TLV (pg 3)results based on sampling instrument presented in Table 3 (pg 5) in both million particles per cubic ft and particles per mL; 0.4-20.9 mppcffiber sampling results in Table 4 (pg 6) based on sampling instrument in both mfpcf and fpmL; 0.11-0.57 mfpcf |
| Particle size characterization: | Particles shorter than 1 micron accounted for 84 per cent of all those visible and only five per cent were longer than five microns; Ninety-four per cent of the particles were less than 0.5 microns wide and only 0.6 per cent were thicker than one micron; Most of the particles whose outlines could be seen clearly were straight fibers with an aspect ratio, of length to width, of over 10 to 1 (pg 1; Table 1, pg 2)fibers defined as particles longer than 5 microns and length was >3x their width (pg 4)mass sampling of airborne dust for different instruments in Table 5 (pg 9); 0.29-1.06 mg/m3 |
| Exposure duration: | 6 hrs/day of sampling; each sampling period was 3 hours (pg 4) |
| Personal protective equipment: | they provided the workers with efficient face masks. The masks were modified Siebe Gorman, Mark VIII models, which have a resinwool filter insert and nonreturn valves. The modification was an additional pad of resin wool in front of the standard filter. (pg 3) |

**EVALUATION**

| Domain | | Metric | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Medium | Sampling/analytical methodology is not an approved OSHA/NIOSH method but is an acceptable methodology. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Medium | It is not clear whether data are from the U.S. or the U.K. |
| | Metric 3: | Applicability | Low | Data are for an asbestos factory, a non-legacy use, but may still be informative. |
| | Metric 4: | Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| | Metric 5: | Sample Size | Medium | Sample distribution characterized by limited statistics (means) but discrete samples not provided and distribution not fully characterized. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Sample type and exposure type provided but missing metadata such as exposure frequency. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | Variability addressed by sampling with multiple instruments, but uncertainty is not addressed. |

## Overall Quality Determination — Low

| | |
|---|---|
| **Study Citation:** | Rodelsperger, K., Woitowitz H-J, Krieger, H. G. (1980). Estimation of exposure to asbestos-cement dust on building sites. IARC Scientific Publications 30(30):845-853. |
| **HERO ID:** | 3101344 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Roofing work, siding work, and installation of ventilation shafts and fire insulation. [PDF Pg. 2] |
| Physical form: | Dust (solid) [PDF Pg. 2]. |
| Personal sampling data: | [PDF Pg. 5]Cutting asbestos-cement sheets in stacks: 2.2 (mg/m^3)Cutting asbestos-cement sheets on roofs: 1.82 (mg/m^3) |
| Area sampling data: | [PDF Pg. 5]Cutting asbestos-cement sheets in stacks: 0.51 (mg/m^3)Cutting asbestos-cement sheets on roofs: 0.5 (mg/m^3) |
| Particle size characterization: | 1-5 um length and 0.1-0.4 um width [PDF PG. 5] |
| Exposure frequency: | Handling corrugated sheets: 39.2 days/yearHandling shingles: 39.4 days/yearHandling front plates: 30.3 days/year[PDF Pg. 6] |
| Number of workers: | 50,000 roofers [PDF Pg. 2] |
| Comments: | Altogether, four static and four personal dust samplers and a Tyndallometer were used. Mass concentrations of total dust and fine dust were determined. For static sampling, the asbestos content in the fine dust was measured by infrared spectrography. Fibre counting and fibre analysis were done by phase-contrast and by scanning electron microscopy.[PDF Pg. 2] |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Medium | Sampling or analytical methodology is not equivalent to an approved OSHA or NIOSH method and EPA review of information indicates the methodology is acceptable. Differences in methods are not expected to lead to lower quality data. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Medium | Data are from Germany, an OECD country. |
| | Metric 3: | Applicability | High | Data are for Chemical Substances in Construction, Paint, Electrical, and Metal Products, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Monitoring data are greater than 20 years old. |
| | Metric 5: | Sample Size | Medium | Sample distribution characterized by limited statistics (mean) but discrete samples not provided and distribution not fully characterized. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Sample type and exposure type provided but missing exposure duration. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | High | The monitoring report addresses variability through multiple sample types (area and personal), and measurement uncertainty is addressed in sampling/analytical methodology. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Rodelsperger, K., Woitowitz, H. J., Spurny, K. (1979). Problems of Measuring Intermittent Exposure to Asbestos Dust. Archives of Industrial Hygiene and Toxicology 30(Suppl 2):1023-1029. |
| **HERO ID:** | 6899383 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Workers cut off overlapping asbestos cement roof coverings with a grinding machine. (2/7) |
| Exposure route: | inhalation (2/7) |
| Physical form: | fine dust (2/7) |
| Personal sampling data: | (IR-SPEC) The median concentrations of fine dust measured by personal sampling were 1.39 mg/m3, with a range of 0.5-5.8 mg/m3. (5/7) |
| Area sampling data: | (SEM) Area and samples in open-air cutting places showed concentrations of 0.5-1.5 fibers/mL. (3/7) |
| Particle size characterization: | Mean geometrical diameters were 0.4+-0.26 micrometers and mean length was 5+-3.5 micrometers. (3/7) |
| Exposure duration: | 1 to 8 hours (2/7) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Medium | Sampling/analytical methodology is not an approved OSHA/NIOSH method but is an acceptable methodology. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Medium | Data are from Germany, an OECD country. |
| | Metric 3: | Applicability | High | Data are for commercial use in construction materials, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| | Metric 5: | Sample Size | Medium | Sample distribution characterized by limited statistics (median, standard deviations, ratios ranges) but discrete samples not provided and distribution not fully characterized. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Sampling data provided, but missing exposure, frequency, number of workers, PPE, and engineering controls. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | Uncertainty and variability not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Roh, S., Park, S., Tae, G., Song, J. (2016). A case of laryngeal cancer induced by exposure to asbestos in a construction site supervisor. 28:34. |
| **HERO ID:** | 3531387 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | ”Accounting demolition, inspecting materials,supervising the construction processes. (3/6)” |
| Exposure route: | inhalation (4/6) |
| Personal sampling data: | The report summarizes sampling data from other literature sources. In the first study, personal samples had an average concentration of 7.5 f/cc. In a second study, concentrations ranged from ND-175 f/cc. In a third study, concentrations ranged from 0.001-16.1 f/cc. In a fourth study, concentrations ranged from 0.01-0.32 f/cc. In the last study, concentrations ranged from 0.01-0.866 f/cc. (4/6) |
| Exposure duration: | 3-4 hours/day spent on site inspections (3/6) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Low | Sampling methodology not specified. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Medium | Data are from Korea, an OECD country. |
| | Metric 3: | Applicability | High | Data are for commercial use in construction materials, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | High | Monitoring data were collected after the most recent PEL and no more than 10 years old. |
| | Metric 5: | Sample Size | Medium | Sample distribution characterized by limited statistics (mean, ranges) but discrete samples not provided and distribution not fully characterized. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Exposure type and sampling data provided, but missing number of workers, exposure frequency, particle size, engineering controls and PPE. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | High | Uncertainty is addressed by discussing limitations of the study in the concluding paragraph. Variability is addressed by using multiple studies to determine exposure concentrations. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Ross, M. (2001). Exposure to amphibole-asbestos and mixed fibers: Rapporteur's report. Canadian Mineralogist, special issue 5 :71-74. |
| **HERO ID:** | 6863389 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Shipyard insulation workers and construction insulation workers. Source also includes information about an asbestos cement factory. |
| Exposure route: | Inhalation |
| Physical form: | Fibers |
| Area sampling data: | Shipyard workers had on average 17.5 f/mL exposure where construction insulation workers had 12.5 f/mL exposure on average. Exposure to crocidolite happened more commonly.Asbestos concentration in the town surrounding an asbestos cement manufacturing plant ranged 0.001 to 0.0055 f/mL. 70-80% of the fibers were chrysotile, with 15-30% being amphibole.Concentrations of asbestos in air inside buildings with asbestos fireproofing materials was less than 0.00082 f/mL. |
| Number of workers: | 17,800 workers for shipyard insulation workers. |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Sampling and Analytical Methodology | Low | Sampling/analytical methodology is not specified. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | Data are from the U.S. |
| Metric 3: | Applicability | High | Data are for use in construction materials, an in-scope occupational scenario. |
| Metric 4: | Temporal Representativeness | Low | Monitoring data are greater than 20 years old. |
| Metric 5: | Sample Size | Low | Sample distribution is characterized by no statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Medium | Sample type and exposure type provided but missing metadata such as exposure duration and exposure frequency. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Low

| | |
|---|---|
| **Study Citation:** | Ruhe, R. L. (1983). Health Hazard Evaluation Report No. HETA-83-189-1368, Goodyear Aerospace Corporation, Akron, Ohio. NIOSH(HETA-83-189-1368):83-189. |
| **HERO ID:** | 3656253 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Workers at an aerospace corporation exposed to asbestos in the ceiling and wall insulation. (4/14) |
| Exposure route: | inhalation (6/14) |
| Physical form: | fibers (6/14) |
| Personal sampling data: | (PCM) All personal samples were below the LOD except for the tool and die maker (0.02 f/cc) and machinist (0.04 f/cc). (10/14) |
| Area sampling data: | (PCM) All area samples were below the LOD except for three areas, which were all 0.02 f/cc. (10/14) |
| Engineering control: | NIOSH recommends that the asbestos insulation be carefully removed from the plant. (7/14) |
| Comments: | TABLE IIResults of Personal and Area Samples for Asbestos |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Sampling and Analytical Methodology | High | Sampling/analytical methodology is an approved NIOSH method. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | Data are from the U.S. |
| Metric 3: | Applicability | High | Data are for industrial use in construction materials, an in-scope occupational scenario. |
| Metric 4: | Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Medium | Exposure type and sampling data provided, but missing number of workers, exposure duration, frequency, PPE, and particle size. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Medium | Uncertainty is addressed in sampling/analytical methodology. Variability isn't addressed. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Ryckman, M. D., Ryckman, D. W., Peters, J. L. (1983). ASBESTOS CONTROL PROGRAM FOR INSTITUTIONAL FACILITIES. Journal of Environmental Engineering 109(2):275-288. |
| **HERO ID:** | 3584930 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Maintenance personnel where ceiling materials contain asbestos (2/14) |
| Exposure route: | inhalation, dermal (2/14) |
| Physical form: | dust (1/14) |
| Area sampling data: | During the removal process, asbestos concentration was 0.042 f/cc. (10/14) Prior to isolation and decontamination, asbestos concentration was 4.9 f/mL (PCM). After isolation and decontamination, concentration was 0.00712 f/mL (SEM). (11/14) |
| Particle size characterization: | "Fiber length is 0.03-30 microns, and fiber diameter is 100 to 250 A. (2/14) 65%of all fiber particles released are smaller than five microns in length. 96% of all fibers released into the air are smaller than 5 microns in diameter (3/14)" |
| Number of workers: | 23,000 maintenance workers at schools (2/14) |
| Personal protective equipment: | Disposable hoods, coveralls, gloves, boots, respirators (7/14) |
| Engineering control: | Four separate control zones were defined to prevent dust propagation outside the contaminated area. The work zone isolated the decontamination operations from the rest of the building. The entire work area was sealed off and covered with 6-mil polyethylene plastic to prevent dust fibers from contaminating furniture, carpeting, and other articles in the work zone. In addition, all openings in the work area including heating, ventilating, and air conditioning system ducts were sealed off to prevent dust propagation via the plenum. (9/14) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Sampling and Analytical Methodology | High | Sampling/analytical methodology is equivalent to an approved [OSHA/NIOSH] method. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | Data are from the U.S. |
| Metric 3: | Applicability | High | Data are for commercial use in construction materials, an in-scope occupational scenario. |
| Metric 4: | Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Medium | Exposure type and sampling data provided, but missing exposure duration and frequency. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Medium | Uncertainty is addressed in sampling/analytical methodology, but measurement variability is not addressed. |

## Overall Quality Determination High

**Continued on next page . . .**

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| | |
|---|---|
| **Study Citation:** | Ryckman, M. D., Ryckman, D. W., Peters, J. L. (1983). ASBESTOS CONTROL PROGRAM FOR INSTITUTIONAL FACILITIES. Journal of Environmental Engineering 109(2):275-288. |
| **HERO ID:** | 3584930 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|

| | |
|---|---|
| **Study Citation:** | Ryer, F. H. (1978). AIR POLLUTION EXPOSURES TO FIVE TARGET HEALTH HAZARDS. American Industrial Hygiene Association Journal 11(11):928-931; 1978. |
| **HERO ID:** | 3659698 |
| **Conditions of Use:** | Other: |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Exposure route: | inhalation |
| Area sampling data: | 80% of samples <5 fibers/cm3 (Table 1, pg 2) |
| Comments: | Source provides number of U.S. workers exposed during MFG, which is not in-scope for legacy. Exposure duration not provided despite FT-screening flag. |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Low | Sampling/analytical methodology is not specified. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | Low | OES not specified. |
| | Metric 4: | Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| | Metric 5: | Sample Size | Low | Sample distribution is characterized by no statistics; only provide % above and below the PEL |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Uninformative | Sample type and exposure type not provided. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Uninformative

**Study Citation:** Ryer, F. H. (1974). Exposures to five target health hazards. :389-394.
**HERO ID:** 6897725
**Conditions of Use:** Other:

**EXTRACTION**

| Parameter | Data |
|---|---|
| Worker activity description: | Asbestos miners and millers, and fireproofing manufacturers. (1/6) |
| Exposure route: | inhalation (1/6) |
| Physical form: | airborne fibers (1/6) |
| Personal sampling data: | Of 1,912 samples taken, 1,518 showed concentrations within the TLV, 223 were above the TLV of 5 f/cc, and 171 were above the ceiling value of 10 f/cc. (2/6) |
| Number of workers: | More than 200,000 workers in the U.S. are exposed to asbestos while mining, milling, and processing fireproofing material. (1/6) |
| Personal protective equipment: | NIOSH certified dust respirators, and protective clothing (2/6) |
| Engineering control: | Warning signs and labeling of dangerous products, monitoring of dust levels, enclosure and local exhaust ventilation applied to equipment operations, dust collection systems, and wetting and dampening methods to minimize dust generation. (2/6) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Sampling and Analytical Methodology | High | Specific sampling method not specified, but sampling was conducted by OSHA, so assumed a reliable method. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | Data are from the U.S. |
| Metric 3: | Applicability | Uninformative | Data are for manufacturing of asbestos-containing products, which isn't in scope. |
| Metric 4: | Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| Metric 5: | Sample Size | Medium | Sample distribution characterized by limited statistics (number of samples in ranges) but discrete samples not provided and distribution not fully characterized. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Medium | Exposure type and sampling data provided, but missing exposure duration, frequency, and particle size. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Uninformative

| | |
|---|---|
| **Study Citation:** | Rödelsperger, K., Teichert, U., Marfels, H., Spurny, K., Arhelger, R., Woitowitz, H. J. (1989). Measurement of inorganic fibrous particulates in ambient air and indoors with the scanning electron microscope. IARC Scientific Publications, no. 90 :361-366. |
| **HERO ID:** | 3098456 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | asbestos removal (abstract) |
| Area sampling data: | Table 2 (pg 3) presents fiber counts both < and >5 um, but the volume unit isnt specified (assumed m3): 524 fibers <5 um and 1974 fibers >5 um for asbestos removal |
| Particle size characterization: | median length:diameter ratios >10:1 (pg 4); Figure 1 (pg 5)fiber lengths between 3.8 and 12.6 um; fiber diameters between 0.1 and 1.4 um (pg 4) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Sampling and Analytical Methodology | Medium | Sampling/analytical methodology is not an approved OSHA/NIOSH method but is an acceptable methodology. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | Medium | Data are from Germany, an OECD country. |
| | Metric 3: Applicability | High | Data are for construction materials (asbestos removal), an in-scope occupational scenario. |
| | Metric 4: Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| | Metric 5: Sample Size | Medium | Sample distribution characterized by limited statistics (means, ranges) but discrete samples not provided and distribution not fully characterized. |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | Low | Sample type provided but no other metadata. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Medium | Variability addressed by sampling for fibers of different sizes, but uncertainty is not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Safety Health Environment International Consultants, (1994). Support: the asabestos exposure of workers in the Manville Diatomaceous Earth Plant also involved in cohort mortality study of diatomite industry with cover letter dated 121694. |
| **HERO ID:** | 3653704 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | fibers were transported to the warehouse or areas where it would be used. The bags were opened by one man and he put the fiber into he a machine where the fibre was milled. the milled fibre was collected in a bin, then re-fed and mixed with DE. This mixed product was fed to a bag packing machine. After packing, the finished product was loaded on pallets for transfer to the warehouse area. The product was then loaded into railcars for shipment. Samples of fibre were milled in the lab and tested for permeability.Maintenance personnel who repaired production equipment and repaired kilns and other equipment where asbestos containing materials were used. Many of the plant buildings were constructed of asbestos cement sheeting and maintenance employees worked on these sheets. |
| Exposure route: | inhalation |
| Physical form: | inhalable fibers |
| Area sampling data: | note asbestos was not used in the plant in the 1940sCelite Specialties – Brick plant1970 GAS unloading RR car of asbestos- Mean: 4.2 f/ml1971 GAS unloading RR car of asbestos- Mean: 1.80 f/ml1972 GAS unloading RR car of asbestos- Mean: 0.90 f/ml1975 GAS unloading RR car of asbestos- Mean: 0.10 f/ml1970 Forklift operating unloading RR car of asbestos- Mean: 5.0 f/ml1971 Forklift operating unloading RR car of asbestos- Mean: 2.7 f/ml1972 Forklift operating unloading RR car of asbestos- Mean: 1.6 f/ml1975 Forklift operating unloading RR car of asbestos- Mean: 0.5 f/mlCelite Specialties1972 Cleaned dust control air - Vent baghouse Mean 4.1 f/ml Range: 0.20-0.30 f/ml1976 GRS – lunch room Mean: 0.00 1976 GRS – lunch room Mean: 0.00 1974 Mortar Plant feed operator Mean: 1.2 f/ml Range: 0.40-1.20 f/ml1974 Mortar Plant feed operator Cassiar AY Mean: 2.70 f/ml 1975 Mortar Plant feed operator Cassiar AY Mean: 2.55 f/ml Range: 1.90-4.60 f/ml1976 Mortar Plant feed operator Cassiar AY Mean: 2.75 f/ml Range: 2.7-2.8 f/ml1976 Mortar Plant feed operator Diaseal M Atlas A2-20 Mean: 1.5 f/ml Range: 1.5-1.7 f/ml1976 Mortar Plant feed operator Diaseal M Mean: 0.29 f/ml 1977 Mortar Plant feed operator Hyflo DC, Hysweet, Fibra-Flo 7c Mean: 1.1 f/ml Range: 0.8-1.1 f/ml1970 Mortar Plant feed operator Fibra-Flo Mean: 7.7 f/ml 1971 Mortar Plant feed operator Cassiar AY Mean: 6.3 f/ml 1972 Mortar Plant feed operator Cassiar AY Mean: 6.9 f/ml 1972 Mortar Plant feed operator Fibra-Flo Mean: 5.78 f/ml Range: 3.1-8.8 f/ml1973 Mortar Plant feed operator Fibra-Flo Mean: 5.6 f/ml Range: 4.8-6.3 f/ml1976 Mortar Plant feed operator Fibra-Flo Mean: 1.63 f/ml Range: 0.00-4.1 f/ml1977 Mortar Plant feed operator Fibra-Flo Mean: 0.20 f/ml1970 Mortar plant packer operator Fibra-Flo Mean: 0.7 f/ml1971 Mortar plant packer operator Fibra-Flo Mean: 3.7 f/ml1972 Mortar plant packer operator Fibra-Flo Mean: 4.9 f/ml1973 Mortar plant packer operator Fibra-Flo Mean: 2.7 f/ ml Range: 2.0-3.4 f/ml1974 Mortar plant packer operator Fibra-Flo Mean: 2.0 f/ml1975 Mortar plant packer operator Fibra-Flo Mean: 0.5 f/ ml Range: 0.3-0.7 f/ml1976 Mortar plant packer operator Fibra-Flo Mean: 0.37 f/ ml Range: 0.1-0.7 f/ml1977 Mortar plant packer operator Fibra-Flo Mean: 1.56 f/ml Range: 0.6-3.6 f/ml1973 Mortar plant packer operator Mean: 3.0 f/ml 1974 Mortar plant packer operator Mean: 0.8 f/ml Range: 0.6-1.0 f/ml1976 Mortar plant packer operator – Diaseal M Mean: 0.2 f/ml 1972 Mortar plant packer operator – Cassiar AY Mean: 1.3 f/ml 1977 Mortar plant packer operator – Hysweet, Fibra-Flo 7C Mean: 1.1 f/ml E&R1974 GRS Machine Shop Mean: 0.70 f/ml Range: 0.1 -0.2 f/ml1976 GRS Machine Shop – Fibra Flo – Mortar plant Mean: 0.10 f/ml 1976 GRS store room – Diaseal M – Mortar plant Mean: 0.0 f/ml 1977 Brake Lining Mean: 0.17 f/ml Range: 0.1-0.2 f/ml1977 Brake Lining Mean: 0.17 f/ml Range: 0.1-0.2 f/ml1978 Maintainer – repairing brick in furnace Mean: 8.25 f/ml Range: 3.0-16.3 f/mlMortar plant1976 Mortar plant clean out operator Fibra Flo 7C Mean: 0.4 f/ml Range: 0.3-0.5 f/ml1976 Mortar plant clean out operator Diaseal M Mean: 0.8 f/ml Range: 0.8-0.8 f/ml1976 GAS RAIL SE of Mortar Plant Fibra Flo Mean 0.01976 GAS RAIL SE of Mortar Plant Diaseal M Mean 0.1 f/mlPowder Mills1972 Bulk bin packing station operator Dieseal M Mean: 3.1 f/ml1973 Bulk bin packing station operator Dieseal M Mean: 3.2 f/ml Range: 3.2-3.2 f/ml1972 Bulk bin press well operator Dieseal M Mean: 3.8 f/ml1975 Bulk bin press well operator Dieseal M Mean: 1.7 f/ml1972 Mixing plant fee hopper operator – Ultrabestos Mean: 1.75 f/ml Range: 1.70-1.70 f/ml1975 Mixing plant fee hopper operator – Diaseal M Mean: 2.1 f/ml1972 XP Plant – Mixsin Hopper operator – Diaseal M Ultrabestos 3.9 f/ml1974 Positioning asbestos blanket at No. 6 Nat. Baghouse 2.4 f/ml Range: 1.2-4.2 f/mlQuality control1975 Analytical lab technician Fibra Flo Mean 0.3 f/ml1976 Analytical lab technician Fibra Flo Mean 0.03 f/ml Range: 0.00 – 0.1 f/cm 1977 Analytical lab technician Fibra Flo Mean 0.25 f/ml Range: 0.2 – 0.3 f/cm Shipping & Receiving1974 Unit Loader operator – Loading Van Trucks Mean: 1.8 f/ml Range: 1.2-1.8 f/ml1976 Unit Loader operator – Loading Van Trucks Fibra Flo 7C Mean: 1.3 f/ml 1977 Unit Loader operator – Loading Van Trucks Mean: 0.8 f/ml Range: 0.8-0.8 f/ml1977 Unit Loader operator – Loading RR Cars Mean: 0.6 f/ml Range: 0.5-0.6 f/ml1977 GAS Center of Warehouse 1162 col L25 Mean: 0.1Maintenance Operations1979 Removing transit roofing Range: 0.1-0.7 f/ml1982 Installing asbestos on kiln head – sheetmetal shop Range: 0.1-0.2 f/ml1987 Transite cutting Range: 0.01-1.31 f/ml1987 Silicate plant asbestos removal Range: $<$ 0.1 f/ml1987 No 11 mill asbestos removal Range: 0.09-0.16 f/ml1988 Removal of pipe covering Powder mills Furnace Area Range: 0.08-0.43 f/ml1991 Removal of brick and insulation board No 7 kiln head Range: 4.99-7.83 f/ml |
| Exposure duration: | working hours were 8 per daydetailed estimates are provided for each job code on Table 24 Pages 123-145)Cumulative exposures were not calculated |

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| | |
|---|---|
| **Study Citation:** | Safety Health Environment International Consultants, (1994). Support: the asabestos exposure of workers in the Manville Diatomaceous Earth Plant also involved in cohort mortality study of diatomite industry with cover letter dated 121694. |
| **HERO ID:** | 3653704 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

| EVALUATION | | | |
|---|---|---|---|
| Domain | Metric | Rating | Comments |
| Number of workers: | 2271 considered in this study | | |
| Personal protective equipment: | respirators were available prior to 1950 and noted for dust baghouse socking shaking in the 1940s. note these older respirators were designed for protection from PM not fibers. | | |
| Comments: | The intent of this study is to take a close look at those who may have been exposed to asbestos and should be removed from a separate study investigating silica-lung cancer mortality rates. The detailed assessment identified that a larger portion of the workforce at this site were exposed to Asbestos. the plan being investigated stopped handling asbestos in 1977. Note this is a recreated assessment of earlier exposure (1920-1940 and 1951-1977) and may not be representative of today | | |

| EVALUATION | | | | |
|---|---|---|---|---|
| Domain | | Metric | Rating | Comments |
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | High | NIOSH method PECAM 239 - PCM method |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Medium | US |
| | Metric 3: | Applicability | High | The data are for an occupational scenario (asbestos containing building products) within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Low | 1993 prior to PEL (1994) test data 1977 - more than 20 years old |
| | Metric 5: | Sample Size | Medium | Mean values and/or ranges |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Monitoring data include most critical metadata, such as sample type, exposure type, exposure durations, exposure frequency, and worker activities, but lacks ample durations. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | High | where range data are provided variability can be assessed, It is assumed that uncertainty was addressed in the NIOSH method. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Sahle, W., Laszlo, I. (1996). Airborne inorganic fibre level monitoring by transmission electron microscope (TEM): Comparison of direct and indirect sample transfer methods. Annals of Occupational Hygiene 40(1):29-44. |
| **HERO ID:** | 1751609 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Area sampling data: | Direct > 5 micron length: 0.04 +/- 0.01 >0.5 micron length: 0.05 +/- 0.1 Indirect > 5 micron length: 0.05 +/- 0.01 >0.5 micron length: 0.07 +/- 0.04 |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Medium | This was an assessment of different methods in handling samples for TEM so the focus was on the analysis. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Medium | Sweden - OECD member |
| | Metric 3: | Applicability | Medium | It is unclear what sources (brake manufacture or demolition) that the reported concentration represent. |
| | Metric 4: | Temporal Representativeness | Medium | 1995 - after PEL but more than 20 years old. |
| | Metric 5: | Sample Size | Medium | typical value plus or minus variance. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Low | Monitoring data include sample type (e.g., personal breathing zone) but no other metadata. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | included variability but not uncertainty |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Sakai, K., Hisanaga, N., Shibata, E., Ono, Y., Takeuchi, Y. (2006). Asbestos exposures during reprocessing of automobile brakes and clutches. International Journal of Occupational and Environmental Health 12(2):95-105. |
| **HERO ID:** | 3079817 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Reprocessing of automobile brakes and clutches. |
| Exposure route: | inhalation |
| Physical form: | Fiber |
| Personal sampling data: | The highest geometric mean concentration of asbestos (44.2fibers/ cm3) was found when grinding brake linings using a band grinder, even though a local exhaust ventilator was in use. The geometric mean asbestos concentrations during the attaching of linings to brake shoes and the attaching of facings to clutch disks were 0.859 fibers/cm3 and 0.780 fibers/cm3, respectively. The heaviest exposure observed during the attaching of brake linings to shoes (4.80 fibers/ cm3) was due to drilling the lining. The heaviest exposure observed during the attaching of clutch facings (3.15 fibers/ cm3) to clutch disks was due to the riveting on of a clutch facing. (P. 5/12)See Table 3, pgs 7-8/12 |
| Area sampling data: | Highest geometric mean concentration of asbestos (1.253 fibers/cm3) was obtained during the operation of attaching clutch facings to disks. The geometric mean concentration exceededthe occupational exposure limit (0.15 fibers/cm3) in the following operations: drilling holes in clutch facings, grinding brake linings with a grindstone, stripping worn brake linings and clutch facings, attaching brake linings to shoes, visual inspection and packaging,and gluing linings to brake shoes. The asbestos concentration in a locker room in factory B was 1.72 fibers/cm3. (P. 7/12)See Table 4, pg. 9 and Table 5, pg 11/12 for literature reported values |
| Personal protective equipment: | Only a few workers used personal respiratory protectiveequipment. (P. 4/12) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | High | Sampling or analytical methodology is an approved OSHA or NIOSH method or is well described and found to be equivalent to approved OSHA or NIOSH methods. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Medium | The data are from an OECD country, Japan. |
| | Metric 3: | Applicability | High | The data are for an occupational scenario within the scope of the risk evaluation. Processing of automobile components-Brake pads. |
| | Metric 4: | Temporal Representativeness | Low | Data is more than 20 years old. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | Monitoring data include all associated metadata. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | High | The monitoring study addresses variability in the determinants of exposure for the sampled site or sector. |

## Overall Quality Determination High

**Study Citation:** Sakol, G., Muszynska-Graca, M. (2019). Air Pollution during Asbestos Removal. Polish Journal of Environmental Studies 28(2):1007-1011.
**HERO ID:** 6890958
**Conditions of Use:** Disposal

**EXTRACTION**

| Parameter | Data |
|---|---|
| Worker activity description: | Transfer of asbestos-cement products into a disposal container. (2/6) |
| Exposure route: | inhalation (3/6) |
| Physical form: | dust (3/6) |
| Area sampling data: | (PCM) During transfer of asbestos cement waste to a container at a block of flats, respirable fibers were 0.18+-2.77 f/cm3 with a range of 0.24-0.84 f/cm3. During transfer of asbestos cement waste to a container at a cooling tower, respirable fibers were 0.05+-2.25 f/cm3 with a range of 0.01-0.29. (3/6) |
| Particle size characterization: | More than half of the dimensioned fibers were in the range 5-10 µm with diameters thinner than 1 µm. (2/6) Table 2 presents the full fiber size distribution. (3/6) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | High | Sampling or analytical methodology is an approved OSHA or NIOSH method or is well described and found to be equivalent to approved OSHA or NIOSH methods. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Medium | Data are from Poland, an OECD country. |
| | Metric 3: | Applicability | High | Data are for disposal of asbestos material, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | High | Monitoring data were collected after the most recent PEL and no more than 10 years old. |
| | Metric 5: | Sample Size | Medium | Sample distribution characterized by limited statistics (means, standard deviations, ranges, percentages) but discrete samples not provided and distribution not fully characterized. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Exposure type and sampling data provided, but missing number of workers, exposure duration, frequency, engineering controls, and PPE. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | Uncertainty is not addressed. Variability is addressed by sampling at two disposal sites with different purposes. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Sakol, G., Muszynska-Graca, M. (2019). Air Pollution during Asbestos Removal. Polish Journal of Environmental Studies 28(2):1007-1011. |
| **HERO ID:** | 6890958 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Stripping and removing asbestos-cement. (2/6) |
| Exposure route: | inhalation (3/6) |
| Physical form: | dust (3/6) |
| Area sampling data: | (PCM) During stripping of asbestos cement in a block of flats, respirable fibers were 0.20+-2.74 f/cm3 with a range of 0.03-0.90 f/cm3. During removal of asbestos cement from a cooling tower, respirable fibers were 0.04+-1.87 f/cm3 with a range of 0.01-0.20 f/cm3. (3/6) |
| Particle size characterization: | More than half of the dimensioned fibers were in the range 5-10 µm with diameters thinner than 1 µm. (2/6) Table 2 presents the full fiber size distribution. (3/6) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | High | Sampling or analytical methodology is an approved OSHA or NIOSH method or is well described and found to be equivalent to approved OSHA or NIOSH methods. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Medium | Data are from Poland, an OECD country. |
| | Metric 3: | Applicability | High | Data are for demolition of asbestos products, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | High | Monitoring data were collected after the most recent PEL and no more than 10 years old. |
| | Metric 5: | Sample Size | Medium | Sample distribution characterized by limited statistics (means, standard deviations, ranges, percentages) but discrete samples not provided and distribution not fully characterized. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Exposure type and sampling data provided, but missing number of workers, exposure duration, frequency, engineering controls, and PPE. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | Uncertainty is not addressed. Variability is addressed by sampling at two demolition sites with different purposes. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Salisbury, S., Koenig, J. (1989). Health hazard evaluation report no. HETA 87-0379-1977, Keebler Company, Atlanta, Georgia. |
| **HERO ID:** | 3097748 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Previous activity performed at the plant included removal of asbestos insulation from oven Line No. 3. PDF Pg. 2 |
| Exposure route: | Inhalation. |
| Physical form: | Fibers (solid). |
| Area sampling data: | Using phase contrast microscopy (PCM) no fibers of any type were found in air samples collected in the Line No. 3 oven area. PDF Pg. 15 |
| Number of workers: | When the NIOSH investigators conducted the first site visit, the bakery employed about 340 production workers. PDF Pg. 4 |
| Engineering control: | Local exhaust ventilation. PDF Pg. 4 |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Sampling and Analytical Methodology | High | Sampling/analytical methodology is an approved NIOSH method. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | Data are from the U.S. |
| Metric 3: | Applicability | High | Data are for construction, paint, electrical, and metal products, an in-scope occupational scenario. |
| Metric 4: | Temporal Representativeness | Low | Monitoring data are greater than 20 years old. |
| Metric 5: | Sample Size | Low | Sample distribution is characterized by no statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | High | Sample type and exposure type provided but missing exposure duration and frequency. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Medium | Uncertainty is addressed in sampling/analytical methodology but variability is not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Sallemi, B. M. (2012). A life-time mortality risk analysis and cost benefit analysis associated with asbestos exposure from the collapse of the World Trade Center on 9/11: Does the cost of US-EPA's residential dust clean-up in lower Manhattan exceed its benefit?. |
| **HERO ID:** | 6897672 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | removing debris at ground zero after 9/11 (pg 10) |
| Exposure route: | inhalation |
| Physical form: | airborne fibers |
| Personal sampling data: | Note: Including whole portions of text for context (e.g., dates important to 9/11 cleanup sampling, analytical methods)Seven of these samples were collected indoors with two being additionally analyzed via ATEM analysis. Three of the seven were personal air samples with the remaining four being ambient air samples. One of the three personal air sample results returned a result greater than 0.01 f/mL (0.023 f/mL), which triggered analysis by ATEM. The ATEM analysis of those fibers observed by PCM did not confirm the presence of asbestos (pg 62)One hundred seventy-eight (178) PCM samples were collected outdoors on September 15, 2001, with twenty-five (14%) of those samples additionally analyzed by ATEM. 51 of the 178 outdoor samples collected were ambient air samples with the remaining samples representing personal air samples... Outdoor personal air sample results range from none detected to 0.105 f/mL, which triggered 25 of them to be further analyzed by ATEM. The ATEM data for the outdoor personal air samples detected asbestos in 3 of the 25 (12%). These ranged in concentration from 0.012 to 0.017 f/mL. (pg 62-63)OSHA data also exists for the period of September 23, 2001 through April 3, 2002. In all, 548 ambient and 664 personal air samples were collected. The data is not clear as to whether they represent indoor or outdoor environments; we will assume that the majority of the data represents the outdoor environment... All but 22 of the 664 (3.3%) personal air samples were less than 0.01 f/mL, with the results ranging from 0.01 to 0.073 f/mL (pg 63)The NYS Public Employee Safety & Health (PESH) Program collected asbestos air samples during four separate occasions... For the period ending November 29, 2001, six personal air samples were collected and analyzed using the NIOSH 7400 methodology, which counts total fibers that meet a 3:1 aspect ratio and are 5µm or greater in length. All six samples returned results greater than 0.01 f/mL, but less than 0.1 f/mL... On December 18, 2001, three additional personal air samples were collected and analyzed via NIOSH 7400. Two of these samples returned results greater than 0.01 f/mL, but less than 0.1 f/mL... On January 30, 2002 a total of 2 personal air samples were collected by NYS PESH and analyzed via NIOSH 7400. The results of the two personal air samples were greater than 0.01 f/mL, but less than 0.1 f/mL... The final period of sampling conducted by PESH ranges from March 12, 2002 through April 20, 2002 in which a total of 23 air samples (8 ambient samples and 15 personal samples) were collected and analyzed using PCM and the NIOSH 7400 methodology... fourteen of the fifteen personal samples were equal to or greater than 0.014 f/mL, but less than 0.1 f/mL. Only one personal sample was reported as being "not detected". (pg 65)The arithmetic mean of personal asbestos exposure to Search & Rescue worker's was calculated to be 0.009 af/mL. In conducting this calculation airborne asbestos fiber determinations using ATEM were used instead of total fiber counts by PCM. These calculations also used zero where no asbestos was detected using ATEM. The worst-case Search & Rescue worker asbestos exposure was evaluated at 0.2 f/mL collected from an ironworker on September 28, 2001, just one day before the Search & Rescue operations would cease. However this result was downgraded by ATEM analysis as the majority of the fibers counted using PCM analysis were not asbestos. The true worst-case asbestos related exposure was determined to be 0.07 af/mL after conversion. This sample represented a personal air sample collected by OSHA on a laborer on September 25, 2001. (pg 72; proceeded by cumulative exposure calculations)Site Clean-up and Recovery activities were initiated on September 30, 2001, and lasted through March 30, 2002. The arithmetic mean of personal asbestos exposure to the Clean-up & Recovery workers was 0.0007 af/mL. Similarly, in conducting this calculation, airborne asbestos fiber determinations using ATEM were used instead of total fiber counts by PCM. This calculation also used zero where no asbestos was detected using ATEM. The worst-case personal air concentration collected during the Clean-up and Recovery activities was 0.8 f/mL, which was downgraded to zero by ATEM as none of the fibers counted using PCM were asbestos. The true worst case asbestos-related personal exposure to any Clean-up and Recovery worker was 0.05 af/mL on an air sample collected by OSHA on March 27, 2002. (pg 73; proceeded by cumulative exposure calculations) |

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|---|---|
| **Study Citation:** | Sallemi, B. M. (2012). A life-time mortality risk analysis and cost benefit analysis associated with asbestos exposure from the collapse of the World Trade Center on 9/11: Does the cost of US-EPA's residential dust clean-up in lower Manhattan exceed its benefit?. |
| **HERO ID:** | 6897672 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Area sampling data: | | | Note: source calls a lot of this data "ambient" sampling, I guess because it's area sampling outdoors. Assuming this is in-scope as area sampling due to nature of 9/11 cleanup. Including whole portions of text for context (e.g., dates important to 9/11 cleanup sampling, analytical methods)Seven of these samples were collected indoors with two being additionally analyzed via ATEM analysis. Three of the seven were personal air samples with the remaining four being ambient air samples... Of the remaining four ambient samples collected in the same period, two were greater than 0.01 f/mL, however, the larger result of the two (0.069 f/mL) was additionally analyzed by ATEM. The ATEM results of this sample confirmed airborne asbestos fiber concentrations of 0.015 asbestos fibers per milliliter (f/mL) (pg 62)One hundred seventy-eight (178) PCM samples were collected outdoors on September 15, 2001, with twenty-five (14%) of those samples additionally analyzed by ATEM. 51 of the 178 outdoor samples collected were ambient air samples with the remaining samples representing personal air samples. The outdoor ambient air sample showing the highest result was 0.034 f/mL. All of the outdoor ambient air samples were analyzed by PCM which count total fibers that meet the 3:1 aspect ratio (pg 62)OSHA data also exists for the period of September 23, 2001 through April 3, 2002. In all, 548 ambient and 664 personal air samples were collected. The data is not clear as to whether they represent indoor or outdoor environments; we will assume that the majority of the data represents the outdoor environment. All but 4 of the 548 (0.7%) ambient air samples were less than 0.01 f/mL, with the elevated concentrations ranging from 0.011 f/mL to 0.028 f/mL (pg 63)US-EPA PCM air sample data exists for the period representing September 22 through 24, 2001. In total, 42 air samples were collected from various locations in the five boroughs [likely not in-scope if not Manhattan but doesn't specify], with all samples returning results below 0.01 f/mL. (pg 63)US-EPA air samples were also collected on September 24, 2001 in lower Manhattan. Sixteen samples were collected and analyzed using the ATEM/AHERA methodology. Four of the 16 air samples detected the presence of airborne asbestos, with none greater than 70 s/mm2 (pg 63)pg 63-64 have ambient sampling for Staten Island and NJ, as well as roof sampling and sampling 2.5 miles away from ground zero in Manhattan that are likely out of scopeThe NYS Public Employee Safety & Health (PESH) Program collected asbestos air samples during four separate occasions... The final period of sampling conducted by PESH ranges from March 12, 2002 through April 20, 2002 in which a total of 23 air samples (8 ambient samples and 15 personal samples) were collected and analyzed using PCM and the NIOSH 7400 methodology. The results of all eight of the ambient samples were reported as "not detected" (pg 64-65)The New York City School Construction Authority (NYCSCA) collected asbestos related air samples during the period of September 13-18, 2001. In total, 134 air samples (45 ambient air samples, 80 low volume air samples with calculated 8-hour TWA's, and 9 thirty minute short duration excursion samples) were collected and analyzed using PCM.Thirty nine of the fortyfive ambient air samples were reported greater than 0.01 f/mL. Five of the eighty (6.25%) calculated 8-hour TWA's were greater than 0.1 f/mL, and zero of the nine low volume short duration samples were greater than 0.1 f/mL. A total of seven low-volume, short duration air samples exceeded 0.1 f/mL (pg 65)On September 15, 2001, NYCSCA also collected additional air samples and analyzed them for airborne asbestos using ATEM using the AHERA methodology. In total fifteen (15) samples were collected, of which nine (9) or 60% exceeded 70 s/mm2 (pg 66)Pg 66-67 has school and residential exposure sampling, out-of-scope The arithmetic mean of ambient asbestos air sampling conducted during the Search & Rescue operations was 0.015 af/mL. In conducting this calculation, similar to the personal exposures above, airborne asbestos fiber determinations using ATEM were used instead of total fiber counts by PCM. These calculations also used zero where no asbestos was detected using ATEM. The worst-case ambient air concentration collected during the Search & Rescue operations was 0.2 f/mL (total fibers) and was collected by the NYCSCA on the intersection of Murray & West Streets on September 15, 2001. The greatest airborne asbestos determination was also made on September 15, 2001 and was 0.1 af/mL. This determination, that is specific for asbestos was used in the exposure calculations to follow. (pg 72; proceeded by cumulative exposure calculations)The arithmetic mean of ambient air sampling conducted during the clean-up and recovery activities were 0.003 af/mL. In conducting this calculation, similar to the personal exposures above, airborne asbestos fiber determinations using ATEM were used instead of total fiber counts by PCM. These calculations also used zero where no asbestos was detected using ATEM. The worst-case ambient air concentration collected during the Search & Rescue operation was 0.9 f/mL, which was downgraded by ATEM to zero as none of the fibers counted using PCM were asbestos. The true worst-case ambient exposure was evaluated at 0.03 af/mL collected by OSHA on October 5, 2001. (pg 73; proceeded by cumulative exposure calculations) |
| Particle size characterization: | | | different fiber size categories discussed throughout |
| Exposure duration: | | | see sampling durations8-hr/day (pg 70) |
| Exposure frequency: | | | The above referenced preliminary air data has been examined, and synthesized into three main potential exposure groups: an 18-day exposure group for emergency workers that conducted Search & Rescue activities, and who arrived onsite on September 12, 2001, the day following the collapse of the WTC as the National Guard slowly allowed additional workers around Ground Zero which formally ended on September 29, 2001; a 182-day exposure group for Clean-up and Recovery workers, which formally ended on March 30, 2002; 250 work days/year (pg 70) |
| Comments: | | | Analytical Transmission Electron Microscopy (ATEM), Phase Contrast Microscopy (PCM), Polarized Light Microscopy (PLM), Phase Contrast Microscopy Equivalent (PCMe); analytical methods described in Table 2, pg 104 |

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|---|---|
| **Study Citation:** | Sallemi, B. M. (2012). A life-time mortality risk analysis and cost benefit analysis associated with asbestos exposure from the collapse of the World Trade Center on 9/11: Does the cost of US-EPA's residential dust clean-up in lower Manhattan exceed its benefit?. |
| **HERO ID:** | 6897672 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

| Domain | Metric | EVALUATION Rating | Comments |
|---|---|---|---|

| Domain | Metric | EVALUATION Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Sampling and Analytical Methodology | High | Sampling/analytical methodology is equivalent to an approved OSHA/NIOSH method. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | High | Data are from the U.S. |
| | Metric 3: Applicability | High | Data are for construction materials (9/11 cleanup), an in-scope occupational scenario. |
| | Metric 4: Temporal Representativeness | Medium | Monitoring data were collected after the most recent PEL and greater than 10 years old. |
| | Metric 5: Sample Size | Medium | Sample distribution characterized by limited statistics (means, maximums) but discrete samples not provided and distribution not fully characterized. |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | High | All metadata provided. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Medium | Variability addressed by using different analytical methods and sampling at different time periods following 9/11, but uncertainty is not addressed. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Sallemi, B. M. (2012). A life-time mortality risk analysis and cost benefit analysis associated with asbestos exposure from the collapse of the World Trade Center on 9/11: Does the cost of US-EPA's residential dust clean-up in lower Manhattan exceed its benefit?. |
| **HERO ID:** | 6897672 |
| **Conditions of Use:** | Other: |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Area sampling data: | >5 million particles per cubic foot (mppcf) (pg 16) |
| Comments: | impinger method |

**EVALUATION**

| Domain | | Metric | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Medium | Sampling/analytical methodology is not an approved OSHA/NIOSH method but is an acceptable methodology. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | Low | Data are for textile MFG, an upstream out-of-scope occupational scenario, but data may still be informative. |
| | Metric 4: | Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| | Metric 5: | Sample Size | Medium | Sample distribution characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Low | Sample type provided but no other metadata. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination — Low

| | |
|---|---|
| **Study Citation:** | Sanderson, W. T., Ferguson, R. P. (1987). Health Hazard Evaluation Report No. MHETA-85-226-1839, Freshlabs, Inc., Warren, Michigan. Division of Physical Sciences and Engineering(CT-147-19D):147-19. |
| **HERO ID:** | 3099464 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | asbestos-containing insulation (pg 3)asbestos found at: 1) in- coming air duct in mixing room Sigma III; 2) ventilation duct in compression room #15; 3) on pipes outside the men's upstairs restroom; 4) over the doorway to the sugar coating compressor room; 5) a storage rack in the warehouse; and 6) a electrical box near storage rack #15 (pg 9)building maintenance, repair, renovation or other activities disturb asbestos-containing material, or if it is damaged... Damaged asbestos insulation is located on the ceiling throughout the Freshlabs facility (pg 14) |
| Exposure route: | inhalation |
| Physical form: | solid (dust) |
| Personal sampling data: | Five (15.6%) total dust samples exceeded the ACGIH recommended exposure level for nuisance dusts. None of the respirable dust samples, but two total dust samples from the compression area, exceeded the OSHA-PEL (pg 8)Table VI presents personal respirable and total dust measurements in 10 areas; resp. range: 0.04-1 mg/m3; total range: 0.08-53 mg/m3 (pg 23) |
| Area sampling data: | dust measurements were found to be below the OSHA permissible exposure limits for "nuisance" dust (pg 3)Dust concentrations at press #10 were clearly excessive, whereas concentrations at the other presses were under required limits. (pg 5)airborne dust concentrations in those areas [compression or blending departments] were considerably higher than concentrations in other areas (pg 7)Table II presents area respirable and total dust measurements in 4 areas; resp. range: 0.18-18.10 mg/m3; total range: 2.86-11.05-"overloaded" mg/m3 (pg 19) |
| Particle size characterization: | Table VIII (pg 26) has PSD data for dust, not asbestos-specific |
| Number of workers: | 70 people in production, maintenance, housekeeping, and line supervision (pg 4)Table XII (pg 30) breaks down 63 workers interviewed by work area (8 different work areas), ranging from 2-19 workers |
| Personal protective equipment: | disposable dust masks (pg 5)Gloves and tight fitting clothing may actually compound the problem by holding the materials close to the skin (pg 15) |
| Engineering control: | local exhaust ventilation (pg 3)asbestos insulation encapsulated (pg 5)discussion of ventilation on pg 9Local exhaust hoods should be designed to enclose the hoppers and mixing barrels in the compression, milling, and blending areas as much as possible... [air] velocity should be approximately 100-200fpm. (pg 15)Table IX (pg 27) presents data on ventilation systems |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Sampling and Analytical Methodology | High | Sampling/analytical methodology is an approved NIOSH method. (NIOSH HHE) |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | Data are from the U.S. |
| Metric 3: | Applicability | Medium | Data are for construction materials, an in-scope occupational scenario; however, data are for dust, of which asbestos is a part, but not asbestos-specific sampling. |
| Metric 4: | Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| Metric 5: | Sample Size | Medium | Sample distribution characterized by limited statistics (means, ranges) but discrete samples not provided and distribution not fully characterized. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Medium | Sample type and exposure type provided but missing metadata such as exposure frequency. |

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|---|---|
| **Study Citation:** | Sanderson, W. T., Ferguson, R. P. (1987). Health Hazard Evaluation Report No. MHETA-85-226-1839, Freshlabs, Inc., Warren, Michigan. Division of Physical Sciences and Engineering(CT-147-19D):147-19. |
| **HERO ID:** | 3099464 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

| | | EVALUATION | |
|---|---|---|---|
| Domain | Metric | Rating | Comments |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Medium | Variability is addressed by sampling in various areas as well as for total and respirable dust concentrations, but uncertainty is not addressed. |

## Overall Quality Determination — Medium

**Study Citation:** Sawyer, R. N. (1977). Asbestos exposure in a Yale building: Analysis and resolution. Environmental Research 13(1):146-169.
**HERO ID:** 180
**Conditions of Use:** Disposal

**EXTRACTION**

| Parameter | Data |
|---|---|
| Worker activity description: | Workers performed various remedial and demolition work on the ceilings. Electricians and carpenters were sampled. (7/24) |
| Exposure route: | inhalation, ingestion (1/24) |
| Physical form: | fibers (2/24) |
| Area sampling data: | During removal, concentrations ranged from 82.2+-24.7 f/cm3 (dry removal) to 8.1+-4.6 f/cm3 (treated water removal). (10/24) |
| Particle size characterization: | Only fibers longer than 5um were measured in this study. (7/24) |
| Exposure duration: | Typical remediation, lighting, and carpentry tasks took about 1 hour. (8/24) |
| Number of workers: | 40 contractors (14/24) |
| Personal protective equipment: | Protection included full body coveralls, disposable head covers, and mechanical filter respirators. Where heavy contamination was anticipated, full face, constant air flow, hose-supplied respirators were employed. (8/24) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | High | Sampling/analytical methodology is equivalent to an approved [OSHA/NIOSH] method. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for disposal of asbestos material, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| | Metric 5: | Sample Size | Medium | Sample distribution characterized by limited statistics (mean, standard deviations, ranges) but discrete samples not provided and distribution not fully characterized. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Sample type and exposure type provided, but missing exposure frequency, and engineering control. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | High | Uncertainty is addressed in sampling/analytical methodology. Variability addressed by sampling before, during, and after removal. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Sawyer, R. N. (1977). Asbestos exposure in a Yale building: Analysis and resolution. Environmental Research 13(1):146-169. |
| **HERO ID:** | 180 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Exposure route: | inhalation, ingestion (1/24) |
| Physical form: | fibers (2/24) |
| Area sampling data: | Before painting over the ceiling, area sampling detected a mean of 0.3 f/cm3 and range of 0.1-0.5 f/cm3. After painting over the ceiling, mean concentrations were 0.1 f/cm3 with a range of 0.0-0.2 f/cm3. (6/24) Electricians installing lighting units were exposed to 7.7+-2.9 and 1.1+-0.8 f/cm3. (9/24) |
| Particle size characterization: | Only fibers longer than 5um were measured in this study. (7/24) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | High | Sampling/analytical methodology is equivalent to an approved [OSHA/NIOSH] method. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for commercial use of chemical substances in construction products, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| | Metric 5: | Sample Size | Medium | Sample distribution characterized by limited statistics (mean, standard deviations, ranges) but discrete samples not provided and distribution not fully characterized. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Sample type and exposure type provided, but missing exposure duration, frequency, worker information, PPE, and engineering control. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | High | Uncertainty is addressed in sampling/analytical methodology. Variability addressed by sampling before, and after painting. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Sawyer, R. N., Rohl, A. N., Langer, A. M. (1985). Airborne fiber control in buildings during asbestos material removal by amended water methodology. Environmental Research 36(1):46-55. |
| **HERO ID:** | 3083482 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Removal of asbestos material. (P. 1/10) |
| Physical form: | fiber, dust |
| Personal sampling data: | Mean = 1.6 Range = 0.7 - 2.9 fibers/cm^3. DURING AMENDED WET REMOVAL |
| Area sampling data: | Work area fiber counts (fibers/cm^3)Dry removal: mean = 38.9, range = 8.1 - 117.8Wet removal: mean = 1.1 , range = 0.0 - 37.1Bagging: mean = 3.9, range = 0.0 - 8.1 |
| Engineering control: | Control of fiber emission by material wetting. Wetting increases the cohesiveness of friable material, reduces dust emission, and can reduce the aerodynamic capability of released fibers. A surfactant is used to produce amended water to both thoroughly penetrate the friable material and reduce the amount of water required for adequate wetting. |
| Comments: | Table 1 lists fiber counts in seven categories that follow the work sequence of a removal operation. Data are presented in all categories for the work area, five categories outside the barriers, and two outside the building. |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | High | Sampling or analytical methodology is an approved OSHA or NIOSH method or is well described and found to be equivalent to approved OSHA or NIOSH methods. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | The data are from the United States. |
| | Metric 3: | Applicability | High | The data are for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Low | Report is more than 20 years old. |
| | Metric 5: | Sample Size | Medium | Mean, standard deviation and range given but individual data points not provided. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Monitoring data include most critical metadata, such as sample type and exposure type, but lacks additional metadata, such as exposure durations and exposure frequency. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | Variability is addressed by sampling for different work sequence but uncertainty is not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Scansetti, G., Pira, E., Botta, G. C., Turbiglio, M., Piolatto, G. (1993). Asbestos exposure in a steam-electric generating plant. Annals of Occupational Hygiene 37(6):645-653. |
| **HERO ID:** | 3093853 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Workers at a steam power plant (2/9) |
| Exposure route: | inhalation (1/9) |
| Physical form: | fibers (1/9) |
| Area sampling data: | (SEM) Near the boilers, 45% of air samples contained <1 f/L, 50% of samples contained between 1 and 2 f/L, and 5% of samples contained between 2 and 4 f/L. Near the turbines, 38% of samples contained <1 f/L, 33% of samples contained between 1 and 2 f/L, 14.5% of samples contained between 2-4 f/L. 9.5% of samples contained 4-6 f/mL, and 5% of samples contained >=6 f/L. (3/9) |
| Number of workers: | 521 men at the power plant (2/9) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Sampling and Analytical Methodology | High | Sampling/analytical methodology is equivalent to an approved [OSHA/NIOSH] method. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | Medium | Data are from Italy, an OECD country. |
| Metric 3: | Applicability | High | Data are for industrial use in construction materials, an in-scope occupational scenario. |
| Metric 4: | Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| Metric 5: | Sample Size | Medium | Sample distribution characterized by limited statistics (percentages, ranges) but discrete samples not provided and distribution not fully characterized. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Medium | Exposure type and sampling data provided, but missing exposure duration, frequency, particle size, engineering controls, and PPE. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | High | Uncertainty is addressed in sampling/analytical methodology. Variability is addressed by sampling near the boilers and the turbines. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Scarlett, H. P., Delzell, E., Sathiakumar, N., Oestenstad, R. K., Postlethwait, E. (2010). Exposure to airborne asbestos in Jamaican hospitals. West Indian Medical Journal 59(6):668-673. |
| **HERO ID:** | 2573668 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Boiler operators, pipe fitters, electricians, plumbers, and carpenters working on hospitals. ONUs include porters, sanitation workers, and security guards (3/6). |
| Exposure route: | inhalation (2/6) |
| Physical form: | fibers (2/6) |
| Personal sampling data: | Using PCM, 163 personal and area samples ranged from 0.001-0.013 f/cc. The mean (SD)fiber concentration was 0.0019 (+-0.0014) f/cc. 131 personal TWAs ranged from <0.002-0.013 f/cc. The overall mean estimated 8-hour TWA was 1.85 x10-3 f/cc (SD =0.0013). However, when tested with TEM, the fibers were not confirmed to be asbestos. (4/6) |
| Area sampling data: | Using PCM, 163 personal and area samples ranged from 0.001-0.013 f/cc. The mean (SD)fiber concentration was 0.0019 (+-0.0014) f/cc. |
| Particle size characterization: | Long ($\geq$ 8 µm in length) and thin ($\leq$ 1.5 µm in width) asbestos fibers have the greatest inhalation potential. (2/6) |
| Exposure duration: | 8 hours (3/6) |
| Number of workers: | Globally, an estimated 125 million people are still occupationally exposed to asbestos (2/6) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Sampling and Analytical Methodology | High | Sampling/analytical methodology is an approved NIOSH method. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | Low | Data are from Jamaica, a non-OECD country. |
| Metric 3: | Applicability | High | Data are for commercial use in construction materials, an in-scope occupational scenario. |
| Metric 4: | Temporal Representativeness | Medium | Monitoring data were collected after the most recent PEL and greater than 10 years old. |
| Metric 5: | Sample Size | Medium | Sample distribution characterized by limited statistics (ranges, mean, median, SD) but discrete samples not provided and distribution not fully characterized. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Medium | Exposure type and sampling data provided, but missing exposure frequency, engineering controls, and PPE. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | High | Uncertainty is addressed in sampling/analytical methodology. Variability is addressed by sampling at two facilities and comparing PCM with TEM. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Scarselli, A., Corfiati, M., Di Marzio, D. (2016). Occupational exposure in the removal and disposal of asbestos-containing materials in Italy. International Archives of Occupational and Environmental Health 89(5):857-865. |
| **HERO ID:** | 3531414 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Workers handling asbestos mostly in the construction sector (pg 857) |
| Exposure route: | inhalation (pg 857) |
| Physical form: | In the analysis by mineral type, fiber concentrations were the highest for the anthophyllite (N = 446, GM = 0.0093 f/cc, GSD = 5.60, 75th percentile = 0.050) and actinolite (N = 420, GM = 0.0088 f/cc, GSD = 5.54, 75th percentile = 0.050) and lowest for chrysotile (N = 8403, GM = 0.0040 f/cc, GSD = 6.46, 75th percentile = 0.011). (pg 859) |
| Area sampling data: | The mean airborne concentration of asbestos fibers in workplaces was 0.025 f/cc (N = 15,860, AM = 0.025 f/cc, GM = 0.006 f/cc, GSD = 6.55, 95 % CI 0.0058–0.0061, 75th percentile = 0.0318). (pg 859) |
| Number of workers: | Data was collected for 2470 workers in 241 different firms (pg 858) |
| Personal protective equipment: | The use of more adequate respiratory protective equipment make the current asbestos exposure clearly lower than in the past (pg 863) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Sampling and Analytical Methodology | Low | Sampling or analytical methodology is not specified. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | Medium | The data are from an OECD country other than the U.S. |
| Metric 3: | Applicability | High | The data are for an occupational scenario within the scope of the risk evaluation. |
| Metric 4: | Temporal Representativeness | Medium | Data from 1996-2013. |
| Metric 5: | Sample Size | Medium | Mean and standard deviation provided but individual data points not given. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Medium | Monitoring data include most critical metadata, such as sample type and exposure type, but lacks additional metadata, such as sample durations, exposure durations, exposure frequency, and/orworker activities. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Medium | Variability is addressed by sampling many locations but uncertainty is not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Scarselli, A., Marinaccio, A., Corfiati, M., Di Marzio, D., Iavicoli, S. (2020). Occupational asbestos exposure after the ban: a job exposure matrix developed in Italy. European Journal of Public Health 30(5):936-941. |
| **HERO ID:** | 6874951 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Work sectors in the study include civil engineers, safety inspectors, concrete placers, carpenters, insulation workers, plumbers, building finishers, sheet-metal workers, cement operators, chemical product machine operators, garbage collectors, building construction laborers, and manufacturing laborers. (3/6) |
| Exposure route: | inhalation (1/6) |
| Physical form: | fiber (1/6) |
| Area sampling data: | The geometric mean of the airborne asbestos fiber concentration in 1996-2016 was 7.93+-9.6 f/L. (2/6) Table 2 breaks down exposures by year and occupation. (3/6) |
| Number of workers: | 46,422 workers (86% male) were estimated potentially at risk of exposure to asbestos in the selected industrial sectors (2/6) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Sampling and Analytical Methodology | High | Sampling/analytical methodology is equivalent to an approved [OSHA/NIOSH] method. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | Medium | Data are from Italy, an OECD country. |
| Metric 3: | Applicability | High | Data are for commercial use of chemical substances in construction products, an in-scope occupational scenario. |
| Metric 4: | Temporal Representativeness | High | Monitoring data were collected after the most recent PEL and no more than 10 years old. |
| Metric 5: | Sample Size | Medium | Sample distribution characterized by limited statistics (mean, standard deviations, confidence intervals, percentages) but discrete samples not provided and distribution not fully characterized. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Medium | Sample type and exposure type provided, but missing exposure duration, frequency, particle size, PPE, and engineering control. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | High | Uncertainty is addressed in sampling/analytical methodology. Variability addressed by sampling across 10 years of data in different occupations. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Schneider, T. (1984). Recordkeeping on occupational exposures and cancer. Scandinavian Journal of Work, Environment and Health 10(3):208-208. |
| **HERO ID:** | 3100846 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | removal of sprayed crocidolite (pg 2) |
| Area sampling data: | Table 1 (pg 2): 0.05-311 f/cm3 |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Low | Sampling/analytical methodology is not specified. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Medium | Data are from Denmark, an OECD country. |
| | Metric 3: | Applicability | High | The data are for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| | Metric 5: | Sample Size | Medium | Uncertain whether these values are discrete or averages. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Monitoring data include most critical metadata, such as sample type and exposure type, but lacks additional metadata, such as sample durations, exposure durations, and exposure frequency. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination — Low

| | |
|---|---|
| **Study Citation:** | Schroeder, P. W., Pekron, P. (1990). Asbestos abatement during major coke plant steelwork repairs. Ironmaking Conference Proceedings, vol. 49 :169-171. |
| **HERO ID:** | 6879303 |
| **Conditions of Use:** | Disposal |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Area sampling data: | Area samples were all below 0.1 f/cc. (4/5) |
| Personal protective equipment: | Respirators and protective clothing was used. (4/5) |
| Engineering control: | Alleyways were isolated from abatement areas with metal shields, contaminated surfaces were sprayed with encapsulants, platforms were equipped with HEPA filters, surfaces were wetted, and decontamination stations were used. All asbestos removed was double bagged and labeled. (4/5) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Sampling and Analytical Methodology | Low | Sampling methodology not specified. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | High | Data are from the U.S. |
| | Metric 3: Applicability | High | Data are for asbestos abatement, an in-scope occupational scenario. |
| | Metric 4: Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| | Metric 5: Sample Size | Medium | Sample distribution characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | Medium | Sampling data provided, but missing physical form, exposure duration, frequency, worker activity, particle size, and number of workers. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Low | Uncertainty and variability not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Sebastien, P., Bignon, J., Martin, M. (1982). Indoor airborne asbestos pollution: from the ceiling and the floor. Science 216(4553):1410-1413. |
| **HERO ID:** | 185 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Area sampling data: | Crocidolite [PDF Pg. 2]Corridors 1, 2, and 3: 0.2, 0.5, and 0.9 (ng/m^3)Workshop: 33 (ng/m^3)Chrysotile [PDF Pg. 2]Corridors 1, 2, and 3: 8. 21, and 25 (ng/m^3)Workshop: 170 (ng/m^3) |
| Number of workers: | 300 workers [PDF Pg. 2] |
| Comments: | Study involved ceilings sprayed with a crocidolite-containing material and floors covered with vinyl-chrysotile tiles. |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Sampling and Analytical Methodology | Medium | Sampling/analytical methodology is equivalent to an approved OSHA/NIOSH method. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | Data are from the U.S. |
| Metric 3: | Applicability | Low | Data are for Chemical Substances in Construction, Paint, Electrical, and Metal Products, an in-scope occupational scenario. However, data are for ambient air in office buildings. |
| Metric 4: | Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Low | Sample type provided but no other metadata. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Medium | Variability addressed by sampling at different locations, but uncertainty is not addressed. |

## Overall Quality Determination — Medium

| | |
|---|---|
| **Study Citation:** | Sebastien, P., Billon, M. A., Dufour, G., Gaudichet, A., Bonnaud, G., Bignon, J. (1979). Levels of asbestos air pollution in some environmental situations. Annals of the New York Academy of Sciences 330:401-415. |
| **HERO ID:** | 6867234 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Construction workers (3/15) |
| Exposure route: | inhalation (3/15) |
| Physical form: | fibers (1/15) |
| Area sampling data: | (TEM) Area samples taken at construction sites ranged from 0.2-9.0 f/ng3. (4/15) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | High | Sampling/analytical methodology is equivalent to an approved [OSHA/NIOSH] method. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Medium | Data are from France, an OECD country. |
| | Metric 3: | Applicability | High | Data are for commercial use in construction materials, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Exposure type and sampling data provided, but missing number of workers, exposure duration, frequency, PPE, particle size, and engineering controls. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | High | Uncertainty is addressed in sampling/analytical methodology. Variability is addressed by sampling at multiple locations in different industries. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Sebastien, P., Billon, M. A., Dufour, G., Gaudichet, A., Bonnaud, G., Bignon, J. (1979). Levels of asbestos air pollution in some environmental situations. Annals of the New York Academy of Sciences 330:401-415. |
| **HERO ID:** | 6867234 |
| **Conditions of Use:** | Consumer Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Office workers in schools, banks, halls, post offices, theaters, laboratories, parking garages, and libraries. (5/15) |
| Exposure route: | inhalation (3/15) |
| Physical form: | fibers (1/15) |
| Area sampling data: | (TEM) Area samples in office settings were 2.0-100,000 f/ng3 amphibole and 0.1-750 f/ng3 chrysotile. (5/15) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Sampling and Analytical Methodology | High | Sampling/analytical methodology is equivalent to an approved [OSHA/NIOSH] method. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | Medium | Data are from France, an OECD country. |
| Metric 3: | Applicability | Low | Data are for office workers exposures, which is similar to commercial use of construction products. |
| Metric 4: | Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Medium | Exposure type and sampling data provided, but missing number of workers, exposure duration, frequency, PPE, particle size, and engineering controls. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | High | Uncertainty is addressed in sampling/analytical methodology. Variability is addressed by sampling at multiple locations in different industries. |

## Overall Quality Determination Medium

**Study Citation:** Senitkova, I., Stevulova, N. (1999). Indoor pollution by asbestos and man-made mineral fibers. :613-618.
**HERO ID:** 6863279
**Conditions of Use:** Other:

**EXTRACTION**

| Parameter | Data |
|---|---|
| Area sampling data: | administration buildings: 0.00082 f/mlpublic buildings: 0.00046 f/mlschools: 0.00073 f/ml (pg 5) |
| Particle size characterization: | diameter <2-3 um, length >5um with ratio greater than 3:1. fibers longer than 8 um and less than 0.5 um thick have the greatest carcinogenic potential (pg 2) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Medium | Sampling/analytical methodology is not an approved OSHA/NIOSH method but is an acceptable methodology. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Medium | Data are from Slovakia, an OECD country. |
| | Metric 3: | Applicability | Low | Data are for exposure to general population rather than workers. |
| | Metric 4: | Temporal Representativeness | Medium | Monitoring data are greater than 20 years old. It is unclear whether the data was taken before or after the PEL |
| | Metric 5: | Sample Size | Low | Sample distribution is characterized by no statistics. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Low | Sample type provided but no other metadata. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Low

| | |
|---|---|
| **Study Citation:** | Sheehan, P., Mowat, F., Weidling, R., Floyd, M. (2010). Simulation tests to assess occupational exposure to airborne asbestos from artificially weathered asphalt-based roofing products. Annals of Occupational Hygiene 54(8):880-892. |
| **HERO ID:** | 2581178 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Roofing installation, tear-out, and replacement |
| Physical form: | Fiber, dust |
| Personal sampling data: | Study by the National Roofing Contractors Association (NRCA) found in over 1500 individual monitoring results and several thousand personal breathing-zone samples between 1986-1991, none exceeded 0.1 fibers per cubic centimeter. Table 3 on page 8 provides 30 minutes asbestos PBZ. The total range of values is between 0.004-0.24 fibers per cubic centimeter. The same table also provides 30 minutes chrysotile PBZ. The total range of values is between 0.005-0.05 fibers per cubic centimeters |
| Area sampling data: | Previous study conducted by the National Roofing Contractors Association (NRCA) indicated removing asbestos-containing roof flashings, mastics, coatings, and cements yielded low asbestos fiber concentrations [range: 0.004-0.027 fibers per cubic centimeter; mean: 0.024] (1994)A 1982 study found airborne asbestos concentration of 0.1-0.6 fibers per cubic centimeter during tear-out and replacement of roofing materials however the type of material during tear-out and replacement was not specified.A 1987 study from Australia estimated TWAs during building demolition for old buildings as 0.02-0.6 fibers per cubic centimeter.The 8-hr TWAs are provided in Table 4 on page 10. The range of values for total asbestos fibers is 0.005-0.011 fibers per cubic centimeters. The range of values for chrysotile fibers is 0.001-0.002 fibers per cubic centimeter. |
| Comments: | The products tested as part of this study are no longer manufactured. They were ”C-8 Plastic Roof Cement and B-10 Fibered Roof Coating” from ”Monsey and Henry”.Analytical method was NIOSH 7400 and 7402.Study simulated weather conditions for up to a year before taking airborne level concentrations.Transmission electron microscopy was used to analyze asbestos fiber concentration using NIOSH Method 7402. |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Medium | Sampling or analytical methodology is not equivalent to an approved OSHA or NIOSH method and EPA review of information indicates the methodology is acceptable. Differences in methods are not expected to lead to lower quality data. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Medium | Data from U.S and other OECD countries. |
| | Metric 3: | Applicability | High | The data are for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Medium | Monitoring results are 10 years old and also 20 years old. |
| | Metric 5: | Sample Size | Medium | Distribution of samples is characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Monitoring data include most critical metadata, such as sample type and exposure type, but lacks additional metadata, such as exposure durations, exposure frequency, and/or worker activities. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | High | Variability is addressed by including personal and area samples. Uncertainty is also addressed. |

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| | |
|---|---|
| **Study Citation:** | Sheehan, P., Mowat, F., Weidling, R., Floyd, M. (2010). Simulation tests to assess occupational exposure to airborne asbestos from artificially weathered asphalt-based roofing products. Annals of Occupational Hygiene 54(8):880-892. |
| **HERO ID:** | 2581178 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

| | | EVALUATION | |
|---|---|---|---|
| Domain | Metric | Rating | Comments |
| **Overall Quality Determination** | | **Medium** | |

| | |
|---|---|
| **Study Citation:** | Sheehan, P., Mowat, F., Weidling, R., Floyd, M. (2011). Simulation Tests to Assess Occupational Exposure to Airborne Asbestos from Artificially Weathered Asphalt-Based Roofing Products (vol 54, pg 880, 2010). Annals of Occupational Hygiene 55(7):827-827. |
| **HERO ID:** | 3582200 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Asphalt-based roofing workers. (1/1) |
| Exposure route: | inhalation (1/1) |
| Physical form: | fibers (1/1) |
| Personal sampling data: | (TEM) Personal asbestos concentrations over 30 minutes on roofing workers ranged from 0.0009-0.24 f/cc. Chrysotile concentrations ranged from <0.009-0.05 f/cc. (1/1) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Medium | Sampling/analytical methodology is not specified as an approved OSHA/NIOSH method but is an acceptable methodology. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for commercial use in construction materials, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Medium | Monitoring data were collected after the most recent PEL and greater than 10 years old. |
| | Metric 5: | Sample Size | Medium | Sample distribution characterized by limited statistics (ranges, sensitivities) but discrete samples not provided and distribution not fully characterized. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Exposure type and sampling data provided, but missing number of workers, exposure duration and frequency, particle size, engineering controls and PPE. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | High | Uncertainty is addressed by including analytical sensitivities. Variability is addressed by sampling workers handling different products on different days. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Sheers, G., Coles, R. M. (1980). Mesothelioma risks in a naval dockyard. Archives of Environmental Health 35(5):276-282. |
| **HERO ID:** | 3084124 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | The following occupations were studied:laggers/sprayers, painters, welders/burners, boilermakers, shipwrights, electrical fitters, and engine fitters |
| Exposure route: | inhalation |
| Physical form: | solid |
| Area sampling data: | Conditions have been worse in boiler rooms than inengine rooms, with mean values of 171 fibers/ml in boilerrooms and 88 fibers/ml in engine rooms, for samplestaken during the removal of lagging The highest fiber counts (mean value = 353 fibers/ml)have been recorded during the sweeping and bagging ofasbestos debris which were carried out by laborers. (P. 3/8) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Medium | Sampling or analytical methodology is not specified but it is assumed to be PCM. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | The data are from the United States and are representative of the industry being evaluated. |
| | Metric 3: | Applicability | High | The data are for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Low | Metadata on the operations, equipment, and worker activities associated with the data show that the data agree representative of outdated operations, equipment, and activities rather than current operations, equipment, and worker activities. The data were collected before the most recent PEL update. |
| | Metric 5: | Sample Size | Medium | Distribution of samples is characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Monitoring data include most critical metadata, such as sample type and exposure type, but lacks additional metadata, such as sample durations, exposure durations, exposure frequency, and/orworker activities. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | The monitoring study provides only limited discussion of the variability in the determinants of exposure for the sampled site or sector. The monitoring study provides only limited discussion of the uncertainty in the exposure estimates. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Shell Chemical, (1983). Interoffice memorandum regarding IH survey of asbestos during gasket cutting with attachments and cover sheet. |
| **HERO ID:** | 4158387 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | gasket cutting (pg 3)punching gaskets from asbestos containing materials (pg 5)punch press, power shear, roussel press, picking, tumbling, materials handling, platen press (pg 7-8) |
| Exposure route: | inhalation |
| Physical form: | airborne fiber |
| Personal sampling data: | 15 minute samples: 0.12, 0.13, 1.85 f/cc (pg 3)Pg 7-8 table: 0.04-0.81 f/cc |
| Area sampling data: | Pg 5-6 table: 0.04-0.81 f/cc |
| Exposure duration: | Shipping Process Technician spends about 30 minutes per week cutting gasket material into various diameters (pg 3) |
| Personal protective equipment: | A 3M #9920 dust mask (pg 3) |
| Comments: | phase contrast microscopy (pg 5) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Sampling and Analytical Methodology | Medium | Sampling/analytical methodology is not an approved OSHA/NIOSH method but is an acceptable methodology. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | High | Data are from the U.S. |
| | Metric 3: Applicability | Low | Data are for gasket production, an out-of-scope upstream use but data may still be informative for mechanical treatment of ACM. |
| | Metric 4: Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| | Metric 5: Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | Medium | Monitoring data include most critical metadata such as sample type and exposure type, but lacks additional metadata such as exposure durations, exposure frequency, and worker activity details. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | High | The monitoring study addresses variability through collection of multiple sample types (area and personal), as well as multiple worker activities, and measurement uncertainty can be determined from the distribution of sample measurements. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Shell Chemical, (1987). Interoffice memorandum regarding IH monitoring of turnaround activites - Anacortes Refinery with attachments and cover sheet. |
| **HERO ID:** | 4158389 |
| **Conditions of Use:** | Other: |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Demolition and removal of asbestos insulation and other asbestos-containing material. (8/28) |
| Exposure route: | inhalation (9/28) |
| Physical form: | dusts (9/28) |
| Personal sampling data: | Personal samples were 0.07 and 0.06 f/cc during removal of ACM from a pump and <0.04-0.10 f/cc during removal of asbestos from the bottom of a reactor. (18/28) |
| Personal protective equipment: | The PPE required for entry included disposable Tyvek coveralls with hood, gloves, goggles, boots, hard hat and a half face dual cartridge respirator. (9/28) |
| Engineering control: | Prior to asbestos removal, the contractor secured the area with barrier tape and placed warning placards about the perimeter. Large amounts of water were used to wet the ACM to reduce dusts. All insulation removed was placed in labeled plastic bags and stored in a separate dumpster for shipment to a disposal site. (9/28) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Sampling and Analytical Methodology | Low | Sampling methodology not specified. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | Data are from the U.S. |
| Metric 3: | Applicability | High | Data are for demolition of asbestos products, an in-scope occupational scenario. |
| Metric 4: | Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Medium | Exposure type and sampling data provided, but missing number of workers, exposure duration, frequency, and particle size. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Shell Oil, (1985). Interoffice memorandum regarding asbestos monitoring results for Transite Clad Biotreater Buildings with attachments and cover sheet. |
| **HERO ID:** | 4158388 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | A contractor sized and cut the transite siding for construction. (3/6) |
| Physical form: | fibers (3/6) |
| Area sampling data: | Area samples were <0.02-0.05 f/cc. (5/6) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Low | Sampling methodology not specified. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for commercial use in construction materials, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Exposure type and sampling data provided, but missing number of workers, exposure duration, frequency, particle size, engineering controls and PPE. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | Variability is addressed by sampling three buildings at three dates. Uncertainty isn't addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Sinks, T. H., Hartle, R. W., Boeniger, M. F., Mannino, D. M. (1993). Health hazard evaluation report no. HETA 88-119-2345 Hawaiin Commercial & Sugar Company, Puunene, Hawaii, Hamakua Sugar Plantation, Honakaa, Hawaii. |
| **HERO ID:** | 3970494 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Area sampling data: | [PDF Pg. 13]Machinists and mechanics (10 samples): 0.001-0.774 (f/cm^3).Samples from two workers operating planting machinery (onefrom each plantation) had low concentrations (0.017 and 0.018 fibers/cc) of asbestos.Bagasse tractor driver had a single airborne asbestos concentration of 0.77 fibers/cc. Two additional samples on this same worker, taken sequentially on the same day, found no detectable asbestos fibers. |
| Comments: | Samples for inorganic fibers were collected on 25-mm cellulose open-faced filters with conductive cowls. Stationary and personal breathing zone samples were collected at a flow rate of 3 lpm. Analysis was performed using transmission electron microscopy (TEM) at 10,500X magnification for sizing and counting fibers with a length to width ratio of 3:1 or more. Energy dispersive X-ray probe analysis was used for confirmation of the elemental constituents of each fiber. Bulk cane leaf and bagasse dust analysis for inorganic fiber identification and counting, free of an organic matrix, was performed by weighing a given amount of dried leaf, ashing this, and suspending an aliquot of the ash in solution to be distributed on a 25-mm filter. One hundred fields in the resulting filter preparation were examined, and all fibers which met the width to aspect ratio of 1:3 were counted at a microscope setting of10,500X magnification. Fibers in which silica was not a primary constituent were not counted. [PDF Pg. 4] |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Sampling and Analytical Methodology | High | Sampling/analytical methodology is equivalent to an approved OSHA/NIOSH method. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | High | Data are from the U.S. |
| | Metric 3: Applicability | High | Data are for Chemical Substances in Construction, Paint, Electrical, and Metal Products, an in-scope occupational scenario. |
| | Metric 4: Temporal Representativeness | Low | Monitoring data are greater than 20 years old. |
| | Metric 5: Sample Size | Medium | Sample distribution characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | Low | Sample type provided but no other metadata. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | High | Uncertainty is addressed in sampling/analytical methodology. Variability addressed by sampling multiple worker activities. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Smolianskiene, G., Adamoniene, D., Seskauskas, V. (2005). Studies on occupational asbestos in Lithuania: Achievements and problems. Indoor and Built Environment 14(3-4):331-335. |
| **HERO ID:** | 3581050 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | The greatest number of workers was found in the construction industry and in private households where such personnel was hired. (2/5) |
| Exposure route: | inhalation (2/5) |
| Physical form: | fibers (2/5) |
| Personal sampling data: | (PCM) The average concentration of asbestos fibers in workplace atmospheres was 0.02 f/cm3 in the energy industry, 0.03 f/cm2 in the machinery production industry, 0.03 f/cm3 in the construction industry, 0.07 f/cm3 in the chemistry industry, and 0.13 f/cm3 in the transportation industry. (3/5) |
| Particle size characterization: | The greatest danger comes from inhalation asbestos fibers which are longer than um and with a diameter less than 3um and with an aspect ratio <=3. (2/5) |
| Number of workers: | Worldwide, millions of workers are asbestos-exposed in their workplaces, most often when asbestos-containing building materials are handled, repaired or replaced . In Lithuania, the number of potentially exposed workers is as high as 7500. The greatest number of workers was found in the construction industry (3100 (44%)) and in private households where such personnel was hired (2300 (33%)) (2/5) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Sampling and Analytical Methodology | High | Sampling/analytical methodology is equivalent to an approved [OSHA/NIOSH] method. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | Medium | Data are from Lithuania, an OECD country. |
| Metric 3: | Applicability | High | Data are for commercial use of chemical substances in construction products, an in-scope occupational scenario. |
| Metric 4: | Temporal Representativeness | Medium | Monitoring data were collected after the most recent PEL and greater than 10 years old. |
| Metric 5: | Sample Size | Medium | Sample distribution characterized by limited statistics (means, ranges) but discrete samples not provided and distribution not fully characterized. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Medium | Sample type and exposure type provided, but missing exposure duration, frequency, PPE, and engineering control. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Medium | Uncertainty is addressed by using control subjects. Variability is not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Southern Analytical Lab, (1979). Atmosphere filtering monitoring report [878211250]. |
| **HERO ID:** | 4158205 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Area sampling data: | 0.008 f/cc (30 min)0.005 f/cc (30 min)0.0068 f/cc (30 min) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Medium | Sampling or analytical methodology is not specified, but can be assumed to be PCM. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | The data are from the United States and are representative of the industry being evaluated. |
| | Metric 3: | Applicability | Medium | The data are for an occupational scenario that is similar to an occupational scenario within the scope of the risk evaluation, in terms of the type of industry, operations, and work activities. |
| | Metric 4: | Temporal Representativeness | Low | Metadata on the operations, equipment, and worker activities associated with the data show that the data agree representative of outdated operations, equipment, and activities rather than current operations, equipment, and worker activities. The data were collected before the most recent PEL establishment or update. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Low | Monitoring data include sample type (e.g., personal breathing zone) but no other metadata. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | The monitoring study does not address variability or uncertainty. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Southern Analytical Lab, (1979). Atmosphere filtering monitoring report [878211251]. |
| **HERO ID:** | 4158206 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Personal sampling data: | A personal sample taken on a worker behind the control room was 0.08 f/cc. (7/8) |
| Area sampling data: | Two area samples on the USS Forrestal were 0.01 and 0.1 f/cc behind the control room. (5/8) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Low | Sampling methodology not specified. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | Uninformative | No activity description is provided, so the samples are assumed to be ambient air sampling, which isn't in scope. |
| | Metric 4: | Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Sampling data provided, but missing physical form, exposure duration, frequency, worker activity, particle size, PPE, engineering controls, and number of workers. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | Uncertainty and variability not addressed. |

## Overall Quality Determination Uninformative

| | |
|---|---|
| **Study Citation:** | Southern Analytical Lab, (1979). Atmosphere filtering monitoring report [878211254]. |
| **HERO ID:** | 4158208 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Insulation removal in the engine room of the U.S.S. Fox |
| Exposure route: | Inhalation |
| Physical form: | Fibers |
| Personal sampling data: | 0.9 f/cc measured during insulation removal using 170-min sampling time and 2 LPM flowrate. |
| Area sampling data: | 0.1 f/cc measured after insulation removal using 30-min sampling time and 2 LPM flowrate. |
| Engineering control: | The removal area was blocked off from the rest of the ship. |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Sampling and Analytical Methodology | Low | Sampling methodology not specified. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | Data are from the U.S. |
| Metric 3: | Applicability | High | Data are for removal of asbestos products, an in-scope occupational scenario. |
| Metric 4: | Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Medium | Exposure type and sampling data provided, but missing number of workers, exposure frequency, PPE, and particle size. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Southern Analytical Lab, (1979). Atmosphere filtering monitoring report [878211255]. |
| **HERO ID:** | 4158209 |
| **Conditions of Use:** | Other: |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Unknown activities in Engine Room #4 of USS Manley. |
| Exposure route: | Inhalation. |
| Physical form: | Fibers. |
| Personal sampling data: | Personal samples in the engine room of the U.S.S. Manley were 0.077 f/cc, but analysis revealed the fibers were not asbestos, and were calcium silicate. (5/8) |
| Area sampling data: | Area samples in the engine room of the U.S.S. Manley were 0.028 and 0.0008 f/cc. (6/8) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Sampling and Analytical Methodology | Low | Sampling methodology not specified. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | High | Data are from the U.S. |
| | Metric 3: Applicability | Uninformative | Data are for unknown activities. |
| | Metric 4: Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| | Metric 5: Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | Medium | Exposure type and sampling data provided, but missing worker information, exposure duration, frequency, PPE, particle size, and engineering controls. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Medium | Monitoring report variability is addressed through multiple sample types (area and personal), but measurement uncertainty is not characterized. |

## Overall Quality Determination — Uninformative

| | |
|---|---|
| **Study Citation:** | Southern Analytical Lab, (1979). Atmosphere filtering monitoring report [878211257]. |
| **HERO ID:** | 4158210 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Personal sampling data: | 0.025 fibers/cc (pg 6) |
| Area sampling data: | boiler room (pg 4) - 0.002 fibers/ccboiler room (pg 5) - 0.03 fibers/ccboiler room (pg 7) - 0.002 fibers/cc |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Low | Sampling/analytical methodology is not specified. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for building/construction materials, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Low | Sample type provided but no other metadata. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Southern Analytical Lab, (1979). Atmosphere filtering monitoring report [878211273]. |
| **HERO ID:** | 4158211 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Personal sampling data: | 0.01 fibers/cc (pg 6) |
| Area sampling data: | 0.0006 fibers/cc (pg 4-5)0.003 fibers/cc (pg 7) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Low | Sampling/analytical methodology is not specified. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | Medium | Data are for a machine shop, which is similar to the in-scope occupational scenario metal products. |
| | Metric 4: | Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Low | Sample type provided but no other metadata. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination — Low

| | |
|---|---|
| **Study Citation:** | Southern Analytical Lab, (1979). Atmosphere filtering monitoring report [878211275]. |
| **HERO ID:** | 4158212 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Area sampling data: | Machine Shop: 0.42 f/cc (pg 4-5) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Low | Sampling/analytical methodology is not specified. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | The data are for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Low | The data were collected before the most recent PEL establishment or update or are more than 20 years old if no PEL is established. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Low | Monitoring data include sample type (e.g., personal breathing zone) but no other metadata. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | The monitoring study does not address variability or uncertainty. |

## Overall Quality Determination **Medium**

| | |
|---|---|
| **Study Citation:** | Southern Analytical Lab, (1979). Atmosphere filtering monitoring report [878211277]. |
| **HERO ID:** | 4158213 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | insulation removal (pg 6) |
| Personal sampling data: | 0.002 fibers/cc (pg 7) |
| Area sampling data: | 0.0008 fibers/cc (pg 4-5); 0.002 fibers/cc (pg 6) |
| Engineering control: | area sealed off (pg 6-8) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Low | Sampling/analytical methodology is not specified. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for construction materials, an in-scope occupational scenario |
| | Metric 4: | Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Low | Sample type provided but no other metadata. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Medium

**Study Citation:** Southern Analytical Lab, (1979). Atmosphere filtering monitoring report by Southern Analytical Lab [878211278].
**HERO ID:** 4158214
**Conditions of Use:** Other:

**EXTRACTION**

| Parameter | Data |
|---|---|
| Worker activity description: | Unknown activities in Engine Room of USS Manley |
| Exposure route: | Inhalation |
| Physical form: | Fibers |
| Personal sampling data: | 6hr sample - 0.71 f/cc |
| Area sampling data: | 6hr sample - 0.88 f/cc30min sample - 0.03 f/cc |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Low | Sampling or analytical methodology is not specified. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | The data are from the United States. |
| | Metric 3: | Applicability | Uninformative | Condition of use of monitoring data is unknown. |
| | Metric 4: | Temporal Representativeness | Low | The data were collected before the most recent PEL establishment. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Monitoring data include most critical metadata, such as sample type and exposure type, but lacks additional metadata, such as exposure durations, exposure frequency, and worker activities. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | Monitoring report addresses variability through multiple sampling types (area and personal), but measurement uncertainty is not characterized. |

## Overall Quality Determination Uninformative

| | |
|---|---|
| **Study Citation:** | Southern Analytical Lab, (1979). Atmosphere filtering monitoring report [878211280]. |
| **HERO ID:** | 4158215 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Insulation removal on the U.S.S. Manley. (5/8) |
| Exposure route: | inhalation (6/8) |
| Physical form: | fibers (5/8) |
| Personal sampling data: | (2 samples) 0.9 f/cc during insulation removal. (6/8) |
| Area sampling data: | 1 sample: 1.1 f/cc.3 samples: 0.08 f/cc. |
| Engineering control: | The sampling data state that the area was sealed off from other parts of the ship. (5/8) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Sampling and Analytical Methodology | Low | Sampling or analytical methodology is not specified. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | Data are from the U.S. |
| Metric 3: | Applicability | High | Data are for asbestos removal, an in-scope occupational scenario. |
| Metric 4: | Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Medium | Exposure type and sampling data provided, but exposure duration, frequency, particle size, and PPE missing. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Medium | Variability is addressed by including personal and area samples but uncertainty is not addressed. |

## Overall Quality Determination Medium

**Study Citation:** Southern Analytical Lab, (1979). Atmosphere filtering monitoring report [878211279].
**HERO ID:** 4158218
**Conditions of Use:** Other:

**EXTRACTION**

| Parameter | Data |
|---|---|
| Worker activity description: | Workers in the engine room of the USS Manley. |
| Exposure route: | Inhalation |
| Physical form: | Fibers |
| Personal sampling data: | A personal sample taken on employees in the engine room of the U.S.S. Manley was 0.85 f/cc. Sampling time was 6-hr. |
| Area sampling data: | Area samples in the engine room of the U.S.S. Manley were 0.09 and 0.93 f/cc. Sampling times were 30-min and 6-hr, respectively. |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Sampling and Analytical Methodology | Low | Sampling methodology not specified. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | Data are from the U.S. |
| Metric 3: | Applicability | Uninformative | Condition of use unknown for work conducted in the engine room of the USS Manley. |
| Metric 4: | Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Medium | Exposure type and sampling data provided, but missing number of workers, exposure duration and frequency, engineering controls, PPE, and particle size. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Low | The monitoring report addresses variability through multiple sample types (area and personal), but measurement uncertainty is not characterized. |

## Overall Quality Determination Uninformative

**Study Citation:** Southern Analytical Lab, (1979). Atmosphere filtering monitoring report [878210740].
**HERO ID:** 4158222
**Conditions of Use:** Other:

**EXTRACTION**

| Parameter | Data |
|---|---|
| Worker activity description: | Unknown activities in Boiler Room on USS Manley. |
| Exposure route: | Inhalation |
| Physical form: | Fibers |
| Personal sampling data: | 0.9 f/cc measured in boiler room over 8-hr sampling period. |
| Area sampling data: | 1.2 f/cc measured in boiler room over 8-hr sampling period.0.08 f/cc measured in boiler room over 30-min sampling period. |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Sampling and Analytical Methodology | Low | Sampling methodology not specified. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | High | Data are from the U.S. |
| | Metric 3: Applicability | Uninformative | Conditions of use are unknown. |
| | Metric 4: Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | Medium | Exposure type and sampling data provided, but missing number of workers, exposure frequency, PPE, particle size, and engineering controls. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Low | Monitoring report addresses variability through multiple sampling types (area and personal), but measurement uncertainty is not addressed. |

## Overall Quality Determination Uninformative

| | |
|---|---|
| **Study Citation:** | Southern Analytical Lab, (1979). Atmosphere filtering monitoring report [878210741]. |
| **HERO ID:** | 4158223 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Exposure route: | inhalation |
| Physical form: | fibers |
| Personal sampling data: | 2 samples: 0.05 f/cc. (6/8) |
| Area sampling data: | 1 sample: 0.09 f/cc3 samples: 0.01 f/cc. |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Low | Sampling or analytical methodology is not specified. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for industrial/commercial use in construction materials, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Exposure type and sampling data provided, but missing number of workers, exposure duration, frequency, particle size, and PPE. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | Variability is addressed by including both personal and area sampling data, but uncertainty is not addressed. |

## Overall Quality Determination **Medium**

| | |
|---|---|
| **Study Citation:** | Southern Analytical Lab, (1979). Atmosphere filtering monitoring report [878210743]. |
| **HERO ID:** | 4158224 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Area sampling data: | [PDF Pg. 5]USS ”Manly” Boiler Room1.5 fibers/cc (1 sample) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Low | Sampling/analytical methodology is not specified. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | The data are for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Low | Monitoring data is greater than 20 years old. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Low | Monitoring data include sample type (e.g., personal breathing zone) but no other metadata. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Southern Analytical Lab, (1978). Atmosphere filtrating monitoring report [878211248]. |
| **HERO ID:** | 4158226 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Insulation removal from pipes |
| Personal sampling data: | 0.072 f/cc (194 min)0.118 f/cc (169 min) |
| Area sampling data: | 0.0167 f/cc (60 min)0.09 f/cc (194 min) |
| Engineering control: | Work area was blocked off and water was sprayed to control dust. |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Low | Sampling or analytical methodology is not specified. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | The data are from the United States. |
| | Metric 3: | Applicability | High | The data are for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Low | The data were collected more than 20 years ago. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Monitoring data include most critical metadata, such as sample type and exposure type, but lacks additional metadata, such as exposure durations, exposure frequency, and more information on worker activities. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | Monitoring report addresses variability through multiple sampling types (area and personal), but measurement uncertainty is not characterized. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Southern Analytical Lab, (1978). Atmosphere filtrating monitoring report [878211249]. |
| **HERO ID:** | 4158227 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Insulation removal from pipes from engine room of USS Barry. |
| Exposure route: | Inhalation |
| Physical form: | Fibers |
| Personal sampling data: | Insulation removal from pipes (2 samples): 0.0218; 0.025 (fibers/cc) |
| Area sampling data: | Insulation removal from pipes: 0.0375 (fibers/cc)Certification sampling (60-min): 0.00083 (fibers/cc) |
| Exposure duration: | 160 minutes |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Sampling and Analytical Methodology | Low | Sampling/analytical methodology is not specified. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | Data are from the U.S. |
| Metric 3: | Applicability | High | Data are for Chemical Substances in Construction, Paint, Electrical, and Metal Products, an in-scope occupational scenario. |
| Metric 4: | Temporal Representativeness | Low | Monitoring data are greater than 20 years old. |
| Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Medium | Monitoring data include most critical metadata such as sample type and exposure type, but lacks additional metadata such as exposure durations, exposure frequency, and worker activity details. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Medium | The monitoring report addresses variability through multiple sample types (personal and area), but measurement uncertainty is not characterized. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Southern Analytical Lab, (1978). Monitoring the atmosphere filtration [878211012]. |
| **HERO ID:** | 4158261 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | insulation removal from pipes |
| Personal sampling data: | 2 personal samples0.0218 f/cc (160 minutes), 0.025 (160 minutes) |
| Area sampling data: | 2 area samples0.00083 f/cc (60 minutes), 0.0375 (160 minutes) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Low | Sampling or analytical methodology is not specified. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | The data are from the United States and are representative of the industry being evaluated. |
| | Metric 3: | Applicability | High | The data are for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Low | Metadata on the operations, equipment, and worker activities associated with the data show that the data agree representative of outdated operations, equipment, and activities rather than current operations, equipment, and worker activities. The data were collected more than 20 years ago. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Monitoring data include most critical metadata, such as sample type and exposure type, but lacks additional metadata, such as exposure durations. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | The monitoring study provides only limited discussion of the variability in the determinants of exposure for the sampled site or sector. The monitoring study provides only limited discussion of the uncertainty in the exposure estimates. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Southern Analytical Lab, (1978). Monitoring the atmosphere filtration [878211013]. |
| **HERO ID:** | 4158262 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Area sampling data: | After asbestos cleanup60 minute sample: 0.0042 f/cc (5 samples) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Low | Sampling or analytical methodology is not specified. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | The data are from the United States and are representative of the industry being evaluated. |
| | Metric 3: | Applicability | High | The data are for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Low | The data were collected before the most recent PEL establishment or update or are more than 20 years old if no PEL is established. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Monitoring data include most critical metadata, such as sample type and exposure type, but lacks additional metadata, such as exposure durations, exposure frequency, and worker activities. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | The monitoring study does not address variability or uncertainty. |

## Overall Quality Determination **Medium**

**Study Citation:** Southern Analytical Lab, (1979). Monitoring the atmosphere filtering [878212087].
**HERO ID:** 4158265
**Conditions of Use:** Other:

**EXTRACTION**

| Parameter | Data |
|---|---|
| Physical form: | fibers (5/7) |
| Personal sampling data: | A personal sample in the engine room of the U.S.S. Sampson was 1.54 f/cc. (6/7) |
| Area sampling data: | An area sample in the engine room of the U.S.S. Sampson was 0.77 f/cc. (5/7) |
| Exposure duration: | 1 hour (6/7) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Sampling and Analytical Methodology | Low | Sampling methodology not specified. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | Data are from the U.S. |
| Metric 3: | Applicability | Uninformative | Condition of use unknown. |
| Metric 4: | Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Medium | Exposure type and sampling data provided, but missing worker information, exposure frequency, PPE, and particle size. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Uninformative

| | |
|---|---|
| **Study Citation:** | Southern Analytical Lab, (1979). Monitoring the atmosphere filtering [878212088]. |
| **HERO ID:** | 4158266 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Exposure route: | inhalation |
| Physical form: | fibers |
| Personal sampling data: | Personal sample in the fan room of the U.S.S. Saratoga was 0.05 f/cc. (5/8) |
| Area sampling data: | Area samples in the fan room of the U.S.S. Saratoga were 0.03 f/cc (2 samples) & 0.001 f/cc (3 samples). (6/8) |
| Engineering control: | The area with insulation was secured from other parts of the ship. (6/8) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Low | Sampling or analytical methodology is not specified. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | The data are for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Exposure type and sampling data provided, but missing worker information, exposure duration, frequency, particle size, and PPE. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | Variability is addressed by including personal and area samples but uncertainty is not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Southern Analytical Lab, (1979). Monitoring the atmosphere filtering [878212090]. |
| **HERO ID:** | 4158267 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Area sampling data: | 0.0001 f/cc (certificate; pg 4-5)1.5 hr area sample (#1 Main Machine Room): 0.04 f/cc (pg 6) |

**EVALUATION**

| Domain | | Metric | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Low | Sampling/analytical methodology is not specified. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | Low | OES not explicitly stated; assumed construction materials (naval ship sampling) |
| | Metric 4: | Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Low | Sample type and sample duration provided but no other metadata. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Low

**Study Citation:** Southern Analytical Lab, (1979). Monitoring the atmosphere filtering [878210791].
**HERO ID:** 4158269
**Conditions of Use:** Other:

**EXTRACTION**

| Parameter | Data |
|---|---|
| Worker activity description: | Removal of asbestos insulation around valves. (6/12) |
| Exposure route: | inhalation (8/12) |
| Physical form: | fibers (6/12) |
| Personal sampling data: | Personal samples during valve insulation removal on the U.S.S. Saratoga was 0.80 f/cc. (8/12) |
| Area sampling data: | Area samples during valve insulation removal on the U.S.S. Saratoga were 0.70 f/cc and 0.003 f/cc. (6/12) |
| Engineering control: | The removal area was secured from other parts of the ship. (6/12) |

**EVALUATION**

| Domain | | Metric | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Low | Sampling instruments and methods are reported in codes with no way to determine their meanings. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for demolition of asbestos products, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Low | Exposure type and sampling data provided, but missing number of workers, exposure duration, frequency, particle size, and PPE. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Southern Analytical Lab, (1979). Monitoring the atmosphere filtering [878210800]. |
| **HERO ID:** | 4158271 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Clean up work and asbestos removal on the U.S.S. Saratoga. |
| Exposure route: | inhalation |
| Physical form: | fibers |
| Area sampling data: | Area asbestos concentrations were measured at 1.37 f/cc during cleanup of asbestos material (4 samples), and 0.38 f/cc (1 sample) and 1.75 f/cc (3 samples) during asbestos removal. |
| Engineering control: | There was a tent put up to protect workers in the area. (5/11) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Sampling and Analytical Methodology | Low | Sampling or analytical methodology is not specified. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | High | Data are from the U.S. |
| | Metric 3: Applicability | High | Data are for asbestos removal, an in-scope occupational scenario. |
| | Metric 4: Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| | Metric 5: Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | Medium | Exposure type and sampling data provided, but missing number of workers, exposure duration, frequency, particle size, and PPE. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Medium | Variability is addressed by sampling during different activities but uncertainty is not addressed. |

## Overall Quality Determination Medium

**Study Citation:** Southern Analytical Lab, (1979). Monitoring the atmosphere filtering [878210776].
**HERO ID:** 4158273
**Conditions of Use:** Other:

**EXTRACTION**

| Parameter | Data |
|---|---|
| Worker activity description: | Unknown activities in Engine Room of USS Tattnal |
| Exposure route: | inhalation |
| Physical form: | fiber |
| Personal sampling data: | 0.85 f/cc (13.5 hr) |
| Area sampling data: | 0.05 f/cc (30 min)0.6 f/cc (13.5 hr) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Sampling and Analytical Methodology | Low | Sampling or analytical methodology is not specified. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | The data are from the United States. |
| Metric 3: | Applicability | Uninformative | Conditions of use are unknown. |
| Metric 4: | Temporal Representativeness | Low | The data were collected before the most recent PEL update. |
| Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Medium | Monitoring data include most critical metadata, such as sample type and exposure type, but lacks additional metadata, such as exposure durations, exposure frequency, and worker activities. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Low | The monitoring study does not address variability or uncertainty. |

## Overall Quality Determination Uninformative

**Study Citation:** Southern Analytical Lab, (1979). Atmosphere filtering monitoring report [878210779].
**HERO ID:** 4158275
**Conditions of Use:** Other:

**EXTRACTION**

| Parameter | Data |
|---|---|
| Physical form: | fibers (4/10) |
| Personal sampling data: | One personal sample of a worker in the engine room was 0.003 f/cc. (9/10) |
| Area sampling data: | Area samples in the engine room of the U.S.S. Yosemite were 0.0003, 0.0008, and 0.002 f/cc. (4/10) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Sampling and Analytical Methodology | Low | Sampling methodology not specified. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | Data are from the U.S. |
| Metric 3: | Applicability | Uninformative | Condition of use is not specified. |
| Metric 4: | Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Low | Exposure type and sampling data provided, but missing most critical metadata such as worker information, exposure duration, frequency, engineering controls, PPE, and particle size. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Uninformative

| | |
|---|---|
| **Study Citation:** | Southern Analytical Lab, (1979). Monitoring the atmosphere filtering [878210794]. |
| **HERO ID:** | 4158280 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Removal of insulation around valves on USS Saratoga. |
| Exposure route: | Inhalation |
| Physical form: | Fibers |
| Personal sampling data: | [PDF Pg. 7]0.90 fibers/cc measures during removal of insulation around valves with 25-min sampling time. |
| Area sampling data: | [PDF Pg. 6]0.85 fibers/cc during removal of insulation around valves with 25-min sampling time.[PDF Pg. 10]0.001 fibers/cc after removal of insulation around valves with 30-min sampling time. |
| Engineering control: | Work area was secured during removal. |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Low | Sampling/analytical methodology is not specified. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for Chemical Substances in Construction, Paint, Electrical, and Metal Products, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Monitoring data are greater than 20 years old. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Monitoring data include most critical metadata such as sample type and exposure type, but lacks additional metadata such as exposure durations, exposure frequency, and worker activity details. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | The monitoring study addresses variability by presenting both area and personal monitoring data, but measurement uncertainty is not characterized. |

## Overall Quality Determination **Medium**

| | |
|---|---|
| **Study Citation:** | Southern Analytical Lab, (1978). Atmosphere filtrating monitoring report [878210735]. |
| **HERO ID:** | 5913573 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Insulation removal from two steam tanks in fire room on USS Montgomery. |
| Personal sampling data: | 0.221 f/cc (159 min)0.110 f/cc (159 min) |
| Area sampling data: | 0.0042 f/cc (60 min)0.147 f/cc (159 min) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Low | Sampling or analytical methodology is not specified. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | The data are from the United States. |
| | Metric 3: | Applicability | High | The data are for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Low | The data were collected before the most recent PEL update. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Monitoring data include most critical metadata such as sample type and exposure type, but lacks additional metadata such as worker activity details and exposure frequency. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | The monitoring study addresses variability through the collection of multiple sample types (area and personal), but measurement uncertainty is not characterized. |

## Overall Quality Determination Medium

**Study Citation:** Southern Analytical Lab, (1979). Atmosphere filtering monitoring report prepared by Southern Analytical Lab [878210734].
**HERO ID:** 5913578
**Conditions of Use:** Other:

**EXTRACTION**

| Parameter | Data |
|---|---|
| Personal sampling data: | 0.09 f/cc (30 min)0.11 f/cc (30 min)engine room |
| Area sampling data: | 0.0003 f/cc (30 min)engine room |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Low | Sampling or analytical methodology is not specified. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | The data are from the United States. |
| | Metric 3: | Applicability | Uninformative | Condition of use is unknown. |
| | Metric 4: | Temporal Representativeness | Low | The data were collected more than 20 years ago. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Monitoring data include most critical metadata, such as sample type and exposure type, but lacks additional metadata, such as exposure durations, exposure frequency, and worker activities. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | Monitoring report addresses variability through multiple sample types (area and personal), but measurement uncertainty is not characterized. |

## Overall Quality Determination Uninformative

| | |
|---|---|
| **Study Citation:** | Southern Analytical Lab, (1979). Monitoring the atmosphere filtering [878212089]. |
| **HERO ID:** | 9606500 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Removal of insulation around valve on USS Saratoga. |
| Exposure route: | Inhalation |
| Physical form: | Fibers |
| Personal sampling data: | 0.01 fibers/cm3 measured during insulation removal with 15-min sampling time and 2 LPM flowrate. |
| Area sampling data: | 0.05 fibers/cm3 measured during insulation removal with 15-min sampling time and 2 LPM flowrate.0.02 fibers/cm3 measured after insulation removal with 30-min sampling time and 2 LPM flowrate. |
| Engineering control: | Area secured during removal of insulation around valve. |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Low | Sampling or analytical methodology is not specified. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | The data are from the United States. |
| | Metric 3: | Applicability | High | The data are for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Low | Data are more than 20 years old. |
| | Metric 5: | Sample Size | High | Discrete data measurements provided. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Monitoring data include most critical metadata, such as sample type and exposure type, but lacks additional metadata such as exposure durations, exposure frequency, and worker activity details. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | Monitoring report addresses variability through multiple sample types (area and personal), but does not characterize measurement uncertainty. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Southern Analytical Lab, (1979). Monitoring the atmosphere filtering [878212091]. |
| **HERO ID:** | 9606963 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Tent operation in Main Machine Room on USS Saratoga. |
| Exposure route: | Inhalation |
| Physical form: | Fibers |
| Personal sampling data: | 0.05 fibers/cm3 measured during operations with 1.5-hr sampling time and 2 LPM flowrate. |
| Area sampling data: | 0.09 fibers/cm3 measured during operations with 1.5-hr sampling time and 2 LPM flowrate.0.0001 fibers/cm3 measured after operations with 30-min sampling time and 2 LPM flowrate. |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Sampling and Analytical Methodology | Low | Sampling or analytical methodology is not specified. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | High | The data are from the United States. |
| | Metric 3: Applicability | Medium | The data are for an occupational scenario within the scope of the risk evaluation. Details are limited on what was being monitored |
| | Metric 4: Temporal Representativeness | Low | Data more than 20 years old. |
| | Metric 5: Sample Size | High | Discrete data measurements provided. |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | Medium | Monitoring data include most critical metadata, such as sample type and exposure type, but lacks additional metadata such as exposure durations, exposure frequency, and worker activity details. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Medium | Monitoring report addresses variability through multiple sampling types (area and personal), but does not characterize measurement uncertainty. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Southern Analytical Lab, (1979). Monitoring the atmosphere filtering [878210792]. |
| **HERO ID:** | 9607703 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Removal of insulation around valves on USS Saratoga. |
| Exposure route: | Inhalation |
| Physical form: | Fibers |
| Personal sampling data: | 0.40 fibers/cm3 measured during insulation removal with 30-min sampling time and 2 LPM flowrate. |
| Area sampling data: | 0.20 fibers/cm3 measured during insulation removal with 30-min sampling time and 2 LPM flowrate.0.001 fibers/cm3 measured after insulation removal with 30-min sampling time and 2 LPM flowrate. |
| Engineering control: | All areas secured during insulation removal. |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Low | Sampling or analytical methodology is not specified. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | The data are from the United States. |
| | Metric 3: | Applicability | High | The data are for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Low | Data more than 20 years old. |
| | Metric 5: | Sample Size | High | Discrete data measurements provided. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Monitoring data include most critical metadata, such as sample type and exposure type, but lacks additional metadata such as exposure durations, exposure frequency, and worker activity details. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | Monitoring report addresses variability through multiple sampling types (personal and area), but does not describe measurement uncertainty. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Southern Analytical Lab, (1979). Monitoring the atmosphere filtering [878210793]. |
| **HERO ID:** | 9607724 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Removal of asbestos insulation around valves. (6/12) |
| Exposure route: | inhalation (8/12) |
| Physical form: | fibers |
| Personal sampling data: | Personal samples during valve insulation removal on the U.S.S. Saratoga were 0.70 f/cc (2 samples). (8/12) |
| Area sampling data: | Area samples during valve insulation removal on the U.S.S. Saratoga were 0.60 f/cc (1 sample) and 0.002 f/cc (3 samples). (6/12) |
| Engineering control: | The removal area was secured from other parts of the ship. (6/12) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Low | Sampling or analytical methodology is not specified. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for demolition of asbestos products, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | The data were collected before the most recent PEL establishment or update or are more than 20 years old if no PEL is established. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Exposure type and sampling data provided, but missing exposure duration, frequency, particle size, and PPE. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | Variability is addressed by including personal and area samples but uncertainty is not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Southern Analytical Lab, (1979). Atmosphere filtering monitoring report [878211256]. |
| **HERO ID:** | 9638789 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Exposure route: | Inhalation |
| Physical form: | Fibers |
| Personal sampling data: | 0.027 fibers/cm3 measured in the Fire Room of the USS Manley over a 55 min sampling period using 2 LPM flowrate. |
| Area sampling data: | 0.0002 fibers/cm3 measured in the Fire Room of the USS Manley over a 30 min sampling period using 2 LPM flowrate.0.002 fibers/cm3 measured in the Fire Room of the USS Manley over a 50 min sampling period using 2 LPM flowrate. |

**EVALUATION**

| Domain | | Metric | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Low | Sampling or analytical methodology is not specified. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | The data are from the United States. |
| | Metric 3: | Applicability | Low | Though the data may represent exposures in an occupational setting, there is no indication of the work being done. |
| | Metric 4: | Temporal Representativeness | Low | Data is more than 20 years old. |
| | Metric 5: | Sample Size | Medium | Discrete data points provided, sample size is small. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Low | Monitoring data include sample type (e.g., personal breathing zone) but no other critical metadata. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | Variability addressed by different types of sampling (area and personal), but uncertainty is not described. |

## Overall Quality Determination — Low

| | |
|---|---|
| **Study Citation:** | Southern Analytical Lab, (1979). Atmosphere filtering monitoring report [878211274]. |
| **HERO ID:** | 9640849 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Exposure route: | inhalation (6/8) |
| Physical form: | fibers (5/8) |
| Personal sampling data: | A personal sample of a worker in the fire room of the U.S.S. Manley had a concentration of 0.004 f/cc. (6/8) |
| Area sampling data: | Area asbestos concentrations were measured at 0.00001 and 0.002 f/cc in the fire room of the U.S.S. Manley. (5/8) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Low | Sampling instruments and methods are reported in codes with no way to determine their meanings. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | Medium | The data are for an occupational scenario that is similar to an occupational scenario within the scope of the risk evaluation, in terms of the type of industry, operations, and work activities. |
| | Metric 4: | Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Low | Monitoring data include sample type (e.g., personal breathing zone) but no other metadata. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination — Low

| | |
|---|---|
| **Study Citation:** | Southern Analytical Lab, (1979). Atmosphere filtering monitoring report [878211276]. |
| **HERO ID:** | 9640850 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Exposure route: | Inhalation |
| Physical form: | Fibers |
| Personal sampling data: | 1.17 fibers/cm3 inside machine shop of USS Manley. Sampling took place for 60 min using flowrate of 2 LPM. |
| Area sampling data: | 0.33 fibers/cm3 inside dishwashing room of USS Manley. Sampling took place for 30 min using flowrate of 2 LPM.1.04 fibers/cm3 inside machine shop of USS Manley. Sampling took place for 60 min using flowrate of 2 LPM.1.07 fibers/cm3 inside engine room of USS Sampson. Sampling took place for 60 min using flowrate of 2 LPM. |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Sampling and Analytical Methodology | Low | Sampling or analytical methodology is not specified. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | The data are from the United States. |
| Metric 3: | Applicability | Low | Though the data may represent exposures in an occupational setting, there is no indication of the work that was being done. |
| Metric 4: | Temporal Representativeness | Low | Data is more than 20 years old. |
| Metric 5: | Sample Size | High | Discrete data points are provided. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Low | Monitoring data include sample type (e.g., personal breathing zone) but no other critical metadata. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Medium | Variability is addressed by sampling of different locations, but uncertainty is not described. |

## Overall Quality Determination — Low

| | |
|---|---|
| **Study Citation:** | Southern Analytical Lab, (1979). Atmosphere filtering monitoring report [878210739]. |
| **HERO ID:** | 9640854 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Insulation cleanup inside boiler room on USS Manley |
| Personal sampling data: | 0.04 fibers/cc |
| Area sampling data: | 0.09 fibers/cc |
| Engineering control: | Area sealed off |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Low | Sampling or analytical methodology is not specified. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | The data are from the United States. |
| | Metric 3: | Applicability | High | The data are for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Low | Data are more than 20 years old. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized, as the samples are discrete data points. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Monitoring data include most critical metadata, such as sample type and exposure type, but lacks additional metadata, such as exposure durations and exposure frequency. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | Variability is addressed by multiple sampling types (i.e., both personal and area monitoring), but uncertainty is not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Southern Analytical Lab, (1979). Atmosphere filtering monitoring report [878210742]. |
| **HERO ID:** | 9640857 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Exposure route: | inhalation (2/4) |
| Physical form: | fibers (2/4) |
| Personal sampling data: | A personal sample of a worker in the boiler room of the U.S.S. Manley had a concentration of 0.05 f/cc. (2/4) |
| Area sampling data: | Two area asbestos concentrations were measured at 0.09 and 0.01 f/cc in the boiler room of the U.S.S. Manley. (2/4) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Low | Sampling instruments and methods are reported in codes with no way to determine their meanings. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | Medium | The data are for an occupational scenario that is similar to an occupational scenario within the scope of the risk evaluation, in terms of the type of industry, operations, and work activities. |
| | Metric 4: | Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Low | Monitoring data include sample type (e.g., personal breathing zone) but no other metadata. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Low

| | |
|---|---|
| **Study Citation:** | Spence, S. K., Rocchi, P. S. J. (1996). Exposure to asbestos fibres during gasket removal. Annals of Occupational Hygiene 40(5):583-588. |
| **HERO ID:** | 3580451 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | personal exposure to asbestos fibers during gasket removal |
| Exposure route: | inhalation |
| Physical form: | Fiber |
| Personal sampling data: | Group A was the 'first pass' group.The average fiber concentration for work method A was 0.042 0.242 fibers/ml . When converted to exposure averaged over 8 h, it varied between 0.036 and 0.215 fibers/ml.If the gasket proved difficult to remove or broke in the process, it was left for group B.The average fiber concentration, as determined by PCM, ranged between below the detection limit and 0.02 fibers/ml . When this is converted to an 8-h limit, then the value ranges from below the detection limit to 0.005 fibers/ml. |
| Personal protective equipment: | Workers must wear personal protective equipment (HEPA filter full-face mask respiratory protection, hooded coveralls, gloves and boots). (P. 3/6) |
| Engineering control: | The area must be cordoned off during removal activities. |
| Comments: | See Table 1 and Table 2. |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Sampling and Analytical Methodology | High | Sampling or analytical methodology is an approved OSHA or NIOSH method. Published in Ann. occup. Hyg. journal. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | Medium | The data are from an OECD country. |
| | Metric 3: Applicability | High | The data are for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: Temporal Representativeness | Low | More than 20 years old |
| | Metric 5: Sample Size | Medium | Distribution of samples is characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | Medium | Monitoring data include most critical metadata but lacks additional metadata, such as sample durations, exposure durations, exposure frequency, and/or worker activities. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | High | The monitoring study addresses variability in the determinants of exposure for the sampled site or sector. Multiple samples and analysis methods. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Spencer, J. W., Plisko, M. J., Balzer, J. L. (1999). Asbestos fiber release from the brake pads of overhead industrial cranes. Applied Occupational and Environmental Hygiene 14(6):397-402. |
| **HERO ID:** | 3615974 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Airborne asbestos fibers to the work environment from the operation of overhead cranes and hoists that use asbestos composition brake pads. |
| Exposure route: | inhalation |
| Physical form: | Traditionally, friction products have contained blends ofasbestos, cellulose, synthetic fibers, and non-fibrous bindingmaterials. |
| Area sampling data: | Phase Contrast Microscopy [PCM] results.Air sample results summary table for atmospheric screening test: 0- < 0.010 f/ccAir sample results summary table for baseline sample collection: < 0.010 f/cc [PCM], < 0.0060 f/cc [TEM]. (P. 5/6)Air sample results summary table for Process Evaluation Samples: up to 0.011 f/cc [PCM], < 0.0031 f/cc [TEM] |
| Exposure duration: | eight hour shifts |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Sampling and Analytical Methodology | High | Sampling or analytical methodology is an approved OSHA or NIOSH method. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | High | The data are from the United States |
| | Metric 3: Applicability | High | The data are for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: Temporal Representativeness | Low | more than 20 years old |
| | Metric 5: Sample Size | High | Statistical distribution of samples is fully characterized. |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | High | Monitoring data include all associated metadata |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | High | The monitoring study addresses variability in the determinants of exposure for the sampled site or sector. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Spurny, K. R. (1989). On the release of asbestos fibers from weathered and corroded asbestos cement products. Environmental Research 48(1):100-116. |
| **HERO ID:** | 380 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Area sampling data: | Ambient air concentrations of these asbestos fibers were for the most part less than 10^3 fibers/m^2. (Page 1). |
| Particle size characterization: | Table 3 (page 10) provides mean values for fiber mass and fiber number/mass conversionmass of one fiber (pg): mean - 0.4; SD - 0.8; min - 0.05; max - 4.2fibers/mass (fibers/ng): mean - 4928; SD - 3711, min - 239; max - 2 x 10^4Table 4 (page 10) provides the mean size values of emitted fibersFiber length Lf(um): mean - 4.0; SD - 2.0; min - 1.7; max - 9.5Fiber diameter Df(um): mean - 0.22; SD - 0.09; min - 0.1; max - 0.5ratio (Lf/Df): mean - 25.1; SD - 11.7; min - 10.2; max - 66.0There is a second set of data for an Lf max and Df max. Lf max (um): mean - 23.7; SD - 23.1; min - 3.5; max - 140;Df max (um): mean - 1.07; SD - 0.6; min - 0.5; max - 3.0Lf/Df max: mean - 250; SD - 193; min - 27; max - 910 |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Sampling and Analytical Methodology | High | Sampling or analytical methodology is an approved OSHA or NIOSH method or is well described and found to be equivalent to approved OSHA or NIOSH methods. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | Medium | The data are from an OECD country. other than the U.S. |
| | Metric 3: Applicability | High | The data are for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: Temporal Representativeness | Low | Data are more than 20 years old. |
| | Metric 5: Sample Size | High | Statistical distribution of samples is fully characterized. |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | Medium | Monitoring data include most critical metadata, such as sample type and exposure type, but lacks additional metadata, such as sample durations, exposure durations, exposure frequency, and/orworker activities. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Medium | The monitoring study provides only limited discussion of the variability in the determinants of exposure for the sampled site or sector. The monitoring study provides only limited discussion of the uncertainty in the exposure estimates. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | SRI International, (1980). Asbestos sampling with cover letter. |
| **HERO ID:** | 4158369 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Oven removal. [PDF Pg. 5] |
| Personal sampling data: | [PDF Pg. 5]Fireman wet down insulation: 5.12 (fibers/cm^3)Insulation removal: 14.27 (fibers/cm^3)Insulation removal: 14.27 (fibers/cm^3) |
| Area sampling data: | Area 6 ft. from oven and 4 ft. from floor by window: 1.24 (f/cm^3) |
| Personal protective equipment: | Disposable coveralls, caps, and dustfoe 66 respirators. [PDF Pg. 5] |
| Engineering control: | Insulation is wetted down using a fire hose. [PDF Pg. 5] |
| Comments: | Sampling done using PCM methods. [PDF Pg. 5] |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Medium | Sampling/analytical methodology is equivalent to an approved OSHA/NIOSH method. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for Chemical Substances in Construction, Paint, Electrical, and Metal Products, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Monitoring data are greater than 20 years old. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Sample type and exposure type provided but missing exposure duration and frequency. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | High | Uncertainty is addressed in sampling/analytical methodology. Variability addressed by taking both personal and area samples. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Standard Oil Company of California, (1979). Measurements of airborne asbestos in building one with cover letter and attachment. |
| **HERO ID:** | 3649379 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Technical workers at Standard Oil's refineries. (8/189) Navy cadets and officers aboard a ship. (26/189) Unspecified brake repair mechanics (60/189) |
| Exposure route: | inhalation (6/189) |
| Physical form: | fibers (6/189) |
| Personal sampling data: | Personal samples taken during unspecified brake repair ranged from 0-0.5 f/mL. (61/189) Personal samples taken on coast guard members on a ship in the engine room were both <0.002 f/cc. (116/189) A personal sample during drilling holes in brake linings were 0.14 f/cc. (125/189) |
| Area sampling data: | Two samples taken underneath a steam pipe with loose asbestos contained 0.01 and 0.002 f/cc. Another sample taken while dusting off insulated pipes was 0.017 f/cc. (6/189) Area samples taken on Navy ships ranged from 0-0.228 f/cc. (33/189) Area samples taken at a power plant near boilers ranged form <0.0016-<0.01 f/cc. (58/189) Area samples on a Coast Guard ship ranged from <0.002-0.003 f/cc. (115/189) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | High | Sampling/analytical methodology is an approved NIOSH method. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for industrial use in construction materials, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Exposure type and sampling data provided, but missing number of workers, exposure duration, frequency, particle size, engineering controls, and PPE. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | High | Uncertainty is addressed in sampling/analytical methodology. Variability is addressed by sampling at many locations. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Standard Oil Company of California, (1979). Measurements of airborne asbestos in building one with cover letter and attachment. |
| **HERO ID:** | 3649379 |
| **Conditions of Use:** | Consumer Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Office workers (171/189) |
| Exposure route: | inhalation (171/189) |
| Physical form: | fibers (171/189) |
| Area sampling data: | Two area samples in an office building were 0.001 and 0.003 f/cc. (171/189) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Sampling and Analytical Methodology | High | Sampling/analytical methodology is an approved NIOSH method. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | Data are from the U.S. |
| Metric 3: | Applicability | Low | Data are for office workers exposures, which is similar to commercial use of construction products. |
| Metric 4: | Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Medium | Exposure type and sampling data provided, but missing number of workers, exposure duration, frequency, particle size, engineering controls, and PPE. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Medium | Uncertainty is addressed in sampling/analytical methodology. Variability isn't addressed. |

## Overall Quality Determination Medium

**Study Citation:** Standard Oil Company of California, (1979). Measurements of airborne asbestos in building one with cover letter and attachment.
**HERO ID:** 3649379
**Conditions of Use:** Other:

**EXTRACTION**

| Parameter | Data |
|---|---|
| Worker activity description: | Stripping and bagging pipe insulation (17/189) |
| Exposure route: | inhalation (17/189) |
| Physical form: | fibers (17/189) |
| Personal sampling data: | Personal samples for stripping old insulation were 0.7-0.8 f/cc. (17/189) Personal samples for stripping and bagging old oven insulation were 0.4-1.5 f/cc. (19/189) Personal samples for insulation removal on pipes was 0.1-0.3 f/cc. (100/189) Personal samples during insulation removal from a ship were 0.012-0.204 f/cc. (120/189) A personal sample during another steam pipe lagging removal was 0.6 f/cc. (125/189) Personal sample during insulation removal at a refinery were 0.9-21.4 f/mL (median 4.9 f/mL). (130/189) |
| Area sampling data: | An area sample during insulation removal was 0.004 f/cc. (120/189) Area samples for insulation removal at a refinery were 0.4-3.3 f/mL. (130/189) |
| Personal protective equipment: | Employees were seen wearing protective clothing and respirators during insulation removal. (98/189) |
| Engineering control: | Insulation was wet before removal. (98/189) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | High | Sampling/analytical methodology is an approved NIOSH method. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for demolition of asbestos products, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Exposure type and sampling data provided, but missing number of workers, exposure duration, frequency, and particle size. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | High | Uncertainty is addressed in sampling/analytical methodology. Variability is addressed by sampling at many locations. |

## Overall Quality Determination High

**Study Citation:** Standard Oil, (1977). Asbestos sampling of telecom workers with attachment.
**HERO ID:** 3653804
**Conditions of Use:** Other:

**EXTRACTION**

| Parameter | Data |
|---|---|
| Worker activity description: | Driving near asbestos mine. [PDF Pg. 4] |
| Exposure route: | Inhalation |
| Personal sampling data: | [PDF Pg. 4]Driving near asbestos mines: 3.95; 0.99 (fibers > 5um/mL) |
| Exposure duration: | 4 hours/day [PDF Pg. 3] |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Sampling and Analytical Methodology | Low | Sampling/analytical methodology is not specified. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | High | Data are from the U.S. |
| | Metric 3: Applicability | Low | Data are for driving in proximity to asbestos mines, which is may be similar to various in-scope occupational scenarios where asbestos is disturbed and introduced into the atmosphere. |
| | Metric 4: Temporal Representativeness | Low | Monitoring data are greater than 20 years old. |
| | Metric 5: Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | Medium | Sample type and exposure type provided but missing sampling methods. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Low

| | |
|---|---|
| **Study Citation:** | Standard Oil, (1982). Occupational health survey Chevron U.S.A. Inc. manufacturing Pascagoul Refinery. |
| **HERO ID:** | 4158129 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | insulation removal from pipes, wet down before removal (p. 20, 23) |
| Personal sampling data: | 3 samples0.3 f/cc; 0.13 f/cc TWA0.2 f/cc; 0.08 f/cc TWA0.1 f/cc; 0.04 f/cc TWA |
| Exposure duration: | 205 min samples (p. 23) |
| Number of workers: | 3 workers involved in activity (p. 23) |
| Personal protective equipment: | Protective clothing and respirators, wetted surface before insulation removal. |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Low | Sampling or analytical methodology is not specified. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | The data are from the United States. |
| | Metric 3: | Applicability | High | The data are for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Low | The data were collected more than 20 years ago |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | Monitoring data include all associated metadata, including sample types, exposure types, sample durations, exposure durations worker activities, and exposure frequency. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | The monitoring report addresses variability through sampling multiple contractors, however the measurement uncertainty is not characterized. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Standard Oil, (1972). ASB dust survey of several insulation operations Richmond Refinery. |
| **HERO ID:** | 4158130 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Insulation installation, unpacking and stocking performed pipe insulation, insulation removal. [PDF Pg. 4] |
| Personal sampling data: | [PDF Pg. 5]Insulation Removal: 0.9-21.4 (fibers/mL) |
| Area sampling data: | [PDF Pg. 5]Insulation shop stocking: <2 (fibers/mL)Insulation installation: <2 (fibers/mL)Insulation Removal: 0.4-3.3 (fibers/mL)Cleanup of Removed Insulation: <2 (fibers/mL) |
| Personal protective equipment: | Approved air-purifying respirators should be worn [PDF Pg. 5]. |
| Comments: | Sampling method said to be the OSHA standard. |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Sampling and Analytical Methodology | High | Sampling/analytical methodology is an approved OSHA method. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | High | Data are from the U.S. |
| | Metric 3: Applicability | High | Data are for Chemical Substances in Construction, Paint, Electrical, and Metal Products, an in-scope occupational scenario. |
| | Metric 4: Temporal Representativeness | Low | Monitoring data are greater than 20 years old. |
| | Metric 5: Sample Size | Medium | Sample distribution characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | Medium | Sample type and exposure type provided but missing exposure frequency and duration. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Medium | Variability addressed by sampling multiple activities but uncertainty is not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Standard Oil, (1982). Asbestos dust survey. |
| **HERO ID:** | 4158131 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Physical form: | airborne fibers |
| Area sampling data: | <0.01 (2x), <0.002, <0.004, <0.0016, <0.0021 f/cc (pg 3) |
| Comments: | phase contrast microscopy (pg 3) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Medium | Sampling/analytical methodology is not an approved OSHA/NIOSH method but is an acceptable methodology. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | Medium | Data are for sampling in a power plant around boilers and generators, indicating that this is likely associated with building materials (insulation), an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Low | Sample type provided but no other metadata. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Medium

**Study Citation:** Standard Oil, (1978). Asbestos exposure during roof coating batching.
**HERO ID:** 4158132
**Conditions of Use:** Other:

**EXTRACTION**

| Parameter | Data |
|---|---|
| Worker activity description: | Asbestos exposure during roof coating batching. |
| Physical form: | Fiber |
| Personal sampling data: | 3.31 fibers/cc. for 30 min<1 fibers/cc for 8-hr TWA (P. 3/5) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Sampling and Analytical Methodology | Low | Sampling or analytical methodology is not specified. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | The data are from the United States. |
| Metric 3: | Applicability | Uninformative | The data are ”roof coating batching,” which is considered processing with asbestos. Processing is not in-scope of the asbestos legacy risk evaluation. |
| Metric 4: | Temporal Representativeness | Low | Data is more than 20 years old. |
| Metric 5: | Sample Size | Medium | Distribution of samples is characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Low | Monitoring data include sample type (e.g., personal breathing zone) but no other metadata. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Low | The monitoring study does not address variability or uncertainty. |

## Overall Quality Determination Uninformative

| | |
|---|---|
| **Study Citation:** | Standard Oil, (1978). Asbestos investigation - stripping block insulation from oven. |
| **HERO ID:** | 4158133 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Stripping and bagging wet block insulation from end of oven, Clean-up man bagging old wet insulation. [PDF Pg. 3] |
| Area sampling data: | [PDF Pg. 3]Stripping and bagging wet block insulation from end of oven: 1.5 (f/cc)Clean-up man bagging old wet insulation: 0.4 (f/cc)Clean-up man bagging old wet insulation: 1.0 (f/cc) |
| Personal protective equipment: | Protective clothing and respirators [PDF Pg. 3] |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Low | Sampling/analytical methodology is not specified. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for Chemical Substances in Construction, Paint, Electrical, and Metal Products, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Monitoring data are greater than 20 years old. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Low | Sample type provided but no other metadata. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | Variability addressed by sampling multiple worker activities, but uncertainty is not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Standard Oil, (1979). Assessment of asbestos concentrations in the engineroom environment of marine vessels prepared by ITT Res & Inst. |
| **HERO ID:** | 4158135 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Ship workers |
| Personal sampling data: | 3 ships: 1 sample taken near the worker's breathing zone 0.01 f/cc0.012 f/cc0.02 f/cc |
| Area sampling data: | 3 area samples taken in engine room in each of 3 ships0.049 f/cc0.229 f/cc0.134 f/cc0.012 f/cc0.017 f/cc0.013 f/cc0.018 f/cc0.032 f/cc0.028 f/cc |
| Particle size characterization: | distribution of samples was given between < 5 um and > 5 um |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | High | Sampling or analytical methodology is an approved OSHA or NIOSH method or is well described and found to be equivalent to approved OSHA or NIOSH methods. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | The data are from the United States and are representative of the industry being evaluated. |
| | Metric 3: | Applicability | Medium | The data are for an occupational scenario that is similar to an occupational scenario within the scope of the risk evaluation, in terms of the type of industry, operations, and work activities. |
| | Metric 4: | Temporal Representativeness | Low | The data were collected before the most recent PEL establishment or update or are more than 20 years old if no PEL is established. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Monitoring data include most critical metadata, such as sample type and exposure type, but lacks additional metadata, such as sample durations, exposure durations, exposure frequency, andworker activities. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | Variability is addressed by sampling at different locations but uncertainty is not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Standard Oil, (1984). Industrial hygiene survey Baltimore Asphalt Plant. |
| **HERO ID:** | 4158138 |
| **Conditions of Use:** | Other: |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Personal sampling data: | 2 samples during formulation0.006 f/cc (0.006 f/cc TWA)<0.003 f/cc |
| Area sampling data: | 2 area samples<0.001 f/cc<0.003 f/cc |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Low | Sampling or analytical methodology is not specified. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | The data are from the United States. |
| | Metric 3: | Applicability | Uninformative | The data are from an occupational scenario that does not apply to any occupational scenario within the scope of the risk evaluation (asphalt formulation). |
| | Metric 4: | Temporal Representativeness | Low | The data were collected more than 20 years ago. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Low | Monitoring data include sample type (e.g., personal breathing zone) but no other metadata. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | The monitoring study does not address variability or uncertainty. |

## Overall Quality Determination Uninformative

| | |
|---|---|
| **Study Citation:** | Standard Oil, (1980). Occupational health survey - marine machine shop. |
| **HERO ID:** | 4158143 |
| **Conditions of Use:** | Disposal |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Removing lagging from a steam pipe (5/7) |
| Personal sampling data: | One personal sample TWA was 0.02 f/cc. (5/7) |
| Exposure duration: | 8 hours (5/7) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Sampling and Analytical Methodology | Low | Sampling methodology not specified. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | High | Data are from the U.S. |
| | Metric 3: Applicability | High | Data are for asbestos removal, an in-scope occupational scenario. |
| | Metric 4: Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| | Metric 5: Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | Medium | Sampling data provided, but missing physical form, frequency, particle size, number of workers, PPE, and engineering controls. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Low | Uncertainty and variability not addressed. |

## Overall Quality Determination Medium

**Study Citation:** Standard Oil, (1979). Occupational health survey El Segundo Asphalt Plant.
**HERO ID:** 4158145
**Conditions of Use:** Other:

**EXTRACTION**

| Parameter | Data |
|---|---|
| Worker activity description: | walktop mixer |
| Personal sampling data: | 0.02 fibers/cc (page 5) |
| Personal protective equipment: | respirator (page 6) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Low | Sampling or analytical methodology is not specified. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | Uninformative | Data are for manufacture of asphalt, which is not in-scope of the legacy asbestos risk evaluation. |
| | Metric 4: | Temporal Representativeness | Low | Monitoring data are greater than 20 years old.(1979) |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Low | Sample type provided but no other metadata. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Uninformative

**Study Citation:** Standard Oil, (1978). Occupational health survey Oakland Asphalt Plant.
**HERO ID:** 4158148
**Conditions of Use:** Other:

**EXTRACTION**

| Parameter | Data |
|---|---|
| Worker activity description: | Formulation of Walktop, Colorcoat 300 Green, Jet Seal and Industrial Membrane Premix |
| Exposure route: | Inhalation |
| Physical form: | Dust |
| Area sampling data: | 0.02 - 0.4 fibers per cubic· centimeter (cc) |
| Exposure duration: | 8-hour shifts |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Sampling and Analytical Methodology | Low | Sampling or analytical methodology is not specified. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | The data are from the United States. |
| Metric 3: | Applicability | Uninformative | The data are for processing materials using asbestos, which is not in-scope of the legacy asbestos risk evaluation. |
| Metric 4: | Temporal Representativeness | Low | Data is more than 20 years old. |
| Metric 5: | Sample Size | Medium | Distribution of samples is characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Low | It is unclear whether samples were area or personal monitoring. The only metadata provided is shift duration. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Low | The monitoring study does not address variability or uncertainty. |

## Overall Quality Determination Uninformative

**Study Citation:** Standard Oil, (1980). Occupational health survey on the US Fleet Hillyer Brown.
**HERO ID:** 4158149
**Conditions of Use:** Other:

**EXTRACTION**

| Parameter | Data |
|---|---|
| Worker activity description: | General exposure to engineers and oilers on board the Hillyer Brown |
| Exposure route: | Inhalation |
| Physical form: | Fibers |
| Personal sampling data: | Personal samples from a third engineer and a third oiler were both <0.002 f/cc. (8/9) |
| Area sampling data: | Area samples were <0.002 f/cc everywhere except in the officer quarters, which they were 0.003 f/cc. (7/9) |
| Personal protective equipment: | Half facepiece, dual cartridge respirator is adequate for concentrations up to 20 f/cc. If levels of asbestos aren't known, a supplied air respirator is required for ripout operations. |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Low | Sampling methodology not specified. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | Low | Data are for exposure to asbestos containing materials in the absence of asbestos disturbing operations. |
| | Metric 4: | Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Low | Exposure type and sampling data provided, but missing number of workers, worker activities, exposure duration and frequency, engineering controls, and particle size. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Low

**Study Citation:** Standard Oil, (1979). Occupational health survey Portland Asphalt Plant.
**HERO ID:** 4158150
**Conditions of Use:** Other:

**EXTRACTION**

| Parameter | Data |
|---|---|
| Worker activity description: | Asphalt production, mixing of slurries containing asbestos. |
| Personal sampling data: | 8 hr TWA0.01 f/cc |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Low | Sampling or analytical methodology is not specified. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | The data are from the United States. |
| | Metric 3: | Applicability | Uninformative | CoU is out of scope- formulation of asbestos-containing cement |
| | Metric 4: | Temporal Representativeness | Low | The data were collected before the most recent PEL update. |
| | Metric 5: | Sample Size | Medium | Distribution of samples is characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Low | Monitoring data include sample type (e.g., personal breathing zone) but no other metadata. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | The monitoring study does not address variability or uncertainty. |

## Overall Quality Determination Uninformative

**Study Citation:** Standard Oil, (1982). QC lab transite study - asbestos investigation with attached analysis report.
**HERO ID:** 4158155
**Conditions of Use:** Other:

**EXTRACTION**

| Parameter | Data |
|---|---|
| Personal sampling data: | <0.0037 f/cc (2 samples) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Low | Sampling or analytical methodology is not specified. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | The data are from the United States and are representative of the industry being evaluated. |
| | Metric 3: | Applicability | Uninformative | The source does not include information on use, the occupational exposure scenario can not be determined |
| | Metric 4: | Temporal Representativeness | Low | The data were collected before the most recent PEL update. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Low | Monitoring data include sample type (e.g., personal breathing zone) but no other metadata. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | The monitoring study does not address variability or uncertainty. |

## Overall Quality Determination Uninformative

| | |
|---|---|
| **Study Citation:** | Standard Oil, (1981). Report correction to indus hygiene report dated 101581. |
| **HERO ID:** | 4158156 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Refinery operators, specifically at the cracking unit (4/9) |
| Physical form: | fibers (4/9) |
| Area sampling data: | (PLM) Area samples were <0.00091 f/cc near the corner cracking unit, <0.00083 f/cc through the cracking unit, <0.00084 f/cc and the end of a treater, and <0.00084 f/cc between stills. (4/9) |
| Personal protective equipment: | If insulation material needs to be removed, respirators and protective clothing must be worn. (7/9) |
| Engineering control: | If insulation material needs to be removed, it must be wet with water first to reduce dust. (7/9) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Sampling and Analytical Methodology | Low | Sampling or analytical methodology is not specified. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | Data are from the U.S. |
| Metric 3: | Applicability | Uninformative | Data are for exposure to asbestos in the absence of use, not in scope of legacy asbestos risk evaluation. |
| Metric 4: | Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Medium | Exposure type and sampling data provided, but missing number of workers, exposure duration, frequency, and particle size. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Medium | Monitoring report addresses variability through multiple sample locations, but measurement uncertainty is not characterized. |

## Overall Quality Determination Uninformative

| | |
|---|---|
| **Study Citation:** | Standard Oil, (1981). Sampling results airborne asbestos survey with attachments. |
| **HERO ID:** | 4158159 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | asbestos insulation removal (pg 3) |
| Personal sampling data: | 2 samples - 0.02 f/cc (0.005 f/cc 8-hr TWA) (pg 5)3 samples - 0.012, 0.115, 0.204 f/cc (0.003, 0.033, 0.060 f/cc 8-hr TWA )(pg 6) |
| Area sampling data: | 1 sample - 0.004 f/cc (0.001 f/cc 8-hr TWA) (pg 5) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Low | Sampling/analytical methodology is not specified. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for construction materials, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Sample type and exposure type provided but missing metadata such as exposure frequency. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | Variability is addressed by including personal and area monitoring data. Uncertainty is not addressed. |

## Overall Quality Determination **Medium**

| | |
|---|---|
| **Study Citation:** | Standard Oil, (1978). Asbestos investigation of worker exposure [878211916]. |
| **HERO ID:** | 9551167 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | cleaning and washing area, stripping and bagging old insulation, insulating 4" lines with epitherm 1200 (pg 3) |
| Personal sampling data: | 8 hr TWA: 0.7 f/cc, 0.7 f/cc, 0.8 f/cc (pg 3) |
| Personal protective equipment: | protective clothing, respirators (pg 3) |
| Engineering control: | wetting (pg 3) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Low | Sampling/analytical methodology is not specified. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | The data are for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Sample type and exposure type provided but missing metadata such as exposure frequency. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | State of North Carolina Office of State Personnel, (2000). OSHA training for workers and their supervisors who remove intact resilient asbestos-containing flooring. |
| **HERO ID:** | 3981065 |
| **Conditions of Use:** | Disposal |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | inform workers who will remove the flooring, employer of employees working in the area and the building owner that Asbestos containing flooring has been identified.demarcate the identified regulated area with signage.vacuum the entire flooring using a HEPA vacuumIf possible removal the whole flooring: wood underlayment and flooring.Separate carpet from tile underlayment (if needed)Mist the flooring with water with detergent prior removing the flooring (unless heat will be used to loosen the adhesive)stripping machine one worker runs the machine and a second mops the stripper solution on to the flooring and vacuums up the used solution.Scrubbing machine - one worker operates the machine and a second applies scrubbing solutions and vacuums up used solution. Wipe vacuum and put cloth into waste container and seal .Emptying HEP vacuum - remove and lightly mist bags and filters prior to placing into a label leak proof waste container oLabel waste for disposal ”Danger. Contains asbestos fibers. Avoid creating dust. Cancer and lung disease hazard.”Send to an approved land fill. |
| Exposure route: | inhalation |
| Physical form: | inhalable fibers |
| Area sampling data: | Tile removal pried up individually supplemented with heat to loosen the adhesive followed by hand scraping under damp conditions, finished with a low speed terrazzo floor machine using wet silica sand or floor buffing machined with floor stripping solution 0.022 f/ccSheet flooring removal slicing the vinyl flooring in 4-8 inch strips, peeling and rolling the wear layer while wetting the nip point with liquid detergent solution and scraping the residual backing Average TWA 0.027 f/cccutback adhesive removal using damp hand scraping and wet mechanical grinding average TWA 0.004 f/ccTile and cutback adhesive removal using damp scraping and wet mechanical grinding 0.016 f/ccEthanolamine stripper 8 hour TWA ranged 0.0149 to 0.0416 f/ccscrubbing machine used to clean asbestos tile 8 hour TWA ranged 0.0237 to 0.0365 f/ccit is unclear when PCM and TEM were used but it does reference the Environ report entitled ”Recommended WorkPractices for Removal of Resilient Floor Coverings” |
| Exposure duration: | OSHA average 91 hours per year per building on O&M work involving active exposure to asbestos.O&M means a program of work practices to maintain asbestos in good condition, ensure cleanup of asbestos fibers previously released, and prevent further release by minimizing and controlling asbestos disturbance or damage. O&M is needed regardless of whether the asbestos present is friable or nonfriable, intact or non-intact, since the potential exists for it to become friable or non-intact. |
| Personal protective equipment: | Author noted that the follow are not required if concentrations are less than PEL:safety glassesglovesprotective clothingrespirators ( in confined spaces) the document specificially states that a respirator is not needed for floor removal as there is an agreement that these activities do not exceed the PEL. |
| Engineering control: | WR Grace supposedly has developed a foam that can seep into asbestos to ”digest” the fibers within 24 hours (fluorine, in ionic form, reacts selectively with chrysotile asbestos fibers, breaking them down into inert inorganic matter). This product was anticipated to be available in 1998. |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Sampling and Analytical Methodology | High | most of the monitoring data is from an ENRON testing project. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | US |
| Metric 3: | Applicability | High | The data are for an occupational scenario (asbestos containing flooring removal) within the scope of the risk evaluation. |
| Metric 4: | Temporal Representativeness | Medium | 2000- after the PEL, but more than 20 years old |
| Metric 5: | Sample Size | Medium | Range data are provided only |
| Domain 3: Accessibility/ Clarity | | | |

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| | |
|---|---|
| **Study Citation:** | State of North Carolina Office of State Personnel, (2000). OSHA training for workers and their supervisors who remove intact resilient asbestos-containing flooring. |
| **HERO ID:** | 3981065 |
| **Conditions of Use:** | Disposal |

| | | EVALUATION | | |
|---|---|---|---|---|
| Domain | | Metric | Rating | Comments |
| | Metric 6: | Metadata Completeness | Low | Monitoring data include sampling methods ( some times) but no other metadata. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | High | Range data are provided that can be used to assess variability, but would need to access the underlaying reference for more details about the PCM and TEM methods uses. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Stewart Industrial Hygiene & Safety, (1982). Johns-Manville airborne asbestos evaluation Sibley Missouri. |
| **HERO ID:** | 4158255 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Removal of asbestos containing insulation. [PDF Pg. 7] |
| Exposure route: | Inhalation |
| Personal sampling data: | [PDF Pg. 8]Tony Lemos: 0.47; 0.54; <0.15; <0.15; 0.71; <0.15; 0.91 (fibers/cm^3)Harlan May: <0.11; 0.22; 0074 (fibers/cm^3) |
| Area sampling data: | [PDF Pg. 8]Area/base of tower: <0.01 (fibers/cm^3)Ambient sample: <0.005 (fibers/cm^3) |
| Personal protective equipment: | Protective coveralls, hard hats and respirators [PDF Pg. 7]. |
| Engineering control: | Wetting the asbestos insulation [PDF Pg. 7]. |
| Comments: | Asbestos fibers were counted with NIOSH P&CAM 239 Method. [PDF PG. 13] |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | High | Sampling/analytical methodology is an approved NIOSH method. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for Chemical Substances in Construction, Paint, Electrical, and Metal Products, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Monitoring data are greater than 20 years old. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Sample type and exposure type provided but missing exposure duration and frequency. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | High | Uncertainty is addressed in sampling/analytical methodology. Variability addressed by sampling multiple people and area sampling. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Stewart-Taylor, A. J., Cherrie, J. W. (1998). Does risk perception affect behaviour and exposure? A pilot study amongst asbestos workers. Annals of Occupational Hygiene 42(8):565-569. |
| **HERO ID:** | 3581369 |
| **Conditions of Use:** | Other: |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Removal of asbestos containing wall boards, ceiling boards, or tiles and cleanup afterwards. (1/5) |
| Physical form: | fiber (2/5) |
| Area sampling data: | Measured fiber concentrations ranged from 0.01 f/mL to 4.4 f/mL from 41 measurements at 10 sites. (2/5) The median cumulative exposure for removal and combined removal and cleaning were 22 and 36 fibers/ml*min. The value for just cleaning was 2.6 fibers/mL*min. The model indicated that the use of power tools increased cumulative exposure from approximately 17 fibers/ml*min to 119 fibers/ml*min. (2/5) |
| Exposure duration: | Tasks took 12-132 minutes. (2/5) |
| Number of workers: | 17 workers (2/5) |
| Engineering control: | Avoiding the use of power tools, careful bagging of debris, (2/5) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Medium | Sampling/analytical methodology is not an approved OSHA/NIOSH method but is an acceptable methodology. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Medium | Data are from the U.K., an OECD country. |
| | Metric 3: | Applicability | High | Data are for demolition of asbestos products, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Medium | Monitoring data were collected after the most recent PEL and greater than 10 years old. |
| | Metric 5: | Sample Size | Medium | Sample distribution characterized by limited statistics (ranges, medians, p-values) but discrete samples not provided and distribution not fully characterized. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Exposure type and sampling data provided, but missing exposure frequency, PPE, and particle size. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | High | Uncertainty is addressed in sampling/analytical methodology. Variability is addressed by sampling the removal of different materials and levels of risk perception. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Straub, W. E. (1976). Health hazard evaluation report no. HETA 76-4-310, ACF Industries, Amcar Division, Milton, PA. |
| **HERO ID:** | 3970493 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Furnishing, Cleaning, Treatment Care Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Welders using a fireproof asbestos blanket. (2/6) |
| Exposure route: | dermal (2/6) |
| Physical form: | fabric (2/6) |
| Area sampling data: | Two area samples near where the asbestos blanket was used were both <0.01 f/cc. (6/6) |
| Particle size characterization: | Fibers longer than 5 micrometers in length. (6/6) |
| Number of workers: | 5 employees had regular contact with the blanket. (3/6) |
| Personal protective equipment: | Workers normally wore leather aprons covering the front of the trunk, upper legs and shoulder areas. In addition, full length gloves open at the top- but tight at the wrists were used.(4/6) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | High | Sampling/analytical methodology is equivalent to an approved [OSHA/NIOSH] method. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for industrial use in textiles, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Exposure type and sampling data provided, but missing exposure duration, frequency, and engineering controls. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | Uncertainty is addressed in sampling/analytical methodology. Variability isn't addressed. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Straub, W. E. (1976). Health hazard evaluation report no. HETA 76-4-310, ACF Industries, Amcar Division, Milton, PA. |
| **HERO ID:** | 3970493 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Packaging, Paper, Plastic, Toys, Hobby Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Railroad tank car manufacturers cutting strips of asbestos paper boards. (2/6) |
| Exposure route: | dermal (2/6) |
| Physical form: | dust (2/6) |
| Personal sampling data: | Two personal samples during asbestos paper insulation area were <0.01 f/cc. (6/6) |
| Particle size characterization: | Fibers longer than 5 micrometers in length. (6/6) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | High | Sampling/analytical methodology is equivalent to an approved [OSHA/NIOSH] method. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for industrial use in paper products, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Exposure type and sampling data provided, but missing number of workers, exposure duration, frequency, PPE, and engineering controls. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | Uncertainty is addressed in sampling/analytical methodology. Variability isn't addressed. |

## Overall Quality Determination — High

| | |
|---|---|
| **Study Citation:** | Sumner, P., Wood, H. T. (1979). Air Quality in the Underground Stations of the Rail Transportation System (Metro) of Washington, D.C. Journal of Environmental Health 42(2):75. |
| **HERO ID:** | 6893367 |
| **Conditions of Use:** | Other: |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Metro employees (guards, toll booth operators, and maintenance men). |
| Area sampling data: | [PDF Pg. 4] (fibers/m^3)Union Station: 2Judiciary Square: 0Gallery Place: 0Metro Center: 0Farragut North: 3Dupont Circle: 2Stadium Armory: 2Potomac Avenue: 1Eastern Market: 1Capitol South: 0Federal Center: 0L'Enfant Plaza: 2Smithsonian: 0Federal Triangle: 0Metro Center: 1McPherson Square: 1Farragut West: 0Foggy Bottom: 3Rosslyn: 5Pentagon: 4Pentagon City: 1Crystal City: 5 |
| Comments: | Data is area sampling data with no personal sampling data in the document. Samples were analyzed with PCM [PDF Pg. 3] |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Sampling and Analytical Methodology | High | Sampling/analytical methodology is equivalent to an approved OSHA/NIOSH method. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | Data are from the U.S. |
| Metric 3: | Applicability | Uninformative | Data are for exposures to the general population and are not useable for the occupational exposure assessment. |
| Metric 4: | Temporal Representativeness | Low | Monitoring data are greater than 20 years old. |
| Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Low | Sample type provided but no other metadata. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Medium | Variability addressed by sampling at multiple metro stations, but report does not address measurement uncertainty. |

## Overall Quality Determination Uninformative

| | |
|---|---|
| **Study Citation:** | Sussell, A., Shults, R. (1993). Health hazard evaluation report no. HETA 91-053-2320, Union Tank Car, Cleveland, Texas. |
| **HERO ID:** | 3970487 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | scraping and buffing of asbestos-containing valve gaskets (P. 1) |
| Personal sampling data: | Three to eight samples of 8 to 98 minutes duration were collected for each of the 3 workers sampled. A total of 32 air samples were submitted for asbestos analysis by PCM, and if appropriate TEM. None of the samples contained detectable levels of fibers (limit of detection 7 fibers/mm2) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | High | Sampling or analytical methodology is an approved OSHA or NIOSH method or is well described and found to be equivalent to approved OSHA or NIOSH methods. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | The data are from the United States and are representative of the industry being evaluated. |
| | Metric 3: | Applicability | High | The data are for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Medium | Operations, equipment, and worker activities are expected to be reasonably representative of current conditions. The monitoring data were collected after the most recent PEL establishment or update but are generally more than 10 years old |
| | Metric 5: | Sample Size | Medium | Distribution of samples is characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Monitoring data include most critical metadata, such as sample type and exposure type, but lacks additional metadata, such as exposure durations, exposure frequency, and worker activities. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | The monitoring study provides only limited discussion of the variability in the determinants of exposure for the sampled site or sector. The monitoring study provides only limited discussion of the uncertainty in the exposure estimates. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Swuste, P., Dahhan, M., Burdorf, A. (2008). Linking expert judgement and trends in occupational exposure into a job-exposure matrix for historical exposure to asbestos in The Netherlands. Annals of Occupational Hygiene 52(5):397-403. |
| **HERO ID:** | 2590661 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | handling products, transportation, waste management, and supervision and inspection (pg. 4) |
| Exposure route: | inhalation |
| Physical form: | dust of asbestos fibers |
| Area sampling data: | Table 2. Average exposure to asbestos (fibres ml1 air) in different exposure groups in the asbestos–cement industry inThe Netherlands during the period 1970–1989 pg. 4 |
| Comments: | Monitoring data included tasks not a part of the scope, they are not included under worker activity. |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Sampling and Analytical Methodology | Low | Sampling/analytical methodology is not specified. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | Medium | Data are from the Netherlands, an OECD country |
| Metric 3: | Applicability | High | The data is primarily for Use and Disposal, which is an in-scope occupational scenario |
| Metric 4: | Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| Metric 5: | Sample Size | Medium | Sample distribution characterized by limited statistics (number of samples, geometric mean, geometric standard deviation, and arithmetic mean) but discrete samples not provided and distribution not fully characterized. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Low | Sample type provided but no other metadata. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Low | Uncertainty is addressed in the document over the potential for miscategorization of studies into the appropriate work types. Variability is not addressed. |

## Overall Quality Determination Low

| | |
|---|---|
| **Study Citation:** | Szeszenia-Dabrowska, N. (2011). Asbestos abatement workers versus asbestos workers: exposure and health-effects differ: Answer to the letter of John Lange et al.. International Journal of Occupational Medicine and Environmental Health 24(4):420-421. |
| **HERO ID:** | 3541377 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Asbestos abatement workers (AAW) engaged in removing asbestos-containing building materials. |
| Exposure route: | Inhalation |
| Physical form: | Fibers |
| Area sampling data: | ”Analysis of about 450 measurements carried out in recent years has shown that the concentrations of asbestos fibers at workplaces during the removal of asbestos-containing products in the open air are not likely to exceed the level of 0.001 f/cc” |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Sampling and Analytical Methodology | Low | Sampling or analytical methodology is not specified. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | Medium | The data are from an OECD country. other than the U.S., and locality-specific factors (e.g., potential differences in regulatory occupational exposure limits, industry/ process technologies) may impact exposures relative to the U.S. |
| | Metric 3: Applicability | High | The data are for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: Temporal Representativeness | Medium | The monitoring data were collected after the most recentPEL establishment or update but are generally more than 10 years old. If no PEL is established, the data are more than 10 years but generally, no more than 20 years old. |
| | Metric 5: Sample Size | Medium | Distribution of samples is characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | Medium | Monitoring data include most critical metadata, such as sample type and exposure type, but lacks additional metadata, such as sample durations, exposure durations and exposure frequency. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Low | The monitoring study does not address variability or uncertainty. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Szeszenia-Dąbrowska, N., Swiątkowska, B., Szubert, Z., Wilczyńska, U. (2011). Asbestos in Poland: occupational health problems. International Journal of Occupational Medicine and Environmental Health 24(2):142-152. |
| **HERO ID:** | 2575095 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Today's occupational exposure to asbestos in Poland concerns workers involved in the maintenance and removal of asbestos-containing materials. |
| Physical form: | dust fibers |
| Personal sampling data: | Studies on asbestos fibre concentration in the breathing zone of workers employed at removal of various types of asbestos cement goods indicated low concentration levels ranging from 0.001 f/cm3 to 0.080 f/cm3.pg. 3/11 |
| Number of workers: | the number of workers with intermittent exposure to asbestos dust from the use of asbestos-containing products is estimated to be ca. 150,000. pg.3/11 |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Sampling and Analytical Methodology | Low | Sampling/analytical methodology is not specified. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | Medium | Data are from Poland, an OECD country. |
| | Metric 3: Applicability | High | Data are for "Industrial Commercial Use : Chemical Substances in Construction, Paint, Electrical, and Metal Products" an in-scope occupational scenario. |
| | Metric 4: Temporal Representativeness | Medium | Monitoring data were collected after the most recent PEL and greater than 10 years old. |
| | Metric 5: Sample Size | Medium | Sample distribution characterized by limited statistics (max and min) but discrete samples not provided and distribution not fully characterized. |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | Low | Sample type provided but no other metadata. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Low

| | |
|---|---|
| **Study Citation:** | Szeszenia-Dąbrowska, N., Świątkowska, B. (2015). An unjustified prognosis of the number of asbestos-related lung cancer cases caused by an increase in airborne asbestos concentrations as a result of removing of asbestos-cement products. The Scientific World Journal 2015:264568. |
| **HERO ID:** | 3077791 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Exposure route: | Inhalation is assumed since asbestos levels in the air are discussed. |
| Physical form: | Fibers |
| Area sampling data: | 2 to 8 fibers/cm^3 [PDF Pg. 2] |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Low | Sampling/analytical methodology is not specified. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Medium | Data are from Poland, an OECD country. |
| | Metric 3: | Applicability | High | The data are for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Low | The data were collected before the most recent PEL establishment or update or are more than 20 years old if no PEL is established. |
| | Metric 5: | Sample Size | Medium | Sample distribution characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Low | Sample type provided but no other metadata. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Low

| | |
|---|---|
| **Study Citation:** | Tannahill, S. N., Jackson, M. H., Willey, R. J. (1990). Effect of Cowl on Air Samples for Amosite in the Workplace and in the Laboratory. Annals of Occupational Hygiene 34(5):521-527. |
| **HERO ID:** | 2066465 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Asbestos (amosite) containing ceiling tile removal. |
| Exposure route: | inhalation |
| Physical form: | inhalable fibers |
| Personal sampling data: | meanWith cowl 0.87 f/mlWithout cowl 0.80 f/mlMean of differences 0.07SD of differences 0.14It does not matter if samples are obtained with or without a cowl. |
| Area sampling data: | meanWith cowl 0.22 f/mlWithout cowl 0.23 f/mlMean of differences 0.00667SD of differences 0.049It does not matter if samples are obtained with or without a cowl. |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Medium | Does not appear to be a NIOSH methodsampling pumps were pre- and post-calibrated to 2 1. min" 1and the air was drawn through a Millipore 25 mm diameter mixed cellulose ester filter membrane with a pore size of 0.8 /mi. Sampling times depended on the test volunteer, but the fiber density on the filter did not exceed 1000 f mm" 2 in any individual case |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Medium | UK - OECD member |
| | Metric 3: | Applicability | High | The data are for an occupational scenario (renovation) within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Low | 1989 - prior to PEL and more than 20 years old. |
| | Metric 5: | Sample Size | High | actual results were provided along with mean, mean differences and SD of differences. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Monitoring data include most critical metadata, such as sample type, exposure type, and worker activities, but lacks additional metadata, such as sample durations, exposure durations, and exposure frequency. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | The monitoring study provides limited discussion of the variabilityof exposure for the sampled site. The monitoring study provided no information on uncertainty in the exposure estimates. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Tannahill, S. N., Willey, R. J., Jackson, M. H. (1990). Workplace protection factors of HSE approved negative pressure full-facepiece dust respirators during asbestos stripping: preliminary findings. Annals of Occupational Hygiene 34(6):547-552. |
| **HERO ID:** | 3082488 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | asbestos stripping (pg 1) |
| Personal sampling data: | 0.012 f/ml in mask, 2.37 f/ml for lapel sample (just one example of testing condition) (pg 4) |
| Personal protective equipment: | negative pressure full-facepiece dust respirators (pg 1)Protection factors: range, geometric mean, geometric SD, 5th percentile:Respirator A: 11-2090, 200, 4.3, 19Respirator B: 26-3493, 577, 5.2, 41Respirator C: 17-500, 120, 4.4, 11 (pg 4) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Medium | Sampling/analytical methodology is not an approved OSHA/NIOSH method but is an acceptable methodology. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Medium | Data are from the UK, an OECD country |
| | Metric 3: | Applicability | High | Data are for asbestos stripping, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Monitoring data are greater than 20 years old. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided; however it's just one data point). |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Low | Sample type provided but no other metadata. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | Variability is addressed by studying different respirators, but uncertainty is not addressed |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Tech Servs Inc, (1982). Atmosphere filtering monitoring report [878210790]. |
| **HERO ID:** | 4158204 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Cleanup of asbestos material on the U.S.S. Lexington. (5/6) |
| Physical form: | fibers (5/6) |
| Area sampling data: | An area sample taken during cleanup on the U.S.S. Lexington was 0.08 f/cc. (5/6) |
| Engineering control: | The cleanup area was secured from the rest of the ship. (5/6) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Sampling and Analytical Methodology | Low | Sampling or analytical methodology is not specified. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | Data are from the U.S. |
| Metric 3: | Applicability | High | The data are for an occupational scenario within the scope of the risk evaluation. |
| Metric 4: | Temporal Representativeness | Low | Monitoring data is more than 20 years old. |
| Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Medium | Exposure type and sampling data provided, but missing number of workers, exposure duration, frequency, particle size, and PPE. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Tech Servs Inc, (1979). Atmosphere filtering monitoring report [878211252]. |
| **HERO ID:** | 4158207 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Asbestos removal from Main Machine Room of USS Forrestal. |
| Exposure route: | Inhalation |
| Physical form: | Fibers |
| Personal sampling data: | 1.5 hr sample: 0.85 f/cc |
| Area sampling data: | 1.5 hr sample: 0.75 f/cc30 min sample: 0.05 f/cc |
| Engineering control: | Area secured |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Sampling and Analytical Methodology | Low | Sampling/analytical methodology is not specified. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | Data are from the U.S. |
| Metric 3: | Applicability | High | Data are for asbestos removal, an in-scope occupational scenario. |
| Metric 4: | Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Medium | Sample type and exposure type provided, but missing additional metadata such as exposure frequency and worker activity details. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Medium | The monitoring report addresses variability through collection of multiple sampling types (area and personal), but measurement uncertainty is not addressed. |

## Overall Quality Determination Medium

**Study Citation:** Tech Servs Inc, (1979). Atmosphere filtering monitoring report [878211281].
**HERO ID:** 4158216
**Conditions of Use:** Other:

**EXTRACTION**

| Parameter | Data |
|---|---|
| Personal sampling data: | 6.5 fibers/cc (10.5 hr)boiler room |
| Area sampling data: | 4.5 fibers/cc (10.5 hr)boiler room |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Low | Sampling or analytical methodology is not specified. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | The data are from the United States. |
| | Metric 3: | Applicability | Uninformative | Condition of use is unknown. |
| | Metric 4: | Temporal Representativeness | Low | The data were collected before the most recent PEL update. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Monitoring data include most critical metadata, such as sample type and exposure type, but lacks additional metadata, such as sample durations, exposure durations, exposure frequency, and worker activities. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | Monitoring report addresses variability through multiple sampling types (area and personal), but measurement uncertainty is not characterized. |

## Overall Quality Determination Uninformative

| | |
|---|---|
| **Study Citation:** | Tech Servs Inc, (1979). Atmosphere filtering monitoring report [878210738]. |
| **HERO ID:** | 4158221 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Insulation cleanup in the boiler room of USS Manley |
| Exposure route: | inhalation |
| Physical form: | solid fibers |
| Personal sampling data: | 2 samples - 0.45 f/cc, 300 minutes (p. 6) |
| Area sampling data: | 1 sample - 0.10 f/cc, 300 minutes (p. 5)3 samples - 0.03 f/cc, 20 minutes (p. 7) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Low | Sampling or analytical methodology is not specified. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | The data are from the United States and are representative of the industry being evaluated. |
| | Metric 3: | Applicability | High | The data are for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Low | The data are more than 20 years old. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Monitoring data include most critical metadata, such as sample type and exposure type, but lacks additional metadata, such as exposure durations, exposure frequency, and detailed information onworker activities. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | Variability is addressed by including personal and area samples but uncertainty is not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Tech Servs Inc, (1979). Atmosphere filtering monitoring report [878210744]. |
| **HERO ID:** | 4158225 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Personal sampling data: | 2 samples - 15.0 fibers/cc (pg 5) |
| Area sampling data: | Boiler room (pg 4) - 1 sample - 10.0 fibers/ccBoiler room (pg 6) - 3 samples - 10.0 fibers/cc |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Low | Sampling/analytical methodology is not specified. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for building/construction materials (Naval ship), an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Low | Monitoring data include sample type (e.g., personal breathing zone) but no other metadata. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | Variability addressed by including personal and area samples but uncertainty is not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Tech Servs Inc, (1979). Monitoring the atmosphere filtration [878210795]. |
| **HERO ID:** | 4158270 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Removal of asbestos from lower head of USS Saratoga |
| Exposure route: | Inhalation |
| Physical form: | Fibers |
| Area sampling data: | 0.02 f/cc measured during 30-min sampling period using 2 LPM flowrate |
| Engineering control: | Area secured during asbestos removal |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Sampling and Analytical Methodology | Low | Sampling or analytical methodology is not specified. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | The data are from the United States. |
| Metric 3: | Applicability | High | The data are for an occupational scenario within the scope of the risk evaluation. |
| Metric 4: | Temporal Representativeness | Low | The data were collected before the most recent PEL update. |
| Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Medium | Monitoring data include most critical metadata such as sample type and exposure type, but lacks additional metadata such as exposure durations, exposure frequency, and worker activity details. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Low | The monitoring study does not address variability or uncertainty. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Tech Servs Inc, (1979). Monitoring the atmosphere filtering [878210801]. |
| **HERO ID:** | 4158272 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Asbestos removal and clean-up from Main Machine Room #2 on USS Saratoga. |
| Exposure route: | Inhalation |
| Physical form: | Fibers |
| Personal sampling data: | 0.50 fibers/cm3 measured during asbestos removal with 2-hr sampling time and 2 LPM flowrate. |
| Area sampling data: | 0.40 fibers/cm3 measured during asbestos removal with 2-hr sampling time and 2 LPM flowrate.0.01 fibers/cm3 measured after clean-up with 30-min sampling time and 2 LPM flowrate. |
| Engineering control: | The removal area was secured from the rest of the ship. |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Sampling and Analytical Methodology | Low | Sampling methodology not specified. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | High | Data are from the U.S. |
| | Metric 3: Applicability | High | Data are for removal of asbestos products, an in-scope occupational scenario. |
| | Metric 4: Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| | Metric 5: Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | Medium | Exposure type and sampling data provided, but missing number of workers, exposure duration, frequency, PPE, and particle size. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Medium | Monitoring report addresses variability through multiple sample types (area and personal), but does not characterize measurement uncertainty. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Tech Servs Inc, (1979). Atmosphere filtering monitoring report [878210780]. |
| **HERO ID:** | 4158276 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Area sampling data: | Environmental Sample [PDF Pg. 4]U.S.S. Yosemite Evaporator Room: 2.5 fibers/cc (1 sample) Certificate Sample [PDF Pg. 5]U.S.S. Yosemite Evaporator Room: 1.2 fibers/cc (3 samples) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Low | Sampling or analytical methodology is not specified. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | The data are from the United States and are representative of the industry being evaluated. |
| | Metric 3: | Applicability | High | The data are for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Low | The data were collected before the most recent PEL establishment or update or are more than 20 years old if no PEL is established. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Low | Monitoring data include sample type (e.g., personal breathing zone) but no other metadata. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | The monitoring study does not address variability or uncertainty. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Tech Servs Inc, (1979). Atmosphere filtering monitoring report [878210781]. |
| **HERO ID:** | 4158277 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Removal of asbestos-containing material from Machine Room on USS Yosemite. |
| Personal sampling data: | 1.9 fibers/cc measure during removal of asbestos with 6.5-hr sampling time. |
| Area sampling data: | 0.85 fibers/cc measure during removal of asbestos with 6.5-hr sampling time.0.15 fibers/cc measure after removal of asbestos with 30-min sampling time. |
| Engineering control: | Area secured during asbestos removal. |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Low | Sampling/analytical methodology is not specified. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for Chemical Substances in Construction, Paint, Electrical, and Metal Products, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Monitoring data are greater than 20 years old. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Monitoring data include most critical metadata such as sample type and exposure type, but lacks additional metadata such as exposure durations, exposure frequency, and worker activity details. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | Monitoring report addresses variability through the collection of multiple sample types (area and personal), but measurement uncertainty is not characterized. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Tech Servs Inc, (1979). Monitoring the atmosphere filtering [878210796]. |
| **HERO ID:** | 9608776 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Removal of asbestos on the U.S.S. Saratoga. (5/10) |
| Personal sampling data: | Personal samples during removal were 0.20 f/cc at the Higher Head and 0.25 f/cc at the Lower Head. (6/10) |
| Area sampling data: | Area asbestos concentrations were measured at 0.05, 0.10, and 0.15 f/cc at the Higher Head and 0.10 f/cc at the Lower Head. (4/10) |
| Engineering control: | The sampling data state that the area was secured from other parts of the ship. (5/10) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Low | Sampling instruments and methods are reported in codes with no way to determine their meanings. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for asbestos removal, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Low | Monitoring data include sample type (e.g., personal breathing zone) but other metadata is limited. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | The monitoring study does not address variability or uncertainty. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Tech Servs Inc, (1979). Monitoring the atmosphere filtering [878210797]. |
| **HERO ID:** | 9608987 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | asbestos removal |
| Exposure route: | inhalation |
| Physical form: | fiber |
| Personal sampling data: | 2 samples: 0.10 f/cc (30 minutes) (p. 9) |
| Area sampling data: | 3 samples: 0.0009 f/cc (30 min sample duration)(p. 5)3 samples: 0.003 f/cc (30 minutes) (p. 7)1 sample: 0.09 f/cc (30 minutes) (p. 8) |
| Engineering control: | Secure area from other areas. |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Sampling and Analytical Methodology | Low | Sampling or analytical methodology is not specified. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | The data are from the United States and are representative of the industry being evaluated. |
| Metric 3: | Applicability | High | The data are for an occupational scenario within the scope of the risk evaluation. |
| Metric 4: | Temporal Representativeness | Low | Metadata on the operations, equipment, and worker activities associated with the data show that the data agree representative of outdated operations, equipment, and activities rather than current operations, equipment, and worker activities. The data were collected more than 20 years ago. |
| Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Medium | Monitoring data include most critical metadata, such as sample type, sample duration, and exposure type, but lacks additional metadata such as exposure durations, exposure frequency, and/orworker activities. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Medium | Variability is addressed by including personal and area samples but uncertainty is not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Tech Servs Inc, (1979). Monitoring the atmosphere filtering [878210798]. |
| **HERO ID:** | 9609086 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Asbestos removal from engine rooms of USS Saratoga. |
| Exposure route: | Inhalation |
| Physical form: | Fibers |
| Personal sampling data: | 0.20 fibers/cm3 measured in Main Engine Room during asbestos removal with 1.5-hr sampling time and 2 LPM flowrate. |
| Area sampling data: | 0.10 fibers/cm3 measured in Main Engine Room during asbestos removal with 1.5-hr sampling time and 2 LPM flowrate.0.007 fibers/cm3 measured in Engine Room #2 after asbestos removal with 30-min sampling time and 2 LPM flowrate. |
| Engineering control: | Tent control utilized during asbestos removal. |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Sampling and Analytical Methodology | Low | Sampling or analytical methodology is not specified. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | High | The data are from the United States. |
| | Metric 3: Applicability | High | The data are for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: Temporal Representativeness | Low | Data more than 20 years old. |
| | Metric 5: Sample Size | High | Discrete data measurements provided. |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | Medium | Monitoring data include most critical metadata, such as sample type and exposure type, but lacks additional metadata such as exposure durations, exposure frequency, and worker activity details. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Medium | Monitoring report addresses variability through multiple types of sampling (personal and area), but does not describe measurement uncertainty. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Tech Servs Inc, (1979). Monitoring the atmosphere filtering [878210799]. |
| **HERO ID:** | 9609339 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Removal of asbestos from bottom wet room and engine room of USS Saratoga. |
| Exposure route: | Inhalation |
| Physical form: | Fiber |
| Personal sampling data: | (2 samples) 0.01 fibers/cm3 measured in bottom wet room with 1-hr sampling duration and 2 LPM flowrate.(2 samples) 0.15 fibers/cm3 measured in engine room with 1.5-hr sampling duration and 2 LPM flowrate. |
| Area sampling data: | (1 sample) 0.01 fibers/cm3 measured in bottom wet room with 1-hr sampling duration and 2 LPM flowrate.(3 samples) 0.009 fibers/cm3 measured in bottom wet room after asbestos removal with 30-min sampling duration and 2 LPM flowrate.(1 sample) 0.09 fibers/cm3 measured in engine room with 1.5-hr sampling duration and 2 LPM flowrate. |
| Engineering control: | Asbestos was wetted and area was secured during asbestos removal in bottom wet room. For asbestos removal in engine room, tent control was utilized. |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Sampling and Analytical Methodology | Low | Sampling or analytical methodology is not specified. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | The data are from the United States. |
| Metric 3: | Applicability | High | The data are for an occupational scenario within the scope of the risk evaluation. |
| Metric 4: | Temporal Representativeness | Low | Data more than 20 years old. |
| Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Medium | Monitoring data include most critical metadata, such as sample type and exposure type, but lacks additional metadata such as exposure durations and exposure frequency. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Medium | Monitoring report addresses variability through multiple sampling types (personal and area), but uncertainty is not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Tech Servs Inc, (1979). Atmosphere filtering monitoring report [878210786]. |
| **HERO ID:** | 9610580 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Asbestos removal and clean-up |
| Exposure route: | Inhalation |
| Physical form: | Fiber |
| Personal sampling data: | 0.85 fibers/cm3 measured during asbestos removal on USS Yosemite with 1.5 hr sampling time and 2 LPM flowrate. |
| Area sampling data: | 0.75 fibers/cm3 measured during asbestos removal on USS Yosemite with 1.5 hr sampling time and 2 LPM flowrate.0.07 fibers/cm3 measured after clean-up on USS Yosemite with 30 min sampling time and 2 LPM flowrate. |
| Engineering control: | Area secured during asbestos removal. |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Low | Sampling or analytical methodology is not specified. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | The data are from the United States. |
| | Metric 3: | Applicability | High | The data are for asbestos removal and clean-up, which are occupational scenarios within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Low | Data are more than 20 years old. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Monitoring data include most critical metadata, such as sample type and exposure type, but lacks additional metadata such as exposure durations and exposure frequency. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | Monitoring study addresses variability through multiple sampling types (personal and area), but does not describe measurement uncertainty. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Tech Servs Inc, (1979). Atmosphere filtering monitoring report [878211253]. |
| **HERO ID:** | 9638788 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Removal of asbestos |
| Exposure route: | Inhalation |
| Physical form: | Fiber |
| Personal sampling data: | 1.2 fibers/cm3 measured on USS Forrestal over a 3.5 hr sampling period using 2 LPM flowrate (2 samples). |
| Area sampling data: | 0.05 fibers/cm3 measured on USS Forrestal over a 30 min sampling period using 2 LPM flowrate (3 samples). 1.5 fibers/cm3 measured on USS Forrestal over a 3.5 hr sampling period using 2 LPM flowrate (1 sample). |
| Engineering control: | Asbestos removal area secured. |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Low | Sampling or analytical methodology is not specified. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | The data are from the United States. |
| | Metric 3: | Applicability | High | The data are for asbestos removal, an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Low | Data are more than 20 years old. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Monitoring data include most critical metadata, such as sample type and exposure type, but lacks additional metadata, such as exposure durations and exposure frequency. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | Variability is addressed through multiple types of sampling (area and personal), but uncertainty is not described. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Tech Servs Inc, (1979). Atmosphere filtering monitoring report [878210745]. |
| **HERO ID:** | 9640858 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Exposure route: | inhalation (2/4) |
| Physical form: | fibers (2/4) |
| Personal sampling data: | 2 samples - 10.0 f/cc |
| Area sampling data: | 1 sample - 9.0 f/cc |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Low | Sampling or analytical methodology is not specified. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | The data are for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Exposure type and sampling data provided, but missing worker activity, exposure duration, frequency, particle size, engineering controls, and PPE. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | Variability addressed by including personal and area samples. Uncertainty is not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Terazono, A., Sakai, S., Takatsuki, H. (2000). The great Hanshin-Awaji Earthquake of Japan 1995 and asbestos emission. Advances in Air Pollution Series (Vol. 8) :583-592. |
| **HERO ID:** | 6880182 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | asbestos removal |
| Area sampling data: | Table 1 (pg 3): presents sampling data (geo. means and ranges, measured via PCM) for indoor, "around door", exhaust outlet, and outdoor for 16 buildings before, during, and after asbestos removal: <0.2-130,000 f/LPg 4: site boundary sampling during demolition of 2 of the 16 buildings: Building A: 14.7 f/L and 11.3 f/L via PCM; 78 f/L via TEM or EDS (not certain which)Building B: <1 f/L via PCMPg 4: site boundary sampling of demolished condo, which did not undergo "pre-removal" of asbestos (crocidolite): 160 and 250 f/L (PCM); filter that resulted in 250 f/L sample via PCM resulted in 5,300 f/L for all fiber lengths and 310 f/L for fibers 5 um or longer via TEMPg 8: "As a result of calculation by plume-puff model, for each of the 16 sampling points, the concentration increase was about 0.1 f/L (0.010 to 0.31 f/L) in the earthquake zone from February through April owing to demolition without pre-removal of sprayed-on asbestos. Figure 4(a) compares our calculation with the data from Environment Agency monitoring at sampling points. Sampling readings for the concentration increase were between -0.070 and 3.4 f/L" |
| Engineering control: | water sprinkling (pg 2) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Medium | Sampling/analytical methodology is not an approved OSHA/NIOSH method but is an acceptable methodology. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Medium | Data are from Japan, an OECD country. |
| | Metric 3: | Applicability | High | Data are for construction materials, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Monitoring data are greater than 20 years old. |
| | Metric 5: | Sample Size | Medium | Sample distribution characterized by limited statistics (ranges, means) but discrete samples not provided and distribution not fully characterized. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Low | Sample type provided but no other metadata. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | Variability addressed by comparing analytical methods, but uncertainty is not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Teschke, K., Ahrens, W., Andersen, A., Boffetta, P., Fincham, S., Finkelstein, M., Henneberger, P., Kauppinen, T., Kogevinas, M., Korhonen, K., Liss, G., Liukkonnen, T., Osvoll, P., Savela, A., Szadkowska-Stanczyk, I., Westbergh, H., Widerkiewicz, K. (1999). Occupational exposure to chemical and biological agents in the nonproduction departments of pulp, paper, and paper product mills: An International Study. American Industrial Hygiene Association Journal 60(1):73-83. |
| **HERO ID:** | 5241760 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Packaging, Paper, Plastic, Toys, Hobby Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Non-production jobs, such as maintenance, construction, cleaning, storage, loading, shipping, power generation (4/12). |
| Exposure route: | inhalation (6/12) |
| Physical form: | fibers (6/12) |
| Personal sampling data: | ”Maintenance, construction, and cleaning TWA: 0-0.5 f/cc (mean of 0.081, median of 0.004 f/cc)Storage, yard, loading, and shipping TWA: 0-28 f/cc (mean of 7.2, median of 0.18 f/cc)Power generation TWA: 0-0.1 f/cc (mean of 0.013, median of 0 f/cc)” |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Low | Sampling methodology not specified. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Medium | Data are from many different countries, all of which are OECD countries. |
| | Metric 3: | Applicability | Medium | Data are for industrial use in paper products, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Measurements dates range from 1956-1993, so most are prior to the most recent PEL. |
| | Metric 5: | Sample Size | Medium | Sample distribution characterized by limited statistics (min, max, mean, median) but discrete samples not provided and distribution not fully characterized. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Exposure type and sampling data provided, but missing number of workers, particle size, exposure duration, frequency, engineering controls, and PPE. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | Uncertainty isn’t addressed. Variability is addressed by gathering data from multiple paper mills in various countries. |

## Overall Quality Determination — Low

| | |
|---|---|
| **Study Citation:** | TOMA, (1979). Cross-sectional health study of workers at the Follansbee, West Virginia plant of Koppers Company, Inc. |
| **HERO ID:** | 3230139 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | operator activity and location listed; included mill operations, addition of asbestos to batches (pg 137)areas sampled were next to shredder for asbestos (pg 237) "Asbestos monitoring was conducted during the production of Roof Resaturant 410" (pg 353) |
| Physical form: | bagged asbestos received at site (pg 1121) |
| Personal sampling data: | samples for fibers >5micron given with sample period in minutes and other sampling parameters; range of values from ND to 1.4 f/cc; located at Irving, TX plant for Koppers Company Inc. (pg 137) ... "The one day's monitoring of the Painter/Insulators at the Follansbee Plant showed asbestos fiber TWA exposures of 0.04 and 0.06 fibers per cc " (pg 177 and 229) ... Monitoring data for 8am-4pm shift at Fontana Tar Plant given in different time periods with range of exposures 0.14 to 1.6 fibers/cm3 (pg 237) ... Process worker for resaturant mixer at Youngstown, OH plant had TWA of 0.15 f/cc and peak exposures up to 1.14 f/cc (pg 258) ... samples for fibers >5micron given with sample period in minutes and other sampling parameters; range of values from 0.03 to 1.63 f/cc; located at Youngstown Tar Plant for Koppers Company Inc. (pg 263) ... personal samples for fibers >5micron given with sample period in minutes and other sampling parameters located at Los Angeles, CA Plant for Koppers Company Inc. (pg 294) ... personal samples at Garwood, NJ plant for Koppers Company Inc (pg 327) |
| Area sampling data: | Monitoring data for 8am-4pm shift at Fontana Tar Plant near shredder given in different time periods with range of concentrations 0.11 to 0.21 fibers/cm3 (pg 237) ... Area samples for felt unwind and asbestos storage areas at Youngstown, OH plant had TWA of 0.01 and 0.03 f/cc (pg 258) ... samples in warehouse and near mixer for fibers >5micron given with sample period in minutes and other sampling parameters; range of values from <0.01 to 2.82 f/cc; located at Youngstown Tar Plant for Koppers Company Inc. (pg 263) ... area samples near Myers mixer for fibers >5micron given with sample period in minutes and other sampling parameters located at Los Angeles, CA Plant for Koppers Company Inc. (pg 294) ... area samples at Garwood, NJ plant for Koppers Company Inc (pg 327) |
| Exposure duration: | given as TWA or specific times ranging from 15min to several hours (pg 137) |
| Personal protective equipment: | "operator monitored, who handled the asbestos, wore an MSA Model GMA-H respirator with NIOSH approval TC-23C-155 while handling the material" (pg 127) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | High | Sampling/analytical methodology is an approved NIOSH method. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | Medium | Data are for manufacturing of tar, which is similar to the in-scope occupational scenario for industrial uses. |
| | Metric 4: | Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | All metadata provided. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | High | Uncertainty is addressed in sampling/analytical methodology. Variability addressed by data collection at different sites. |

**Continued on next page . . .**

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| | |
|---|---|
| **Study Citation:** | TOMA, (1979). Cross-sectional health study of workers at the Follansbee, West Virginia plant of Koppers Company, Inc. |
| **HERO ID:** | 3230139 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

| | | EVALUATION | |
|---|---|---|---|
| Domain | Metric | Rating | Comments |
| **Overall Quality Determination** | | **High** | |

| | |
|---|---|
| **Study Citation:** | Toth, L., Călămar, A., Găman, G. A., Pupăzan, D., Simion, S. (2016). Risk assessment of occupational exposure to asbestos dust at industrial workplaces. :539-546. |
| **HERO ID:** | 6871253 |
| **Conditions of Use:** | Other: |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Work areas are: Calender metal cord - Threads, Area BU, Quota 6.8 Mixer L2 - Feeder Belt, Butyl Storage area, storage area - control room, quota 14, Quota 0 -platen L2, Quota 0 - platen L5. |
| Exposure route: | inhalation |
| Physical form: | particulate |
| Personal sampling data: | 67 samples (unknown if area/personal), all = 0 fibers/cm3 |
| Area sampling data: | 67 samples (unknown if area/personal), all = 0 fibers/cm3 |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Sampling and Analytical Methodology | Medium | Sampling/analytical methodology is not an approved OSHA/NIOSH method but is an acceptable methodology. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | Medium | Data are from Bulgaria, an OECD country. |
| | Metric 3: Applicability | Uninformative | Data are for residual exposure from former mfg activities (and unknown current existence of asbestos), which is not an in-scope or similar to an in-scope occupational scenario. |
| | Metric 4: Temporal Representativeness | High | Monitoring data are no more than 10 years old. |
| | Metric 5: Sample Size | Low | Sample distribution is described qualitatively. 67 samples indicated but only 10 samples shown. |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | Low | Sample type and exposure type not provided. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Uninformative

| | |
|---|---|
| **Study Citation:** | U.S. EPA, (1991). Indoor air - Assessment: Indoor concentrations of environmental carcinogens. |
| **HERO ID:** | 17763 |
| **Conditions of Use:** | Consumer Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Exposure route: | inhalation (7/56) |
| Physical form: | fibers (26/56) |
| Area sampling data: | (TEM) Table 4 presents a summary of studies that used TEM to measure airborne asbestos contamination indoors. Concentrations ranged from 0.1 to 217 ng/m3. (26/56) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Sampling and Analytical Methodology | High | Sampling/analytical methodology is equivalent to an approved [OSHA/NIOSH] method. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | Medium | Data are from the U.S., France, U.K., and Canada |
| Metric 3: | Applicability | Uninformative | Source only provides general inhalation exposure in buildings. |
| Metric 4: | Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| Metric 5: | Sample Size | Medium | Sample distribution characterized by limited statistics (mean, ranges) but discrete samples not provided and distribution not fully characterized. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Medium | Sampling data provided, but missing exposure duration, frequency, worker activity, particle size, PPE, engineering controls, and number of workers. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Medium | Variability is addressed by compiling results from different studies. Uncertainty is not addressed. |

## Overall Quality Determination Uninformative

| | |
|---|---|
| **Study Citation:** | U.S. EPA, (1992). Observations on asbestos release during demolition activities. |
| **HERO ID:** | 3970144 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Demolition activities. |
| Exposure route: | inhalation |
| Physical form: | Fiber |
| Area sampling data: | Average airborne asbestos concentrations during building demolition at the Pacific Garden Mall in Santa Cruz, California. ~0.004 - <0.025 structures/cc. Figure 1. (P. 4/14)demolition of a building in Watsonville, California. 0.0153-0.0512 s/cc. background level- 0.006 s/cc. (P. 5/14)implosion/demolition of a 26-story building in Cincinnati,·Ohio.~ <0.012 s/cc. Figure 4, (P. 8/14)demolition of the Ft. Wainwright Elementary School in Fairbanks, Alaska. well below 0.005 asbestos structures/cc. Figure 5. (P. 11/14) |
| Engineering control: | Control practices consisted of spraying the demolitionsite with water from fire-hoses while demolition dozers, end loaders, and trucks were operating. (P.3/14) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Sampling and Analytical Methodology | High | The U.S. Environmental Protection Agency's. Risk Reduction Engineering Laboratory (RREL) data. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | The data are from the United States. |
| Metric 3: | Applicability | High | The data are for an occupational scenario within the scope of the risk evaluation. Demolition. |
| Metric 4: | Temporal Representativeness | Low | More than 20 years old. |
| Metric 5: | Sample Size | Medium | Distribution of samples is characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Medium | Monitoring data include most critical metadata, such as sample type and exposure type, but lacks additional metadata, such as sample durations, exposure durations, exposure frequency, and/orworker activities. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Medium | The monitoring study provides only limited discussion. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | U.S. EPA, (1993). Airborne asbestos concentrations during buffing of resilient floor tile. |
| **HERO ID:** | 3970145 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Spray-buffing asbestos containing floor tile. [PDF Pg. 3] |
| Exposure route: | Inhalation |
| Personal sampling data: | Range of total fiber concentrations: ND - 0.295 (f/cm^3). *Samples per location are shown on PDF Pg. 7*. |
| Area sampling data: | Range of average asbestos concentrations during buffing of floor tile: 0-0.414 (s/cm^3). *Samples per location are shown on PDF Pg. 4*. |
| Particle size characterization: | Overall, less than 1 % of the asbestos fibers measured before and during were greater than 5 $\mu$m in length. [PDF Pg. 4] |
| Exposure duration: | The average time spent buffing floors on a typical day ranges from 1.5 to 2.5 hr. [PDF Pg. 3] |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Sampling and Analytical Methodology | High | Sampling or analytical methodology is an approved OSHA or NIOSH method or is well described and found to be equivalent to approved OSHA or NIOSH methods. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | Data are from the U.S. |
| Metric 3: | Applicability | High | Data are for Chemical Substances in Construction, Paint, Electrical, and Metal Products, an in-scope occupational scenario. |
| Metric 4: | Temporal Representativeness | Low | Monitoring data are greater than 20 years old. |
| Metric 5: | Sample Size | Medium | Sample distribution characterized by limited statistics (min, max, mean) but discrete samples not provided and distribution not fully characterized. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Medium | Monitoring data include most critical metadata, such as sample type and exposure type, but lacks additional metadata, such as exposure frequency. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Medium | Uncertainty is not addressed. Variability addressed by sampling at multiple sites. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | U.S. EPA, (1993). Airborne asbestos concentrations three years after abatement in seventeen schools. |
| **HERO ID:** | 3970146 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Student/Teacher |
| Exposure route: | inhalation |
| Physical form: | inhalable fibers |
| Area sampling data: | School A Previous abated area- Mean: 0.001 s/cm3 Min: 0 s/cm3 Max: 0.003 s/cm3 non-abated area - Mean: 0.003 s/cm3 Min: 0 s/cm3 Max: 0.008 s/cm3 School B Previous abated area- Mean: 0.027 s/cm3 Min: 0.01 s/cm3 Max: 0.055 s/cm3 non-abated area - Mean: 0.012 s/cm3 Min: 0.004 s/cm3 Max: 0.024 s/cm3 School C Previous abated area- Mean: 0.005 s/cm3 Min: 0 s/cm3 Max: 0.012 s/cm3 non-abated area - Mean: 0.001 s/cm3 Min: 0 s/cm3 Max: 0.003 s/cm3 School D Previous abated area- Mean: 0.020s/cm3 Min: 0.003 s/cm3 Max: 0.059 s/cm3 non-abated area - Mean: 0.004 s/cm3 Min: 0 s/cm3 Max: 0.009 s/cm3 School E Previous abated area- Mean: 0.037 s/cm3 Min: 0.011 s/cm3 Max: 0.069 s/cm3 non-abated area - Mean: 0.010 s/cm3 Min: 0 s/cm3 Max: 0.029 s/cm3 School F Previous abated area- Mean: 0.043 s/cm3 Min: 0.032 s/cm3 Max: 0.066 s/cm3 non-abated area - Mean: 0.036 s/cm3 Min: 0.010 s/cm3 Max: 0.058 s/cm3 School G Previous abated area- Mean: 0.027 s/cm3 Min: 0.011 s/cm3 Max: 0.037 s/cm3 non-abated area - Mean: 0.005 s/cm3 Min: 0 s/cm3 Max: 0.011 s/cm3 School H Previous abated area- Mean: 0.004 s/cm3 Min: 0 s/cm3 Max: 0.014 s/cm3 non-abated area - Mean: 0.005 s/cm3 Min: 0 s/cm3 Max: 0.011 s/cm3 School I Previous abated area- Mean: 0.004 s/cm3 Min: 0 s/cm3 Max: 0.007 s/cm3 non-abated area - Mean: 0.005 s/cm3 Min: 0 s/cm3 Max: 0.011 s/cm3 School J Previous abated area- Mean: 0.003 s/cm3 Min: 0 s/cm3 Max: 0.011 s/cm3 non-abated area - Mean: 0 s/cm3 Min: 0 s/cm3 Max: 0 s/cm3 School K Previous abated area- Mean: 0.041 s/cm3 Min: 0.014 s/cm3 Max: 0.097 s/cm3 non-abated area - Mean: 0.003 s/cm3 Min: 0 s/cm3 Max: 0.007 s/cm3 School L Previous abated area- Mean: 0.006 s/cm3 Min: 0 s/cm3 Max: 0.016 s/cm3 non-abated area - Mean: 0.003 s/cm3 Min: 0 s/cm3 Max: 0.006 s/cm3 School M Previous abated area- Mean: 0.023 s/cm3 Min: 0 s/cm3 Max: 0.056 s/cm3 non-abated area - Mean: 0.004 s/cm3 Min: 0 s/cm3 Max: 0.007 s/cm3 School N Previous abated area- Mean: 0.004 s/cm3 Min: 0.003 s/cm3 Max: 0.009 s/cm3 non-abated area - Mean: 0.015 s/cm3 Min: 0 s/cm3 Max: 0.046 s/cm3 School O Previous abated area- Mean: 0.005 s/cm3 Min: 0 s/cm3 Max: 0.022 s/cm3 non-abated area - Mean: 0 s/cm3 Min: 0 s/cm3 Max: 0 s/cm3 School P Previous abated area- Mean: 0.004 s/cm3 Min: 0 s/cm3 Max: 0.011 s/cm3 non-abated area - Mean: 0.001 s/cm3 Min: 0 s/cm3 Max: 0.004 s/cm3 School Q Previous abated area- Mean: 0.009 s/cm3 Min: 0.004 s/cm3 Max: 0.018 s/cm3 non-abated area - Mean: 0.012 s/cm3 Min: 0.004 s/cm3 Max: 0.024 s/cm3 School R Previous abated area- Mean: 0.005 s/cm3 Min: 0 s/cm3 Max: 0.010 s/cm3 non-abated area - Mean: 0.001 s/cm3 Min: 0 s/cm3 Max: 0.004 s/cm3 School S Previous abated area- Mean: 0.001 s/cm3 Min: 0 s/cm3 Max: 0.004 s/cm3 non-abated area - Mean: 0.003 s/cm3 Min: 0 s/cm3 Max: 0.011 s/cm3 School T Previous abated area- Mean: 0.001 s/cm3 Min: 0 s/cm3 Max: 0.007 s/cm3 non-abated area - Mean: 0.001 s/cm3 Min: 0 s/cm3 Max: 0.004 s/cm3 |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Sampling and Analytical Methodology | High | EPA study |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | US |
| Metric 3: | Applicability | High | The data are for an occupational scenario ( school) within the scope of the risk evaluation. |
| Metric 4: | Temporal Representativeness | Low | 1991 - prior to the latest PEL and more than 20 years old |
| Metric 5: | Sample Size | High | mean, min max were provided. single factor ANOVA was preformed and significance evaluated. |
| Domain 3: Accessibility/ Clarity | | | |

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**Study Citation:** U.S. EPA, (1993). Airborne asbestos concentrations three years after abatement in seventeen schools.
**HERO ID:** 3970146
**Conditions of Use:** Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products

| | | | EVALUATION | |
|---|---|---|---|---|
| Domain | | Metric | Rating | Comments |
| | Metric 6: | Metadata Completeness | Medium | Monitoring data include most critical metadata, such as sample type and exposure type, but lacks additional metadata, such as sample durations, exposure durations, exposure frequency, and/orworker activities. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | High | information about mean, min and max values were provide which can be used to assess variance within and between locations. It is assumed that uncertainty was considered in the EPA methodology as the document notes field and sampling blanks. |

## Overall Quality Determination High

**Study Citation:** U.S. EPA, (2008). Comparison of the alternative asbestos control method and the NESHAP method for demolition of asbestos-containing buildings.
**HERO ID:** 3970151
**Conditions of Use:** Disposal

**EXTRACTION**

| Parameter | Data |
|---|---|
| Worker activity description: | Removal of Asbestos containing materials ( all for NESHAP and movable material for AACM).Predemolition wettingDemolition for NESHAP and continued wetting and demolition for AACMSite clean up including soil removalBagging and removal of debris.Transport to landfillStorage in landfill |
| Exposure route: | inhalation or exposure to contaminated water. |
| Physical form: | fibers |
| Personal sampling data: | Personal Samples—0.8-$\mu$m pore size MCE air sampling filters were prepared and analyzed for total fibers using NIOSH Method 7400 —Asbestos Fibers by PCM (A Counting Rules). Fibers greater than 5 $\mu$m in length and with an aspect ratio greater than 3:1 were counted.ISO Method 10312:1995, Ambient Air - Determination of Asbestos Fibres -Direct-Transfer Transmission Electron Microscopy Method.‖ Note: After TEM analysis, a sector from the same filter was then analyzed using PCM.Fort ChaffeeMax TEM NESHAP approach 0.093 s/cm3 Abatement workers Mean 0.032 Min 0 Max 0.071 S/cm3 Load out workers Mean 0.065 Min 0.041 Max 0.093 S/cm3 AACM approach Max 0MAX TWA PCM fibers NESHAP approach 0.10 f/cm3 AACM approach 0.03 f/ccm3Abatement worker details are provided in Table 6-15. for Total asbestos, PCME Asbestos and total fibers for excavators, hose operators and laborers, truck drivers and walkers.Land fillNESHAP Bulldozer operator 0.0048 S/cm3 NESHAP Compact Operator 0 AACM Bulldozer operator 0 AACM Compact Operator 0 Results from individual sampling events are provided in table A-9 (Adobe Page 212) and A-10 (Adobe page 213) |
| Area sampling data: | Perimeter Samples—The 0.45-$\mu$m pore size MCE air sampling filters were prepared and analyzed for total fibers using NIOSH Method 7400 —Asbestos Fibers by PCM‖ (A Counting Rules).Perimeter Samples—The 0.45-$\mu$m pore size MCE air sampling filters were prepared and analyzed using ISO Method 10312:1995, Ambient Air -Determination of Asbestos Fibres Direct-Transfer Transmission Electron Microscopy Method.‖ Note: After TEM analysis, a sector from the same filter was then analyzed using PCM.Fort ChaffeeNESHAP approach mean: 0.000054 s/cm3 (range 0-0.00049 s/cm3)AACM approach mean: 0.00012 s/cm3 (range 0-0.0019 s/cm3) The maximum value was associated with soil extraction and removal for AACM.Total asbestos concentrations and PCME asbestos concentrations for each day of the demolition are provided in Table 6-3; Table 6-6 provided airborne total fibers (PCM) during demolition. for each ring and height sampled - peak value occurred for AACM on the second day at Ring 1 height 15 ft (0.016 f/cm3)Landfill NESHAP Mean 0 Min 0 Max 0 S/CM3AACM Day 1 Mean 0.00005 Min 0 Max 0.00048 S/CM3 Day 2 Mean 0.00005 Min 0 Max 0.00049 S/cm3Results for individual sampling events are noted in Table (A-2) for NESHAP Building A-3 for AACM Building, ( adobe pages 199-204 ), A-5 for Landfills (pages 206)for TEM Chrysotile, Amphibole and total S/CM3 and PCM f/CM3 |
| Dermal exposure data: | nan |
| Exposure duration: | NESHAP - 10 days: includes removal of ACM, demolition (1 day) and cleanup.AACM total duration was difficult to assess as the process was interrupted by weather events. Demolition took 1 day. rough estimate of total time was noted to be 1.5 days. |
| Personal protective equipment: | tyvek suits, respirators, and gloves |
| Engineering control: | application of water augmented with wetting agent to allow the water to get into smaller spaces. |
| Comments: | In 2006 and 2007 the Environmental Protection Agency (EPA) conducted three tests to examine the cost and environmental effectiveness of Alternative Asbestos Control Method (AACM). Two tests were conducted in Fort Chafee, Arkansas and one was conducted in Forth Worth, Texas. The EPA discontinued testing the AACM due to technical deficiencies. The AACM remains unapproved and should not be used. |

**EVALUATION**

| Domain | | Metric | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | High | EPA study approved methods used and noted above. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | US |

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**Study Citation:** U.S. EPA, (2008). Comparison of the alternative asbestos control method and the NESHAP method for demolition of asbestos-containing buildings.
**HERO ID:** 3970151
**Conditions of Use:** Disposal

| Domain | | Metric | EVALUATION Rating | Comments |
|---|---|---|---|---|
| | Metric 3: | Applicability | High | The data are for an occupational scenario ( asbestos contaminated building demolition) within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Medium | 2006-2007 more than 10 and less than 20 years old |
| | Metric 5: | Sample Size | High | detailed statistics provided along with statistical testing. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | Monitoring data include all associated metadata |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | High | variability was formally discussed and it was assumed that uncertainty was addressed in the approved methodologies. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | U.S. EPA, (1993). Evaluation of asbestos fiber release during maintenance of asbestos-containing floor tile. |
| **HERO ID:** | 3970155 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Vinyl asbestos tile floor wax stripping and rebuilding of a new wax surface. (13/71) |
| Exposure route: | inhalation (23/71) |
| Personal sampling data: | Personal samples ranged from 0-0.0555 f/cc for PCM and 0-0.014946 f/cc for TEM. (61/71) |
| Area sampling data: | (TEM) Area samples ranged from 0-0.043513 f/cc. (66/71) |
| Exposure duration: | 8 hours (10/71) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | High | Sampling/analytical methodology is an approved NIOSH method. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for commercial use of chemical substances in construction products, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Sample type and exposure type provided, but missing exposure frequency, number of workers, particle size, PPE, and engineering controls. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | High | Uncertainty is addressed in sampling/analytical methodology. Variability addressed by sampling different operations and different schools. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | U.S. EPA, (1986). Assessment of assay methods for evaluating asbestos abatement technology at the Corvallis Environmental Research Laboratory. |
| **HERO ID:** | 6892380 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | 6 weeks after asbestos abatement (pg 22) |
| Exposure route: | inhalation |
| Physical form: | particulate |
| Area sampling data: | 0.002 to 0.057 fiber/cm3 during aggressive (air turbulence introduced via blower, pg 25) sampling conditions; <0.01 fibers/cm3 for nonaggressive conditions (pg 13)Figure 7 (pg 32) presents TEM sampling data, 6-78.3 fibers/LFull sampling results in Tables 1 and 5 (pg 39, 48-49), <0.002-0.18 fibers/cm3Figures 10-11, Tables 2-4 present the sampling data in different ways. |
| Engineering control: | fume hood (pg 18) |
| Comments: | PCM and TEM sampling; PCM samples analyzed with NIOSH Method P&CAM 239 (pg 28) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Sampling and Analytical Methodology | High | Sampling/analytical methodology is an approved [NIOSH/OSHA] method. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | Data are for the U.S. |
| Metric 3: | Applicability | High | Data are for construction materials, an in-scope occupational scenario |
| Metric 4: | Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Medium | Sample type and exposure type provided but missing metadata such as exposure frequency. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | High | Uncertainty is addressed in sampling/analytical methodology. Variability addressed by sampling various rooms with different levels of asbestos abatement, comparing samples to non-asbestos areas and outside, etc. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | U.S. EPA, (1986). Assessment of assay methods for evaluating asbestos abatement technology. |
| **HERO ID:** | 6892385 |
| **Conditions of Use:** | Consumer Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Office and school workers at locations where friable asbestos had been removed. (18/86) |
| Exposure route: | inhalation (58/86) |
| Physical form: | fibers (33/86) |
| Area sampling data: | During aggressive sampling, PCM results ranged from 2000 f/m3 to 110,000 f/m3 and TEM results ranged from 17,000-1,267,000 f/m3. (40/86) For all post abatement PCM measurements, the mean concentration during aggressive sampling was 27,000 f/m3. For TEM measurements, the mean concentration during aggressive sampling was 266,000 f/m3. (46/86) |
| Engineering control: | At the school, the air-moving system encompasses 32 air handlers (7 multizone and 25 single-zone), 282 fan coil units, convectors, and unit heaters. Air is supplied via a ducted supply air system, and return air is provided by a ceiling plenum system. (20/86) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | High | Sampling/analytical methodology is an approved NIOSH method. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | Low | Data are for school and office workers exposures, which is similar to commercial use of construction products. |
| | Metric 4: | Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Exposure type and sampling data provided, but missing number of workers, exposure duration, frequency, PPE, and particle size. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | High | Uncertainty is addressed in sampling/analytical methodology. Variability is addressed by comparing PCM to TEM results, and doing a statistical analysis. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | U.S. EPA, (1991). Evaluation of two cleaning methods for removal of asbestos fibers from carpet. |
| **HERO ID:** | 6900998 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Furnishing, Cleaning, Treatment Care Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Sampling data is experimentally measured area monitoring from dry- and wet-vacuuming artificially contaminated asbestos carpeting. [PDF Pg. 2]Real-world sources: "under certain conditions, asbestos fibers can be released from fire-proofing, acoustical plaster, and other surfacing material. The episodic release of asbestos from aging and deteriorating ACM relates to several factors, such as the condition and amount of asbestos present, the accessibility of the material, activity within the area, vibration, temperature, humidity, airflow, use patterns, etc." [PDF Pg. 1] |
| Area sampling data: | [graphs on PDF Pg. 6; Asbestos intentionally added to carpet/]Low Contamination Carpet:Prior to wet-vacuum: ~0.06 (s/cm^3)After wet-vacuum: ~0.17 (s/cm^3)Prior to dry-vacuum: ~0.05 (s/cm^3)After dry-vacuum: ~0.25 (s/cm^3)High Contamination Carpet:Prior to wet-vacuum: ~0.075 (s/cm^3)After wet-vacuum: ~0.16 (s/cm^3)Prior to dry-vacuum: ~0.14 (s/cm^3)After dry-vacuum: ~0.225 (s/cm^3) |
| Engineering control: | HEPA filtration systems were used to reduce the airborne asbestos concentrations to background levels after each experiment. These units were operated during both preparation and decontamination of the test rooms. The air filtration units did not operate during the carpet cleaning phase of each experiment. [PDF Pg. 2]Wet cleaning significantly decreased asbestos contamination in the carpet by 70% [PDF Pg.5] |
| Comments: | Samples were analyzed using TEM method. [PDF Pg. 3] |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Sampling and Analytical Methodology | High | Sampling/analytical methodology is equivalent to an approved OSHA/NIOSH method. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | High | Data are from the U.S. |
| | Metric 3: Applicability | High | Data are for Chemical Substances in Furnishing, Cleaning, Treatment Care Products, an in-scope occupational scenario. |
| | Metric 4: Temporal Representativeness | Low | Monitoring data are greater than 20 years old. |
| | Metric 5: Sample Size | Medium | Sample distribution characterized by limited statistics (mean) but discrete samples not provided and distribution not fully characterized. |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | High | Monitoring data include all associated metadata. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | High | Uncertainty is addressed in sampling/analytical methodology. Variability addressed by by testing two different vacuum methods under two different carpet scenarios (high contamination and low contamination). |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | U.S. EPA, (1989). Asbestos fiber reentrainment during vacuuming and wet-cleaning of carpet at a captive research site. |
| **HERO ID:** | 6901552 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Two carpet cleaning techniques (HEPA-filtered dry vacuumingand HEPA-filtered hot water extraction) were used on carpetartificially contaminated with 100 million and 1 billion asbestosstructures per square foot (a.s./ft2). |
| Area sampling data: | Table 2low contaminationbefore cleaning: 0.0571 s/cc (HEPA-vacuum); 0.0673 s/cc (Extraction)During cleaning: 0.2531 s/cc (HEPA-vacuum); 0.1639 s/cc (Extraction)high contaminationbefore cleaning: 0.1424 s/cc (HEPA-vacuum); 0.0761 s/cc (Extraction)During cleaning: 0.2248s/cc (HEPA-vacuum); 0.1577 s/cc (Extraction) |
| Comments: | TABLE 5. COMPARISON OF TEM AND PCM ANALYSES OFSELECTED AIR SAMPLES |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | High | Sampling or analytical methodology is an approved OSHA or NIOSH method or is well described and found to be equivalent to approved OSHA or NIOSH methods. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | The data are from the United States and are representative of the industry being evaluated. |
| | Metric 3: | Applicability | Low | This is a simulated study for an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Metadata on the operations, equipment, and worker activities associated with the data show that the data agree representative of outdated operations, equipment, and activities rather than current operations, equipment, and worker activities. The data were collected more than 20 years ago. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | Monitoring data include all associated metadata, including sample types, exposure types, sample durations, exposure durations worker activities, and exposure frequency. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | High | The monitoring study addresses variability in the determinants of exposure for the sampled site or sector. The monitoring study addresses uncertainty in the exposure estimates or uncertainty can be determined from the sampling and analytical method. |

## Overall Quality Determination High

**Study Citation:** U.S. EPA, (2000). Sampling and analysis of consumer garden products that contain vermiculite.
**HERO ID:** 783704
**Conditions of Use:** Other:

**EXTRACTION**

| Parameter | Data |
|---|---|
| Worker activity description: | Simulated use of lawn & garden care products containing vermiculite both indoors (a 10'x10'x10' enclosure) and outdoors. |
| Exposure route: | Inhalation |
| Physical form: | Fibers |
| Personal sampling data: | The only detectable levels of asbestos were found in simulations using Zonolite Chemical Packaging Vermiculite. Because this product was mined at Libby, and we do not expect continued use of Libby lawn & garden care vermiculite, the exposure values from the Zonolite simulations are irrelevant. All other simulations lead to non-detect values for asbestos. |
| Area sampling data: | All non-detect |
| Particle size characterization: | Fibers > 5 microns |
| Exposure duration: | Sampling was conducted over 30 and 100 min periods. However, for risk calculation, it was assumed that exposure occurs 4 hours/day. |
| Exposure frequency: | 1 day/yr |
| Engineering control: | No ventilation for indoor scenarios |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | High | Sampling or analytical methodology is an approved OSHA or NIOSH method or is well described and found to be equivalent to approved OSHA or NIOSH methods. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | The data are from the United States and are representative of the industry being evaluated. |
| | Metric 3: | Applicability | High | The data are for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Low | Data are more than 20 years old. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | Monitoring data include all associated metadata, including sample types, exposure types, sample durations, exposure durations worker activities, and exposure frequency. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | High | The monitoring study addresses variability in the determinants of exposure for the sampled site or sector. The monitoring study addresses uncertainty in the exposure estimates or uncertainty can be determined from the sampling and analytical method. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | van Orden, D. R., Lee, R. J., Bishop, K. M., Kahane, D., Morse, R. (1995). Evaluation of ambient asbestos concentrations in buildings following the Loma Prieta earthquake. Regulatory Toxicology and Pharmacology 21(1):117-122. |
| **HERO ID:** | 3615956 |
| **Conditions of Use:** | Other: |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Clean-up and abatement workers (3/6) |
| Exposure route: | inhalation (4/6) |
| Physical form: | fibers (4/6) |
| Personal sampling data: | Personal samples during clean up were 8.89523 structures/mL (1.20199 f/mL >5um). Personal samples during abatement were 0.76092 structures/mL (0.05726 f/mL >5um). Converting to 8h-TWAs, clean up samples averaged 0.00981 f/mL and abatement samples averaged 0.03266 f/mL. (4/6) |
| Area sampling data: | Area samples during clean up were 0.0182 structures/mL (0.00240 f/mL >5um). Area samples during abatement were 0.09799 structures/mL (0.01122 f/mL > 5um). (4/6) |
| Particle size characterization: | Fibers at least 5 um long with a diameter of at least 0.25 um (4/6). |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Sampling and Analytical Methodology | High | Sampling/analytical methodology is an approved NIOSH method. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | Data are from the U.S. |
| Metric 3: | Applicability | High | Data are for disaster response activities, an in-scope occupational scenario. |
| Metric 4: | Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| Metric 5: | Sample Size | Medium | Sample distribution characterized by limited statistics (averages, ranges) but discrete samples not provided and distribution not fully characterized. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Medium | Exposure type and sampling data provided, but missing number of workers, exposure duration, frequency, engineering controls, and PPE. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | High | Uncertainty is addressed in sampling/analytical methodology. Variability is addressed by sampling at multiple sites. |

## Overall Quality Determination High

**Study Citation:** Velsicol Chem Corp, (1982). Industrial hygiene sampling summary Velsicol Chemical Corporation asbestos with cover letter and index.
**HERO ID:** 5914623
**Conditions of Use:** Other:

**EXTRACTION**

| Parameter | Data |
|---|---|
| Area sampling data: | [PDF Pg. 5]Chattanooga Plant1/8/79 (1 sample): <0.11 (fibers/cm^3)8/25/80 (12 samples): 0.004-0.127 (fibers/cm^3)Memphis Plant6/26/78 (9 samples): 0.02-2.72 (fibers/cm^3)5/12/81 (13 samples): 0.007-1.87 (fibers/cm^3) |
| Personal protective equipment: | All personnel handling asbestos are required to wear a NIOSH approved respirator or dust mask, disposable coveralls, gloves, and head and foot coverings. [PDF Pg. 5] |
| Comments: | Asbestos samples were collected in accordance with the NIOSH recommended sampling analytical method. Calibrated high flow pumps were used to draw air through open-faced 0.8 um Millipore filters at an approximate flow rate of 2.0 liters per minute. The filter cassette was attached to a stationary object (area sample) on the worker's lapel or collar to obtain representative breathing zone samples.Analysis was performed utilizing the phase contrast microscopy technique. [PDF Pg. 5] |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Sampling and Analytical Methodology | High | Sampling/analytical methodology is an approved NIOSH method. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | Data are from the U.S. |
| Metric 3: | Applicability | Uninformative | Data are for manufacturing of hexachlorocyclopentadiene products, not in-scope for the asbestos legacy risk evaluation. |
| Metric 4: | Temporal Representativeness | Low | Monitoring data are greater than 20 years old. |
| Metric 5: | Sample Size | Medium | Sample distribution characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Low | Sample type provided but no other metadata. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | High | Uncertainty is addressed in sampling/analytical methodology. Variability addressed by sampling on multiple dates and at two plant locations. |

## Overall Quality Determination Uninformative

| | |
|---|---|
| **Study Citation:** | Verma, D. K., Clark, N. E. (1995). Relationships between phase contrast microscopy and transmission electron microscopy results of samples from occupational exposure to airborne chrysotile asbestos. American Industrial Hygiene Association Journal 56(9):866-873. |
| **HERO ID:** | 786485 |
| **Conditions of Use:** | Other: |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Dumping and loading asbestos for tape production, and brake manufacturing. (3/9) |
| Exposure route: | inhalation (2/8) |
| Physical form: | fibers (3/8) |
| Personal sampling data: | The ratio of fibers measured with EM to those measured with PCM were 18.4+-6.6 for tape product manufacturing and 19.4+-12.7 for brake manufacturing. (4/8) |
| Particle size characterization: | Long thin fibers with L>8 um and D<1.5 um made up 5.4% of samples for tape manufacturing, and 10.6% of samples for brake manufacturing. (5/8) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Sampling and Analytical Methodology | High | Sampling/analytical methodology is an approved NIOSH method. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | Medium | Data are from Canada, an OECD country. |
| | Metric 3: Applicability | Uninformative | Data are for manufacturing of asbestos-containing products, which isn't in scope. |
| | Metric 4: Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| | Metric 5: Sample Size | Medium | Sample distribution characterized by limited statistics (ratios, standard deviations, means, percentages) but discrete samples not provided and distribution not fully characterized. |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | Medium | Exposure type and sampling data provided, but missing number of workers, exposure duration, frequency, engineering controls, and PPE. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | High | Uncertainty is addressed in sampling/analytical methodology. Variability is addressed by sampling using TEM and PCM. |

## Overall Quality Determination Uninformative

| | |
|---|---|
| **Study Citation:** | Verma, D. K., Kurtz, L. A., Sahai, D., Finkelstein, M. M. (2003). Current chemical exposures among Ontario construction workers. Applied Occupational and Environmental Hygiene 18(12):1031-1047. |
| **HERO ID:** | 157093 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Sites and activities where sampling occurred listed in Table II (pg 4): primarily demolition, construction, roofing, and related sites with activities such as cutting, welding, fireproof spraying, excavation, installation, demolition by hand or machine, carpentry, drywalling, etc."Asbestos is still important in sectors of the industry involved in demolition, decommissioning, or industrial renovations or maintenance as was recently reported for demolition workers at the World Trade Center. Painters, asbestos workers, or laborers will be exposed to asbestos or lead during paint removal operations and decommissioning projects. Mechanical workers such as electricians, pipefitters, sheet metal workers, ironworkers, and millwrights will be exposed to asbestos while repairing, removing, or installing mechanical equipment or other specialized structures in pre-existing asbestos-containing industrial or commercial facilities" (pg 14) |
| Exposure route: | inhalation |
| Physical form: | chrysotile, respirable silica (as surrogate) |
| Personal sampling data: | Concentrations of respirable silica and respirable dust are provided in Table III for various occupations and tasks - potential surrogates (pgs 5-9) |
| Area sampling data: | Only one demolition sample was found to contain chrysotile asbestos. This sample was collected in obvious uncontrolled conditions (along with lead paint) in a retail environment during renovations. Many of the construction sites we visited were in new construction only, where asbestos or other historically important agents such as lead and PCBs were not used. |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Sampling and Analytical Methodology | Medium | Sampling/analytical methodology is not an approved OSHA/NIOSH method but is an acceptable methodology. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | Medium | Data are from Canada, an OECD country. |
| | Metric 3: Applicability | Low | Data are for dust and silica present in the construction/demolition industries, which may be used as surrogate data for asbestos. |
| | Metric 4: Temporal Representativeness | Medium | Monitoring data were collected after the most recent PEL and greater than 10 years old. |
| | Metric 5: Sample Size | Medium | Sample distribution characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | Medium | Sample type and exposure type provided but missing exposure frequency and other metadata. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | High | Uncertainty is addressed in sampling/analytical methodology. Variability addressed by concentrations across different tasks and occupations. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Verma, D. K., Middleton, C. G. (1980). Occupational exposure to asbestos in the drywall taping process. American Industrial Hygiene Association Journal 41(4):264-269. |
| **HERO ID:** | 3084138 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Drywall joint tapers (2/7) |
| Exposure route: | inhalation (3/7) |
| Physical form: | dust (3/7) |
| Personal sampling data: | Personal samples ranged from 0.4-26.5 f/cc, with means from 0.9-19.6 f/cc. (4/7) |
| Area sampling data: | Area samples ranged from 0.3-7.0 f/cc, with means from 2.0-3.2 f/cc. (4/7) |
| Particle size characterization: | Particles measured were greater than 5 microns. (4/7) |
| Exposure duration: | 3-80 minutes, mean: 18 minutes |
| Number of workers: | 15-20 employees per company (3/7) |
| Personal protective equipment: | Respirators were available, but use was not widespread. (5/7) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | High | Sampling/analytical methodology is an approved NIOSH method. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Medium | Data are from Canada, an OECD country. |
| | Metric 3: | Applicability | High | Data are for commercial use of chemical substances in construction products, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| | Metric 5: | Sample Size | Medium | Sample distribution characterized by limited statistics (mean, ranges, medians) but discrete samples not provided and distribution not fully characterized. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Sample type and exposure type provided, but missing exposure frequency and engineering controls. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | High | Uncertainty is addressed in sampling/analytical methodology. Variability is addressed by sampling at residential and commercial sites. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Vernez, D., Duperrex, O., Herrera, H., Perret, V., Rossi, I., Regamey, L., Guillemin, B. (2019). Exposure to amosite-containing ceiling boards in a public school in Switzerland: A case study. International Journal of Environmental Research and Public Health 16(24):5069. |
| **HERO ID:** | 6874591 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Students, teachers, and janitors exposed to asbestos during maintenance activities. |
| Exposure route: | inhalation |
| Physical form: | inhalable fibers |
| Personal sampling data: | Estimated annual exposure concentrationPupils Average 59 f/m3 Max 1055 f/m3Teachers Average 52 f/m Max 170 f/m3Janitor Real 200 f/m3 Max 320 f/m3 |
| Area sampling data: | From testing using VDI 3492:2013 (SEM method)5,035 f/m3 of amosite observed in one classroom95-731 f/m3 observed in neighboring roomsConcentration values used in this assessmentHitting a ceiling panel (incident) 1000 f/m3Ceiling panel replacement (regular maintenance) 50,000 f/m3Lamp replacement (regular maintenance) 20,000 f/m3Ceiling panel replacement (regular maintenance) 400 f/m3Lamp replacement (regular maintenance) 200 f/m3Cutting /adjusting a ceiling panel 9000 f/m3Breaking a ceiling panel (incident) 5500 f/m3Fall (incl. breaking) of a ceiling panel (incident) 10,500 f/m3 |
| Exposure duration: | Average ScenarioHitting a ceiling panel (incident) 4 hrs Ceiling panel replacement (regular maintenance) 0.25 hrsLamp replacement (regular maintenance) 0.17 hrsCeiling panel replacement (regular maintenance) 4 hrsLamp replacement (regular maintenance) 4 hrsBreaking a ceiling panel (incident) 4 hrsFall (incl. breaking) of a ceiling panel (incident) 4 hrsRemediation work after a fire (incident) 50.0 hrsRemediation work after a fire (incident) 61.8 hrsRemediation work after a fire (incident) 80 hrs |
| Exposure frequency: | Average scenarioHitting a ceiling panel (incident) 19.0 /yrCeiling panel replacement (regular maintenance) 2.5 /yrLamp replacement (regular maintenance) 37.5 /yrCeiling panel replacement (regular maintenance) 0.06 /yrLamp replacement (regular maintenance) 0.94 /yrBreaking a ceiling panel (incident) 0.01 /yrFall (incl. breaking) of a ceiling panel (incident) 0.01 /yrRemediation work after a fire (incident) 1.00 /yr (2008)Remediation work after a fire (incident) 1.00 /yrRemediation work after a fire (incident) 1.0 /yrAverage duration of exposureStudents 8,000- 11,000 hrsTeachers average 9 years, max 13 yearsAnnual attendance 582 hours max 1482 hours Average Janitor duration 15 years |
| Number of workers: | 1972 - 2015 over 3,000 students passed through the school. |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Sampling and Analytical Methodology | High | Swiss study based on SEM approach using VDI 3492:2013-06 |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | Medium | The data are from an OECD country other than the U.S. |
| | Metric 3: Applicability | High | The report is for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: Temporal Representativeness | High | Data is less than 10 years old. |
| | Metric 5: Sample Size | Medium | Exposure concentrations were represented with average and max values. |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | High | Monitoring data include all associated metadata, including sample types, exposure types, sample durations, exposure durations worker activities, and exposure frequency. |
| Domain 4: Variability and Uncertainty | | | |

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| | |
|---|---|
| **Study Citation:** | Vernez, D., Duperrex, O., Herrera, H., Perret, V., Rossi, I., Regamey, L., Guillemin, B. (2019). Exposure to amosite-containing ceiling boards in a public school in Switzerland: A case study. International Journal of Environmental Research and Public Health 16(24):5069. |
| **HERO ID:** | 6874591 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

| | | **EVALUATION** | |
|---|---|---|---|
| Domain | Metric | Rating | Comments |
| | Metric 7: Metadata Completeness | Medium | Exposure concentrations were represented with average and max values which can be used to assess variability, but measurement uncertainty is not characterized. |

## Overall Quality Determination — High

**Study Citation:** Vitello, C. (2001). Asbestos exposure & health impacts in New York City. Hazardous Materials Management 13(5):15-16.
**HERO ID:** 6893115
**Conditions of Use:** Disposal

**EXTRACTION**

| Parameter | Data |
|---|---|
| Worker activity description: | Firefighters, emergency response and rescue crews, and police officers after 9/11. (1/4) |
| Exposure route: | inhalation (1/4) |
| Physical form: | dust, ACM debris (1/4) |
| Area sampling data: | Debris samples collected outside buildings on cars and other surfaces contained small percentages, ranging from 2.1 to 3.3–above the permitted one per cent level for asbestos. As of September 21, the EPA had taken a total of 97 samples from 11 sites in lower Manhattan and four in New Jersey. Seven samples at or near ground zero had marginally higher levels of asbestos that exceeded the level of concern for long-term exposure. (2/4) |
| Personal protective equipment: | Many rescue workers and journalists on the scene immediately following the incident wore various types of masks. (1/4) Rescue crews were provided asbestos respirators, breathing apparatuses, suits, and eye equipment by the EPA. (2/4) |
| Engineering control: | Vacuum trucks and street sweepers were used to clean up the asbestos-laced debris and dust. (2/4) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Sampling and Analytical Methodology | Low | Sampling methodology not specified. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | Data are from the U.S. |
| Metric 3: | Applicability | High | Data are for cleanup and disposal of asbestos material, an in-scope occupational scenario. |
| Metric 4: | Temporal Representativeness | Medium | Monitoring data were collected after the most recent PEL and greater than 10 years old. |
| Metric 5: | Sample Size | Medium | Sample distribution characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Medium | Sample type and exposure type provided, but missing exposure duration, frequency, number of workers, and particle size. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Low | Uncertainty and variability not addressed. |

## Overall Quality Determination Medium

**Study Citation:** W R Grace & Co, (1983). Response to EPA request for results of tests on vermiculite and tremolite with attachment.
**HERO ID:** 3092239
**Conditions of Use:** Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products

**EXTRACTION**

| Parameter | Data |
|---|---|
| Worker activity description: | defines work history for each worker; includes construction, tester, dry mill operator, euclid operator, etc. |
| Personal sampling data: | Exposure levels provided for work history with exposures as estimates in units of fibers per cubic centimeter; values typically within range of 1 to 40 f/cc (pgs 5-25) |
| Exposure duration: | provides months on the job for each exposed employee (pgs 5-25) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Low | Sampling/analytical methodology is not specified. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | Medium | Data are for manufacturign and construction-related operations, an in-scope occupational scenario, though the source of asbestos is unknown. |
| | Metric 4: | Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Low | Sample type provided but no other metadata. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Low

**Study Citation:** Wallingford, K. M., Snyder, E. M. (2001). Occupational exposures during the World Trade Center disaster response. Toxicology and Industrial Health 17(5-10):247-253.
**HERO ID:** 1642214
**Conditions of Use:** Other:

**EXTRACTION**

| Parameter | Data |
|---|---|
| Worker activity description: | The workers at the WTC disaster site were involved in avariety of activities including search and rescue, construction, demolition, and support services. Support serviceworkers were from many different occupations such ashealth care professionals, safety and health professionals,engineers, armed forces personnel, perimeter control personnel, food service workers and clergy, among others |
| Personal sampling data: | PBZ air samples collected from individual workers.Potential hazard n Concentration NIOSH REL OSHA PEL Samples exceeding PELAsbestos a (f/cm3) 636 ND - 0.54 0.10 0.10 25Asbestos b (f/cm3) 114 ND - 0.024c 0.10c - Asbestos d(f/cm3) 168 ND - 0.89 - 1.0 0a Time-weighted average air samples analyzed by PCM.b Time-weighted average air samples analyzed by TEMc Fibers identified by TEM as asbestos. d Short-term exposure limit air samples analyzed by PCM. 45% of samples had asbestos fibers present. |
| Area sampling data: | 33 ”Bulk” samples were collected from undistrubed, settled debris 29 were analyzed for asbestos. - > 26 had< 1% mass asbestos, 3 had 1-3% mass asbestos.. |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | High | Sampling/analytical methodology is an approved NIOSH method. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for demolition/disposal, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Medium | Monitoring data were collected after the most recent PEL and greater than 10 years old. |
| | Metric 5: | Sample Size | Medium | Sample distribution characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Sample type and exposure type provided but missing worker task, exposure time, etc. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | Uncertainty is addressed in sampling/analytical methodology but variability is not addressed. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Weiner, R., Rees, D., Lunga, F. J., Felix, M. A. (1994). Third wave of asbestos-related disease from secondary use of asbestos. A case report from industry. SAMJ South African Medical Journal 84(3):158-160. |
| **HERO ID:** | 3081889 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Sanding asbestos sheets, sweeping the workshop, assembling asbestos sheets, and drilling asbestos sheets. (1/3) |
| Exposure route: | inhalation (1/3) |
| Physical form: | dust (1/3) |
| Personal sampling data: | (SEM) Before cleanup, four personal samples were 1.9-27.5 fibers/mL. After cleanup, four personal samples were 0.5-1.7 fibers/mL. (2/3) |
| Area sampling data: | (SEM) Before cleanup, an area sample was 2.2 fibers/mL. After cleanup, four area samples were 0.01-0.6 fibers/mL. (2/3) |
| Number of workers: | 80 workers (1/3) |
| Engineering control: | An extractor system was installed at the cutting and sanding stations, but it was only partially operational. Instead, a compressed air facility was used. (1/3) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Sampling and Analytical Methodology | High | Sampling/analytical methodology is equivalent to an approved [OSHA/NIOSH] method. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | Low | Data are from South Africa, a non-OECD country, |
| Metric 3: | Applicability | High | Data are for industrial use in construction materials, an in-scope occupational scenario. |
| Metric 4: | Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Medium | Sampling data provided, but missing exposure duration, frequency, particle size, and PPE. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Medium | Variability is addressed by sampling before and after cleanup. Uncertainty isn't addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Welsh, D. E. (2007). Asbestos exposure during an abatement project. Journal of Occupational and Environmental Hygiene 4(2):D7-D9. |
| **HERO ID:** | 3079700 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | The employees involved in the asbestos removal. |
| Physical form: | asbestos fibers |
| Personal sampling data: | Employee 1Sample 1 57 minutes 2.6 f/ccSample 2 137 minutes 5.3 f/ccSample 3 113 minutes 4.7 f/ccEmployee 2Sample 1 73 minutes 6.0 f/ccSample 2 141 minutes 10 f/ccSample 3 125 minutes 8.5 f/cc |
| Number of workers: | 9 |
| Personal protective equipment: | Each employee was wearing disposable coveralls, protective boots, and an N-99 elastomeric half-mask respirator. |
| Engineering control: | The workers were using a pressure washer to wet the insulation both in advance of scraping it from the walls and ceilings and again prior to shoveling the waste into disposal bags. |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | High | Sampling or analytical methodology is an approved OSHA or NIOSH method or is well described and found to be equivalent to approved OSHA or NIOSH methods. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | The data are from the United States. |
| | Metric 3: | Applicability | High | The data are for an occupational scenario within the scope of the risk evaluation - Asbestos removal. |
| | Metric 4: | Temporal Representativeness | Medium | More than 10 years but, no more than 20 years old. |
| | Metric 5: | Sample Size | Medium | Distribution of samples is characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Monitoring data include most critical metadata, such as sample type and exposure type, but lacks additional metadata, such as exposure durations and exposure frequency. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | The monitoring study does not address variability or uncertainty. |

## Overall Quality Determination Medium

**Study Citation:** WHO, (1998). Chrysotile asbestos.
**HERO ID:** 4140385
**Conditions of Use:** Other:

**EXTRACTION**

| Parameter | Data |
|---|---|
| Worker activity description: | Vehicle maintenance: grinding, blowing off, dry brushing (pg 63-64; Table 11)pg 60 (table 8): textile MFG activities: unloading, stacking, roving, spinning, carding, doubling, rope spinning, mixing, beaming, rope cardspg 61 (cement production): willow operators, forming machine operators, lathe operators, bag opening and mixing, cement cutting and grindingpg 63 (friction product MFG): table 10: storage/distribution, preparation, impregnation/forming, grinding, drilling, boring, inspection, packing, office/lab; spinning and grinding |
| Exposure route: | inhalation |
| Physical form: | airborne fiber |
| Personal sampling data: | pg 61-62 (cement production): Exposure estimates in a Canadian plant (Finkelstein, 1983) for the years 1949,1969 and 1979 were 40,20 and0.2 f/ml, respectively, for willow operators, 16, 8 and 0.5 f/ml for forming machine operators, and 8, 4 and 0.3 f/ml for lathe operators. In Japan, Kimura (1987) reported geometric mean concentrations in bag opening and mixing of 4.5-9.5 f/ml in 1970-1975 and 0.03-1.6 f/ml in 1984-1986, whilst in cement cutting and grinding the mean concentrations were 2.5-3.5 f/ml in 1970-1975 and 0.17-0.57 in 1984-1986. Albin et al. (1990) reported fibre concentrations, based on estimates, in a Swedish asbestos-cement plant of 1.5-6.3 f/ml during 1956. Later, based on direct measurements, values were 0.3-5.0 f/ml in 1969 and 0.9-1.7f/ml in 1975. Higashi et al. (1994) reported geometric average concentrations of 0.05-0.45 f/ml measured in area samples and 0.05-0.78 f/ml in personal samples of an asbestos-cement plant. |
| Area sampling data: | Pg 24-25:mining/milling (Quebec): >20 fibers/mL in 1970s down to <<1 f/mL; more detail starting pg 53cement production (Japan): 2.5-9.5 f/mL in 70s down to 0.05-0.45 f/mLtextile MFG (Japan): 2.6-12.8 f/mL in 70s down to 0.1-0.2 f/mL in 80s; also pg 59friction materials production (Japan): 10-35 f/mL in 70s down to 0.2-5.5 f/mL in 80s; UK: >20 f/mL before 1931 and <1 f/mL in 70sPg 52:Environmental Health Criteria 53 (IPCS, 1986) reported that 58.5% of samples had fibre concentrations of < 0.5 f/ml and 80.7%< 1.0 f/ml in textile industries in the United Kingdom over the period 1972-t978. Corresponding measurements in France in 1984 were 65.3% with < 0.5 f/ml and 85.4% with < 1.0 f/ml. It also reported 86.5% of samples with < 0.5 f/ml and 95.0% with < 1 f/ml in asbestos cement industries in the United Kingdom during the period 1972-1978. Corresponding measurements in France in 1984 were 93.5% with < 0.5 f/ml and 97.4% with < 1.0 f/ml. In industries manufacturing friction products, 71.0% of samples had < 0.5 f/ml and 85.5% < 1.0 f/ml in the United Kingdom during 1972-1978, while the corresponding results in France in 1984 were 62.8% with < 0.5 f/ml and 85.0% with < 1.0 f/ml pg 60 (table 8): sampling data for UK textile plantfriction product MFG: McDonald et al. (1984) reported that in the 1930s estimated average dust levels were 35-180 mpcm (1-5 mpcf) in 67% of analysed locations, while in the 1960s average dust levels were below 7 mpcm (0.2 mpcf) at 38% of locations and below 18 mpcm (0.5 mpcf) at 67% of locations in which measurements were obtained. (pg 62); pg 63 table 10 has related dataKimura (1987) reported geometric mean fibre concentrations of10.2-35.5 f/ml in 1970-1975, and 0.24-5.5 f/ml in 1984-1986 in spinning and grinding of friction products in Japan. (pg 63)pg 64-65 (table 11): sampling data for maintenance/replacement of vehicle brakes pg 67 (including table 13): Rickards (1991, 1994) reported the results of the measurement of asbestos fibre concentrations covering exposures of over 39,900 workers n 27 countries in 1989 and over 26,500 workers in 28 countries in 1991 and 1992. His modified results are presented in Table 13. The 1993 data, by industry sector, is shown in Fig. 3 (AIA, 1995). Kogevinas et al. (1994) summarized exposure data obtained from chrysotile-exposed workers in 11 countries. The exposure levels ranged considerably, reflecting industry and other factorsFigure 3 (pg 68)Pg 69: Fei & Huang (1989) reported fibre concentrations in an asbestos paper factory utilizing chrysotile in the Sichuan Province of west China. The concentration of 135 fibre measurements ranged between 0.6 f/ml and 55.1 f/ml, the latter value being the average of 6 assays in a pulp-reducing area.Pg 160: product manufacture in China indicate that concentrations may be very high (up to 100 f/ml) in production facilities without adequate dust control. In a recent survey of chrysotile mills in India, average concentrations of 2 to 13 f/ml were reported. |
| Particle size characterization: | the percentage of fibres more than 5 um long in mining and milling being about 1.3 and 4.1%, respectively (Gibbs & Hwang, 1980), while data show that up to 24% of fibres may be longer than 5 um in certain textile spinning operations (Gibbs, 1994). Virtually all airborne fibres have a diameter of less than 3 um and arethus respirable. (pg 37) |
| Comments: | membrane filter method/PCOM (pg 39); more discussion of analytical methods on following pages |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |

**Continued on next page . . .**

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**Study Citation:** WHO, (1998). Chrysotile asbestos.
**HERO ID:** 4140385
**Conditions of Use:** Other:

| Domain | | Metric | EVALUATION Rating | Comments |
|---|---|---|---|---|
| | Metric 1: | Sampling and Analytical Methodology | Medium | Discusses typical sampling/analytical methodologies but does not specify which methods correspond to each dataset. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Medium | Data are from various OECD countries. |
| | Metric 3: | Applicability | Medium | Data are for asbestos product MFG and automobile brakes, out-of-scope scenarios but may still be informative. |
| | Metric 4: | Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL and/or is greater than 20 years old. |
| | Metric 5: | Sample Size | Medium | Sample distribution characterized by limited statistics (ranges, assumed means/averages) but discrete samples not provided and distribution not fully characterized. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Sample type and exposure type provided but missing metadata such as exposure frequency. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | Variability addressed by providing sampling data for various sites and over different time periods but uncertainty is not addressed |

## Overall Quality Determination Medium

**Study Citation:** WHO, (1998). Chrysotile asbestos.
**HERO ID:** 4140385
**Conditions of Use:** Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products

**EXTRACTION**

| Parameter | Data |
|---|---|
| Worker activity description: | building maintenance: telecommunications switchwork, above-ceiling work, utility space work |
| Exposure route: | inhalation |
| Physical form: | airborne fiber |
| Personal sampling data: | Pg 25/161: maintenance in buildings with control plans: 8-hr TWA: 0.002-0.02 f/mLPg 25/66/161:TWAs:telecommunications switchwork: 0.009 f/mLabove-ceiling work: 0.037 f/mLutility space work: 0.51 f/mLmedian concentrations: 0.01-0.02 f/mLPg 66: The Health Effects Institute (1991) evaluated an operation andmaintenance programme in a hospital on the basis of 394 air samples obtained during 106 on-site activities. The mean asbestos concentration (PCOM) was about 0.11 f/ml for personal samples and about 0.012 f/ml for area samples. Eight-hour TWA concentrations showed that 99%o of the personal samples were below 0.2 f/ml, and 95% were below 0.1 f/ml.Table 12 (pg 66): measured concentrations during work and 8-hr TWAs for electrical/plumbing work, cable running, and HVAC workPg 25/67/161: short-term: sweeping: 1.6 f/mL; library book dusting: 15.5 f/mL |
| Comments: | membrane filter method/PCOM (pg 39); more discussion of analytical methods on following pages |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Sampling and Analytical Methodology | Medium | Discusses typical sampling/analytical methodologies but does not specify which methods correspond to each dataset. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | Data are from the U.S. |
| Metric 3: | Applicability | High | Data are for construction materials, an in-scope occupational scenario. |
| Metric 4: | Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL and/or is greater than 20 years old. |
| Metric 5: | Sample Size | Medium | Sample distribution characterized by limited statistics (ranges, assumed means/averages) but discrete samples not provided and distribution not fully characterized. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Medium | Sample type and exposure type provided but missing metadata such as exposure frequency. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Medium | Variability addressed by sampling at various sites and during different time periods, but uncertainty is not addressed |

## Overall Quality Determination Medium

**Study Citation:** WHO, (1998). Chrysotile asbestos.
**HERO ID:** 4140385
**Conditions of Use:** Other:

**EXTRACTION**

| Parameter | Data |
|---|---|
| Worker activity description: | Vehicle maintenance: blowing off debris from drums (pg 25, 160); pg 61 (table 9): cement production activities: regrinding, mixing, forming, siding and shingle finishing, panel finishing, flat and corrugated finishing, warehouse, maintenancepg 58 (table 6): textile MFG activities: fiber preparation, carding, spinning, twisting, winding, weaving |
| Exposure route: | inhalation |
| Physical form: | airborne fibers |
| Personal sampling data: | pg 61 (table 9): sampling data for cement production plant; In 80% of the samples the concentrations were less than 2 f/ml,and in about 60%they were less than 0.5 f/mlvehicle maintenance (friction materials): 16 f/mL in 70s, <0.2 f/mL after 1987 (pg 25, 160)TWA exposures during vehicle maintenance (assumed personal): <0.05 f/mL (pg 25, 160) |
| Area sampling data: | pg 58 (table 6); pg 59 (table 7): sampling data for textile plants in USA |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Medium | Discusses typical sampling/analytical methodologies but does not specify which methods correspond to each dataset. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | Medium | Data are for asbestos product MFG, upstream of in-scope scenarios, but may be informative. |
| | Metric 4: | Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL and/or is greater than 20 years old. |
| | Metric 5: | Sample Size | Medium | Sample distribution characterized by limited statistics (ranges, assumed means/averages) but discrete samples not provided and distribution not fully characterized. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Sample type and exposure type provided but missing metadata such as exposure frequency. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | Variability addressed by providing sampling data for various sites and over different time periods but uncertainty is not addressed |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | WHO, (1998). Chrysotile asbestos. |
| **HERO ID:** | 4140385 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | installation of asbestos-cement: cutting, sanding, drilling, otherwise abrading (pg 62) |
| Exposure route: | inhalation |
| Physical form: | airborne fibers |
| Personal sampling data: | Pg 62: Weiner et al. (1994) reported concentrations in a South African workshop in which chrysotile asbestos-cement sheets were cut into components for insulation. The sheets were cut manually, sanded and subsequently assembled. Initial sampling showed personal sample mean concentrations of 1.9 f/ml for assembling, 5.7 f/ml for sweeping, 8.6 f/ml for drilling and27.5 f/ml for sanding. After improvements and clean-up of the work environment, the concentrations were 0.5-1.7 f/ml.Nicholson (1978) reported concentrations of 0.33-1.47 f/ml in aroom during and after sawing and hammering of an asbestos-cement panel. |
| Area sampling data: | Pg 26 (public building air concentrations):fibers >5um in length: Germany/Canada: <0.002 f/mLBelgium, Canada, Slovak Republic, UK, USA: 0.00005-0.0045 f/mLPg 67:Higashi et al. (1994) reported the results of their environmental evaluations at 510 workplaces in 1985 (roofing materials, asbestos-cement sheets, friction materials, construction materials) and 430 workplaces in 1992. The percentage of workplaces in which exposure concentrations were less than 0.3 f/ml was 70% in 1985 and 98% in 1992. All concentrations in a modernized asbestos-cement plant were less than 0.1 f/ml. |
| Particle size characterization: | 0.67% of fibers >5 um (pg 26; corresponds with public building air sampling)most airborne chrysotile fibers are <3 um, equal to an aerodynamic diameter of about 10 um (pg 26) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Sampling and Analytical Methodology | Medium | Discusses typical sampling/analytical methodologies but does not specify which methods correspond to each dataset. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | Medium | Data are from various OECD countries |
| | Metric 3: Applicability | High | Data are for construction materials, an in-scope occupational scenario |
| | Metric 4: Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL and/or is greater than 20 years old. |
| | Metric 5: Sample Size | Medium | Sample distribution characterized by limited statistics (ranges, assumed means/averages) but discrete samples not provided and distribution not fully characterized. |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | Medium | Sample type and exposure type provided but missing metadata such as exposure frequency. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Medium | Variability addressed by providing sampling data for various sites and over different time periods but uncertainty is not addressed |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Whysner, J., Covello, V. T., Kuschner, M., Rifkind, A. B., Rozman, K. K., Trichopoulos, D., Williams, G. M. (1994). ASBESTOS IN THE AIR OF PUBLIC BUILDINGS - A PUBLIC-HEALTH RISK. Preventive Medicine 23(1):119-125. |
| **HERO ID:** | 3087131 |
| **Conditions of Use:** | Consumer Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Wear or abrasion of heat insulation, fireproofing, concrete, wall and ceiling insulation, and ceiling and floor tiles (2/7). |
| Exposure route: | inhalation (2/7) |
| Physical form: | fibers (2/7) |
| Area sampling data: | Early surveys of building air sample medians have ranged from 0.00006 to 0.5 f/cc. An EPA sponsored survey of 43 ACM containing federal buildings found mean concentrations of 0.00007 and 0.00008 f/cc for buildings with undamaged and damaged ACM, respectively. Another study determined means of 0.00003, 0.00008, and 0.00016 f/cc for commercial, university, and other public buildings. (2/7) An extensive study estimated average classroom levels of 0.00018 f/cc. A recent HEI-AR report found an average of 0.00051 f/cc in classrooms. One study reported that asbestos removal increased air levels from <0.0002 to 0.0004 f/cc 18 weeks after removal. In another study, the concentration increased from <0.0001 to 0.003 f/cc. (3/7) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Sampling and Analytical Methodology | Low | Sampling methodology not specified. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | Data are from the U.S. |
| Metric 3: | Applicability | Low | Data are for consumer use in construction materials, which is similar to the in-scope occupational scenario commercial use of construction materials. |
| Metric 4: | Temporal Representativeness | Medium | Monitoring data were collected after the most recent PEL and greater than 10 years old. |
| Metric 5: | Sample Size | Medium | Sample distribution characterized by limited statistics (means, medians, ranges) but discrete samples not provided and distribution not fully characterized. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Medium | Exposure type and sampling data provided, but missing number of workers, particle size, exposure duration, frequency, engineering controls, and PPE. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Medium | Uncertainty isn't addressed. Variability is addressed by gathering data from multiple studies. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Williams, M. G., Crossman, R. N. (2003). Asbestos release during removal of resilient floor covering materials by recommended work practices of the resilient floor covering institute. Applied Occupational and Environmental Hygiene 18(6):466-478. |
| **HERO ID:** | 3080352 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | The release of asbestos during maintenance and removal of resilient floor covering. |
| Exposure route: | inhalation |
| Physical form: | Fiber |
| Area sampling data: | Sheet vinyl removal—Hospital home medical equipment store Air sample analysis: PCM 0.011 - 0.031 f/cc (area 1 - area3) ATEM 0.562 - 0.902 total s/cc12” x 12” vinyl asbestos tile removal-Air sample analysis: PCM 0.003 - 0.012 f/cc (area 1 - area3) ATEM 0.035 - 0.236 total s/ccAsphalt tile removal—High school cafeteriaAir sample analysis: PCM 0.008 - 0.015 f/cc (area 1 - area3) ATEM 0.099 - 0.2387 total s/ccRFCI mastic removal—High school cafeteriaAir sample analysis: PCM 0.011 - 0.075 f/cc (area 1 - area2) ATEM 0.094 - 1.749 total s/ccpgs. 8-11/14 |
| Engineering control: | isolate the work area by an impermeable barrier, which may include a wall, closed door, or window as required by law. Require proper cleanup by HEPA vacuum/wet wipingwithin the removal area and the contiguous areas.(P.12/14) |
| Comments: | Table I-V |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Sampling and Analytical Methodology | High | Sampling or analytical methodology is an approved OSHA or NIOSH method. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | The data are from the United States. |
| Metric 3: | Applicability | High | The data are for an occupational scenario within the scope of the risk evaluation. |
| Metric 4: | Temporal Representativeness | Medium | More than 10 years, but no more than 20 years old. |
| Metric 5: | Sample Size | Medium | Distribution of samples is characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Medium | Monitoring data include most critical metadata, such as sample type and exposure type, but lacks additional metadata, such as sample durations, exposure durations, exposure frequency, and/orworker activities. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Medium | The monitoring study provides only limited discussion of the variability in the determinants of exposure for the sampled site or sector. The monitoring study provides only limited discussion of the uncertainty in the exposure estimates. |

## Overall Quality Determination High

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| | |
|---|---|
| **Study Citation:** | Williams, P. R. D., Phelka, A. D., Paustenbach, D. J. (2007). A review of historical exposures to asbestos among skilled craftsmen (1940-2006). Journal of Toxicology and Environmental Health, Part B: Critical Reviews 10(5):319-377. |
| **HERO ID:** | 1971635 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|



| | |
|---|---|
| **Study Citation:** | Williams, P. R. D., Phelka, A. D., Paustenbach, D. J. (2007). A review of historical exposures to asbestos among skilled craftsmen (1940-2006). Journal of Toxicology and Environmental Health, Part B: Critical Reviews 10(5):319-377. |
| **HERO ID:** | 1971635 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |



**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | InsulatorsInsulators work in virtually every type of industrial, commercial, and institutional location. In shipyards, these workers were often called laggers, pipe coverers, or pipe coverers and insulators(PC&I). Their primary job function is to apply insulating materials to exposed surfaces of structures such as pipes and ductwork, storage tanks, or other mechanical systems to help control and maintain temperature and provide personal protection against contact with high-temperature surfaces. They are responsible for applying insulating materials, such as fiberglass, foam rubber, styrofoam, cork, urethane, asbestos, or mineral wool, based on heat-retaining or heat-excluding characteristics. Insulators brush adhesives on or attach metal adhesive-backed pins to flat surfaces to facilitate the application of insulation material, or bind wire netting over the insulating material in place and clip metal bands or wire to pipe insulation to secure it to the pipes. They measure and cut insulation materials to specified sizes and shapes for covering flat or round surfaces and then attach required insulation material around or to the structures according to specifications. Once insulating materials are pressed into place, insulators coat pipe insulation and joints with asbestos cement and wrap them with cloth or cotton duck cloth to form a seal. In some industries, insulators may install firestopping for both electrical and mechanical systems.The specific tasks performed by insulators have been categorized as (1) cutting and shaping insulation materials using hand or power saws (prefabrication); (2) mixing of mineral wool, asbestos or fibrous glass cements (mixing); (3) installing or fitting amosite, chrysotile, or both amosite and chrysotile insulation block or sections of pipe covering using wire or asbestos cements or spraying asbestos-containing insulation materials (application); (4) coating insulation materials with cements, resins, cloth, or sealers (finishing); (5) dismantling or tearing out unusable materials while insulating or re-insulating (removal); and (6) the cleaning up of old insulation and debris and transporting insulation materials (cleanup). Most of these tasks created the potential for significant exposure to asbestos if they were performed in Naval shipyards or involved the spraying of asbestos.PipefittersThe primary job duties of pipefitters are to assemble, install, maintain, and repair many different types of pipelines or pipe systems. This includes the installation and repair of high- and/or low pressure pipe systems, as well as automatic controls, which modulate the flow of fluids in the various pipes and vessels. These pipe systems may carry water, steam, air, or other liquids or gases that are used in manufacturing, in the generation of electricity, and in heating and cooling of buildings. Some pipefitters specialize in only one type of system; for example, steamfitters install pipe systems that move liquid or gases under high pressure and/or high temperature. Pipefitters select the type and size of pipe and related materials and equipment, such as supports, hangers, and hydraulic cylinders, according to plans, blueprints, or instructions. They typically cut, thread, and bend pipe or tubing (by hand or machine) prior to assembling and installing a variety of metal and nonmetal pipe and pipe fittings. They connect pipes using threaded, caulked, soldered, brazed, fused, or cemented joints and hand tools and secure pipes to structures with brackets, clamps, and hangers. Pipefitters install and maintain hydraulic and pneumatic components of machines and equipment, such as valves, pumps, and cylinders, as well as refrigeration and air-conditioning systems. They inspect work sites to determine the presence of obstructions and to ascertain that holes cut for pipes will not cause structural weakness, and sometimes test piping systems for leaks or weld holding fixtures to structural steel members. In shipyards, pipefitters install and maintain ships' piping systems, layout pipe sections, cut and bore holes in bulkheads and decks for installation of pipes, operate shop machines to cut and thread pipe and pipe fittings, and perform repairs to valve, pumps, and controls.Most pipefitter tasks can be categorized as (1) working on piping in the field (installation or repair); (2) installing or fabricating gaskets for use in piping, valves, pumps, and other equipment to prevent the leakage of fluids between solid surfaces (preformed or gasket making - the fabrication of gaskets, which could include hand punching, mechanical punching, machine punching, machine shearing, and machine nibbling); (3) removing and replacing gaskets and the packing from pumps and valves (gasket and packing removal); (4) performing general work in the field or shop area (pipe shop); and (5) performing general cleanup and maintenance work (cleanup). WeldersWelders join metal parts by applying heat to metal pieces and melting and fusing them to forma permanent bond. Welders also join steel beams when constructing buildings, bridges, and otherstructures, and join pipes in pipeline systems, power plants, and refineries. Welding may be manualor semiautomatic, and arc welding is the most common method by which metal is joined (soldering and brazing are similar processes used for specialized applications). Welders use specified electrodes and insert electrodes into portable holders or thread consumable electrode wire through a portable welding gun. They manually guide electrode or gun along weld line and examine the weld for bead size and other specifications. They may manually apply filler rod to supply weld metal and clean or degrease weld joints or workpieces or remove paints and coatings ahead of the weld. Welders also perform related tasks such as flame cutting or grinding. Scarfing or gauging were tasks that were commonly performed during shipbuilding and repair, in which a copper jacketed carbon road and high electric current were used to melt and "gauge" away the metal away. Welders also sometimes repair broken or cracked parts, fill holes, and increase the size of metal parts.Not surprisingly, the primary task for this trade (welding) does not involve the use of asbestos |

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| | | EVALUATION | |
|---|---|---|---|
| Domain | Metric | Rating | Comments |
| Exposure route: | inhalation | | |
| Physical form: | inhalable fibers | | |
| Personal sampling data: | Aggregated data (see reference for more details) f/ccInsulatorsbuilding construction and removalPrefabMean 8.5 Range 0.1-24.3Application Mean 0.174-67 Range 0.4->100Finishing Mean0.6-2.7Range 0.1-24.4Removal Mean8.4-8.9Range 0.2-49.3Mixing Mean 0.05-4.6Range 0.1-29.0Cutting Mean 0.2-50.0Cleaning Mean1-4.8 Range 0-22.9Misc. Mean 0.127 Range >1.0-579ShipyardApplication Mean 4.2-43 Range 0.2-129Finishing Mean0.4 Range 0.2-1.3Removal Mean6.74-419.7 Range ND-1040Mixing Mean14.2-256 Range 0.7-579Cutting Mean54 Range 152Cleaning Mean0.2-155Range0-277RefineryCutting Range0.6-3.3Removal Range0.2-1.5GeneralApplication Mean 40PipefittersShip yard Shop Mean 0.3 Range0.01-3.1Shipboard Mean 2.9 Range 0.01-25.0Flat Blade Scraping Mean 0.03-0.017 Range 0.014-0.019Wire brushing Mean 0.002-0.009 Range 0-0.010Hand Punching Mean 0.009-0.07 Range <0.05-3Mechanical punch Mean <0.05-0.19 Range <0.03-0.7Machine punch Mean 0.05-5 Range <0.03-5Hand Shaping Mean 0.13 Range <0.03-0.3Machine Shearing Mean 0.07-0.9 Range 0.05-1.3Machine Nibbing Mean 0.14-0.42 Range <0.08-0.8Installation Mean <0.03-0.09 Range <0.03-0.3Clean up Mean<0.05 Range <0.05-1.92Removal and Cleanup Mean 0.09-0.13 Range 0.02-0.44Gasket repair Mean <0.005-0.03 Range 0.01-0.23Gasket Making Mean <0.005Stem packing removal Mean <0.011-0.009 Range 0.008-0.010Worker Mean <0.009 Range 3.4Chemical/oil Gasket fabrication Mean 0.009-0.388 Range 0.001-0.049Gasket removal Mean 0.508 Range 0.11-1.4Gasket replacement Mean <0.06SteampowerPacking removal Range0.2-1.3Worker Range 0.1-0.9Power Plant Blade scraping Mean 0.032-8.8 Range 0.028-15.7Wire brushing Mean 0.006-21.8 Range0-31.0Gasket making Mean 0.045 Range 0.038-0.052Stem packing removal Mean 0.026 Range 0.024-0.027Helper Mean 2.4-15.9 Range 1.2-24.0General IndustryGasket Repair Mean 0.08Gasket fabrication Mean 0.004-4.0Gasket removal Range 0.042-0.44Gasket installation Mean 0.004-0.2 Range 0.13-0.29Packing removal Mean 0.29 Range 0.05-1.01Packing installation Mean <0.004-0.1 Range 0.04-0.52Helper Mean <0.003-0.014Sawing asbestos cement pipe Range 1.4-15Finishing water pipe Range 0.4-3.2Grinding water pipe Range 0.1-0.2Paper millScraping & wire brushing Mean3.7 Range 1.5-10.1WeldersShip Range 2.2-5.0Mail center Range <0.01Using Asbestos Gloves Range 0.07-0.99Metal WorkerSheet metal shop Range 0.003-1.61Office Building Mean 0.19Electricians Mean 0.002-124.8 Range 0.001-0.23CarpentersRoofing Mean 0.009-0.15Walls Mean 0.13-0.24Ceiling Mean 0.045-0.35 Range 0.003-3.5Flooring Mean 0.02Misc Mean 0.3-245 Range 0.04-787Renovation Mean 0.02-2.6New Mean 0.13PaintersSanding Mean 4.9-11.5 Range 1.2-24.2Application Mean 0.9 Range 0.4-1.3Mixing Mean 2.4-11.2 Range 1.2-12.4Sweeping Mean 15.1 Range 4.0-26.5Renovation Mean 0.08LaborersPipe repair Range 0.24-1.92Worker Range 3.4Cleaning Mean 0.031-0.66 Range 0.0045-3.3Carpet removal Mean 0.23Debris Cleanup Mean 0.074 Range 0.012-0.36MaintenanceShip Pipe repair Range ND-0.19Pipe repair Range 0.35-0.44Welding Range 2.2-5.0Cleaning Range 0.24-3.3Valve repair Range 0.23Worker Range 3.4BuildingCeiling Mean 0.12-0.35 Range 0-3.5Electrical and Plumbing Mean 0.01-0.34 Range 0.001-0.228HVAC Range 0-0.077Removal Range 0.015-0.115Misc Range 0-0.031Walls Mean 0.24Cleaning Mean 0.031-0.66 Range 0.012-0.36Flooring Mean 0.23AbatementSpraying Range 0.05-0.74Cleaning Mean 0.031-0.098 Range 0.002-2.3Removal Range 0.015-9.14 | | |
| Area sampling data: | Aggregated data (see reference for more details) f/ccInsulatorsbuilding construction and removal Mean 0.45-2.5Installation Mean 0.1-2Spraying Mean 19.5-28.0 Range 5-80Cutting Mean 1.6Removal Mean 0.011-0.64Shipyard Mean 88-257 Range ND-3021Removal Mean 83-353 Range 177-493Cleaning Mean 0.6-1.2Refinery Cutting Range 0-0.9Removal Range 0-0.9PipefittersShipyard Mean 0.001-0.021 Range <0.001-1.14General Industry Mean <0.002-1.2 Range 0.00-0.99Steam power Range 0.06-0.4Power Plant Mean 0.008-0.040 Range 0.001-15.7Office Pipe repair Mean 0.0067 Range NA-0.084Welders Mean 0.06-0.6 Range 0.2-0.4Metal Worker Range 0.11-0.23Electricians Mean 0.0067-100.2 Range NA-0.35Carpenters Public Buildings Mean 0.0024-0.11 Range NA-0.056PaintersConstruction Mean 0.003-47.2 Range 0.5-59Mixing Mean 2 Range 1.2-2.7Sanding Mean 3.2 Range 0.3-7.0LaborersShipyard RangeND - 2.6Boiler removal Range 29-1040 Bagging debris Range 0.203-3815Office Carpet removal Mean 0.0049 Range NS-0.0996Public Building Vacuuming Mean 0.027 Range 0.0023-0.062MaintenanceShipyard Application Range 0.05-40Removal Range 29-1040Bagging Range 106-3815Building Range 0.0-0.086Routine Maintenance Mean 0.29-0.51 Range 0.11-0.86Ceiling Mean 0.0024-0.056 Range NA-0.4513Pipe repair Mean 0.0067-0.011 Range NA-0.0840HVAC Mean 0.006-0942 Range 0.004-0.054Clean up Mean 0.027-0.203 Range 0.0023-0.062Misc Mean 0.0041-0.1272 Range NA-0.4513Boiler Mean 0.018Drywall Mean 0.075Roofing Mean 0.012Drywall Mean 0.075Flooring Mean 0.0049-0.11 Range NA-0.0996Removal Range 0.002-0.6Electrical Mean 0.0067-0.1654 Range 0.002-0.08General IndustryRepair pipe insulation Mean 0.011Repair boiler insulation Mean 0.025Gasket replacement Mean0.08Maintenance Mean 0.004AbatementDemolition Mean 0.001-0.61Removal Mean 0.002-20 Range 0.0031-1.5Abatement Mean 0.022-0.85Misc Mean 0.012 | | |
| Personal protective equipment: | The only mentions is abatement worker using respirators | | |

| | | EVALUATION | |
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| Domain | Metric | Rating | Comments |

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| | | | EVALUATION | |
|---|---|---|---|---|
| Domain | | Metric | Rating | Comments |
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Low | Sampling or analytical methodology is not specified. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Medium | Mix of countries including the US and other OECD countries |
| | Metric 3: | Applicability | Medium | The data are for an occupational scenario (variety of craftsmen who could be exposed to asbestos) within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Low | Studies are from 1937-2006 |
| | Metric 5: | Sample Size | Medium | Varies by study - distribution of samples is characterized by mean and/or standard deviation and range values. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Monitoring data include most critical metadata, such as sample type, exposure type, sample durations, and worker activities, but lacks additional metadata, such as exposure durations, and exposure frequency. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | The monitoring study provides only a limited discussion of the variability though it often includes standard deviations and a range of values. The monitoring study provides no discussion of the uncertainty in the exposure estimates. |
| **Overall Quality Determination** | | | **Low** | |

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**EVALUATION**

| Domain | Metric | Rating | Comments |
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**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | InsulatorLaborer MasonMaintenancePipefitterBoilermakerMillwright Carpenter Welder Sheet-MetalElectrician PainterInsulators - The primary job function of insulators is to apply insulating materials to exposed surfaces of equipment, such as boilers, tanks, hot or cold air ducts or pipes, steam generators, or ductwork (or other mechanical systems), in order to help control and maintain temperature. According to an API (1972) report on the petroleum refining industry, insulators are responsible for selecting the type of insulating materials, on the basis of heat-retaining or heat-excluding characteristics. It is also the insulator's job to bind wire netting around the object being insulated to hold the insulating material in place (prior to applying one or more coats of insulating material), and to clip metal bands to pipe insulation to secure the insulation on pipes. Once insulating materials are pressed into place, insulators coat joints with cement and wrap them with cloth tape to form a seal.Insulators spent the majority (>50%) of their time installing or fitting insulation block or sections of pipe covering (application) and coating insulation materials with cements, resins, cloth, or sealers (finishing). Insulators spent another 15–30% of their workday (1) cutting and shaping insulation materials (blocks or reformed pipe insulation) or working in the general shop area (prefabrication/ shop); (2) mixing mineral wool, asbestos, fibrous glass, and cements; (3) cleaning up old insulation and debris and transporting insulation materials; (4) and walking around and bidding on projects at the work site.Pipefitters - Pipefitters are responsible for fabricating, assembling, installing, maintaining, and repairing many different types of piping and piping systems, fixtures, and equipment for steam, hot water, heating, cooling, lubricating, and industrial processing systems. Pipefitters typically cut, thread, and bend pipe or tubing (by hand or machine) prior to assembling and installing a variety of metal and nonmetal pipe and pipe fittings. These tradesmen also install and maintain refrigeration and air conditioning systems and test piping systems for leaks, and sometimes weld holding fixtures to structural steel members. At this refinery, pipefitters were qualified to handle any type of pipe, including both high- and low-pressure pipe systems carrying water, steam, air, or other liquids or gases. Specialized steamfitters, such as those working on highpressure lines in shipyards or other petroleum refineries, were not required at this refinery.Some of the tasks performed by pipefitters at this refinery may have had the potential for exposure to asbestos. Specifically, these tradesmen spent approximately 60% of their time installing or repairing piping or pipe systems in the field and working in the shop area, and 5–10% of their time performing general cleanup work. Pipefitters spent another 3% of their time fabricating gaskets for use in piping, valves, pumps, and other equipment and 5% of their time removing or replacing gaskets and packing from pipes and valves.WeldersWelders join metal parts by applying heat to metal pieces and melting and fusing them to form a permanent bond. Welders in various industries use both gas welding or brazing and any combination of arc welding processes (API, 1972). Welders are also responsible for performing related tasks, such as flame cutting and grinding, and sometimes repair broken or cracked parts, fill holes, and increase the size of metal parts. At this refinery, welders were primarily responsible for joining pipes using both manual and semiautomatic methods depending on the type of steel welding. The primary activity in which these tradesmen was involved (welding) did not involve exposure to asbestos. Welders may have come into contact with asbestos-containing materials in the past due to the handling of blankets, gloves, and mats (which would have taken about 20–30% of their time). For example, asbestos blankets were historically used at the refinery to keep pipes from cooling too rapidly (i.e., during "heat treating" when new piping was installed and welded) and to contain sparks and protect welders from getting burned. Starting in the mid-1970s, nonfriable materials such as fiberglass were substituted for asbestos in welding blankets. Although no historical measurements have been found during the handling or use of asbestos-containing blanks, simulated work with asbestos gloves yielded average fiber concentrations ranging from 0.07 to 0.99 fibers/cc. A few welding rods could also have been coated with asbestos-containing flux. Welders typically spent about 5 to 10% of their time working on "hot" or "very hot" pipes at the this refinery, except during new construction, during which time they would have been near asbestos-containing insulation.Sheet-Metal Workers- Sheet-metal workers fabricate, assemble, install, and repair sheet-metal products and equipment. At this refinery, these craftsmen typically worked with sheet metal for HVAC (heating, ventilation, and air conditioning), ducts, control boxes, drainpipes, and furnace casings, but may also have sometimes worked with fiberglass and plastic materials. Although some workers may have been involved in putting preassembled metal jackets around insulation, this task was typically performed by insulators. Because their primary tasks at the refinery involved (1) fabricating sheet-metal projects, (2) installing and repairing old sheet-metal, and (3) removing old sheets, sheet-metal workers would have experienced minimal exposures to asbestos over most time periods. These craftsmen may have had some contact with asbestos-containing materials during the removal of old ducts that were wrapped with asbestos paper (this would have been a very infrequent occurrence, accounting for less than 2%of their time).Boilermakers - The primary duties of boilermakers are to make, install, repair, and clean boilers, tanks, vats, and other large or pressure vessels that hold liquids and gases. Boilermaker work often entail following blueprints and using hand and power tools as well as assisting in testing assembled vessels for evidence of leakage. In some industries, these tradesmen have also |

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**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Personal sampling data: | | | Asbestos concentrations at various ExxonMobile Facilities after 1970 – (primarily from Exxon monitoring data) Augusta Refinery MobilPersonal mean: 0.828 f/cc SD: 0.878 f/cc min: 0.110 f/cc max: 2.00 f/cc 50 %ile: 0.60 f/cc 75%ile: 1.25 f/cc 95%ile: 1.85 f/ccBaton Rouge Refinery ExxonPersonal mean: 0.014 f/cc SD: 0.018 f/cc min: 0.002 f/cc max: 0.06 f/cc 50 %ile: 0.01 f/cc 75%ile: 0.02 f/cc 95%ile: 0.04 f/ccBaton Rouge Chemical ExxonPersonal mean: 0.019 f/cc SD: 0.002 f/cc min: 0.018 f/cc max: 0.02 f/cc 50 %ile: 0.02 f/cc 75%ile: 0.02 f/cc 95%ile: 0.02 f/ccBaytown Refinery Exxon Personal mean: 0.070 f/cc SD: 0.213 f/cc min: 0.005 f/cc max: 1.61 f/cc 50 %ile: 0.03 f/cc 75%ile: 0.06 f/cc 95%ile: 0.14 f/ccBaytown Chemical ExxonPersonal mean: 0.001 f/cc min: 0.001 f/cc max: 0.00 ? f/cc 50 %ile: 0.00 f/cc 75%ile: 0.00 f/cc 95%ile: 0.00 f/ccBeaumont Refinery MobilPersonal mean: 0.064 0.289 f/cc min: 0.001 f/cc max: 4.20 f/cc 50 %ile: 0.00 f/cc 75%ile: 0.01 f/cc 95%ile: 0.32 f/ccBeaumont Chemical MobilPersonal mean: 0.010 f/cc SD: 0.008 f/cc min: 0.001 f/cc max: 0.03 f/cc 50 %ile: 0.01 f/cc 75%ile: 0.01 f/cc 95%ile: 0.03 f/ccBillings Refinery ExxonPersonal mean: 0.015 f/cc min: 0.015 f/cc max: 0.01(?) f/cc 50 %ile: 0.02 f/cc 75%ile: 0.02 f/cc 95%ile: 0.02 f/ccChalmette Refinery MobilPersonal mean: 1.986 f/cc SD: 6.236 f/cc min: 0.001 f/cc max: 39.47 f/cc 50 %ile: 0.05 f/cc 75%ile: 0.28 f/cc 95%ile:15.80 f/ccEdison Refinery MobilPersonal mean: 0.280 f/cc min: 0.280 f/cc max: 0.28 f/cc 50 %ile: 0.28 f/cc 75%ile:0.28 f/cc 95%ile: 0.28 f/ccFerndale Refinery MobilPersonal mean: 1.760 f/cc SD: 7.180 f/cc min: 0.001 f/cc max: 31.00 f/cc 50 %ile: 0.00 f/cc 75%ile: 0.01 f/cc 95%ile: 9.16 f/ccIllinois Refinery MobilPersonal mean: 2.200 f/cc SD: 1.571 f/cc min: 0.300 f/cc max: 4.10 f/cc 50 %ile: 2.20 f/cc 75%ile: 2.90 f/cc 95%ile: 3.86 f/ccJoliet Refinery MobilPersonal mean: 0.165 f/cc SD: 0.614 f/cc min: 0.001 f/cc max: 5.22 f/cc 50 %ile: 0.01 f/cc 75%ile: 0.04 f/cc 95%ile: 0.77 f/ccPaulsboro Refinery MobilPersonal mean: 0.222 0.941 0.001 f/cc min: 9.76 f/cc max: 0.01 f/cc 75%ile: 0.04 f/cc 95%ile: 1.00 f/ccTorrance Refinery MobilPersonal mean: 0.047 f/cc SD: 0.072 f/cc min: 0.001 f/cc max: 0.38 f/cc 50 %ile: 0.02 f/cc 75%ile: 0.05 f/cc 95%ile: 0.22 f/ccN.S. (Facility name not specified)Personal mean: 0.142 f/cc SD: 0.299 f/cc min: 0.002 f/cc max: 1.25 f/cc 50 %ile: 0.01 f/cc 75%ile: 0.06 f/cc 95%ile: 0.82 f/ccAll Facilities Personal mean: 0.426 f/cc SD: 2.743 0.0005 f/cc max: 39.47 f/cc 50 %ile: 0.01 f/cc 75%ile: 0.05 f/cc 95%ile: 0.88 f/ccExposure concentrations by job and year at Beaumont50th PercentileInsulator 1940-50 18 f/cc 1951-65 11 f/cc 1966-71 5 f/cc 1972-75 1 f/cc 1976-85 0.09 f/cc 1986-93 0.02 f/cc 1994-2006 0.02 f/ccLaborer 1940-50 4 f/cc 1951-65 3 f/cc 1966-71 0.9 f/cc 1972-75 0.3 f/cc 1976-85 0.02 f/cc 1986-93 0.005 f/cc 1994-2006 0.005 f/ccMason 1940-50 1 f/cc 1951-65 1 f/cc 1966-71 0.3 f/cc 1972-75 0.09 f/cc 1976-85 0.006 f/cc 1986-93 0.002 f/cc 1994-2006 0.002 f/ccMaintenance 1940-50 1 f/cc 1951-65 1 f/cc 1966-71 0.3 f/cc 1972-75 0.09 f/cc 1976-85 0.006 f/cc 1986-93 0.002 f/cc 1994-2006 0.002 f/ccPipefitter 1940-50 1 f/cc 1951-65 0.8 f/cc 1966-71 0.2 f/cc 1972-75 0.07 f/cc 1976-85 0.004 f/cc 1986-93 0.001 f/cc 1994-2006 0.001 f/ccBoilermaker 1940-50 1 f/cc 1951-65 0.8 f/cc 1966-71 0.2 f/cc 1972-75 0.07 f/cc 1976-85 0.004 f/cc 1986-93 0.001 f/cc 1994-2006 0.001 f/ccMillwright 1940-50 1 f/cc 1951-65 0.8 f/cc 1966-71 0.2 f/cc 1972-75 0.07 f/cc 1976-85 0.004 f/cc 1986-93 0.001 f/cc 1994-2006 0.001 f/ccCarpenter 1940-50 0.7 f/cc 1951-65 0.6 f/cc 1966-71 0.2 f/cc 1972-75 0.05 f/cc 1976-85 0.004 f/ccWelder 1940-50 0.6 f/cc 1951-65 0.5 f/ f/cc cc 1966-71 0.2 f/cc 1972-75 0.04 f/cc 1976-85 0.003 f/ccSheet-Metal 1940-50 0.6 f/cc 1951-65 0.5 f/cc 1966-71 0.2 f/cc 1972-75 0.04 f/cc 1976-85 0.003 f/ccElectrician 1940-50 0.6 f/cc 1951-65 0.5 f/cc 1966-71 0.2 f/cc 1972-75 0.04 f/cc 1976-85 0.003 f/ccPainter 1940-50 0.6 f/cc 1951-65 0.5 f/cc 1966-71 0.2 f/cc 1972-75 0.04 f/cc 1976-85 0.003 f/ccOther studiesPersonal Commercial Buildings (1968) PCM Pre-fabrication mean: 8.5 f/cc range: 0.1–24.3 f/cc Application mean: 6.4 f/cc range: 0.1–61.6 f/cc Finishing mean: 2.7 f/cc range: 0.1–24.4 f/cc Removal mean: 8.9 f/cc range: 0.2–26.3 f/cc Mixing mean:2.6 f/cc range: 0.2–10.7 f/cc Cleaning mean: 4.8 f/cc range: 0.1–22.9 f/cc Personal Light/Heavy Industrial Buildings (1968) PCM Pre-fabrication mean: 6.6 f/cc range: 1.6–19.4 f/cc Application mean: 2.0 f/cc range: 0.2–18.3 f/cc Finishing mean: 0.6 f/cc range: 0.1–6.3 f/cc Removal mean: 8.4 f/cc range: 1.2–49.3 f/cc Mixing mean: 3.1 f/cc range: 0.1–19.4 f/cc Cleaning mean: 1.0 f/cc range: 0–14.0 f/ccPersonal Construction (1971) PCM Mixing and applying cement and cloth covering to insulation mean: 2.5 f/cc (standard) 0.5 f/cc (improved) Cutting and applying insulation block or sections of pipe covering mean: 5.2 f/cc (standard) 2.5 f/cc (improved) Cutting materials for later use mean: 7.6 f/cc (standard) 1.5 f/cc (improved)Personal Refinery (1973) PCM Indoor cutting or mixing operations range: 0.6–3.3 f/ccOutdoor insulation removal or installation operations range: 0.2–1.5 f/cc |

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**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Area sampling data: | | | Asbestos concentrations at various ExxonMobile Facilities after 1970 – (primarily from Exxon monitoring data) Baton Rouge Refinery ExxonArea mean: 0.001 f/cc SD: 0.000 f/cc min: 0.001 f/cc max: 0.00 ? f/cc 50 %ile: 0.0014 f/cc 75%ile: 0.0017 f/cc 95%ile: 0.0020 f/ccBaton Rouge Chemical ExxonArea mean: 0.003 f/cc SD: 0.002 f/cc min: 0.001 f/cc max: 0.01 f/cc 50 %ile: 0.00 f/cc 75%ile: 0.00 f/cc 95%ile: 0.01 f/ccBaytown Refinery Exxon Area mean: 0.020 f/cc SD: 0.063 f/cc min: 0.001 f/cc max: 0.68 f/cc 50 %ile: 0.01 f/cc 75%ile: 0.01 f/cc 95%ile: 0.08 f/ccBeaumont Refinery MobilArea mean: 0.314 f/cc SD: 1.369 f/cc min: 0.001 f/cc max: 10.00 f/cc 50 %ile: 0.01 f/cc 75%ile: 0.06 f/cc 95%ile: 1.20 f/ccBeaumont Chemical MobilArea mean: 0.005 f/cc SD: 0.004 f/cc min: 0.001 f/cc max: 0.02 f/cc 50 %ile: 0.00 f/cc 75%ile: 0.01 f/cc 95%ile: 0.30 f/ccChalmette Refinery MobilArea mean: 0.556 f/cc SD: 3.163 f/cc min: 0.001 f/cc max: 32.47 f/cc 50 %ile: 0.01 f/cc 75%ile: 0.04 f/cc 95%ile: 0.67 f/ccFerndale Refinery MobilArea mean: 0.202 f/cc SD: 0.349 f/cc min: 0.001 f/cc max: 1.40 f/cc 50 %ile: 0.01 f/cc 75%ile: 0.10 f/cc 95%ile: 0.77 f/ccIllinois Refinery MobilArea mean: 0.700 f/cc min: 0.700 f/cc max: 0.70 f/cc 50 %ile: 0.70 f/cc 75%ile: 0.70 f/cc 95%ile: 0.70 f/ccJoliet Refinery MobilArea mean: 0.046 f/cc SD: 0.160 f/cc min: 0.000 f/cc max: 0.77 f/cc 50 %ile: 0.01 f/cc 75%ile: 0.01 f/cc 95%ile: 0.18 f/ccNichols Refinery MobilArea mean: 0.268 f/cc SD: 0.228 f/cc min: 0.005 f/cc max: 0.40 f/cc 50 %ile: 0.40 f/cc 75%ile: 0.40 f/cc 95%ile: 0.40 f/ccPaulsboro Refinery MobilArea mean: 0.059 f/cc SD: 0.439 f/cc min: 0.001 f/cc max: 8.20 f/cc 50 %ile: 0.01 f/cc 75%ile: 0.01 f/cc 95%ile: 0.07 f/ccTorrance Refinery MobilArea mean: 0.202 f/cc SD: 1.638 f/cc min: 0.001 f/cc max: 22.00 f/cc 50 %ile: 0.00 f/cc 75%ile: 0.01 f/cc 95%ile: 0.06 f/ccN.S. (Facility name not specified)Area mean: 0.005 f/cc SD: 0.001 f/cc min: 0.005 f/cc max: 0.01 f/cc 50 %ile: 0.01 f/cc 75%ile: 0.01 f/cc 95%ile: 0.01 f/ccAll Facilities Area mean: 0.199 f/cc SD: 1.680 f/cc min: 0.0004 f/cc max: 32.47 f/cc 50 %ile: 0.01 f/cc 75%ile: 0.01 f/cc 95%ile: 0.35 f/ccGrand Total mean: 0.293 f/cc SD: 2.186 f/cc min: 0.0004 f/cc max: 39.466 f/cc 50 %ile: 0.007 f/cc 75%ile: 0.02 f/cc 95%ile: 0.57375 f/ccExposure concentration for Insulators at Beaumont by year (50 percentile) Prefabrication or Shop 1940-50 13 f/cc 1951-65 11 f/cc 1966-71 8 f/cc 1972-75 2 f/cc 1976-85 0.1 f/cc 1986-93 0.1 f/cc 1994-2006 0.1 f/cc Mixing 1940-50 9 f/cc 1951-65 7 f/cc 1966-71 3 f/cc 1972-75 1 f/cc 1976-85 0.0 1986-93 0.0 1994-2006 0.0Application 1940-50 25 f/cc 1951-65 21 f/cc 1966-71 5 f/cc 1972-75 1 f/cc 1976-85 0.0 1986-93 0.0 1994-2006 0.0Finishing 1940-50 7 f/cc 1951-65 6 f/cc 1966-71 2 f/cc 1972-75 0.7 f/cc 1976-85 0.0 1986-93 0.0 1994-2006 0.0Removal 1940-50 34 f/cc 1951-65 29 f/cc 1966-71 9 f/cc 1972-75 1 f/cc 1976-85 0.1 f/cc 1986-93 0.1 f/cc 1994-2006 0.1 f/ccCleanup 1940-50 29 f/cc 1951-65 25 f/cc 1966-71 3 f/cc 1972-75 3 f/cc 1976-85 2 f/cc 1986-93 0.1 f/cc 1994-2006 0.1 f/ccScoping and Travel 1940-50 0.1 f/cc 1951-65 0.1 f/cc 1966-71 0.1 f/cc 1972-75 0.1 f/cc 1976-85 0.2 f/cc 1986-93 0.0021 f/cc 1994-2006 0.001 f/ccExposure concentration by task and refineryInsulatorAll Exxon Application mean: 0.192 f/cc SD: 0.409 f/ cc min: 0.004 f/ cc max: 2.000 f/ cc Cleanup mean: 0.242 f/cc SD: 0.496 f/ cc min: 0.010 f/ cc max: 1.250 f/ cc Prefabrication mean: 0.153 f/cc SD: 0.163 f/ cc min: 0.049 f/ cc max: 0.341 f/ cc Removal mean: 0.765 f/cc SD: 1.553 f/ cc min: 0.002 f/ cc max: 9.760 f/ cc Beaumont, TX Application mean: 0.073 f/cc SD: 0.162 f/ cc min: 0.004 f/ cc max: 0.830 f/ cc Removal mean: 0.421 f/cc SD: 0.816 f/ cc min: 0.005 f/ cc max:4.200 f/ cc PipefitterAll Exxon Install and repair piping mean: 0.010 f/cc SD: 0.008 f/ cc min: 0.003 f/ cc max:0.025 f/ cc Make gaskets mean: 0.007 f/cc SD: 0.010 f/ cc min: 0.001 f/ cc max: 0.028 f/ cc Remove stem packing or gaskets mean: 0.012 f/cc SD: 0.007 f/ cc min: 0.001 f/ cc max: 0.021 f/ cc Beaumont, TX Install and repair piping mean: 0.009 f/cc SD: 0.008 f/ cc min: 0.003 f/ cc max: 0.014 f/ cc WelderAll Exxon Contact with asbestos materials mean: 0.057 f/cc SD: 0.025 f/ cc min: 0.039 f/ cc max: 0.074 f/ cc Welding mean: 0.015 f/cc SD: 0.011 f/ cc min: 0.001 f/ cc max: 0.040 f/ cc Beaumont, TX Welding mean: 0.011 f/cc SD: 0.011 f/ cc min: 0.001 f/ cc max: 0.031 f/ cc Sheet-Metal WorkerAll Exxon Fabrication mean: 0.046 f/cc SD: 0.012 f/ cc min: 0.038 f/ cc max: 0.055 f/ cc BoilermakerAll Exxon Make gaskets mean: 0.059 f/ cc min: 0.059 f/ cc max: 0.059 f/ cc N/A mean: 4.381 f/cc SD: 11.068 f/ cc min: 0.001 f/ cc max: 31.000 f/ cc Piping and insulation work mean: 0.005 f/cc SD: 0.000 f/ cc min: 0.005 f/ cc max: 0.005 f/ cc Mason All Exxon Install firebrick in boilers mean: 0.202 f/cc SD: 0.186 f/ cc min: 0.012 f/ cc max: 0.541 f/ cc Millwright / ElectricianAll Exxon Work in shop mean: 0.005 f/cc SD: 0.003 f/ cc min: 0.001 f/ cc max: 0.010 f/ cc Cleanup mean: 0.002 f/cc SD: 0.000 f/ cc min: 0.002 f/ cc max: 0.002 f/ cc Install and repair electrical equip mean: 0.094 f/cc SD: 0.051 f/ cc min: 0.058 f/ cc max: 0.130 f/ cc Pull cable mean: 0.010 f/cc SD: 0.000 f/ cc min: 0.010 f/ cc max: 0.010 f/ cc Work in shop mean: 0.005 f/cc SD: 0.001 f/ cc min: 0.004 f/ cc max: 0.005 f/ cc Beaumont, TX Work in shop mean: 0.005 f/cc SD: 0.003 0.003 0.010 f/ cc Install and repair electrical equip mean: 0.130 f/cc SD: 0.130 0.130 f/ cc Work in shop mean: 0.005 f/cc SD: 0.001 0.004 0.005 f/ cc Carpenter LabororAll Exxon Work in shop mean: 0.009 f/cc SD: 0.007 f/ cc min: 0.001 f/ cc max: 0.026 f/ cc Assist other trades mean: 0.149 f/cc SD: 0.310 f/ cc min: 0.005 f/ cc max: 1.000 f/ cc Cleanup mean: 0.032 f/cc SD: 0.039 f/ cc min: 0.005 f/ cc max: 0.190 f/ cc Misc mean: 0.200 f/cc SD: 0.305 f/ cc min: 0.005 f/ cc max: 0.990 f/ cc Beaumont, TX Work in shop mean: 0.006 f/cc SD: 0.005 f/ cc min: 0.001 f/ cc max: 0.012 f/ cc Assist other trades mean: 0.009 f/ cc min: 0.009 f/ cc min: f/ cc max: 0.009 f/ cc Cleanup mean: 0.044 f/cc SD: 0.065 f/ cc min: 0.005 f/ cc max: 0.190 f/ cc Misc mean: 0.343 f/cc SD: 0.365 f/ cc min: 0.050 f/ cc max: 0.990 f/ cc Maintenance Worker All Exxon Asbestos-related work mean: 0.364 f/cc SD: 0.404 f/ cc min: 0.030 f/cc max: 1.380 f/ cc Install and repair machinery mean: 0.007 f/ cc SD: 0.007 f/ cc min: 0.001 f/ cc max: 0.030 f/ cc Maintenance work mean: 0.019 f/ cc SD: 0.051 f/ cc min: 0.001 f/ cc max: 0.280 f/ cc Beaumont, TX Asbestos-related work mean: 0.378 SD: 0.413 min: 0.030 max: 1.380 Install and repair machinery mean: 0.005 SD: 0.004 min: 0.001 max: 0.014 Maintenance work mean: 0.005 SD: 0.005 min:0.001 max: 0.020 |

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| **HERO ID:** | 1971634 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Exposure duration: | | | According to an unpublished report of insulators in the petroleum industry in the late 1930s, these workers typically spent about 60% (or less) of their working time exposed to materials that may have contained asbestos. Published studies of insulators in the construction industry during the 1960s and 1970s also indicated that these workers spent only about 45% of their time working with asbestos materials.Of all crafts, insulators were estimated to have spent the most time working with or around such materials (at least 40% of their time prior to 1972), followed by laborers (at least 25% of their time prior to 1972). Because of their work involving the installation of firebrick (which may have entailed contact with asbestos-containing mortar or surrounding insulation), masons were also estimated to have spent more time working with asbestos-containing materials than the other trades (at least 5% of their time prior to 1972). Several crafts (sheet-metal workers, welders, electricians, carpenters, and painters) were estimated to have had very little contact with asbestos-containing materials during all time periods. For all crafts, the time spent working with asbestos-containing materials at the refinery was estimated to have decreased significantly after the early 1970s, and particularly after the mid-1980s, when specialized abatement workers would handle most activities related to asbestos insulation.Insulator 1940-50 45-60 % time spent around asbestos1951-65 45-60 % time spent around asbestos1966-71 40-50 % time spent around asbestos1972-75 15-35 % time spent around asbestos1976-85 5-20 % time spent around asbestos1986-93 2-10 % time spent around asbestos1994-2005 1-5 % time spent around asbestosLaborer 1940-50 25-40 % time spent around asbestos1951-65 25-40 % time spent around asbestos1966-71 25-40 % time spent around asbestos1972-75 10-30 % time spent around asbestos1976-85 5-20 % time spent around asbestos1986-93 2-15 % time spent around asbestos1994-2005 1-5 % time spent around asbestosMason1940-50 5-20 % time spent around asbestos1951-65 5-20 % time spent around asbestos1966-71 5-15 % time spent around asbestos1972-75 3-10 % time spent around asbestos1976-85 1-10 % time spent around asbestos1986-93 0.5-1 % time spent around asbestos1994-2005 0.1-0.5 % time spent around asbestosPipefitter, Boilermaker, Millwright, Maintenance worker 1940-50 5-15 % time spent around asbestos1951-65 5-15 % time spent around asbestos1966-71 5-10 % time spent around asbestos 1972-75 2-10 % time spent around asbestos1976-85 1-5 % time spent around asbestos1986-93 0.5-1 % time spent around asbestos1994-2005 0.1-0.5 % time spent around asbestosWorker, Welder, Electrician, Carpenter, Painter1940-50 0.1-5 % time spent around asbestos1951-65 0.1-5 % time spent around asbestos1966-71 0.1-3 % time spent around asbestos1972-75 0.1-1 % time spent around asbestos1976-85 0.01-0.1 % time spent around asbestos1986-93 0.001-0.01% time spent around asbestos 1994-2005 0.0001-0.001 % time spent around asbestosDistribution of Task Durations by Craft at the Petroleum Refinery in Beaumont, TX (Duration (h/day))Insulator Prefabrication of insulation materials or working in shop 0.4 min 1.5 maxMixing of cement and insulation materials 0.3 min 0.5 maxApplication of insulation 2.5 min 4.5 maxFinishing of insulation 1.5 min 3.0 maxRemoval of insulation 0.5 min 1.0 maxClean-up of insulation debris 0.3 min 0.6 maxScoping work and travel to job sites 0.5 min 2.0 maxPipefitter Installation and repair of piping or pipe systems 1.0 min 4.0 maxRemoval of piping insulation 0.1 min 0.5 maxFabrication of gaskets 0.1min 0.3 maxRemoval and replacement of packing or gaskets 0.2 min 0.5 maxWork in pipe shop 1.0 min 3.0 maxClean-up and routine maintenance activities 0.3 min 0.6 maxWorking in the vicinity of other trades 0.1 min 0.2 maxScoping work and travel to job sites 0.5 min 2.0 maxWelder Welding and finishing surface 1.5 min 4.5 maxContact with asbestos-containing materials 0.5 min 2.0 maxWorking in the vicinity of other trades 0.1 min 0.2 maxScoping work and travel to job sites 0.5 min 2.0 maxSheet-Metal Worker Fabrication of sheet-metal products 1.5 min 4.0 maxInstallation and repair of sheet-metal products 1.5 min 3.0 maxRemoval of old sheets 0.5 min 1.0 maxContact with asbestos-containing materials 0.1min 0.2 maxCleanup activities 0.3 min 0.6 maxWorking in the vicinity of other trades 0.1 min 0.2 maxScoping work and travel to job sites 0.5 min 2.0 maxBoilermaker Production of boilers, vats, and other vessels 1.5 min 4.0 maxInstallation of boiler frame tanks or vats 1.0 min 2.0 maxRepair and replacement of boiler fittings 0.5 min 1.0 maxCleaning of boilers, heat exchanger, and boiler furnaces 1.0 min 2.0 maxPiping and insulation work 0.1 min 0.2 maxWorking in the vicinity of other trades 0.1 min 0.2 maxScoping work and travel to job sites 0.5 min 2.0 maxMason Mixing cement or masonry material 1.0 min 1.5 maxLaying brick 2.5 min 5.0 maxRepair and maintain cement in boilers and furnaces 0.5 min 1.5 maxCleanup activities 0.5 min 2.0 maxWorking in the vicinity of other trades 0.1 min 0.2 maxScoping work and travel to job sites 0.3 min 1.0 maxMillwright Installation and repair of machinery 2.0 min 3.0 maxDismantaling of machinery 0.5 min 2.0 maxWork in shop (prefabrication work) 1.0 min 2.0 maxMaintenance work 1.0 min 2.5 maxCleanup activities 0.3 min 0.6 maxWorking in the vicinity of other trades 0.1 min 0.2 maxScoping work and travel to job sites 0.5 min 2.0 maxElectrician Installation and repair of electrical equipment 1.0 min 5.0 maxPulling of cable 0.5 min 1.5 maxWork in electrical shop 2.0 min 3.0 maxWorking in the vicinity of other trades 0.1 min 0.2 maxScoping work and travel to job sites 0.5 min 2.0 maxCarpenter Installation and repair of structures 2.0 min 5.0 maxInstallation of drywall and insulation 0.5 min 1.5 maxWork in shop (prefabrication work) 0.5 min 3.0 maxDemolition work 0.5 min 2.0 maxCleanup activities 0.3 min 0.6 maxWorking in the vicinity of other trades 0.1 min 0.2 maxScoping work and travel to job sites 0.5 min 2.0 maxPainter Application of paint 2.0 min 5.0 maxPreparation of surface material and installation of drywall 0.5 min 3.0 maxCleanup activities 0.5 min 1.0 maxScoping work and travel to job sites 0.5 min 2.0 maxLaborer Cleanup activities 0.5 min 2.5 maxPreventative maintenance 0.5 min 2.0 maxAssisting other trades 3.0 min 5.0 maxTear out of asbestos-containing materials (e.g., kiln cement, insulation) 0.5 min 1.0 maxMiscellaneous work (not related to craftsmen) 0.8 min 1.5 maxWorking in the vicinity of other trades 0.1 min 0.2 maxTravel to job sites 0.5 min 2.0 maxMaintenance WorkerInstallation and repair of machinery 2.0 min 3.0 maxMaintenance work 1.0 min 2.5 maxAsbestos-related work 0.5 min 2.0 maxGeneral housekeeping 0.5 min 2.5 maxWorking in the vicinity of other trades 0.1 min 0.2 maxScoping work and travel to job sites 0.5 min 2.0 max |

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| | | EVALUATION | |
|---|---|---|---|
| Domain | Metric | Rating | Comments |
| Personal protective equipment: | Respirator use Beaumont TX1940–1950Insulator 5–10% Labor 0–10 %Other Crafts 0–5% 1951–1965 Insulator 5–10% Labor 0–10%Other Crafts 0–5%1966–1971 Insulator 10–20% Labor 10–20% Other Crafts 0–10%1972–1975 Insulator 10–25% Labor 10–25% Other Crafts 0–10 %1976–1985 Insulator 50–100% Labor 50–100%Other Crafts 50–100%1986–1993 Insulator 50–100% Labor 50–100%Other Crafts 50–100%1994–2005 Insulator 75–100% Labor 75–100% Other Crafts 75–100%Respirator effectiveness1940–1950Effectiveness 10–50%1951–1965 Effectiveness 10–50% 1966–1971 Effectiveness 10–50%1972–1975 Effectiveness 10–50%1976–1985 Effectiveness 50-75%1986–1993 Effectiveness 75–100 %1994–2005 Effectiveness 75–100% | | |

| | | | EVALUATION | |
|---|---|---|---|---|
| Domain | | Metric | Rating | Comments |
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Medium | Derived from multiple data sources - including facility testing since 1970s - unfortunately, sampling and analytic methods used were not provided. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | US |
| | Metric 3: | Applicability | High | The data are for an occupational scenario( refinery workers exposed to asbestos) within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Medium | 1940-2006 - after PEL (1994), more than 10 and less than 20 years old |
| | Metric 5: | Sample Size | High | Full array of statistical summaries provided |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Monitoring data include most critical metadata, such as sample type and exposure type, worker activities, and exposure durations but lacks additional metadata, such as sample durations, and exposure frequency. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | detailed information about variance is provided, but uncertainty is not quantified. |

## Overall Quality Determination — High

| | |
|---|---|
| **Study Citation:** | Wilson, J., Murray, V., Kettle, J. N. (2009). The July 2005 London bombings: environmental monitoring, health risk assessment and lessons identified for major incident response. Occupational and Environmental Medicine 66(10):642-643. |
| **HERO ID:** | 3313336 |
| **Conditions of Use:** | Other: |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Exposure route: | inhalation |
| Physical form: | inhalable fibers |
| Personal sampling data: | Results provided in fibers/mlKings Cross (7–25 July 2005)Personnel in vicinity of damaged carriages < 0.02 to < 0.08 Personal 4 h control limit (MDHS39/4)Russell Square (7–25 July 2005)Personnel in vicinity of damaged carriages < 0.04 to < 0.16 Personal 4 h control limit (MDHS39/4) |
| Area sampling data: | Results provided in fibers/mlTunnels (proximal and distal) < 0.01 to < 0.02 (MDHS39/43)Platforms and other publicly accessible areas < 0.01 to < 0.04 (MDHS39/4)Covent Garden (8–10 July 2005)Platforms < 0.01 (MDHS39/4)Russell Square (7–25 July 2005)Tunnels (near and distal to damaged carriages) < 0.01 to < 0.02 (MDHS39/4)Platforms and other publicly accessible areas <0.01 to < 0.02 (MDHS39/4)Aldgate (7–8 July 2005)Platforms < 0.01 (MDHS39/4)Ramp (25 m from end of damaged carriage) < 0.01 (MDHS39/4)Edgware Road (7 July 2005)Platform (50 m to rear carriage of damaged train) <0.01 (MDHS39/4)Open carriage opposite blast damaged carriage <0.01 (MDHS39/4) |
| Personal protective equipment: | P3 respiratory protection. |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | High | Used UK Methods for the Determination of Hazardous Substances 39/4 asbestos fibers in the air (PCM) 1995 |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Medium | UK |
| | Metric 3: | Applicability | Medium | Bombing event - rare occurrence |
| | Metric 4: | Temporal Representativeness | Medium | 2016 publication of 2005 sampling event - after PEL and more than 10 but less than 20 years old |
| | Metric 5: | Sample Size | Low | range of less than values provided |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Low | Monitoring data include sample type (e.g., personal breathing zone) but no other metadata. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | Range of less than values were provided which could be used to assess variability. Uncertainty not discussed but assumed it was included in the UK sampling methodology. |

## Overall Quality Determination Medium

**Study Citation:** Wilson, R., Price, B. (2001). Risk assessment for asbestos and management of low levels of exposure to chrysotile. Canadian Mineralogist :265-275.
**HERO ID:** 2224140
**Conditions of Use:** Other:

**EXTRACTION**

| Parameter | Data |
|---|---|
| Worker activity description: | Student/Teacher |
| Exposure route: | Inhalation |
| Physical form: | inhalable fibers |
| Area sampling data: | NOTE these data are included in the section of the report for risk to general population, but some of these situations could be considered occupational:Wet spray 93% less than 0.0006 f/mlDry spray 92% less than 0.003 f/ccConnecticut offices 0.0024 f/ccNYC offices 0.006 f/ccSprayed asbestos 0.00015 f/ccSchools 0.00042 f/ccPublic Buildings 0.00026 f/ccMinnesota public buildings 0.00009 f/ccSchools 0.00024 f/ccSchools 0.0002 f/ccSchools and university 0.0001 f/cc |
| Exposure duration: | children are exposed 6 hrs per day |
| Exposure frequency: | 150 days per year for 10 year period (student) 30 year period (teacher) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Sampling and Analytical Methodology | Low | Sampling or analytical methodology is not specified |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | Low | unknown countries |
| Metric 3: | Applicability | High | The data are for an occupational scenario ( classroom exposure) within the scope of the risk evaluation. |
| Metric 4: | Temporal Representativeness | Low | Report published in 2001 after the PEL which is used in the analysis. It should be noted that the some of the underlying data is prior to the PEL and more than 20 years old. |
| Metric 5: | Sample Size | Low | no statistical summaries are included in the data |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Low | Monitoring data include sample type (e.g., personal breathing zone) but no other meta-data. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Low | The monitoring study does not address variability or uncertainty. |

## Overall Quality Determination Low

| | |
|---|---|
| **Study Citation:** | Woitowitz, H. J., Kraus, T. (2000). Screening of asbestos-exposed workers in Germany. People and work research reports, 36 :42-52. |
| **HERO ID:** | 3086899 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Much of the asbestos materials which were installed remain in buildings, factories, and homes. During renovation, repair or demolition of these structures, exposure to asbestos dust becomes a hazard, especially for craftsmen in construction trades |
| Area sampling data: | 90th percentile of fiber concentrations at German workplaces given for studies from 1950 to 1990; logarithmic decrease , with levels from 300 fibers/mL in 1950s down to 0.7 fibers/mL in 1990 |
| Number of workers: | 58,000 workers being exposed to asbestos during demolition, repair, and renovation in Germany. Data from over 20 years ago. |
| Comments: | generic industrial/commercial data; not COU-specific |

**EVALUATION**

| Domain | | Metric | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | Low | Sampling/analytical methodology is not specified. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Medium | Data are from Germany, an OECD country. |
| | Metric 3: | Applicability | Medium | Data are for generic industrial uses, including in-scope occupational scenarios. |
| | Metric 4: | Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: | Sample Size | Medium | Sample distribution characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Low | Sample type provided but no other metadata. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | Variability addressed by change in concentrations over time, but uncertainty is not addressed. |

## Overall Quality Determination — Low

**Study Citation:** Yager, B. J. (1981). Evaluation of asbestos fiber hazard from wire gauzes. Journal of Chemical Education 58(4):A134.
**HERO ID:** 6864715
**Conditions of Use:** Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products

**EXTRACTION**

| Parameter | Data |
|---|---|
| Worker activity description: | Students in chemistry laboratories using wire gauzes. (1/1) |
| Physical form: | fibers (1/1) |
| Area sampling data: | No measurable concentration of asbestos fibers were found. (1/1) |
| Exposure duration: | 7 hours/day (1/1) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | High | Sampling/analytical methodology is an approved NIOSH method. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for commercial use of chemical substances in metal products, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Monitoring data were collected prior to the most recent PEL. |
| | Metric 5: | Sample Size | Low | Sample distribution is described qualitatively. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Sample type and exposure type provided, but missing exposure frequency, number of workers, particle size, PPE, and engineering controls. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | Uncertainty is addressed in sampling/analytical methodology. Variability is not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Yeung, P., Patience, K., Apthorpe, L., Willcocks, D. (1999). An Australian study to evaluate worker exposure to chrysotile in the automotive service industry. Applied Occupational and Environmental Hygiene 14(7):448-457. |
| **HERO ID:** | 3080975 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Table I. Work activities and control measuresService garage for light vehicles: Replace/check brake drum & disc brake (6 h/week - 6 h/day, Controls - aerosol spray or squirt bottle and compressed air drying), Replace clutch (occasionally)Service depot for buses: Replace brake drum (3 h/week, Controls - dry wiping and respirators)Brake bonding workshops: Bonding, cutting, radius grinding & packing (1 h/day - 8 h/day, Controls - respirator)Gasket processing workshop: Machine cutting & stamping (2 h/day) |
| Personal sampling data: | Generally less than 0.05 f/mL for all activities listed above. Sampling times ranged from 77 - 130 min (Table II) |
| Area sampling data: | Generally less than 0.05 f/mL for all activities listed above. Sampling times ranged from 75 - 125 min (Table II) |
| Particle size characterization: | The median diameter on samples taken from the service garages (passenger cars) was 0.5 - 1.0 um, and was 0.2 - 0.5 um for brake bonding and gasket processing workshop (p.6) |
| Exposure duration: | See durations listed with the worker activities. |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Sampling and Analytical Methodology | Medium | Sampling or analytical methodology is not equivalent to an approved OSHA or NIOSH method and EPA review of information indicates the methodology is acceptable. Differences in methods are not expected to lead to lower quality data. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | Medium | The data are from an OECD country other than the U.S. |
| Metric 3: | Applicability | High | The data are for an occupational scenario within the scope of the risk evaluation (braking and gear-changing (clutch) components). |
| Metric 4: | Temporal Representativeness | Medium | The data are more than 10 years but generally, no more than 20 years old. |
| Metric 5: | Sample Size | Medium | Distribution of samples is characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | High | Monitoring data include all associated metadata, including sample types, exposure types, sample durations, exposure durations worker activities, and exposure frequency. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Medium | The monitoring study provides only limited discussion of the variability in the determinants of exposure for the sampled site or sector. The monitoring study provides only limited discussion of the uncertainty in the exposure estimates. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Yu, I. J., Yoo, C. Y., Chung, Y. H., Han, J. H., Yhang, S. Y., Yu, G. M., Song, K. S. (2004). Asbestos exposure among Seoul metropolitan subway workers during renovation of subway air-conditioning systems. Environment International 29(7):931-934. |
| **HERO ID:** | 3531609 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Exposure to gaskets, ceiling boards, ceiling materials, and dust settled inside ducts. Workers installed light fixtures, layed brick, instlaled ceiling panels, painted pipes |
| Exposure route: | inhalation |
| Physical form: | solidbulk sampling: <0.1->90% chrysotile or tremolite asbestos (Table 1) |
| Personal sampling data: | 0.003 to 0.02 fibers/cm372 personal samples taken, 9 detected asbestos (Table 2) |
| Exposure duration: | The samplings were performedduring the normal work periods 08:00 – 15:00 and 00:00 –17:00. The typical durations used in air sampling were 180–240 min for night shift and 300– 360 min for day shift |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Sampling and Analytical Methodology | High | Sampling or analytical methodology is an approved OSHA or NIOSH method or is welldescribed and found to be equivalent to approved OSHA or NIOSH methods. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Medium | The data are from an OECD country. other than the U.S., and locality-specific factors (e.g., potential differences in regulatory occupational exposure limits, industry/ process technologies) may impact exposures relative to the U.S. |
| | Metric 3: | Applicability | High | The data are for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Medium | Operations, equipment, and worker activities are expected to be reasonably representative of current conditions. The monitoring data were collected are more than 10 years but generally, no more than 20 years old. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Monitoring data include most critical metadata, such as sample type and exposure type, but lacks additional metadata such as exposure durations and exposure frequency |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | High | The monitoring study addresses variability in the determinants of exposure for the sampled site or sector. Uncertainty canbe determined from the sampling and analytical method. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Zichella, L., Baudana, F., Zanetti, G., Marini, P. (2021). Vinyl-asbestos floor risk exposure in three different simulations. International Journal of Environmental Research and Public Health 18(4):2073. |
| **HERO ID:** | 7459759 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Simulation of vinyl tile breakage and vinyl tile abrasion. |
| Exposure route: | Inhalation |
| Physical form: | Fibers |
| Area sampling data: | Vinyl tile abrasion simulations: 0-24.42 fibers/LVinyl tile breakage simulations: 1.53-3.05 fibers/L |
| Engineering control: | ”Three remediation methods for asbestos are: 1. Removal—it is mandatory for brittle materials and compact materials in the case of damages for more than 10% of its surface.2. Encapsulation—covering of the asbestos-containing materials (ACMs) with severallayers of a specific encapsulation coating, producing a physical barrier between thecontaminated matter and the external environment.3. Over coverage—occulting and sealing the ACMs by means of the physical barriersuch as panels, walls or insulation. (3/18)” |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Sampling and Analytical Methodology | Medium | Sampling/analytical methodology is not an approved OSHA/NIOSH method but is an acceptable methodology. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | Medium | Data are from Italy, an OECD country. |
| | Metric 3: Applicability | High | The data are for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: Temporal Representativeness | High | Monitoring data were collected after the most recent PEL and no more than 10 years old. |
| | Metric 5: Sample Size | Medium | Sample distribution characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | Medium | Exposure type and sampling data provided, but missing number of workers, exposure duration, frequency, PPE, and particle size. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | High | Uncertainty is addressed in sampling/analytical methodology. Variability is addressed by using different impact and abrasion tests. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Ahrenholz, S. H. (1988). Health hazard evaluation report no. HETA 86-422-1891, City of Ames Municipal Power Plant, Ames, Iowa. |
| **HERO ID:** | 3970491 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Power plant operator, auxiliary operator, fireman B, fireman C, coal handlers, electrician, electrical technician, mechanic, and maintenance worker. |
| Personal sampling data: | Instrument repair: 0.004 fibers/cm^3Fireman C: 0.01 fibers/cm^3Custodian: 0.003 fibers/cm^3Maintenance mechanic: 0.002 fibers/cm^3Fireman C: 0.004 fibers/cm^3Table VIII. |
| Exposure duration: | Work shifts are 8 hours/day. [PDF Pg. 3] |
| Number of workers: | The power plant employs about 44 workers. [PDF Pg. 3] |
| Personal protective equipment: | All workers are provided with uniforms. Workers have a choice of laundering them at the plant or at home. Disposable coveralls along with hooded denum coveralls are provided for use when working on electrostatic precipitators and showering is required after the work is completed. These denim coveralls are laundered at the plant. Workers are issued ear muffs to use with their hard hats and ear plugs are available. Safety glasses are required and chemical goggles are available. Steel toed shoes are furnished for all maintenance workers, electricians, and any others required to do work involving moving heavy equipment. Rubber suits, boots, and gloves are available when transferring acids or caustics. Work gloves are also available.No formal respiratory protection program existed, however nuisance dust and disposable organic vapor-acid gas respirators were provided depending upon the area and job. Self contained breathing apparatus units (2) were present in the sulfuric acid and chlorine handling and storage areas of the cooling towers. No program for the use of these devices by qualified personnel was in place. [PDF Pg. 4] |
| Comments: | Samples taken with TEM method. |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Methodology | High | Assessment uses high quality data/techniques/methods from frequently-used sources. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | Data are from the U.S. |
| Metric 3: | Applicability | High | Data are for building and construction materials, an in-scope occupational scenario. |
| Metric 4: | Temporal Representativeness | Low | Assessment is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Medium | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | High | Uncertainty is addressed by sampling methods. Variability addressed by sampling multiple work activities. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | ATSDR, (2001). Toxicological profile for asbestos (Update, September 2001). |
| **HERO ID:** | 786664 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Asbestos abatement; building maintenance and repair. |
| Exposure route: | Inhalation and dermal. |
| Physical form: | Solid fibers. |
| Personal sampling data: | Abatement Activities (f/mL) [PDF Pg. 193]Roofing material (wet method) (non-TWA): 0.0047-0.0752 Floor tile and mastic (non-TWA): <0.008-0.094Drywall (TWA): 0.12-3.16Floor tile and mastic (TWA): 0.01-0.08Pipe/boiler crawl space: 0.005-0.957 Ceiling tile removal in mini-containment: 0.005-0.154Transite removal: 0.005-0.278Building Maintenance or Repair (f/mL) [PDF Pg. 196]Ceiling removal/installation: 0.000-0.035Electrical/plumbing: 0.002-0.216HVAC work: 0.000-0.077Miscellaneous work: 0.000-0.031Removal/encapsulation: 0.015-0.115Run cable: 0.001-0.228ACM debris cleanup: 0.012-0.36Bulk sample collection: 0.0030-0.17Cable pull: 0.011-0.20Ceiling tile replacement: 0.030-3.5Electrical installation: 0.01-0.11Electrical repair: 0.003-0.052Fluorescent lamp replacement: 0.0054-0.065HEPA vacuum/wet wiping dust/debris: 0.029-0.304Wet wipe cleaning: 0.018-0.048Spray-buffing tile (poor): 0.008-0.0081Spray-buffing tile (medium): 0.003-0.032Spray-buffing tile (good): 0.004-0.046Wet-stripping tile (medium): 0.055-2.58Wet-stripping tile (good): 0.010-0.128UHS burnishing tile (poor): 0.046-1.692UHS burnishing tile (good): 0.004-1.106Wet-stripping tile (poor): 0.004-2.58Wet-stripping tile (good): 0.006-0.128 |
| Area sampling data: | Abatement Activities (f/mL) [PDF Pg. 193]Roofing material (wet method) (non-TWA): <0.0006-0.0162 Floor tile and mastic (non-TWA): <0.002-0.067Pipe/boiler in a crawl space: 0.005-1.542Pipe/boiler in a crawl space: 0.005-0.998Ceiling tile removal in mini-containment: 0.005-0.331Floor tile and mastic (solvent method) removal: 0.005-0.010Mastic removal (blast method): 0.005-0.005Building Maintenance or Repair (f/mL) [PDF Pg. 196]Ceiling removal/installation: 0.001-0.044Electrical/plumbing: 0.004-0.054HVAC work: 0.001-0.024Miscellaneous work: 0.000-0.083Removal/encapsulation: 0.003-0.019Run cable: 0.000-0.086Ceiling tile replacement: 0.0020-0.056Fluorescent lamp replacement: 0.0039-0.0067HEPA vacuum/wet wiping dust/debris: 0.0023-0.027Office environment: 0.0016-0.057 |
| Exposure duration: | 8-hr TWA concentrations sampled. [PDF Pg. 193-195] |
| Exposure frequency: | 5 days/week [PDF Pg. 189] |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Methodology | High | Assessment uses high quality [data/techniques/methods] from frequently-used sources. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | Data are from the U.S. |
| Metric 3: | Applicability | High | Data are for asbestos abatement and construction activities, an in-scope occupational scenario. |
| Metric 4: | Temporal Representativeness | Low | Assessment is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| Metric 5: | Sample Size | Medium | Sample distribution characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | |

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| | |
|---|---|
| **Study Citation:** | ATSDR, (2001). Toxicological profile for asbestos (Update, September 2001). |
| **HERO ID:** | 786664 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

| | | | EVALUATION | |
|---|---|---|---|---|
| Domain | | Metric | Rating | Comments |
| | Metric 7: | Metadata Completeness | High | Uncertainty is addressed by sampling methods. Variability addressed by area and personal samples of multiple worker activities. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Beckett, R. R. (1976). Asbestos exposure control at Puget Sound Naval Shipyard. Environmental Research 11(2):248-260. |
| **HERO ID:** | 3584195 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Pipe coverers and insulators at a naval shipyard. (1/13) |
| Exposure route: | inhalation (1/13) |
| Physical form: | dust (1/13) |
| Number of workers: | Employment varies between 8,000-10,000 workers. Of the group, 40-120 persons work as pipe coverers and insulators. (1/13) |
| Personal protective equipment: | A respirator program was initiated to reduce exposures until other control methods could be developed. (1/13) Protective coveralls would be worn by all employees engaged in the ripping out of asbestos insulation. (3/13) |
| Engineering control: | Wetting of amosite materials reduced airborne asbestos dust production by 50-60%. Also, substitution of materials, new methods, and ventilation control techniques were implemented. (1/13) Dust collection systems are attached to power saws to capture dust. All process tables have waste container systems to prevent material from falling to the flow. (7/13) During asbestos removal, pipe coverers and insulators attempt to isolate the area with curtains, portable partitions, or enclosure of the work area to provide capture of the dust by ventilation, and prevent spreading of dust to adjacent work areas. (10/13) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Methodology | High | Assessment uses high quality data from frequently-used sources. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | High | Data are from the U.S. |
| | Metric 3: Applicability | High | Data are for industrial use of chemical substances in construction products, an in-scope occupational scenario. |
| | Metric 4: Temporal Representativeness | Low | Assessment is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: Sample Size | Medium | Sample distribution characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | Low | Assessment results are provided but underlying methods, assumptions, and data sources are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Low | Uncertainty and variability not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Cameo Chemicals, (2016). Chemical datasheet: asbestos (blue). |
| **HERO ID:** | 3981008 |
| **Conditions of Use:** | Other: |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Exposure route: | inhalation (2/4) |
| Physical form: | Slender, fine, flaxy fiber (1/4) |
| Personal protective equipment: | Protective clothing and eye protection. (2/4) |
| Engineering control: | If spilled, isolate the spill in all directions for at least 25 meters for solids. If a fire breaks out, use CO2, water, or a dry chemical to put out the fire, move containers from the area if possible, and stay away from tanks engulfed in fire. If spilled, cover the spill with plastic or tarp to minimize spreading. (2/4) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Methodology | High | Assessment uses high quality data from frequently-used sources. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | Data are from the U.S. |
| Metric 3: | Applicability | Medium | Data are for all conditions of use as general guidance. |
| Metric 4: | Temporal Representativeness | High | Monitoring data were collected after the most recent PEL and no more than 10 years old. |
| Metric 5: | Sample Size | Low | Distribution of samples is qualitative or characterized by no statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Medium | Methods, results, and assumptions are clearly documented, but underlying data sources are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Low | The assessment does not address variability or uncertainty. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Cherrie, J. W., Tindall, M., Cowie, H. (2005). Exposure and risks from wearing asbestos mitts. Particle and Fibre Toxicology 2:5. |
| **HERO ID:** | 3079914 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Furnishing, Cleaning, Treatment Care Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | personal monitoring was undertaken on a subject wearing anasbestos apron and gauntlets while carrying objects and doing bench work (p.1-2)personal airborne fibre exposure from wearing asbestos safety coats, hoods, gloves and leggings was measured for workers at two ore reduction plants. The men working on furnaces prepared channels along which molten iron flowed, tapped the furnaces andkept the channels clear of slag during casting. (p.2)A second survey was undertaken at a small plant manufacturing elemental phosphorous where four men carried out work similar to that at the steel works. Asbestos safety coats and leggings were worn throughout the slagging operations but hoods and gloveswere worn only when necessary (p.2) |
| Exposure route: | inhalation |
| Personal sampling data: | Lab study: The airborne fibre concentrations measuredin their six tests ranged from 2.4 to 4.2 fibres/ml, with amean airborne fibre concentration of 3.5 fibres/ml. (p.2)At the steel works, the mean airborne fibre concentrationmeasured during the 39 personal monitoring tests was 2.0fibres/ml, with a range from 0.3 to 5.0 fibres/ml, based ona mean sampling period of 52 minutes. The analysis ofthese data suggested that the fibre release increased withage of the garments up to 8 weeks, although the numberof measurements was too small and the correlation coefficient too low to reliably predict fibre release from garments of different ages. (p.2)At the phosphorous manufacturing plant, the mean personal airborne fibre concentration measured by personal sampling was 14 fibres/ml. This was based on 6 tests and a mean exposureperiod of 35 minutes. The measured airborne fibre concentrations ranged from 9.9 to 26 fibres/ml. The reason for the considerable differences in measured airborne fibre concentrations between the two plants was not known, although Gibbs suggests the higher levels were because the coats and mittens in the phosphorous plant were untreated (i.e., not aluminized outside or dust suppressed) and leggings were also quite badly damaged. (p.2) |
| Area sampling data: | In the studies performed on workers in their actual workplaces, air samples were collected from the breathing zone of each worker and 75 cm above the tabletop where the gloves were laid or tossed.The mean time weighted average (TWA) concentrations ofairborne fibres from the 176 measurements in the isolation chamber, ranged from 0.95 to 12 fibres/ml. The minimum TWA concentration measured was 0.61 fibres/ml for well-worn and heavily soiled gloves. The maximum TWA concentration measured was 16 fibres/ml for wellworn and clean gloves. The results showed that clean wellworn gloves emitted significantly more fibres than did brand-new gloves, but fibre emission decreased with increased surface soiling.Eighty air samples were collected during a simulation carried out in the well-ventilated laboratory. The range of mean TWA airborne fibre concentrations was 0.07 to 0.99 fibres/ml for the personal samples, and 0.06 to 0.60 fibres/ml for the static samples. Thirteen samples were collected by Samimi and Williamsin actual workplaces. The maximum and minimum TWAairborne fibre concentrations ranged from 0.07 to 2.93fibres/ml for personal samples and from 0.04 to 0.74fibres/ml for static samples (sampling over an 8-hourshift). (p.2-3) |
| Exposure duration: | Steel works: based on a mean sampling period of 52 minutes (p.2)Phosphorus plant: mean exposure period of 35 minutes (p.2) |
| Exposure frequency: | Steel works: castings (0.5 to 1.25 hours) were repeated at approximately 4-hour intervals |
| Number of workers: | Phosphorus plant: 4 workers (p. 2) |
| Personal protective equipment: | Steel works: Asbestos safety coats and leggings were wornthroughout the slagging operations but hoods and gloveswere worn only when necessaryPhosphorus plant: coats and mittens (p. 2) |
| Engineering control: | Laboratory study: The laboratory was well ventilatedwith approximately 10 air changes per hour extracted atceiling level. (p. 2) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Methodology | Medium | The assessment or report uses high quality data and/or techniques or sound methods that are not from a frequently used source, and associated information does not indicate flaws or quality issues. |
| Domain 2: Representativeness | | | |

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**Study Citation:** Cherrie, J. W., Tindall, M., Cowie, H. (2005). Exposure and risks from wearing asbestos mitts. Particle and Fibre Toxicology 2:5.
**HERO ID:** 3079914
**Conditions of Use:** Industrial/Commercial Uses-Chemical Substances in Furnishing, Cleaning, Treatment Care Products

| | | EVALUATION | | |
|---|---|---|---|---|
| Domain | Metric | | Rating | Comments |
| | Metric 2: | Geographic Scope | Medium | The data are from an OECD country other than the U.S., and locality-specific factors (e.g., potential differences in regulatory occupational exposure or emission limits, industry/ processtechnologies) may impact exposures or releases relative to the U.S. |
| | Metric 3: | Applicability | High | The assessment is for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Medium | The assessment captures operations, equipment, and worker activities that are expected to be reasonably representative of current conditions. The completed exposure or risk assessment is generally, more than 10 years but no more than 20 years old. |
| | Metric 5: | Sample Size | Medium | Distribution of samples is characterized by a range with uncertain statistics. It is unclear if analysis is representative. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Assessment or report clearly documents results, methods, and assumptions. Data sources are generally described but not fully transparent. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | The assessment provides only limited discussion of the variability and uncertainty in the results. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Choi, S., Kang, D., Park, D., Lee, H., Choi, B. (2017). Developing Asbestos Job Exposure Matrix Using Occupation and Industry Specific Exposure Data (1984-2008) in Republic of Korea. Safety and Health at Work 8(1):105-115. |
| **HERO ID:** | 6869209 |
| **Conditions of Use:** | Other: |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Welders, ship builders, construction workers, hospital workers, railroad mechanics, equipment technicians, laboratory workers, furnace operators, waste treatment workers, maintenance workers. (4/11) |
| Physical form: | fibers (3/11) |
| Personal sampling data: | From 1984-2008, the range of weighted arithmetic means for occupational asbestos exposure was 0.0002-7.5 f/mL with a maximum of 26.7 f/mL. Welding with asbestos cloth resulted in a WAM of 1.54 f/mL (0.01-11.40 f/mL). Ship repairing resulted in a WAM of 0.23 f/mL (0.01-2.45 f/mL). Ship building resulted in a WAM of 0.02 f/mL. Ship mechanics resulted in a WAM of 0.13 f/mL (0.0005-1.68 f/mL). Construction workers resulted in a WAM of 0.0393 f/mL (0.004-0.32 f/mL). Railroad train mechanics resulted in a WAM of 0.0371 f/mL (0.005-0.16 f/mL). Hospital workers resulted in a WAM of 0.0056 f/mL (0.003-0.008 f/mL). Broadcasting equipment technicians resulted in a WAM of 0.0054 f/mL (0.005-0.01 f/mL). Sampling in a laboratory resulted in a WAM of 0.1191 f/mL (0-0.94 f/mL). Furnace operation resulted in a WAM of 0.0337 f/mL (0.001-0.239 f/mL). Waste treatment workers resulted in a WAM of 0.016 f/mL (0-0.0578 f/mL). Crushing waste containing asbestos resulted in a WAM of 0.013 f/mL (0.0004-0.028 f/mL). Maintenance work in a power plant resulted in a WAM of 0.0036 f/mL (0-0.0236 f/mL).(4/11) |
| Area sampling data: | Sampling in a factory constructed with asbestos resulted in a WAM of 0.0258 f/mL (0.0118-0.0383 f/mL). (8/11) |
| Number of workers: | Recently, the WHO reported that there are about 125 million people in the world exposed to asbestos at the workplace. (2/11) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Methodology | High | Assessment uses high quality data from frequently-used sources. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | Medium | Data are from Korea, an OECD country. |
| Metric 3: | Applicability | High | Data are for various industrial and commercial conditions of use, all of which are in scope. |
| Metric 4: | Temporal Representativeness | Medium | Report is based on current industry conditions and data no more than 10 years old. Reference is from 2016 but the data collected was from 1984 to 2008 |
| Metric 5: | Sample Size | Medium | Sample distribution characterized by limited statistics (weighted means, minimums, maximums) but discrete samples not provided and distribution not fully characterized. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | High | Uncertainty is addressed in a discussion paragraph mentioning limits and improvements upon the study. Variability is addressed by taking literature data from 3 databases. |

## Overall Quality Determination High

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| | |
|---|---|
| **Study Citation:** | Choi, S., Kang, D., Park, D., Lee, H., Choi, B. (2017). Developing Asbestos Job Exposure Matrix Using Occupation and Industry Specific Exposure Data (1984-2008) in Republic of Korea. Safety and Health at Work 8(1):105-115. |
| **HERO ID:** | 6869209 |
| **Conditions of Use:** | Other: |

| | | **EVALUATION** | |
|---|---|---|---|
| Domain | Metric | Rating | Comments |

**Study Citation:** Chrostowski, P. C., Foster, S. A., Anderson, E. L. (1991). Human health risks associated with asbestos abatement. Risk Analysis 11(3):465-481.
**HERO ID:** 3082333
**Conditions of Use:** Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products

**EXTRACTION**

| Parameter | Data |
|---|---|
| Worker activity description: | Asbestos abatement actions currently take four forms:removal, encapsulation, enclosure, and operation and maintenance controls (p. 1)"In a typical removal action, the area which containsACM is isolated from the rest of the building using polyethylene sheeting, air locks, and negative pressure ventilation systems. The ACM is dampened with water and the asbestos is mechanically removed (e.g., by scrapers, wire brushes, brooms, etc.). Once this gross removal has been accomplished, the surfaces are vacuumed with a High Efficiency Particulate Air (HEPA) vacuum and,often, covered with an encapsulant material. The polyethylene or other isolation materials are then removed, and the area is cleaned by a combination of HEPA vacuuming and wet hand cleaning. During the removal, personal and/or environmental air monitoring is performed both by collection of samples for subsequent laboratory analysis and also by on-line, real-time measurements.Following removal and cleanup, a final inspection and air sampling are performed." (p. 2) |
| Exposure route: | inhalation |
| Physical form: | solid |
| Personal sampling data: | asbestos concentrations during abatement activities ranging from 0.01 f/cm3 to 40 f/cm3 (Table V)Asbestos personal concentrations were taken in for teachers before and after asbestos encapsulation (Table VII). Concentrations ranged from 2.5E-03 - 2.2E-01 f/cm3.Asbestos personal exposure samples were taken during operation and maintenance activities (wet-mopping, vacuuming, dry mopping with an oiled mop, and sweeping). A total of 48 samples were taken, asbestos concentrations ranged from 16.6 - 182 f/cm3 (Table VIII). |
| Area sampling data: | indoor air samples of schools with asbestos materials ranged between 1.5 - 217 ng/m3 (p. 9)Asbestos concentrations were taken in 4 schools before, during, and after encapsulation (Table VI). Concentrations ranged from 1.5E-05 - 1.4E-01 f/cm3Air samples were taken in various buildings during different maintenance/housekeeping activities Samples ranged from 0.02 - 17.7 f/cm3, with a max of 643 ng/m3 (Table IX) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Methodology | High | Sampling or analytical methodology is an approved OSHA or NIOSH method or is well described and found to be equivalent to approved OSHA or NIOSH methods (PCM and TEM) |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | The data are from the United States and are representative of the industry being evaluated. |
| Metric 3: | Applicability | High | The data are for an occupational scenario within the scope of the risk evaluation. |
| Metric 4: | Temporal Representativeness | Low | Metadata on the operations, equipment, and worker activities associated with the data show that the data agree representative of outdated operations, equipment, and activities rather than current operations, equipment, and worker activities. The data were collected more than 20 years ago. |
| Metric 5: | Sample Size | Medium | Distribution of samples is characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Medium | Monitoring data include most critical metadata, such as sample type and exposure type, but lacks additional metadata, such as sample durations, exposure durations, and exposure frequency. |

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**Study Citation:** Chrostowski, P. C., Foster, S. A., Anderson, E. L. (1991). Human health risks associated with asbestos abatement. Risk Analysis 11(3):465-481.
**HERO ID:** 3082333
**Conditions of Use:** Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products

| | | EVALUATION | |
|---|---|---|---|
| Domain | Metric | Rating | Comments |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | High | The monitoring study addresses variability in the determinants of exposure for the sampled site or sector. Uncertainty canbe determined from the sampling and analytical method. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Cowan, D. M., Cheng, T. J., Ground, M., Sahmel, J., Varughese, A., Madl, A. K. (2015). Analysis of workplace compliance measurements of asbestos by the U.S. Occupational Safety and Health Administration (1984-2011). Regulatory Toxicology and Pharmacology 72(3):615-629. |
| **HERO ID:** | 3520562 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Personal sampling data: | ”Compiled CEHD and IMIS data for analysis; provides range, number of samples, number of nondetects, and range of years when data were collected with data stratified by industry groups including mining, agriculture, building construction, manufacturing, transportation, etc. (pgs 5-7)””from 2010 to 2011, personal air samples ranged in concentrations from 0.003 to 1.1 f/cc. Airborne concentrations associated with personal samples collected from 1984 to 1989 were significantly higher when compared with samples collected in the 1990s, 2000s, and the period from 2010 to 2011 ($p < 0.05$).”” (pg 8)” |
| Area sampling data: | ”Compiled CEHD and IMIS data for analysis; provides range, number of samples, number of nondetects, and range of years when data were collected with data stratified by industry groups including mining, agriculture, building construction, manufacturing, transportation, etc. (pgs 5-7) |
| Personal protective equipment: | Some samples have notation for whether PPE is used; ”Although some sampling points included information related to PPE, many did not.” |
| Comments: | Summary/compilation of OSHA and IMIS data |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Methodology | High | Assessment uses high quality data from frequently-used sources. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | Data are from the U.S. |
| Metric 3: | Applicability | High | Includes data for construction and manufacturing industries, which are in-scope occupational scenarios. |
| Metric 4: | Temporal Representativeness | Medium | Assessment includes data that is less than 10 years old, but is primarily made up of data that is greater than 10 or 20 years old. Industry conditions expected to be representative of current industry conditions. |
| Metric 5: | Sample Size | Medium | Sample distribution characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Low | Assessment results are provided but underlying methods, assumptions, and data sources are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Medium | Variability addressed by stratifying data by SIC code and years collected, but uncertainty is not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Finley, B. L., Pierce, J. S., Phelka, A. D., Adams, R. E., Paustenbach, D. J., Thuett, K. A., Barlow, C. A. (2012). Evaluation of tremolite asbestos exposures associated with the use of commercial products. Critical Reviews in Toxicology 42(2):119-146. |
| **HERO ID:** | 2692980 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | auto repair (p. 12) |
| Exposure route: | inhalation |
| Area sampling data: | In the only known analysis of clutch wear debris for fiber type, Blake et al. (2008) (using PLM) reported that dust from a clutch disc face was composed of 5% chrysotile asbestos; no amphibole fibers were found. In addition, no asbestos fibers (chrysotile oramphiboles) were identified in the residue removed from the bell housing. (p. 12)In a subsequent analysis of airborne asbestos during the servicing and handling of automobile asbestos-containing gaskets, Blake et al. (2006) reported that approximately 21% of all air samples collected during gasket work contained measurable concentrationsof chrysotile fibers, but noted that no amphibole fibers were identified in any sample. (p. 15) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Methodology | Medium | The assessment or report uses high quality data and/or techniques or sound methods that are not from a frequently used source, and associated information does notindicate flaws or quality issues. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | The data are from the United States and are representative of the industry being evaluated. |
| Metric 3: | Applicability | Medium | The assessment is for an occupational scenario that is in scope and is evaluated with a similar occupational scenario that is not within the scope of the risk evaluation, in terms of the type of industry, operations, and work activities. |
| Metric 4: | Temporal Representativeness | Medium | The assessment captures operations, equipment, and worker activities that are expected to be reasonably representative of current conditions. The completed exposure or risk assessment is generally, more than 10 years but no more than 20 years old. |
| Metric 5: | Sample Size | Low | Distribution of samples is characterized by no statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Low | Assessment or report provides results, but the underlying methods, data sources, and assumptions are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Low | The assessment does not address variability or uncertainty. |

## Overall Quality Determination Low

| | |
|---|---|
| **Study Citation:** | Gibbs, G., Pigg, B. J., Nicholson, W. J., Morgan, A., Lippmann, M., Davis, J. M. G., Mossman, B. T., Mcdonald, J. C., Landrigan, P. J., Nicholson, W. J., Schreier, H. (1998). Task group on Environmental health criteria for chrysotile asbestos meeting, Geneva, Switzerland, 1-6 July 1996. Environmental Health Criteria 203:III-197. |
| **HERO ID:** | 7482318 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | ”Work activities for asbestos cement included regrinding, mixing, forming, siding and shingle finishing, panel finishing, flat and corrugated finishing, exposures in warehouse, and maintenance (pg 62)Production of friction products included spinning, grinding, and drilling among other activities (pg 64)Building maintenance activities included cable running, electrical/plumbing work, and HVAC work (pg 67)” |
| Personal sampling data: | ”In the maintenance of vehicles, peak concentrations of up to 16 f/ml were reported in the 1970s, while practically all measured levels after 1987 were less than 0.2 f/ml. Time-weighted average exposures during passenger vehicle repair in the 1980s were generally less than 0.05 f/ml” (pg 26)”There is potential for exposure of maintenance personnel to mixed asbestos fibre types due to large quantities of friable asbestos in place. In buildings with control plans, personal exposure of building maintenance personnel in the USA, expressed as 8h time-weighted averages, was between 0.002 and 0.02 f/mI. These values are of the same order of magnitude as typical exposures during telecommunication switchwork (0.009 f/ml) and above-ceiling work (0.037 f/mI), although higher concentrations were reported in utility space work (0.5 f/ml).” (pg 26) |
| Area sampling data: | ”In the production of asbestos-cement in Japan, typical mean concentrations were 2.5-9.5 f/ml in 1970s, while mean concentrations of 0.05-0.45 f/ml were reported in 1992.... Trends have been similar in the production of friction materials: based on data available from the same country, mean concentrations of 10-35 f/ml were measured in the period between 1970 and 1975, while levels 0.2-5.5 f/ml were reported in the period between 1984 and 1986” (pg 25-26)Exposure data provided for asbestos-cement production; late 1970s facility in the USA showed ”In 80% of the samples the concentrations were less than 2 f/ml, and in about 60% they were less than 0.5 f/ml.” including other data given with limited statistics (pg 62-63)Exposure data provided for friction products; average concentrations of chrysotile fibers during various tasks for woven asbestos products were all less than 2 fibers/mL during most recent time period up to 1979 (pg 63-64)Exposure data provided for building maintenance personnel; fiber concentrations generally below 1 fiber/mL in all samples (pg 67-68)”reported the results of their environmental evaluations at 510 workplaces in 1985 (roofing materials, asbestos cement sheets, friction materials, construction materials) and 430 workplaces in 1992. The percentage of workplaces in which exposure concentrations were less than 0.3 f/ml was 70% in 1985 and 98% in 1992.” (pg 68) |
| Particle size characterization: | ”Most airborne chrysotile fibres are considered respirable because their fibre diameters are less than 3 micron, equal to an aerodynamic diameter of about 10 micron. ” (pg 27) |
| Comments: | IPCS Environmental Health Criteria assessment for chrysotile asbestos |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | Medium | Assessment uses high quality data that are not from frequently-used sources and there are no known quality issues. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Includes data from the U.S. |
| | Metric 3: | Applicability | High | Data are for manufacture and maintenance of asbestos-containing products in the construction and automotive industries, which are in-scope occupational scenarios. |
| | Metric 4: | Temporal Representativeness | Low | Assessment is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: | Sample Size | Medium | Sample distribution characterized by limited statistics (including ranges, number of samples below certain thresholds, etc) but discrete samples not provided and distribution not fully characterized. |

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| | |
|---|---|
| **Study Citation:** | Gibbs, G., Pigg, B. J., Nicholson, W. J., Morgan, A., Lippmann, M., Davis, J. M. G., Mossman, B. T., Mcdonald, J. C., Landrigan, P. J., Nicholson, W. J., Schreier, H. (1998). Task group on Environmental health criteria for chrysotile asbestos meeting, Geneva, Switzerland, 1-6 July 1996. Environmental Health Criteria 203:III-197. |
| **HERO ID:** | 7482318 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

| | | **EVALUATION** | |
|---|---|---|---|
| Domain | Metric | Rating | Comments |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Medium | Methods, results, and assumptions are clearly documented, but underlying data sources are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Medium | Variability addressed by temporal changes and concentrations across various countries and tasks, but uncertainty is not addressed. |

## Overall Quality Determination — Medium

| | |
|---|---|
| **Study Citation:** | Gibbs, G., Pigg, B. J., Nicholson, W. J., Morgan, A., Lippmann, M., Davis, J. M. G., Mossman, B. T., Mcdonald, J. C., Landrigan, P. J., Nicholson, W. J., Schreier, H. (1998). Task group on Environmental health criteria for chrysotile asbestos meeting, Geneva, Switzerland, 1-6 July 1996. Environmental Health Criteria 203:III-197. |
| **HERO ID:** | 7482318 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Furnishing, Cleaning, Treatment Care Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Activities for asbestos-containing textiles included fiber preparation, carding, spinning, twisting, winding, and weaving (pg 60) |
| Area sampling data: | "In asbestos textile manufacture in Japan, mean concentrations were between 2.6 and 12.8 f/ml in the period between 1970 and 1975, and 0.1-0.2 f/ml in the period between 1984 and 1986"(pg 25)Exposure data provided for textile production; concentrations shown to be around 7.5 fibers/mL or less by 1971 (pg 56-61) |
| Particle size characterization: | "Most airborne chrysotile fibres are considered respirable because their fibre diameters are less than 3 micron, equal to an aerodynamic diameter of about 10 micron. " (pg 27) |
| Engineering control: | Shows exposure concentrations in chrysotile fiber textile plant in areas with and without controls for comparison; noticeable reductions in fiber concentrations seen (pg 60) |
| Comments: | IPCS Environmental Health Criteria assessment for chrysotile asbestos |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Methodology | Medium | Assessment uses high quality data that are not from frequently-used sources and there are no known quality issues. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | High | Includes data from the U.S. |
| | Metric 3: Applicability | High | Data are for manufacture of asbestos-containing textile products, an in-scope occupational scenario. |
| | Metric 4: Temporal Representativeness | Low | Assessment is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: Sample Size | Medium | Sample distribution characterized by limited statistics (including ranges, means, etc) but discrete samples not provided and distribution not fully characterized. |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | Medium | Methods, results, and assumptions are clearly documented, but underlying data sources are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Medium | Variability addressed by temporal changes and concentrations across various sites and tasks, but uncertainty is not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Gunter, B. J. (1978). Health hazard evaluation report no. HHE 78-128-549, Nixon Power Plant, Colorodo Springs, Colorado. |
| **HERO ID:** | 3970523 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Personal sampling data: | Plumber: 0.02-0.06 (fibers/cm^3) [PDF PG. 5] |
| Area sampling data: | General room samples: 0.03-0.187 (fibers/cm^3) [PDF Pg. 5] |
| Exposure duration: | 2 hours [PDF PG. 4] |
| Comments: | See table 1. Samples were collected on open face AA filters and were analyzed according to NIOSH method P&CAM #239 utilizing phase contrast microscopy. [PDF Pg. 2] |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | Assessment uses high quality data/techniques/methods from frequently-used sources. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for Chemical Substances in Construction, Paint, Electrical, and Metal Products, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Assessment is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | High | Uncertainty is addressed by sampling method. Variability addressed by sampling areas an personal breathing zones. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Hirsch, A., Di Menza, L., Carre, A., Harf, A., Perdrizet, S., Cooreman, J., Bignon, J. (1979). ASBESTOS RISK AMONG FULL-TIME WORKERS IN AN ELECTRICITY GENERATING POWER STATION. Annals of the New York Academy of Sciences 330(ED.):NEW YORK. |
| **HERO ID:** | 2731346 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | lagging operations, particularly during the dismantling and stripping of old lagging material; asbestos insulation (p. 1) |
| Exposure route: | inhalation (p.1) |
| Area sampling data: | 0.1-6000 x10-9 g/m3 chrysotile (power plant) 1 x10-9 g/m3 chrysotile (automobile factory) ND-90 x10-9 g/m3 amphibole (power plant)ND amphibole (automobile factory) (p. 7) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | The assessment or report uses high quality data and/or techniques or sound methods that are from a frequently used source (journal article), and associated information does not indicate flaws or quality issues. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Medium | The data are from France, an OECD country other than the U.S., and locality-specific factors (e.g., potential differences in regulatory occupational exposure or emission limits, industry/ processtechnologies) may impact exposures or releases relative to the U.S. |
| | Metric 3: | Applicability | Medium | The assessment is for lagging related to asbestos-containing materials, an occupational scenario that is similar to an occupational scenario within the scope of the risk evaluation, in terms of the type of industry, operations, and work activities. |
| | Metric 4: | Temporal Representativeness | Low | The completed exposure or risk assessment is more than 20 years old. The assessment captures materials, operations, equipment, and worker activities that are expected to be outdated. |
| | Metric 5: | Sample Size | Medium | Distribution of samples is characterized by a range with uncertain statistics. It is unclear if analysis is representative. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | Assessment or report clearly documents its data sources, assessment methods, results, and assumptions |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | Variability was addressed by sampling in various locations, and only limited discussion of uncertainty in air results. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Irving, K. F., Alexander, R. G., Bavley, H. (1980). ASBESTOS EXPOSURES IN MASSACHUSETTS PUBLIC-SCHOOLS. American Industrial Hygiene Association Journal 41(4):270-276. |
| **HERO ID:** | 3582560 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Area sampling data: | Most of the air sampling results were below the Commission's predetermined background level of 0.04 fibers per cc. However, fiber concentrations were elevated at four schools with counts ranging from 0.06 to 0.16 fibers per cc. [PDF Pg. 6] |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Methodology | High | Assessment uses high quality data/techniques/methods from frequently-used sources. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | High | Data are from the U.S. |
| | Metric 3: Applicability | High | Data are for Chemical Substances in Construction, Paint, Electrical, and Metal Products, an in-scope occupational scenario. |
| | Metric 4: Temporal Representativeness | Low | Assessment is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: Sample Size | Low | Sample distribution is characterized by no statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Medium | Uncertainty is addressed by a discussion on method limitations. Variability is not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Lee, R. J., Van Orden, D. R. (2008). Airborne asbestos in buildings. Regulatory Toxicology and Pharmacology 50(2):218-225. |
| **HERO ID:** | 2604527 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Physical form: | Asbestos having a length of at least 0.5um and at least 5 times the width (p. 3) |
| Area sampling data: | 120 Commercial buildings, 746 samples, 0.00190-0.00371 structure/ml, 0.00126-0.00239 s/ml, 2.47-14.07 ng/m3See Table 1, pg. 3/8 (other data sets provided, residential, school, etc) |
| Particle size characterization: | Asbestos having a length of at least 0.5um and at least 5 times the width (p. 3) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | The assessment or report uses high quality data and/or techniques or sound methods that are from a frequently used source (e.g., European Union or OECD reports, NIOSH HHEs, journalarticles, Kirk-Othmer) and are generally accepted by the scientific community, and associated information does not indicate flaws or quality issues. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | The data are from the United States and includes commercial buildings. |
| | Metric 3: | Applicability | Medium | The assessment is for commercial buildings with likely similarity to an occupational scenario within the scope of the risk evaluation, in terms of the type of industry, operations, and work activities. |
| | Metric 4: | Temporal Representativeness | Medium | The assessment captures operations, equipment, and worker activities that are expected to be reasonably representative of current conditions. The completed exposure or risk assessment is generally, more than 10 years but no more than 20 years old. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized. Sample size is sufficiently representative. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | Assessment or report clearly documents its data sources, assessment methods, results, and assumptions. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | High | The assessment addresses variability and uncertainty in the results. Uncertainty is well characterized. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Longo, W. E., Egeland, W. B., Hatfield, R. L., Newton, L. R. (2002). Fiber release during the removal of asbestos-containing gaskets: a work practice simulation. Applied Occupational and Environmental Hygiene 17(1):55-62. |
| **HERO ID:** | 3080516 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Removal of asbestos-containing sheet gaskets from steamflanges. |
| Physical form: | Fiber |
| Personal sampling data: | Study 1. Scraping and hand wire brushing: small flanges. PCM airborne exposure levels (fibers greater than 5 micrometers). The worker in Study 1 had a peak exposure level of 10.1 fibers per cubic centimeter (f/cc) and an 8-hour TWA exposure of 1.5 f/cc. (P. 4/9) TEM airborne exposure levels (asbestos fibers greater than 5 micrometers): range = 29.9 - 144.2 (f/cc) Study 2. Scraping and hand wire brushing: large flanges. PCM airborne exposure levels (fibers greater than 5 micrometers)The worker in this study had a peak exposure level of 24.0 f/cc and an 8-hour TWA of 3.6 f/cc.Study 3. Power wire brushing. PCM airborne exposure levels(fibers greater than 5 micrometers)The peak exposure level found while power wire brushing was 31.0 f/cc and the calculated 8-hour TWA was 2.3 f/cc. (P. 5/9) |
| Area sampling data: | Study 2: PCM- 2.1–8.4 fibers/cc TEM- 3.3–108.8 fibers/ccstudy 3: PCM - 7.6–15.7 fibers/cc TEM- 56.9–801.9 fibers/cc |
| Personal protective equipment: | A HEPA vacuum cleaner and wetting agents should be used, and The worker should wear a respirator appropriate for the airborne asbestos concentrations generated by the activities. (P. 8/9) |
| Engineering control: | A negative pressure enclosure should be used.The enclosure should have a HEPA filtering/air blower system. (P. 8/9) |
| Comments: | All PCM and TEM data in the tables are expressed for comparison purposes as fibers per cubic centimeter (f/cc) greater than 5.0 micrometers in length.Please check tables for more information. |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Methodology | High | The assessment or report uses high quality data and/or techniques or sound methods. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | The data are from the United States. |
| Metric 3: | Applicability | High | The assessment is for an occupational scenario within the scope of the risk evaluation. |
| Metric 4: | Temporal Representativeness | Low | More than 20 years old data. |
| Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized. Sample size is sufficiently representative. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | High | Assessment or report clearly documents its data sources, assessment methods, results, and assumptions. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | High | The assessment addresses variability and uncertainty in the results. Uncertainty is well characterized. |

## Overall Quality Determination High

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| | |
|---|---|
| **Study Citation:** | Longo, W. E., Egeland, W. B., Hatfield, R. L., Newton, L. R. (2002). Fiber release during the removal of asbestos-containing gaskets: a work practice simulation. Applied Occupational and Environmental Hygiene 17(1):55-62. |
| **HERO ID:** | 3080516 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|

| | |
|---|---|
| **Study Citation:** | Matrat, M., Pairon, J. C., Paolillo, A. G., Joly, N., Iwatsubo, Y., Orlowski, E., Letourneux, M., Ameille, J. (2004). Asbestos exposure and radiological abnormalities among maintenance and custodian workers in buildings with friable asbestos-containing materials. International Archives of Occupational and Environmental Health 77(5):307-312. |
| **HERO ID:** | 3080192 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Furnishing, Cleaning, Treatment Care Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | asbestos exposure to custodian and maintenance workers in buildings with friable asbestos-containing materials (ACMs). |
| Area sampling data: | Table 1 Estimated intensity of asbestos exposure for elementary tasks recorded in the questionnaireTask Estimated intensity of exposure (in f/ml)Dry sweeping after intervention on ACMs 10Intervention on friable-asbestos heat-insulators, drilling of friable ACMs 5Performing any of the following tasks close to asbestos flock: repair or maintenanceof air-conditioning ventilation, heating device; setting-up or maintenance of electricaldevice; setting up of doors or windows; cable pulling; plumbing; painting 1 Dry sweeping of building having uncovered asbestos flock 0.5Use of asbestos protection for welding 0.1 |
| Number of workers: | 277 custodian and maintenance employees working in buildings with friable asbestos-containing materials |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Methodology | High | The assessment or report uses high quality data and/or techniques or sound methods. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | The data are from the United States |
| Metric 3: | Applicability | High | The assessment is for an occupational scenario within the scope of the risk evaluation. |
| Metric 4: | Temporal Representativeness | Medium | more than 10 years but no more than 20 years old. |
| Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Medium | Assessment or report clearly documents results, methods, and assumptions. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | High | The assessment addresses variability and uncertainty in the results. Uncertainty is well characterized |

## Overall Quality Determination — High

| | |
|---|---|
| **Study Citation:** | Neitzel, R. L., Sayler, S. K., Demond, A. H., D'Arcy, H., Garabrant, D. H., Franzblau, A. (2020). Measurement of asbestos emissions associated with demolition of abandoned residential dwellings. Science of the Total Environment 722:37891-37891. |
| **HERO ID:** | 6865897 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Demolition of Abandoned Residential Dwellings |
| Exposure route: | inhalation |
| Physical form: | Fiber |
| Area sampling data: | concentration of 0.0075 fibers/cc or greater.The LODs for the samples taken in this study were 0.00038 to 0.5 fibers/cc for PCM and 0.000086 to 0.013 fibers/cc for TEM. (P. 6/21) |
| Comments: | Table 2. |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Methodology | High | The assessment or report uses high quality data and/or techniques or sound methods that are from a frequently used source (NIOSH). |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | The data are from the United States. |
| Metric 3: | Applicability | High | The assessment is for an occupational scenario within the scope of the risk evaluation. |
| Metric 4: | Temporal Representativeness | High | less than 10 years old. |
| Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | High | Assessment or report clearly documents its data sources, assessment methods, results, and assumptions |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | High | The assessment addresses variability and uncertainty in the results. |

## Overall Quality Determination — High

| | |
|---|---|
| **Study Citation:** | NIOSH, (1983). Health hazard evaluation report: HETA-82-96-1259. Kaiser Aluminum and Chemical Corporation, Ravenswood, West Virginia. NIOSH:19831983. |
| **HERO ID:** | 2068882 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Furnace operator [PDF Pg. 29] |
| Physical form: | Solid (dust) [PDF Pg. 18] |
| Personal sampling data: | Furnace operator: 0.004 fibers/cm^3[PDF Pg. 29] |
| Area sampling data: | Entry, horizontal heat treat furnace: 0.015 fibers/cm^3Exit end, prior to water quench: 0.031 fibers/cm^3[PDF Pg. 29] |
| Particle size characterization: | The asbestos fibers were present in dimensions of less than five micrometers long and approximately one to two micrometers (um) wide. [PDF Pg. 14] |
| Number of workers: | 1418 hourly employees [PDF Pg. 4]. |
| Comments: | Analysis done with PCM method. No engineering controls were given for asbestos. |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Methodology | High | Assessment uses high quality data/techniques/methods from frequently-used sources. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | Data are from the U.S. |
| Metric 3: | Applicability | High | Data are for building and construction materials, an in-scope occupational scenario. |
| Metric 4: | Temporal Representativeness | Low | Assessment is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | High | Uncertainty is addressed by sampling methods. Variability addressed by sampling multiple areas and taking a personal sample. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Paustenbach, D. J., Madl, A. K., Donovan, E., Clark, K., Fehling, K., Lee, T. C. (2006). Chrysotile asbestos exposure associated with removal of automobile exhaust systems (ca. 1945-1975) by mechanics: results of a simulation study. Journal of Exposure Science and Environmental Epidemiology 16(2):156-171. |
| **HERO ID:** | 3531296 |
| **Conditions of Use:** | Consumer Uses-Chemical Substances in Automotive, Fuel, Agriculture, Outdoor Use Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Automobile exhaust repair and custom work for current, as well asvintage automobiles. All work was performed by either oftwo mechanics who were employed by the muffler shop andwho had at least 5 to 16 years of experience. |
| Exposure route: | inhalation |
| Physical form: | fibers |
| Personal sampling data: | Personal (Mechanic) PCM = Range: 0.006-0.066 (f/cc), Average: 0.022 (f/cc) TEM = Range: 0.0005-0.105 (f/cc), Average: 0.013 (f/cc) PCMadj = Range: 0.002-0.04 (f/cc), Average: 0.018 (f/cc)(P. 8/16) Table 2 |
| Area sampling data: | Airborne asbestos concentrations (f/cc) for mechanics and bystanders during removal of automobile exhaust systems containing asbestos gaskets.Bystander Average: 0.012 f/cc (PCM), 0.004 f/cc (TEM), 0.008 f/cc (PCMadj) Remote (Indoor) Average: 0.005 f/cc (PCM), 0.002 f/cc (TEM), 0.003 f/cc (PCMadj) Background (Indoor) Average: 0.008 f/cc (PCM), 0.0004 f/cc (TEM), 0.022 f/cc (PCMadj) Ambient (Outdoor) Average: 0.003 f/cc (PCM), 0.001 f/cc (TEM)(P. 8/16) Table 2 |
| Exposure duration: | 8 hr TWA |
| Personal protective equipment: | Neither mechanic wore respiratory protection in the past while working on older vehicles, nor did they choose to wear respiratory protection while performing the work outlined in this study. |
| Comments: | See details in Table 2. Airborne asbestos concentrations (f/cc) for mechanics and bystanders during removal of automobile exhaust systems containing asbestos gaskets. |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Methodology | High | The assessment or report uses high quality data and/or techniques or sound methods. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | The study was conducted at a muffler shop in Santa Rosa,CA, USA. |
| Metric 3: | Applicability | High | The assessment is for an occupational scenario within the scope of the risk evaluation. |
| Metric 4: | Temporal Representativeness | Medium | More than 10 years but no more than 20 years old. |
| Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized. Sample size is sufficiently representative. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | High | Assessment or report clearly documents its data sources, assessment methods, results, and assumptions |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | High | The assessment addresses variability and uncertainty in the results. Uncertainty is well characterized. |

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| | |
|---|---|
| **Study Citation:** | Paustenbach, D. J., Madl, A. K., Donovan, E., Clark, K., Fehling, K., Lee, T. C. (2006). Chrysotile asbestos exposure associated with removal of automobile exhaust systems (ca. 1945-1975) by mechanics: results of a simulation study. Journal of Exposure Science and Environmental Epidemiology 16(2):156-171. |
| **HERO ID:** | 3531296 |
| **Conditions of Use:** | Consumer Uses-Chemical Substances in Automotive, Fuel, Agriculture, Outdoor Use Products |

| | | **EVALUATION** | |
|---|---|---|---|
| Domain | Metric | Rating | Comments |
| **Overall Quality Determination** | | **High** | |

| | |
|---|---|
| **Study Citation:** | Reed, L. D. (1985). Health hazard evaluation report no. HETA 84-321-1590, Asbestos Shingle Tear-Off, Rockford, Illinois. |
| **HERO ID:** | 3970496 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Manual tear-off of an old asbestos shingle roof from-a large residential building. Applying a new asphalt-shingle roof to adjacent and previously cleared portions of the building. [PDF Pg. 4] |
| Exposure route: | Inhalation (assumed from personal breathing one sampling). |
| Physical form: | Solid Fibers. |
| Personal sampling data: | Sample results in fibers/cm^3 [PDF Pg. 10]Tear-off #1: <0.04-0.16 (PCM)Tear-off #2: 0.11-0.14 (PCM); 0.75-1.12 (TEM)Tear-off #3: <0.04-<0.08 (PCM)Tear-off #4: 0.06-0.09 (PCM)Tear-off #5: 0.08-0.11 (PCM)New Shingle #1: 0.03 (PCM)New Shingle #2: 0.03 (PCM)New Shingle #3: 0.07 (PCM); 0.32 (TEM)New Shingle #4: 0.04 (PCM)New Shingle #5: 0.08 (PCM); 0.37 (TEM)Asbestos Clean-up #1: 0.13 (PCM)Asbestos Clean-up #2: 0.16 (PCM) |
| Area sampling data: | Sample results in fibers/cm^3 [PDF Pg. 10]Area #1: 0.05 (PCM); 0.51 (TEM)Area #2: 0.14 (PCM); 0.74 (TEM)Area #3: <0.02 (PCM)Area #4: <0.02 (PCM) |
| Exposure duration: | 3-hour procedure [PDF Pg. 4] |
| Number of workers: | 7 workers performed the tear-off [PDF Pg. 4] |
| Personal protective equipment: | Half-face respirators with high-efficiency particulate filters were worn by all members of the tear-off and clean-up crews. [PDF Pg. 3] |
| Comments: | Samples collected according to NIOSH Method P&CAM 239 utilizing phase contrast microscopy (PCM). Six of the samples were further analyzed with TEM. Particle size not given, just the particle size limits of the PCM method. No engineering controls given. |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Methodology | High | Assessment uses high quality data/techniques/methods from frequently-used sources. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | Data are from the U.S. |
| Metric 3: | Applicability | High | The assessment is for an occupational scenario within the scope of the risk evaluation. |
| Metric 4: | Temporal Representativeness | Low | Assessment is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | High | Uncertainty is addressed by sampling methods. Variability addressed by multiple personal and area samples. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | U.S. EPA, (2004). Additives in plastics processing (compounding) – Generic scenario for estimating occupational exposures and environmental release – Draft. |
| **HERO ID:** | 6311218 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Products not Described by Other Codes |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Unloading and charging additives to process, container cleaning, equipment cleaning, and compounding processes |
| Exposure route: | dermal and inhalation |
| Personal sampling data: | ”dermal: Provides methods for modeling exposures to both solids and non-volatile liquids Inhalation: Provides methods for modeling exposures to both solids and volatile liquids” |
| Exposure frequency: | 250 days/yr |
| Number of workers: | 24 workers/site |
| Engineering control: | Forced ventilation |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Methodology | High | Assessment uses high quality data/techniques/methods from frequently-used sources. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | High | This GS is based on U.S. data |
| | Metric 3: Applicability | Uninformative | Plastic processing is not in-scope for the legacy asbestos risk evaluation. |
| | Metric 4: Temporal Representativeness | Medium | Assessment is generally based on data greater than 10 years old but no more than 20 years old and industry conditions that are expected to be representative of current industry conditions. |
| | Metric 5: Sample Size | Low | Model results characterized by no statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Medium | Uncertainty not addressed. Variability addressed by considering multiple plastic types, additive types, and worker activities. |

## Overall Quality Determination Uninformative

| | |
|---|---|
| **Study Citation:** | Wages, R.,obert, Markowitz, S.,teven, Kieding, S.,ylvia, Griffon, M.,ark, Ellenbecker, M.,ichael (1998). Former worker medical surveillance program at Idaho National Engineering and Environmental Laboratory (INEEL) Phase I: Needs assessment. |
| **HERO ID:** | 3974967 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Worker job titles: decontamination technicians, instrument technicians, insulators, mechanics, pipe fitters, and operators (p. 15) |
| Personal protective equipment: | asbestos blankets and asbestos gloves used to protectagainst heat while working on production equipment |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | Medium | The assessment or report uses high quality data and/or techniques or sound methods that are not from a frequently used source, and associated information does not indicate flaws or quality issues. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | The data are from the United States and are representative of the industry being evaluated. |
| | Metric 3: | Applicability | Medium | The assessment included mention of some in-scope CoU's (work with asbestos in-place materials), but data was qualitative and included information on out of scope uses (brake work) |
| | Metric 4: | Temporal Representativeness | Low | The completed exposure or risk assessment is more than 20 years old. The assessment captures operations, equipment, and worker activities that are expected to be outdated. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized. Sample size is sufficiently representative. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | Assessment or report clearly documents its data sources, assessment methods, results, andassumptions |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | The assessment provides limited discussion of the variability and uncertainty in the results. |

## Overall Quality Determination Medium

**Study Citation:** Anonymous, (2013). Compaction in nuclear asbestos removal. Nuclear Engineering International 58(708):37.
**HERO ID:** 6881650
**Conditions of Use:** Other:

**EXTRACTION**

| Parameter | Data |
|---|---|
| Engineering control: | 750 HEPA filters were used for filtration during removal. (1/3) During companion of the waste, the compactor was placed in a full enclosure with a three-stage air lock with HEPA filters. (2/3) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | Medium | Report uses high quality data that are not from frequently-used sources and there are no known quality issues. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Medium | Data are from the U.K., an OECD country. |
| | Metric 3: | Applicability | High | Data are for demolition of asbestos products, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | High | Report is based on current industry conditions and data no more than 10 years old. |
| | Metric 5: | Sample Size | N/A | N/A - This metric is not applicable to the data being extracted |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Low | Assessment results are provided but underlying methods, assumptions, and data sources are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Anonymous, (1996). Positive action with glove bags can eliminate negative-pressure needs. Power Engineering 100(5):50. |
| **HERO ID:** | 6903616 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Maintenance operations or removal of asbestos from pipes, elbows, and other connections. |
| Personal protective equipment: | Workers must use respiratory protection. |
| Engineering control: | OSHA regulations for glove bags: bag must cover section of pipe or structure being worked on; loose or friable material adjacent to the glove bag must be wrapped and sealed in two layers of plastic or otherwise rendered intact; each glove bag may only be used once. Cleanup performed by at least two workers. Cleanup: Glove bags are collapsed with a HEPA filter vacuum and waste is placed in leak-tight containers. |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | Medium | The assessment or report uses high quality data and/or techniques or sound methods that are not from a frequently used source and associated information does not indicate flaws or quality issues. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | The data are from the United States and are representative of the industry being evaluated. |
| | Metric 3: | Applicability | High | The report is for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Low | The report is more than 20 years old. |
| | Metric 5: | Sample Size | N/A | Information from this report is not based on sampling. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Low | Assessment or report provides results, but the underlying methods, data sources, and assumptions are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | N/A | No scope to address variability and uncertainty. |

## Overall Quality Determination Medium

**Study Citation:** Anonymous, (2009). Asbestosis-related disease continues to take lives. Safety Compliance Letter (2497):13.
**HERO ID:** 6907372
**Conditions of Use:** Other:

**EXTRACTION**

| Parameter | Data |
|---|---|
| Number of workers: | "An estimated 1.3 million construction and generalindustry workers in the United States potentially are exposed to asbestos each year, mainly from manipulation of asbestos during renovation or demolition activities. (1/2)" |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | Low | Report does not specify the data used. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for workers in all industrial uses of asbestos, which is in-scope. |
| | Metric 4: | Temporal Representativeness | Medium | Report is based on data greater than 10 years old but no more than 20 years old and industry conditions that are expected to be representative of current industry conditions. |
| | Metric 5: | Sample Size | Medium | Sample distribution characterized by limited statistics (number of workers) but discrete samples not provided and distribution not fully characterized. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Low | Assessment results are provided but underlying methods, assumptions, and data sources are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Medium

**Study Citation:** Anonymous, (2008). New larger D-Con unit. HazMat Management 20(2):34.
**HERO ID:** 6908195
**Conditions of Use:** Other:

**EXTRACTION**

| Parameter | Data |
|---|---|
| Worker activity description: | Demolition and asbestos abatement workers. (1/2) |
| Engineering control: | One company has introduced a new asbestos decontamination unit. The unit is a safe enclosure space that offers three-ply plastic construction border with fire retardant film, triple flap entrances and exits, and PVC poles that lock in place. Reinforced floors and ceilings enhance the stability of the unit. The new three-stage 4x4 can be setup in 15 minutes without the need for any tools. (1/2) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | Medium | Report uses high quality data that are not from frequently-used sources and there are no known quality issues. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for demolition of asbestos products, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Medium | Report contains data that is older than 20 years old and data that is less than 20 years old, but no data is less than 10 years old. |
| | Metric 5: | Sample Size | N/A | N/A - This metric is not applicable to the data being extracted |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Anonymous, (1990). Asbestos in the workplace: Employers beware. Canadian Occupational Safety 28(6):6, 9. |
| **HERO ID:** | 6909384 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Sources of exposure include fire-proofing materials, insulation, and floor tiles/wallboards. (1/2) |
| Physical form: | fibers (1/2) |
| Engineering control: | Options to control asbestos material at a facility include management, encapsulation, and enclosure. (1/2) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | Low | Report does not specify the data used. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Medium | Data are from Canada, an OECD country. |
| | Metric 3: | Applicability | High | Data are for managing asbestos in commercial construction materials, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: | Sample Size | N/A | N/A - This metric is not applicable to the data being extracted |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Low | Assessment results are provided but underlying methods, assumptions, and data sources are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Low

| | |
|---|---|
| **Study Citation:** | Anonymous, (1989). Reducing asbestos risk. Construction and Building Materials 3(2):108. |
| **HERO ID:** | 6910689 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Workers replacing or fitting insulation on steam and process lines. (1/1) |
| Engineering control: | The older type of asbestos materials have in some cases been replaced with asbestos-free calcium silicate pipes and blocks. In addition, a company has come up with a process to impregnate the asbestos-free material with a blue dye so that they are easily differentiable.(1/1) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Methodology | Low | The data, data sources, and/or techniques or methods used in the assessment or report are not specified. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | High | The data are from the United States. |
| | Metric 3: Applicability | High | The report is for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: Temporal Representativeness | Low | The report is more than 20 years old. |
| | Metric 5: Sample Size | N/A | N/A - This metric is not applicable to the data being extracted |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | Low | Assessment or report provides results, but the underlying methods, data sources, and assumptions are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | N/A | N/A - This metric is not applicable to the data being extracted |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | ATSDR, (2010). Health consultation: Former Arizona tanning company site (aka Santan Tannery): Santan Industrial Park, district 4, Gila River Indian Community Pinal County, Arizona: EPA facility ID: AZD074441676. |
| **HERO ID:** | 3970376 |
| **Conditions of Use:** | Disposal |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Exposure route: | inhalation |
| Physical form: | ”Due to the fire which took place in 2009, building materials are now in a highly friable state which facilitates the release of airborne asbestos fibers” (pg 18) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | Report uses high quality data and information from frequently-used sources. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for demolition of structures with asbestos-containing materials, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Medium | Report is based on data greater than 10 years old but no more than 20 years old and industry conditions that are expected to be representative of current industry conditions. |
| | Metric 5: | Sample Size | N/A | N/A - This metric is not applicable to the data being extracted |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Low | Assessment results are provided but underlying methods, assumptions, and data sources are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Baldwin, C. A., Beaulieu, H. J., Buchan, R. M., Johnson, H. H. (1982). Asbestos in Colorado schools. Public Health Reports 97(4):325-331. |
| **HERO ID:** | 3615183 |
| **Conditions of Use:** | Consumer Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Teachers, students, and other school employees. (2/7) |
| Exposure route: | inhalation (2/7) |
| Physical form: | fibers (1/7) |
| Engineering control: | Four asbestos control approaches are removal, encapsulation, enclosure, and periodic inspection. (2/7) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Methodology | High | Report uses high quality methods and data from frequently-used sources. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | High | Data are from the U.S. |
| | Metric 3: Applicability | Uninformative | Data are for general inhalation exposure in schools, which isn't in scope. |
| | Metric 4: Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: Sample Size | Low | Distribution of samples is qualitative or characterized by no statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Medium | Variability is addressed by comparing sampling results to literature. Uncertainty isn't addressed. |

## Overall Quality Determination Uninformative

| | |
|---|---|
| **Study Citation:** | Balmes, J. R., Daponte, A., Cone, J. E. (1991). Asbestos-related disease in custodial and building maintenance workers from a large municipal school district. Annals of the New York Academy of Sciences 643(1):540-549. |
| **HERO ID:** | 3082254 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Area sampling data: | Custodial activity (e.g., sweeping and vacuuming) in an urban grammar school with an exposed ceiling containing 15% chrysotile was associated with a mean airborne asbestos concentration of 643 ng/m3, with a range of 186 to 1,100 mg/m3. (p. 1) |
| Number of workers: | The EPA has also estimated that approximately 23,000 janitorial and maintenance workers are potentially exposed to airborne asbestos in these schools. (p. 1)Primarily on the basis of job classification, the school district had determined by 1983 that approximately 900 of its employees had likely been exposed to asbestos dust while working for the district. (p. 2) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Methodology | High | The assessment uses data from a source citing EPA/OAQPS techniques and methods. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | Data are from the U.S. |
| Metric 3: | Applicability | High | Data are for existing asbestos in school construction, an in-scope occupational scenario. |
| Metric 4: | Temporal Representativeness | Low | Data are more than 20 years old. |
| Metric 5: | Sample Size | Medium | Sample distribution characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Low | Sample type and exposure type not provided. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Banks, A. J. (1991). Asbestos Removal in the Construction Industry. :76. |
| **HERO ID:** | 3102239 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Removal of asbestos and asbestos containing materials. |
| Engineering control: | A ventilation system should be installed to create a negative pressure within the enclosure with respect to the outside area. |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | Medium | Report uses high quality [data/techniques/methods] that are not from frequently-used sources and there are no known quality issues. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | The report is for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: | Sample Size | N/A | N/A - worker activity description and engineering control. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Methods, results, and assumptions are clearly documented, but underlying data sources are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | N/A | N/A - worker activity description and engineering control. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Bard, D., Burdett, G. (2007). Exposure of UK industrial plumbers to asbestos, Part II: Awareness and responses of plumbers to working with asbestos during a survey in parallel with personal sampling. Annals of Occupational Hygiene 51(2):113-119. |
| **HERO ID:** | 3079698 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Industrial plumbing (p. 2) |
| Exposure route: | Inhalation (p. 2) |
| Physical form: | >5 um asbestos structures (p. 4) |
| Personal sampling data: | Rounds 1 & 2 Concentration of PCME asbestos fibres (f ml-1) of workers with knowledge of work with asbestos: 0.05Rounds 1 & 2 Concentration of PCME asbestos fibres (f ml-1) of workers with no knowledge of work with asbestos: 0.06Rounds 1 & 2 Concentration of >5 um long asbestos structures (s ml-1) of workers with knowledge of work with asbestos: 0.39Rounds 1 & 2 Concentration of >5 um long asbestos structures (s ml-1) of workers with no knowledge of work with asbestos: 1.55 (p. 5) |
| Exposure duration: | Furthermore, most of the (90%) over the last year thought they did not work at all with asbestos (30%) or worked <10 h (60%). Only 10% of the plumbers answered 10-40 h and none of them ticked the box 40-100 h or >100 h. (p. 3) |
| Exposure frequency: | About half of the respondents (52%) thought they worked with ACM only once a year, 29% every 6 months and 14% once a month. (p. 3) |
| Number of workers: | In Round 1, a total of 96 passive samplers and questionnaires were sent out to plumbers, who had indicated they were willing to participate in the survey. In Rounds 1 and 2, 50 and 24 samplers with activity logs were returned along with 48 questionnaires completed in Round 1. (p. 2) |
| Personal protective equipment: | 20% mentioned overall or protective clothing, 20% gloves and 10% other personal protective equipment such as goggles or hat. Only 15% of them thought about wetting, which is an important control measure. Few thought about personal decontamination (7%) and similarly, keep disturbance to a minimum (5%), avoid breaking ACM (2%) or dispose of asbestos waste (5%)...Some plumbers answered 'ventilate the area' (7%). (p. 2-3) |

**EVALUATION**

| Domain | | Metric | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | The assessment or report uses high quality data and/or techniques or sound methods that are from frequently used sources. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Medium | The data are from an OECD country other than the U.S. |
| | Metric 3: | Applicability | High | The report is for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Medium | Survey results are between 10 and 20 years old. |
| | Metric 5: | Sample Size | Medium | Distribution of samples is characterized by a range with uncertain statistics. It is unclear if analysis is representative. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | Assessment or report clearly documents its data sources, assessment methods, results, and assumptions. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | The report provides only limited discussion of the variability and uncertainty in the results. |

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| | |
|---|---|
| **Study Citation:** | Bard, D., Burdett, G. (2007). Exposure of UK industrial plumbers to asbestos, Part II: Awareness and responses of plumbers to working with asbestos during a survey in parallel with personal sampling. Annals of Occupational Hygiene 51(2):113-119. |
| **HERO ID:** | 3079698 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

| | | EVALUATION | |
|---|---|---|---|
| Domain | Metric | Rating | Comments |
| **Overall Quality Determination** | | **High** | |

| | |
|---|---|
| **Study Citation:** | Beddows, N. A. (1990). Concerns about indoor air quality warrant review of HVAC systems. Occupational Health and Safety 59(5):77-81, 87. |
| **HERO ID:** | 3615220 |
| **Conditions of Use:** | Consumer Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Exposure route: | inhalation (2/5) |
| Physical form: | fibers (2/5) |
| Engineering control: | In usual operation of HVAC systems, general exhaust fans pull 5-10% of the indoor air to the outside, and outdoor ”make-up” air is brought in for ventilation. The mixed air passes through both a filter and the HVAC apparatus before distribution. Normally, circulating 15-20 cubic feet of outside air per minute per occupant will be adequate for odor control and respiratory needs. (1/5) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Methodology | High | Report uses high quality methods and data from frequently-used sources. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | High | Data are from the U.S. |
| | Metric 3: Applicability | Low | Data are for general exposure to asbestos in public and commercial buildings, which is similar to the in-scope occupational scenario commercial use of construction products. |
| | Metric 4: Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: Sample Size | Low | Distribution of samples is qualitative or characterized by no statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | Low | Assessment results are provided but underlying methods, assumptions, and data sources are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination — Low

| | |
|---|---|
| **Study Citation:** | Bonar, G. M., Leitch, P. A. (1991). In-house asbestos management: The goal is an asbestos-safe mill. Pulp and Paper Canada 92(12):131-133. |
| **HERO ID:** | 3584911 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Personal protective equipment: | During sampling all workers wear respirators, disposable coveralls(taped at sleeves and boots), safety glasses, hard hat and hearing protection. |
| Comments: | Mostly this article describes the sampling process, not the industrial process associated with the installation or removal of the asbestos. |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | Fist hand information was provided about PPE used in sampling |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Medium | Canada - OECD member |
| | Metric 3: | Applicability | Low | The report focuses on sampling activities related to occupational exposure, but no information was provided of the actual exposure to the workers. |
| | Metric 4: | Temporal Representativeness | Low | 1991 - more than 20 years old |
| | Metric 5: | Sample Size | N/A | Qualitative information was provided about PPE |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | Assessment or report clearly documents its data sources |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | N/A | Qualitative information was provided about PPE |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Bone, J. (1992). Custodial workers face asbestos hazards. Safety and Health 146(1):70-75. |
| **HERO ID:** | 6904976 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | 1.) Custodial and maintenance activities (changing a filter in a heat pump, or adjusts a mixer box that's part of the heating and ventilating system, changing light fixtures)2.) Small-scale, short duration tasks (e.g., replacing pipe valves)3.) Large scale, long duration tasks (e.g., removing asbestos or working on asbestos pipes, demolition and renovation operations) |
| Number of workers: | Racine Unified School District: 450 custodial, maintenance, engineering, food service, and office workers238 custodial and maintenance personnel (p. 7) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Methodology | Medium | The assessment or report uses high quality data and/or techniques or sound methods that are not from a frequently used source and associated information does not indicate flaws or quality issues. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | The data are from the United States. |
| Metric 3: | Applicability | Medium | The report is for an occupational scenario that is similar to an occupational scenario within the scope of the risk evaluation, in terms of the type of industry, operations, and work activities. |
| Metric 4: | Temporal Representativeness | Low | The report is more than 20 years old. |
| Metric 5: | Sample Size | N/A | n/a - no sampling data |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Medium | Assessment or report clearly documents results, methods, and assumptions. Data sources are generally described but not fully transparent. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Medium | The report provides only limited discussion of the variability and uncertainty in the results. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Boulanger, G., Andujar, P., Pairon, J. C., Billon-Galland, M. A., Dion, C., Dumortier, P., Brochard, P., Sobaszek, A., Bartsch, P., Paris, C., Jaurand, M. C. (2014). Quantification of short and long asbestos fibers to assess asbestos exposure: a review of fiber size toxicity. Environmental Health: A Global Access Science Source 13:59. |
| **HERO ID:** | 2536841 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Particle size characterization: | General Indoor Environment:Samples were collected during normal building occupancy and usage, in the roomswhere one ACM was present. Size comparison broken into two categories: Short Asbestos Fibers (SAF): L $<$ 5 $\mu$m, d $<$ 3 $\mu$m and L/d $>$ 3 and regulatory WHO fibers: L $\geq$ 5 $\mu$m, d $<$ 3 $\mu$m and L/d $>$ 3,sprayed asbestos (25 samples), 69.6% SAF, 30.4% WHOheat insulation (8 samples), 78.2% SAF, 21.8% WHOsuspended ceiling (25 samples), 87.0% SAF, 13.0% WHOfloor tiles (25 samples), 91.5% SAF, 8.5% WHOcoating (10 samples); 95.4% SAF, 4.6% WHOasbestos cement (12 samples). 96.3% SAF, 3.7% WHO(Figure 1, pg 3/18)Generic "Occupational Environment":98% of the 45,000 fibers counted (from 192 samples?) were chrysotile representing 7 industrial sectors: asphalt production, brake manufacturing, mining, textiles, ACM removal, recycling and asbestos cement production.The average and maximum concentrations were 16.3 and505.2 f.mL$-$1 respectively for SAF; 0.4 and 18.4 f.mL$-$1 forLAF with a diameter $<$ 0.2 $\mu$m, and 0.5 and 9.3 f.mL$-$1 forfibers with PCM measured dimensions (L $>$ 5; D $>$0.2 $\mu$m). There was little variation in the percentage ofSAF and LAF with a diameter $<$ 0.2 $\mu$m between thesesamples (from 87% to 96% and 2.1% to 5.6% respectively).(pg 3/18) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Methodology | Medium | Report uses high quality data and techniques that are not from frequently-used sources and there are no known quality issues. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | Medium | Data are from France, an OECD country. |
| | Metric 3: Applicability | Medium | Data are for Asbestos Containing Material Removal and ambient air concentrations, which is similar to the in-scope occupational scenario Industrial/Commercial USe Chemical Substances in Construction, Paint, Electrical, and Metal Products |
| | Metric 4: Temporal Representativeness | Medium | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: Sample Size | Low | Sample distribution is characterized by no statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | Low | Assessment results are provided but underlying methods, assumptions, and data sources are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Medium | Variability addressed by the box and whisker plots used to present the data but uncertainty is not addressed. |

## Overall Quality Determination — Low

| | |
|---|---|
| **Study Citation:** | Bragg, G. M. (1988). The basics of asbestos dust control. |
| **HERO ID:** | 6904663 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Personal protective equipment: | respirators and clothing (pg 13)above PEL: negative-pressure respirators fitted with replaceable filters; ”exceptionally high dust levels”: positive-pressure respirators which have air supplied by battery-powered pumps or other sources (pg 22)head covering and coverall (pg 23)disposal: respirators when bags are changed on dust collectors (pg 24) |
| Engineering control: | general asbestos controls: containment, wetting (in detail on pg 19-20), ventilation (pg 6)semi-automatic or remote-control (inconvenient and infrequently used); Dilution ventilation and general exhaust ventilation are usually ineffective and uneconomical uses of ventilation power; hoods/enclosures (pg 13)Housekeeping (e.g. vacuuming, wet floor cleaning) most important control method; more careful handling methods (pg 15)do NOT use compressed air or dry sweeping; use vacuum w/ HEPA filter or hose outlets from a central vacuum fan should be a high-pressure type producing suction pressures of at least 500 mm of water, central bag house. (pg 16)plastic bags, enclosure (e.g. hood), operator’s booth (pg 18)local exhaust system: exhaust hood with fabric filters, bag house, cyclones etc.; 99.995% efficiency for bag filters, fan (detailed discussion, including cleaning of filters and other maintenance, on pg 25-34)In scope:installation/maintenance/repair of ACM products: wetting techniques, hand tools or power tools equipped w/ dust collectors (pg 12; pg 36)construction/repair: do NOT use high speed power tools; Alternatives to high speed power tools are nibblers, rasps, files, shears, knives, hand drills, hand saws and special low speed tools producing large chips (pg 20)installation/removal of friction products (general, so still in scope): hand tools or specially equipped power tools, HEPA equipped vacuum, low pressure water spray; air hose, dry brush or rag should NOT be used. (pg 21) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Methodology | Medium | Report uses high quality data/techniques/methods that are not from frequently-used sources and there are no known quality issues. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | Medium | Data are from Canada, an OECD country. |
| | Metric 3: Applicability | High | Data are for construction materials, an in-scope occupational scenario. |
| | Metric 4: Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: Sample Size | N/A | Qualitative data without sampling. |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | Medium | Methods, results, and assumptions are clearly documented, but underlying data sources are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Medium | Variability is addressed by discussion of various of control technologies, but uncertainty is not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Burkhart, G., Schulte, P. A., Robinson, C., Sieber, W. K., Vossenas, P., Ringen, K. (1993). Job tasks, potential exposures, and health risks of laborers employed in the construction industry. American Journal of Industrial Medicine 24(4):413-425. |
| **HERO ID:** | 50488 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Aggregate weighmenAsbestos removalAsphalt kettlemenAsphalt saw operatorsAsphalt takersAsphalt tampersBatch dumpmen on leversBlade grade operators-Bottom men sewerBrick settersCarpenter tenderCarrying reinforcementCaulkers and yarnersCement dumpersCement handlersCenter steel menChain saw operatorChip spreadersCompressed air workersConcrete chippers andConcrete form strippersConcrete puddlersConcrete saw operatorCutters and burnersDebris cleaning andcleaningDeck hands on boatsDirt spottersDismantlersDrain and tile layersDrillersDynamite shootersExpansion jointsExplosive handlersFiber opticsrods-grindersFlagmenFlaremenForm liners and tampersForm oilersForm settersGas service menGravel box menGunnite nozzlemenGypsum handlersHandlingkonveyingcreosoteHandling creosoteHod carriersHoppermenHot tar and kettlemenHousemoversJackhammer manLaying of steel meshLead and leadite burnersMachine cleanersMason tenderMat weaverMixing asphalt emulsionMonorail track layerMortar menMotorized concreteMuckersPile driver tenderPipe wrappingmachine manPlasterers tendersPower tool operatorRip rap stone layerRiver underwater workRock dust handlersRod and chain manbuggymanRubbing of concreteSalamander heatSandblaster pot tenderSandblaster, nozzlemenSandblastingSawmen and trimmersScaffold menScaffold workServicing of allvibratorsShoring and bracingSignal manSkip menSlip form men onSmall boat motorizedStriking off concreteString menSwampers, crane,tractorTending all typesheatersTile & pipe layersTool room manTop manTrack layers, railroadTree trimmers/toppersTruck helpersTunnel & shaft minersUnskilled laborersWatchmen, guardsWater distributorsWindlass manWoods menWreckers-torch men |
| Exposure route: | Inhalation |
| Physical form: | airborne fibers |
| Number of workers: | 5 million workers employed in the construction and demolition of buildings, highways, sewers, utilities, pipelines, tunnels,shipyards, and power plants, i.e., the construction industry. 681,000 are laborers [North Carolina DOL, 19911. Approximately 340,000 manual construction laborers are active members in the Laborers International Union of North America (LIUNA), making it the largest union of construction laborers in the United States. Construction workers potentially exposed to asbestos = 14,457*Derived from the Job Exposure Matnx utilizing data from the NationalOccupational Exposure Survey conducted by NIOSH between 1981 and 1983 [NIOSH, 1988, 1990a, b]. Construction laborers were identified using code 869 [BOC, 19821 |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Methodology | High | A variety of NIOSH and state data are used in this assessment |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | US |
| Metric 3: | Applicability | High | The report is for an occupational scenario (construction work) within the scope of the risk evaluation. |
| Metric 4: | Temporal Representativeness | Low | 1993 - more than 20 years old |
| Metric 5: | Sample Size | Low | No summary statistics were provided |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | High | Assessment clearly documents its data sources, assessment methods, results, and assumptions. |
| Domain 4: Variability and Uncertainty | | | |

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| | |
|---|---|
| **Study Citation:** | Burkhart, G., Schulte, P. A., Robinson, C., Sieber, W. K., Vossenas, P., Ringen, K. (1993). Job tasks, potential exposures, and health risks of laborers employed in the construction industry. American Journal of Industrial Medicine 24(4):413-425. |
| **HERO ID:** | 50488 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| | Metric 7: | Metadata Completeness | Low | The report does not address variability or uncertainty. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Burr, G. A. (2003). Health hazard evaluation report no. HETA 2005-0369-3034, City of Cleveland Heights, Cleveland Heights, Ohio. |
| **HERO ID:** | 3970535 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Vehicle maintenance, small equipment repair, and vehicular body repair. [PDF Pg. 6] |
| Exposure route: | Inhalation |
| Physical form: | Fibers (solid) [PDF Pg. 8] |
| Number of workers: | [PDF Pg. 6]8 people work in vehicle maintenance, 1 person works in small equipment repair, 2-3 people work in vehicle body repair. |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Methodology | High | Report uses high quality data/techniques/methods from frequently-used sources. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | Data are from the U.S. |
| Metric 3: | Applicability | High | Data are for Chemical Substances in Construction, Paint, Electrical, and Metal Products, an in-scope occupational scenario. |
| Metric 4: | Temporal Representativeness | Medium | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| Metric 5: | Sample Size | Low | Distribution of samples is qualitative or characterized by no statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Low | The report does not address variability or uncertainty. |

## Overall Quality Determination Medium

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| | |
|---|---|
| **Study Citation:** | CalEPA, (1995). Asbestos demolition and renovation. |
| **HERO ID:** | 3981096 |
| **Conditions of Use:** | Disposal |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|

| | |
|---|---|
| **Study Citation:** | CalEPA, (1995). Asbestos demolition and renovation. |
| **HERO ID:** | 3981096 |
| **Conditions of Use:** | Disposal |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | The employer shall identify a competent person to set up the enclosure, ensure its integrity, limit entry and exit, supervise employee exposure monitoring, ensure that proper protective clothing and respirators are being worn, ensure employees are properly trained, ensure that employees use hygiene facilities and observe decontamination procedures, and ensure that engineering controls are functioning.The following procedures are recommended for entering and leaving a contaminated site:for entering and exiting sites:1. Before entering the contaminated area:- Make sure the respirator is operating properly.- Make sure you have all materials necessary to conduct the inspectionsafely (e.g., disposable towels, extra plastic bags, spray bottle, etc.). All materials that must be carried into the work areas should be sealed in a plastic bag to minimize contamination.-If you take a camera into the contaminated area, precautions must be taken to minimize contamination or to decontaminate the camera. Possible solutions include using a waterproof camera or sealing a conventional camera in an impermeable box. Both of these methods am used by scuba divers.- Leave all street clothing on. Short-sleeve shirts and short pants are preferable to long-sleeve shirts and long pants. If you am wearing long pants or long sleeves roll them up.- Don an inner disposable coverall and inner booties (e.g., Tyvep or equivalent) over street clothes.- If an SCBA is to be used, wear the SCBA with the air valve closed Let the respirator facepiece hang from the neck by the strap.- Don outer disposable coverall. Use coverall with an expandable back if an SCBA is used.- Don disposable outer boots and gloves. Use duct tape to attach the boots and gloves to the outer coverall.- Fit the respirator facepiece to the face and open the air valve for an SCBA, and tighten the facepiece straps. If an air-purifying respirator is used, conduct negative pressure and positive pressure field tests.- Fit the coverall hood snugly around the respirator facepiece.- zip up the suit.- Proceed to the contaminated area and make inspection.2. Before leaving the contaminated area:- Standing near the exit, HEPA vacuum (if possible) and wet wipe all visible debris from the outer protective clothing (use a spray bottle containing water and disposable towels to wet wipe the suit; use plenty of water). Standing at the doorway inside the work area, remove outer protective clothing and immediately step outside the area.3. Outside the contaminated area:- Once outside, thoroughly wet wipe and mist spray the respirator and inner protective clothing. Move away from the doorway and remove the respirator and inner protective clothing.- Place all disposable materials in a proper container for disposable.- Seal all contaminated non-disposable materials in a plastic bagand take them with you to decontaminate later.Procedures for entering and leaving a site where a 3-stage decontamination system is available:1. Prior to entering he clean room - Determine that the respirator is functioning properly.- Make sure you have all materials necessary to conduct theinspection safely (e.g., duct tape, disposable towels, protectiveclothing, respirator, extra plastic bags, spray bottle, etc. ). Allmaterials that must be carried into the contaminated areashould be sealed in a plastic bag to minimize contamination.- If you take a camera into the contaminated area, precautionsmust be taken to minimize contamination or to decontaminatethe camera. Possible solutions include using a waterproofcamera or sealing a conventional camera in an impermeableclear camera box. Both of these methods are used by scubadivers2. In the Clean Room:- Remove all street clothing including socks and underwear andstore in a clean, sealed plastic bag. If desired, wear a bathingsuit (or equivalent) and inner booties. You may prefer to havethe bathing suit on before going to the site.- If an SCBA is being used, close the air valve and don theSCBA, let the respirator facepiece hang from the neck by thestrap.- Don disposable full body, hooded coverall. Use a coverallwith an expandable back if an SCBA is being used.- Don disposable outer boots and gloves. Use duct tape to sealto outer suit.- Fit respirator facepiece to face. For an air purifying respirator,perform negative and positive pressure field checks. For anSCBA, open the air valve and adjust facepiece straps.- Fit the coverall hood snugly around the respirator facepieceand sip up coverall if not yet done.- Emceed to the shower area.3. In the Shower Area:- Leave disposable towels (sealed in a plastic bag) near theshower.- Proceed to the contaminated area and make inspection.4. Before leaving the contaminated area- HEPA vacuum (if possible) and wet wipe all visible debrisfrom protective clothing (use a spray bottle and disposabletowels to wipe the suit). Proceed to the equipment room.5. In the Equipment Room:- Seal all contaminated non-disposable materials in a plastic bagand take them with you to decontaminate at a later time.- Remove protective clothing and place them in a proper containerfor disposal. Keep your respirator on.- With respirator on, proceed to the shower area.6. In the Shower Area:- Thoroughly shower down with the respirator and bathing suiton. Remove respirator and clean it.- Remove bathing suit, thoroughly rinse it, and place it in aplastic bag. Finish showering by thoroughly washing the entirebody with soap and water.- Proceed to the clean room.7. In the Clean Room:- Dress into street clothes.InspectionOBSERVATION & PREPARATION- check inspection equipment (i.e. protective equipment, etc.)- survey property perimeter for possible public exposure (i.e.residential, commercial/industrial, schools, etc.)- check for posting of asbestos exposure warning signs.- just prior to entering immediate proximity, of work area inspectorto don respirator. If in the judgment of the inspector it is safe to do so, the respirator may be removed until entering actual containment work area- identify location of asbestos waste storage area Check for possibleasbestos debris around storage area.- locate and assess general trash storage area for possible asbestosdisposal.SITE ENTRY- contact appropriate job site official establishing individual's name, job title and business affiliation.- identify yourself showing proper credentials. Explain authority and purpose of inspection (i.e. routine notification compliance determination, complaint, investigation referral), liability waiver - agency policy prohibits the signing of any liability waivers by District staff - discuss procedure and sequence |

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**Study Citation:** CalEPA, (1995). Asbestos demolition and renovation.
**HERO ID:** 3981096
**Conditions of Use:** Disposal

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Exposure route: | inhalation | | |
| Physical form: | inhalable fibers | | |
| Personal protective equipment: | Protective, lightweight garments worn by workers performing asbestos abatement to prevent gross bodily contamination. Respirator - A protective device which filters harmful substances from air inhaled by workers in a contaminated area. The minimum respirator protection required for asbestos Workers is a half-faced, dual-cartridge respirator with HFPA filters. Supplied air respirator - A respirator that has a central source ofbreathing air supplied to the wearer by way of an airline. Half-Musk. Fits over the bridge of the nose, along the cheek, and under the chin. Two head bands form a four-point suspension to hold the mask in place and maintain the facepiece seal. During inhalation a slight vacuum (negative pressure) is created within the facepiece, causing ambient air to be drawn through High Efficiency Particulate Air (HEPA) filter media and into the facepiece. The expired air exits through an exhalation valve at thebottom of the facepieceFull-face. Fits over the face across the forehead, along the temple and the cheek, and under the chin. These devices have a head harness with a 5- or 6- point suspension. During inhalation a slight vacuum (negative pressure) is created in the facepiece, causing ambient air to be drawn through the HEPA filter media and into the facepiece. The expired air exits through an exhalation valve at the bottom of the facepiecePowered air-purifying respirators (PAPRs). Have auxiliary battery-powered, motorized filtration units which blow purified air to the facepiece. Since this creates a slight positive pressure in the mask, any breach in the facepiece seal should permit only the outward flow of air from the mask, thereby preventing inhalation of contaminated air. Air-line (Type C) respirators. Consist of a half-mask, full-facepiece,hood or helmet to which Grade D breathing air is supplied through a small diameter, high pressure air line.Air-Line Respirator with Self Contained Auxiliary Air Supply. This respirator combines an air-line respirator with an auxiliary air supply (SCBA) to provide the user with respirable air if the main air supply fails. Supplied-Air (Type C) respirator with HEPAjtlter. This respirator system consists of a full-facepiece air-line respirator with a backup HEPA filter. It allows the user to discamect from the air supply system in an emergency and proceed through standard decontamination procedures while breathing through the HEPA cartridges. The serf-contained breathing apparatus. Consists of a full- facepiece, regulator, and a respirable compressed air supply. The SCBA allows the user to carry the air supply, thus eliminating the need for a stationary air supply. The SCBA must operate in the pressure demand mode to be used in asbestos-contaminated atmospheres The overall protection afforded by a given respirator may be stated in terms of its protection factor (PF) and fit factor (PF), both of which are defined as the ratio of the concentration of a contaminant in the ambient atmosphere to that inside the respirator facepiece under use conditions. Protection factors are assigned values which address a certain class of respirators as a whole. In general, they provide an average value which takes into account the variety of makes and models, and the different facial structures of the user population. Fit factors are specific to a given respirator model and to the individual being tested. Thus, a respirator given a protection factor of 10 may be used in atmospheres not exceeding levels of 10 times the PEL. The protection factor can only be applied when a comprehensive respirator program exists and the overall limits of the respirator are known. The Los Alamos Scientific Laboratory was responsible for determining universally accepted protection factors for all types of respirators:- Not in excess of Two f/cc ‘(10 x PEL) - Half mask air-purifying respirator equipped with high efficiency filters.- Not in excess of Ten f/cc *( 50 x PEL) - Full facepiece air-purifying respirator equipped with high efficiency filters.- Not in excess of Twenty f/cc *(l00 x PEL) 1. Any powered air-purifying respirator (PAPR) equipped with high-efficiency filters. 2. Any supplied-air respirator operated in continuous flow mode.- Not in excess of 200 f/cc *(I000 x PEL) - Full facepiece supplied air respirator operated in pressure demand mode. - Greater than 200 f/cc (>l000 x PEL) or unknown concentration - Full facepiece supplied air respirator operated in pressure demand mode equipped with an auxiliary positive pressure self-contained breathing apparatus. Fit factors are determined by conducting a separate, quantitative fit test that is specific to the individual and to the make and model of the respirator to be used. As with protection factors, a fit factor is defined as the ratio of challenge agent concentration outside with respect to the inside of a respirator inlet covering (facepiece or enclosure). Unlike protection factors, fit factors are determined for negative pressure, non-powered air purifying respirators only since individual fit testing is not required for respirators with positive pressure at the facepiece.Once a respirator is selected, a positive and negative “fit check” is performed. A negative pressure “fit check” involves blocking the respirator inlet while inhaling. The positive pressure “fit check” involves blocking the exhalation valve and breathing out to test the facepiece seal.Quantitative fit testing is also conducted using a challenge atmosphere within an enclosure, but a probe is attached to the respirator which samples the atmosphere inside the facepiece. Both the atmosphere inside the facepiece and inside the test chamber are measured using an electronic instrument that quantities the test agent. The ratio of the two values provides a “quantitative” determination as to how well the respirator fits. The report provides more details concerning the process of qualitative and quantitative fit test along with details about how respirators should be inspected, cleaned and stored.Protective clothingProtective clothing for asbestos abatement projects usually consists of disposable coveralls, foot and head coverings, and gloves. 1. A disposable, full-body, hooded, outer coverall (e.g., Tyvek@ or equivalent). A coverall with an expanded back should be worn with an SCBA. 2. A bathing suit (or equivalent), an inner disposable coverall or disposable undergarments. When possible, particularly when a changing or decontamination area is available, all street clothing should be removed before donning protective clothing. When clothing is removed, the inspector may choose to wear a bathing suit under the protective clothing. If it is not possible to remove street clothing, the inspector should toll up pant legs and sleeves and don an inner disposable coverall. 3. Disposable gloves (PVC or equivalent).4. Disposable inner booties (e.g., Tyvek@ or equivalent).5. Disposable outer booties (taped to outer coverall).6. Safety helmets or hard hats.7. Safety shoes.Safety glasses- Protective eye equipment | | |

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**Study Citation:** CalEPA, (1995). Asbestos demolition and renovation.
**HERO ID:** 3981096
**Conditions of Use:** Disposal

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Engineering control: | | | Whenever feasible, a negative pressure enclosure shall be established.The employer shall use one or any combination of the following control methods to reduce the fiber level below the PEL- local exhaust ventilation equipped with HEPA filter dust collection systems;- general ventilation systems;- vacuum cleaners equipped with HEPA filters;- use of work practices or other engineering controls that theAssistant Secretary can show to be feasible; and- wherever the feasible engineering and work practice controlsdescribed above are not sufficient to reduce employee exposureto at or below the PEL, the employer shall use them to reduce employee exposure to the lowest levels attainable by these controls, and shall supplement them by the use of respiratory protection. Equipment Room (Change Room) - Contaminated room located within the decontamination area that is equipped for the disposal of contaminated materials.Washroom - A room between the work area and the clean room in the equipment decontamination enclosure system where workers shower. Shower room - A room between the clean room and the equipment room in a worker decontamination system in which workers shower prior to leaving the work area. |
| Comments: | | | The appendix includes EPA regulations and policy documents along with relevant information from different California air quality districts. |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Methodology | High | Detailed information from CARB |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | High | US |
| | Metric 3: Applicability | High | The report is for an occupational scenario (inspection of site remediation) within the scope of the risk evaluation. |
| | Metric 4: Temporal Representativeness | Medium | 1995 - after the most recent PEL but more than 20 years old. |
| | Metric 5: Sample Size | N/A | Qualitative information provided |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | High | Assessment or report clearly documents its data sources, assessment methods, results, and assumptions. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | N/A | Qualitative information provided |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Cameo Chemicals, (2016). Chemical datasheet: asbestos. |
| **HERO ID:** | 3981007 |
| **Conditions of Use:** | Other: |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Exposure route: | Inhalation, ingestion, skin and/or eye contact |
| Physical form: | Fiber |
| Personal protective equipment: | Protective clothing, protective eyewear |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | Medium | The assessment or report uses high quality data and/or techniques or sound methods that are not from a frequently used source and associated information does not indicate flaws or quality issues |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | The data are from the United States and are representative of the industry being evaluated. |
| | Metric 3: | Applicability | High | The report is for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | High | The report captures operations, equipment, and worker activities expected to be representative of current conditions. The report is generally no more than 10 years old. |
| | Metric 5: | Sample Size | N/A | n/a - no sampling data |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | Assessment or report clearly documents its data sources, assessment methods, results, and assumptions. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | N/A | No scope to address variability and uncertainty. |

## Overall Quality Determination — High

| | |
|---|---|
| **Study Citation:** | Caplan, P. E. (1985). Preliminary Survey Report: Control Technology Of Asbestos Removal Industry, Report No. CT-147-17a, Baseline Junior High School, Boulder, Colorado. NIOSH(CT-147-17a):147-17. |
| **HERO ID:** | 3101590 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Exposure route: | inhalation |
| Physical form: | inhalable fibers |
| Personal protective equipment: | •Use of air purifying respirators with high efficiency filters (HEPA) for initial removal •Site prep and final stages of removal half face cartridge respirators•Disposable coveralls•Boots |
| Engineering control: | •Isolation/Containment barrier•Negative air control system•Dust suppression•Dilution/Local ventilation•Remote control rooms•Supplied-air cabs |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Methodology | High | NIOSH study |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | US |
| Metric 3: | Applicability | High | The report is for an occupational scenario ( Asbestos removal from a school) within the scope of the risk evaluation. |
| Metric 4: | Temporal Representativeness | Low | 1984- more than 20 years old |
| Metric 5: | Sample Size | Medium | a range of concentrations was provided |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | High | NIOSH assessment clearly documents its data sources, assessment methods, results, and assumptions. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Medium | The report provided range of concentrations which can be helpful in assessing variability, but nothing was provided related to uncertainty in the results. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | CAREX Canada, (2016). Substance profile: Asbestos. |
| **HERO ID:** | 3978366 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | The largest industrial groups exposed are specialty trade contractors, followed by building construction, automotive repair, and shipbuilding. By occupation, the largest exposed groups are carpenters and cabinetmakers, followed by construction trade helpers and laborers. Exposure in construction workers is difficult to monitor due to the wide variety of worksites and the transient nature of employment for many workers. Despite this, the INSPQ in Quebec released a report on exposures to asbestos in the construction industry. Other occupational groups that may be exposed to asbestos include electricians, plumbers, plaster and drywall installers, and auto mechanics. (pg 3 of 6) |
| Exposure route: | Inhalation is the most important route of occupational exposure to asbestos. (pg 3 of 6) |
| Number of workers: | CAREX Canada estimates that approximately 152,000 Canadians are exposed to asbestos in the workplace. (pg 3 of 6) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Methodology | High | Report uses high quality data. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | Medium | The data are from an OECD country other than the U.S. |
| | Metric 3: Applicability | High | The report is for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: Temporal Representativeness | High | The report is generally no more than 10 years old. |
| | Metric 5: Sample Size | N/A | No sample data. |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | High | Report clearly documents its data sources. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | N/A | No scope to address variability and uncertainty. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Castleman, B. (2006). Asbestos products, hazards, and regulation. International Journal of Health Services 36(2):295-307. |
| **HERO ID:** | 3520517 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Products not Described by Other Codes |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | workers were employed in companies manufacturing brake lining (pg 298), |
| Exposure route: | inhalation |
| Physical form: | fibrous |
| Personal sampling data: | In one study, exposures during blow-out with compressed air and beveling of brake linings were 10.5 f/cc and 37.3 f/cc (pg 298). |
| Number of workers: | In 1975, NIOSH estimated that about 900,000 workers in the United States were regularly exposed to asbestos in brake servicing. |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Methodology | High | the report uses high quality data that are from frequently used sources (NIOSH) |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | The data are from the United States |
| Metric 3: | Applicability | High | The report is for an occupational scenario within the scope of the risk evaluation. |
| Metric 4: | Temporal Representativeness | Medium | The report is generally more than 10 years but no more than 20 years old. |
| Metric 5: | Sample Size | Low | Distribution of samples is characterized by no statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | High | the report clearly documents its data sources |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Low | The report does not address variability or uncertainty. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | CDC, (2003). NIOSH Recommendations for limiting potential exposures of workers to asbestos associated with vermiculite form Libby, Montana. |
| **HERO ID:** | 3978124 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Exposure route: | inhalation |
| Physical form: | fibers, dust |
| Personal protective equipment: | When needed to reduce asbestos exposure below the OSHA 8-hour time-weighted average limit of 0.1 fiber/cubic centimeter or OSHA excursion limit of 1.0 fiber/cc averaged over 30 minutes, respirators equipped with high-efficiency (e.g., N100) filters or supplied air respirators should be used. |
| Engineering control: | Avoid handling or disturbing loose vermiculite.Isolate work areas with temporary barriers or enclosures to avoid spreading fibers.Use wet methods, if feasible, to reduce exposure.Never use compressed air for cleaning.Avoid dry sweeping, shoveling, or other dry clean-upmethods. |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | The assessment or report uses high quality data and/or techniques or sound methods that are from frequently used sources (e.g., European Union or OECD reports, NIOSH HHEs, journalarticles, Kirk-Othmer) and are generally accepted by the scientific community, and associated information does not indicate flaws or quality issues. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | The data are from the United States and are representative of the industry being evaluated. |
| | Metric 3: | Applicability | Medium | The report is for an occupational scenario that is similar to an occupational scenario within the scope of the risk evaluation, in terms of the type of industry, operations, and work activities. |
| | Metric 4: | Temporal Representativeness | Medium | The report captures operations, equipment, and worker activities that are expected to be reasonably representative of current conditions. The report is generally more than 10 years but no more than 20 years old. |
| | Metric 5: | Sample Size | N/A | n/a - no sampling data |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | Assessment or report clearly documents its data sources, assessment methods, results, and assumptions. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | The report provides only limited discussion of the variability and uncertainty in the results. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | CDM Federal Programs Corporation, (2015). Site-wide human health risk assessment. |
| **HERO ID:** | 3970083 |
| **Conditions of Use:** | Other: |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Outdoor worker involved in disturbances of yard soil |
| Exposure route: | Inhalation |
| Physical form: | The vermiculite deposit near Libby contains a distinct form of naturally-occurring amphibole asbestos that is comprised of a range of mineral types and morphologies. There were several mineral varieties of amphibole asbestos present, including (in order of decreasing abundance) winchite, richerite, and tremolite, with lower levels of magnesio-riebeckite, edenite, and magnesio-arfvedsonite. Some minerals may also be classified as actinolite. The mixture of asbestos present at the Site is referred to as Libby amphibole asbestos or LA. (pg 1-2) |
| Personal sampling data: | Though the document mentions collection of personal air samples, the results are not included in this document. |
| Area sampling data: | Based on Figure 5-6 (pg 184 of 425), maximum mean air concentrations in Libby was ~1.4e-5 s/cc observed in August and the minimum mean air concentrations in Libby was close of zero observed in January. |
| Dermal exposure data: | nan |
| Exposure duration: | As per Table 6-22 (pg 262 of 425), exposure duration was 30 days/year as reasonable maximum exposure for outdoor workers |
| Engineering control: | no information was available regarding engineering controls |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Methodology | High | report uses high quality data |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | The data are from the United States |
| Metric 3: | Applicability | High | The report is for an occupational scenario within the scope of the risk evaluation. |
| Metric 4: | Temporal Representativeness | High | The report is generally no more than 10 years old. |
| Metric 5: | Sample Size | Low | Distribution of samples is qualitative |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | High | report clearly documents its data sources, assessment methods, results |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Medium | The report does include some discussion on variability or uncertainty. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Cely-García, M. F., Sánchez, M., Breysse, P. N., Ramos-Bonilla, J. P. (2012). Personal exposures to asbestos fibers during brake maintenance of passenger vehicles. Annals of Occupational Hygiene 56(9):985-999. |
| **HERO ID:** | 2560364 |
| **Conditions of Use:** | Consumer Uses-Chemical Substances in Automotive, Fuel, Agriculture, Outdoor Use Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | All the activities conducted by the mechanics during brake repair and maintenance operations were closely followed and recorded in activity diaries. |
| Physical form: | fibers |
| Personal sampling data: | Personal asbestos concentrations based on transmission electron microscopy counts were extremely high, ranging from 0.006 to 3.493 f cm−3 for 8-h TWA and from 0.015 to 8.835 f cm−3 for 30-min samples.For BRS1, three of the four TWA 8-h personal samples exceeded 0.1f cm−3 based on TEM results. BRS2 had full-shift exposures (based on TEM) that exceeded 0.1 f cm−3. In BRS3, one of the three full shift personal samples exceeded (based on TEM) 0.1f cm−3. (P.10/15) |
| Number of workers: | 6 (P. 6/15) Table 2 |
| Personal protective equipment: | Workers occasionally use filtering face-piece respirators. (P. 4/15) |
| Comments: | Table 7. TEM statistics summary for all BRS sampled. |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Methodology | High | The assessment or report uses high quality data and/or techniques or sound methods that are from frequently used sources, NIOSH. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | Low | The data are from a non-OECD country, Colombia. |
| | Metric 3: Applicability | High | The report is for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: Temporal Representativeness | High | Less than 10 year old. |
| | Metric 5: Sample Size | Medium | Distribution of samples is characterized by a range with uncertain statistics. It is unclear if analysis is representative. |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | High | Assessment or report clearly documents its data sources, assessment methods, results, and assumptions. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Medium | The report provides only limited discussion of the variability and uncertainty in the results. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Cheng, Y. S., Holmes, T. D., Fan, B. (2006). Evaluation of respirator filters for asbestos fibers. Journal of Occupational and Environmental Hygiene 3(1):26-35. |
| **HERO ID:** | 3079849 |
| **Conditions of Use:** | Other: |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Removal of asbestos in buildings. (2/11) |
| Exposure route: | inhalation (2/11) |
| Physical form: | fibers (2/11) |
| Particle size characterization: | Fiber diameter was 0.18+-0.01 um for amosite, 0.083+-0.015 um for crocidolite, and 0.030+-0.004 um for chrysotile. Fiber length was 1.19+-0.19 um for amosite, 0.53+-0.05 um for crocidolite, and 0.62+-0.12 um. (8/11) |
| Personal protective equipment: | Four types of respirators: a disposable low-efficiency face mask, a dust filter cartridge, a HEPA filter for powered respirators, and a regular HEPA filter. (3/11) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | Medium | Report uses high quality data that are not from frequently-used sources and there are no known quality issues. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for demolition of asbestos products, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Medium | Monitoring data were collected after the most recent PEL and greater than 10 years old. |
| | Metric 5: | Sample Size | Medium | Sample distribution characterized by limited statistics (means, standard deviations) but discrete samples not provided and distribution not fully characterized. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | Variability is addressed by comparing different respirators and fiber types, Uncertainty isn't addressed. |

## Overall Quality Determination — High

| | |
|---|---|
| **Study Citation:** | Churg, A., Wright, J. L. (1989). Fibre content of lung in amphibole- and chrysotile-induced mesothelioma: Implications for environmental exposure. IARC Scientific Publications 90(90):314-318. |
| **HERO ID:** | 3082876 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Shipyard and insulation workers, miners and millers |
| Physical form: | Fiber |
| Particle size characterization: | Mean fiber sizes provided in Table 4 for fibers found in dry lung samplesLength varied from 2.0 to 2.7 and width varied from 0.03 to 0.16 |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | Medium | The assessment or report uses high quality data and/or techniques or sound methods that are not from a frequently used source and associated information does not indicate flaws or quality issues. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Medium | The data are from an OECD country other than the U.S. |
| | Metric 3: | Applicability | High | The report is for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Low | The report is more than 20 years old. |
| | Metric 5: | Sample Size | Medium | Distribution of samples is characterized by a range with uncertain statistics. It is unclear if analysis is representative. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Assessment or report clearly documents results, methods, and assumptions. Data sources are generally described but not fully transparent. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | The report does not address variability or uncertainty. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Cicioni, C., London, S. J., Garabrant, D. H., Bernstein, L., Phillips, K., Peters, J. M. (1991). Occupational asbestos exposure and mesothelioma risk in Los Angeles County: application of an occupational hazard survey job-exposure matrix. American Journal of Industrial Medicine 20(3):371-379. |
| **HERO ID:** | 3082446 |
| **Conditions of Use:** | Other: |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | High exposure industries were ship and boat building and repairing. High exposure occupations were boilermakers, shipfitters, and asbestos and insulation workers. Many low exposure industries and occupations are listed in the appendix. (9/9) |
| Number of workers: | 539,871 workers were surveyed for asbestos exposure (4/9) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Methodology | High | Report uses high quality methods and data from frequently-used sources. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | High | Data are from the U.S. |
| | Metric 3: Applicability | High | Data applies to more than 1 COU. |
| | Metric 4: Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: Sample Size | Medium | Sample distribution characterized by limited statistics (number of workers) but discrete samples not provided and distribution not fully characterized. |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Clay, E., Ewing, W., Demyanek, M., Spain, W. (1986). Protective clothing: a worthwhile precaution for asbestos workers. Occupational Health and Safety 55(8):27-8, 44. |
| **HERO ID:** | 3083247 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Personal protective equipment: | Disposable coveralls, foot coverings and head covering are the most common types of protective clothing worn. They may be supplemented with hard hats, safety shoes or boots, and eye protection when necessary. (p. 1) |
| Engineering control: | The work area is typically sealed wit hplastic sheeting and the heating, ventilation and air conditioning unit is shut off and sealed. Water is sprayed on the asbestos material to minimize airborne fiber concentrations...Gloves should be worn... (p. 1) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Methodology | Low | Sampling/analytical methodology is not applicable. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | Data are from the U.S. |
| Metric 3: | Applicability | High | Data are for asbestos abatement, which is in scope and similar to the the occupational scenario of construction. |
| Metric 4: | Temporal Representativeness | Low | Data are from over 20 years ago. |
| Metric 5: | Sample Size | Low | Sample distribution is described qualitatively. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Low | Assessment or report provides results, but the underlying methods, data sources, and assumptions are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Medium | Variability is addressed in different protective clothing choices and uncertainty are not addressed. |

## Overall Quality Determination Low

| | |
|---|---|
| **Study Citation:** | Clayton, M. P., Bailey, A. E., Vaughan, N. P., Rajan, R. (2002). Performance of power assisted respirators during simulated asbestos removal. Annals of Occupational Hygiene 46(1):49-59. |
| **HERO ID:** | 3080505 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Personal protective equipment: | Two unit types were tested: Type A - a full face mask with integral fan and filter unit and a belt mounted battery pack. Type B - a full face mask, to which is connected a breathing hose which delivers the air from the belt mounted fan/filter/battery unit. [PDF Pg. 3]Over 21 tests (Shown in Table 1 on PDF Pg. 5), the overall protection factors had the following ranges:Type A: 400 - 10,000Type B: 3,550 - 20,000*Discrete results for certain conditions shown in Table 1. |
| Comments: | Respirator protection factor testing during simulated asbestos stripping. This is PPE, not engineering control. |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Methodology | High | Report uses high quality data/techniques/methods from frequently-used sources. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | Medium | Data are from the United Kingdom, an OECD country. |
| | Metric 3: Applicability | High | Data are for Chemical Substances in Construction, Paint, Electrical, and Metal Products, an in-scope occupational scenario. |
| | Metric 4: Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | High | Uncertainty is addressed by performing multiple tests. Variability addressed by testing two types of respirators on multiple individuals. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Constantinidis, K. (1977). Asbestos exposure–its related disorders. British Journal of Clinical Practice 31(7-8):89-101. |
| **HERO ID:** | 3084498 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Pipe fitters, joiners, and general laborers that work in the vicinity of asbestos building material. (2/13) |
| Exposure route: | inhalation (2/13) |
| Physical form: | dust (1/13) |
| Particle size characterization: | The mean value of the fibril diameters are generally in the range of 30 - 40 nm. (1/13) |
| Personal protective equipment: | Protective overalls and respirators are recommended for asbestos workers. (2/13) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Methodology | High | Report uses high quality methods and data from frequently-used sources. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | Medium | Data are from the U.K., an OECD country. |
| Metric 3: | Applicability | High | Data are for commercial use in construction materials, an in-scope occupational scenario. |
| Metric 4: | Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| Metric 5: | Sample Size | Medium | Sample distribution characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | CPWR, (1998). Savannah River building trades medical screening program: A needs assessment. |
| **HERO ID:** | 3974975 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Drilling, cutting, and applying transite, asbestos gasket and packing work, demolition workers, pipe fitters, and insulation workers (p. 19/44). |
| Exposure route: | Inhalation (p. 17/44). |
| Number of workers: | 62,000 building construction workers employed at one site since 1950 (p. 4/44). 1,500 construction workers were on site as of 1998 (p. 12/44). |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Methodology | High | Report uses high quality methods and data from frequently-used sources. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | Data are from the U.S. |
| Metric 3: | Applicability | High | Data are for commercial use in construction materials, an in-scope occupational scenario. |
| Metric 4: | Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| Metric 5: | Sample Size | Medium | Sample distribution characterized by limited statistics (number of workers) but discrete samples not provided and distribution not fully characterized. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Darcey, D. J., Alleman, T. (2004). Occupational and environmental exposure to asbestos. :17-33. |
| **HERO ID:** | 6865356 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Building maintenance workers, construction workers, electricians, custodians. (3/17) |
| Exposure route: | inhalation (6/17) |
| Physical form: | fibers (7/17) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | Report uses high quality methods and data from frequently-used sources. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for commercial use in construction materials, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Medium | Report is based on data greater than 10 years old but no more than 20 years old and industry conditions that are expected to be representative of current industry conditions. |
| | Metric 5: | Sample Size | N/A | N/A - This metric is not applicable to the data being extracted |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Dessoff, A. L. (1994). Safety makes the grade on college campuses. Safety and Health 150(3):60. |
| **HERO ID:** | 6885657 |
| **Conditions of Use:** | Consumer Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Students and faculty on college campuses (1/5) |
| Engineering control: | Campus safety officers should establish an operations-and-maintenance program that includes identification and regular inspection of asbestos-containing materials. Also train some of the physical-plant personnel in what to do if a problem develops. (3/5) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | Medium | Report uses high quality data that are not from frequently-used sources and there are no known quality issues. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | Low | Data are for school and office workers exposures, which is similar to commercial use of construction products. |
| | Metric 4: | Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: | Sample Size | N/A | N/A - This metric is not applicable to the data being extracted |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Methods, results, and assumptions are clearly documented, but underlying data sources are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination — Low

| | |
|---|---|
| **Study Citation:** | Deucher, V. M., Moore, T. L., Hemlin, S. (2000). Access denied: Asbestos contamination as catalyst and hindrance to collection retrieval and preservation. Journal of the American Institute for Conservation 39(1):75-84. |
| **HERO ID:** | 6865379 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Products not Described by Other Codes |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Workers decontaminated museum artifacts by disposal, washout (a low-pressure power wash amended with surfactant), HEPA vacuum, wet-wipe (using a cloth dampened with water and surfactant), compressed air blown on or into the object, encapsulation/removal, sealing or removing asbestos as integral parts of the object, and no clean/test out for objects too fragile to withstand decontamination. (7/11) |
| Particle size characterization: | Fibers >5 um in length with a 3:1 ratio of length to width. (4/11) |
| Personal protective equipment: | NMAH required staff to wear powered air-purifying respirators. (4/11) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | Medium | Report uses high quality data that are not from frequently-used sources and there are no known quality issues. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for commercial use of museum artifacts, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: | Sample Size | N/A | N/A - This metric is not applicable to the data being extracted |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Methods, results, and assumptions are clearly documented, but underlying data sources are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | Variability is addressed by listing multiple decontamination methods. Uncertainty isn't addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | DOE, (2003). A needs assessment for medical screening of construction workers at the Portsmouth and Paducah gaseous diffusion plants. |
| **HERO ID:** | 3974976 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | carpenters - from cutting and otherwise working with transiste materials Pipefitters and boilermakers - replacing/removing insulation around pipesInsulators - applying thermal insulationWelders ElectriciansSheetmetal workersIn the late 1970's workers would lie on asbestos blankets with large fans blowing over them to work in hot areas. |
| Number of workers: | Portsmouth 1954 22,500 construction workers 2002 9,000Paducah 1950s 29,000 construction workers 2002 8,000 |
| Personal protective equipment: | Respirator and gloves |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Methodology | High | DOE |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | US |
| Metric 3: | Applicability | High | The report is for an occupational scenario ( nuclear facility workers) within the scope of the risk evaluation. |
| Metric 4: | Temporal Representativeness | Medium | 2003 - between 10 and 20 years old. |
| Metric 5: | Sample Size | N/A | Qualitative information provided. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | High | DOE Assessments at gaseous Diffusion Plants |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | N/A | Qualitative information provided. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Driscoll, R. J. (1991). Health hazard evaluation report no. HETA 87-392-2099, Loral Systems Group, Akron, Ohio. |
| **HERO ID:** | 3970514 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Manufacturing and assembling aircraft brake linings. [PDF Pg. 3] |
| Exposure route: | Inhalation [PDF Pg. 5] |
| Number of workers: | 166 [PDF Pg. 3] |
| Personal protective equipment: | Respiratory protection. [PDF Pg. 9] |
| Comments: | Asbestos concentration, exposure duration, and engineering controls are not given in the document. |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Methodology | High | Report uses high quality data/techniques/methods from frequently-used sources. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | Data are from the U.S. |
| Metric 3: | Applicability | High | Data are for Chemical Substances in Construction, Paint, Electrical, and Metal Products, an in-scope occupational scenario. |
| Metric 4: | Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| Metric 5: | Sample Size | N/A | N/A - no sample data. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | N/A | N/A - no sample data. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | EC, (2012). Practical guidelines for the information and training of workers involved with asbestos removal or maintenance work. |
| **HERO ID:** | 3981018 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Prior to the demolition of the complete building, workers must remove and dispose of all materials containing asbestos, such as roof and facade coverings made of asbestos cement and weakly-bound asbestos products inside the building. (p. 37)Spatial separation is used to separate asbestos products from theirsurroundings in a dust-proof manner by means of additional building components. Joints and cable ducts must be sealed very carefully. (p. 39)Demolition, Clearance, and Maintenance work (p. 37-39) |
| Personal protective equipment: | For activities involving asbestos only respirators (P2/P3) are used in general. They are divided into: respirators with replaceable filters and with or without a ventilator; respirators with filters that cannot be replaced. (p. 34) |
| Engineering control: | Sprayers are used to minimise fibre release during dismantling and transportation and to bind fibres to material or room surfaces. Sprayers contain water and suitable binding agents. Hand-held pump sprayers and airless sprayers are proven devices for this purpose. (p. 25)For large-scale work, especially with spray-applied asbestos products, a multichamber system consisting of three chambers with an antechamber or four chambers in a modular system or as a permanent container installation, e.g. according to figure 1, must be provided. (p. 27) floors, walls and ceilings are made of a solid, washable, smooth material, a sanitary block with an automatic shower control and hand shower, automatically closing chamber doors, preferably with a mutual automatic locking mechanism, routed airflow through the lock in the direction of the black area. This might be achieved by maintaining negative pressure in chamber 3 and the antechamber or in chamber 4 with a negative pressure measurement in chamber 3. The negative pressure here must not be higher than in the black area (work area), diagonal ventilation of all chambers with an at least 10 times air change per hour in chamber 3 and the antechamber or in chamber 4. Infiltrations must be avoided, that sufficient ambient air and water temperatures are ensured, cleaning of the shower water in a filtering system and discharge into the sewerage. |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Methodology | High | The assessment or report uses high quality data and/or techniques or sound methods that are from frequently used sources (e.g., European Union report) and are generally accepted by the scientific community, and associated information does not indicate flaws or quality issues. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | Medium | The data are from an OECD country other than the U.S., and locality-specific factors (e.g., potential differences in regulatory occupational exposure or emission limits, industry/ processtechnologies) may impact exposures or releases relative to the U.S. |
| Metric 3: | Applicability | High | The report is for an occupational scenario within the scope of the risk evaluation. |
| Metric 4: | Temporal Representativeness | High | The report captures operations, equipment, and worker activities expected to be representative of current conditions. The report is generally no more than 10 years old. |
| Metric 5: | Sample Size | Low | Distribution of samples is qualitative or characterized by no statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | High | Assessment or report clearly documents its data sources, assessment methods, results, and assumptions. |
| Domain 4: Variability and Uncertainty | | | |

**Continued on next page . . .**

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| | |
|---|---|
| **Study Citation:** | EC, (2012). Practical guidelines for the information and training of workers involved with asbestos removal or maintenance work. |
| **HERO ID:** | 3981018 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

| | | EVALUATION | |
|---|---|---|---|
| Domain | Metric | Rating | Comments |
| | Metric 7: Metadata Completeness | Medium | The report provides only limited discussion of the variability and uncertainty in the results. |

## Overall Quality Determination — High

| | |
|---|---|
| **Study Citation:** | Edelman, D. A. (1989). Laryngeal cancer and occupational exposure to asbestos. International Archives of Occupational and Environmental Health 61(4):223–227. |
| **HERO ID:** | 3095533 |
| **Conditions of Use:** | Other: |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Number of workers: | Table 1, PDF pg 2 and Table 3, PDF pg 3 lists number of workers in different exposed cohorts from previous studies |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | Medium | Report uses high quality data/techniques/methods that are not from frequently-used sources and there are no known quality issues. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the US and other OECD countries |
| | Metric 3: | Applicability | Medium | Data are for mostly out of scope scenarios (processing), but there is some data for shipyard workers, which is similar to construction materials, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: | Sample Size | N/A | Number of workers in different cohorts data |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Methods, results, and assumptions are clearly documented, but underlying data sources are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | Variability addressed by providing data for different industries/countries but uncertainty is not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Edwards, C. (1990). Asbestos in the workplace: Control and removal. Canadian Occupational Safety 28(6):6, 9. |
| **HERO ID:** | 6909348 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Exposure route: | inhalation (1/2) |
| Physical form: | fibers (1/2) |
| Engineering control: | Asbestos management options include encapsulation, where the ACM is coated with an agent to seal fibers, or enclosure, where a barrier in installed to close off the ACM. (1/2) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | Low | The data, data sources, and/or techniques or methods used in the assessment or report are not specified. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Medium | The data are from an OECD country other than the U.S. |
| | Metric 3: | Applicability | High | The report is for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Low | The report is more than 20 years old. |
| | Metric 5: | Sample Size | N/A | N/A - This metric is not applicable to the data being extracted |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Low | Assessment or report provides results, but the underlying methods, data sources, and assumptions are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | N/A | N/A - This metric is not applicable to the data being extracted |

## Overall Quality Determination — Low

| | |
|---|---|
| **Study Citation:** | Egilman, D. (2009). Ford, General Motors, Chrysler, asbestos, and a ”sane appreciation of the risks”. International Journal of Occupational and Environmental Health 15(1):109-110. |
| **HERO ID:** | 3079271 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Brake maintenance workers |
| Exposure route: | inhalation |
| Physical form: | Dust and Fibers |
| Personal protective equipment: | Respirators, safety glasses, head covering, long sleeve shirt |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | The assessment or report uses high quality data from a frequently used journal article and are generally accepted by the scientific community, and associated information does not indicate flaws or quality issues. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | The data are from the United States and are representative of the industry being evaluated. |
| | Metric 3: | Applicability | High | The report is for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Medium | The report captures operations, equipment, and worker activities that are expected to be reasonably representative of current conditions. The report is generally more than 10 years but no more than 20 years old. |
| | Metric 5: | Sample Size | N/A | n/a - data not based on sampling |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | Assessment or report clearly documents its data sources, assessment methods, results, and assumptions. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | N/A | No scope to address variability and uncertainty. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Elias, J. D. (1981). Dry removal of asbestos. American Industrial Hygiene Association Journal 42(8):624-625. |
| **HERO ID:** | 3098756 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Personal protective equipment: | Impervious disposable clothing, including hoods, gloves, and boots. All openings (arms, legs, neck) taped closed. Pressure demand air line respirators used during cleanup (pg 2) |
| Engineering control: | Wet removal (pg 2)Change areas and decontamination areas (pg 2) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Methodology | High | The assessment or report uses high quality data and/or techniques or sound methods that are from frequently used sources. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | Medium | Data are from Canada, an OECD country. |
| Metric 3: | Applicability | High | The report is for an occupational scenario within the scope of the risk evaluation. |
| Metric 4: | Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| Metric 5: | Sample Size | N/A | PPE/controls info |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Medium | Methods, results, and assumptions are clearly documented, but underlying data sources are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | N/A | No scope to address variability and uncertainty. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Esmen, N. A. (1991). THE COSTS OF IMPRECISION PERSPECTIVES IN ASBESTOS ABATEMENT. Annals of the New York Academy of Sciences 643(ED.):EXPOSURE TO ASBESTOS IN PLACE: PUBLIC HEALTH CONTROL; CONFERENCE. |
| **HERO ID:** | 3097064 |
| **Conditions of Use:** | Other: |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Asbestos removal workers (4/8) |
| Physical form: | fibers (5/8) |
| Personal protective equipment: | Use of a respirator requires the proper selection and fit of the respirator to the user, periodic training of the user by an industrial hygienist, as well as medical examination to ascertain that the worker is fit to wear a respirator, and on-the-job supervision to ascertain that the respirator is being properly used. (3/8) |
| Engineering control: | Airborne fibers are generated only if the fibers are free to be dislodged from the fiber-containing matrix, and most such matrices can be stabilized by several methods, such as permeating a bonding material into the matrix. Such a technique will not only avoid exposure to the building's occupants, but will also reduce the exposure to workers performing maintenance or modification tasks on or around the stabilized material. Other aspects include isolation of the asbestos containing material by an impermeable shield and limited removal from places of constant access. (5/8) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Methodology | Medium | Report uses high quality data that are not from frequently-used sources and there are no known quality issues. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | High | Data are from the U.S. |
| | Metric 3: Applicability | High | Data are for demolition of asbestos products, an in-scope occupational scenario. |
| | Metric 4: Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: Sample Size | N/A | N/A - This metric is not applicable to the data being extracted |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Ewing, W. M., Spain, W. H. (1984). Getting to the very fiber of industrial asbestos removal. Occupational Health and Safety (June):29-33, 60, 68. |
| **HERO ID:** | 3083601 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | removing friable asbestos from buildings: 1) planning 2) protect workers 3) sealing off 4) removal 5) final clean-up 6) completion (pg 1)pg 1 describes the following asbestos removal project roles:coordinator, architect/engineer, IH, safety professional, legal council, analytical lab, med. clinic, contractortwo men scrape material from substrate while a third places material in bags/keeps it wet; after material is scraped, residue is brushed and wiped clean with damp rag, followed by application of water-based sealant (pg 5)pipe lagging: 1 man removes lagging while the other wets the material (pg 5) |
| Number of workers: | 3 (2 for pipe lagging) (pg 5) |
| Personal protective equipment: | respirators, clothing, showers (pg 1)continuous-flow, supplied-air respirators; approved by NIOSH or MSHA (pg 2)disposable coveralls, hardhats, steel-toed boots, safety goggles (pg 2)hood and foot coverings (pg 4-5) |
| Engineering control: | sealing off (shut down HVAC, plasticize, negative air, etc.)wet removal methods (pg 1)HEPA vacuum (pg 1)polyethylene sheets (pg 3)airlocks/decontamination area; 3 rooms: change room (clean), shower facility, equipment room (contaminated) (pg 4)glovebag (pipe lagging) (pg 5) |
| Comments: | One team has 3 workers. Total number of workers may be much larger. |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Methodology | Medium | Report uses high quality [data/techniques/methods] that are not from frequently-used sources and there are no known quality issues. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | Data are from the U.S. |
| Metric 3: | Applicability | High | Data are for construction materials, an in-scope occupational scenario. |
| Metric 4: | Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| Metric 5: | Sample Size | Low | Distribution of samples is qualitative or characterized by no statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Medium | Methods, results, and assumptions are clearly documented, but underlying data sources are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Medium | Variability addressed by differentiating between pipe lagging and other asbestos material removal but uncertainty is not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Fajen, J. M., Hills, B. (1990). Health hazard evaluation report no. HETA 89-126-2057, Hagaman Finishing, Hagaman, New York. |
| **HERO ID:** | 3970519 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Workers transfer hides and skins from the finishing line to a drying hook and distribute finishing material into the hides. These jobs are close to the dryers, which are lined with asbestos insulation. (4/29) |
| Exposure route: | inhalation (7/29) |
| Physical form: | fibers (7/29) |
| Personal protective equipment: | Hearing protection, respirators, gloves and goggles are provided to the workers. (8/29) |
| Engineering control: | Four choices are available for managing asbestos: encapsulation, enclosure, surveillance of the material, or removal. (25/29) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Methodology | High | Report uses high quality methods and data from frequently-used sources. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | High | Data are from the U.S. |
| | Metric 3: Applicability | High | Data are for industrial use in construction materials, an in-scope occupational scenario. |
| | Metric 4: Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: Sample Size | Low | Distribution of samples is qualitative or characterized by no statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Fischbein, A., Rohl, A. N., Langer, A. M., Selikoff, I. J. (1979). Drywall construction and asbestos exposure - reply. American Industrial Hygiene Association Journal 40(9):829-830. |
| **HERO ID:** | 3582532 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | pole sanding |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | Medium | As the author refers to the original article, it is not possible to accurately assess the data quality. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | US |
| | Metric 3: | Applicability | High | The report is for an occupational scenario (dry wall worker) within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Low | 1979 - more than 20 years old |
| | Metric 5: | Sample Size | Low | Distribution of samples is qualitative or characterized by no statistics. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | The author clearly notes that the original assessment included the concentration data. To assess the clarity, methods, and assumptions we would need to consider the original report. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | Range of concentrations was provided that could help in assessing variability. Uncertainty was not mentioned. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Forgue, J. M. (1992). Respiratory protection for fire fighters. Professional Safety 37(11):37-40. |
| **HERO ID:** | 6887784 |
| **Conditions of Use:** | Other: |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | fire-fighting |
| Personal protective equipment: | Recommended - respiratory protection. The use of SCBAs is recommended where: a) the atmosphere is hazardous; b) the atmosphere is suspected of being hazardous; or c) the atmosphere may rapidly become hazardous. (pg 38) Training is a crucial aspect of any respiratory protection program (pg 39). |
| Engineering control: | Ensuring quality of air for SCBS (pg 40) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | Medium | The assessment or report uses high quality data and/or techniques or sound methods that are not from a frequently used source and associated information does not indicate flaws or quality issues. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | The data are from the United States. |
| | Metric 3: | Applicability | High | The report is for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Low | The report is more than 20 years old. |
| | Metric 5: | Sample Size | N/A | No sample data. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | Report clearly documents its data sources. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | N/A | No scope to address variability and uncertainty. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Freeman, M. D., Kohles, S. S. (2012). Assessing specific causation of mesothelioma following exposure to chrysotile asbestos-containing brake dust. International Journal of Occupational and Environmental Health 18(4):329-336. |
| **HERO ID:** | 2554714 |
| **Conditions of Use:** | Other: |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | "Mechanics who work with asbestos-containing brake systems without effective particulate control measures are exposed to asbestos dust. The exposure is highest when themechanic grinds or machines a new asbestos-containing brake component and uses compressed air or a drybrush to clean out the wear dust from the old brakelining. (2/9)" |
| Exposure route: | inhalation (2/9) |
| Physical form: | particulates (2/9) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | Report uses high quality methods and data from frequently-used sources. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | Medium | The report is for an occupational scenario that is similar to an occupational scenario within the scope of the risk evaluation. (Braking and gear changing components in a variety of industrial and commercial machinery applications) |
| | Metric 4: | Temporal Representativeness | Medium | Report is based on data greater than 10 years old but no more than 20 years old and industry conditions that are expected to be representative of current industry conditions. |
| | Metric 5: | Sample Size | Low | Distribution of samples is qualitative or characterized by no statistics. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | High | Uncertainty is addressed by presenting confidence intervals and discussing under and overestimations. Variability is addressed by utilizing many studies from the industry. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Frost, G., Harding, A. H., Darnton, A., Mcelvenny, D., Morgan, D. (2008). Occupational exposure to asbestos and mortality among asbestos removal workers: a Poisson regression analysis. British Journal of Cancer 99(5):822-829. |
| **HERO ID:** | 2587816 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | [PDF Pg. 1]The key tasks involved in asbestos removal include preparingthe work area, removing the substance, bagging the debris, andcleaning up the site area. |
| Physical form: | Dust (fiber) |
| Exposure duration: | [PDF Pg. 4]<10 - 40+ hours per week spent stripping. |
| Personal protective equipment: | [PDF Pg. 4]Positive pressure masks, airstream helmets, full face unpowered mask, half face mask. |
| Engineering control: | Wetting the area where removal is being carried out controlsasbestos fibres and reduces airborne contamination. |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Methodology | High | Report uses high quality data/techniques/methods from frequently-used sources. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | Medium | Data are from the United Kingdom, an OECD country. |
| Metric 3: | Applicability | High | The report is for an occupational scenario within the scope of the risk evaluation. |
| Metric 4: | Temporal Representativeness | Medium | The report captures operations, equipment, and worker activities that are expected to be reasonably representative of current conditions. The report is generally more than 10 years but no more than 20 years old. |
| Metric 5: | Sample Size | N/A | N/A - no sample results. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | N/A | No scope to address variability and uncertainty. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Fujikawa, Y., Shimo, M., Yonehara, H., Tujimoto, T. (2011). The optimized risk management of the waste from TENORM and nuclear industries: How to harmonize risk from various sources. :497-502. |
| **HERO ID:** | 6877553 |
| **Conditions of Use:** | Disposal |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Exposure route: | inhalation |
| Number of workers: | 251 |
| Engineering control: | vitrification |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | Medium | The assessment uses high quality data form the Terazono et al report which is not a frequently used source and associated information does not indicate flaws or quality issues. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Medium | Japan - and OECD member |
| | Metric 3: | Applicability | High | The report is for an occupational scenario (disposal of hazardous waste) within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Medium | 2010 - more than 10 and less than 20 years old |
| | Metric 5: | Sample Size | Low | Distribution of samples is not characterized by statistics. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Assessment clearly documents results, and assumptions. Data sources are generally described but not fully transparent. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | The report does not address variability or uncertainty for asbestos. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Gandhi, S., Lyon, R., Speitel, L. (1999). Potential health hazards from burning aircraft composites. Journal of Fire Sciences 17(1):20-41. |
| **HERO ID:** | 3581550 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Products not Described by Other Codes |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Particle size characterization: | The collected fibers had a mean diameter in the range of 4.2 um versus 7 um for the virgin fibers (p. 13) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | The assessment or report uses high quality data and/or techniques or sound methods that are from frequently used sources (journal article) and are generally accepted by the scientific community, and associated information does not indicate flaws or quality issues. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | The data are from the United States and are representative of the industry being evaluated. |
| | Metric 3: | Applicability | High | The report is for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Low | The report is more than 20 years old. The report captures operations, equipment, and worker activities that are expected to be outdated. |
| | Metric 5: | Sample Size | Medium | Distribution of samples is characterized by a range with uncertain statistics. It is unclear if analysis is representative. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | Assessment or report clearly documents its data sources, assessment methods, results, and assumptions. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | The report does not address variability or uncertainty. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Gardner, B. (2000). Asbestos in buildings: Controlling risks during removal. Safety and Health Practitioner 18(2):13-16. |
| **HERO ID:** | 6886202 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Stripping away and removing asbestos containing materials. [PDF Pg. 2] |
| Exposure route: | Inhalation [PDF Pg. 1] |
| Personal protective equipment: | Respiratory protective equipment [PDF Pg. 1] |
| Engineering control: | Containment of the carcinogenic dust moreover, is achieved by enclosing the removal work within a tent made from wood and polythene held together with sticky tape. There is an extraction system to keep the area under negative pressure, but no-one checks to see if it runs effectively and continuously. [PDF Pg. 1] |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Methodology | Medium | Report uses high quality data/techniques/methods that are not from frequently-used sources and there are no known quality issues. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | Data are from the U.S. |
| Metric 3: | Applicability | High | Data are for Chemical Substances in Construction, Paint, Electrical, and Metal Products, an in-scope occupational scenario. |
| Metric 4: | Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| Metric 5: | Sample Size | N/A | N/A - no sample data. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Medium | Methods, results, and assumptions are clearly documented, but underlying data sources are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | N/A | No scope to address variability and uncertainty. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Garshick, E., Schenker, M. B., Woskie, S. R., Speizer, F. E. (1987). Past exposure to asbestos among active railroad workers. American Journal of Industrial Medicine 12(4):399-406. |
| **HERO ID:** | 3099705 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Products not Described by Other Codes |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Railroad workers, employed at diesel shop, carshop, foreman, conductor, engineer, bridge & building worker, clerk, executive, agent, dispatcher, and other (pg 401) |
| Exposure duration: | The duration of exposure of these older active workers was short, (median = 3 years; range, 6 months to 15 years) (pg 399). The duration of asbestos job exposure (available for 47 of the 50 workers) ranged from 6 months to 15 years with a median of 3 years. (pg 402). For workers between the age from 25 to 48, The duration of asbestos job exposure, which was available for six workers, was 1-8 years, and a median of 3.5 years. (pg 402). |
| Number of workers: | Study population was 659 white males (pg 400) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Methodology | High | Report uses high-quality data |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | High | The data are from the United States |
| | Metric 3: Applicability | High | The report is for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: Temporal Representativeness | Low | The report is more than 20 years old. |
| | Metric 5: Sample Size | High | Statistical distribution of samples is fully characterized. |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | High | report clearly documents its data sources |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Low | The report does not address variability or uncertainty. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Gasson, E. E. (1974). Asbestos in industry. 2. Occupational Health: A Journal for Occupational Health Nurses 26(9):352-362. |
| **HERO ID:** | 3084723 |
| **Conditions of Use:** | Other: |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Physical form: | dust (2/11) |
| Personal protective equipment: | PPE must consist of an approved respirator, protective equipment and suitable clothing. Determination of what type of PPE is needed can be done through air monitoring. (2/11) |
| Engineering control: | A considerable amount of dust control is achieved by moistening the asbestos which is being processed. This method may have to be augmented by exhaust ventilation. (1/11) If dry asbestos must be handled, dust can be prevented from entering workroom air if operations are conducted under a total dust-tight enclosure. In terms of exhaust ventilation, systems normally consist of a hood, ducting, a dust collector, and a fan. (2/11) Cleaning of contaminated work areas should be done no less than daily |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Methodology | Low | Report does not specify the data used. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | Medium | Data are from the U.K., an OECD country. |
| Metric 3: | Applicability | High | Data are for all conditions of use as general guidance. |
| Metric 4: | Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| Metric 5: | Sample Size | N/A | N/A - This metric is not applicable to the data being extracted |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Low | Assessment results are provided but underlying methods, assumptions, and data sources are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Medium | Variability in control methods and PPE are provided. Uncertainty isn't addressed. |

## Overall Quality Determination — Low

**Study Citation:** Giordano, R. J., Gardner, D. L., Taylor, C. A. (1987). Practical radiation, contamination and asbestos control techniques for decommissioning.
**HERO ID:** 6891991
**Conditions of Use:** Other:

**EXTRACTION**

| Parameter | Data |
|---|---|
| Worker activity description: | The asbestos worker, in respiratory protection and full body "Tyvek" coveralls, physically entered the tent enclosure to perform removal tasks. Each tent containment was maintained under negative air pressure with HEPA filtration units during asbestos removal. At the conclusion of asbestos removal and clean-up, the interior walls and floor of the containment were vacuumed and wet wiped to remove any asbestos fiber contamination. The plastic enclosure was freed from its supports, folded in on itself anddisposed of as asbestos waste. |
| Exposure route: | inhalation |
| Physical form: | inhalable fibers |
| Personal protective equipment: | Personnel Protection Requirements. To protect the project workers, all work areas with airborne asbestos levels greater than 0.1 fibers/cc of air were designated as asbestos control areas requiring protective clothing and medical surveillance. Respiratory protection was required for all work in asbestos control areas. The standard for the type of respiratory protection was set at 10% of the OSHA standards that were current at the beginning of the project. That is, at the NIOSH and OSHA proposed maximum allowable airborne asbestos levels forunprotected exposure to chrysotile (white) asbestos. Chrysotile asbestos is the most harmful variety, as well as the type least likely to be found in normal asbestos type materials. Most asbestos removed under this project was in the form of amosite bricks and spray-on fireproofing. In addition to the higher standard for respiratory protection, an action level was set at 50% of the maximum allowable airborne level for each type respirator. At the action level, IT was required to either take necessary actions to reduce the airborne concentration or to increase the respiratoryprotection by going to the type respirator with the next level of protection factor.Any work in an Asbestos Work Area required that workers wear The following protective clothing and equipment:• Full-face air purifying respirators with high efficiency particulate filters or pressure demand air line respirators (Type C) were used when asbestos was removed without glove bags. When glove bags were used, full face air purifying respirators with high efficiencyparticulate filters were employed.• In addition to respiratory protection, all workers in asbestos control areas were dressed in full protective clothing. All workers wore surgical suits, cotton glove liners, two pairs of gloves, disposable protective suits with hoods, neoprene boots and PVC-coated booties over the boots. All potential avenues for asbestos fiber exposure, such as where booties overlap the disposable suit and around respirator face pieces, were sealed withtape.The protective clothing was disposable to preclude problems in laundering the clothing. All workers entered and exited the asbestos work areas through air locks. Contaminated clothing was discarded as asbestos waste during egress. All workers were then required to shower prior to entering locker areas containing their street clothing. Routine personnel and area samples were taken for airborne asbestos levels both within the asbestos work area andin the surrounding areas.• Safety glasses, hard hats, and safety shoes were worn by all workers, except that neither safety glass or hard hats were worn when respirators were used. |
| Engineering control: | The full room containments were erected of Fasilon, a fire retardant, reinforced Herculite material, with frames consisting of either PVC pipe or wood with fire retardant paint. Negative air pressure was maintained using Micro-Trap HEPA filtered portable ventilation systems. A minimum of six (6) total air changes per hour was required, therefore, the number of units used depended upon the size of the area. Double chambered air locks with triple overlapping flaps were used as access control points for the containments. Areas within the containments including the air lock, were designated as asbestos work areas (AWAs). |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | Medium | Documents were from the 1987 International Decommissioning Symposium ( nucelar facility decommissiong) |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | US |
| | Metric 3: | Applicability | High | The report is for an occupational scenario (nuclear power plant decommissioning) within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Low | 1987 - more than 20 years old |

**Continued on next page . . .**

. . . continued from previous page

**Study Citation:** Giordano, R. J., Gardner, D. L., Taylor, C. A. (1987). Practical radiation, contamination and asbestos control techniques for decommissioning.
**HERO ID:** 6891991
**Conditions of Use:** Other:

| | | | EVALUATION | |
|---|---|---|---|---|
| Domain | | Metric | Rating | Comments |
| | Metric 5: | Sample Size | N/A | Qualitative information provided |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | The articles clearly documented data sources, assessment methods, results, and assumptions. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | N/A | Qualitative information provided |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Gough, M. (1983). Sources and interpretation of asbestos exposure data. Journal of Toxicology. Clinical Toxicology 21(1-2):211-235. |
| **HERO ID:** | 3083846 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | shipyard workers; insulation work; asbestos products plants |
| Number of workers: | Number of workers exposed given in three papers as total 8 to 11 million; 7 to 8 million; or close to 8 million... Also specifies number of workers exposed to certain exposure levels, such as "heavy" or 4 fibers per cubic centimeter (differs for each paper) (pg 7 and 8) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | Report uses high quality information that are not from frequently-used sources and there are no known quality issues. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | Medium | Data are for generic industrial uses, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: | Sample Size | N/A | N/A - This metric is not applicable to the data being extracted |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Methods, results, and assumptions are clearly documented, but underlying data sources are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | Uncertainty is addressed by review of different sources. Variability is not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Gough, M. (1983). Sources and interpretation of asbestos exposure data. Journal of Toxicology. Clinical Toxicology 21(1-2):211-235. |
| **HERO ID:** | 3083846 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Products not Described by Other Codes |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | shipyard workers; insulation work; asbestos products plants |
| Number of workers: | Number of workers exposed given in three papers as total 8 to 11 million; 7 to 8 million; or close to 8 million... Also specifies number of workers exposed to certain exposure levels, such as "heavy" or 4 fibers per cubic centimeter (differs for each paper) (pg 7 and 8) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | Report uses high quality information that are not from frequently-used sources and there are no known quality issues. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | Medium | Data are for generic industrial uses, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: | Sample Size | N/A | N/A - This metric is not applicable to the data being extracted |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Methods, results, and assumptions are clearly documented, but underlying data sources are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | Uncertainty is addressed by review of different sources. Variability is not addressed. |

## Overall Quality Determination — Medium

| | |
|---|---|
| **Study Citation:** | Gough, M. (1983). Sources and interpretation of asbestos exposure data. Journal of Toxicology. Clinical Toxicology 21(1-2):211-235. |
| **HERO ID:** | 3083846 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Furnishing, Cleaning, Treatment Care Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | shipyard workers; insulation work; asbestos products plants |
| Number of workers: | Number of workers exposed given in three papers as total 8 to 11 million; 7 to 8 million; or close to 8 million... Also specifies number of workers exposed to certain exposure levels, such as "heavy" or 4 fibers per cubic centimeter (differs for each paper) (pg 7 and 8) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | Report uses high quality information that are not from frequently-used sources and there are no known quality issues. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | Medium | Data are for generic industrial uses, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: | Sample Size | N/A | N/A - This metric is not applicable to the data being extracted |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Methods, results, and assumptions are clearly documented, but underlying data sources are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | Uncertainty is addressed by review of different sources. Variability is not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Gough, M. (1983). Sources and interpretation of asbestos exposure data. Journal of Toxicology. Clinical Toxicology 21(1-2):211-235. |
| **HERO ID:** | 3083846 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Packaging, Paper, Plastic, Toys, Hobby Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | shipyard workers; insulation work; asbestos products plants |
| Number of workers: | Number of workers exposed given in three papers as total 8 to 11 million; 7 to 8 million; or close to 8 million... Also specifies number of workers exposed to certain exposure levels, such as "heavy" or 4 fibers per cubic centimeter (differs for each paper) (pg 7 and 8) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Methodology | High | Report uses high quality information that are not from frequently-used sources and there are no known quality issues. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | High | Data are from the U.S. |
| | Metric 3: Applicability | Medium | Data are for generic industrial uses, an in-scope occupational scenario. |
| | Metric 4: Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: Sample Size | N/A | N/A - This metric is not applicable to the data being extracted |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | Medium | Methods, results, and assumptions are clearly documented, but underlying data sources are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Medium | Uncertainty is addressed by review of different sources. Variability is not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Harries, P. G. (1970). Protection of dockyard workers against asbestosis. Proceedings of the Royal Society of Medicine 63(10):1015. |
| **HERO ID:** | 3084906 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Employees in HM Dockyards. (1/1) |
| Exposure route: | inhalation (1/1) |
| Physical form: | dust (1/1) |
| Personal protective equipment: | In order to protect the men from crocidolite dust and high concentrations of amosite asbestos they are issued with a complete change of clothing, impervious overalls, and air-fed respirators. Supervisors are supplied with impervious overalls and a full face-piece respirator with a polythene hood attached to it. Men who remove debris from the ships wear ordinary dust respirators in addition to their air-fed hoods. (1/1) |
| Engineering control: | Outside air is obtained from the dockyard compressed air supply, and oil and water removed by a filter unit. (1/1) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Methodology | High | The assessment or report uses high quality data and/or techniques or sound methods that are from frequently used sources. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | Medium | The data are from an OECD country other than the U.S. |
| | Metric 3: Applicability | High | The report is for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: Temporal Representativeness | Low | The report is more than 20 years old. |
| | Metric 5: Sample Size | N/A | No sample data. |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | Medium | Assessment or report clearly documents results, methods, and assumptions. Data sources are generally described but not fully transparent. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | N/A | No scope to address variability and uncertainty. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Hatfield, R., Longo, W., Newton, L., Templin, J. (2003). Asbestos exposure from gasket removal. AIHA Journal 64(5):595; author reply 595-7. |
| **HERO ID:** | 3530953 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Gasket Removal. Gaskets arc removed from flanges on steam lines that have been in place for any significant amount of time, they rarely come off fully intact. (P. 1/1) |
| Area sampling data: | 1.0 -3.6 f/cc |
| Exposure duration: | 8-hr |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Methodology | High | The assessment or report uses high quality data |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | The data are from the United States |
| Metric 3: | Applicability | High | The report is for an occupational scenario within the scope of the risk evaluation. |
| Metric 4: | Temporal Representativeness | Medium | The report is generally more than 10 years but no more than 20 years old. |
| Metric 5: | Sample Size | Low | Distribution of samples is qualitative or characterized by no statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Low | Assessment or report provides results, but the underlying methods, data sources, and assumptions are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Low | The report does not address variability or uncertainty. |

## Overall Quality Determination — Medium

| | |
|---|---|
| **Study Citation:** | Hawkins, J. W., Haynes, D. C., Istone, W. K., Schmidt, A. F. (1988). ASBESTOS .2. ABATEMENT REMOVAL PROGRAMS. Tappi Journal :199-200. |
| **HERO ID:** | 6864225 |
| **Conditions of Use:** | Other: |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Asbestos abatement contractors (1/2) |
| Personal protective equipment: | Type C air respirators must be worn for the duration of the project, and there must be provision of sufficient negative air pressure. (2/2) |
| Engineering control: | Asbestos removal assures that no more fibers will enter the air, and no ongoing monitoring or further encapsulation will be required. Before removal, a site survey must be performed to determine existing plant conditions and to find access to the proper utilities required to do the work. Also, effective communication between the owner and the contractor in developing a coordinated work schedule and in working out the details concerning vehicles, security, placement of equipment, etc. Proper preparation includes sealing off the work area, placing warning flags and barriers around the work site, and erecting scaffolding where necessary. (1/2) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Methodology | Medium | Report uses high quality data that are not from frequently-used sources and there are no known quality issues. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | High | Data are from the U.S. |
| | Metric 3: Applicability | High | Data are for demolition of asbestos products, an in-scope occupational scenario. |
| | Metric 4: Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: Sample Size | N/A | N/A - This metric is not applicable to the data being extracted |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | Low | Assessment results are provided but underlying methods, assumptions, and data sources are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Heikkilä, P., Kauppinen, T. (1992). Occupational exposure to carcinogens in Finland. American Journal of Industrial Medicine 21(4):467-480. |
| **HERO ID:** | 1233885 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Number of workers: | 350 construction workers. |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Methodology | High | Report uses high quality data/techniques/methods from frequently-used sources. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | Medium | Data are from Finland, an OECD country. |
| | Metric 3: Applicability | High | Data are for construction, paint, electrical, and metal products, an in-scope occupational scenario. |
| | Metric 4: Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: Sample Size | Low | Sample distribution is characterized by no statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Hibbert, L. (2011). Asbestos lies hidden in many older buildings and plants - posing a hidden danger to maintenance workers. Professional Engineering 24(1):18. |
| **HERO ID:** | 3585409 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Setting up containment structures and the removal of asbestos. [PDF Pg. 4] |
| Engineering control: | A containment structure is used during asbestos removal as well as powerclad sheeting to provide protection of asbestos from the environment as well as to contain any material that falls on the ground. [PDF Pg. 4] |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | Medium | Report uses high quality data/techniques/methods that are not from frequently-used sources and there are no known quality issues. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Medium | Data are from the United Kingdom, an OECD country. |
| | Metric 3: | Applicability | High | Data are for deconstruction of asbestos containing materials, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Medium | Report is based on data greater than 10 years old but no more than 20 years old and industry conditions that are expected to be representative of current industry conditions. |
| | Metric 5: | Sample Size | N/A | N/A - Worker activity and engineering controls. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Methods, results, and assumptions are clearly documented, but underlying data sources are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | N/A | N/A - Worker activity and engineering controls. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Hollett, B. A. (1985). Walk-Through Survey Report No. CT-147-12a: Control Technology For Asbestos Removal Industry At James Monroe Elementary School, Norfolk, Virginia. NIOSH(CT-147-12a):147-12. |
| **HERO ID:** | 3101527 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | removal of boiler insulation, pipe lagging, boiler ends and arr duct insulation. |
| Exposure route: | inhalation |
| Physical form: | inhalable fibers |
| Personal protective equipment: | •Use of air purifying respirators with high efficiency filters (HEPA) for initial removal •Site prep and final stages of removal half face cartridge respirators•Disposable coveralls•Boots |
| Engineering control: | •Isolation/Containment barrier•Negative air control system•Dust suppression•Dilution/Local ventilation•Remote control rooms•Supplied-air cabs |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | NIOSH study |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | US |
| | Metric 3: | Applicability | High | The report is for an occupational scenario ( asbestos removal from a school) within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Low | 1985 - more than 20 years old. |
| | Metric 5: | Sample Size | Medium | Concentration data represented by a range |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | NIOSH assessment or report clearly documents its data sources, assessment methods, results, and assumptions. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | The report provided range of concentrations which can be helpful in assessing variability, but nothing was provided related to uncertainty in the results. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Hollett, B. A. (1985). Walk-Through Survey Report No. CT-147-13a: Control Technology For Asbestos Removal Industry At Tidewater Park Elementary School, Norfolk, Virginia. NIOSH(CT-147-13a):147-13. |
| **HERO ID:** | 3101529 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | removal of boiler insulation, pipe lagging, boiler ends and air duct insulation. |
| Personal protective equipment: | •Use of air purifying respirators with high efficiency filters (HEPA) for initial removal •Site prep and final stages of removal half face cartridge respirators•Disposable coveralls•Boots |
| Engineering control: | •Isolation/Containment barrier•Negative air control system•Dust suppression•Dilution/Local ventilation•Remote control rooms•Supplied-air cabs |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | NIOSH Study |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | US |
| | Metric 3: | Applicability | High | The report is for an occupational scenario ( asbestos removal from a school) within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Low | 1995 - more than 20 years old |
| | Metric 5: | Sample Size | Medium | Concentration data represented by a range |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | NIOSH assessment or report clearly documents its data sources, assessment methods, results, and assumptions. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | The report provided range of concentrations which can be helpful in assessing variability, but nothing was provided related to uncertainty in the results. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Hopper, L. J. (1993). Removal of asbestos. The Structural Engineer 71(17):316. |
| **HERO ID:** | 6913906 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Asbestos removal contractors (1/2) |
| Engineering control: | The initial action in this case of abatement was to seal the asbestos by spraying with a fire-retardant polymer coating. This original method didn't work, so the decision was made to remove the asbestos completely. When the asbestos was removed, the ceiling was covered with fabric adhered with polymer coating to encapsulate any remaining asbestos. (2/2) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Methodology | Low | The data, data sources, and/or techniques or methods used in the assessment or report are not specified. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | High | The data are from the United States and are representative of the industry being evaluated. |
| | Metric 3: Applicability | High | The report is for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: Temporal Representativeness | Low | The report is more than 20 years old. |
| | Metric 5: Sample Size | N/A | N/A - This metric is not applicable to the data being extracted |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | Low | Assessment or report provides results, but the underlying methods, data sources, and assumptions are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | N/A | N/A - This metric is not applicable to the data being extracted |

## Overall Quality Determination — Medium

| | |
|---|---|
| **Study Citation:** | Hossain, M.,dS, Fakhruddin, A., Chowdhury, M. A. Z., Gan, S. (2016). Impact of ship-Breaking activities on the coastal environment of Bangladesh and a management system for its sustainability. Environmental Science and Policy 60(Elsevier):84-94. |
| **HERO ID:** | 3352103 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | The process of ship disposal that involves breaking up ships for scrap recycling (1/11) |
| Physical form: | fibers and flocks (6/11) |
| Number of workers: | Ship-breaking activities provide direct employment opportunities for approximately 25,000 people. Moreover, another 200,000 people are also engaged in different businesses related to shipbreaking activities. (3/11) |
| Engineering control: | Precleaning is a requirement prior to demolition in which all hazardous materials and wastes contained in scrapped ships are safely removed. (7/11) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Methodology | High | The assessment or report uses high quality data and/or techniques or sound methods that are from frequently used sources. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | Low | The data are from a non-OECD country (Bangladesh). |
| | Metric 3: Applicability | High | The report is for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: Temporal Representativeness | High | The report is generally no more than 10 years old. |
| | Metric 5: Sample Size | N/A | No sample data. |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | High | Assessment or report clearly documents its data sources, assessment methods, results, and assumptions. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | N/A | No scope to address variability and uncertainty. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Howell, D. (2020). Asbestos abatement in pipeline repair. Pipeline and Gas Journal 247(1):45-47. |
| **HERO ID:** | 6892212 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Exposure route: | inhalation |
| Personal protective equipment: | Workers will be asbestos trained (Minimum 8-hour certification program) and wear fit-tested respirators.Workers will wear Tyvek type work uniforms, one-half face respirators, hard hats, safety glasses, steel toe work boots, and gloves during abatement activities. |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | The assessment or report uses high quality data and/or techniques or sound methods that are from frequently used source. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | The data are from the United States. |
| | Metric 3: | Applicability | High | The report is for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | High | The report is generally no more than 10 years old. |
| | Metric 5: | Sample Size | N/A | No sample data. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Assessment or report clearly documents results, methods, and assumptions. Data sources are generally described but not fully transparent. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | N/A | No scope to address variability and uncertainty. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Huncharek, M. (1987). Chrysotile asbestos exposure and mesothelioma. British Journal of Industrial Medicine 44(4):287-288. |
| **HERO ID:** | 3083161 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | brake mechanic (auto), elevator mechanic, and railroad brake banding. (p. 1-2) |
| Exposure route: | inhalation (p. 1) |
| Physical form: | 99% chrysotile, 1% amosite |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | Low | Sampling/analytical methodology is not specified. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Medium | Data are from Canada, an OECD country. |
| | Metric 3: | Applicability | Low | Data are for brake mechanic and elevator mechanic, which is similar to the the in-scope occupational scenario of Other machinery, mechanical appliances. |
| | Metric 4: | Temporal Representativeness | Low | Data are greater than 20 years old. |
| | Metric 5: | Sample Size | N/A | N/A - This metric is not applicable to the data being extracted |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Low | Assessment or report provides results, but the underlying methods, data sources, and assumptions are not fully transparent |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | The report does not address variability or uncertainty |

## Overall Quality Determination — Low

| | |
|---|---|
| **Study Citation:** | Huncharek, M., Capotorto, J. (1988). Asbestos related lung disease in maintenance workers. British Journal of Industrial Medicine 45(3):203-204. |
| **HERO ID:** | 3082992 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Furnishing, Cleaning, Treatment Care Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | ”rag sorters” working in the reprocessed textile industry. Theseindividuals were exposed to asbestos fibres freed from polypropylene bags previously used to transport asbestos. These bags were cut and used in the textile plants to cover bales of rags before shipment (pg 1-2) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Methodology | Medium | Report uses high quality data/techniques/methods that are not from frequently-used sources and there are no known quality issues. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | High | Data are from the U.S. |
| | Metric 3: Applicability | High | Data are for asbestos textiles, an in-scope occupational scenario. |
| | Metric 4: Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: Sample Size | N/A | worker activity description |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | Low | Assessment results are provided but underlying methods, assumptions, and data sources are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Hunsinger, R. B., Roberts, K. J., Lawrence, J. (1980). CHRYSOTILE ASBESTOS FIBER REMOVAL DURING POTABLE WATER-TREATMENT - PILOT-PLANT STUDIES. Environmental Science and Technology 14(3):333-336. |
| **HERO ID:** | 3583339 |
| **Conditions of Use:** | Disposal |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Exposure route: | ingestion |
| Physical form: | fibers in drinking water |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | The assessment or report uses high quality data and/or techniques |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Medium | Canada - OECD Member |
| | Metric 3: | Applicability | Medium | The report is for a scenario (drinking water) that is similar to scenarios within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Low | 1975 - more than 20 years old |
| | Metric 5: | Sample Size | N/A | General observation about exposure route and form. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | Assessment or report clearly documents its data sources, assessment methods, results, and assumptions. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | N/A | General observation about exposure route and form. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | IMAREST, (2004). Removing asbestos responsibly. Marine Engineers Review ():14. |
| **HERO ID:** | 6873818 |
| **Conditions of Use:** | Disposal |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Exposure route: | Inhalation |
| Personal protective equipment: | Dust tight overalls and adducted air masks. |
| Engineering control: | Extraction fans |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | Medium | Report uses high quality data/techniques/methods that are not from frequently-used sources and there are no known quality issues. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Medium | Data are from the UK, an OECD country. |
| | Metric 3: | Applicability | High | Data are for disposal, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Medium | Report is based on data greater than 10 years old but no more than 20 years old and industry conditions that are expected to be representative of current industry conditions. |
| | Metric 5: | Sample Size | N/A | N/A - engineering controls, PPE, exposure route. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Low | Assessment results are provided but underlying methods, assumptions, and data sources are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | N/A | N/A - engineering controls, PPE, exposure route. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Johnston, A. M., Hughson, G. W., Vincent, J. H., Jones, A. D. (1988). Localized Electrostatic Precipitation as an Alternative to Exhaust Ventilation for Controlling Airborne Dust in Textile Workplaces. Textile Research Journal 58(11):619-625. |
| **HERO ID:** | 6865880 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Products not Described by Other Codes |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Engineering control: | The article presents results that shows the possible use of electrostatic precipitation- either supplementary or as an alternative to conventional ventilation technology - as a means of reducing dust release from industrial processes. The possible advantages of electrostatically based systems in terms of cost-efficiency are considered against possible disadvantages associated with operational accessibility. |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | The report uses high quality data and/or techniques that are from frequently used sources. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Medium | The data are from an OECD country other than the U.S. |
| | Metric 3: | Applicability | Medium | The report is for an occupational scenario that is similar to an occupational scenario within the scope of the risk evaluation, |
| | Metric 4: | Temporal Representativeness | Low | The report is more than 20 years old. |
| | Metric 5: | Sample Size | N/A | N/A - This metric is not applicable to the data being extracted |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | Report clearly documents its data sources, assessment methods, results, and assumptions. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | The report does not address variability or uncertainty. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Jones, R. N. (1992). Asbestos exposures and thoracic neoplasms. Seminars in Roentgenology 27(2):94-101. |
| **HERO ID:** | 3082173 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Access to the underside of the ceilings was by the use of mobile scaffold towers, obviously made rather awkward because of the subdivisions of the area into manageable portions. Portionsof the ceiling not accessible with the towers were accessed by climbing over ductwork and judicious placing of Youngman boarding. This second phase lasted approximately 6 months,even with a nightshift (p. 1-2) |
| Engineering control: | adjacent areas are protected by sealing the work area with polyethylene sheeting, completely sealed and with airlock access and subject to smoke testing to ensure airtightness. The work area is then subject to a lowering of air pressure, relative to surrounding areas, by means of filtered extractors. The purpose of this is to eliminate any possibility of contaminating the adjacent areas with asbestos fibres. (p. 1) All adjacent areas were air-monitored by independent analysts a number of times a day inorder to ensure that no leakage of asbestos fibres took place to occupied areas. The polyethylene sheeting dividing off areas was monitored carefully at least once a day and repaired where necessary (p. 2) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Methodology | Low | Sampling/analytical methodology is not specified. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | Low | Location is not specified, but language choices suggest the work took place in England. |
| Metric 3: | Applicability | High | The report is for asbestos removal, an occupational scenario within the scope of the risk evaluation. |
| Metric 4: | Temporal Representativeness | Low | The information is greater than 20 years old. |
| Metric 5: | Sample Size | N/A | N/A - This metric is not applicable to the data being extracted |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Low | Assessment or report provides results, but the underlying methods, data sources, and assumptions are not fully transparent |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Low | The report does not address variability or uncertainty |

## Overall Quality Determination Low

| | |
|---|---|
| **Study Citation:** | Jung, H. S., Cha, J., Kim, S., Lee, W., Lim, H., Kim, H. (2015). Evaluating the efficiency of an asbestos stabilizer on ceiling tiles and the characteristics of the released asbestos fibers. Journal of Hazardous Materials 300:378-386. |
| **HERO ID:** | 3090049 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Products not Described by Other Codes |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Physical form: | fibers |
| Particle size characterization: | the fiber lengths were measured as 4.67 um from the untreated tiles, 7.43 um from the titles treated with inorganic stabilizers, and 8.03 um from the titles treated with organic and/or synthetic resin. (pg 382) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Methodology | High | report uses high quality data |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | Medium | The data are from an OECD country other than the U.S |
| Metric 3: | Applicability | High | The report is for an occupational scenario within the scope of the risk evaluation. |
| Metric 4: | Temporal Representativeness | High | The report is generally no more than 10 years old. |
| Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | High | Report clearly documents its data sources |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Low | The report does not address variability or uncertainty. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Jung, S. H., Kim, H. R., Koh, S. B., Yong, S. J., Chung, M. J., Lee, C. H., Han, J., Eom, M. S., Oh, S. S. (2012). A decade of malignant mesothelioma surveillance in Korea. American Journal of Industrial Medicine 55(10):869-875. |
| **HERO ID:** | 3531005 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Shipbuilding, construction, refinery work, cement work, and boiler making (3/7) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | Report uses high quality methods and data from frequently-used sources. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Medium | Data are from Korea, an OECD country. |
| | Metric 3: | Applicability | High | Data are for industrial use in construction materials, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Medium | Report contains data that is older than 20 years old and data that is less than 20 years old, but no data is less than 10 years old. |
| | Metric 5: | Sample Size | N/A | No sample data |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | Uncertainty is addressed in a discussion paragraph mentioning limits and improvements upon the study. Variability is not addressed. |

## Overall Quality Determination — High

| | |
|---|---|
| **Study Citation:** | Järvholm, B., Sandén, A. (1988). Asbestos-associated diseases in Swedish shipyard workers. Arhiv za Higijenu Rada i Toksikologiju / Archives of Industrial Hygiene and Toxicology 39(4):437-440. |
| **HERO ID:** | 3082922 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Spraying asbestos insulation. [PDF Pg. 1] |
| Number of workers: | 1960: 15,000 manual shipyard workers [PDF PG. 1]1988: 2,000 manual shipyard workers |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | Medium | Report uses high quality data/techniques/methods that are not from frequently-used sources and there are no known quality issues. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Medium | Data are from Sweden, an OECD country. |
| | Metric 3: | Applicability | High | Data are for construction, paint, electrical, and metal products, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: | Sample Size | Low | Sample distribution is characterized by no statistics. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Methods, results, and assumptions are clearly documented, but underlying data sources are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | Variability addressed by describing # workers for different time periods but uncertainty is not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Kauppinen, T., Pajarskiene, B., Podniece, Z., Rjazanov, V., Smerhovsky, Z., Veidebaum, T., Leino, T. (2001). Occupational exposure to carcinogens in Estonia, Latvia, Lithuania and the Czech Republic in 1997. Scandinavian Journal of Work, Environment and Health 27(5):343-345. |
| **HERO ID:** | 1942774 |
| **Conditions of Use:** | Other: |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Number of workers: | Estonia 2,000Latvia 3,000Lithuania 7,000Czech republic 56,000 |

**EVALUATION**

| Domain | | Metric | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | Medium | The government agency that provided the data for each country noted.Estonia - Estonian Statistical OfficeLatvia - Latvian Central Statistical BoardLithuania - State Department of StatisticsCzech Republic - Czech Hygienic Service |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Medium | OECD member countries |
| | Metric 3: | Applicability | Low | Unknow occupational groupings |
| | Metric 4: | Temporal Representativeness | Low | 1997 more than 20 years old |
| | Metric 5: | Sample Size | Low | No statistical data were provided, just exposure counts |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | Data sources were clearly noted and methods documented. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | The report does not address variability or uncertainty. |

## Overall Quality Determination Low

| | |
|---|---|
| **Study Citation:** | Keesler AFB, (1995). Asbestos operating plan. |
| **HERO ID:** | 3981067 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | ACM Workers, Contract Supervisors, Supervisors, Inspectors, Management Planner, Project Designer (30/41) |
| Exposure route: | inhalation (6/41) |
| Physical form: | long, thin fibers (5/41) |
| Personal protective equipment: | If asbestos is less than 1 f/cc, a half mask air purifying respirator is required. If concentrations are less than 5 f/cc, a full facepiece air purifying respirator with high efficiency filters is required. If concentrations are less than 10 f/cc, any powered air purifying respirator with high efficiency filters or any supplied air respirator is required. If concentrations are less than 100 f/cc, a full facepiece supplied air respirator operated to pressure demand mode is required. If concentrations are over 100 f/cc, a full facepiece supplied air respirator operated in pressure demand mode equipped with an auxiliary positive pressure SCBA is required. (33/41). Other PPE includes coveralls or similar full-body work clothing, gloves, hard hats, safety shoes or disposable shoe coverlets, and eye protection. (34/41) |
| Engineering control: | The specific engineering and work practice controls required will depend on the type of ACM involved and the likelihood that the material will be disturbed during the work. Exposure monitoring should also be conducted. (31/41) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Methodology | Medium | The assessment or report uses high quality data and/or techniques or sound methods that are not from a frequently used source and associated information does not indicate flaws or quality issues. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | Data are from the U.S. |
| Metric 3: | Applicability | High | Data are for industrial use in construction materials, an in-scope occupational scenario. |
| Metric 4: | Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| Metric 5: | Sample Size | N/A | No sample data. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Low | Assessment results are provided but underlying methods, assumptions, and data sources are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Medium | Variability is addressed by explaining different PPE requirements at different concentrations. Uncertainty isn't addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Kelly, J. E., Van Glider, T. J. (1994). Health hazard evaluation report HETA 93-0562-2464, Ohio University, Athens, Ohio. |
| **HERO ID:** | 3102323 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | The project included the removal of acoustical plaster, thermalsystem insulation, and floor tile. The floor tile removal included removal ofthe tile mastic, the adhesive which bonds the tile to the floor.Removal was performed by first pouring the solvent onto the floor surface from a 5-gallon container, agitating the mastic-coated surface for approximately 10 minutes using heavy-bristle push brooms, collecting the mixture of solvent and dissolved mastic using a squeegee and a shovel. and then placing this mixture into the empty 5-gallon containers. The 5-gallon containers were double-bagged for disposal as ACM. |
| Number of workers: | The abatement crew consisted of 10 workers, 9 of whom worked inside the containment on the day of sampling. |
| Personal protective equipment: | During the removal of the mastic, workers inside containment wore coveralls and half-face air-purifying respirators (APRs), which were provided by the employer. The coveralls were made of 100% spun-bonded polypropylene orTyvek (depending on which one the worker preferred)-. The respirators were equipped with combination cartridges consisting of a high-efficiency particulate air (HEPA) filter coupled with an organic vapor cartridge. Workers also wore cotton gloves and rubber boots. Eye protection was not worn by any of the workers. |
| Engineering control: | Removal was performed under containment, with outside walls and doorways sealed off with polyethylene plastic and air filtration devices (AFDs) used to maintain negative pressure in the containment area. |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | The assessment or report uses high quality data and/or techniques or sound methods that are from frequently used sources (e.g., European Union or OECD reports, NIOSH HHEs, journal articles, Kirk-Othmer) and are generally accepted by the scientific community, and associated information does not indicate flaws or quality issues |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for Industrial/Commercial Use: Chemical Substances in Construction, Paint, Electrical, and Metal Products, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Medium | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: | Sample Size | Low | Sample distribution is described qualitatively. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Low | Assessment results are provided but underlying methods, assumptions, and data sources are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Kern, D. G., Frumkin, H. (1990). Asbestos-related disease in the jewelry industry. Journal of Occupational Medicine 32(2):87. |
| **HERO ID:** | 3082615 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Products not Described by Other Codes |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Before the boards hardened, their surfaces were indented in the shape of the specific jewelry pieces to be soldered. In preaparation for new pieces, workers would rub together two boards to obliterate the existing impressions, re-wet the boards' surfaces, and make fresh impressions. When asbestos powder was unavailable, asbestos sheets were ground up instead. (p. 1)A secont recent report described a similar finding among Native American craftspeople who produce jewelry. They use "pounding boards" made of asbestos to insulate worktables from the heat of brazing torches and molten metal. When silver slag accumulates on these boards, they are clapped or rubbed together, resulting in substantial airborne asbestos exposure. (p. 1) |
| Exposure route: | inhalation (p. 1) |
| Physical form: | asbestos powder from 25-45% chrysotile asbestos (p. 1) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Methodology | Low | Sampling/analytical methodology is not specified. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | Data are from the U.S. |
| Metric 3: | Applicability | Uninformative | Data are for jewelry making which is not in-scope or similar to an in-scope occupational scenario. |
| Metric 4: | Temporal Representativeness | Low | The report is more than 20 years old. The report captures operations, equipment, and worker activities that are expected to be outdated |
| Metric 5: | Sample Size | N/A | N/A - This metric is not applicable to the data being extracted |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Low | Assessment or report provides results, but the underlying methods, data sources, and assumptions are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Low | The report does not address variability or uncertainty. |

## Overall Quality Determination Uninformative

| | |
|---|---|
| **Study Citation:** | Kern, D. G., Frumkin, H. (1988). Asbestos-related disease in the jewelry industry: Report of two cases. American Journal of Industrial Medicine 13(3):407-410. |
| **HERO ID:** | 3083016 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Manufacture of costume and precious jewelry. |
| Exposure route: | inhalation |
| Physical form: | Powder |
| Number of workers: | 2 |
| Engineering control: | Five to 10 years ago, major jewelry manufacturers converted to asbestos-free soldering boards. |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | Low | The data, data sources, and/or techniques or methods used in the assessment or report are not specified. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | the data are from the United States |
| | Metric 3: | Applicability | Medium | The report is for an occupational scenario that is similar to an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Low | The report is more than 20 years old. |
| | Metric 5: | Sample Size | Medium | Distribution of samples is characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Low | Assessment or report provides results, but the underlying methods, data sources, and assumptions are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | The report does not address variability or uncertainty. |

## Overall Quality Determination — Low

| | |
|---|---|
| **Study Citation:** | Kichula, D. M. (1988). Asbestos removal in the public eye. One hospital's story. AIPE Facilities Management, Operations and Engineering 15(6):19. |
| **HERO ID:** | 6894662 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Exposure duration: | 24-hr shifts |
| Engineering control: | wetting procedures, controlled removal and bagging methods, maintenance of differential air pressure, secondary and tertiary levels of containment, security safeguards including the use of wood framed and sheathed barriers and lockable ports of entry, modification of building HVAC |
| Comments: | Removal of 70,000 sq ft of asbestos-containing acoustical ceiling plaster. |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | Medium | Report uses high quality data that are not from frequently-used sources and there are no known quality issues. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for abatement, an in-scope occupational scenario |
| | Metric 4: | Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: | Sample Size | N/A | engineering controls data |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Low | Assessment results are provided but underlying methods, assumptions, and data sources are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | N/A | engineering controls data |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Kiefer, M., Tepper, A., Miller, R. (1992). Health hazard evaluation report no. HETA 91-338-2187, IMC Corporation, Sterlington, Louisiana. |
| **HERO ID:** | 3970510 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | DodCo employees worked with an encapsulant for sealing, or "locking down" asbestos, and a spray adhesive which was used to attach polyethylene sheets to framing when constructing enclosures. |
| Number of workers: | DodCo had approximately 180 employees on-site conducting asbestos work 24 hours per day (2 shifts) |
| Personal protective equipment: | Cotton gloves, disposable coveralls, and half-face respirators with cartridges designed for protection from asbestos exposure (p. 8) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Methodology | High | The assessment or report uses high quality data and/or techniques or sound methods that are from frequently used sources. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | High | The data are from the United States and are representative of the industry being evaluated. |
| | Metric 3: Applicability | High | The report is for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: Temporal Representativeness | Low | The report is more than 20 years old. |
| | Metric 5: Sample Size | N/A | No sample data. |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | Medium | Assessment or report clearly documents results, methods, and assumptions. Data sources are generally described but not fully transparent. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | N/A | No scope to address variability and uncertainty. |

## Overall Quality Determination — High

| | |
|---|---|
| **Study Citation:** | Klim, J. P. (1990). Asbestos in the work place. :209-211. |
| **HERO ID:** | 6859493 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Encapsulation, use of wetting agents, removal of asbestos |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | Medium | The assessment or report uses high quality data and/or techniques or sound methods that are not from a frequently used source and associated information does not indicate flaws or quality issues. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | The data are from the United States and are representative of the industry being evaluated. |
| | Metric 3: | Applicability | High | The report is for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Low | The report is more than 20 years old. The report captures operations, equipment, and worker activities that are expected to be outdated. |
| | Metric 5: | Sample Size | N/A | n/a - no sampling data |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | Assessment or report clearly documents its data sources, assessment methods, results, and assumptions. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | The report provides only limited discussion of the variability and uncertainty in the results. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Kogevinas, M., Boffetta, P., Pearce, N. (1994). Occupational exposure to carcinogens in developing countries. IARC Scientific Publication, vol. 129 :63-95. |
| **HERO ID:** | 1357271 |
| **Conditions of Use:** | Other: |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Top sources of exposure were roofing material, brake linings, cement pipes, tiles, insulation, demolition, paints, and shipyards. (5/34) |
| Exposure route: | inhalation (5/34) |
| Number of workers: | Asbestos exposure by country: 1,000 workers in Angola, 500-700 in Bahrain, 100 in Botswana, 20-30,000 in Brazil, 2,200 in Cuba, 330 in Cyprus, 9,900 in India, 200 in Jordan, 425 in Kuwait, 1,300 in Morocco, 600 in Peru, 2,596 in Singapore, 2,000 in Thailand, and 15,600 in Tanzania. (4/34) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Methodology | High | Report uses high quality methods and data from frequently-used sources. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | Low | Data is worldwide, but mostly from non-OECD countries. |
| | Metric 3: Applicability | High | Data are for all occupational uses of asbestos. |
| | Metric 4: Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: Sample Size | Medium | Sample distribution characterized by limited statistics (number of workers) but discrete samples not provided and distribution not fully characterized. |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Medium | Variability is addressed by gathering data from numerous studies in different countries. Uncertainty isn't addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Kominsky, J. R. (1979). Health Hazard Evaluation Determination, Report No. HHE-78-119-637, Texaco, Inc., Bayonne Terminal, Bayonne, New Jersey. NIOSH(HHE-78-119-637):78-119. |
| **HERO ID:** | 3651835 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | 18 operators are compounders and 14 compounder helpers working in proximity to pipe insulation containing asbestos. However, no asbestos disturbing activities are taking place. |
| Exposure route: | inhalation |
| Physical form: | inhalable fibers |
| Exposure duration: | 8 hours per day ( 3 shifts) |
| Exposure frequency: | 40 hours per week |
| Number of workers: | 20 people 18 operators and 2 supervisors |
| Personal protective equipment: | All respirators used should be those certified under the NIOSH respirator standards, 30 CRF Part 11. Refer to the NIOSH CertifiedEquipment List as of July 1, 1978 (Publication No. 79-107) for a listing of NIOSH-approved respirators. |
| Comments: | Primary focus of this study was not asbestos but exposure to hazardous organic chemicals. |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Methodology | High | The evaluation uses high quality data and techniques that are generally accepted by the EPA and associated information does not indicate flaws or quality issues. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | High | The data are from the United States. |
| | Metric 3: Applicability | Uninformative | The report is for work activities that take place near ACM, but work activities are not related to the ACM. No disturbance of asbestos is occurring during work activities. |
| | Metric 4: Temporal Representativeness | Low | 1979- more than 20 years old |
| | Metric 5: Sample Size | Low | Distribution of samples is qualitative or characterized by no statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | High | Assessment or report clearly documents its data sources, assessment methods, results, and assumptions. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Low | The report does not address variability or uncertainty. |

## Overall Quality Determination Uninformative

| | |
|---|---|
| **Study Citation:** | Koné Pefoyo, A. J., Genesove, L., Moore, K., Del Bianco, A., Kramer, D. (2014). Exploring the usefulness of occupational exposure registries for surveillance: the case of the Ontario Asbestos Workers Registry (1986-2012). Journal of Occupational and Environmental Medicine 56(10):1100-1110. |
| **HERO ID:** | 3531039 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | renovations, maintenance, and demolition of buildings containing asbestos (pg 1) |
| Exposure duration: | Fifty percent of women exposed had more than 346 hours of exposure compared with 86 hours among men (pg 6)Figures 3 and 4 (pg 7) |
| Number of workers: | 30,829 (Ontario Asbestos Workers Registry), 2,000 workers still exposed annually until 2006 (abstract)114 of 125 workers for one asbestos-specialized company registered on OAWR; another company registered 0 of their 10 employees (pg 3)144 workers per 100,000 in construction industry annually reported in OAWR (pg 3); 18 per 100,000 in MFG industry, 16.7 and 5.5 per 100,000 for educational and government services respectively, 3.5 per 100,000 in mining and <1.5 in all other industries (pg 5)Between 1986 and June 2012, 26,704 workers newly exposed to asbestos; 263 in 2011 vs 1447 in 1986 (pg 5)In 1986, 29.7 per 100,000 workers in Ontario exposed to asbestos. Reached 70 in 1989, 20.5 in 2005, and 9.9 in 2011 (pg 6)Figures 3 and 4 (pg 7) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Methodology | Medium | Report uses high quality data/techniques/methods that are not from frequently-used sources and there are no known quality issues. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | Medium | Data are from Canada, an OECD country. |
| | Metric 3: Applicability | High | Data are for construction, an in-scope occupational scenario. |
| | Metric 4: Temporal Representativeness | Medium | Report is based on data both less and greater than 10 years old. |
| | Metric 5: Sample Size | Medium | Sample distribution characterized by limited statistics (averages) but discrete samples not provided and distribution not fully characterized. |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | Medium | Assessment or report clearly documents results, methods, and assumptions. Data sources are generally described but not fully transparent. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Medium | Variability addressed by providing data for multiple industries over many years but uncertainty is not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Kushner, L. (1988). Environmental projects: Volume 4. Asbestos survey. |
| **HERO ID:** | 6894315 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Exposure route: | inhalation & ingestion |
| Physical form: | fibers |
| Area sampling data: | ”Air sampling and analysis were not included in the scope of thesurvey.” [PDF pg 71/413] |
| Number of workers: | 246 onsite personnel and 55 located in the Barstow facility. |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | The report uses high quality data and techniques that are from frequently used sources. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | The data are from the United States. |
| | Metric 3: | Applicability | High | The report is for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Low | 1988- prior to latest PEL and more than 20 years old. |
| | Metric 5: | Sample Size | N/A | No sample data collected. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | Assessment or report clearly documents its data sources, assessment methods, results, and assumptions. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | The report provides only limited discussion of the variability and uncertainty in the results. |

## Overall Quality Determination — High

| | |
|---|---|
| **Study Citation:** | Landrigan, P. J., Diliberti, J. H., Graef, J. W., Jackson, R. I., Nathenson, G. (1987). American Academy of Pediatrics Committee on Environmental Hazards: Asbestos exposure in schools. Pediatrics 79(2):301-305. |
| **HERO ID:** | 3083143 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Exposure to teachers and/or workers at school: ACM, over time, become friable, which can flake off to become fine dust that settles on surfaces and readily resuspended in classroom air. [PDF pg. 1] |
| Number of workers: | EPA estimated more than 250,000 teachers, maintenance workers, and other adults were potentially exposed. |
| Engineering control: | Options to handle asbestos exposure in schools: (1) Removal, (2) Enclosure involves construction of airtight walls and (drop) ceilings adjacent to surface with friable asbestos. (3) Encapsulation involves spraying friable asbestos-containing surfaces with sealants to prevent further release of asbestos fibers. Enclosure and encapsulation are only temporary solutions. (4) Finally, for hazards that are not immediate or are of low priority, a periodic building maintenance and inspection program can be set up to detect any appreciable changes in conditions. |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | The assessment or report uses high quality data and/or techniques or sound methods that are from frequently used sources (e.g., European Union or OECD reports, NIOSH HHEs, journalarticles, Kirk-Othmer) and are generally accepted by the scientific community, and associated information does not indicate flaws or quality issues. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | The data are from the United States and are representative of the industry being evaluated. |
| | Metric 3: | Applicability | High | The report is for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Low | The report is more than 20 years old. |
| | Metric 5: | Sample Size | N/A | N/A- no sampling data. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | Assessment or report clearly documents its data sources, assessment methods, results, andassumptions. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | High | The report addresses variability and uncertainty in the in engineering controls information. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Lange, J. H., Mastrangelo, G., Buja, A. (2006). Smoking and alcohol use in asbestos abatement workers. Bulletin of Environmental Contamination and Toxicology 77(3):338-342. |
| **HERO ID:** | 3531078 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Asbestos containing material removal workers |
| Exposure route: | Inhalation |
| Physical form: | Fibers |
| Number of workers: | 37 participants |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | The assessment or report uses high quality data and/or techniques or sound methods that are from frequently used sources. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | The data are from the United States. |
| | Metric 3: | Applicability | High | The report is for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Medium | The report captures operations, equipment, and worker activities that are expected to be reasonably representative of current conditions. The report is generally more than 10 years but no more than 20 years old. |
| | Metric 5: | Sample Size | N/A | n/a - no sampling data |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Assessment or report clearly documents results, methods, and assumptions. Data sources are generally described but not fully transparent |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | N/A | No scope to address variability and uncertainty. |

## Overall Quality Determination High

**Study Citation:** Langer, A. M. (2001). Summary of the symposium. Canadian Mineralogist SI 5:291-296.
**HERO ID:** 6863396
**Conditions of Use:** Other:

**EXTRACTION**

| Parameter | Data |
|---|---|
| Particle size characterization: | The unit fibril diameter varies among the amphibole species, with crocidolite forming the finest fibril, about 0.05-0.08 um, followed by amosite, about 0.12-0.20 um. (2/6) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | Report uses high quality methods and data from frequently-used sources. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | General particle size data, but it can be applied to all in-scope COUs. |
| | Metric 4: | Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: | Sample Size | Medium | Sample distribution characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Lawrence, J., Tosine, H. M., Zimmermann, H. W., Pang, T. W. S. (1975). REMOVAL OF ASBESTOS FIBERS FROM POTABLE WATER BY COAGULATION AND FILTRATION. Water Research 9(4):397-400. |
| **HERO ID:** | 3585186 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Products not Described by Other Codes |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Exposure route: | Ingestion |
| Physical form: | Fiber |
| Particle size characterization: | Chrysotile consists of parallel bundles of submicroscopic fibres about 20 nm diameter. the majority of those found in surface water are less than 5 um long and about 0.1 um india. (P. 1/4) |
| Comments: | two coagulation/flocculation methods have been optimized for the removal of asbestiformfibres from potable water. |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | Medium | Report uses high quality data/techniques/methods that are not from frequently-used sources and there are no known quality issues. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Medium | Data are from Canada, an OECD country. |
| | Metric 3: | Applicability | High | Data are for disposal, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: | Sample Size | Low | Distribution of samples is qualitative or characterized by no statistics. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Methods, results, and assumptions are clearly documented, but underlying data sources are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | Variability addressed by evaluating different WWT methods, but uncertainty is not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Lim, J. W., Koh, D., Khim, J. S., Le, G. V., Takahashi, K. (2011). Preventive measures to eliminate asbestos-related diseases in singapore. Safety and Health at Work 2(3):201-209. |
| **HERO ID:** | 3078487 |
| **Conditions of Use:** | Disposal |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Removal of asbestos-based insulating laggingThere are three different methods that could be used for the removal of asbestos-based insulating lagging. The spray method, using a manually controlled low pressure water spray, is suitable for ACM which is not covered by other materials that require prior removal, such as paint or cladding. If the asbestos-based material is too thick whereby the dust cannot be controlled significantly by the spray method alone, a second method of soaking involving total saturation can be used as an alternative. The third, dry method should only be considered in situation where the spray or soaking method cannot be used. This method requires the insulating lagging to be isolated fully using plastic screening. The outer surface of insulation should be cleaned by vacuum cleaners fitted with HEPA filters to remove loose ACM. Asbestos waste should not be allowed to accumulate in the work areas. Dampening of asbestos waste to reduce dustiness before disposal is highly recommended. Dry sweeping must never be used to clean asbestos dust from any surface but rather, a vacuum cleaning device with a HEPA filter should be used to minimize dust accumulation. When vacuum cleaning is impractical, the surface can be wiped clean simply by using a wet rag and the floor can be cleaned by gently applying a water spray.Upon completion of the asbestos removal job, all the equipment including access scaffolds and elevating platforms must be cleaned using water or a HEPA-filtered vacuum. Further, all asbestos waste and any polyethylene sheets used as barriers should be disposed of in airtight containers. |
| Exposure route: | inhalation, dermal, ingestion (after mucociliary clearance) |
| Physical form: | fibrous dust |
| Personal protective equipment: | Regular dust monitoring is required when asbestos work is in progress. If PEL is exceeded, the contactors must take all the measures mentioned above to reduce generation of asbestos dust at the workplace.PPE must be used even when effective asbestos dust control can be achieved by other techniques. The workers must be fully instructed in the use and maintenance of PPE.Water-proof full body protective clothing should be worn by persons engaged in removal of asbestos-based insulation and in work areas where asbestos dust is likely to be generated.Such protective clothing should not have pockets. The clothing is best made of synthetic fiber material that does not permit the penetration of asbestos fibers. Eye irritation can be prevented by wearing goggles. In addition, respirators with a HEPA filter must be used whenever the work processes create asbestos dust during working of ACM. Workers must be taught to change the filters whenever they detect an increase in breathing resistance, and fit testing should be conducted to ensure correct size of respirators. |
| Engineering control: | A designated asbestos work area must be established before work begins. This area should be segregated and sealed to prevent the escape of asbestos dust to other spaces, and access allowed only to authorized workers who are directly involved in the asbestos workWarning signs (part of the administrative control) should be displayed at each asbestos work area, posted at high-human traffic areas, and at the entrance to the asbestos work area. Such signs should be written in simple language to be comprehensible to all persons and they must remain posted until the work has been completedWithin the work area, all movable furniture should be removed to avoid contamination with asbestos dust. Impervious polyethylene sheets also should be used to completely cover pieces of furniture and fittings that cannot be removed from the work area. Air conditioning systems must be shut down as they can circulate asbestos dust to other parts of buildings.All exhaust air from the asbestos work area must pass through a high efficiency particulate air (HEPA) filter before release into the environment.For decontamination purposes, it is also important to set up proper washing and changing facilities for workers to wash themselves and to change into street clothing after the asbestos removal work (Fig. 3). Three areas including a “clean area”, a “shower area” and a “dirty area” have to be established in the worksite. During the asbestos removal work, workers should only be allowed to enter and exit the worksite through the established washing and changing facilitiesPPE should be put on before entering the asbestos work area.Efficient local exhaust systems should be installed whenever mechanical cutting, sawing or machining of soft asbestos insulating boards or hard asbestos cement building boards takes place. Alternatively, water can be used as a dust suppressant for power cutting.For the removal of ACM from buildings, wet methods should be used where feasible as this can prevent the asbestos fibers from becoming airborne. Wetting should be done before as well as continually throughout the removal work. All debris should be collected and wrapped up immediately in impermeable polyethylene sheets while still wet, and all asbestos waste must be affixed with proper warning labels before disposal |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |

**Continued on next page . . .**

. . . continued from previous page

**Study Citation:** Lim, J. W., Koh, D., Khim, J. S., Le, G. V., Takahashi, K. (2011). Preventive measures to eliminate asbestos-related diseases in singapore. Safety and Health at Work 2(3):201-209.
**HERO ID:** 3078487
**Conditions of Use:** Disposal

| Domain | | Metric | EVALUATION Rating | Comments |
|---|---|---|---|---|
| | Metric 1: | Methodology | High | Report uses high quality data and methods that are from frequently-used sources and there are no known quality issues. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Low | Data are from Singapore, a non-OECD country. |
| | Metric 3: | Applicability | High | Data are for demolition/renovation, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Medium | Report is based on data greater than 10 years old but no more than 20 years old and industry conditions that are expected to be representative of current industry conditions. |
| | Metric 5: | Sample Size | N/A | no sample related data |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Methods, results, and assumptions are clearly documented, but underlying data sources are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | High | Variability is addressed by discussing the variability of adherence to the current requirements and uncertainty in the effectiveness of preventative measures. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Luxon, S. (1970). Respirators for protection against asbestos. Annals of Occupational Hygiene 13(1):41. |
| **HERO ID:** | 3084914 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Personal protective equipment: | High efficiency dust respirators with a protection factor of 400 should be used to protect against high concentrations of Chrysotile fibers. These respirators include full facepiece or positive pressure type respirators. Another type of respirator that can be used is a half mask respirator fed with compressed air. |
| Comments: | Unclear if automotive brake pad replacement so the document was screened. |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Methodology | High | Report uses high quality data/techniques/methods from frequently-used sources. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | Medium | Data are from Britain, an OECD country. |
| | Metric 3: Applicability | High | Data are for construction, paint, electrical, and metal products, an in-scope occupational scenario. |
| | Metric 4: Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: Sample Size | N/A | N/A - PPE. |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | Low | Assessment results are provided but underlying methods, assumptions, and data sources are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | N/A | N/A - PPE. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Luxon, S. G. (1971). The use of dust respirators against asbestos dust hazards in the United Kingdom. American Industrial Hygiene Association Journal 32(11):723-725. |
| **HERO ID:** | 3084863 |
| **Conditions of Use:** | Other: |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Physical form: | Fibers (dust) |
| Personal protective equipment: | Dust respirators meet the criteria of British Standard 2091 when they do not allow more than 5% of particulate to penetrate the filter and face seal, suitable up to 40 f/cc for chrysotile asbestos and amosite asbestos and 4 f/cc for crocidolite asbestos. Positive-pressure dust respirators (<1% penetration), ultra high-efficiency dust respirators (<0.1% penetration), and positive-pressure airline breathing apparatus are used for higher exposure levels. |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Methodology | High | The assessment or report uses high quality data and/or techniques or sound methods that are from frequently used sources. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | Medium | The data are from an OECD country other than the U.S. (U.K.), and locality-specific factors (e.g., potential differences in regulatory occupational exposure or emission limits, industry/ processtechnologies) may impact exposures or releases relative to the U.S. |
| | Metric 3: Applicability | High | The report is for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: Temporal Representativeness | Low | The report is more than 20 years old. The report captures operations, equipment, and worker activities that are expected to be outdated. |
| | Metric 5: Sample Size | N/A | n/a - not dependent on sampling |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | High | Assessment or report clearly documents its data sources, assessment methods, results, and assumptions. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Medium | Variability is addressed by discussing different types of respirators but uncertainty is not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Macdonald, B. (2004). Managing the asbestos risk. Health Estate Journal 58(2):29-31. |
| **HERO ID:** | 3531147 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Sources of exposure are thermal insulation of pipes and boilers, fire protection in ducts, panels , and celling panels, insulating boards, millboard, and cement products. (1/3) |
| Physical form: | fibers (1/3) |
| Engineering control: | If the asbestos materials are in poor condition or in a vulnerable location it may be appropriate to remove, encapsulate or repair the materials. In most cases the material should be left in place and a system put in place to make sure maintenance workers and others are warned before any work is started and to ensure that appropriate precautions are taken. There will also be a need to regularly check the condition of those materials retained. (2/3) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | Report uses high quality data that are from frequently-used sources and there are no known quality issues. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Medium | Data are from the U.K., an OECD country. |
| | Metric 3: | Applicability | High | Data are for commercial use in construction materials, which is similar to the in-scope occupational scenario commercial use of construction materials. |
| | Metric 4: | Temporal Representativeness | Medium | Report contains data that is older than 20 years old and data that is less than 20 years old, but no data is less than 10 years old. |
| | Metric 5: | Sample Size | N/A | N/A - This metric is not applicable to the data being extracted |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Methods, results, and assumptions are clearly documented, but underlying data sources are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Mancuso, T. F. (1991). Mesotheliomas among railroad workers in the United States. Annals of the New York Academy of Sciences 643:333-346. |
| **HERO ID:** | 3082302 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Products not Described by Other Codes |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Lagging removal and installation on the boilers of steam engines. (P. 2) |
| Exposure route: | inhalation (p. 2) |
| Physical form: | The asbestos lagging used was approximately 4 feet long, 4 inches thick, and 6 inches wide and was applied as blocks. (p. 1) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Methodology | Medium | The assessment or report uses high quality data and/or techniques or sound methods that are not from a frequently used source and associated information does not indicate flaws or quality issues |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | Data are from the U.S. |
| Metric 3: | Applicability | Uninformative | Data are for workers on railroad equipment which is not in-scope or similar to an in-scope occupational scenario. |
| Metric 4: | Temporal Representativeness | Low | The report is more than 20 years old. The report captures operations, equipment, and worker activities that are expected to be outdated |
| Metric 5: | Sample Size | Medium | Distribution of samples is characterized by a range with uncertain statistics. It is unclear if analysis is representative. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Medium | Assessment or report clearly documents results, methods, and assumptions. Data sources are generally described but not fully transparent. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Medium | The report provides only limited discussion of the variability and uncertainty in the results |

## Overall Quality Determination Uninformative

| | |
|---|---|
| **Study Citation:** | Marconi, A., Menichini, E., Paoletti, L. (1984). A comparison of light microscopy and transmission electron microscopy results in the evaluation of the occupational exposure to airborne chrysotile fibres. Annals of Occupational Hygiene 28(3):321-331. |
| **HERO ID:** | 3083685 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Products not Described by Other Codes |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Railway workshop dealing with maintenance and repairs. Fiber exposure resulted from asbestos tapes and paperboards handling, and from asbestos-cement board sanding (pg 322) |
| Physical form: | Fiber. Fiber type was chrysotile (pg 322) |
| Area sampling data: | Results showed a very good agreement with the Poisson distribution has been obtained for the samples with a density of up to 5 fibres per graticule area (about 650 fibres mm^2), with a maximum agreement for the samples with density up to 1 fibre/graticule area (pg 324) |
| Particle size characterization: | All the fibres belonging to one of the following size classes were considered for analysis: (1) l>5 um, 0.3 um<d<3 um, l/d> 3 (microscopic fibres); (2) l> 5 um, d<=0.3 um, l/d>3 (submicroscopic fibres); (3)l<5 um, d <3 um, l/d>3 (short fibres). The whole of microscopic plus submicroscopic fibres are reported as 'total' fibres (l> 5 um). Minimum diameter and minimum length of fibres detected by TEM were estimated to be, respectively 10^-2 and 3 x 10^-2 um. (pg 323) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Methodology | High | Report uses high quality data using well described techniques |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | Medium | The data are from an OECD country other than the U.S. |
| | Metric 3: Applicability | High | The report is for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: Temporal Representativeness | Low | The report is more than 20 years old. |
| | Metric 5: Sample Size | Low | Distribution of samples is characterized by no statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | High | Report clearly documents its data sources, assessment methods, results, and assumptions. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Medium | The report provides only limited discussion of the variability and uncertainty in the results. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Markowitz, S.,teven, Scarbrough, C.,arl, Kieding, S.,ylvia, Griffon, M.,ark (2004). Y-12 and Oak Ridge National Laboratory medical surveillance program, Phase I: Needs assessment. |
| **HERO ID:** | 3974971 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Exposure from building materials, other reported uses included asbestos blankets asbestos covering on piping, and asbestos gloves (maintenance workers) (p. 17) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | Medium | The assessment or report uses high quality data and/or techniques or sound methods that are not from a frequently used source and associated information does not indicate flaws or quality issues. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | The data are from the United States and are representative of the industry being evaluated |
| | Metric 3: | Applicability | High | The report is for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Medium | The report captures operations, equipment, and worker activities that are expected to be reasonably representative of current conditions. The report is generally more than 10 years but no more than 20 years old. |
| | Metric 5: | Sample Size | Low | Distribution of samples is qualitative or characterized by no statistics. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Assessment or report clearly documents results, methods, and assumptions. Data sources are generally described but not fully transparent. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | The report does not address variability or uncertainty. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Matos, L., Santos, P., Barbosa, F. (2012). Exposure to fibres in the occupational environment. :375-379. |
| **HERO ID:** | 6865201 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Exposure route: | Inhalation [PDF Pg. 2] |
| Physical form: | Fibers (solid) [PDF Pg. 2] |
| Personal protective equipment: | Protective clothing, gloves, masks, and goggles. [PDF Pg. 4] |
| Engineering control: | Adequate general and localized ventilation. [PDF Pg. 4] |
| Comments: | For the sampling and measurement of asbestos and other fibres, can be used NIOSH method 7400 (7400NIOSH, 1994), whose analytical technique is the manual counting of fibres using a phase contrast microscope. Regarding asbestos, you can also apply the NIOSH 7402 method (7402NIOSH, 1994), whose determination is made using the electronic transmission microscope. [PDF Pg. 4]Worker activity description and particle size characterization now given in the document. |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Methodology | High | Report uses high quality data/techniques/methods from frequently-used sources. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | Medium | Data are from Portugal, an OECD country. |
| | Metric 3: Applicability | High | Data are for all in scope occupational scenarios. |
| | Metric 4: Temporal Representativeness | High | Report is based on current industry conditions and data no more than 10 years old. |
| | Metric 5: Sample Size | N/A | N/A - no sample results. |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | N/A | N/A - no sample results. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Mckenna, J. (2016). Working safely with asbestos cement. Journal of the New England Water Works Association 130(4):266-271. |
| **HERO ID:** | 6897563 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Removal of asbestos cement pipes. [PDF Pg. 5]The approved method for AC pipe removal consists of keeping the pipes predominantly in whole pieces. By wetting the section that is going to be cut prior to cutting, the release of fibers will be minimized. Snap cutters and carbide-tipped blade cutters, along with manual field lathes, are the tools that can best accomplish ACM pipe removal without generating dust and small broken pieces. DLS regulations have allowances when working with non friable ACM, provided that the material does not become friable, and no dust is generated by the work procedures used. |
| Exposure route: | Inhalation [PDF Pg. 1] |
| Physical form: | Dust fibers (solid) [PDF Pg. 5] |
| Personal protective equipment: | Respirators and full body disposable suits. [PDF Pg. 5] |
| Engineering control: | Miniature containment system or HEPA-shrouded tools. [PDF Pg. 5] |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Methodology | High | Report uses high quality data/techniques/methods from frequently-used sources. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | High | Data are from the U.S. |
| | Metric 3: Applicability | High | Data are for Chemical Substances in Construction, Paint, Electrical, and Metal Products, an in-scope occupational scenario. |
| | Metric 4: Temporal Representativeness | High | Report is based on current industry conditions and data no more than 10 years old. |
| | Metric 5: Sample Size | N/A | N/A - No sample data. |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | N/A | No scope to address variability and uncertainty. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Mesothelioma Cancer Alliance, (2018). A lurking danger: Proper disposal of residual asbestos critical to preventing disease. Solid Waste & Recycling 23(2):25. |
| **HERO ID:** | 6886507 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Construction workers and home renovators removing asbestos. Source of exposure is furnaces and heating systems, cement and plaster, building insulation, floor and ceiling tiles, and house siding. (1/2) |
| Personal protective equipment: | Disposable suits and a half-face respirator are required (1/2) |
| Engineering control: | Compressed air cannot be used to remove dust or clean tools, and wetting agents must be used to prevent asbestos fibers from becoming airborne.(2/2) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Methodology | Medium | Report uses high quality data that are not from frequently-used sources and there are no known quality issues. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | Medium | Data are from Canada, an OECD country. |
| Metric 3: | Applicability | High | The report is for an occupational scenario within the scope of the risk evaluation. |
| Metric 4: | Temporal Representativeness | High | Data are no more than 10 years old. |
| Metric 5: | Sample Size | N/A | N/A - This metric is not applicable to the data being extracted |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Low | Assessment results are provided but underlying methods, assumptions, and data sources are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Michiels, P. (2013). Dismantling the nuclear research reactor Thetis. :V002T03A032. |
| **HERO ID:** | 6870302 |
| **Conditions of Use:** | Disposal |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Packing asbestos materials into drums [PDF Pg. 4]. |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | Report uses high quality data/techniques/methods from frequently-used sources. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Medium | Data are from Belgium, an OECD country. |
| | Metric 3: | Applicability | High | Data are for disposal, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | High | Report is based on current industry conditions and data no more than 10 years old. |
| | Metric 5: | Sample Size | N/A | N/A - Worker activity. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | N/A | N/A - Worker activity. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Millette, , J. R., Harmon, A., Few, P., Turner, W. L., Jr, Boltin, W. R. (2009). Analysis of amphibole asbestos in chrysotile-containing ores and a manufactured asbestos product. Microscope 57(1):19-22. |
| **HERO ID:** | 6897208 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Particle size characterization: | Table 1: Tremolite fibers in gasketsLength: 1.4-8.3 umWidth: 0.15-0.6 umAspect ratio: 5.6-22 um |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | The assessment or report uses high quality data and/or techniques or sound methods that are from frequently used sources (journal article) and are generally accepted by the scientific community, and associated information does not indicate flaws or quality issues. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | The data are from the United States and are representative of the industry being evaluated. |
| | Metric 3: | Applicability | Medium | The report is for an occupational scenario that is similar to an occupational scenario within the scope of the risk evaluation, in terms of the type of industry, operations, and work activities. |
| | Metric 4: | Temporal Representativeness | Medium | The report captures operations, equipment, and worker activities that are expected to be reasonably representative of current conditions. The report is generally more than 10 years but no more than 20 years old. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized. Sample size is sufficiently representative. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | Assessment or report clearly documents its data sources, assessment methods, results, and assumptions. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | The report provides only limited discussion of the variability and uncertainty in the results. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Milne, J. (1969). Fifteen cases of pleural mesothelioma associated with occupational exposure to asbestos in Victoria. Medical Journal of Australia 2(14):669-673. |
| **HERO ID:** | 3084987 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Products not Described by Other Codes |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Occupations are presented in Table 1 (pg 670). Ship building and laboring in a naval dockyard are well known to be occupational sources of asbestos exposure. Lagging, asbestos carding and asbestos string winding involved heavy asbestos exposure about 25 years ago, and the truck driver is known to have worked for the asbestos Winding firm. Other workers were from munitions factory (pg 670). |
| Exposure route: | Inhalation (pg 672) |
| Physical form: | For four patients, it was found that they were exposed to crocidolite dust (pg 672) |
| Exposure duration: | Subjects in this study began their exposure either during or before 1942. The longest exposure was 30 years. Five patients had been exposed for five years or less, one of them for only six months (pg 671). |
| Number of workers: | 15 (pg 669) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Methodology | High | assessment uses high quality data and/or techniques |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | Medium | data are from an OECD country other than the U.S |
| | Metric 3: Applicability | High | The report is for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: Temporal Representativeness | Low | The report is more than 20 years old. |
| | Metric 5: Sample Size | Low | Distribution of samples is characterized by no statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | Medium | Data sources are generally described but not fully transparent. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Low | The report does not address variability or uncertainty. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Mimides, T. M., Aggelides, S. M., Kaplanides, A. C. (1997). Refuse disposal of asbestos and other mineral fibres and environmental health hazards. 1-3:2011-2015. |
| **HERO ID:** | 3086854 |
| **Conditions of Use:** | Disposal |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Exposure route: | inhalation (2/5) |
| Physical form: | fibers (1/5) |
| Personal protective equipment: | Adequate respiratory protection should be worn (4/5) |
| Engineering control: | Engineering controls include damping down of any asbestos spillages, immediate covering with any spillages, and washing contaminated clothes and equipment. (4/5) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Methodology | Medium | Report uses high quality data that are not from frequently-used sources and there are no known quality issues. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | Medium | Data are from Greece, an OECD country. |
| | Metric 3: Applicability | High | Data are for disposal of asbestos products, an in-scope occupational scenario. |
| | Metric 4: Temporal Representativeness | Medium | Report is based on data greater than 10 years old but no more than 20 years old and industry conditions that are expected to be representative of current industry conditions. |
| | Metric 5: Sample Size | N/A | N/A - This metric is not applicable to the data being extracted |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Mossman, B. T., Bignon, J., Corn, M., Seaton, A., Gee, J. B. L. (1990). Asbestos: Scientific developments and implications for public policy. Science 247(4940):294-301. |
| **HERO ID:** | 709711 |
| **Conditions of Use:** | Disposal |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | custodians and service workersin buildings with severely damaged ACM Pg 6 |
| Exposure route: | Inhalation Pg 1 |
| Engineering control: | worker education and building maintenance Pg 7 |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | The assessment or report uses high quality data and/or techniques or sound methods that are from frequently used sources (e.g., European Union or OECD reports, NIOSH HHEs, journal articles, Kirk-Othmer) and are generally accepted by the scientific community, and associated information does not indicate flaws or quality issue |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | The data are from the United States and are representative of the industry being evaluated. |
| | Metric 3: | Applicability | Low | The report is a review of general asbestos exposure information, not occupation-specific data. |
| | Metric 4: | Temporal Representativeness | Medium | The report captures operations, equipment, and worker activities that are expected to be reasonably representative of current conditions. The report is generally more than 10 years but no more than 20 years old. |
| | Metric 5: | Sample Size | N/A | N/A - This metric is not applicable to the data being extracted |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | Report clearly documents its data sources, assessment methods, results, and assumptions. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | N/A | N/A - This metric is not applicable to the data being extracted |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Mundt, D. J., van Wijngaarden, E., Mundt, K. A. (2007). An assessment of the possible extent of confounding in epidemiological studies of lung cancer risk among roofers. Journal of Occupational and Environmental Hygiene 4:163-174. |
| **HERO ID:** | 3088227 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Area sampling data: | "Two studies evaluated the potential for asbestos exposure during tear-off operations. (71,72) Exposure to asbestos was found to be low with no single exposure value exceeding the permissible exposure limit (PEL) of 0.1 fibers per cubic centimeter time-weighted average for asbestos. (72) An earlier U.S. study found that there was a hazard from exposure to asbestos during the tear-off of an asbestos shingle roof. (71)" (pg 7) |
| Number of workers: | The U.S. roofing industry employs about 200,000 workers and estimates indicate about 50,000 on-roof workers are exposed to asphalt fumes during approximately 40% of their working hours. |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Methodology | High | The assessment or report uses high quality data and/or techniques or sound methods that are from frequently used sources. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | High | Data are from the U.S. |
| | Metric 3: Applicability | High | The report is for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: Temporal Representativeness | Low | Information is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: Sample Size | Low | Distribution of samples is qualitative or characterized by no statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | Medium | Methods, results, and assumptions are clearly documented, but underlying data sources are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Murphy, R. L., Levine, B. W., Al-Bazzaz, F. J., Lynch, J. J., Burgess, W. A. (1971). Floor tile installation as a source of asbestos exposure. American Review of Respiratory Disease 104(4):576-580. |
| **HERO ID:** | 3084874 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Products not Described by Other Codes |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | installers of floor tile (pg 576) |
| Personal sampling data: | Dust concentrations from 2 personal samplers were 1.2 fibers and 1.3 fibers per ml of air. (pg 577) |
| Exposure duration: | One of the men worked for 19 years as a floor tile installer, and the other man worked for 30 years installing asphalt and vinyl tile. (pg 577) |
| Number of workers: | 2 |
| Personal protective equipment: | The results suggested that before the tile sanding procedure is performed adequate respiratory protection should be provided or alternate, available installation methods should be used. |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Methodology | Low | The data, data sources, and/or techniques or methods used in the assessment or report are not specified. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | The data are from the United States |
| Metric 3: | Applicability | High | The report is for an occupational scenario within the scope of the risk evaluation. |
| Metric 4: | Temporal Representativeness | Low | The report is more than 20 years old. |
| Metric 5: | Sample Size | Low | Distribution of samples is characterized by no statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Low | Report provides results, but the underlying methods, data sources, and assumptions are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Low | The report does not address variability or uncertainty. |

## Overall Quality Determination — Low

**Study Citation:** (2017). PubChem: Chrysotile.
**HERO ID:** 3860485
**Conditions of Use:** Other:

**EXTRACTION**

| Parameter | Data |
|---|---|
| Physical form: | WHITE, GREY, GREEN OR YELLOWISH FIBROUS SOLID |
| Personal protective equipment: | Respirator, protective gloves, protective clothing, safety goggles or eye protection |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | The assessment or report uses high quality data and/or techniques or sound methods that are from frequently used sources (e.g., European Union or OECD reports, NIOSH HHEs, journalarticles, Kirk-Othmer) and are generally accepted by the scientific community, and associated information does not indicate flaws or quality issues. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | The data are from the United States and are representative of the industry being evaluated. |
| | Metric 3: | Applicability | High | The report is for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | High | The report captures operations, equipment, and worker activities expected to be representative of current conditions. The report is generally no more than 10 years old. |
| | Metric 5: | Sample Size | N/A | This data is not reliant on sampling |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | Assessment or report clearly documents its data sources, assessment methods, results, and assumptions. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | N/A | No scope to address variability and uncertainty. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | (2017). PubChem: Crocidolite. |
| **HERO ID:** | 3860486 |
| **Conditions of Use:** | Other: |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Exposure route: | inhalation (20/24) |
| Physical form: | Slender, fine, flaxy fiber (1/24) |
| Personal protective equipment: | Closes system breathing protection and ventilation, protective gloves and clothing, safety goggles. (17/24) |
| Engineering control: | Isolate spills or leaks in all directions for at least 50 meters for liquids and 25 meters for solids. If there is a fire, isolate and evacuate for 800 meters. Cover solids with a plastic sheet to minimize spreading. (15/24) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Methodology | High | Assessment uses high quality data from frequently-used sources. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | Data are from the U.S. |
| Metric 3: | Applicability | High | Data are for all conditions of use as general guidance. |
| Metric 4: | Temporal Representativeness | Medium | Report is based on data greater than 10 years old but no more than 20 years old and industry conditions that are expected to be representative of current industry conditions. |
| Metric 5: | Sample Size | Low | Distribution of samples is qualitative or characterized by no statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Medium | Methods, results, and assumptions are clearly documented, but underlying data sources are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | (2017). Safe work practices: Asbestos. |
| **HERO ID:** | 3860565 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Custodial, maintenance, and construction staff that may disturb asbestos containing material. |
| Personal protective equipment: | A half or full facepiece, negative pressure, air purifying respirator with replaceable high-efficiency filters.A half or full facepiece powered air purifying respirator (PAPR) with replaceable high-efficiency filters. This has a battery powered pump which assists breathing and provides positive pressure in the facepiece (p. 4)Proper O&M cleaning will involve the use of wet cleaning or wetwiping practices to pick up asbestos fibers. Dry sweeping or dusting can result in asbestos fibers being resuspended into the building's air and therefore should not be used. Once wet cloths, rags, or mops have been used to pick up asbestos fibers, they should be properly discarded as asbestos waste while still wet (p. 5)Steam Cleaning Carpets (p. 6) |
| Engineering control: | 1. Wet methods (such as applying water to ACM with a low pressure sprayer).2. Use of minienclosures.3. Use of portable power tools equipped with special local ventilation attachments.4. Area isolation.5. Avoidance of certain activities, such as sawing, sanding, and drilling ACM (p. 3)Use of HEPA vacuums (p. 5) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | The assessment or report uses high quality data and/or techniques or sound methods that are from frequently used sources (US EPA) and are generally accepted by the scientific community, and associated information does not indicate flaws or quality issues. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | The data are from the United States and are representative of the industry being evaluated. |
| | Metric 3: | Applicability | High | The report is for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | High | The report captures operations, equipment, and worker activities expected to be representative of current conditions. The report is generally no more than 10 years old (was captured in 2017). |
| | Metric 5: | Sample Size | N/A | n/a - no sampling |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Assessment or report clearly documents results, methods, and assumptions. Data sources are generally described but not fully transparent. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | The report provides only limited discussion of the variability and uncertainty in the results. |

## Overall Quality Determination **High**

| | |
|---|---|
| **Study Citation:** | (2015). Asbestos hazards encountered in the welding and cutting environment. Welding Journal 94(10):170. |
| **HERO ID:** | 6883407 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Construction and maintenance activities. [PDF Pg. 1] |
| Exposure route: | Inhalation |
| Personal protective equipment: | Disposable garments and respirators. [PDF Pg. 1] |
| Engineering control: | Negative pressure enclosures. [PDF Pg. 1] |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Methodology | High | Report uses high quality data/techniques/methods from frequently-used sources. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | Data are from the U.S. |
| Metric 3: | Applicability | Medium | Data are for Chemical Substances in Construction, Paint, Electrical, and Metal Products, an in-scope occupational scenario. |
| Metric 4: | Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| Metric 5: | Sample Size | N/A | N/A - no sample data. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | N/A | N/A - no sample data. |

## Overall Quality Determination High

**Study Citation:** NCBI, (2021). PubChem: Chrysotile.
**HERO ID:** 7594560
**Conditions of Use:** Other:

**EXTRACTION**

| Parameter | Data |
|---|---|
| Physical form: | Asbestos, white is a white asbestos is a slender, fine, flaxy fiber [PDF Pg. 1] |
| Particle size characterization: | Industrial chrysotile fibers are aggregates of these unit fibers that usually exhibit diameters from 0.1 to 100 um; their lengths range from a fraction of a millimeter to several centimeters, although most chrysotile fibers used are <1 cm. [PDF Pg. 5] |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Methodology | High | Report uses high quality data/techniques/methods from frequently-used sources. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | High | Data are from the U.S. |
| | Metric 3: Applicability | High | Data are general and applicable to all in-scope occupational scenarios. |
| | Metric 4: Temporal Representativeness | High | Report is based on current industry conditions and data no more than 10 years old. |
| | Metric 5: Sample Size | N/A | N/A - Life cycle description, particle size characterization, and physical form. |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | N/A | N/A - Life cycle description, particle size characterization, and physical form. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | NCDOL, (2013). A guide to asbestos for industry. |
| **HERO ID:** | 3982247 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Class I asbestos work includes the removal of thermal system insulation and sprayed-on or troweled-on surfacing asbestos-containing materials applied to pipes, boilers, tanks, ducts or other structural components. Class II work includes removal of floor or ceiling tiles, siding, roofing, or transite panels. Class III work includes repair and maintenance operations where asbestos-containing or presumed asbestos containing materials are disturbed. Class IV work includes custodial activities where employees clean up asbestos-containing waste and debris. (8/38) |
| Exposure route: | inhalation, ingestion (7/38) |
| Physical form: | airborne particles (7/38) |
| Number of workers: | Approximately 3.2 million workers in new construction, building renovation, and maintenance and custodial work in buildings and industrial facilities are affected by the asbestos standard. (7/38) |
| Personal protective equipment: | For all employees performing Class I work in regulated areas and for jobs without a negative exposure assessment, employers must provide full-facepiece supplied-air respirators operated in pressure-demand mode and equipped with an auxiliary positive-pressure, self-contained breathing apparatus. Employers must provide half-mask purifying respirators, other than disposable respirators, equipped with high efficiency filters for Class II and III asbestos jobs without a negative exposure assessment and for Class III jobs where work disturbs thermal system insulation or surfacing asbestos-containing or presumed asbestos-containing materials. (21/38) IN addition, employers must provide protective clothing such as coveralls, gloves, and foot coverings. (22/38) |
| Engineering control: | Areas where asbestos is handled must be marked off. (14/38) Local exhaust ventilation, enclosure of dust, vacuum cleaners with HEPA filters, wetting agents, and prompt cleanup and disposal are necessary to reduce exposure. (17/38) For higher class work, glove bags and drop cloths should be used. (18/38) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Methodology | High | Report uses high quality methods and data from frequently-used sources. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | Data are from the U.S. |
| Metric 3: | Applicability | High | Data are for commercial use in construction materials, an in-scope occupational scenario. |
| Metric 4: | Temporal Representativeness | High | Report is based on current industry conditions and data no more than 10 years old. |
| Metric 5: | Sample Size | N/A | N/A - This metric is not applicable to the data being extracted |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Medium | Variability is addressed by listing different options of controls and PPE by situation. Uncertainty isn't addressed. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Newcomer, D. A., Lapuma, P., Brandys, R., Northcross, A. (2017). Capture efficiency of portable high efficiency air filtration devices used during building construction activities. Journal of Occupational and Environmental Hygiene 15(4):285-292. |
| **HERO ID:** | 4164549 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Renovation and/or asbestos abatement. |
| Engineering control: | The portable high-efficiency air filtration (PHEAF) device is used to control particulate matter (PM) generated from construction-type activities occurring within the built environment. Examples of activities where PHEAF devices are mobilized include building renovation and asbestos abatement.HEPA Filter performance:overall capture effiecncy8% of the traditional metal box designed filters met the HEPA capture efficiency. Mean capture efficiency 94.81%81% of the polyethylene cabinet filters met HEPA capture efficiency criteria. Mean capture efficiency 99.96%Make/model % meeting HEPA criteria Capture efficiency range (%) Average capture efficiency, %, (SD)A041.78-99.8277.36 (24.438)B098.22-99.7399.04 (0.760)C62.599.53->99.9799.93 (0.160)D42.999.53->99.9797.48 (6.480)E7.182.63->99.9795.76 (12.0)F33.319.26->99.9799.62 (0.813)G10097.97->99.97>99.97 (0.065)H4.873.52->99.9796.6 (6.029) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Methodology | High | The report uses high quality data and techniques that are from frequently used sources. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | High | The data are from the United States. |
| | Metric 3: Applicability | High | HEPA filter performance for asbestos abatement. |
| | Metric 4: Temporal Representativeness | High | 2018- less than 10 years old. |
| | Metric 5: Sample Size | High | Statistical distribution of samples is fully characterized. |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | High | Assessment or report clearly documents its data sources, assessment methods, results, and assumptions. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Medium | Variability is addressed by testing various PHEAF device models, and measurement uncertainty is characterized by resulting means and standard deviations of data measurements. |

## Overall Quality Determination High

**Study Citation:** NFPA, (2012). Understanding & implementing standards: NFPA 1500, 1720, and 1851.
**HERO ID:** 11133511
**Conditions of Use:** Other:

**EXTRACTION**

| Parameter | Data |
|---|---|
| Number of workers: | Minimum Staffing Requirements for Fire Response:Urban area - 15 firefightersSuburban area - 10 firefightersRural area - 6 firefightersRemote area - 4 firefighters |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | National Fire Protection Association guidelines |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | The data are from the United States and are representative of the industry being evaluated. |
| | Metric 3: | Applicability | High | The report is for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | High | NFPA guidelines are current. |
| | Metric 5: | Sample Size | N/A | Sample size not applicable to NFPA guidelines. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | Report clearly states source of staffing guidelines. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | High | The report addresses variability by describing variations in staffing requirements based on population density, and uncertainty is addressed by providing the percent of occurrences where guidelines are upheld. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | NFPA, (2022). US Fire Department Profile 2020. |
| **HERO ID:** | 11133512 |
| **Conditions of Use:** | Other: |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Exposure frequency: | All-career and mostly-career firefighters protect 70% of the population, whereas all-volunteer and mostly-volunteer firefighters protect 30% of the population. |
| Number of workers: | Of the total number of firefighters in 2020, 364,300(35 percent) were career, while 676,900 (65 percent) were volunteers. |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | Study conducted by the the National Fire Protection Association and statistics are expected to be accurate. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | The data are from the United States and are representative of the industry being evaluated. |
| | Metric 3: | Applicability | High | The report is for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | High | Statistics are from 2020. |
| | Metric 5: | Sample Size | High | Statistics are based on a sample survey and the sample size was sufficiently representative. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | Assessment or report clearly documents its data sources, assessment methods, results, and assumptions. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | High | The report addresses variability and uncertainty in the results. Uncertainty is well characterized. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Nicholson, W. J., Rohl, A., Fischbein, S. A., Selikoff, I. J. (1975). Occupational and community asbestos exposure from wallboard finishing compounds. Bulletin of the New York Academy of Medicine 51(10):1180-1181. |
| **HERO ID:** | 3583525 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Applying and finishing tape and spackle at the joints of wallboard. (1/2) |
| Exposure route: | inhalation (2/2) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | The assessment or report uses high quality data and/or techniques or sound methods that are from frequently used sources. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | The data are from the United States and are representative of the industry being evaluated. |
| | Metric 3: | Applicability | High | The report is for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Low | The report is more than 20 years old. |
| | Metric 5: | Sample Size | N/A | No sample data. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Assessment or report clearly documents results, methods, and assumptions. Data sources are generally described but not fully transparent. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | N/A | No scope to address variability and uncertainty. |

## Overall Quality Determination High

**Study Citation:** NIH, (2016). Report on carcinogens: Asbestos.
**HERO ID:** 3982328
**Conditions of Use:** Other:

**EXTRACTION**

| Parameter | Data |
|---|---|
| Exposure route: | Inhalation and minimal dermal absorption [PDF Pg. 2]. |
| Physical form: | Solid fibers. |
| Particle size characterization: | Fibers longer than 8 $\mu$m with a diameter of less than 1.5 $\mu$m are the most potent carcinogens (IPCS 1986). [PDF Pg. 2] |
| Number of workers: | 215,265 [PDF Pg. 3] |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Methodology | High | Report uses high quality [data/techniques/methods] from frequently-used sources. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | Data are from the U.S. |
| Metric 3: | Applicability | High | Data are for all conditions of use. |
| Metric 4: | Temporal Representativeness | Low | Actual data is more than 20 years old. |
| Metric 5: | Sample Size | Low | Sample distribution is characterized by no statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Medium

**Study Citation:** NIOSH, (2016). NIOSH pocket guide to chemical hazards: Asbestos.
**HERO ID:** 3974865
**Conditions of Use:** Other:

**EXTRACTION**

| Parameter | Data |
|---|---|
| Exposure route: | inhalation, ingestion, skin and/or eye contact |
| Physical form: | White or greenish (chrysotile), blue (crocidolite), or gray-green (amosite) fibrous, odorless solids. |
| Personal protective equipment: | At concentrations above the NIOSH REL, or where there is no REL, at any detectable concentration:(APF = 10,000) Any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode (APF = 10,000) Any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained positive-pressure breathing apparatus Escape:(APF = 50) Any air-purifying, full-facepiece respirator with an N100, R100, or P100 filter.Any appropriate escape-type, self-contained breathing apparatus |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Methodology | High | The assessment or report uses high quality data and/or techniques or sound methods that are from frequently used sources (CDC - NIOSH). |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | The data are from the United States and are representative of the industry being evaluated. |
| Metric 3: | Applicability | High | The report is for an occupational scenario within the scope of the risk evaluation. |
| Metric 4: | Temporal Representativeness | High | 2016 - less than 10 years |
| Metric 5: | Sample Size | N/A | No sample data. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | High | Assessment or report clearly documents its data sources, assessment methods, results, and assumptions. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | N/A | No scope to address variability and uncertainty. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | NIOSH, (1988). Occupational safety and health guideline for asbestos potential human carcinogen. |
| **HERO ID:** | 3978125 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Common operations in which asbestos exposure may occur are asbestos removal and demolition of buildings. (3/6) |
| Exposure route: | inhalation, ingestion (2/6) |
| Physical form: | fiber (1/6) |
| Personal protective equipment: | Workers should be provided with chemical protective clothing, gloves, and other appropriate clothing necessary to prevent skin contact. (3/6) Respiratory protection should be employed as a last resort or when engineering controls aren't feasible or are being installed. (4/6) |
| Engineering control: | Process enclosure, LEV, wetting of processes, and water spray. (3/6) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | The assessment or report uses high quality data and/or techniques or sound methods that are from frequently used sources. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | The data are from the United States and are representative of the industry being evaluated. |
| | Metric 3: | Applicability | High | The report is for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Low | The report is more than 20 years old. |
| | Metric 5: | Sample Size | N/A | No sample data. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Assessment or report clearly documents results, methods, and assumptions. Data sources are generally described but not fully transparent. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | N/A | No scope to address variability and uncertainty. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | NIOSH, (2011). Current intelligence bulletin 62: Asbestos fibers and other elongate mineral particles: State of the science and roadmap for research [Revised April 2011]. |
| **HERO ID:** | 759233 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Exposure route: | inhalation |
| Physical form: | fiber dust, having: (1) an aspect ratio of 3:1or greater and (2) a length greater than 5 µm.Historically, chrysotile accounted for morethan 90% of the world's mined asbestos; itpresently accounts for over 99% |
| Number of workers: | On the basis of mine employment data [MSHA 2002], NIOSH estimated that 44,000 miners and other mine workers may be exposed to asbestos or amphibole cleavage fragments during the mining of some mineral commodities [NIOSH 2002]. OSHA estimated in 1990 that about 568,000 workers in production and services industries and 114,000 in construction industries may be exposed to asbestos in the workplace [OSHA 1990]. More recently, OSHA has estimated that 1.3 million employees in construction and general industry face significant asbestos exposure on the job [OSHA 2008]. |
| Comments: | Production/Import volume provided not relevant to legacy uses. |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | Assessment uses high quality data from frequently-used sources. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | Medium | Data are for general asbestos exposures, which includes the in-scope occupational scenario Industrial/Commercial Use: Chemical Substances in Construction, Paint, Electrical, and Metal Products. |
| | Metric 4: | Temporal Representativeness | Medium | Report is based on data greater than 10 years old but no more than 20 years old and industry conditions that are expected to be representative of current industry conditions. |
| | Metric 5: | Sample Size | Medium | Sample distribution characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | Uncertainty is addressed by in the roadmap of strategic research (designed to clarify uncertainties). Variability addressed similarly in the description of how to develop better lab standards to follow (to decrease variability). |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | NIOSH, (2019). NIOSH pocket guide to chemical hazards: Asbestos. |
| **HERO ID:** | 9109830 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Products not Described by Other Codes |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Exposure route: | inhalation, ingestion, skin and/or eye contact (pg 2 of 2) |
| Physical form: | White or greenish (chrysotile), blue (crocidolite), or gray-green (amosite) fi brous, odorless solids. (pg 1 of 2) |
| Personal protective equipment: | Any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand orother positive-pressure mode (pg 2 of 2) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Methodology | High | report uses high quality data |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | The data are from the United States |
| Metric 3: | Applicability | High | The report is for an occupational scenario within the scope of the risk evaluation. |
| Metric 4: | Temporal Representativeness | High | The report is generally no more than 10 years old. |
| Metric 5: | Sample Size | Low | Distribution of samples is qualitative |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Low | data sources, and assumptions are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Low | The report does not address variability or uncertainty. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Oberta, A. F. (2005). Standards for asbestos control: A holistic approach to managing a health hazard. Standardization News 33(5):20-23. |
| **HERO ID:** | 6865544 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Engineering control: | Controlling the release of airborne fibers emphasizes wetting the material; "thickened substances" such as shaving cream can effectively capture debris. The use of mechanical equipment such as dust capture shrouds and vacuum cleaners is discouraged because these devices become contaminated as soon as they are used, requiring special training and facilities to clean and maintain them. Such resources may not be available in some developing countries where E 2394 is expected to be used. [PDF Pg. 4] |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Methodology | Medium | Report uses high quality data/techniques/methods that are not from frequently-used sources and there are no known quality issues. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | High | Data are from the U.S. |
| | Metric 3: Applicability | High | Data are for Chemical Substances in Construction, Paint, Electrical, and Metal Products, an in-scope occupational scenario. |
| | Metric 4: Temporal Representativeness | Medium | Report is based on data greater than 10 years old but no more than 20 years old and industry conditions that are expected to be representative of current industry conditions. |
| | Metric 5: Sample Size | Low | Distribution of samples is qualitative or characterized by no statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | Medium | Methods, results, and assumptions are clearly documented, but underlying data sources are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Low | The report does not address variability or uncertainty. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | OECD, (2009). Emission scenario document on adhesive formulation. |
| **HERO ID:** | 3827299 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Products not Described by Other Codes |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | adhesive manufacturing |
| Exposure route: | inhalation and dermal |
| Physical form: | volatile liquid chemical vapors, solid chemical particles |
| Dermal exposure data: | Dermal exposure data |
| Exposure duration: | EPA assumes a maximum exposure duration of eight hours per day (pg 81 of 168) |
| Exposure frequency: | Frequency of release during container cleaning (provided in table 4.2 on pg 65 of 168) is equal to the lesser of N(cont_empty_site_yr) or TIME(working_days). Similar values are provided for other operations. |
| Number of workers: | Adhesive manufacturing facilities employed a total of 21,048 workers (pg 21 of 168). As per pg 107 of 168, It is assumed that 22 adhesive formulation workers are potentially exposed to thechemical at each site. The total number of workers is 110. |
| Personal protective equipment: | No information on typical personal protective equipment (PPE) specific to adhesive formulation was found; however, a great deal of information is available on typical PPE for the application and use of adhesive formulations. This information mainly focuses on minimizing exposure due to spray application or VOC emissions. General assumptions can be made based on the known hazards of certain adhesive formulation processes: hot-melt adhesives are processed at temperatures over 150°C and solution adhesives generally have VOC concerns. Chemical submissions recently submitted to EPA by adhesive chemical manufacturers show that, at a minimum, all manufacturers recommended the use of gloves and safety glasses with side shields or goggles. Approximately half of the submissions also recommended the use of some kind of ventilation and respirators if necessary. One submission for a hot-melt adhesive chemical also specifically recommended the use of thermal gloves. (pg 79 of 168) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Methodology | High | report uses high quality data |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | High | The data are from the United States |
| | Metric 3: Applicability | High | The report is for an occupational scenario |
| | Metric 4: Temporal Representativeness | Medium | The report is generally more than 10 years but no more than 20 years old. |
| | Metric 5: Sample Size | Low | Distribution of samples is characterized by no statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | High | report clearly documents its data sources |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | High | The report addresses variability and uncertainty in the results. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Oliver, L. C. (1998). Asbestos in building: Management and related health effects. Journal of Clean Technology, Environmental Toxicology, and Occupational Medicine 7(4):433-443. |
| **HERO ID:** | 3092160 |
| **Conditions of Use:** | Other: |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | electrical conduit pipe MFG: beater operators mixing raw materials (pg 5-6) |
| Number of workers: | 1261 workers exposed to chrysotile asbestos in the manufacture of asbestos textile products (pg 5) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | Medium | Report uses high quality data/techniques/methods that are not from frequently-used sources and there are no known quality issues. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | Low | Data are for nonlegacy uses but may still be informative. |
| | Metric 4: | Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: | Sample Size | N/A | number of workers data |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Methods, results, and assumptions are clearly documented, but underlying data sources are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination — Low

| | |
|---|---|
| **Study Citation:** | Orlowski, E.,wa, Audignon-Durand, S., Goldberg, M., Imbernon, E., Brochard, P. (2015). EV@LUTIL: An Open Access Database on Occupational Exposures to Asbestos and Man-Made Mineral Fibres. American Journal of Industrial Medicine 58(10):1059-1074. |
| **HERO ID:** | 3089885 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | A motor-vehicle mechanic performing diverse operations on ACMOperations on gaskets containing asbestos. |
| Personal sampling data: | Plot of data is provided. Not reasonable to transcribe here. |
| Area sampling data: | concentrations measured ranged from 0.01 f/ml to more than 10 f/ml. (P. 13/16) |
| Comments: | This document outlines a database system and only provides data in this document as an example. |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | Medium | The assessment or report uses high quality data and/or techniques or sound methods that are not from a frequently used source. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | The data are from the United States and other OECD countries. |
| | Metric 3: | Applicability | High | Data are for Industrial/Commercial Use: Chemical Substances in Construction, Paint, Electrical, and Metal Products, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | The most data in the report are more than 20 years old. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Assessment or report clearly documents results, methods, and assumptions. Data sources are generally described but not fully transparent. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | The report provides only limited discussion of the variability and uncertainty in the results. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | OSHA, (2002). Asbestos standard for the construction industry (revised 2002). |
| **HERO ID:** | 3102401 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| Parameter | Data |
|---|---|
| Worker activity description: | To determine expected exposures, a competent (Trained) person must perform an initial exposure assessment to assesses exposures immediately before or as the operation begins. For Class I asbestos work, until employers document that employees will not be exposed in excess of the 8-hour TWA PEL and short-term exposure limit STEL, employers must assume that employee exposures are above those limits. Class I asbestos work is the most potentially hazardous class of asbestos jobs. This work involves the removal of asbestos-containing thermal system insulation and sprayed-on or troweled-on surfacing materials. Employers must presume that thermal system insulation and surfacing material found in pre-1981 construction is ACM. That presumption, however, is rebuttable. If you believe that the surfacing material or thermal system insulation is notACM, the OSHA standard specifies the means that you must use to rebut that presumption. Thermal system insulation includes ACM applied to pipes, boilers, tanks, ducts, or other structural components to prevent heat loss or gain. Surfacing materials include decorative plaster on ceilings and walls; acoustical materials on decking, walls, and ceilings; and fireproofing on structural members. Class II work includes the removal of other types of ACM that are not thermal system insulation such as resilient flooring and roofing materials. Examples of Class II work include removal of asbestos-containing floor or ceiling tiles, siding, roofing, or transite panels. Class III asbestos work includes repair and maintenance operations where ACM or presumed ACM (PACM) are disturbed. Class IV work includes custodial activities where employees clean up asbestos-containing waste and debris produced by construction, maintenance, or repair activities. This work involves cleaning dust-contaminated surfaces, vacuuming contaminated carpets, mopping floors, and cleaning up ACM or PACM from thermal system insulation or surfacing material.Employers must determine employee exposure measurements from breathing zone air samples representing the 8-hour TWA and 30-minute short-term exposures for each employee. Employers must take one or more samples representing full-shift exposure to determine the 8-hour TWA exposure in each work area. To determine short-term employee exposures, you must take one or more samples representing 30-minute exposures for the operations most likely to expose employees above the excursion limit in each work area.For Class I and II jobs, employers must conduct monitoring daily that is representative of each employee working in a regulated area, unless you have produced a negative exposure assessment for the entire operation and nothing has changed. When all employees use supplied-air respirators operated in positive-pressure mode, however, you may discontinue daily monitoring. When employees perform Class I work using control methods not recommended in the standard, you must continue daily monitoring even when employees use supplied-air respirators. |
| Exposure route: | airborne fibers |
| Personal protective equipment: | Employers must determine employee exposure measurements from breathing zone air samples representing the 8-hour TWA and 30-minute short-term exposures for each employee. Employers must take one or more samples representing full-shift exposure to determine the 8-hour TWA exposure in each work area. To determine short-term employee exposures, you must take one or more samples representing 30-minute exposures for the operations most likely to expose employees above the excursion limit in each work area.For Class I and II jobs, employers must conduct monitoring daily that is representative of each employee working in a regulated area, unless you have produced a negative exposure assessment for the entire operation and nothing has changed. When all employees use supplied-air respirators operated in positive-pressure mode, however, you may discontinue daily monitoring. When employees perform Class I work using control methods not recommended in the standard, you must continue daily monitoring even when employees use supplied-air respirators.Class I Employers must create a decontamination area adjacent to and connected with the regulated area. Workers must enter and exit the regulated area through the decontamination area |
| Engineering control: | Employers must ensure the following for all Class I jobs: Isolating heating, ventilating, and air-conditioning (HVAC) systems in regulated areas by sealing with a double layer of 6 mil plastic or the equivalent. Placing impermeable drop cloths on surfaces beneath all removal activity. Covering and securing all objects within the regulated area with impermeable drop cloths or plastic sheeting. Ventilating the regulated area to move the contaminated air away from the employee breathing zone and toward a HEPA filtration or collection device for jobs without a negative exposure assessment or where exposure monitoring shows the PEL is exceeded. In addition, employees performing Class I work must use one or more of the following control methods: Negative-pressure enclosure systems when the configuration of the work area does not make it infeasible to erect the enclosure. Glove bag systems to remove ACM or PACM from piping. Negative-pressure glove bag systems to remove asbestos or PACM from piping. Negative-pressure glove box systems to remove asbestos or ACM from pipe runs. Water spray process systems to remove asbestos or PACM from cold-line piping if employees carrying out the process have completed a 40-hour training course on its use in addition to training required for all employees performing Class I work. Small walk-in enclosure that accommodates no more than 2 people (mini-enclosure) if the disturbance or removal can be completely contained by the enclosure.Article discusses requirements for Class II, III, and IV as well. Not reproduced here for brevity, |

**Continued on next page . . .**

. . . continued from previous page

**Study Citation:** OSHA, (2002). Asbestos standard for the construction industry (revised 2002).
**HERO ID:** 3102401
**Conditions of Use:** Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products

| Domain | Metric | EVALUATION Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Methodology | High | Report uses high quality data from frequently-used sources. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | High | Data are from the U.S. |
| | Metric 3: Applicability | High | Data are for Industrial/Commercial Use: Chemical Substances in Construction, Paint, Electrical, and Metal Products, an in-scope occupational scenario. |
| | Metric 4: Temporal Representativeness | High | Report is based on current industry conditions and data no more than 10 years old. |
| | Metric 5: Sample Size | Low | Sample distribution is described qualitatively. |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | OSHA, (2017). Substance and technical information for asbestos - Non-mandatory. |
| **HERO ID:** | 3978183 |
| **Conditions of Use:** | Disposal |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Personal protective equipment: | Air-purifying respirators equipped with a high-efficiency particulate air (HEPA) filter can be used where airborne asbestos fiber concentrations do not exceed 1.0 f/cc; otherwise, more protective respirators such as air-supplied, positive-pressure, full facepiece respirators must be used. Disposable respirators or dust masks are not permitted to be used for asbestos work |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | The assessment or report uses high quality data and/or techniques or sound methods that are from frequently used sources (Department of Labor) and are generally accepted by the scientific community, and associated information does not indicate flaws or quality issues. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | The data are from the United States and are representative of the industry being evaluated. |
| | Metric 3: | Applicability | High | The report is for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Low | The report is more than 20 years old. The report captures operations, equipment, and worker activities that are expected to be outdated. |
| | Metric 5: | Sample Size | N/A | n/a - no sampling data |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | Assessment or report clearly documents its data sources, assessment methods, results, and assumptions. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | The report does not address variability or uncertainty. |

## Overall Quality Determination Medium

**Study Citation:** OSHA, (1995). Asbestos standard for general industry.
**HERO ID:** 3978184
**Conditions of Use:** Other:

**EXTRACTION**

| Parameter | Data |
|---|---|
| Exposure route: | inhalation, ingestion (2/11) |
| Personal protective equipment: | For any employee exposed to airborne concentrations of asbestos that exceed the PEL and/or EL, employer must provide at no cost to the employee, and require the use of, protective clothing, such as coveralls or similar full body clothing, head coverings, gloves, and foot coverings. In addition, wherever the possibility of eye irritation exists, face shields, vented goggles, or other appropriate protective equipment must be provided and worn. (4/11) |
| Engineering control: | Engineering controls are the following: Employers are required to design, construct, install, and maintain local exhaust ventilation and dust collection systems and provide a local exhaust ventilation system for all hand operated and power operated tools such as saws, scorers, abrasive wheels, and drills that produce or release fibers of asbestos. They must handle, mix, apply, remove, cut, score, or work asbestos in a wet state to prevent employee exposure. They cannot remove cement, mortar, coating, grout, plaster, or similar materials containing asbestos from bags, cartons, or other containers that are being shipped without wetting, enclosing, or ventilating them. Do not sand floors containing asbestos. Do not use compressed air to remove asbestos or materials containing asbestos unless the compressed air is used in conjunction with a ventilation system designed to capture the dust cloud created by tile compressed air. (4/11) |
| Comments: | TimeWeighted Average (TWA) The employer shall ensure that no employee is exposed to an airborne concentration of asbestos in excess of 0.1 fiber per cubic centimeter of [air] as averaged over an 8-hour TWA day.Excursion Limit (ELT) The employer shall ensure that no employee is exposed to an airborne concentration of asbestos in excess of 1.0 fiber per cubic centimeter of air as averaged over a sampling period of 30 minutes.Except for brake and clutch repair where a ”preferred” control method is used, each employer who has a workplace or work operation covered by this standard must assess all asbestos operations for their potential to generate airborne fibers. Where exposure may exceed the PEL, employee exposure measurements must be made from breathing zone air samples representing the 8hour TWA and 30minute EL for each employee. |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | Report is Asbestos Standard For General Industry from the U.S. Department of Labor Occupational Safety and Health Administration, OSHA 3095, 1995 (Revised) |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | The data are from the United States and are representative of the industry being evaluated. |
| | Metric 3: | Applicability | High | The report is relevant to all occupational scenarios for asbestos. |
| | Metric 4: | Temporal Representativeness | High | Though the standard was set over 20 years ago, the PEL and EL are still in effect. |
| | Metric 5: | Sample Size | N/A | Regulatory standard and related information do not require sample size. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | N/A | Regulatory standard and related information do not require assessment methods and other metadata. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | N/A | Regulatory standard and related information do not require variability and uncertainty analyses. |

**Continued on next page . . .**

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**Study Citation:** OSHA, (1995). Asbestos standard for general industry.
**HERO ID:** 3978184
**Conditions of Use:** Other:

| | | EVALUATION | |
|---|---|---|---|
| Domain | Metric | Rating | Comments |
| **Overall Quality Determination** | | **High** | |

**Study Citation:** OSHA, (1996). Occupational exposure to asbestos, tremolite, anthophyllite and actinolite.
**HERO ID:** 3978199
**Conditions of Use:** Other:

**EXTRACTION**

| Parameter | Data |
|---|---|
| Worker activity description: | roof removal (pg 2)Class III work includes maintenance work for which a small amount of ACM must be cut away to access mechanical or structural components of buildings (pg 3)clean-up work (pg 3) |
| Personal protective equipment: | When exposures are less than 10 times the PEL, half-mask air-purifying respirators equipped with high efficiency filters may be used. Full-facepiece air-purifying respirators with high efficiency filters are permissible for exposures up to 50 times the PEL. Higherexposures require the use of positive pressure respirators, either powered air-purifying respirators (for exposures up to 100 times the PEL) or full facepiece supplied-air respirators (for even higher exposures). (pg 1)employees may request more effective respirator than what is necessary from employer (pg 1) |
| Engineering control: | critical barriers (or equivalent isolation methods) or negative pressure enclosures (pg 2)glovebag (pg 3) |
| Comments: | Correction of provisions of asbestos standards from 1994 - 1995. |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Methodology | High | Report uses high quality data from frequently-used sources. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | Data are from the U.S. |
| Metric 3: | Applicability | High | The report is relevant to occupational scenarios within the scope of the risk evaluation. |
| Metric 4: | Temporal Representativeness | Medium | Report is more than 20 years old, but standards are still in effect. |
| Metric 5: | Sample Size | N/A | N/A - This metric is not applicable to the data being extracted |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Medium | Variability addressed by describing respirator requirements for various exposure levels but uncertainty is not addressed. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Paglietti, F., Malinconico, S., Di Molfetta, V., Bellagamba, S., Damiani, F., Gennari, F., De Simone, P., Sallusti, F., Giangrasso, M. (2012). Asbestos risk: From raw material to waste management: The Italian experience. Critical Reviews in Environmental Science and Technology 42(17):1781-1861. |
| **HERO ID:** | 3582178 |
| **Conditions of Use:** | Disposal |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Exposure route: | All : soils, water, wastewater, indoor air |
| Physical form: | airborne or waterborne fibers. |
| Personal protective equipment: | full facemasks with P3 filters or class 3 electric respiratorsTHP3 and TMP3 electric respiratorsdisposable glovestyvek overallsrubber footwear |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | The assessment or report uses high quality data and/or techniques or sound methods that are from frequently used sources (e.g., European Union |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Medium | Italy - OECD member country |
| | Metric 3: | Applicability | High | The report is for an occupational scenario (superfund site remediation) within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | High | 2012 - ten years old |
| | Metric 5: | Sample Size | N/A | Qualitative information provided about exposure route and PPE |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | Assessment or report clearly documents its data sources, assessment methods, results, and assumptions. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | N/A | Qualitative information provided about exposure route and PPE |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Paglietti, F., Malinconico, S., Di Molfetta, V., Giangrasso, M. (2012). Guidelines for asbestos remediation at Italian superfund sites. Journal of Environmental Science and Health, Part C: Environmental Carcinogenesis & Ecotoxicology Reviews 30(3):253-286. |
| **HERO ID:** | 3541115 |
| **Conditions of Use:** | Other: |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Number of workers: | Nowadays, about 125 million people are occupationally exposed to asbestos and about 90,000 asbestos-related deaths occur worldwide every year [9–11]. (pg 4) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | Medium | Report uses high quality information that are not from frequently-used sources and there are no known quality issues. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Medium | Data are from Italy, an OECD country. |
| | Metric 3: | Applicability | Medium | Data are for general occupational scenarios, which includes in-scope occupational scenarios. |
| | Metric 4: | Temporal Representativeness | Medium | Report is based on data greater than 10 years old but no more than 20 years old and industry conditions that are expected to be representative of current industry conditions. |
| | Metric 5: | Sample Size | N/A | N/A - This metric is not applicable to the data being extracted |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Methods, results, and assumptions are clearly documented, but underlying data sources are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Palluzi, R. P. (1988). Asbestos removal need not be daunting. Chemical Engineering 95(12):95-99. |
| **HERO ID:** | 6867199 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Engineering control: | An airlock and decontamination chamber are used during removal operationsNegative pressure in work area, area is enclosed with plastic |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | The assessment or report uses high quality data and/or techniques or sound methods that are from frequently used sources (journalarticles) and are generally accepted by the scientific community, and associated information does not indicate flaws or quality issues. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | The data are from the United States and are representative of the industry being evaluated. |
| | Metric 3: | Applicability | High | The report is for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Low | The report is more than 20 years old. The report captures operations, equipment, and worker activities that are expected to be outdated. |
| | Metric 5: | Sample Size | N/A | n/a - no sampling conducted |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | Assessment or report clearly documents its data sources, assessment methods, results, and assumptions. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | The report provides only limited discussion of the variability and uncertainty in the results. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Park, W. M., Myung, R. J., Kim, K. Y. (2016). Evaluation on the collection efficiency and performance of the sound pressure machine equipped with a HEPA filter eliminating asbestos particles. MATEC Web of Conferences, vol. 62 62:01001. |
| **HERO ID:** | 6871208 |
| **Conditions of Use:** | Other: |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Engineering control: | sound pressure machine equipped with a glass fiber HEPA filter to get rid of friable asbestos at the asbestos elimination field was evaluated, the collection efficiency of those with the size of 0.3um was examined to be 98.91%. That of the particles of 0.5um size was proved to be 99.21% on average, which is a little bit higher than that of 0.3um size. The 1.0um particles showed 100% of efficiency (abstract) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | Medium | Report uses high quality data/techniques/methods that are not from frequently-used sources and there are no known quality issues. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Medium | Data are from Korea, an OECD country. |
| | Metric 3: | Applicability | Medium | Article mentions various in-scope uses in intro, however it is not clear which OES the controls data is applicable for. |
| | Metric 4: | Temporal Representativeness | High | Report is based on current industry conditions and data no more than 10 years old. |
| | Metric 5: | Sample Size | Medium | Sample distribution characterized by limited statistics (assumed mean) but discrete samples not provided and distribution not fully characterized. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Low | Assessment results are provided but underlying methods, assumptions, and data sources are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | Variability is addressed by presenting data for various particle sizes but uncertainty is not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Parker, J. E. (1984). Preliminary regulatory impact and regulatory flexibility analysis of the proposed revisions to the standard for regulating occupational exposure to asbestos. |
| **HERO ID:** | 6902122 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Exposure route: | inhalation |
| Physical form: | inhalable fibers |
| Area sampling data: | Primary Manufacturingf/ccAsbestos-Cement Pipe1.00f/ccAsbestos-Cement Sheet1.00f/ccfloor Tile - Receiving, introductions mixing0.50f/cc - Rest of plant0.20f/ccPaintings, Coatings and Sealants - Mixing, compounding and packaging0.00f/cc - Rest of plant0.75f/ccSecondary FabricatorsCement Sheets2.00f/ccShipbuilding and Repair0.5f/cc - Ship building5f/cc - Ship Repair0.5f/ccConstruction Installation of New Materials - Asbestos-Cement Pipe0.75f/cc - Asbestos-Cement Sheet2f/cc - Roofing Felts0.15f/ccRepair and Maintenance Drywall removal, renovation, demolition20.00f/cc Repair and maintenance0.20f/cc Repair and maintenance involving asbestos removal0.15f/cc Maintenance workers in schools, chemical plants, electrical generating plants, and foundries0.15f/ccAsbestos Paper - Receiving, introduction mixing & preparation0.75f/cc - Rest of plant0.20f/ccGaskets, Seals and Packings - Sheet formation, cutting and packaging0.20f/cc - Rest of plant0.75f/ccTextiles-Wet Process0.75f/cc-Dry Process1.50f/ccSecondary FabricatorsPaper Products2.00f/ccPackings and Gaskets2.00f/ccTextiles1.00f/cc |
| Number of workers: | Primary ManufacturingWorkersAsbestos-Cement Pipe675Asbestos-Cement Sheet225floor Tile4,746 - Receiving, introductions mixing1,187 - Rest of plant3,559Paintings, Coatings and Sealants135 - Mixing, compounding and packaging34 - Rest of plant101Secondary FabricatorsCement Sheets4,301Shipbuilding and Repair1,522 - Ship building304 - Ship Repair1,21SConstruction Installation of New Materials - Asbestos-Cement Pipe5,458 - Asbestos-Cement Sheet1,765 - Roofing Felts2,499Repair and Maintenance Drywall removal, renovation, demolition12,955 Repair and maintenance38,866 Repair and maintenance involving asbestos removal14,845Asbestos Paper1,897 - Receiving, introduction mixing & preparation474 - Rest of plant1,423Gaskets, Seals and Packings876 - Sheet formation, cutting and packaging219 - Rest of plant657Textiles1,125-Wet Process375-Dry Process750Secondary FabricatorsPaper Products4,301Packings and Gaskets4,301Textiles4,301 |
| Personal protective equipment: | RESPIRATORY PROTECTIONThe current OSHA standard allows the use of respiratoryprotection in three situations: (1) during the time necessary toinstall engineering controls or implement work practices (2) inwork situations for which engineering controls and supplementalwork practice controls are insufficient to reduce the exposuresto the proposed PEL; and (3) during an emergency, includingduring the period of the Emergency Temporary Standard. Therequired respirators, primarily air-purifying respirators, as outlined in the proposed standard are currently available. Hence, technological feasibility is not a constraint.While it is technologically feasible for all workers to wearrespirators, some practical constraints do exist. Some individualsare unable to wear an effectively fitted respirator and function normally in the work environment. The proposed standard would require that such individuals be rotated to an available job not requiring the use of a respirator, without experiencing any loss in seniority, status, or pay rate. It is not possible to determine, a priori, how many positions exist that do not require a respirator, how many workers would be affected, or how such a requirement would affect existing contractual arrangements between employees and employers. The proposed standard would allow for the use of disposable air-purifying respirators, provided that exposur.es do not exceed 10 times the PEL. Therefore, for all applications where respirators would be required, air-purifying respirators would be used. |

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| | |
|---|---|
| **Study Citation:** | Parker, J. E. (1984). Preliminary regulatory impact and regulatory flexibility analysis of the proposed revisions to the standard for regulating occupational exposure to asbestos. |
| **HERO ID:** | 6902122 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Engineering control: | | | Receiving. Several methods of control and several newly developed packaging techniques would reduce asbestos exposure problems in the receiving areas. These include: lined rail cars, palletized loading, wider cargo doors, pelletized or blocked asbestos fibers, and double-sealed bags. Use of fully containerized shipments as opposed to shipment in bags would further reduce the exposures that occur when bags are damaged.If these control methods and proper work practices are implemented, then OSHA expects that the levels of exposure could be maintained below 0.3 f/CC.Introduction. The exposures during the fiber introduction could be adequately controlled if the bags or containers of asbestos are opened by machine. If the bags or containers are opened manually, a semi-enclosed local exhaust ventilation system would be necessary to limit fiber emissions. Using these control methods and proper housekeeping, it is expected that the exposure levels could be reduced to 0.4 f/cc.Processing. Fiber loss during mixing can be reduced by negative pressure, which is generally connected to a local exhaust dust control system. Complete enclosure of the mixer is also a method that can be used to reduce exposures during this step. During the cutting, sawing, and finishing steps, the installation of local exhaust and hooding could reduce exposures. Special tools, such as single-point cutting tools, could reduce fiber emissions during particular activities.Shipbuilding and Ship RepairAsbestos exposures during shipbuilding are currently beingreduced through the use of substitutes for asbestos products.The movement toward prefabrication in ships where adequatecontrols are available is also contributing to exposure control.Ship repair, on the other hand, includes removal or refurbishingof old asbestos products o~ site (which is generally a narrow,small compartment). OSHA expects that the control techniquesavailable for demolition activities could be applied whenasbestos products are removed. Since wet handling andventilation procedures are not always practical due to theconfined space, OSHA expects respirators will be necessary tomeet reduced PELs. The refurbishing process in ship repairgenerally uses prefabricated materials where possible. Somelimited finishing, however, may be necessary on site. It isexpected that the control methods available for the finishingactivities in construction could be used to reduce exposuresduring ship repair or that respirators will be used.ConstructionEngineering controls for construction activities are assumedto include local exhaust ventilation systems, substitution of anon-asbestos product, and modification or isolation of a process.The installation of local exhaust ventilation systems on powertools or the use of mobile vacuum units could reduce the emissionof asbestos fibers during cutting and finishing activities.Because some work sites are continually moving as the workprogresses, the development and use of portable equipment wouldbe necessary. Prefabrication where possible may limit theexposures to asbestos; some fitting and finishing, however, maystill ~e necessary on site and thus exposures would still occur.Wet cutting could also be used to reduce exposures, although thereduced productivity due to the messy work conditions and thedanger of electrical shock may limit adoption of this option.Repair, maintenance, and demolition activities could use anamended water method when asbestos materials are to be removed or altered. The wetting of the material significantly reduces the exposure levels by limiting the initial creation of dust and its subsequent entrainment in the air.Complete discussion of Engineering controls are provide in section IV Technology Feasibility ( adobe pages 194-231) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Methodology | High | OSHA regulatory impact study |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | High | US |
| | Metric 3: Applicability | High | The report is for an occupational scenario within the scope of the risk evaluation |
| | Metric 4: Temporal Representativeness | Low | 1984 - more than 20 years old |
| | Metric 5: Sample Size | Low | Distribution of samples is qualitative or characterized by no statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | Low | Due to the breadth of the the assessment, results are provided and clearly referenced, but the underlying methods, data sources, and assumptions are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | |

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| | |
|---|---|
| **Study Citation:** | Parker, J. E. (1984). Preliminary regulatory impact and regulatory flexibility analysis of the proposed revisions to the standard for regulating occupational exposure to asbestos. |
| **HERO ID:** | 6902122 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

| | | **EVALUATION** | | |
|---|---|---|---|---|
| Domain | | Metric | Rating | Comments |
| | Metric 7: | Metadata Completeness | Low | The report does not address variability or uncertainty. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Pasetto, R., Terracini, B., Marsili, D., Comba, P. (2014). Occupational burden of asbestos-related cancer in Argentina, Brazil, Colombia, and Mexico. Annals of Global Health 80(4):263-268. |
| **HERO ID:** | 3077864 |
| **Conditions of Use:** | Other: |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Agriculture, hunting, forestry, and fishing; Mining and quarrying; Manufacturing; Electricity, gas, and water; Construction; Wholesale and retail trade and restaurants and hotels; Transport, storage, and communication; Financing, insurance, real estate, and business services; Community, social, and personal services |
| Number of workers: | Table 2: Proportion of Workers Exposed to Asbestos by Economic Sector in EU countries 1990-1993Agriculture, hunting, forestry, and fishing: 0.012; Mining and quarrying: 0.102; Manufacturing: 0.006; Electricity, gas, and water: 0.017; Construction: 0.052; Wholesale and retail trade and restaurants and hotels: 0.003; Transport, storage, and communication: 0.00068; Financing, insurance, real estate, and business services: 0.003; Community, social, and personal services: 0.012; |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Methodology | Medium | Report uses high quality data/techniques/methods that are not from frequently-used sources and there are no known quality issues. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | Medium | Data are from the EU. |
| | Metric 3: Applicability | Medium | Data are for various occupational scenarios. |
| | Metric 4: Temporal Representativeness | Low | Data is more than 20 years old. |
| | Metric 5: Sample Size | Medium | Sample distribution characterized by limited statistics (assumed mean) but discrete samples not provided and distribution not fully characterized. |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Petrovic, E. K. (2017). Persisting issues with the most recognized building material health risks: lead and asbestos. Woodhead Publishing series in composites science and engineering :155-174. |
| **HERO ID:** | 6698258 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Any workers exposed to asbestos in products such as roof tiles, wall claddings, vinyl flooring, sprayed fire protection, decorative ceilings, roofing membranes, adhesives, and paints. (11/20) |
| Exposure route: | inhalation, dermal, ingestion (14/20) |
| Physical form: | fibers(10/20) |
| Particle size characterization: | Normally, asbestos is defined as a mineral fiber with lengths of 5-10 µm, proportionally small fiber diameters of usually under 1 µm, and with an aspect ratio >3:1 (10/20) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Methodology | High | Report uses high quality methods and data from frequently-used sources. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | Medium | Data are from New Zealand, an OECD country. |
| Metric 3: | Applicability | High | Data are for industrial, commercial, and consumer use in construction products. Industrial and commercial uses are in scope. |
| Metric 4: | Temporal Representativeness | High | Report is based on current industry conditions and data no more than 10 years old. |
| Metric 5: | Sample Size | N/A | Sample size is not applicable to data extracted. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | N/A | Variability and uncertainty are not applicable to data extracted. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Piacitelli, L. (1983). Health hazard evaluation report no. HETA-83-112-1309, Saint Francis High School, Morgantown, West Virginia. |
| **HERO ID:** | 3970481 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Personal protective equipment: | An approved respirator should be worn. |
| Engineering control: | As an engineering control, the ventilation system should be turned off and remain off until the work is completed and the area has been cleaned. Spray the asbestos containing material with water before it is disturbed. |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Methodology | High | report uses high quality data |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | High | The data are from the United States |
| | Metric 3: Applicability | High | The report is for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: Temporal Representativeness | Low | The report is more than 20 years old. |
| | Metric 5: Sample Size | N/A | N/A - This metric is not applicable to the data being extracted |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | High | report clearly documents its data sources |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Low | The report does not address variability or uncertainty. |

## Overall Quality Determination Medium

**Study Citation:** Pinchin, D. (2006). Asbestos abatement: Impact of new regs on contractors and their clients. HazMat Management 18(3):28-29.
**HERO ID:** 6915464
**Conditions of Use:** Other:

**EXTRACTION**

| Parameter | Data |
|---|---|
| Worker activity description: | Asbestos removal workers (1/2) |
| Personal protective equipment: | When removing sprayed fireproofing, a supplied air full or half facepiece respirator is required. (2/2) |
| Engineering control: | Negative pressure of 0.02 inches of water is required in Type 3 (most hazardous) abatement sites. (2/2) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Methodology | High | Report uses high quality methods and data from frequently-used sources. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | Medium | Data are from Canada, an OECD country. |
| | Metric 3: Applicability | High | Data are for demolition of asbestos products, an in-scope occupational scenario. |
| | Metric 4: Temporal Representativeness | Medium | Report is based on data greater than 10 years old but no more than 20 years old and industry conditions that are expected to be representative of current industry conditions. |
| | Metric 5: Sample Size | N/A | N/A - This metric is not applicable to the data being extracted |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | Medium | Methods, results, and assumptions are clearly documented, but underlying data sources are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Piper, S., Grant, M. (1986). NESHAPs (National Emissions Standards for Hazardous Air Pollutants) asbestos demolition and renovation inspection workshop manual. |
| **HERO ID:** | 6901133 |
| **Conditions of Use:** | Disposal |

**EXTRACTION**

| Parameter | Data |
|---|---|
| Worker activity description: | Pre-entry• Initial respirator fit test should be performed at leastqualitatively using saccharin nebulizer, or irritant smoke.• Field check the respirator for proper fit by positive pressuremethod, after adjusting straps for a comfortable and close fit.Check exhalation valve seal by negative pressure method.• Don shoes, respirator, and gloves before coveralls or whole bodysuits. A hardhat is worn over the coverall hood.• Tape arm cuffs of coveralls to seal tightly against gloves, leavingtabs for easy removal. If rubber booties are worn, tape tightly tolegs of coveralls. Decontamination• Remove gross fiber contamination from clothing before leaving the work area.• Remove clothing and gloves by pulling inside out to trap externaldust. Dispose of used clothing in plastic bags. • A complete shower is recommended, including rinsing the respirator exterior before removal. Discard wetted filters in plastic bags.• Rinse or wet-wipe hardhat and shoes• Dry gear and body with disposable towels. Discard all wipes andtowels in plastic bags.• Clean rubber or plastic respirator facepiece with soap or milddetergent, and disinfectant. |
| Exposure route: | inhalation |
| Physical form: | inhalable fibers |
| Personal protective equipment: | PROTECTIVE EQUIPMENT• Respirator–OSHA requires one of three respirator groups to be used depending on the expected exposure level to asbestos fibers. Any respirator used should be approved by NIOSH or the Mine Safety Health Administration (MSHA), carrying a written statement of approval on the product data sheet or brochure. It is recommended that a respirator does not bond to the hood of a suit. The three general respirator groups and their recommended use are as follows:1. A reuseable or single use air purifying respirator whenairborne asbestos concentrations are between lx and l0x theOSHA ceiling or TWA standard. These are the levels mostfrequently encountered at demolition and renovation worksites, according to OSHA. Note that cartridge approval for asbestos istypically recorded on the cartridge itself, or at least on thecartridge or mask shipping carton.2. A powered air purifying respirator (belt mounted fan) withap-proved filter when airborne asbestos concentrations arebetween 10x and 100x the OSHA ceiling or TWA standard.3. A continuous flow or pressure-demand, supplied-air respiratorwhen asbestos concentrations are greater than 100x the OSHAceiling or TWA standard. These levels may occur during activedemolition or renovation operations.• Safety Shoes–Safety-toe footwear must meet ANSI standard Z41.1-1967 requirements.• Safety Glasses–Protective eyewear must meet ANSI standardZ87. 1-1979 requirements.•Hard Hat–Helmets must meet A1~SI standard Z89. 1-1 ~81 requirements.•Disposable Gloves–PVC gloves are recom-mended by EPA if any handling of asbestos material is anticipated. • Disposable Suits-Recommended by EPA if any active demolition or renovation operations are anticipated. Some type of protectiveclothing is required by OSHA if ceiling limits are exceeded. EPArecommends disposables made of DuPont Tyvek® or an equivalentprotective material. The suit should include hooded coveralls withattached boot covers. |
| Engineering control: | Negative AIR SYSTEMA negative pressure local air system may be used which containment barriers to reduce the pressure in an enclosed work area, protecting against large-scale fiber release in the event of a breach in the containment. This system may also reduce worker exposure by increasing room air turnover rate. The system should be designed as follows:• Windows and doors are sealed as usual;• Locate exhaust units at a maximum distance from worker accessopenings, allowing makeup air to traverse the work area as much as possible;• Size exhaust system to provide at least four air changes per hour; • Final filter must be a High Efficiency Particulate Air (HEPA)filter, rated for at least 99.97 percent efficiency with 0.03 µm DOPparticles (Military Standard No. 282–Certification No. UL586).Prefilters (5 µm, 10 µm, etc.) should be used to extend HEPA filterlife;• Exhaust system should run 24 hrs/day until job is complete, and at least 4 hours after job completion; and• Replace prefilters and/or HEPA filter if change in pressure across exhaust system exceeds 1.0 in. H2O |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Methodology | High | EPA study |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | US |
| Metric 3: | Applicability | High | The report is for an occupational scenario (Asbestos remediation) within the scope of the risk evaluation. |

**Continued on next page . . .**

. . . continued from previous page

**Study Citation:** Piper, S., Grant, M. (1986). NESHAPs (National Emissions Standards for Hazardous Air Pollutants) asbestos demolition and renovation inspection workshop manual.
**HERO ID:** 6901133
**Conditions of Use:** Disposal

| | | | EVALUATION | |
|---|---|---|---|---|
| Domain | | Metric | Rating | Comments |
| | Metric 4: | Temporal Representativeness | Low | 1984 - prior to the most recent PEL and more than 20 years old. |
| | Metric 5: | Sample Size | N/A | Qualitative information provided |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | Assessment or report clearly documents its data sources, assessment methods, results, and assumptions. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | N/A | Qualitative information provided |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Plato, N., Martinsen, J. I., Kjaerheim, K., Kyyronen, P., Sparen, P., Weiderpass, E. (2018). Mesothelioma in Sweden: Dose-Response Analysis for Exposure to 29 Potential Occupational Carcinogenic Agents. Safety and Health at Work 9(3):290-295. |
| **HERO ID:** | 6875563 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Railway engine drivers and assistants Furnacemen Machinery fitters, machine assemblers Sheet metal workers Plumbers and pipe fitters Welders and flame cutters Electrical fitters and wiremen Nonspecified electrical and electronics work Construction carpenters and joiners Painters Bricklayers Insulators Concrete and construction workers Nonspecified other building and construction work Glass formers and cutters Paper and paperboard workers Chemical and cellulose processing work n.e.c. Crane and hoist operators Riggers and cable splicers Store and warehouse workers Chimney sweeps |
| Exposure route: | inhalation |
| Physical form: | inhalable fibers |
| Area sampling data: | Maximum intensity bins were used in this analysis:0 f/ml; >0-0.1 f/ml; >0.1-0.8 f/ml; >0.8-1.8 f/mlTable 6 also provides probability of exposure and exposure level for the various worker activities listed. |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Methodology | Medium | The assessment uses high quality data and techniques that are not from a frequently used source and associated information does not indicate flaws or quality issues. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | Medium | The data are from an OECD country other than the U.S. |
| | Metric 3: Applicability | High | The report is for occupational scenarios within the scope of the risk evaluation. |
| | Metric 4: Temporal Representativeness | Medium | Assessment is less than 10 years old, but predictions of exposure are more than 20 years old. |
| | Metric 5: Sample Size | N/A | The exposure data appear to be assumed exposure bins based on job descriptions. |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | Medium | Assessment or report clearly documents results, methods, and assumptions. Data sources are generally described but not fully transparent. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Medium | The report provides only limited discussion of the variability and uncertainty in the results. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Polakoff, P. L. (1984). Have we really stopped exposing workers to asbestos?. Occupational Health and Safety 53(9):61-62. |
| **HERO ID:** | 3083561 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Construction workers, automobile body mechanics, engineer room personnel on ships, maintenance workers, steam locomotive repair employees, engineers, firemen, and power station operators. (2/2) |
| Number of workers: | OSHA estimates that 375,000 workers are exposed to asbestos. (1/2) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | Low | The data, data sources, and/or techniques or methods used in the assessment or report are not specified. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | The report is for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: | Sample Size | Low | Distribution of samples is qualitative or characterized by no statistics. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Low | Assessment results are provided but underlying methods, assumptions, and data sources are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Low

| | |
|---|---|
| **Study Citation:** | Price, R. (2018). What you need to know about handling asbestos. Farmers Weekly 170(6):34-35. |
| **HERO ID:** | 6900854 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | asbestos contractor work includes: work with asbestos insulation board, asbestos lagging, and loose asbestos insulation |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | Medium | The assessment or report uses high quality data and/or techniques or sound methods that are not from a frequently used source and associated information does not indicate flaws or quality issues. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Medium | The data are from an OECD country other than the U.S. (U.K.), and locality-specific factors (e.g., potential differences in regulatory occupational exposure or emission limits, industry/ processtechnologies) may impact exposures or releases relative to the U.S. |
| | Metric 3: | Applicability | High | The report is for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | High | The report captures operations, equipment, and worker activities expected to be representative of current conditions. The report is generally no more than 10 years old. |
| | Metric 5: | Sample Size | N/A | N/A - information not based on sampling |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Assessment or report clearly documents results, methods, and assumptions. Data sources are generally described but not fully transparent. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | N/A | No scope to address variability and uncertainty. |

## Overall Quality Determination — High

| | |
|---|---|
| **Study Citation:** | Prust, R. S. (1979). Future problems to be anticipated: Demolition, repair, and disposal. Annals of the New York Academy of Sciences 330(1):545-548. |
| **HERO ID:** | 6868545 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Engineering control: | sealant (pg 2-3) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | Medium | Report uses high quality data/techniques/methods that are not from frequently-used sources and there are no known quality issues. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for construction materials, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: | Sample Size | Medium | Sample distribution characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Methods, results, and assumptions are clearly documented, but underlying data sources are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | Variability addressed in discussion of how to handle asbestos materials in buildings (abatement vs. leave undisturbed), but uncertainty is not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Puncochar, P. (2007). After the Deluge: Outfitting Cleanup Crews. Occupational Health and Safety 76(5):95-99. |
| **HERO ID:** | 6900797 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | hurricane cleanup |
| Exposure route: | inhalation |
| Personal protective equipment: | Dusts containing asbestos require minimum of a half-facepiece reusable respirator with a 100 level particulate filter. OSHA prohibits use of filtering facepiece respirators (disposables) for asbestos (pg 4) |
| Comments: | Additional guidelines are provided for the selection of respiratory protection. (P.4/6) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Methodology | High | Report uses high quality data from frequently-used sources. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | Data are from the U.S. |
| Metric 3: | Applicability | Medium | Data are for construction materials and cleaning, similar to in-scope occupational scenario |
| Metric 4: | Temporal Representativeness | Medium | Report is based on data greater than 10 years old but no more than 20 years old and industry conditions that are expected to be representative of current industry conditions. |
| Metric 5: | Sample Size | Low | Distribution of samples is qualitative or characterized by no statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Medium | Methods, results, and assumptions are clearly documented, but underlying data sources are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Quinn, J. F., Acer, K. (1990). Protection from asbestos exposure includes personal and area monitoring. Occupational Health and Safety 59(2):27-29, 31. |
| **HERO ID:** | 3082617 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Personal protective equipment: | Workers can be equipped with positive-pressure supplied-air respirator like constant-flow, or pressure-demand respirators, air-line respirators with a high-efficiency filter or five-minute escape respirator; or self-contained breathing apparatus. (PDF Page 2) |
| Engineering control: | OSHA requires that employers use labs that have instituted intralaboratory and interlaboratory quality control comparisons and requirements for training microscopists when analyzing asbestos samples from exposure monitoring. (PDF Page 3) |
| Comments: | This article describes the establishment of monitoring criteria for asbestos that may be outdated since the article was published in 1990. The only relevant data here is information about PPE and ECs that are stated in the article. There are no discrete data about asbestos sampling. |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Methodology | High | The methodology mentioned is an OSHA/EPA/NIOSH approved method. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | The data is from the U.S. |
| Metric 3: | Applicability | High | The data are for industrial/commercial use in construction. |
| Metric 4: | Temporal Representativeness | Low | Data is over 20 years old. |
| Metric 5: | Sample Size | Low | No discrete monitoring data. Just PPE that may be worn. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Low | No metadata except for some PPE and ECs. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Low | Does not address variability or uncertainty. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Ravikrishna, R., Lee, H. W., Mbuligwe, S., Valsaraj, K. T., Pardue, J. H. (2010). Air quality during demolition and recovery activities in post-Katrina New Orleans. Environmental Toxicology and Chemistry 29(7):1438-1444. |
| **HERO ID:** | 2582061 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | demolition and cleanup operations |
| Physical form: | crystalline fibers |
| Area sampling data: | There are very few known crystalline fibers, and the visual appearance of the fibers matched the dominant shapes of serpentines and amphibole phases that characterize asbestos. No data specific to asbestos. |
| Comments: | Table 3. Metal concentrations on airborne particulates collected fromthe Lakeview District of New Orleans (Louisiana, USA) October–November 2005 |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Methodology | Medium | The assessment or report uses high quality data and/or techniques or sound methods. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | The data are from the United States |
| Metric 3: | Applicability | Medium | The report is for an occupational scenario that is similar to an occupational scenario. |
| Metric 4: | Temporal Representativeness | Medium | More than 10 years but no more than 20 years old. |
| Metric 5: | Sample Size | Medium | Distribution of samples is characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Medium | Assessment or report clearly documents results, methods, and assumptions. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Low | The report does not address variability or uncertainty. |

## Overall Quality Determination Medium

**Study Citation:** Reed, L. D. (1983). Health Hazard Evaluation Report, No. HETA-82-067-1253, Anchor Hocking Glass Company, Roofing Site, Lancaster, Ohio.
**HERO ID:** 3101121
**Conditions of Use:** Other:

**EXTRACTION**

| Parameter | Data |
|---|---|
| Worker activity description: | "Tearing off of old coal tar pitch roofing. First, loose gravel was collected and removed from the roof surface. A power cutter was then used to breakup the pitch layer down to theinsulation. The loosened material then was shoveled into a wheelbarrow and discarded over the edge of the building. Finally, small pieces of debris and dust were swept from the roof surface (4/11)" |
| Number of workers: | 7 workers (4/11) |
| Personal protective equipment: | NIOSH recommended safety goggles, respiratory protection (powered air-purifying helmet respirators), and sunscreen. (7/11) |
| Engineering control: | NIOSH recommends that water be used to thoroughly wet and dampen the surface of the roof prior to tear-off operations, and that a vacuum system be used instead of a broom for cleanup to reduce dust levels. (7/11) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Methodology | High | Report uses high quality methods and data from frequently-used sources. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | Data are from the U.S. |
| Metric 3: | Applicability | High | Data are for demolition of asbestos products, an in-scope occupational scenario. |
| Metric 4: | Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| Metric 5: | Sample Size | Low | Distribution of samples is qualitative or characterized by no statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Reid, R. (1987). Asbestos in the building? – Examine these options. Occupational Hazards 49(7):39-43. |
| **HERO ID:** | 3100909 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Asbestos abatement and removal |
| Personal protective equipment: | Respiratory protection should be worn until all these steps are completed. Change rooms, showers, and new protective clothing are required every time an employee enters or leaves the asbestos worksite. |
| Engineering control: | To reduce airborne asbestos, the material should be soaked with a water and wetting agent before attempting removal. Asbestos work areas must be sealed off from the rest of the building, with the enclosed area put under negative pressure. Enclosure involves sealing the asbestos material behind airtight walls and ceilings, with signs warning of the presence of the now-hidden hazard. But the fiber release continues behind the enclosure, and special precautions must be taken before maintenance or renovation is undertaken in the area.Encapsulation is described as a temporary measure in which asbestos is sprayed with an EPA-approved, paint-like material that bonds the fibers together in an elastic coating. Periodic reinspection is required to check for damage or deterioration, EPA advises.After abatement is completed, the work area and plastic barrier should be damp mopped or vacuumed with HEPA filter equipment. Inspect all surfaces for dust. Look for holes, voids, or cracks in enclosures or encapsulation. Check behind obstacles such as pipes and ducts. EPA recommends removing any plastic sheets covering floors, walls, or other surfaces after this inspection is complete. Leave in place the sheets that separate the work area from the rest of the building. |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Methodology | Medium | The assessment or report uses high quality data and/or techniques or sound methods that are not from a frequently used source and associated information does not indicate flaws or quality issues. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | High | The data are from the United States and are representative of the industry being evaluated. |
| | Metric 3: Applicability | High | The report is for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: Temporal Representativeness | Low | The report is more than 20 years old. |
| | Metric 5: Sample Size | N/A | Sample size is not relevant for the qualitative data provided. |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | Low | Assessment or report provides results, but the underlying methods, data sources, and assumptions are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | N/A | No scope to address variability and uncertainty. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Reid, R. (1987). How to protect maintenance workers from asbestos. Occupational Hazards 49(11):39-42. |
| **HERO ID:** | 6914767 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Removing small quantities of asbestos material from pipes, replacing asbestos-containing valves on gaskets, installing or removing small sections of drywall, installing electrical conduits through or near to asbestos-containing materials. [PDF Pg. 2] |
| Personal protective equipment: | Dual cartridge respirators equipped with high efficiency particulate air filters. [PDF Pg. 1] |
| Engineering control: | Wet down the asbestos material before disturbing it. [PDF Pg. 1]Employ glove bags or mini-enclosures when working on or removing small quantities of asbestos material from pipes, replacing asbestos-containing valves on gaskets, installing or removing small sections of drywall, installing electrical conduits through or near to asbestos-containing materials, or similar operations. [PDF Pg. 2] |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Methodology | High | Report uses high quality data/techniques/methods from frequently-used sources. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | Medium | Data are from Britain, an OECD country. |
| Metric 3: | Applicability | High | Data are for Chemical Substances in Construction, Paint, Electrical, and Metal Products, an in-scope occupational scenario. |
| Metric 4: | Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| Metric 5: | Sample Size | N/A | N/A - no sample data. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Low | Assessment results are provided but underlying methods, assumptions, and data sources are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | N/A | N/A - no sample data. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Reisch, M. (1990). More workers at risk from asbestos exposure. Chemical & Engineering News 68(27):10. |
| **HERO ID:** | 3584177 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | in repairing or installing ventilating duct systems in older buildings, sheet metal workers may have to scrape asbestos insulation off steel girders |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | Low | Report does not specify the data/techniques/methods used. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for construction materials, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: | Sample Size | N/A | Sample size not applicable to worker activity description. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Low | Assessment results are provided but underlying methods, assumptions, and data sources are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | N/A | Variability and uncertainty are not applicable to worker activity description. |

## Overall Quality Determination Medium

**Study Citation:** Reitze, W. B., Holaday, D. A., Romer, H., Fenner, E. M. (1971). Control of asbestos fiber emissions from industrial and commercial sources. :100-103.
**HERO ID:** 6925897
**Conditions of Use:** Other:

**EXTRACTION**

| Parameter | Data |
|---|---|
| Worker activity description: | Open pit mining (pg 1):drillingblastingshovelinghandling Milling (pg 2):crushingore dryingmillingclassification air separationpackagingsolid waste disposalMFG (pg 2):carding, willowing-enclosures, hoods or pick-upsweaving, spinning, twistingbag opening/emptying/disposal, bins, bobbins, spools |
| Engineering control: | Open pit mining (pg 1):drilling-small bag collectors; waterblasting-no known methodshoveling-filtered air cab, waterhandling-filtered air cab, covered load-canvasMilling (pg 2): bag filters with >99% efficiency (usually enclosed in negative pressure bag house); cyclone may be used as a primary collector; solid waste disposal-tailings are covered with earth (reforestation)MFG (pg 2):carding, willowing-enclosures, hoods or pick-ups vented to bag house (negative pressure, >99% efficiency)weaving, spinning, twisting-wetting fiberbag opening/emptying/disposal, bins, bobbins, spools-enclosure or hood to bag house |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Methodology | Medium | Report uses high quality data/techniques/methods that are not from frequently-used sources and there are no known quality issues. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | Data are from the U.S. |
| Metric 3: | Applicability | Low | Data are for upstream uses that are out-of-scope but may still be informative. |
| Metric 4: | Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| Metric 5: | Sample Size | N/A | qualitative data |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Medium | Methods, results, and assumptions are clearly documented, but underlying data sources are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Medium | Variability is addressed by discussing various control technologies but uncertainty is not addressed. |

## Overall Quality Determination Medium

**Study Citation:** Reitze, W. B., Holaday, D. A., Romer, H., Fenner, E. M. (1971). Control of asbestos fiber emissions from industrial and commercial sources. :100-103.
**HERO ID:** 6925897
**Conditions of Use:** Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products

**EXTRACTION**

| Parameter | Data |
|---|---|
| Worker activity description: | Asbestos cement (pg 2):dry and/or wet mix: bag opening/dumping/disposalpressing wet stock; moulding/forming wet furnishdrying and curingfinishing: cutting, grinding, sawing, planing, routingpackaging and shipping: bagging, boxingwarehousing raw material or finish productAsbestos containing building materials (pg 3):cutting calcium silicate products (pipe covering, block) with handsaw or band saw/table saw/saber sawdry mixing asbestos cementcutting cement products (tightly bound pipe board) with bandsaw, rotary sawsolid waste disposal: scrap from cutting and fitting of pipe covering, and block discarded asbestos cement; demolitionspray application |
| Engineering control: | Asbestos cement (pg 2):dry and/or wet mix: bag opening/dumping/disposal-enclosure or hood to bag house; wet scrubbers also used for dry mixpressing wet stock; moulding/forming wet furnish-no dustdrying and curing-no dustfinishing: cutting, grinding, sawing, planing, routing-enclosure or hood to bag house; primary cyclone may be usedpackaging and shipping: bagging, boxing-pickup point to bag housewarehousing raw material or finish product-vacuum sweeper to disposable bagspray applied asbestos insulation (pg 3-4): The entire floor, or the part of the floor to be insulated shall be enclosed with plastic or other approved tarpaulins in a manner which shall preclude the escape of asbestos containing material from the enclosure. All interior open areas, such as elevator shafts, stairwells, etc., shall be enclosed in a manner which shall prevent the escape of asbestos-containing material from the working area. ”Stack effect” of the shafts, stairwells, etc., shall be considered in providing proper enclosures. An enclosure will be considered satisfactory only if visible insulating material cannot escape from the enclosure; pre-dampingAsbestos containing building materials (pg 3):cutting calcium silicate products (pipe covering, block) with hand saw (no controls) or band saw/table saw/saber saw-bag collectorsdry mixing asbestos cement-marketed in plastic bags suitable for mixingcutting cement products (tightly bound pipe board) with bandsaw, rotary saw-bag collectorssolid waste disposal: scrap from cutting and fitting of pipe covering, and block discarded asbestos cement; demolition-materials enclosed in tightly closed bags/containers, moved in covered trucks to sanitary landfillspray application-enclosure of spray area perimeter, stair wells, elevator shafts and hopper charging areas with canvas plastic or solid board. After completion of spray operation, the area is shoveled, swept and vacuumed clean. |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Methodology | Medium | Report uses high quality data/techniques/methods that are not from frequently-used sources and there are no known quality issues. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | Data are from the U.S. |
| Metric 3: | Applicability | High | Data are for construction materials, an in-scope occupational scenario. |
| Metric 4: | Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| Metric 5: | Sample Size | N/A | qualitative data |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Medium | Methods, results, and assumptions are clearly documented, but underlying data sources are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Medium | Variability addressed by discussing various control technologies, but uncertainty is not addressed. |

**Continued on next page . . .**

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| | |
|---|---|
| **Study Citation:** | Reitze, W. B., Holaday, D. A., Romer, H., Fenner, E. M. (1971). Control of asbestos fiber emissions from industrial and commercial sources. :100-103. |
| **HERO ID:** | 6925897 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| **Overall Quality Determination** | | **Medium** | |

| | |
|---|---|
| **Study Citation:** | Rich, L. A. (1991). Clothing of peril. Occupational Hazards 53(2):30. |
| **HERO ID:** | 6900208 |
| **Conditions of Use:** | Other: |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Personal protective equipment: | Up to 70% of asbestos fibers that come into contact with spunbonded polypropylene penetrate the fabric. Impervious fabrics keep out more than 99% of asbestos fibers. |
| Engineering control: | OSHA requires a decontamination shower after leaving a contaminated area.Average of 63% of fibers are not removed by soap and water |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | Medium | The assessment or report uses high quality data and/or techniques or sound methods that are not from a frequently used source and associated information does not indicate flaws or quality issues. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | The data are from the United States and are representative of the industry being evaluated. |
| | Metric 3: | Applicability | High | The information may be relevant to more than 1 COU. |
| | Metric 4: | Temporal Representativeness | Low | The report is more than 20 years old. The report captures operations, equipment, and worker activities that are expected to be outdated. |
| | Metric 5: | Sample Size | N/A | n/a - data not dependent on sampling |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Assessment or report clearly documents results, methods, and assumptions. Data sources are generally described but not fully transparent. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | N/A | No scope to address variability and uncertainty. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Richter, E. D., Chlamtac, N., Berman, T., Laster, R. (2001). A review of environmental and occupational exposure to asbestos in Israel. Public Health Reviews 29(2-4):247-264. |
| **HERO ID:** | 3080446 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Products not Described by Other Codes |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Number of workers: | Less than 5000 workers using asbestos products and exposed to asbestos in place estimated in Israel. |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | Medium | The assessment or report uses high quality data that are not from a frequently used source. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Medium | Data are from Isreal, an OECD country. |
| | Metric 3: | Applicability | High | Data on number of workers are for workers handling asbestos in place and using asbestos products, which are in-scope of the legacy asbestos risk evaluation. |
| | Metric 4: | Temporal Representativeness | Low | The report is more than 20 years old. |
| | Metric 5: | Sample Size | N/A | Sample size not applicable to number of workers estimate. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Assessment or report clearly documents results, methods, and assumptions. Data sources are generally described but not fully transparent. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | Regarding the number of workers handling asbestos in place, variability and uncertainty are not described. |

## Overall Quality Determination **Medium**

| | |
|---|---|
| **Study Citation:** | Rissanen, S., Smolander, J., Louhevaara, V. (1991). Work load and physiological responses during asbestos removal with protective clothing. International Archives of Occupational and Environmental Health 63(4):241-246. |
| **HERO ID:** | 3082481 |
| **Conditions of Use:** | Disposal |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Asbestos removal (pg 241) |
| Exposure duration: | 5 hrs/day. The field measurements were done in the morning between 7:00 and 12:00 on days chosen at random (pg 242). |
| Number of workers: | 8 (pg 241) |
| Personal protective equipment: | During the work, the men wore permeable or impermeable clothing along with a powered or nonpowered filtering device including a full-face or half-face mask. As of 1988, the regulations of the Finnish Council of State require that the employer provide dust repelling protective clothing and an efficient industrial respirator for asbestos workers. Lightweight, disposable coveralls are the most common type of protective clothing used; they can be permeable, semipermeable, or impermeable. (pg 241) |
| Engineering control: | The asbestos removal was always carried out in an area that had been isolated with plastic sheeting in accordance with legislation The subjects put on the protective clothing in the clean room of the decontamination unit before entering the work area After finishing the work, they took off their contaminated clothing inside the equipment room of the plastic compartment. (pg 242) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Methodology | High | The report uses high quality data, such as regulations of the Finnish Council of State. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | Medium | The data are from an OECD country other than the U.S. |
| | Metric 3: Applicability | High | The report is for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: Temporal Representativeness | Low | The report is more than 20 years old. |
| | Metric 5: Sample Size | N/A | N/A - This metric is not applicable to the data being extracted |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | Medium | Data sources are generally described but not fully transparent. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Low | The report does not address variability or uncertainty. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Roggli, V. L., Sharma, A., Butnor, K. J., Sporn, T., Vollmer, R. T. (2002). Malignant mesothelioma and occupational exposure to asbestos: a clinicopathological correlation of 1445 cases. Ultrastructural Pathology 26(2):55-65. |
| **HERO ID:** | 3080528 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Pipefitter, boilermaker, maintenance, machinist, electrician, sheetmetal, other asbestos workers |
| Physical form: | Fiber |
| Number of workers: | 1445 cases |
| Comments: | Study is a retrospective health analysis of mesothelioma patients. |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | The assessment or report uses high quality data and/or techniques or sound methods that are from frequently used sources. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | The data are from the United States. |
| | Metric 3: | Applicability | High | The report is for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Low | The report is more than 20 years old. |
| | Metric 5: | Sample Size | N/A | No sample data. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | Assessment or report clearly documents its data sources, assessment methods, results, and assumptions. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | N/A | No scope to address variability and uncertainty. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Romundstad, P. R., Rønneberg, A., Leira, H. L., Bye, T. (1998). Health survey of former workers in a Norwegian coke plant: Part. 1. Estimation of historical exposures. Occupational and Environmental Medicine 55(9):616-621. |
| **HERO ID:** | 1019939 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Maintenance General maintenance Coke side maintenance Bricklayers and oven rebuilders Gas side maintenance InsulatorsGas side General gas side Gas cleaning and tar distillery Ammonia synthesis Cracking station Compressor hall |
| Exposure duration: | Maintenance/gas cracking station 0.5-1 hour per weekBricklayers 2.5 hours per week |
| Number of workers: | 383 |
| Personal protective equipment: | Air stream helmets |
| Engineering control: | The sealing of the ovens Larry car and the ram car were equipped with filtered air |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Methodology | Medium | Study performed by University Hospital of Trondheim, Norway. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | Medium | Norway - OECD member |
| Metric 3: | Applicability | High | The report is for an occupational scenario (Coke Plant) within the scope of the risk evaluation. |
| Metric 4: | Temporal Representativeness | Low | 1998 - more than 20 years old |
| Metric 5: | Sample Size | N/A | information was qualitative |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | High | Assessment or report clearly documents its data sources. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | N/A | information was qualitative |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Ross, K. (1996). New glovebag regulations allow safer, cheaper asbestos removal. Occupational Health and Safety 65(9):52-55. |
| **HERO ID:** | 3615675 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Maintenance and removal of asbestos pipes and valves. (1/3) |
| Personal protective equipment: | Workers must still wear respiratory protection when using glovebags. (3/3) |
| Engineering control: | Glovebags can be used during maintenance or removal of asbestos from pipes instead of sealing off an entire building or section of a building. (1/3) The glovebag must completely cover the section of pipe where work is to be performed, each glovebag can only be used once, they cannot be used at temperatures above 150F, and they must be collapsed with a HEPA vacuum after use. (3/3) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Methodology | Medium | Report uses high quality data that are not from frequently-used sources and there are no known quality issues. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | High | Data are from the U.S. |
| | Metric 3: Applicability | High | Data are for commercial use in construction materials, an in-scope occupational scenario. |
| | Metric 4: Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: Sample Size | N/A | No sample data. |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | Low | Assessment results are provided but underlying methods, assumptions, and data sources are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | N/A | No scope to address variability and uncertainty. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Rousmaniere, P., Raj, N. (2007). Shipbreaking in the developing world: Problems and prospects. International Journal of Occupational and Environmental Health 13(4):359-368. |
| **HERO ID:** | 3541792 |
| **Conditions of Use:** | Other: |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Workers dismantle a ship's hull and move parts by hand to stores and sheds. (4/11) |
| Number of workers: | 12,000 workers involved in shipbreaking in Alang, India and 20,000 in Chittagong, Bangladesh (3/11) |
| Personal protective equipment: | Helmets and protective glasses are provided (6/11) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | Medium | Report uses high quality data that are not from frequently-used sources and there are no known quality issues. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Low | Data are from India, a non-OECD country. |
| | Metric 3: | Applicability | High | Data are for demolition of asbestos products, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Medium | Report is based on data greater than 10 years old but no more than 20 years old and industry conditions that are expected to be representative of current industry conditions. |
| | Metric 5: | Sample Size | Low | Distribution of samples is qualitative or characterized by no statistics. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Rusu-Zagar, C., Rusu-Zagar, G., Iorga, A., Iorga, O. (2013). Prevention of exposure to asbestos. Effects on workers safety and health. :305-309. |
| **HERO ID:** | 6870209 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | carpenters, joiners, shop-fitters, plumbers, gas technicians, electricians, computer cable installers, porters etc., Workers in demolition, dismantling and ship repair personnel, automotive technicians and mechanics (pg 12) |
| Exposure route: | inhalation, ingestion, dermal (pg 11) |
| Personal protective equipment: | autonomous insulating breathing apparatus (pg 11) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Methodology | Medium | Report uses high quality data/techniques/methods that are not from frequently-used sources and there are no known quality issues. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | Low | Data are from Romania, a non-OECD country. |
| Metric 3: | Applicability | High | Data are for construction materials, an in-scope occupational scenario. |
| Metric 4: | Temporal Representativeness | High | Report is based on current industry conditions and data no more than 10 years old. |
| Metric 5: | Sample Size | N/A | no quantitative info |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Medium | Methods, results, and assumptions are clearly documented, but underlying data sources are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Ryckman, M. D., Ryckman, D. W., Peters, J. L. (1983). ASBESTOS CONTROL PROGRAM FOR INSTITUTIONAL FACILITIES. Journal of Environmental Engineering 109(2):275-288. |
| **HERO ID:** | 3584930 |
| **Conditions of Use:** | Consumer Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Educational faculty where spray-on materials were used in construction (2/14) |
| Exposure route: | inhalation, dermal (2/14) |
| Physical form: | dust (1/14) |
| Particle size characterization: | ”Fiber length is 0.03-30 microns, and fiber diameter is 100 to 250 A. (2/14) 65%of all fiber particles released are smaller than five microns in length. 96% of all fibers released into the air are smaller than 5 microns in diameter (3/14)” |
| Number of workers: | 250,000 faculty members at schools (2/14) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Methodology | High | Report uses high quality methods and data from frequently-used sources. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | High | Data are from the U.S. |
| | Metric 3: Applicability | Low | Data are for consumer use of construction materials in schools, which is similar to commercial use of construction materials, an in-scope occupational scenario. |
| | Metric 4: Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: Sample Size | Medium | Sample distribution characterized by limited statistics (percentages, ranges) but discrete samples not provided and distribution not fully characterized. |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | Medium | Methods, results, and assumptions are clearly documented, but underlying data sources are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Sallemi, B. M. (2012). A life-time mortality risk analysis and cost benefit analysis associated with asbestos exposure from the collapse of the World Trade Center on 9/11: Does the cost of US-EPA's residential dust clean-up in lower Manhattan exceed its benefit?. |
| **HERO ID:** | 6897672 |
| **Conditions of Use:** | Other: |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Personal protective equipment: | 1931 UK asbestos standards: "breathing apparatus" along with other personal protective equipment including coveralls, head covers, and gloves to employees working with asbestos. (pg 16) |
| Engineering control: | 1931 UK asbestos standards: mechanical exhaust systems (pg 16) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | Medium | Report uses high quality data that are not from frequently-used sources and there are no known quality issues. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Medium | Data are from the UK, and OECD country. |
| | Metric 3: | Applicability | High | Data are for general asbestos handling/use. |
| | Metric 4: | Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: | Sample Size | N/A | qualitative data |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Methods, results, and assumptions are clearly documented, but underlying data sources are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | San Jose Medical Clinic, (1979). Technical report concerning exposure to asbestos with cover letter. |
| **HERO ID:** | 3653829 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | insulators during construction/repair projects; asbestos removal (pg 7) |
| Number of workers: | 47 (pg 8) |
| Personal protective equipment: | respirator (pg 7) |
| Engineering control: | wetting down prior to removal (pg 7) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | Medium | Report uses high quality data/techniques/methods that are not from frequently-used sources and there are no known quality issues. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for construction materials, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: | Sample Size | N/A | Only relevant quantitative data is number of workers. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Methods, results, and assumptions are clearly documented, but underlying data sources are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Scarlett, H. P., Postlethwait, E., Delzell, E., Sathiakumar, N., Oestenstad, R. K. (2012). Asbestos in public hospitals: Are employees at risk?. Journal of Environmental Health 74(6):22-26. |
| **HERO ID:** | 2566558 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | asbestos was primarily in boiler rooms and other areas exposing primarily building maintenance persons and some laundry workers;In the vast majority of cases, the asbestos found was used as TSI on boilers and pipes; in one case asbestos was used as TSI on the ceiling of a boiler room; while in another case asbestos was a part of the roof of an incinerator. |
| Physical form: | friable insulation on boilers, fibers |
| Comments: | Report conducted a survey of public hositipals and contains supplemental facility data (e.g., number of hospitals beds) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Methodology | High | Report is a published journal article, a frequently used source, and associated information does not indicate flaws or quality issues. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | Low | Data is for Jamaica, an non-OECD country. |
| Metric 3: | Applicability | High | Report is for an occupational scenario (construction materials) within the scope of the risk evaluation. |
| Metric 4: | Temporal Representativeness | High | The report is generally no more than 10 years old (2012). |
| Metric 5: | Sample Size | N/A | N/A- qualitative information |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | High | Assessment or report clearly documents its data sources, assessment methods, results, andassumptions. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | High | Variability addressed by measuring various hospitals and uncertainty can be determined from analytical method. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Schempf, H., Mutschler, E., Chemel, B., Boehmke, S., Piepgras, C., Crowley, W. (1998). A robotic pipe-asbestos insulation removal system. Industrial Robot 25(3):196-204. |
| **HERO ID:** | 3583495 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Asbestos insulation abatement (pg 196) |
| Exposure route: | Inhalation |
| Physical form: | Fiber |
| Personal protective equipment: | respiratory systems (pg 203) |
| Engineering control: | Self-propelled, negative-pressure mini-containment system |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | Medium | The assessment or report uses high quality data and/or techniques or sound methods that are not from a frequently used source and associated information does not indicate flaws or quality issues. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | The data are from the United States and are representative of the industry being evaluated. |
| | Metric 3: | Applicability | High | The report is for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Low | The report is more than 20 years old. |
| | Metric 5: | Sample Size | N/A | No sample data. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | Assessment or report clearly documents its data sources, assessment methods, results, and assumptions. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | N/A | No scope to address variability and uncertainty. |

## Overall Quality Determination High

**Study Citation:** Schlezinger, Z. (1986). Use of asbestos in the Israeli defense forces. American Journal of Industrial Medicine 10(5-6):539-541.
**HERO ID:** 3583243
**Conditions of Use:** Other:

**EXTRACTION**

| Parameter | Data |
|---|---|
| Worker activity description: | handling and repair of brake shoes, drums, and clutch plates (army garages) (PDF pg 1)This included two main procedures: dismounting the wheels of vehicles, and repair. Repair was subdivided into four tasks: drilling, threading, rivetting, and surface regrinding (filling). Each task is performed at a different station in the garages. Dismounting and repair are performed by two separate groups of workers. (PDF pg 2)There were two main workplaces where exposure might occur: textile workshops and engine rooms. Most asbestos was found in the engine rooms where operators, working in small enclosed spaces, manually removed and cut from the engine old layers of attached asbestos textile lining (PDF pg 3)Asbestos cement was also used in shipyards as an insulation material for places on the engine insufficiently covered by asbestos textiles. Again, workers manually added water to the cement powder and used this as a filler for uncovered surfaces. (PDF pg 3) |
| Area sampling data: | In 1979-1980 the airborne standard for asbestos was 2 fibers/ml. Measurements at that time showed asbestos levels above this standard only in the filling process... After the standard was reduced to 1 fiber/ml, levels above the standard were occasionally noted also in other work position (PDF pg 2) |
| Exposure duration: | A vehicle mechanic is employed in a professional (noncombat) capacity and is committed to five years of service—three years compulsory, two years as a regular. Thereafter, he is either released from duty or continues his military career. The latter choice may involve continued exposure, if he remains in the same job, or exposure may end with a job promotion (PDF pg 2) |
| Number of workers: | The group involved in the filling process constituted only 1 % of the total workforce of the garages (PDF pg 2) |
| Engineering control: | wet work procedures, cleaning dust with vacuum cleaners (PDF pg 2)installation of suction equipment (PDF pg 2)closed glove compartments (PDF pg 2) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Methodology | Medium | Report uses high quality data that are not from frequently-used sources and there are no known quality issues. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | Medium | Data are from Israel, an OECD country. |
| Metric 3: | Applicability | High | Data are for multiple in scope occupational scenarios |
| Metric 4: | Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| Metric 5: | Sample Size | Low | Sample distribution is described qualitatively. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Medium | Methods, results, and assumptions are clearly documented, but underlying data sources are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Medium | Variability addressed by describing various exposure activities in the IDF but uncertainty is not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Scott, W. C., Estes, E. H., Jr, Coble, Y. D., Jr, Eisenbrey, A. B., Karlan, M. S., Kennedy, W. R., Moulton, M. P., Numann, P. J., Skelton, W. D., Steinhilber, R. M., Strong, J. P., Wagner, H. N., Jr, Wheater, R. H., Doege, T. C. (1991). Asbestos removal, health hazards, and the EPA. JAMA: Journal of the American Medical Association 266(5):696-697. |
| **HERO ID:** | 3613449 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | floor and ceiling tiles; hair dryers; ceiling insulation; filters for cigarettes; packaging for beer, wines, and parenteral fluids; brake linings (pg 1)were used in the construction trades and industrial or other processes, where it served primarily as a reinforcing fiber, thermal insulation, or fire-stop (pg 1) |
| Exposure route: | inhalation |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Methodology | High | Report uses high quality data/techniques/methods from frequently-used sources. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | High | Data are from the U.S. |
| | Metric 3: Applicability | High | Data are for construction materials, an in-scope occupational scenario. |
| | Metric 4: Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: Sample Size | Low | Distribution of samples is qualitative or characterized by no statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | Medium | Methods, results, and assumptions are clearly documented, but underlying data sources are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Selikoff, I. J. (1970). Partnership for prevention–the insulation industry hygiene research program. IMS, Industrial Medicine and Surgery 39(4):162-166. |
| **HERO ID:** | 3084921 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Exposure route: | Inhalation [PDF Pg. 5] |
| Number of workers: | ”18,000 unionized insulation workers in this country aredispersed among some 850 employers - an average of 17workers per employer, with only one-sixth having morethan 20 employees regularly. The unions are organizedby locals and only two of these locals have as many as700 members each. ” [PDF Pg. 4] |
| Personal protective equipment: | Dust masks [PDF Pg. 5] Only 4% of workers always use a mask; 30% have never used one [PDF Pg.6] |
| Engineering control: | Ventilation systems [PDF Pg. 4] |
| Comments: | No data on throughput or # sites in the document. |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Methodology | High | Report uses high quality data/techniques/methods from frequently-used sources. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | Data are from the U.S. |
| Metric 3: | Applicability | High | Data are for construction, paint, electrical, and metal products, an in-scope occupational scenario. |
| Metric 4: | Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| Metric 5: | Sample Size | Low | Sample distribution is described qualitatively. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Low | Assessment results are provided but underlying methods, assumptions, and data sources are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Selikoff, I. J., Churg, J., Hammond, E. C. (1965). Relation between exposure to asbestos and mesothelioma. New England Journal of Medicine 272:560-565. |
| **HERO ID:** | 3085120 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Insulation workers engaged in building, powerhouse, and shipyard construction work. (2/6) |
| Exposure route: | inhalation (1/6) |
| Physical form: | fibers (2/6) |
| Number of workers: | 1522 men in insulator unions until 1962. (2/6) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | Report uses high quality methods and data from frequently-used sources. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for commercial use in construction materials, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: | Sample Size | Medium | Sample distribution characterized by limited statistics (number of workers) but discrete samples not provided and distribution not fully characterized. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | Variability is addressed by sampling 3 worker unions. Uncertainty isn't addressed. |

## Overall Quality Determination — High

| | |
|---|---|
| **Study Citation:** | Selikoff, I. J., Hammond, E. C. (1978). Asbestos-associated disease in United States shipyards. CA: A Cancer Journal for Clinicians 28(2):87-99. |
| **HERO ID:** | 3084452 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | asbestos insulation workers (pg 1)shipyard workers (a boilermaker, a fitter, a shipwright, a welder and a laborer; welders, shipfitters, machinists, pipefitters, electricians, boilermakers and painters; carpenters, riggers, electricians, draftsmen, welders) (pg 3)molders, lead bonders, office workers, draftsmen, guards, and decontamination technicians (pg 7) |
| Number of workers: | In 1943, in the United States, for example, approximately one in 500 shipyard workers was an insulator. (pg 3)during World War II, approximately 4,500,000 men and women worked in our shipyards... After World War II the total number of shipyard workers rapidly decreased from a high of 1,700,000 in the last months of 1943 to 200,000 or so... The 200,000-250,000 figurecharacterized the total number in the yards at one time; however, there was much turnover, and the total number of different individuals was much larger. (pg 3) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Methodology | Medium | Report uses high quality data/techniques/methods that are not from frequently-used sources and there are no known quality issues. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | High | Data are from the U.S. |
| | Metric 3: Applicability | High | The report is for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: Sample Size | Medium | Sample distribution characterized by limited statistics (range, mean, maximum) but discrete samples not provided and distribution not fully characterized. |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | Medium | Methods, results, and assumptions are clearly documented, but underlying data sources are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Medium | Variability addressed by looking at number of workers over time but uncertainty is not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Selikoff, I. J., Lilis, R., Nicholson, W. J. (1979). Asbestos disease in United States shipyards. Annals of the New York Academy of Sciences 330:295-311. |
| **HERO ID:** | 3084380 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Number of workers: | Number of workers (in thousands of workers) in Shipyards (Private, Navy, Total)Jan 1923: 68.5; 22.4; 90.9Jan 1925: 56.4; 21.0; 77.4Jan 1927: 66.2; 20.9; 87.1Jan 1929: 53.8; 23.0; 76.8Jan 1931: 55.6; 20.5; 76.1Jan 1933: 32.9; 21.6; 54.5Jan 1935: 44.1; 18.8; 62.9Jan 1937: 62.0; 33.3; 95.3Jan 1939: 61.7; 39.9; 101.6Jan 1940: 79.4; 57.8; 137.2Jan 1941: 147.7; 107.8; 255.5Jan 1942: 396.0; 192.7; 588.7Jan 1943: 1184.3; 294.6; 1478.9Jan 1944: 1357.2; 326.0; 1683.2Percentage of workers in 1943 by occupation:Welders: 15.3Shipfitters: 11.0Machinists: 8.1Pipefitters: 7.2Electricians: 6.6Carpenters: 6.1Laborers: 5.5Burners: 3.8Painters: 3.1Sheetmetal workers: 3.0Riggers: 2.8Chippers and caulkers: 2.8Boilermakers: 2.3Crane operators: 1.3Pipe coverers: 0.2All Others: 21.1 |
| Comments: | Number of shipyards (sites) is not given. |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Methodology | High | Report uses high quality data/techniques/methods from frequently-used sources. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | Data are from the U.S. |
| Metric 3: | Applicability | High | Data are for construction, paint, electrical, and metal products, an in-scope occupational scenario. |
| Metric 4: | Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| Metric 5: | Sample Size | Low | Sample distribution is characterized by no statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Medium | Variability addressed by looking at number of workers for various years but uncertainty is not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Senior Labour Inspectors Committee, (2006). A practical guide on best practices to prevent or minimise asbestos risks in work that involves (or may involve) asbestos: for the employer, the workers, and the labour inspector.. |
| **HERO ID:** | 3982341 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Furnishing, Cleaning, Treatment Care Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Asbestos removal training is in section 7.2.4Examples of asbestos work are provided in chapters 10-13p. 139, 150 contains more information |
| Personal protective equipment: | personal protective equipment (e.g. disposable overalls; washable boots) and respiratory protective equipment (e.g. asbestos rated disposable respiratory protection EN 149 Type FFP3, or EN405 half masks –with face-fit testing for suitability to the individual and regular replacement of soiled filters), (p. 58) |
| Engineering control: | air locks, enclosures, decontamination units (p. 54)H-type vacuum cleaner, i.e. a vacuum cleaner with High Efficiency Particulate Air (HEPA) filters manufactured to international specifications for use with asbestos; Dust suppression equipment, e.g. local exhaust ventilation connecting to the H-type vacuum cleaner for collecting dust from drilling holes etc. (p. 58)Preparation of an enclosure (p. 91)Decontamination unit (p. 97) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Methodology | High | The assessment or report uses high quality data and/or techniques or sound methods that are from frequently used sources (European Union) and are generally accepted by the scientific community, and associated information does not indicate flaws or quality issues. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | Medium | The data are from an OECD country other than the U.S., and locality-specific factors (e.g., potential differences in regulatory occupational exposure or emission limits, industry/ processtechnologies) may impact exposures or releases relative to the U.S. |
| Metric 3: | Applicability | High | The report is for an occupational scenario within the scope of the risk evaluation. |
| Metric 4: | Temporal Representativeness | Medium | The report captures operations, equipment, and worker activities that are expected to be reasonably representative of current conditions. The report is generally more than 10 years but no more than 20 years old. |
| Metric 5: | Sample Size | N/A | n/a - no sampling data |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | High | Assessment or report clearly documents its data sources, assessment methods, results, and assumptions. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Medium | The report provides only limited discussion of the variability and uncertainty in the results. |

## Overall Quality Determination — High

| | |
|---|---|
| **Study Citation:** | Senior Labour Inspectors Committee, (2006). A practical guide on best practices to prevent or minimise asbestos risks in work that involves (or may involve) asbestos: for the employer, the workers, and the labour inspector.. |
| **HERO ID:** | 3982341 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Asbestos removal training is in section 7.2.4Examples of asbestos work are provided in chapters 10-13p. 139, 150 contains more information |
| Personal protective equipment: | personal protective equipment (e.g. disposable overalls; washable boots) and respiratory protective equipment (e.g. asbestos rated disposable respiratory protection EN 149 Type FFP3, or EN405 half masks –with face-fit testing for suitability to the individual and regular replacement of soiled filters), (p. 58) |
| Engineering control: | air locks, enclosures, decontamination units (p. 54)H-type vacuum cleaner, i.e. a vacuum cleaner with High Efficiency Particulate Air (HEPA) filters manufactured to international specifications for use with asbestos; Dust suppression equipment, e.g. local exhaust ventilation connecting to the H-type vacuum cleaner for collecting dust from drilling holes etc. (p. 58)Preparation of an enclosure (p. 91)Decontamination unit (p. 97) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Methodology | High | The assessment or report uses high quality data and/or techniques or sound methods that are from frequently used sources (European Union) and are generally accepted by the scientific community, and associated information does not indicate flaws or quality issues. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | Medium | The data are from an OECD country other than the U.S., and locality-specific factors (e.g., potential differences in regulatory occupational exposure or emission limits, industry/ processtechnologies) may impact exposures or releases relative to the U.S. |
| | Metric 3: Applicability | High | The report is for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: Temporal Representativeness | Medium | The report captures operations, equipment, and worker activities that are expected to be reasonably representative of current conditions. The report is generally more than 10 years but no more than 20 years old. |
| | Metric 5: Sample Size | N/A | n/a - no sampling data |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | High | Assessment or report clearly documents its data sources, assessment methods, results, and assumptions. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Medium | The report provides only limited discussion of the variability and uncertainty in the results. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Sepulveda, M.,-J, Piacitelli, L. (1981). Health hazard evaluation report no. HHE 81-028-1059, Consolidated Railorad Corporation, Reading, Pennsylvania. |
| **HERO ID:** | 3970499 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Source of exposure was ceiling and pipe insulation. (2/9) |
| Exposure route: | inhalation (3/9) |
| Number of workers: | 4500 workers prior to 1953, 392 workers presently (2/9) |
| Engineering control: | Encapsulation or removal are appropriate methods for controlling asbestos exposure from the insulation of powerhouse boilers. This material is in good condition and in an area that is rarely entered or used. Encapsulation would not be an effective means of controlling asbestos exposure from the insulation of the heating lines. The deteriorated state of this material would not support the sealant. This material must be removed. (4/9) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Methodology | High | Report uses high quality methods and data from frequently-used sources. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | High | Data are from the U.S. |
| | Metric 3: Applicability | High | Data are for commercial use in building construction materials, an in-scope occupational scenario. |
| | Metric 4: Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: Sample Size | Medium | Sample distribution characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Smither, W. J. (1979). Surveillance of high-risk groups–a survey of asbestos workers: The present position in the United Kingdom. Annals of the New York Academy of Sciences 330(1):525-532. |
| **HERO ID:** | 3084370 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Products not Described by Other Codes |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | On pg 527, the report discusses insulation workers exposed to asbestos. |
| Exposure route: | Inhalation |
| Physical form: | solid |
| Number of workers: | An estimate made by the Thermal Insulation Contractor's Association put the number at 7500 directly employed in insulation. An additional 1000 insulators worked in Her Majesty's dockyards. The numbers at "high risk" in 1968 were therefore estimated to be about 20,000 (in the memorandum of the Senior Medical Inspectorate Advisory Panel). (pg 527) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Methodology | Low | The data and data sources used in the report are not specified. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | Medium | The data are from an OECD country other than the U.S. |
| | Metric 3: Applicability | High | The report is for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: Temporal Representativeness | Low | The report is more than 20 years old. |
| | Metric 5: Sample Size | Low | Distribution of samples is characterized by no statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | Low | Report provides results, but the data sources are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Low | The report does not address variability or uncertainty. |

## Overall Quality Determination — Low

| | |
|---|---|
| **Study Citation:** | Snyder, J. G., Virta, R. L., Segreti, J. M. (1987). Evaluation of the phase contrast microscopy method for the detection of fibrous and other elongated mineral particulates by comparison with a STEM technique. American Industrial Hygiene Association Journal 48(5):471-477. |
| **HERO ID:** | 3615922 |
| **Conditions of Use:** | Other: |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Table 1 (pg 3) presents sample sources/locations (construction, abatement, mining, among others) |
| Physical form: | fiber |
| Particle size characterization: | Figure 2, pg 5; Table 2, pg 6: present Log Length, Log Width, Log Aspect RatioTable 3, pg 6: presents particles per mm2 with aspect ratios >3:1Table 4, pg 7: presents % of particles above/below 0.25 um |
| Comments: | Membrane Filter Method employing phase contrast optical microscopy (PCM) compared to scanning transmission electron microscopy (STEM) (pg 2) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Methodology | High | Report uses high quality data/techniques/methods from frequently-used sources. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | Data are from the U.S. |
| Metric 3: | Applicability | High | Data are for multiple in-scope occupational scenarios. |
| Metric 4: | Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| Metric 5: | Sample Size | Medium | Sample distribution characterized by limited statistics (min, max, mean) but discrete samples not provided and distribution not fully characterized. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Medium | Variability addressed by comparing PCM and STEM methods but uncertainty is not addressed. |

## Overall Quality Determination — High

| | |
|---|---|
| **Study Citation:** | Stevens, W. H. (1997). Thermal removal of asbestos pipeline coating. Pipeline and Gas Journal 224(3):41-43. |
| **HERO ID:** | 3582345 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Two certified asbestos workers locate the midpoint of the SO-foot joint and cover a small area beneath it with plastic. Then two lineal feet over the midpoint of the pipe are wetted and draped with wet burlap. The workers then pound off the coating with hammers through the draping, remove the draping and scrape the remaining coating off by hand. [PDF Pg. 3] |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Methodology | Medium | Report uses high quality data/techniques/methods that are not from frequently-used sources and there are no known quality issues. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | High | Data are from the U.S. |
| | Metric 3: Applicability | High | Data are for Chemical Substances in Construction, Paint, Electrical, and Metal Products, an in-scope occupational scenario. |
| | Metric 4: Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: Sample Size | Low | Distribution of samples is qualitative or characterized by no statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | Medium | Methods, results, and assumptions are clearly documented, but underlying data sources are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Low | The report does not address variability or uncertainty. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Subramanian, V., Madhavan, N. (2005). Asbestos problem in India. Lung Cancer 49(Supplement 1):S9-S12. |
| **HERO ID:** | 744931 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Primary exposure to asbestos in India can be encountered in the form of asbestos mining, asbestos cement industries, asbestos processing unit and during renovation and demolition of old asbestos cemented roof or other structures as well as modern electrical as well as mechanical appliances in which asbestos is still found. |
| Exposure route: | Inhalation |
| Physical form: | Fibers |
| Particle size characterization: | Asbestos mineral is composed of fibrils (about 0.03 m diameter) that are packed together. |
| Comments: | Data regarding asbestos production, import, and export are unrelated to asbestos legacy risk evaluation. |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | Medium | The assessment or report uses high quality data and/or techniques or sound methods that are not from a frequently used source and associated information does not indicate flaws or quality issues. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Low | The data are from India, a non-OECD country. |
| | Metric 3: | Applicability | High | Demolition and renovation of old asbestos cemented structures are within scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Medium | The report is generally more than 10 years but no more than 20 years old. |
| | Metric 5: | Sample Size | N/A | Sample size is not applicable to description of worker activities. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Low | Assessment or report provides results, but the underlying methods, data sources, and assumptions are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | The report does not address variability or uncertainty. |

## Overall Quality Determination — Low

| | |
|---|---|
| **Study Citation:** | Sullivan, R. J. (1969). Air pollution aspects of asbestos. |
| **HERO ID:** | 6865572 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Exposure route: | Inhalation |
| Physical form: | fiber |
| Number of workers: | Approximately 100,000 workers have high exposure to asbestos. An additional 3.5 million construction workers are indirectly exposed |
| Engineering control: | Asbestos is contained by enclosing the material in plastic bags during transport |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | Medium | The assessment or report uses high quality data and/or techniques or sound methods that are not from a frequently used source and associated information does not indicate flaws or quality issues. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | The data are from the United States and are representative of the industry being evaluated. |
| | Metric 3: | Applicability | High | The report is for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Low | The report is more than 20 years old. The report captures operations, equipment, and worker activities that are expected to be outdated. |
| | Metric 5: | Sample Size | Low | Distribution of samples is qualitative or characterized by no statistics. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | Assessment or report clearly documents its data sources, assessment methods, results, and assumptions. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | The report provides only limited discussion of the variability and uncertainty in the results. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Sussell, A., Weber, A., Ashley, K., Wall, D. (1993). Health hazard evaluation report no. HETA 92-095-2317, Ohio Universeity, Athens, Ohio. |
| **HERO ID:** | 3970538 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | [PDF Pg. 4]Cleaning buildings grossly contaminated with deteriorated lead-based paint (LBP). |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | Report uses high quality data/techniques/methods from frequently-used sources. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for Chemical Substances in Construction, Paint, Electrical, and Metal Products, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: | Sample Size | N/A | N/A - worker activity description. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | N/A | N/A - worker activity description. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Szeinuk, J., Padilla, M., de la Hoz, R. E. (2008). Potential for diffuse parenchymal lung disease after exposures at World Trade Center Disaster site. Mount Sinai Journal of Medicine 75(2):101-107. |
| **HERO ID:** | 971566 |
| **Conditions of Use:** | Disposal |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Firefighters cleaning up after the World Trade Center disaster. (2/7) |
| Exposure route: | inhalation (5/7) |
| Physical form: | dust (4/7) |
| Particle size characterization: | 96% of the dust samples in the immediate vicinity of the WTC site were composed of particles larger than 10 um in MMAD. <1% was PM >2.5 um, and 0.5-4% were PM <2.5 um. (4/7) |
| Exposure frequency: | 1-75 days (2/7) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Methodology | High | Report uses high quality methods and data from frequently-used sources. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | High | Data are from the U.S. |
| | Metric 3: Applicability | High | Data are for firefighter disposal of asbestos material after September 11, an in-scope occupational scenario. |
| | Metric 4: Temporal Representativeness | Medium | Report is based on data greater than 10 years old but no more than 20 years old and industry conditions that are expected to be representative of current industry conditions. |
| | Metric 5: Sample Size | Medium | Sample distribution characterized by limited statistics (percentages) but discrete samples not provided and distribution not fully characterized. |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Medium | Uncertainty is addressed by stating that settled dust maynot accurately represent the relative proportions ofairborne respirable particles following the collapseof the towers. Variability isn't addressed. |

## Overall Quality Determination High

**Study Citation:** Tinsley, K. (1999). Asbestos, lead and microbial contamination: onsite performance testing of HEPA air units and vacuums. Hazardous Materials Management 11(5):23-23,25.
**HERO ID:** 6891650
**Conditions of Use:** Other:

**EXTRACTION**

| Parameter | Data |
|---|---|
| Engineering control: | The HEPA filter is an extended dry-media filter in a rigid frame that allows for a minimum dust or particulate collection efficiency of 99.97 per cent for all particulate 0.03 micrometres in diameter. The filter media is a highgrade cellulose or paper material that is chemically treated to provide filtration of very small airborne particles. Constructed in a frame that is usually made of stainless steel, aluminum or fire retardant wood board, it traps particulate and hazardous aerosols and is very sensitive to physical damage. The filter media is attached to the frame with adhesives that are woven along separators. Finishing components include gaskets and gel seals that must be carefully constructed to maintain the integrity of the filter. [PDF Pg. 1-2] |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Methodology | High | Report uses high quality data/techniques/methods from frequently-used sources. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | Medium | Data are from Canada, an OECD country. |
| Metric 3: | Applicability | High | Data are applicable to all in-scope conditions of use. |
| Metric 4: | Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| Metric 5: | Sample Size | N/A | N/A - Engineering controls. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | N/A | N/A - Engineering controls. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Trosic, I., Stilinovic, L., Saric, M. (1994). Evidence of harmful health-effects of occupational asbestos exposure. ILSI monographs :587-589. |
| **HERO ID:** | 6864894 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Shipyard workers (2/3) |
| Exposure route: | inhalation (1/3) |
| Physical form: | fibers (1/3) |
| Number of workers: | 560 workers (2/3) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | Medium | Report uses high quality data that are not from frequently-used sources and there are no known quality issues. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Low | Data are from Croatia, a non-OECD country. |
| | Metric 3: | Applicability | High | Data are for commercial/industrial use in construction materials, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: | Sample Size | N/A | No sample data. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | N/A | No scope to address variability and uncertainty. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | U.S. BLS, (2023). U.S. Census Bureau of Labor Statistics Data from 2021. |
| **HERO ID:** | 11138808 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Number of workers: | BLS reports the number of workers in industries that may work with asbestos |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | Report uses high quality data from frequently-used sources. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | The data are from the United States |
| | Metric 3: | Applicability | High | The data are applicable for all OESs |
| | Metric 4: | Temporal Representativeness | High | Report is based on current industry conditions and data no more than 10 years old. |
| | Metric 5: | Sample Size | N/A | N/A - This metric is not applicable to the data being extracted |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | The report provides only limited discussion of the variability and uncertainty in the results. |

## Overall Quality Determination — High

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| | |
|---|---|
| **Study Citation:** | U.S. EPA, (1983). Guidance for controlling friable asbestos-containing materials in buildings. |
| **HERO ID:** | 3647616 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|

| | |
|---|---|
| **Study Citation:** | U.S. EPA, (1983). Guidance for controlling friable asbestos-containing materials in buildings. |
| **HERO ID:** | 3647616 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Carpets should be steam cleaned or vacuumed with a high efficiency particulate air (HEPA)-filtered vacuum cleaner.• Contaminated books and furniture should be cleaned with HEPA-equipped vacuum cleaners, or dusted in the manner described below.• Dusting and mopping should be done with wet or damp cloths and mops. These should be discarded in sealed plastic bags according to EPA regulations for asbestos removal and disposal. Workers should be encouraged to wear a respirator as a precautionary measure.• When filters in a central air ventilation system are replaced, they should be treated as asbestos-contaminated waste. That is, they should be sprayed with a light water mist before removal and then sealed in plastic bags for disposal.• Building occupants and maintenance workers should be cautioned about further damaging the aSbestos-containing materials (for example, by hanging plants or mobiles from the ceiling, rewiring electrical circuits, or installing new fixtures).• Maintenance people should be warned about disturbing suspended ceilings or other areas where fibers collect. They should also be told not to patch or repair damaged material before assessment of alternative abatement techniques.REMOVAL• Removal of all types of asbestos except amosite must be initiated only after the material is treated with a solution of water and a wetting agent to reduce fiber release. Some types of amosite-containing materials will not adsorb either water or water amended with the wetting agent suggested by EPA (50% polyoxyethylene ester and 50% polyoxyethylene ether) in Part 1 of the initial guidance document (USEPA 1979). Wetting agents should be tested on the material for adsorption. If the material won't adsorb the wetting agent, a dry removal will have to beundertaken using Type C respiratory protection for the workers. EPA must approve all dry removal operations.• Friable asbestos-containing material must be disposed of in "leak-tight containers," typically 6 mil polyethylene bags. Bags frequently are placed in 55-gallon drums for additional protection.• Once removal and disposal operations are finished, the need to apply a sealant on the exposed surface must be evaluated. This is also the time to decide whether to reinsulate or resound proof with asbestos-free materials. In general, sealants are necessary where the underlying surfaces are porous (for example, concrete blocks or slabs), since a few fibers usually remain after removal.ENCLOSUREEnclosure involves construction of airtight walls and ceilings around surfaces coated with asbestos-containing materials. Enclosures should be constructed with impact-resistant materials. Since the asbestos-containing materials will have to be removedwhen the building is remodeled or demolished, enclosure is only a temporary solution. On the other hand, carefully constructed, airtight enclosures may reduce, if not eliminate, emission of fibers within the building for its remaining life.• Installing an enclosure will probably mean drilling and anchoring into dry asbestos-covered surfaces. This releases dry asbestos fibers and could raise airborne asbestos concentrations to highly dangerous levels. Drills equipped with HEPA vacuum filters will reduce fiber release.• Underlying structures must be able to support new walls and ceilings.• New construction material should be impact-resistant and assembled to be airtight. Gypsum panels taped at the seams, tongue and groove boards, and boards with spline joints all qualify. Suspended ceilings with lay-in panels do not. Joints between walls and ceilings should be caulked.• If lights are recessed into asbestos-containing material, they must be removed carefully to minimize the release of fibers. Lights should be reinstalled in or beneath the new ceiling.• Plumbing lines and computer cables may have to be relocated.• Building records must note the presence of asbestos behind the enclosure to prevent accidental fiber release during remodeling and building demolition.ENCAPSULATIONEncapsulation involves spraying asbestos-containing material with a sealant. Ideally, this activity helps bind together the asbestos fibers and other material components and offers some resistance to impact damage. As with enclosures, encapsulants are, at best, atemporary control measure. The asbestos-containing materials will still have to be removed before building demolition. In addition, the presence of encapsulants can make wetting and thus removing the material more difficult.Encapsulation can be used on granular, cementitious material-commonly known as acoustical plaster. A sealant should penetrate the asbestos-containing material and adhere to the substrate (or form a tough skin over the material), withstand moderate impact, be flexible and flame retardant, resist deterioration over time, and be nontoxic.Sealants should be applied with airless spray equipment. One recommended method is to apply a light (mist) coat, then a full coat applied at a 90 degree angle to the direction of the first. Latex paint can also be applied by roller following the application of the mist coat before it dries.SPECIAL OPERATIONS AND MAINTENANCE PROCEDURES AND PERIODIC REASSESSMENT. All custodial and maintenance personnel should be instructed in special operations procedures. They should be cautioned about removing suspended ceiling panels, installing lighting or plumbing fixtures, repairing air handling systems, or, in general, engaging in any activity that might damage asbestos-containing material or resuspend fibers. Building occupants should be warned not to disturb the material by such acts as hanging plants fromasbestos-covered ceilings and damaging walls with furniture.Periodic reassessments should focus on the condition of the asbestos-containing materials, changes in building use, and changes in occupants' activity patterns. If reassessment suggests that fiber release has occurred or is likely, then other corrective actions should be formally evaluated.CONTROL MEASURES FOR PIPE AND BOILER INSULATIONWhere damage to pipe covering or boiler lagging is limited, the most straightforward approach to abatement is repair. Duct tape can be used to seal open joints, and plastering with non-asbestos material can restore large damaged areas or areas around valves and flanges to their original condition. Where large portions of material must be removed, however, one should use the same protective measures taken in the removal of materials |

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**Study Citation:** U.S. EPA, (1983). Guidance for controlling friable asbestos-containing materials in buildings.
**HERO ID:** 3647616
**Conditions of Use:** Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products

| | | EVALUATION | |
|---|---|---|---|
| Domain | Metric | Rating | Comments |
| Exposure route: | inhalation | | |
| Physical form: | inhalable fibers | | |
| Personal protective equipment: | Worker protection depends on the strict use of NIOSH approved respirators. The OSHA standards specify the use of three different respirators, depending on the expected concentration of fibers in the work area: a half-face mask with either a single-use or replaceable filter, a full-face mask with replaceable filter and a pump to assist breathing, and a full-face mask with a self-contained or remote air supply. NIOSH now recommends that the first type of respirator not be used, because it does not seal properly around the face, nor has it (or any other type) been tested for effectiveness specifically against asbestos fibers.* Supplied air (type ”C”) units offer the most protection. Respirators are required for asbestos removal. They are highly recommended for the other control measures, since enclosure and encapsulation activities may produce fiber levels as high as or higher than those created during asbestos removal. | | |
| Engineering control: | proper work area containment is highly recommended for all abatement techniques except special operating and maintenance practices. Once abatement work begins, all uninvolved persons should be kept out of the area. Containment typically means construction of barriers with 6 mil polyethylene plastic sheets joined with folded seams, and with sealing tape at the seams and boundaries. Some contractors have experienced problems in securing plastic sheets to walls. Thinner sheets or a better attachment system (for example, stapling and taping sheets to furring strips fastened to walls) may be required. (Figure 9 shows the construction of a typical containment system.) Air locks and worker decontamination facilities with showers are recommended.* So, too, are negative air pressure systems, a. Without adequate containment, increased exposure for buildingoccupants is likely. Abatement activities should be conducted during vacations or other times when few people are in the building. | | |

| | | | EVALUATION | |
|---|---|---|---|---|
| Domain | | Metric | Rating | Comments |
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | EPA Report |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | USA |
| | Metric 3: | Applicability | High | The report is for an occupational scenario (site remediation) within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Low | 1983 prior to the most recent PEL ( 1994) and more than 20 years |
| | Metric 5: | Sample Size | N/A | Qualitative information provided |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | EPA report clearly documents its data sources, assessment methods, results, and assumptions. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | N/A | Qualitative information provided |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | U.S. EPA, (1985). Guidance for controlling asbestos-containing materials in buildings: 1985 edition. |
| **HERO ID:** | 6893665 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Collecting asbestos samples. [PDF Pg. 97] |
| Exposure route: | Inhalation [PDF Pg. 28] |
| Personal protective equipment: | Half-face respirator with disposable filters. [PDF Pg. 97]Coveralls [PDF Pg. 17] |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | Report uses high quality data/techniques/methods from frequently-used sources. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for Chemical Substances in Construction, Paint, Electrical, and Metal Products, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: | Sample Size | Medium | Sample distribution characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | Variability addressed by giving concentrations for multiple products but uncertainty is not addressed. |

## Overall Quality Determination **High**

| | |
|---|---|
| **Study Citation:** | U.S. EPA, (2019). National emission standards for hazardous air pollutants for asbestos: Notice of final approval for an alternative work practice standard for asbestos cement pipe replacement. 84:26852-26866. |
| **HERO ID:** | 6906129 |
| **Conditions of Use:** | Disposal |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Personal protective equipment: | PPE requirements remain in effect, and are covered in 40CFR part 763, subpart G. (3/15) |
| Engineering control: | To minimize the exposure to asbestos cement pipes, three methods can be used: Cured-in place pipe (CIPP) lining, abandoned in place, and open trenching. (3/15) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Methodology | Medium | Report uses high quality data from frequently-used sources. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | The data are from the United States |
| Metric 3: | Applicability | High | Data are for asbestos disposal, an in-scope occupation al scenario. |
| Metric 4: | Temporal Representativeness | High | The report is generally no more than 10 years old. |
| Metric 5: | Sample Size | Low | Distribution of samples is qualitative or characterized by no statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Medium | Assessment or report clearly documents results, methods, and assumptions. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Low | The report does not address variability or uncertainty. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | U.S. EPA,, Environmental Quality Management,, Inc., (1995). Buffing, burnishing, and stripping of vinyl asbestos floor tile. |
| **HERO ID:** | 3981057 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Products not Described by Other Codes |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Workers conducting preventative maintenance (low-speed spray-buffing, ultra high-speed burnishing, and wet-stripping) on asbestos-containing floor tiles. (pg 1 of 4) |
| Physical form: | Floor tile contained approximately 5% chrysotile asbestos (pg 1 of 4)/ |
| Area sampling data: | For pre-existing floor care condition, larger (and statistically significant) increases in the TEM airborne asbestos concentrations were observed during wet-stripping than during spray-buffing. None of the individual PCM concentrations exceeded the OSHA PEL of 0.1 f/cm3. Consequently, 8-hour time-weighted average (TWA) concentrations based on these measured levels would not exceed the OSHA PEL. The highest individual PCM concentration (0.023 f/cm3) was measured during wet-stripping. (pg 2 of 4) For the prepared floor studies, the mean relative increase in TEM airborne asbestos concentrations during low-speed spray-buffing tended to decrease as the floor care condition improved; however, the differences between the three levels of floor care were not statistically significant (p = 0.1149). (pg 2 of 4) Larger (and statistically significant) increases in TEM airborne asbestos concentrations were observed during wet-stripping of floors in medium condition than on floors in good condition. The relative increase in airborne asbestos concentrations was approximately 14 times greater, on average, during wet-stripping of floors in medium condition than during wet stripping of floors in good condition. Therefore, although significant increases in airborne asbestos concentrations were observed during wet-stripping of floors in both medium and good condition, the extra layer of sealant on floors in good condition appears to significantly decrease the airborne asbestos levels that were generated by the activity. Overall, significantly larger increases (p = 0.0001) in airborne asbestos concentrations were observed during wet-stripping than during low-speed spray-buffing. The relative increase in airborne asbestos concentrations was approximately 18 times greater, on average, during wet-stripping than during 1ow-speed spray- buffing. (pg 3 of 4) Similar increases in airborne TEM asbestos concentrations ewre seen during ultra high speed burnishing and wet stripping of floors in both poor and good condition. No floor condition or maintenance procedure resulted in significantly higher or lower increases in mean airborne asbestos concentration. Overall, ultra high-speed burnishing and wet-stripping resulted in an 11-fold statistically significant increase, on average, in airborne asbestos concentration. None of the individual PCM concentrations exceeded the OSHA PEL of 0.1 f/cm3. |
| Engineering control: | The results of this study suggest that multiple layers of sealant applied to the floor prior to the application of the floor finish can reduce the release of asbestos fibers during polish removal. (pg 3 of 4) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Methodology | High | report uses high quality data |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | The data are from the United States |
| Metric 3: | Applicability | High | The report is for an occupational scenario within the scope of the risk evaluation. |
| Metric 4: | Temporal Representativeness | Low | The report is more than 20 years old. |
| Metric 5: | Sample Size | Low | Distribution of samples is characterized by no statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Low | report provides results, but the underlying methods, data sources, and assumptions are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | |

**Continued on next page . . .**

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| | |
|---|---|
| **Study Citation:** | U.S. EPA,, Environmental Quality Management,, Inc., (1995). Buffing, burnishing, and stripping of vinyl asbestos floor tile. |
| **HERO ID:** | 3981057 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Products not Described by Other Codes |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| | Metric 7: | Metadata Completeness | Low | The report does not address variability or uncertainty. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Union Carbide, (1987). Population-based mortality surveillance in carbon products manufacturing facilities with cover letter dated 013087. |
| **HERO ID:** | 3656836 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | cutting of gaskets and control boards from asbestos containing sheeting, the cutting of asbestos rope as a packing for sealing parts and the use of asbestos blankets for insulation (pg 18) |
| Exposure route: | inhalation |
| Number of workers: | 2,219 (white male, long-term employees) (pg 4)2,529 employees eligible for follow-up (pg 7)160 non-white men, 150 women (pg 7)6 sites with >100 employees (pg 14)Table 1 (pg 24) number of workers for each site >100: 330, 545, 109, 404, 414, 228Table 2 (pg 25) presents just the # white men for the 6 sites >100 and how many are working/retired/left company for other reasons/deceased |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | Medium | Report uses high quality data/techniques/methods that are not from frequently-used sources and there are no known quality issues. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for construction materials, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete # of workers data provided). |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Methods, results, and assumptions are clearly documented, but underlying data sources are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | Variability addressed by evaluating multiple sites but uncertainty is not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | University of Washington,, Occupational and Environmental Medicine Program, (1997). Needs assessment for medical surveillance of former Hanford workers. |
| **HERO ID:** | 3974972 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | First line supervisors, chemical engineers, environmental engineers, environmental engineers, plant engineers, health physics techs, carpenters, electricians, HVAC mechanics, machinists, masons, millwrights, painters, plumbers and pipefitters structural and metalworkers, vehicle mechanics, welders, insulators, nuclear proc and waste ops, utilities operators, janitors and cleaners, laundry workers, light vehicle drivers (32/127) |
| Exposure route: | inhalation (39/127) |
| Physical form: | fibers (39/127) |
| Number of workers: | 27,988 workers with asbestos exposure (6/127) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Methodology | High | Report uses high quality methods and data from frequently-used sources. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | High | Data are from the U.S. |
| | Metric 3: Applicability | High | Data are for industrial use in construction materials, an in-scope occupational scenario. |
| | Metric 4: Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: Sample Size | N/A | N/A - This metric is not applicable to the data being extracted |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | High | Uncertainty is addressed by discussing limitations and challenges of the study. Variability is addressed by taking data from every job title at the plant. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Utah DEQ, (2017). Pollutants: Asbestos: Intro. |
| **HERO ID:** | 3982264 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Janitors, maintenance personnel, construction workers, insulators, plumbers, mechanics, telephone workers, electrical workers, fire fighters, and asbestos abatement workers. (1/4) |
| Exposure route: | inhalation (2/4) |
| Physical form: | fibers (1/4) |
| Particle size characterization: | Airborne asbestos fibers range in size from 0.1 to 10 microns in length. (2/4) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Methodology | Medium | The assessment or report uses high quality data and/or techniques or sound methods that are not from a frequently used source and associated information does not indicate flaws or quality issues. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | Data are from the U.S. |
| Metric 3: | Applicability | High | The report is for an occupational scenario within the scope of the risk evaluation. |
| Metric 4: | Temporal Representativeness | High | The report is generally no more than 10 years old. |
| Metric 5: | Sample Size | N/A | No sample data. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Medium | Methods, results, and assumptions are clearly documented, but underlying data sources are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Vaughan, N. P., Brown, R. C., Evans, P. G. (1996). The effects of asbestos wet-stripping agents on filters used in powered respirators. Annals of Occupational Hygiene 40(5):539-543, 545-553. |
| **HERO ID:** | 3093055 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Personal protective equipment: | ”None of the agents used in the tests affected the efficiency of pleated glass-fibre paper filters, though they caused a slight and usually short-lived increase in the pressure drop. No serious effect was observed with resin-wool filters during spraying on-site or in a simulation of spraying. However, exposure to very fine mists of wetting agent slightly reduces the efficiency of resin-wool filters, and exposure to very fine mists of penetrant significantly reduces it. Both reduce the pressure drop.” (pg 11 of PDF)””wet-stripping of asbestos can be carried out in a manner that does not compromise respiratory protection. ” (pg 12) |
| Comments: | abatement activities for asbestos; discussion of respirator filter efficiencies |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Methodology | Medium | Report uses high quality data and techniques that are not from frequently-used sources and there are no known quality issues. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | Medium | Data are from the United Kingdom, an OECD country. |
| | Metric 3: Applicability | High | Data are for abatement industry, which is an in-scope occupational scenario. |
| | Metric 4: Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Medium | Variability addressed by by different filter types, but uncertainty is not addressed. |

## Overall Quality Determination Medium

**Study Citation:** Verein Deutscher Ingenieure, (1982). Emission control: Extraction and processing of asbestos treatment of products containing asbestos.
**HERO ID:** 6906351
**Conditions of Use:** Other:

**EXTRACTION**

| Parameter | Data |
|---|---|
| Personal protective equipment: | "aspiration devices" during cleaning (pg 21) |
| Engineering control: | Pg 20 describes controls/procedures required when asbestos is handled in bags or bins (i.e., transportation, shipment, and storage)wetting (pg 21)Pg 21-25 describes dust capture, transfer, and separation technologies (cyclones, wet scrubbers, filters, electrostatic precipitators etc.) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | Medium | Report uses high quality data that are not from frequently-used sources and there are no known quality issues. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Medium | Data are from Germany, an OECD country. |
| | Metric 3: | Applicability | Medium | Data are for upstream, out-of-scope COUs, but data may still be applicable for in-scope COUs |
| | Metric 4: | Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: | Sample Size | N/A | qualitative data |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Methods, results, and assumptions are clearly documented, but underlying data sources are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | Variability addressed by discussing different control technologies but uncertainty is not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Wagg, R. M. (1976). Safety measures when handling asbestos. 96(6):252-255. |
| **HERO ID:** | 3616658 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Workers in factories, electrical stations, institutions, warehouses, ships under construction and repair, and construction/demolition. (2/4) |
| Exposure route: | inhalation (2/4) |
| Physical form: | Fiber (2/4) |
| Personal protective equipment: | A well-fitted approved dust respirator or half mask type respirator are generally suitable to asbestos handling operations. When concentrations are high, more sophisticated PPE is required like a HEPA respirator or air line breathing apparatus. Protective clothing should be made of material with low dust retention properties, and should be vacuumed after the shift. (3/4) |
| Engineering control: | Substitution of other materials for asbestos is one prevention strategy. (2/4) Processes and operations should be designed so that dust exposure is reduced to as low as possible, like with wetting of ACM. Where it is not possible to prevent dust emissions, dust control methods should be employed like process enclosure and exhaust ventilation. Dust collection filters should be properly disposed of. Dust collection system can be used also. (3/4) Impermeable bags should be used in transporting asbestos wastes. (4/4) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Methodology | Medium | Report uses high quality data that are not from frequently-used sources and there are no known quality issues. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | Medium | Data are from the U.K., an OECD country. |
| Metric 3: | Applicability | High | The report is for an occupational scenario within the scope of the risk evaluation. |
| Metric 4: | Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| Metric 5: | Sample Size | N/A | No sample data. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Low | Assessment results are provided but underlying methods, assumptions, and data sources are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Medium | Variability is addressed by discussing different controls and PPE options. Uncertainty isn't addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Wagner, G., Hearl, F. J. (2005). Mineral dusts: Asbestos, silica, coal, manufactured fibers. :1073-1086. |
| **HERO ID:** | 6889039 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Occupations where significant asbestos exposure may occur (Table 46.1):Acoustic product installers, asbestos cement product makers and users, asbestos grout makers and users, asbestos millers/miners, asbestos paper makers and users, asbestos plaster makers and users, asbestos insulators, asbestos tile makers and installers, asphalt mixers, automobile repair workers, boiler makers, brake lining makers, brake refabricators, chemical workers, clay workers, construction workers, demolition workers, Electric appliance workers, Electrical equipment workers, Electrical wire makers, Food processing workers, Gasket makers, Glass workers, Iron ore (taconite) miners and millers, Insulation workers, Loggers, Machinery makers, Maintenance and custodial workers, Nursery (agricultural) workers, Oil and gas extraction workers, Paint makers, Petroleum refinery workers, Primary metal industry workers, Plumbers and pipefitters, Railroad repair workers, Roofers, Rubber makers, Reinforced plastics makers, Shipyard workers, Stone workers, Talc miners and workers, Textile workers, Transportation equipment makers and repairers, Transportation workers, Vermiculite miners and workers |
| Number of workers: | The Occupational Safety and Health Administration(OSHA) estimated in its 1994 Asbestos Standard that about700,000 US workers were potentially exposed to asbestosin general industry and shipyards. |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Methodology | High | The report uses high quality data that are from frequently used sources. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | The data are from the United States. |
| Metric 3: | Applicability | High | The report is for an occupational scenario within the scope of the risk evaluation. |
| Metric 4: | Temporal Representativeness | Low | Data is greater than 20 years old (1994). |
| Metric 5: | Sample Size | N/A | No sample data provided for number of workers. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | High | Assessment or report clearly documents its data sources, assessment methods, results, and assumptions. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Low | The report does not address variability or uncertainty regarding number of workers potentially exposed to asbestos. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Walker, B. L. (2015). Environments of terror: 9/11, World Trade Center dust, and the global nature of New York's toxic bodies. Environmental History 20(4):779-795. |
| **HERO ID:** | 3699619 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Nozzle men (spray on asbestos-containing insulation) and hopper men (mixing of the asbestos-containing insulation), as well as the electricians, plumbers, painters, masons. [PDF Pg. 11] |
| Exposure route: | Inhalation |
| Physical form: | Dust, Fibers (solid) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | Medium | Report uses high quality data/techniques/methods that are not from frequently-used sources and there are no known quality issues. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are for the U.S. |
| | Metric 3: | Applicability | High | Data are for construction, paint, electrical and metal products, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: | Sample Size | N/A | N/A - Exposure route, physical form, and worker activity. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Methods, results, and assumptions are clearly documented, but underlying data sources are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | N/A | N/A - Exposure route, physical form, and worker activity. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Weeks, J. L. (1995). Controlling occupational health hazards in construction. Occupational Medicine 10(2):407-420. |
| **HERO ID:** | 1516652 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Asbestos insulation workers, plumbers, pipe fitters, construction workers. (2/14) |
| Exposure route: | inhalation (1/14) |
| Personal protective equipment: | Full body protection and positive-pressure respirators (8/14) |
| Engineering control: | Controls for asbestos include sealing and isolating the work area, posting warning signs, and wetting the asbestos. Any removed asbestos must be placed in a sealed bag for disposal. (8/14) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Methodology | Medium | Report uses high quality data that are not from frequently-used sources and there are no known quality issues. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | Data are from the U.S. |
| Metric 3: | Applicability | High | Data are for commercial use in construction materials, an in-scope occupational scenario. |
| Metric 4: | Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| Metric 5: | Sample Size | N/A | N/A - This metric is not applicable to the data being extracted |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Medium | Variability is addressed by listing different options of controls and PPE by situation. Uncertainty isn't addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | White, F. A., Getman, R. E. (1990). Indoor air quality: what managers can do. Employment Relations Today 17(2):93-101. |
| **HERO ID:** | 3628392 |
| **Conditions of Use:** | Consumer Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Office workers during remodeling or other maintenance activities. (2/9) |
| Exposure route: | inhalation (2/9) |
| Physical form: | fibers (2/9) |
| Engineering control: | Ensuring adequate ventilation, providing good air filters, and regular cleaning of air handling systems will eliminate 80 percent of all indoor pollution problems. (5/9) Also, consider raising partitions off floors, keep copiers and fax machines in a well ventilated area, and leave the ventilation system on at night and on weekends. (7/9) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Methodology | High | Assessment uses high quality data from frequently-used sources. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | High | Data are from the U.S. |
| | Metric 3: Applicability | Low | Data are for office workers exposures, which is similar to commercial use of construction products. |
| | Metric 4: Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: Sample Size | N/A | N/A - This metric is not applicable to the data being extracted |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Winer, A., Holtgren, W. D. (1976). Asbestosa Case Study of the U. S. Navy's Response to Upgraded Safety and Health Requirements. Naval Engineers Journal 88(6):41-48. |
| **HERO ID:** | 6862794 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Navy members on ships with asbestos insulation, gaskets, packing, etc. (2/8) |
| Exposure route: | inhalation (3/8) |
| Physical form: | dust (3/8) |
| Personal protective equipment: | Protective clothing and respirators. Supplied air respirators, continuous flow, or pressure demand class respirators are required when employees are engaged in spraying, removing, or demolishing pipes, structures, or equipment covered or insulated with asbestos (5/8). |
| Engineering control: | Control consisted of limiting exposure by means of wet processes, exhaust ventilation, protective clothing, vacuuming, development of proper procedures, and respiratory protection. (4/8) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Methodology | High | Report uses high quality methods and data from frequently-used sources. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | Data are from the U.S. |
| Metric 3: | Applicability | High | Data are for industrial use in construction materials, an in-scope occupational scenario. |
| Metric 4: | Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| Metric 5: | Sample Size | N/A | N/A - This metric is not applicable to the data being extracted |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Woodson, R. D. (2012). Quick tips for contractors working with asbestos. :43-51. |
| **HERO ID:** | 6876973 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Worker activity description: | Removal of asbestos-containing insulation and piping. Cleanup of asbestos and friable resilient floor coverings. [PDF Pg. 5-6] |
| Exposure route: | Inhalation |
| Physical form: | Fibers (solid) [PDF Pg. 3] |
| Personal protective equipment: | Disposable Tyvek suit, gloves, and a half-mask respirator with high-efficiency particulate air (HEPA) filters. [PDF Pg. 4] |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Methodology | High | Report uses high quality data/techniques/methods from frequently-used sources. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | Data are from the U.S. |
| Metric 3: | Applicability | High | Data are for Chemical Substances in Construction, Paint, Electrical, and Metal Products, an in-scope occupational scenario. |
| Metric 4: | Temporal Representativeness | High | Report is based on current industry conditions and data no more than 10 years old. |
| Metric 5: | Sample Size | N/A | N/A - no sample data. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | N/A | N/A - no sample data. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Wylie LG, (1984). Hazardous and infectious waste management for health care facilities. |
| **HERO ID:** | 3981100 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Personal protective equipment: | Respirator choice: p. 125 |
| Comments: | Document primarily covers regulations and preparedness planning for hazardous waste disposal |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | Medium | The assessment or report uses high quality data and/or techniques or sound methods that are not from a frequently used source and associated information does not indicate flaws or quality issues. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | The data are from the United States and are representative of the industry being evaluated. |
| | Metric 3: | Applicability | Medium | The report is for an occupational scenario that is similar to an occupational scenario within the scope of the risk evaluation, in terms of the type of industry, operations, and work activities. |
| | Metric 4: | Temporal Representativeness | Low | The report is more than 20 years old. The report captures operations, equipment, and worker activities that are expected to be outdated. |
| | Metric 5: | Sample Size | N/A | n/a - no sampling data |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | Assessment or report clearly documents its data sources, assessment methods, results, and assumptions. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | The report provides only limited discussion of the variability and uncertainty in the results. |

## Overall Quality Determination Medium

**Study Citation:** Anonymous, (2013). Compaction in nuclear asbestos removal. Nuclear Engineering International 58(708):37.
**HERO ID:** 6881650
**Conditions of Use:** Other:

**EXTRACTION**

| Parameter | Data |
|---|---|
| Description of release source: | Removal of insulation surrounding a nuclear reactor pressure vessel. (1/3) |
| Release quantity: | During the campaign, a total of 130 m3 of asbestos was removed from the reactor. (2/3) |
| Waste treatment methods and pollution control: | Waste treatment methods and pollution control |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Methodology | Low | Methodology is not specified. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | Medium | Data are from the U.K., an OECD country, |
| Metric 3: | Applicability | High | Data are for demolition of asbestos products, an in-scope occupational scenario. |
| Metric 4: | Temporal Representativeness | High | Data are no more than 10 years old. |
| Metric 5: | Sample Size | Medium | Sample distribution characterized by limited statistics (waste volume) but discrete samples not provided and distribution not fully characterized. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Medium | Release media and release amount provided but missing emission factors. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Archer, S. R., Blackwood, T. R. (1979). Status assessment of toxic chemicals : Asbestos. :34. |
| **HERO ID:** | 6865816 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Description of release source: | Construction, floor tile, friction products, gaskets and packing, and insulation consumption. (15/34) |
| Release quantity: | Consumption of asbestos in construction was responsible for 54 tons/year of waste to air and 6,804 tons/year to land. Floor tile was responsible for 11,521 tons/year to land. Friction products were responsible for 69,382 tons/year to land. Gaskets and packing was responsible for 28 tons/year to water and 27,779 tons/year to land. Insulation was responsible for 37 tons/year to air and 443 tons/year to land. Other uses contributed 53,115 tons/year to land. (15/34) |
| Release or emission factors: | Release or emission factors |
| Waste treatment methods and pollution control: | Waste treatment methods and pollution control |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Methodology | Low | Methodology is not specified. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | Data are from the U.S. |
| Metric 3: | Applicability | High | Data are for commercial use of construction products, an in-scope occupational scenario. |
| Metric 4: | Temporal Representativeness | Low | Data are greater than 20 years old. |
| Metric 5: | Sample Size | Medium | Sample distribution characterized by limited statistics (totals, emission factors) but discrete samples not provided and distribution not fully characterized. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | High | All metadata provided. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Medium

**Study Citation:** Archer, S. R., Blackwood, T. R. (1979). Status assessment of toxic chemicals : Asbestos. :34.
**HERO ID:** 6865816
**Conditions of Use:** Industrial/Commercial Uses-Chemical Substances in Furnishing, Cleaning, Treatment Care Products

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Description of release source: | Textile consumption (15/34) |
| Release quantity: | Consumption of asbestos in textiles was responsible for 6,963 tons/year to land. (15/34) |
| Waste treatment methods and pollution control: | Waste treatment methods and pollution control |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | Low | Methodology is not specified. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for commercial use of construction products, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Data are greater than 20 years old. |
| | Metric 5: | Sample Size | Medium | Sample distribution characterized by limited statistics (totals, emission factors) but discrete samples not provided and distribution not fully characterized. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Release media and release quantity provided but missing emission factors. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Medium

**Study Citation:** Archer, S. R., Blackwood, T. R. (1979). Status assessment of toxic chemicals : Asbestos. :34.
**HERO ID:** 6865816
**Conditions of Use:** Industrial/Commercial Uses-Chemical Substances in Packaging, Paper, Plastic, Toys, Hobby Products

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Description of release source: | Felts and paper consumption (15/34) |
| Release quantity: | Consumption of asbestos in felts and paper was responsible for 2,631 tons/year to land. (15/34) |
| Waste treatment methods and pollution control: | Waste treatment methods and pollution control |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Methodology | Low | Methodology is not specified. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | Data are from the U.S. |
| Metric 3: | Applicability | High | Data are for commercial use of construction products, an in-scope occupational scenario. |
| Metric 4: | Temporal Representativeness | Low | Data are greater than 20 years old. |
| Metric 5: | Sample Size | Medium | Sample distribution characterized by limited statistics (totals, emission factors) but discrete samples not provided and distribution not fully characterized. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Medium | Release media and release quantity provided but missing emission factors. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Medium

**Study Citation:** Bragg, G. M. (1987). Asbestos in the environment- an industry viewpoint. Environmental Technology Letters 8(6):289-296.
**HERO ID:** 3647211
**Conditions of Use:** Other:

**EXTRACTION**

| Parameter | Data |
|---|---|
| Description of release source: | mining and milling of raw ore in open pit operations (6/9) |
| Release or emission factors: | nan |
| Waste treatment methods and pollution control: | nan |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | Low | Methodology is not specified. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Medium | Data are from Canada, an OECD country. |
| | Metric 3: | Applicability | Uninformative | Data are for mining and milling for manufacture of asbestos products. Such operations have ceased in the United States and are not under investigation in this risk evaluation. |
| | Metric 4: | Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: | Sample Size | Medium | It is unclear whether provided emission factors are averages or discrete data. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Release media and emission factors provided but missing release quantity, and frequency. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | Uncertainty isn't addressed. Variability is addressed by gathering data from 3 different mills. |

## Overall Quality Determination Uninformative

| | |
|---|---|
| **Study Citation:** | Chemistry Industry Association of Canada, (2017). All substances emissions for 2012 and projections for 2015. |
| **HERO ID:** | 3982361 |
| **Conditions of Use:** | Other: |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Release quantity: | 0 asbestos emissions for each of the 6 facilities reporting friable asbestos releases (pgs 13, 21, 33, 39, 45, 53) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Methodology | Low | Methodology is not specified. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | Medium | Data are from Canada, an OECD country. |
| | Metric 3: Applicability | Uninformative | OES not specified |
| | Metric 4: Temporal Representativeness | High | Data are no more than 10 years old. |
| | Metric 5: Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | Low | Release media provided but no other metadata. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Uninformative

| | |
|---|---|
| **Study Citation:** | Chemistry Industry Association of Canada, (2017). All substances emissions for 2011 and projections for 2014. |
| **HERO ID:** | 3982362 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Release quantity: | 9 sites in Canada reported no friable asbestos emissions in 2011 |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | Low | Methodology is not specified. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Medium | Data are from Canada, an OECD country. |
| | Metric 3: | Applicability | High | Data are for industrial use in construction materials, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | High | Data are no more than 10 years old. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Low | Only 0 release quantities provided. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | Variability is addressed by listing different chemical sites. However, measurement uncertainty is not characterized. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Chemistry Industry Association of Canada, (2017). Toutes les substances: émissions pour l' année 2012 and prévisions pour l'année 2015. |
| **HERO ID:** | 3986546 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Release quantity: | In 2012, six companies each reported 0.00 tons of asbestos emissions in Canada.(13,19, 30,35,40,47/52) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | Low | Methodology is not specified. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Medium | Data are from Canada, an OECD country. |
| | Metric 3: | Applicability | High | Data are for industrial use in construction materials, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | High | Data are no more than 10 years old. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Low | Only 0 release quantities provided. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | Variability is addressed by listing different chemical sites. Uncertainty isn't addressed. |

## Overall Quality Determination — Medium

| | |
|---|---|
| **Study Citation:** | Dessoff, A. L. (1994). Safety makes the grade on college campuses. Safety and Health 150(3):60. |
| **HERO ID:** | 6885657 |
| **Conditions of Use:** | Consumer Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Description of release source: | Asbestos in steam tunnels and around pipes. (1/5) |
| Release quantity: | Texas A&M produces 50,000 lbs of hazardous waste per year. It is not known how much is asbestos. (2/5) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | Low | Methodology is not specified. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | Low | Data are for school and office workers exposures, which is similar to commercial use of construction products. |
| | Metric 4: | Temporal Representativeness | Low | Data are greater than 20 years old. |
| | Metric 5: | Sample Size | Medium | Sample distribution characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Release media, and release quantity provided but missing emission factors and controls. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination **Low**

| | |
|---|---|
| **Study Citation:** | DOE, (1999). Advanced mixed waste treatment project: Appendices. |
| **HERO ID:** | 3974977 |
| **Conditions of Use:** | Disposal |

**EXTRACTION**

| Parameter | Data |
|---|---|
| Description of release source: | Accidental releaseFire involveing waste in the box line Fire involving waste in drum lineLoss of all alternating current power/hazardous material from then box lineLoss of all alternating current power/Hazardous material from the drum lineLoss of all alternating current power/ SupercompactorDropped waste box outdoors during transferFire in transuranic waste in the retrieval enclosure/Hazardous material from boxesFire in transuranic waste in the retrieval enclosure/Hazardous material from drumswindborne missile breach of treatment facilityFire involving waste transfer vehicleType II module fireType II module fire /Drums |

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**Study Citation:** DOE, (1999). Advanced mixed waste treatment project: Appendices.
**HERO ID:** 3974977
**Conditions of Use:** Disposal

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Release quantity: | | | Accidental releaseFire involve waste in the box line Material at risk 1.66 E+06(g) Damage Ratio 1Airborne Release Factor 5.00E-04Respiratory Fraction 1Leak Path Factor 1Source term 8.28 E+02Fire involving waste in drum lineMaterial at risk 5.56 E+05(g) Damage Ratio 1Airborne Release Factor 5.00E-04Respiratory Fraction 1Leak Path Factor 1Source term 2.78 E+02Loss of all alternating current powerhazardous material from then box lineMaterial at risk 5.52 E+05(g) Damage Ratio 0.5Airborne Release Factor 5.00E-04Respiratory Fraction 1Leak Path Factor 0.001Source term 1.38 E-01Loss of all alternating current powerHazardous material from the drum lineMaterial at risk 2.32 E+05(g) Damage Ratio 0.5Airborne Release Factor 5.00E-04Respiratory Fraction 1Leak Path Factor 0.001Source term 5.80 E-03Loss of all alternating current powerSuper compactorMaterial at risk 1.39 E+05(g) Damage Ratio 0.3Airborne Release Factor 5.00E-04Respiratory Fraction 1Leak Path Factor 0.001Source term 2.09 E-02Dropped waste box outdoors during transferMaterial at risk 5.52 E+05(g) Damage Ratio 0.5Airborne Release Factor 5.00E-04Respiratory Fraction 1Leak Path Factor 0.5Source term 6.90 E+01Fire in transuranic waste in the retrieval enclosureHazardous material from boxesMaterial at risk 2.76 E+06(g) Damage Ratio 0.18Airborne Release Factor 5.00E-04Respiratory Fraction 1Leak Path Factor 1Source term 2.54 E+02Fire in transuranic waste in the retrieval enclosureHazardous material from boxesMaterial at risk 3.92 E+07(g) Damage Ratio 0.18Airborne Release Factor 5.00E-04Respiratory Fraction 1Leak Path Factor 1Source term 3.61 E+03ire in transuranic waste in the retrieval enclosureHazardous material from boxesMaterial at risk 5.04 E+05(g) Damage Ratio 0.18Airborne Release Factor 5.00E-04Respiratory Fraction 1Leak Path Factor 1Source term 4.64 E+01Fire in transuranic waste in the retrieval enclosureHazardous material from boxesMaterial at risk 6.36 E+07 (g) Damage Ratio 0.18Airborne Release Factor 5.00E-04Respiratory Fraction 1Leak Path Factor 1Source term 5.86 E+03Fire in transuranic waste in the retrieval enclosureHazardous material from drumsMaterial at risk 2.04 E+06 (g) Damage Ratio 0.0013Airborne Release Factor 5.00E-04Respiratory Fraction 1Leak Path Factor 1Source term 1.33 E+00Fire in transuranic waste in the retrieval enclosureHazardous material from drumsMaterial at risk 9.44 E+06 (g) Damage Ratio 0.0013Airborne Release Factor 5.00E-04Respiratory Fraction 1Leak Path Factor 1Source term 6.13 E+00Fire in transuranic waste in the retrieval enclosureHazardous material from drumsMaterial at risk 3.40 E+05 (g) Damage Ratio 0.0013Airborne Release Factor 5.00E-04Respiratory Fraction 1Leak Path Factor 1Source term 2.21 E-01Fire in transuranic waste in the retrieval enclosureHazardous material from drumsMaterial at risk 3.30 E+06 (g) Damage Ratio 0.0013Airborne Release Factor 5.00E-04Respiratory Fraction 1Leak Path Factor 1Source term 2.15 E-00Fire in transuranic waste in the retrieval enclosureHazardous material from drumsMaterial at risk 2.82 E+06 (g) Damage Ratio 0.0013Airborne Release Factor 5.00E-04Respiratory Fraction 1Leak Path Factor 1Source term 1.83 E+00Fire in transuranic waste in the retrieval enclosureHazardous material from drumsMaterial at risk 1.93 E+06 (g) Damage Ratio 0.0013Airborne Release Factor 5.00E-04Respiratory Fraction 1Leak Path Factor 1Source term 1.26 E+00Fire in transuranic waste in the retrieval enclosureHazardous material from drumsMaterial at risk 6.24 E+05 (g) Damage Ratio 0.0013Airborne Release Factor 5.00E-04Respiratory Fraction 1Leak Path Factor 1Source term 4.06 E-01Fire in transuranic waste in the retrieval enclosureHazardous material from drumsMaterial at risk 8.68 E+06 (g) Damage Ratio 0.0013Airborne Release Factor 5.00E-04Respiratory Fraction 1Leak Path Factor 1Source term 5.64 E-00Fire in transuranic waste in the retrieval enclosureHazardous material from drumsMaterial at risk 7.86 E+06 (g) Damage Ratio 0.0013Airborne Release Factor 5.00E-04Respiratory Fraction 1Leak Path Factor 1Source term 5.11 E-00Fire in transuranic waste in the retrieval enclosureHazardous material from drumsMaterial at risk 1.25 E+06 (g) Damage Ratio 0.0013Airborne Release Factor 5.00E-04Respiratory Fraction 1Leak Path Factor 1Source term 8.13 E-01Fire in transuranic waste in the retrieval enclosureHazardous material from drumsMaterial at risk 2.85 E+06 (g) Damage Ratio 0.0013Airborne Release Factor 5.00E-04Respiratory Fraction 1Leak Path Factor 1Source term 1.85 E+00Fire in transuranic waste in the retrieval enclosureHazardous material from drumsMaterial at risk 1.69 E+07 (g) Damage Ratio 0.0013Airborne Release Factor 5.00E-04Respiratory Fraction 1Leak Path Factor 1Source term 1.10 E+01Fire in transuranic waste in the retrieval enclosureHazardous material from drumsMaterial at risk 3.2 E+06 (g) Damage Ratio 0.0013Airborne Release Factor 5.00E-04Respiratory Fraction 1Leak Path Factor 1Source term 2.08 E-00windborne missile breach of treatment facilityMaterial at risk 5.52 E+05 (g) Damage Ratio 0.5Airborne Release Factor 5.00E-04Respiratory Fraction 1Leak Path Factor 0.001Source term 1.38 E-01Fire involving waste transfer vehicleMaterial at risk 2.76 E+06 (g) Damage Ratio 0.25Airborne Release Factor 5.00E-04Respiratory Fraction 1Leak Path Factor 1Source term 3.45 E+02Fire involving waste transfer vehicleMaterial at risk 2.68 E+06 (g) Damage Ratio 0.25Airborne Release Factor 5.00E-04Respiratory Fraction 1Leak Path Factor 1Source term 3.35 E+02Type II module fireMaterial at risk 2.76 E+06 (g) Damage Ratio 0.083Airborne Release Factor 5.00E-04Respiratory Fraction 1Leak Path Factor 1Source term 1.15 E+02Type II module fireMaterial at risk 3.92 E+07 (g) Damage Ratio 0.083Airborne Release Factor 5.00E-04Respiratory Fraction 1Leak Path Factor 1Source term 1.63 E+03Type II module fireMaterial at risk 5.04 E+05 (g) Damage Ratio 0.083Airborne Release Factor 5.00E-04Respiratory Fraction 1Leak Path Factor 1Source term 2.09 E+01Type II module fireMaterial at risk 3.36 E+08 (g) Damage Ratio 0.083Airborne Release Factor 5.00E-04Respiratory Fraction 1Leak Path Factor 1Source term 1.40 E+04Type II module fireMaterial at risk 7.90 E+07 (g) Damage Ratio 0.083Airborne Release Factor 5.00E-04Respiratory Fraction 1Leak Path Factor 1Source term 3.28 E+03Type II module fireDrumsMaterial at risk 2.04 E+06 (g) Damage Ratio 0.005Airborne Release Factor 5.00E-04Respiratory Fraction 1Leak Path Factor 1Source term 5.10 E-00Type II module fireDrumsMaterial at risk 9.44 E+06 (g) Damage Ratio 0.005Airborne Release Factor 5.00E-04Respiratory Fraction 1Leak Path Factor 1Source term 2.36 E+01Type II module fireDrumsMaterial at risk 3.40 E+05 (g) Damage Ratio 0.005Airborne Release Factor 5.00E-04Respiratory Fraction 1Leak Path Factor 1Source term 8.5 E-01Type II module fireDrumsMaterial at risk 3.30 E+06 (g) Damage Ratio 0.005Airborne Release Factor 5.00E-04Respiratory Fraction 1Leak Path Factor 1Source term 8.25 E-00Type II module fireDrumsMaterial at risk 2.82 E+06 (g) Damage Ratio 0.005Airborne Release Factor 5.00E-04Respiratory Fraction 1Leak Path Factor 1Source term 7.05 E-00Type II module fireDrumsMaterial at risk 1.93 E+06 (g) Damage Ratio 0.005Airborne Release Factor 5.00E-04Respiratory Fraction 1Leak Path Factor 1Source term 4.83 E-00Type II module fireDrumsMaterial at risk 6.24 E+05 (g) Damage Ratio 0.005Airborne Release Factor 5.00E-04Respiratory Fraction 1Leak Path Factor 1Source term 1.56 E-00Type II module fireDrumsMaterial at risk 8.68 E+06 (g) Damage Ratio 0.005Airborne Release Factor 5.00E-04Respiratory Fraction 1Leak Path Factor 1Source term 2.17 E+01Type II module fireDrumsMaterial at risk 7.86 E+06 (g) Damage |

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**Study Citation:** DOE, (1999). Advanced mixed waste treatment project: Appendices.
**HERO ID:** 3974977
**Conditions of Use:** Disposal

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| **EVALUATION** | | | |
| Release or emission factors: | Release or emission factors | | |
| Comments: | This is for an advanced Mixed Waste Treatment Project - asbestos if only processed in the non thermal treatment operations.AMWTP Preliminary Safety Analysis Report (PSAR) (BNFL 1998d), which was produced by theBNFL Inc. | | |
| **EVALUATION** | | | |
| Domain | Metric | Rating | Comments |
| Domain 1: Reliability | | | |
| | Metric 1: Methodology | High | DOE Idaho National Engineering and Environmental Lab (INEEL) assessment - The release data methodology is known or expected to be accurate and is known to cover all release sources at the site. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | High | The data are from the United States. |
| | Metric 3: Applicability | High | The release data are for an occupational scenario (hazardous waste disposal) within the scope of the risk evaluation. |
| | Metric 4: Temporal Representativeness | Low | Data collected over 20 years ago. |
| | Metric 5: Sample Size | Low | Distribution of samples is qualitative or characterized by no statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | Low | Release data include release media but no other metadata. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Medium | The release data study provides information about a variety release events that can be used to assess variability at that level. Additional information needed to assess sampling and analysis variability were not provided nor were any data provided on uncertainty. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Edwards, C. (1990). Asbestos in the workplace: Control and removal. Canadian Occupational Safety 28(6):6, 9. |
| **HERO ID:** | 6909348 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Waste treatment methods and pollution control: | Waste treatment methods and pollution control |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | Low | Methodology is not specified. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Medium | Data are from Canada, an OECD country. |
| | Metric 3: | Applicability | High | The release data are for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Low | Data are greater than 20 years old. |
| | Metric 5: | Sample Size | N/A | N/A - This metric is not applicable to the data being extracted |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Low | Release media and control techniques provided, but missing frequency, emission factors, and quantities. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | N/A | N/A - This metric is not applicable to the data being extracted |

## Overall Quality Determination Low

| | |
|---|---|
| **Study Citation:** | Jacko, M. G., Rhee, S. K. (2000). Brake linings and clutch facings. |
| **HERO ID:** | 9038065 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Description of release source: | The primary applications of asbestos-based organic frictional materials are (1) primary drum brake linings (2) secondary and nonservo drum brake linings (3) Class A disk pads (4) Class B disk pads (5) Class C friction materials and (6) clutch friction materials. (2/13) |
| Release or emission factors: | Release or emission factors |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Methodology | Medium | Methodology is known and expected to be accurate but may not cover all release sources at the site. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | Data are from the U.S. |
| Metric 3: | Applicability | High | Data are for commercial use of friction products, an in-scope occupational scenario. |
| Metric 4: | Temporal Representativeness | Medium | Report is based on data greater than 10 years old but no more than 20 years old and industry conditions that are expected to be representative of current industry conditions. |
| Metric 5: | Sample Size | Medium | Sample distribution characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Medium | Release media, and emission factors provided but missing release quantity, frequency, and controls. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Medium | Variability is addressed by driving the test vehicle through various test cycles. However, uncertainty is not addressed in the report. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Japanese Ministry of Environment, (2011). Summary of countermeasures against asbestos in Japan. |
| **HERO ID:** | 3980937 |
| **Conditions of Use:** | Disposal |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Description of release source: | Work to remove friable building materials such as asbestos-containing spray materials and lagging materials. (19/87) |
| Release quantity: | 380,000 tons/year of asbestos waste were generated in 2005. Over 1 million tons/year of asbestos-containing industrial waste was generated. (59/87) |
| Waste treatment methods and pollution control: | Waste treatment methods and pollution control |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Methodology | Low | Methodology is not specified. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | Medium | Data are from Japan, an OECD country. |
| Metric 3: | Applicability | High | Data are for disposal of asbestos material, an in-scope occupational scenario. |
| Metric 4: | Temporal Representativeness | Medium | Data are greater than 10 years old but no more than 20 years old. |
| Metric 5: | Sample Size | Medium | Sample distribution characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Medium | Release media and release quantity provided but missing emission factors and release frequency. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Kaplan, D. E. (1993). UNREGULATED DISPOSAL OF ASBESTOS CONTAMINATED SHOWER WATER EFFLUENT - A QUESTION OF PUBLIC-HEALTH RISK. Journal of Environmental Health 55(6):6-8. |
| **HERO ID:** | 3580609 |
| **Conditions of Use:** | Disposal |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Description of release source: | There is no regulation on waste shower water generated within a decontamination facility. Releases occur when workers shower after leaving the facility before entering the outside world. |
| Release or emission factors: | nan |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | Low | Methodology is not specified. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for disposal, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Data are greater than 20 years old. |
| | Metric 5: | Sample Size | Low | Sample distribution is characterized by no statistics. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Low | Release media provided but no other metadata. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | Variability addressed by samples collected at multiple sites, but uncertainty is not addressed. |

## Overall Quality Determination — Low

| | |
|---|---|
| **Study Citation:** | Kim, Y., Zhang, Y. L., Park, W. J., Chad, G. W., Hong, W. H. (2020). Quantifying asbestos fibers in post-disaster situations: Preventive strategies for damage control. International Journal of Disaster Risk Reduction 48(2212-4209):1563-1563. |
| **HERO ID:** | 6913550 |
| **Conditions of Use:** | Other: |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Description of release source: | When buildings collapse, harmful dust is often generated in large quantities. (1/8) |
| Release quantity: | More than 5000 tons of asbestos waste was discovered after the collapse of the WTC. (1/8) |
| Waste treatment methods and pollution control: | nan |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Methodology | Medium | Methodology is known and expected to be accurate but may not cover all release sources at the site. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | Medium | Data are from Korea, an OECD country, |
| Metric 3: | Applicability | High | Data are for demolition of asbestos products, an in-scope occupational scenario. |
| Metric 4: | Temporal Representativeness | High | Data are no more than 10 years old. |
| Metric 5: | Sample Size | Medium | Sample distribution characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Medium | Release media, controls, and release quantity provided but missing emission factors and frequency. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Medium | Variability is addressed by testing coated and uncoated asbestos roofing. Uncertainty isn't addressed. |

## Overall Quality Determination Medium

**Study Citation:** Logsdon, G. S., Schleppenbach, F. X., Zaudtke, T. M. (1979). FILTRATION WORKS OUT ASBESTOS FIBERS. Water and Sewage Works 126(10):44-46.
**HERO ID:** 3582960
**Conditions of Use:** Other:

**EXTRACTION**

| Parameter | Data |
|---|---|
| Description of release source: | leaching from asbestos cement pipe |
| Release or emission factors: | Release or emission factors |
| Waste treatment methods and pollution control: | Waste treatment methods and pollution control |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | Low | The release data methodology is not specified. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | The data are from the United States. |
| | Metric 3: | Applicability | Low | Drinking water is not in scope for the engineering part of the risk evaluation but some of the information may apply to a similar in-scope COU. |
| | Metric 4: | Temporal Representativeness | Low | 1983 Prior to the latest PEL and more than 20 years old |
| | Metric 5: | Sample Size | Low | Distribution of samples is qualitative or characterized by no statistics. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Low | Release data include release media but no other metadata. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | The release data study does not address variability or uncertainty. |

## Overall Quality Determination Low

| | |
|---|---|
| **Study Citation:** | Logsdon, G. S., Symons, J. M., Sorg, T. J. (1981). Monitoring water filters for asbestos removal. Journal of the Environmental Engineering Division (ASCE) 107(6):1297-1315. |
| **HERO ID:** | 3582963 |
| **Conditions of Use:** | Other: |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Description of release source: | Taconite processing plant; discharge of ore tailings (pg 2) |
| Release quantity: | 67,000 tons/day of ore tailings discharged to Lake Superior (pg 2) |
| Release or emission factors: | Release or emission factors |
| Waste treatment methods and pollution control: | nan |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | Medium | Methodology is known and expected to be accurate but may not cover all release sources at the site. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | Medium | Data are for water treatment, which is similar to the in-scope occupational scenario disposal. |
| | Metric 4: | Temporal Representativeness | Low | Data are greater than 20 years old. |
| | Metric 5: | Sample Size | Medium | Sample distribution characterized by limited statistics (ranges, assumed means/max/min) but discrete samples not provided and distribution not fully characterized. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Low | Release media provided but no other metadata. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | Variability addressed by assessing different treatment methods and varying turbidities, but uncertainty is not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Moll, K. D., Tihansky, D. P. (1977). Risk-benefit analysis for industrial and social needs. American Industrial Hygiene Association Journal 38(4):153-161. |
| **HERO ID:** | 2998840 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Description of release source: | Construction activities, packing, felts & paper, insulation, floor tile, textiles, friction products, and other |
| Release quantity: | Construction ActivitiesWaste: 8,340 (metric tons)Air: 207 (metric tons)Water: 246 (metric tons)PackingWaste: 27,919 (metric tons)Air: 14 (metric tons)Water: 30 (metric tons)Felts and PaperWaste: 3,158 (metric tons)Air: 53 (metric tons)Water: 42 (metric tons)InsulationWaste: 532 (metric tons)Air: 55 (metric tons)Water: 4 (metric tons)Floor TileWaste: 11,906 (metric tons)Air: 38 (metric tons)Water: 4 (metric tons)TextilesWaste: 6,998 (metric tons)Air: 7 (metric tons)Water: 1 (metric tons)Friction ProductsWaste: 69,732 (metric tons)Air: 339 (metric tons)Water: 21 (metric tons)Floor TileWaste: 53,650 (metric tons)Air: 54 (metric tons)Water: 5 (metric tons) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Methodology | Low | Methodology is not specified. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | Data are from the U.S. |
| Metric 3: | Applicability | High | Data are for construction activities, an in-scope occupational scenario. |
| Metric 4: | Temporal Representativeness | Medium | Data were collected prior to the most recent PEL |
| Metric 5: | Sample Size | Low | Sample distribution is characterized by no statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Medium | Release media and release frequency provided but missing pollution control and emission factors. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Medium | Variability addressed by giving releases to multiple medias, but uncertainty is not addressed. |

## Overall Quality Determination — Medium

| | |
|---|---|
| **Study Citation:** | (1977). Hazardous Wastes-a Risk-benefit Framework Applied To Cadmium And Asbestos. |
| **HERO ID:** | 1263623 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Release quantity: | Total 547 metric tons per yearconstruction products 153Floor tile 38Friction products 210Paper and felt 53Textiles 34Gaskets, packing and insulation 32other 54During construction 54 metric tons emitted.Emissions from incinerators = 200 metric tons |
| Release or emission factors: | Release or emission factors |
| Waste treatment methods and pollution control: | Waste treatment methods and pollution control |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Methodology | Low | The release data methodology is not specified |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | US |
| Metric 3: | Applicability | High | The release data are for an occupational scenario (Asbestos product manufacture and disposal) within the scope of the risk evaluation. |
| Metric 4: | Temporal Representativeness | Low | 1977 more than 20 years old. |
| Metric 5: | Sample Size | Low | Distribution of samples is qualitative or characterized by no statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Low | Release data include release media but no other metadata. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Low | The release data study does not address variability or uncertainty. |

## Overall Quality Determination Low

| | |
|---|---|
| **Study Citation:** | Naylor, L. M. (1989). Asbestos in sludge - a significant risk. BioCycle 30(1):51-53. |
| **HERO ID:** | 3095297 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Description of release source: | Release is from sludge from wastewater treatment plants, article implies the ultimate source of asbestos being street dust from brake pads |
| Release or emission factors: | nan |
| Comments: | COU was chosen based on source of asbestos being brake pads |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | Low | Methodology is not specified. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Medium | Majority of data is from Canada, an OECD country. |
| | Metric 3: | Applicability | Low | Data does not specify what activities are producing the wastewater or what process the wastewater is coming from. |
| | Metric 4: | Temporal Representativeness | Low | Data is over 20 years old. |
| | Metric 5: | Sample Size | Medium | Unable to tell if some samples provided are an average, mean, or median from the source. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Release media provided but no other metadata. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | Does not address uncertainty and variability. |

## Overall Quality Determination — Low

| | |
|---|---|
| **Study Citation:** | NRCe, (2022). 2012-2022 National Response Corporation Data: Asbestos. |
| **HERO ID:** | 11138813 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Release quantity: | NRC reports accidental releases of asbestos, providing estimates of release quantities and indicating if asbestos reached water after it was released |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | Low | The release data methodology is not always known and is sometimes estimated by the reporter of the release. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | The data are from the United States. |
| | Metric 3: | Applicability | High | The release data are for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | High | Data are from the last 10 years. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Low | Release data include release media but no other metadata. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | The release data study does not address variability or uncertainty. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Pastuszka, J. S. (2009). Emission of airborne fibers from mechanically impacted asbestos-cement sheets and concentration of fibrous aerosol in the home environment in Upper Silesia, Poland. Journal of Hazardous Materials 162(2-3):1171-1177. |
| **HERO ID:** | 2598575 |
| **Conditions of Use:** | Consumer Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Release or emission factors: | Release or emission factors |
| Comments: | Table 3Concentration of the airborne fibers in two groups of dwellings in four towns in Upper Silesia, Poland (Katowice, Chorzów, Sosnowiec, Bytom)Source looks at residential buildings, but this data can correspond to commercial buildings using the same materials. |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | Medium | The release data methodology is known or expected to be accurate but may not cover all release sources at a commercial or industrial site. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Medium | The data are from an OECD country other than the U.S., and locality-specific factors may impact releases relative to the U.S. |
| | Metric 3: | Applicability | Low | The release data are for a non-occupational scenario that is similar to an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Medium | The release data were collected after the most recent federal regulatory action or update but are generally, more than 10 years old. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized. Sample size is sufficiently representative. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Release data include most critical metadata, including release media but does not include specific activities. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | High | The release data study addresses variability in the determinants of release. The release data study addresses uncertainty in the release results. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Sawyer, R. N. (1977). Asbestos exposure in a Yale building: Analysis and resolution. Environmental Research 13(1):146-169. |
| **HERO ID:** | 180 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Description of release source: | Air currents, ventilation leaks, and vibration resulted in fiber loss from the ceiling. (3/24) |
| Waste treatment methods and pollution control: | Waste treatment methods and pollution control |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | Medium | Methodology is known and expected to be accurate but may not cover all release sources at the site. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for commercial use of chemical substances in construction products, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Data are greater than 20 years old. |
| | Metric 5: | Sample Size | Medium | Sample distribution characterized by limited statistics (mean, standard deviations, ranges) but discrete samples not provided and distribution not fully characterized. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Low | Release media and control techniques provided, but missing frequency, emission factors, and quantities. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | Uncertainty is addressed in the sampling methods. Variability isn't addressed. |

## Overall Quality Determination Medium

**Study Citation:** Sawyer, R. N. (1977). Asbestos exposure in a Yale building: Analysis and resolution. Environmental Research 13(1):146-169.
**HERO ID:** 180
**Conditions of Use:** Disposal

**EXTRACTION**

| Parameter | Data |
|---|---|
| Waste treatment methods and pollution control: | Waste treatment methods and pollution control |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | Medium | Methodology is known and expected to be accurate but may not cover all release sources at the site. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for disposal of asbestos material, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Data are greater than 20 years old. |
| | Metric 5: | Sample Size | Medium | Sample distribution characterized by limited statistics (mean, standard deviations, ranges) but discrete samples not provided and distribution not fully characterized. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Low | Release media and control techniques provided, but missing frequency, emission factors, and quantities. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | The release data study provides only limited discussion of the variability in the determinants of release. The release data study provides only limited discussion of the uncertainty in the release results. |

## Overall Quality Determination Medium

**Study Citation:** Shaver, R. G., Parker, L. C., Rissman, E. F., Slimak, K. M., Smith, R. C. (1975). Assessment of industrial hazardous waste practices: Inorganic chemicals industry.
**HERO ID:** 4539133
**Conditions of Use:** Disposal

**EXTRACTION**

| Parameter | Data |
|---|---|
| Description of release source: | Most prominent hazardous wastes for land disposal of asbestos are associated with manufacture of alkalies and chlorine (SIC 2812). p.35Alkalies and chlorine industry utilized synthetic separators in the Diaphragm Cell process, resulting in asbestos waste. p.56, 99 |
| Release quantity: | 2,300 metric ton per year, dry basis of Asbestos destined for land disposal in 1975 p.100 Table 5-1Projected 3,800 ton per year, dry basis of Asbestos destined for land disposal in 1977 p.103, Table 5-2 Projected 2,000 ton per year, dry basis of Asbestos destined for land disposal in 1983 p.104, Table 5-3 |
| Release or emission factors: | nan |
| Waste treatment methods and pollution control: | Waste treatment methods and pollution control |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Methodology | High | Methodology is known and expected to be accurate and cover all release sources at the site. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | Data are from the U.S. |
| Metric 3: | Applicability | Medium | Data are for alkalies and chlorine processing disposal, which is similar to the the asbestos disposal processes from in-scope occupational scenarios. |
| Metric 4: | Temporal Representativeness | Low | Data are greater than 20 years old. |
| Metric 5: | Sample Size | Medium | Sample distribution characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Medium | Release media and release frequency provided but missing detailed site-specific details such as unit operation. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Medium | Variability addressed by description of data sources, but uncertainty is not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Spasiano, D., Pirozzi, F. (2017). Treatments of asbestos containing wastes. Journal of Environmental Management 204(Pt 1):82-91. |
| **HERO ID:** | 6865998 |
| **Conditions of Use:** | Disposal |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Description of release source: | Asbestos containing wastes from buildings and utilities. (2/10) |
| Release quantity: | In Italy, the amount of asbestos containing wastes can reach 30E6 tons. (2/10) |
| Waste treatment methods and pollution control: | Waste treatment methods and pollution control |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Methodology | Low | Methodology is not specified. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | Medium | Data are from Italy, an OECD country, |
| Metric 3: | Applicability | High | Data are for disposal of asbestos products, an in-scope occupational scenario. |
| Metric 4: | Temporal Representativeness | High | Data are no more than 10 years old. |
| Metric 5: | Sample Size | Medium | Sample distribution characterized by limited statistics (waste volume) but discrete samples not provided and distribution not fully characterized. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Medium | Release media, controls, and release quantity provided but missing emission factors. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Medium | Variability is addressed by comparing different waste treatment methods. Uncertainty isn't addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Spurny, K. R. (1989). Asbestos Fibre Release by Corroded and Weathered Asbestos-Cement Products. IARC Scientific Publications occupational Exposure to Mineral Fibres(90):367-371. |
| **HERO ID:** | 3098454 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Description of release source: | Asbestos-cement products e.g. roof tiles (PDF pg 1); specifically corroded surfaces as a result of aggressive atmospheric pollution (PDF pg 3) |
| Release or emission factors: | Release or emission factors |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | Medium | Methodology is known and expected to be accurate but may not cover all release sources at the site. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Medium | Data are from Germany, an OECD country. |
| | Metric 3: | Applicability | High | Data are for construction materials, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Data are greater than 20 years old. |
| | Metric 5: | Sample Size | Medium | Sample distribution characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Low | Release media provided but no other metadata. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination — Low

| | |
|---|---|
| **Study Citation:** | Spurny, K. R. (1989). On the release of asbestos fibers from weathered and corroded asbestos cement products. Environmental Research 48(1):100-116. |
| **HERO ID:** | 380 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Description of release source: | Release comes from the corrosion of asbestos cement used in roofing tiles and other asbestos cement products. |
| Release or emission factors: | Release or emission factors |
| Comments: | Fibrous emissions were collected on Nuclepore or membrane filters and then the number of fibers, their size distribution, and identities were evaluated by electrom microscopy (SEM and TEM). Details of analytical and sampling methodology are on pages 3-5. |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Methodology | High | Sampling and analytical methodology is thoroughly described in pages 3-5. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | Medium | Samples taken in Germany, an OECD country. |
| Metric 3: | Applicability | High | Data is for environmental release factors of commercial use of asbestos cement (roof tiles) in Germany. |
| Metric 4: | Temporal Representativeness | Low | Source is over 20 years old with samples taken between 1984-1986. |
| Metric 5: | Sample Size | High | Samples are thoroughly characterized through statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Medium | Release data includes emission factors, description of release source, and concentration of asbestos in fibers. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Medium | Addresses variability by sampling across multiple years and sampling from different locations of the asbestos cement. Does not address uncertainty. |

## Overall Quality Determination — Medium

| | |
|---|---|
| **Study Citation:** | Spurny, K. R. (1988). On the emission of fibrous particles from corroded asbestos-cement products. :205-208. |
| **HERO ID:** | 44608 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Description of release source: | Roofing tiles corroded by acid rain (p. 1)20 % of free asbestos fibers are dispersed into the ambient air and 80 % are washed out by rain water (p. 3) |
| Release or emission factors: | Release or emission factors |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | Low | The release data methodology is not specified. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Medium | The data are from an OECD country other than the U.S., and locality-specific factors (e.g., potential differences in regulatory emission limits, industry/ process technologies) may impact releases relative to the U.S. |
| | Metric 3: | Applicability | High | The release data are for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Low | The data were collected are more than 20 years old |
| | Metric 5: | Sample Size | Low | Distribution of samples is qualitative or characterized by no statistics. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Release data include most critical metadata, including release media and release frequency, but lacks additional metadata, such as process, unit operation, and/or activity that is the source ofthe release. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | The release data study does not address variability or uncertainty. |

## Overall Quality Determination — Low

| | |
|---|---|
| **Study Citation:** | Terazono, A. (2010). Experiences of asbestos emission control and waste management in Japan. :539-541. |
| **HERO ID:** | 6877326 |
| **Conditions of Use:** | Disposal |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Release quantity: | 1 million tons of asbestos waste per year in Japan. [PDF Pg. 4] |
| Waste treatment methods and pollution control: | Waste treatment methods and pollution control |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | Low | Methodology is not specified. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Medium | Data are from Japan, an OECD country. |
| | Metric 3: | Applicability | Medium | Data are for disposal, an in-scope occupational scenario. But, release amount might be not similar to the U.S. |
| | Metric 4: | Temporal Representativeness | Medium | Data are greater than 10 years old but no more than 20 years old. |
| | Metric 5: | Sample Size | Low | Sample distribution is characterized by no statistics. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Low | Release media provided but no other metadata. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Low

| | |
|---|---|
| **Study Citation:** | Terazono, A., Moriguchi, Y., Sakai, S.,i, Takatsuki, H. (2000). Environmental impact assessment of sprayed-on asbestos in buildings. Journal of Material Cycles and Waste Management 2(2):80-88. |
| **HERO ID:** | 6915910 |
| **Conditions of Use:** | Disposal |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Description of release source: | Release from sprayed-on asbestos, which has been used as insulation material, during disposal |
| Release quantity: | The case study involved 6500kg (26m3) of sprayed-on asbestos (see Table 1); the emission factor was 7.4 x 10^-5kg/kg, and the constant for unit conversion was 3.0 x 10^13 f/kg (from the assumption of 30 f = 1ng by EPA). Also, provided that ratio of inappropriate disposal is 20%, as EPA assumed, the asbestos emission was estimated to be 2.9 x 10^12 f. |
| Release or emission factors: | Release or emission factors |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Methodology | High | The release data methodology is known or expected to be accurate |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | Medium | The data are from an OECD country other than the U.S. |
| Metric 3: | Applicability | High | The release data are for an occupational scenario within the scope of the risk evaluation. |
| Metric 4: | Temporal Representativeness | Low | The data are more than 20 years old |
| Metric 5: | Sample Size | Low | Distribution of samples is characterized by no statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Medium | Release data include most critical metadata but lacks additional metadata. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Low | The release data study does not address variability or uncertainty. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Terazono, A., Sakai, S., Takatsuki, H. (2000). The great Hanshin-Awaji Earthquake of Japan 1995 and asbestos emission. Advances in Air Pollution Series (Vol. 8) :583-592. |
| **HERO ID:** | 6880182 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Release quantity: | Emissions for the entire earthquake zone were calculated to be 1,320 t [amount of demolition asbestos in zone] x 20% [estimated % of demolished buildings] x 0.01% = about 26.4 kg (pg 8) |
| Release or emission factors: | nan |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | Medium | Methodology is known and expected to be accurate but may not cover all release sources at the site. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Medium | Data are from Japan, an OECD country. |
| | Metric 3: | Applicability | High | Data are for construction materials, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Data are greater than 20 years old. |
| | Metric 5: | Sample Size | Low | Sample distribution is characterized by no statistics. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Low | Release media provided but no other metadata. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination — Low

| | |
|---|---|
| **Study Citation:** | Tomassetti, L., Di Giuseppe, D., Zoboli, A., Paolini, V., Torre, M., Paris, E., Guerriero, E., Petracchini, F., Gualtieri, A. F. (2020). Emission of fibres and atmospheric pollutants from the thermal treatment of asbestos containing waste (ACW). Journal of Cleaner Production 268:122179. |
| **HERO ID:** | 6866441 |
| **Conditions of Use:** | Disposal |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Description of release source: | thermal treatment of commercial asbestos cement, asbestos cement with polymers (pg 3) |
| Release or emission factors: | Release or emission factors |
| Waste treatment methods and pollution control: | Waste treatment methods and pollution control |
| Comments: | Isokinetic sampling of asbestos fiber releases (pg 5) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Methodology | High | Methodology is known and expected to be accurate and cover all release sources at the site. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | Medium | Data are from Italy, an OECD country. |
| Metric 3: | Applicability | High | Data are for disposal, an in-scope occupational scenario. |
| Metric 4: | Temporal Representativeness | High | Data were collected after the most recent NESHAP and no more than 10 years old. |
| Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Low | Release media provided but no other metadata. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Medium | Variability addressed by sampling for different types of asbestos cement, but uncertainty is not addressed. |

## Overall Quality Determination — High

| | |
|---|---|
| **Study Citation:** | U.S. EPA, (2022). National Emissions Inventory (NEI) [database]: Asbestos. |
| **HERO ID:** | 11138795 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Description of release source: | Description of release source is reported to NEI |
| Release quantity: | Release estimates are reported to NEI |
| Release or emission factors: | Release or emission factors |
| Release frequency: | Release days are reported to NEI |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | Methodology is known and expected to be accurate and cover all release sources at the site. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | The release data are for occupational scenarios within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | High | Data were collected after the most recent NESHAPs and are no more than 10 years old. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized. Sample size is sufficiently representative |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | All metadata provided. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | The release data study does not address variability or uncertainty. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | U.S. EPA, (2022). 2016-2020 TRI Data: Asbestos. |
| **HERO ID:** | 11138810 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Release quantity: | Release quantities of asbestos are reported to TRI |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | Low | The release data methodology is not specified. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | The data are from the United States and are representative of the industry being evaluated. |
| | Metric 3: | Applicability | High | The release data are for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | High | Data were collected after the most recent NESHAP for asbestos and are no more than 10 years old. |
| | Metric 5: | Sample Size | Medium | Distribution of samples is characterized by a range with uncertain statistics. It is unclear if analysis is representative. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Low | Release data include release media but no other metadata. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | The release data study does not address variability or uncertainty. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Zhang, Y. L., Byeon, H. S., Hong, W. H., Cha, G. W., Lee, Y. H., Kim, Y. C. (2021). Risk assessment of asbestos containing materials in a deteriorated dwelling area using four different methods. Journal of Hazardous Materials 410(Elsevier):124645. |
| **HERO ID:** | 7462926 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Description of release source: | Demolition of buildings containing ACM. (2/12) |
| Release quantity: | About 165,000 tons of asbestos waste are generated annually. (2/12) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | Low | Methodology is not specified. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Medium | Data are from South Korea, an OECD country. |
| | Metric 3: | Applicability | High | Data are for disposal of asbestos material, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | High | Data are no more than 10 years old. |
| | Metric 5: | Sample Size | Medium | Sample distribution characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Release media and release amount provided but missing emission factors and waste treatment methods. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | ATSDR, (2001). Toxicological profile for asbestos (Update, September 2001). |
| **HERO ID:** | 786664 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Description of release source: | Other anthropogenic sources of asbestos emissions besides mining are the crushing, screening, and milling of the ore, the processing of asbestos into products, the use of asbestos-containing materials, and the transport and disposal of asbestos-containing wastes. [PDF PG. 174]Asbestos is released to water from a number of sources, including erosion of natural deposits and waste piles, corrosion from asbestos-cement pipes, and disintegration of asbestos roofing materials with subsequent transport via rainwater into cisterns, sewers, etc. (Millette et al. 1980). [PDF PG. 175]Soil may be contaminated with asbestos by the weathering of natural asbestos deposits, or by land-based disposal of waste asbestos materials. While disposal of waste asbestos to landfills was a common practice in the past, current regulations restrict this practice (see Chapters 5 and 8). [PDF PG. 175] |
| Release quantity: | Total on-site releases: 13,577,215 (lbs)Total off-site releases: 4,483,383 (lbs)Total on- and off-site releases: 18,420,598 (lbs) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Methodology | High | The assessment or report uses high quality data and/or techniques or sound methods that are from a frequently used source. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | The data are from the United States. |
| Metric 3: | Applicability | High | The assessment is for an occupational scenario within the scope of the risk evaluation. |
| Metric 4: | Temporal Representativeness | Low | The completed exposure or risk assessment is more than 20 years old. |
| Metric 5: | Sample Size | Medium | Distribution of samples is characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Medium | Assessment or report clearly documents results, methods, and assumptions. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Medium | The assessment provides only limited discussion of the variability and uncertainty in the results. |

## Overall Quality Determination Medium

**Study Citation:** KVB Inc, (1980). An inventory of carcinogenic substances released into the ambient air of California: Final report - Task II and Task IV.
**HERO ID:** 5443893
**Conditions of Use:** Other:

**EXTRACTION**

| Parameter | Data |
|---|---|
| Description of release source: | Demolition of buildings, maintenance of industrial facilities, and disposal of solid wastes at landfills. (61/132) Dumping and burial of waste at landfills (67/132) Floor coverings, insulation, fire-resistant textiles, cement piping, roofing products, filters, rubbers and coatings, and caskets and packings. (68/132) |
| Release quantity: | "Asbestos is estimated to be discharged into the air at 460,000 lbs/year. 10% of these releases are from activities other than mining and milling. (22/132) In terms of asbestos dust, an annual release of 47,000 lbs is estimated. (69/132)" |
| Waste treatment methods and pollution control: | nan |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Methodology | High | Assessment uses high quality data from frequently-used sources. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | Data are from the U.S. |
| Metric 3: | Applicability | High | Data from the report encompass all conditions of use, which includes all in scope of the evaluation. |
| Metric 4: | Temporal Representativeness | Low | Assessment is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| Metric 5: | Sample Size | Medium | Sample distribution characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Medium | References are cited in-text, but the source ends before the bibliography. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Medium | Variability is addressed by including data from different manufacturers and use conditions. Uncertainty isn't' addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | OECD, (2009). Emission scenario document on plastic additives. |
| **HERO ID:** | 5079084 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Packaging, Paper, Plastic, Toys, Hobby Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Description of release source: | Raw material handling, compounding, converting, service life, disposal. Releases to air and water. |
| Release or emission factors: | Release or emission factors |
| Comments: | Emission scenario document on plastic additives |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | Assessment uses high quality data/techniques/methods from frequently-used sources. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Medium | This ESD was not developed by EPA, but another OECD-member country. |
| | Metric 3: | Applicability | Medium | Data are for multiple in-scope occupational scenarios; however, data is general and not specific to a chemical. |
| | Metric 4: | Temporal Representativeness | Low | Assessment from 2011 but is based on data greater than 20 years old. |
| | Metric 5: | Sample Size | Medium | Data characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | Variability addressed by presenting emission factors for multiple scenarios/additive types but uncertainty is not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | OECD, (2019). Complementing document to the emission scenario document on plastic additives: Plastic additives during the use of end products. |
| **HERO ID:** | 6306751 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Packaging, Paper, Plastic, Toys, Hobby Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Description of release source: | Release during product use. Environmental media - Air |
| Release or emission factors: | Release or emission factors |
| Comments: | Source is a Generic Scenario. |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Methodology | High | Assessment uses high quality data/techniques/methods from frequently-used sources. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | Medium | This ESD was not developed by EPA, but another OECD-member country. |
| Metric 3: | Applicability | High | Data is for an in-scope occupational scenario and contain chemical-specific emission factors |
| Metric 4: | Temporal Representativeness | High | Assessment is based on data greater than 10 years old but no more than 20 years old and industry conditions that are expected to be representative of current industry conditions. |
| Metric 5: | Sample Size | Low | Sample distribution is characterized by no statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | High | Variability addressed by presenting emission factors for multiple addtive types. Uncertainty is addressed in methodology for measuring emissions. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | U.S. EPA, (2004). Additives in plastics processing (compounding) – Generic scenario for estimating occupational exposures and environmental release – Draft. |
| **HERO ID:** | 6311218 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Packaging, Paper, Plastic, Toys, Hobby Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Description of release source: | Unloading containers, spillage, Container cleaning, dusts and fugitive emissions from compounding, equipment cleaning |
| Release quantity: | Provides models for estimating various fugitive air releases |
| Release or emission factors: | Release or emission factors |
| Release frequency: | 250 days/yr |
| Waste treatment methods and pollution control: | Waste treatment methods and pollution control |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Methodology | High | Assessment uses high quality data/techniques/methods from frequently-used sources. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | This GS is based on U.S. data |
| Metric 3: | Applicability | Uninformative | Plastic processing is not in-scope for the legacy asbestos risk evaluation. |
| Metric 4: | Temporal Representativeness | Medium | Assessment is generally based on data greater than 10 years old but no more than 20 years old and industry conditions that are expected to be representative of current industry conditions. |
| Metric 5: | Sample Size | Medium | Data characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Medium | Uncertainty not addressed. Variability addressed by considering multiple plastic types, and additive types. |

## Overall Quality Determination — Uninformative

| | |
|---|---|
| **Study Citation:** | Abruzzese, C., Marabini, A. M., Paglietti, F., Plescia, P. (1998). "Cordiam" process: A new treatment for asbestos wastes. :563–577. |
| **HERO ID:** | 6878045 |
| **Conditions of Use:** | Disposal |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Waste treatment methods and pollution control: | Waste treatment methods and pollution control |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | Medium | Report uses high quality data/techniques/methods that are not from frequently-used sources and there are no known quality issues. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Medium | Data are from Italy, an OECD country. |
| | Metric 3: | Applicability | High | Data are for disposal, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: | Sample Size | N/A | Information on waste treatment methods. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Methods, results, and assumptions are clearly documented, but underlying data sources are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | Variability addressed by discussing various waste treatment methods but uncertainty is not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Albrecht, L., Buker, L., Davis, D., Morgan, D., AMER NUCL SOC, AMER NUCL SOC, AMER NUCL SOC (1997). Determining end-points for the Decontamination and Decommissioning of facilities. :43-49. |
| **HERO ID:** | 2151615 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Description of release source: | In DOE buildings, asbestos was released from insulation, piping, siding, ceiling tiles, and floor tiles. (3/7) |
| Waste treatment methods and pollution control: | Waste treatment methods and pollution control |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Methodology | High | Report uses high quality methods and data from frequently-used sources. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | Data are from the U.S. |
| Metric 3: | Applicability | High | Data are for commercial use of construction products, an in-scope occupational scenario. |
| Metric 4: | Temporal Representativeness | Low | Data are greater than 20 years old. |
| Metric 5: | Sample Size | N/A | N/A - This metric is not applicable to the data being extracted |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Low | Assessment results are provided but underlying methods, assumptions, and data sources are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Almusawi, M. B. H., Karim, A. T. B.,A, Ethaib, S. (2022). Evaluation of construction and demolition waste management in Kuwait. Recycling 7(6):88. |
| **HERO ID:** | 10631551 |
| **Conditions of Use:** | Other: |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Description of release source: | Construction and demolition waste disposal sites |
| Release frequency: | 17% of sites receive waste daily, 17% of sites receive waste every 3 days, 30% of sites receive waste weekly, and 36% of sites receive waste monthly |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | The assessment uses high quality data and associated information does not indicate flaws or quality issues. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Low | The data are from a non-OECD country. |
| | Metric 3: | Applicability | High | The report is for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | High | The report is generally no more than 10 years old. |
| | Metric 5: | Sample Size | Medium | Distribution of samples is characterized by a range with uncertain statistics. It is unclear if analysis is representative. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | Assessment or report clearly documents its data sources, assessment methods, results, and assumptions. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | The report provides only limited discussion of the variability and uncertainty in the results. |

## Overall Quality Determination — High

**Study Citation:** Anonymous, (1974). Asbestos removal systems perfected. Water and Waste Treatment 17(6):13.
**HERO ID:** 6903583
**Conditions of Use:** Disposal

**EXTRACTION**

| Parameter | Data |
|---|---|
| Waste treatment methods and pollution control: | Waste treatment methods and pollution control |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Methodology | Low | Methodology used to determine asbestos fiber removal efficiency is unclear from report. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | Medium | Data are from Canada, an OECD country. |
| Metric 3: | Applicability | Medium | Data are for asbestos fiber filtration, which may be useful for the disposal scenario. |
| Metric 4: | Temporal Representativeness | Low | Report is based on data greater than 20 years old. |
| Metric 5: | Sample Size | N/A | N/A - pollution control methods. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Low | Assessment results are provided but underlying methods, assumptions, and data sources are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | N/A | N/A - pollution control methods. |

## Overall Quality Determination Low

**Study Citation:** ATSDR, (2008). Letter health consultation: Former Stella Cardwell Hospital: Stella, Newton County, Missouri: EPA facility id: MON000704954.
**HERO ID:** 3970343
**Conditions of Use:** Disposal

**EXTRACTION**

| Parameter | Data |
|---|---|
| Description of release source: | Materials removed included asbestos containing pipe insulation, floor tile and mastic, transite siding, boiler insulation, and linoleum flooring and window caulkThe activities of the EPA contractors during that time did disturb and likely release some small amounts of lead and asbestos from the site. |
| Waste treatment methods and pollution control: | Waste treatment methods and pollution control |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Methodology | High | Report uses high quality information that are from frequently-used sources and there are no known quality issues. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | Data are from the U.S. |
| Metric 3: | Applicability | High | Data are for disposal of asbestos materials, an in-scope occupational scenario. |
| Metric 4: | Temporal Representativeness | Medium | Report is based on data greater than 10 years old but no more than 20 years old and industry conditions that are expected to be representative of current industry conditions. |
| Metric 5: | Sample Size | Low | Distribution of samples is qualitative or characterized by no statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Medium | Methods, results, and assumptions are clearly documented, but underlying data sources are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | ATSDR, (2010). Health consultation: Johns Manville Manufacturing Plant: Nashua, Hillsborough County, New Hampshire. |
| **HERO ID:** | 3970347 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Description of release source: | Asbestos-containing demolition debris. [PDF Pg. 2] |
| Waste treatment methods and pollution control: | Waste treatment methods and pollution control |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | Report uses high quality data/techniques/methods from frequently-used sources. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for Chemical Substances in Construction, Paint, Electrical, and Metal Products, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: | Sample Size | N/A | N/A - description of release source and pollution control methods. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | N/A | N/A - description of release source and pollution control methods. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Bociaga, B. M., Pudlowski, Z. J. (2007). Asbestos products - health hazards in domestic hard waste: A great challenge for engineering education. Monash engineering education series :63-68. |
| **HERO ID:** | 6880124 |
| **Conditions of Use:** | Disposal |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Waste treatment methods and pollution control: | Waste treatment methods and pollution control |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Methodology | Medium | Report uses high quality data that are not from frequently-used sources and there are no known quality issues. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | Medium | Data are from Australia, an OECD country. |
| Metric 3: | Applicability | High | Data are for disposal of asbestos material, an in-scope occupational scenario. |
| Metric 4: | Temporal Representativeness | Medium | Report is based on data greater than 10 years old but no more than 20 years old and industry conditions that are expected to be representative of current industry conditions. |
| Metric 5: | Sample Size | N/A | N/A - This metric is not applicable to the data being extracted |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Medium

**Study Citation:** Bragg, G. M. (1988). The basics of asbestos dust control.
**HERO ID:** 6904663
**Conditions of Use:** Other:

**EXTRACTION**

| Parameter | Data |
|---|---|
| Description of release source: | breakage and wear (pg 17) |
| Waste treatment methods and pollution control: | Waste treatment methods and pollution control |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | Medium | Report uses high quality data/techniques/methods that are not from frequently-used sources and there are no known quality issues. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Medium | Data are from Canada, an OECD country. |
| | Metric 3: | Applicability | Uninformative | Data are for disposal within a manufacturing plant which is not in-scope for the legacy asbestos risk evaluation. |
| | Metric 4: | Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: | Sample Size | N/A | Qualitative data without sampling data. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Methods, results, and assumptions are clearly documented, but underlying data sources are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination — Uninformative

| | |
|---|---|
| **Study Citation:** | Brown, S. K., Angelopoulos, M. (1991). Evaluation of erosion release and suppression of asbestos fibers from asbestos building products. American Industrial Hygiene Association Journal 52(9):363-371. |
| **HERO ID:** | 3583115 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Description of release source: | Asbestos building products, including sprayed insulations, building sheet products, and weathered asbestos-cement claddings (pg 365) |
| Release or emission factors: | Release or emission factors |
| Waste treatment methods and pollution control: | Waste treatment methods and pollution control |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Methodology | High | report uses high quality data and/or techniques or sound methods |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | Medium | data are from an OECD country other than the U.S |
| Metric 3: | Applicability | Medium | report is for an occupational scenario that is similar to an occupational scenario within the scope of the risk evaluation |
| Metric 4: | Temporal Representativeness | Low | The report is more than 20 years old. |
| Metric 5: | Sample Size | Medium | Distribution of samples is characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | High | report clearly documents its data sources, assessment methods |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Medium | The report address variability, but not uncertainty. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Bryant, C. J. (1987). Health hazard evaluation report no. HETA-86-434-1833, Federal Office Building, Evansville, Indiana. |
| **HERO ID:** | 3970468 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Description of release source: | During construction, structural beams and the underside of the steel floor decks were sprayed with an asbestos-containing fireproofing. In the occupied spaces, suspended ceilings form a plenum with the floor decks which is used to return office air to the heating, ventilating, and air-conditioning (HVAC) systems. This directly exposes the friable asbestos-containing fireproofing in the plenum to the HVAC air, which is subsequently returned to the occupied areas. |
| Waste treatment methods and pollution control: | nan |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Methodology | High | NIOSH study |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | USA |
| Metric 3: | Applicability | High | The report is for an occupational scenario (Federal office worker) within the scope of the risk evaluation. |
| Metric 4: | Temporal Representativeness | Low | 1986 - more than 20 years old |
| Metric 5: | Sample Size | Low | non-quantitative data provided. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | High | This NIOSH report clearly documents its data sources, assessment methods, results, and assumptions. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Low | The report does not address variability or uncertainty. |

## Overall Quality Determination — Medium

**Study Citation:** CalEPA, (1995). Asbestos demolition and renovation.
**HERO ID:** 3981096
**Conditions of Use:** Disposal

**EXTRACTION**

| Parameter | Data |
|---|---|
| Waste treatment methods and pollution control: | Waste treatment methods and pollution control |
| Comments: | The appendix includes EPA regulations and policy documents along with relevant information from different California air quality districts. |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | Detailed information from CARB |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | US |
| | Metric 3: | Applicability | High | The report is for an occupational scenario (inspection of site remediation) within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Medium | 1995 - after the most recent PEL but more than 20 years old. |
| | Metric 5: | Sample Size | N/A | Qualitative information provided |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | Assessment or report clearly documents its data sources, assessment methods, results, and assumptions. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | N/A | Qualitative information provided |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | CAREX Canada, (2016). Substance profile: Asbestos. |
| **HERO ID:** | 3978366 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Release quantity: | In US, 5 tonnes of chrysotile asbestos was released from roofing sealant cements and 4 tonnes of anthophyllite asbestos was released from paint primer (pg 4 of 6) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | Report uses high quality data. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | The data are from the United States. |
| | Metric 3: | Applicability | High | The report is for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | High | The report is generally no more than 10 years old. |
| | Metric 5: | Sample Size | N/A | No sample data. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | Report clearly documents its data sources. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | The report does not address variability or uncertainty. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Challands, N. (2010). The relationships between fire service response time and fire outcomes. Fire Technology 46(3):665-676. |
| **HERO ID:** | 10630512 |
| **Conditions of Use:** | Other: |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Description of release source: | Structure fire, approximately 6 minute response time from fire fighting team |
| Release frequency: | One day |
| Comments: | Asbestos was not mentioned, but the source can be used for estimating release duration for fire fighting events. |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | Reported fire fighting response times do not indicate any flaws and are expected to be accurate. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from United States. |
| | Metric 3: | Applicability | High | Fire fighting response time is directly applicable to estimation of release duration during fires. |
| | Metric 4: | Temporal Representativeness | Medium | The report is generally more than 10 years but no more than 20 years old. |
| | Metric 5: | Sample Size | N/A | Sample size is not applicable to the data extracted. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | Assessment or report clearly documents its data sources, assessment methods, results, and assumptions. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | The report provides only limited discussion of the variability and uncertainty in the results. |

## Overall Quality Determination — High

| | |
|---|---|
| **Study Citation:** | Chen, X.,i, Lu, W. (2017). Identifying factors influencing demolition waste generation in Hong Kong. Journal of Cleaner Production 141:799-811. |
| **HERO ID:** | 10630493 |
| **Conditions of Use:** | Other: |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Description of release source: | Deconstruction and demolition of buildings in Hong Kong. |
| Release frequency: | 100 release days per year |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | The report uses high quality data and associated information does not indicate flaws or quality issues. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Low | The data are from a non-OECD country. |
| | Metric 3: | Applicability | High | The report is for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | High | The report is generally no more than 10 years old. |
| | Metric 5: | Sample Size | Medium | Distribution of samples is characterized by a range with uncertain statistics. It is unclear if analysis is representative. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | Assessment or report clearly documents its data sources, assessment methods, results, and assumptions. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | The report provides only limited discussion of the variability and uncertainty in the results. |

## Overall Quality Determination — High

| | |
|---|---|
| **Study Citation:** | CHMR, (1996). Fact sheet: Pollution prevention: Strategies for demolition waste. |
| **HERO ID:** | 3981073 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Waste treatment methods and pollution control: | Waste treatment methods and pollution control |
| Comments: | This is just an general outline of things to know before doing a demolition job and appears to be directed at diy type people. |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | Low | The data, data sources, and/or techniques or methods used in the assessment or report are not specified. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | The data are from the United States and are representative of the industry being evaluated. |
| | Metric 3: | Applicability | High | The report is for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Low | The report is more than 20 years old. The report captures operations, equipment, and worker activities that are expected to be outdated. |
| | Metric 5: | Sample Size | Low | Distribution of samples is qualitative or characterized by no statistics. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Low | Assessment or report provides results, but the underlying methods, data sources, and assumptions are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | The report does not address variability or uncertainty. |

## Overall Quality Determination Low

| | |
|---|---|
| **Study Citation:** | Coelho, A., de Brito, J. (2011). Economic analysis of conventional versus selective demolition - A case study. Resources, Conservation and Recycling 55(3):382-392. |
| **HERO ID:** | 10630489 |
| **Conditions of Use:** | Other: |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Description of release source: | Removal of several town houses built between 1900 and 1945, of low to average building quality, averaging about 100m2 per house, in a total of 13,430m2 of gross floor area removed. Deconstruction occurs approximately 8 hrs/day. |
| Release frequency: | Approximately 6.5 - 12 days/structure during deconstruction. |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | The report uses high quality data and associated information does not indicate flaws or quality issues. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Medium | The data are from an OECD country other than the U.S. |
| | Metric 3: | Applicability | High | The report is for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Medium | The report is generally more than 10 years but no more than 20 years old. |
| | Metric 5: | Sample Size | Medium | Distribution of samples is characterized by a range with uncertain statistics. It is unclear if analysis is representative. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | Assessment or report clearly documents its data sources, assessment methods, results, and assumptions. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | The report provides only limited discussion of the variability and uncertainty in the results. |

## Overall Quality Determination — High

| | |
|---|---|
| **Study Citation:** | Dantata, N., Touran, A., Wang, J. (2005). An analysis of cost and duration for deconstruction and demolition of residential buildings in Massachusetts. Resources, Conservation and Recycling 44(1):1-15. |
| **HERO ID:** | 10630495 |
| **Conditions of Use:** | Other: |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Description of release source: | This study includes deconstruction of six wood-framed residential structures in Gainesville, Florida. |
| Release frequency: | Deconstruction typically occurred between 3 - 10 days/structure. |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | The assessment uses high quality data and associated information does not indicate flaws or quality issues. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | The data are from the United States and are representative of the industry being evaluated. |
| | Metric 3: | Applicability | High | The report is for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Medium | The report is generally more than 10 years but no more than 20 years old. |
| | Metric 5: | Sample Size | Medium | Distribution of samples is characterized by a range with uncertain statistics. It is unclear if analysis is representative. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | Assessment or report clearly documents its data sources, assessment methods, results, and assumptions. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | The report provides only limited discussion of the variability and uncertainty in the results. |

## Overall Quality Determination — High

| | |
|---|---|
| **Study Citation:** | Dechant, R., Piantanida, L. (1984). Reduction of exposure during asbestos lagging rip-out. American Industrial Hygiene Association Journal 45(8):B9. |
| **HERO ID:** | 3583823 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Description of release source: | dust generation during insulation rip-out. |
| Waste treatment methods and pollution control: | Waste treatment methods and pollution control |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | The assessment or report uses high quality data and/or techniques or sound methods that are from frequently used sources. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | The data are from the United States. |
| | Metric 3: | Applicability | High | The report is for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Low | The report is more than 20 years old. |
| | Metric 5: | Sample Size | N/A | No sample data. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Low | Assessment or report provides results, but the underlying methods, data sources, and assumptions are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | N/A | No scope to address variability and uncertainty. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Elias, J. D. (1981). Dry removal of asbestos. American Industrial Hygiene Association Journal 42(8):624-625. |
| **HERO ID:** | 3098756 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Waste treatment methods and pollution control: | nan |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | The assessment or report uses high quality data and/or techniques or sound methods that are from frequently used sources. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Medium | Data are from Canada, an OECD country. |
| | Metric 3: | Applicability | High | The report is for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: | Sample Size | N/A | No sample data. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Methods, results, and assumptions are clearly documented, but underlying data sources are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | The report does not address variability or uncertainty. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Ewing, W. M., Spain, W. H. (1984). Getting to the very fiber of industrial asbestos removal. Occupational Health and Safety (June):29-33, 60, 68. |
| **HERO ID:** | 3083601 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Description of release source: | wastewater from showers (pg 4) |
| Waste treatment methods and pollution control: | Waste treatment methods and pollution control |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | Medium | Report uses high quality data/techniques/methods that are not from frequently-used sources and there are no known quality issues. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for construction materials, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: | Sample Size | Low | Distribution of samples is qualitative or characterized by no statistics. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Methods, results, and assumptions are clearly documented, but underlying data sources are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Fadem, M. E., Hubbard, J., Karches, G. J. (1987). Building owners find alternatives to asbestos removal, replacement. Occupational Health and Safety 56(1):56-67. |
| **HERO ID:** | 6871233 |
| **Conditions of Use:** | Disposal |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Description of release source: | asbestos removal from buildings |
| Waste treatment methods and pollution control: | Waste treatment methods and pollution control |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | Low | The data, data sources, and/or techniques or methods used in the assessment or report are not specified. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | The data are from the United States. |
| | Metric 3: | Applicability | High | The report is for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Low | The report is more than 20 years old. |
| | Metric 5: | Sample Size | N/A | Sample size not applicable to qualitative data. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Low | Assessment or report provides results, but the underlying methods, data sources, and assumptions are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | The report does not address variability or uncertainty. |

## Overall Quality Determination Low

| | |
|---|---|
| **Study Citation:** | First, M. W., Love, D. (1982). Engineering control of asbestos. American Industrial Hygiene Association Journal 43(9):634-639. |
| **HERO ID:** | 3582527 |
| **Conditions of Use:** | Other: |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Description of release source: | - Receipt, storage and handling of raw materials. - Bag opening and empty bag disposal (handling and disposal of empty bags- adding raw materials to the mixers |
| Waste treatment methods and pollution control: | Waste treatment methods and pollution control |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | The assessment or report uses high quality data and/or techniques or sound methods that are from frequently used sources. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | The data are from the United States. |
| | Metric 3: | Applicability | Uninformative | Processing is not in scope for the legacy risk evaluation. |
| | Metric 4: | Temporal Representativeness | Low | The report is more than 20 years old. |
| | Metric 5: | Sample Size | N/A | No sample data. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | Assessment or report clearly documents its data sources, assessment methods, results, and assumptions. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | N/A | No scope to address variability and uncertainty. |

## Overall Quality Determination — Uninformative

| | |
|---|---|
| **Study Citation:** | Fujikawa, Y., Shimo, M., Yonehara, H., Tujimoto, T. (2011). The optimized risk management of the waste from TENORM and nuclear industries: How to harmonize risk from various sources. :497-502. |
| **HERO ID:** | 6877553 |
| **Conditions of Use:** | Disposal |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Release or emission factors: | nan |
| Waste treatment methods and pollution control: | Waste treatment methods and pollution control |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | Medium | The assessment uses high quality data form the Terazono et al report which is not a frequently used source and associated information does not indicate flaws or quality issues. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Medium | Japan - and OECD member |
| | Metric 3: | Applicability | High | The report is for an occupational scenario (disposal of hazardous waste) within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Medium | 2010 - more than 10 and less than 20 years old |
| | Metric 5: | Sample Size | Low | Distribution of samples is not characterized by statistics. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Assessment clearly documents results, and assumptions. Data sources are generally described but not fully transparent. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | The report does not address variability or uncertainty for asbestos. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Giordano, R. J., Gardner, D. L., Taylor, C. A. (1987). Practical radiation, contamination and asbestos control techniques for decommissioning. |
| **HERO ID:** | 6891991 |
| **Conditions of Use:** | Other: |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Waste treatment methods and pollution control: | Waste treatment methods and pollution control |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | Medium | Documents were from the 1987 International Decommissioning Symposium ( nucelar facility decommissiong) |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | US |
| | Metric 3: | Applicability | High | The report is for an occupational scenario (nuclear power plant decommissioning) within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Low | 1987 - more than 20 years old |
| | Metric 5: | Sample Size | N/A | Qualitative information provided |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | The articles clearly documented data sources, assessment methods, results, and assumptions. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | N/A | Qualitative information provided |

## Overall Quality Determination — High

| | |
|---|---|
| **Study Citation:** | Gomez, E., Rani, D. A., Cheeseman, C. R., Deegan, D., Wise, M., Boccaccini, A. R. (2009). Thermal plasma technology for the treatment of wastes: A critical review. Journal of Hazardous Materials 161(2-3):614-626. |
| **HERO ID:** | 2562163 |
| **Conditions of Use:** | Disposal |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Waste treatment methods and pollution control: | Waste treatment methods and pollution control |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | The approaches used to control asbestos appear to be robust. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Medium | UK OECD member |
| | Metric 3: | Applicability | High | The report is for an occupational scenario (stabilization of Asbestos prior to final disposal) within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Medium | 2007 - after the PEL (1994) more than 10 and less than 20 years old. |
| | Metric 5: | Sample Size | N/A | Quality assessment of asbestos control |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | Assessment or report clearly documents its data sources, assessment methods, results, and assumptions. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | N/A | information provided was qualitative. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Harrison, P. T. C., Llewellyn, J. W. (1998). Exposure to asbestos and man-made mineral fibers in buildings and the consequences for health. IAQ Conference :83-93. |
| **HERO ID:** | 7473349 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Description of release source: | asbestos in poor condition or disturbed (abstract)roofing, cladding, thermal and acoustic insulation, fire-resistant internal paneling (pg 1)destruction of buildings by natural or human activity (e.g., fire, earthquake, war); from building materials during construction, maintenance, repair, demolition; erosion and release of fibers from fiber-bearing materials in buildings (such as cement, textured paints, insulation, roofing, cladding, materials used in heating and air supply systems) (pg 3) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Methodology | Medium | Report uses high quality data/techniques/methods that are not from frequently-used sources and there are no known quality issues. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | Medium | Data are from the U.K., an OECD country |
| | Metric 3: Applicability | High | Data are for construction materials, an in-scope occupational scenario. |
| | Metric 4: Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: Sample Size | N/A | description of release source info |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | Medium | Methods, results, and assumptions are clearly documented, but underlying data sources are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Harwood, C. F., Siebert, P. C., Oestreich, D. K. (1977). Optimizing baghouse performance to control asbestos emissions. Chemical Engineering Progress 73(1):54-56. |
| **HERO ID:** | 3585626 |
| **Conditions of Use:** | Other: |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Waste treatment methods and pollution control: | Waste treatment methods and pollution control |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | Report uses high quality methods from frequently-used sources. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for general control technology, which may be used for in-scope occupational scenarios. |
| | Metric 4: | Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: | Sample Size | N/A | No sample data. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Methods, results, and assumptions are clearly documented, but underlying data sources are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | Variability addressed by differing test parameters such as bag type and shake cycle, but uncertainty is not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Hawkins, J. W., Haynes, D. C., Istone, W. K., Schmidt, A. F. (1988). ASBESTOS .2. ABATEMENT REMOVAL PROGRAMS. Tappi Journal :199-200. |
| **HERO ID:** | 6864225 |
| **Conditions of Use:** | Other: |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Description of release source: | Asbestos materials on pipes and vessels can be disturbed by vibrations, renovations, repairs, or impacts. The concentration of asbestos fibers can build up in the environment as these disturbances continue to release fibers into the air. (1/2) |
| Waste treatment methods and pollution control: | Waste treatment methods and pollution control |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | Medium | Report uses high quality data that are not from frequently-used sources and there are no known quality issues. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for demolition of asbestos products, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: | Sample Size | N/A | N/A - This metric is not applicable to the data being extracted |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Low | Assessment results are provided but underlying methods, assumptions, and data sources are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination — Medium

| | |
|---|---|
| **Study Citation:** | Heasman, L., Baldwint, G. (2016). The Destruction of Chrysotile Asbestos Using Waste Acids. Waste Management & Research 4(2):215-223. |
| **HERO ID:** | 6905583 |
| **Conditions of Use:** | Disposal |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Waste treatment methods and pollution control: | Waste treatment methods and pollution control |
| Comments: | Chrysotile asbestos. |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Methodology | High | Report uses high quality data/techniques/methods from frequently-used sources. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | Medium | The data are from an OECD country (UK). |
| Metric 3: | Applicability | High | Data are for disposal, an in-scope occupational scenario. |
| Metric 4: | Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| Metric 5: | Sample Size | Low | Distribution of samples is qualitative or characterized by no statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Medium | All data sources, methods, results, and assumptions are clearly documented. sources are generally described but not fully transparent. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Low | The report does not address variability or uncertainty. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Hoang, N. H., Ishigaki, T., Kubota, R., Tong, T. K., Nguyen, T. T., Nguyen, H. G., Yamada, M., Kawamoto, K. (2020). Waste generation, composition, and handling in building-related construction and demolition in Hanoi, Vietnam. Waste Management 117:32-41. |
| **HERO ID:** | 10630511 |
| **Conditions of Use:** | Other: |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Description of release source: | This study conducted a survey at 15 building construction and demolition sites in Hanoi, Vietnam in order to identify waste generation rates (WGR), composition, and current handling practices of construction and demolition waste (CDW). |
| Release frequency: | Small site average - 12.4 daysLarge site average - 61.3 days |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | The assessment uses high quality data and associated information does not indicate flaws or quality issues. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Medium | The data are from an OECD country other than the U.S. |
| | Metric 3: | Applicability | High | The report is for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | High | The report is generally no more than 10 years old. |
| | Metric 5: | Sample Size | Medium | Distribution of samples is characterized by a range with uncertain statistics. It is unclear if analysis is representative. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | Assessment or report clearly documents its data sources, assessment methods, results, and assumptions. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | The report provides only limited discussion of the variability and uncertainty in the results. |

## Overall Quality Determination — High

| | |
|---|---|
| **Study Citation:** | Hollett, B. A., Caplan, P. E., Cooper, T. C., Froehlich, P. A. (1987). In-Depth Survey Report: Control Technology for Asbestos Removal at Sands Elementary School, Cincinnati, Ohio, Report No. CT-147-19B. Division of Physical Sciences and Engineering(CT-147-19B):147-19. |
| **HERO ID:** | 3099459 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Waste treatment methods and pollution control: | nan |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | NIOSH study |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | US |
| | Metric 3: | Applicability | High | The report is for an occupational scenario (Asbestos removals from a school) within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Low | 1985 - more than 20 years old. |
| | Metric 5: | Sample Size | Low | Distribution of samples is qualitative or characterized by no statistics |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | NIOSH assessment clearly documents its data sources, assessment methods, results, and assumptions. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | The report does not address variability or uncertainty. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Hollett, B. A., Caplan, P. E., Cooper, T. C., Froehlich, P. A. (1987). In-depth survey report: Control technology for asbestos removal at Washburn Elementary School, Cincinnati, Ohio. |
| **HERO ID:** | 3099460 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Waste treatment methods and pollution control: | Waste treatment methods and pollution control |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Methodology | High | Report uses high quality data/techniques/methods from frequently-used sources |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | Data are from the U.S. |
| Metric 3: | Applicability | High | Data are for construction materials, an in-scope occupational scenario. |
| Metric 4: | Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| Metric 5: | Sample Size | N/A | not quantitative |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Hunsinger, R. B., Roberts, K. J., Lawrence, J. (1980). CHRYSOTILE ASBESTOS FIBER REMOVAL DURING POTABLE WATER-TREATMENT - PILOT-PLANT STUDIES. Environmental Science and Technology 14(3):333-336. |
| **HERO ID:** | 3583339 |
| **Conditions of Use:** | Disposal |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Waste treatment methods and pollution control: | Waste treatment methods and pollution control |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Methodology | High | The assessment or report uses high quality data |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | Medium | Canada - OECD member |
| Metric 3: | Applicability | Medium | The report is for a scenario (drinking water) similar to scenarios within the scope of the risk evaluation. |
| Metric 4: | Temporal Representativeness | Low | 1976 - more than 20 years old |
| Metric 5: | Sample Size | N/A | Qualitative information about typical water processing methods |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | High | Assessment or report clearly documents its data sources, assessment methods, results, and assumptions. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | N/A | Qualitative information about typical water processing methods. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | IARC, (2010). Painting, firefighting, and shiftwork. 98:804-804 pages. |
| **HERO ID:** | 1104469 |
| **Conditions of Use:** | Other: |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Description of release source: | Asbestos used in constructions will be released during a fire in the form of fibers; asbestos sheets crack, sometimes disintegrating explosively, and more likely so if the sheet is worn or impregnated with resin. Chrysotile breaks down at 450–800 °C, and the amphiboles at 400–600 °C. Thus, the denaturing of asbestos during fires may reduce exposure to asbestos fibers. |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | WHO IARC Monograph |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Medium | OECD member countries |
| | Metric 3: | Applicability | High | The report is for an occupational scenario (firefighting) within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Medium | 2010 - more than 10 and less than 20 years |
| | Metric 5: | Sample Size | N/A | qualitative information |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | Assessment or report clearly documents its data sources. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | N/A | qualitative information |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | IARC, (2010). Painting, firefighting, and shiftwork. 98:804-804 pages. |
| **HERO ID:** | 1104469 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Description of release source: | In a Swedish investigation covering ten factories manufacturing paint and industrial coatings, exposure to quartz, asbestos, chromium including Cr(VI), and lead was documented in some air samples during the charging operation in some of the companies. |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Methodology | High | WHO IARC Monographs |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | Medium | OECD member countries |
| Metric 3: | Applicability | High | The report is for an occupational scenario (paint manufacture) within the scope of the risk evaluation. |
| Metric 4: | Temporal Representativeness | Medium | 2010 - more than 10 and less than 20 years old |
| Metric 5: | Sample Size | N/A | information was qualitative |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Medium | Assessment or report clearly documents results, methods, and assumptions. Data sources are generally described but not fully transparent. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | N/A | information was qualitative |

## Overall Quality Determination High

**Study Citation:** IMAREST, (2004). Removing asbestos responsibly. Marine Engineers Review ():14.
**HERO ID:** 6873818
**Conditions of Use:** Disposal

**EXTRACTION**

| Parameter | Data |
|---|---|
| Waste treatment methods and pollution control: | Waste treatment methods and pollution control |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | Medium | Report uses high quality data/techniques/methods that are not from frequently-used sources and there are no known quality issues. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Medium | Data are from the UK, an OECD country. |
| | Metric 3: | Applicability | High | Data are for disposal, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Medium | Report is based on data greater than 10 years old but no more than 20 years old and industry conditions that are expected to be representative of current industry conditions. |
| | Metric 5: | Sample Size | N/A | N/A - waste pollution control description |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Low | Assessment results are provided but underlying methods, assumptions, and data sources are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | N/A | N/A - waste pollution control description |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Iowa DOT, (1997). Let me shingle your roadway: Interim report for Iowa DOT research project HR-2079. |
| **HERO ID:** | 3981082 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Description of release source: | Conducted 279 tests of bituminous shingles with three showing asbestos (1.1%). |
| Release quantity: | Approximately ten million tons of waste bituminous roofing are torn off annually in the United States. |
| Waste treatment methods and pollution control: | Waste treatment methods and pollution control |
| Comments: | Source provides information that could be used to estimate releases from roofing shingles. (10 million tons waste/year)*(1.1 % of waste contains asbestos)*(3% asbestos when present) = 6.6 million lbs asbestos waste/year from bituminous roofing shingles in the US. |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Methodology | Low | The data, data sources, and/or techniques or methods used in the assessment or report are not specified. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | The data are from the United States. |
| Metric 3: | Applicability | High | The report is for an occupational scenario within the scope of the risk evaluation. |
| Metric 4: | Temporal Representativeness | Low | The report is more than 20 years old. |
| Metric 5: | Sample Size | Low | Distribution of samples is characterized by no statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Low | Assessment or report provides results, but the underlying methods, data sources, and assumptions are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Low | The report does not address variability or uncertainty. |

## Overall Quality Determination — Low

| | |
|---|---|
| **Study Citation:** | IPCS, (1986). Asbestos and other natural mineral fibres. Environmental Health Criteria :194. |
| **HERO ID:** | 81716 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Description of release source: | Possible sources of particulate (asbestos) mining emissions include: drilling, blasting, loading broken rock, and transporting ore to the primary crusher or waste to dumps. Subsequently, the ore is crushed which may lead to exposure from the following emission sources: unloading ore from the open pit, primary crushing, screening, secondary crushing, conveying and stockpiling wet ore. In well-controlled mills, this is largely confined to the mill building and presents very little emission to the air because the mill air is collected and, usually, ducted through some particulate matter control device. Asbestos cement - Possible emission sources are: (a) the feeding of asbestos fibres into the mix; (b) blending the mix; and (c) cutting or machining end products. Emissions may range from negligible to significant according to the dust control measures and technology.Emissions can also occur from sources other than processingoperations, such as the improper handling and/or shipment of drymaterials containing asbestos and during the cutting or machiningof end-products. Asbestos paper and felt- The feed for paper machines is prepared by mixing short chrysotile fibres with water and binders. Since papermaking is a wet process, little asbestos dust is generated during manufacture. However, finishing operations, such as slitting and calendering, may be sources of dust emission. Asbestos textiles - Asbestos textiles are used in the manufacture of fire-resistant garments, sealing materials, wicks, and thermal insulation, or as an intermediate product in brake linings, clutch facing, insulation, and gaskets. Asbestos textile manufacturing is the dustiest of all asbestos-manufacturing processes, and dustemanating from this process is more difficult and costly tocontrol. Use of products containing asbestos - Few data are available on fiber emissions during the use of products containing asbestos or other mineral fibers. In most construction materials and consumer products, the fibers are firmly bound or encased in a solid matrix and are not expected to be released under normal conditions, but may be emitted during manipulation or renovation of such materials or products (e.g., fiber levels measured by light microscopy in the vicinity of such activities as removal of pipe lagging containing asbestos or the sanding of asbestos-containing drywall topping and spackling compounds may approach or exceed current occupational exposure limits) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Methodology | High | WHO study that uses current report for the time the report was drafted. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | Medium | US, OECD and non-OECD members countries |
| Metric 3: | Applicability | High | The report is for an occupational scenario ( from asbestos processing and manufacturing operations) within the scope of the risk evaluation. |
| Metric 4: | Temporal Representativeness | Low | 1986 more than 20 years old |
| Metric 5: | Sample Size | Low | Distribution of samples is qualitative or characterized by no statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | High | Assessment or report clearly documents its data sources used |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | N/A | Information provided is qualitative. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Irving, K. F., Alexander, R. G., Bavley, H. (1980). ASBESTOS EXPOSURES IN MASSACHUSETTS PUBLIC-SCHOOLS. American Industrial Hygiene Association Journal 41(4):270-276. |
| **HERO ID:** | 3582560 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Waste treatment methods and pollution control: | Waste treatment methods and pollution control |
| Comments: | See table III for Ferris Index results with associated recommendations. |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Methodology | High | Report uses high quality data/techniques/methods from frequently-used sources. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | Data are from the U.S. |
| Metric 3: | Applicability | High | Data are for Chemical Substances in Construction, Paint, Electrical, and Metal Products, an in-scope occupational scenario. |
| Metric 4: | Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| Metric 5: | Sample Size | Low | Distribution of samples is qualitative |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Low | The report does not address variability or uncertainty. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Irwig, H. G., Oliver, L. C., Page, T., Wegman, D. H., Ellenbecker, M. J. (1991). Asbestos in place: A building management perspective. Annals of the New York Academy of Sciences, vol. 643, no. 1 :589-596. |
| **HERO ID:** | 3096569 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Description of release source: | Asbestos can be found in a variety of existing building materials, including sprayed or trowelled-on coatings providing fireproofing or insulation for structural elements, rigid or semi-rigid wrapping for pipes and boilers, finishing materials such as vinyl asbestos tiles, and matrices for bedding and caulking. |
| Waste treatment methods and pollution control: | Waste treatment methods and pollution control |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Methodology | High | The assessment or report uses high quality data and/or techniques or sound methods that are from frequently used sources. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | The data are from the United States. |
| Metric 3: | Applicability | High | The report is for an occupational scenario within the scope of the risk evaluation. |
| Metric 4: | Temporal Representativeness | Low | The report is more than 20 years old. |
| Metric 5: | Sample Size | N/A | No sample data. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Medium | Assessment or report clearly documents results, methods, and assumptions. Data sources are generally described but not fully transparent. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Medium | Variability is addressed by discussing more than 1 option for reducing exposure to asbestos but uncertainty is not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Jain, S., Singhal, S., Jain, N. K. (2019). Construction and demolition waste generation in cities in India: An integrated approach. International Journal of Sustainable Engineering 12(5):333-340. |
| **HERO ID:** | 10631561 |
| **Conditions of Use:** | Other: |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Description of release source: | Construction and demolition waste (C&DW) generation rate in Indian cities. |
| Release frequency: | Waste received is 5000 tons/year and 22 tons/day. Therefore, waste is received in C&D sites about 227 days/year. |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | The assessment uses high quality data and associated information does not indicate flaws or quality issues. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Low | The data are from a non-OECD country. |
| | Metric 3: | Applicability | High | The report is for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | High | The report is generally no more than 10 years old. |
| | Metric 5: | Sample Size | Medium | Distribution of samples is characterized by a range with uncertain statistics. It is unclear if analysis is representative. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | Assessment or report clearly documents its data sources, assessment methods, results, and assumptions. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | The report provides only limited discussion of the variability and uncertainty in the results. |

## Overall Quality Determination — High

**Study Citation:** Japanese Ministry of Environment, (2013). Guidelines for designated waste.
**HERO ID:** 3980940
**Conditions of Use:** Disposal

**EXTRACTION**

| Parameter | Data |
|---|---|
| Waste treatment methods and pollution control: | Waste treatment methods and pollution control |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | Japanese Ministry of the Environment |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Medium | Japan - and OECD member |
| | Metric 3: | Applicability | High | The report is for an occupational scenario (disposal of asbestos contaminated materials) within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | High | 2013 - less than 10 years old. |
| | Metric 5: | Sample Size | N/A | Qualitative information about Japanese disposal requirements |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | Clearly summarized the disposal requirements for asbestos containing waste. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | N/A | Qualitative information about Japanese disposal requirements |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Japanese Ministry of Environment, (1998). Regulatory measures against air pollutants emitted from factories and business sites and the outline of regulation. |
| **HERO ID:** | 3980945 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Description of release source: | Regulation regarding dust generation from dismantling/reconstruction/repair of a building with sprayed asbestos (p. 2) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Methodology | Medium | The assessment or report uses high quality data and/or techniques or sound methods that are not from a frequently used source and associated information does not indicate flaws or quality issues. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | Medium | The data are from an OECD country other than the U.S. (Japan), and locality-specific factors (e.g., potential differences in regulatory occupational exposure or emission limits, industry/ process technologies) may impact exposures or releases relative to the U.S. |
| | Metric 3: Applicability | Uninformative | The report is for an occupational scenario within the scope of the risk evaluation, however it contains no useable engineering information. |
| | Metric 4: Temporal Representativeness | High | The report captures operations, equipment, and worker activities expected to be representative of current conditions. The report is less than 10 years old. |
| | Metric 5: Sample Size | N/A | n/a - no samples provided |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | Low | Assessment or report provides results, but the underlying methods, data sources, andassumptions are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Low | The report does not address variability or uncertainty. |

## Overall Quality Determination Uninformative

| | |
|---|---|
| **Study Citation:** | Japanese Ministry of Environment, (2007). Technologies to support a sound material-cycle society-Development of 3R and waste management technologies. |
| **HERO ID:** | 3980949 |
| **Conditions of Use:** | Disposal |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Waste treatment methods and pollution control: | Waste treatment methods and pollution control |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | The assessment or report uses high quality data and/or techniques or sound methods that are from frequently used sources and are generally accepted by the scientific community, and associatedinformation does not indicate flaws or quality issues. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Medium | The data are from an OECD country other than the U.S., and locality-specific factors (e.g., potential differences in regulatory occupational exposure or emission limits, industry/ processtechnologies) may impact exposures or releases relative to the U.S. |
| | Metric 3: | Applicability | High | The report is for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | High | The report captures operations, equipment, and worker activities that are expected to be reasonably representative of current conditions. The report is generally more than 10 yearsbut no more than 20 years old. |
| | Metric 5: | Sample Size | N/A | N/a - no sampling data |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | Assessment or report clearly documents its data sources, assessment methods, results, and assumptions. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | The report provides only limited discussion of the variability and uncertainty in the results. |

## Overall Quality Determination — High

| | |
|---|---|
| **Study Citation:** | Jeon, S. J., Jin, B. M., Kim, Y. J. (2012). Assessment of the fire resistance of a nuclear power plant subjected to a large commercial aircraft crash. Nuclear Engineering and Design 247:11-22. |
| **HERO ID:** | 10630490 |
| **Conditions of Use:** | Other: |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Description of release source: | Structure fire at power plant. Generally, irrelevant of structure characteristics, 3 hours, or at most 4 hours, can be taken as sufficient time to take any firefighting action, and is therefore often specified as the fire endurance time required for important structures or structural elements (CEN, 2002; U.S. NRC, 2003). |
| Release frequency: | One day |
| Comments: | Asbestos was not mentioned, but the source can be used for estimating release duration for fire fighting events. |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | The assessment uses high quality data and associated information does not indicate flaws or quality issues. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Medium | The data are from an OECD country other than the U.S. |
| | Metric 3: | Applicability | High | Provides average time to extinguish a structure fire. |
| | Metric 4: | Temporal Representativeness | Medium | The report is generally more than 10 years but no more than 20 years old. |
| | Metric 5: | Sample Size | Medium | Distribution of samples is characterized by a range with uncertain statistics. It is unclear if analysis is representative. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | Assessment or report clearly documents its data sources, assessment methods, results, and assumptions. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | The report does not address variability or uncertainty. |

## Overall Quality Determination — Medium

| | |
|---|---|
| **Study Citation:** | Jung, H. S., Cha, J., Kim, S., Lee, W., Lim, H., Kim, H. (2015). Evaluating the efficiency of an asbestos stabilizer on ceiling tiles and the characteristics of the released asbestos fibers. Journal of Hazardous Materials 300:378-386. |
| **HERO ID:** | 3090049 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Products not Described by Other Codes |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Description of release source: | Ceiling tiles |
| Release or emission factors: | Release or emission factors |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | report uses high quality data |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Medium | The data are from an OECD country other than the U.S |
| | Metric 3: | Applicability | High | The report is for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | High | The report is generally no more than 10 years old. |
| | Metric 5: | Sample Size | Low | Distribution of samples is qualitative or characterized by no statistics, specifically for the release information. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | report clearly documents its data sources |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | The report does not address variability or uncertainty. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Kominsky, J. R., Freyberg, D. W., Brackett, K. A. (1993). Evaluation of Three Cleaning Methods for Removing Asbestos from Carpet: Determination of Airborne Asbestos Concentrations Associated with Each Method. (23):90. |
| **HERO ID:** | 3649689 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Furnishing, Cleaning, Treatment Care Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Description of release source: | ACM being disturbed, damaged, or deteriorating; carpet and furnishings (pg 1) |
| Waste treatment methods and pollution control: | Waste treatment methods and pollution control |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | Report uses high quality data/techniques/methods from frequently-used sources. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for furnishings (carpet), an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: | Sample Size | Medium | Sample distribution characterized by limited statistics (assumed mean) but discrete samples not provided and distribution not fully characterized. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | All data sources, methods, results, and assumptions are clearly documented. Sources are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | High | Uncertainty is addressed by comparing to another study. Variability addressed by testing different carpet cleaning types. |

## Overall Quality Determination — High

| | |
|---|---|
| **Study Citation:** | Kominsky, J. R., Freyberg, R. W., Chesson, J., Cain, W. C., Powers, T. J., Wilmoth, R. C. (1990). Evaluation of two cleaning methods for the removal of asbestos fibers from carpet. American Industrial Hygiene Association Journal 51(9):500-504. |
| **HERO ID:** | 3582814 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Furnishing, Cleaning, Treatment Care Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Description of release source: | Artificially contaminated carpet or carpets in ACM buildings. |
| Waste treatment methods and pollution control: | Waste treatment methods and pollution control |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Methodology | High | Report uses high quality data/techniques/methods from frequently-used sources. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | Data are from the U.S. |
| Metric 3: | Applicability | High | Data are for furnishing, cleaning, and treatment care products, an in-scope occupational scenario. |
| Metric 4: | Temporal Representativeness | Medium | Report is based on data greater than 10 years old but no more than 20 years old and industry conditions that are expected to be representative of current industry conditions. |
| Metric 5: | Sample Size | N/A | Sample size is not applicable to description of release source and disposal methods. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | N/A | Variability and uncertainty are not applicable to description of release source and disposal methods. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Koustas, R. N. (1991). CONTROL OF INCIDENTAL ASBESTOS EXPOSURE AT HAZARDOUS-WASTE SITES. Journal of the Air and Waste Management Association (1990-1992) 41(7):1004-1009. |
| **HERO ID:** | 3584160 |
| **Conditions of Use:** | Disposal |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Waste treatment methods and pollution control: | Waste treatment methods and pollution control |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | Low | The data sources used in the report are not specified. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | The data are from the United States |
| | Metric 3: | Applicability | High | The report is for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Low | The report is more than 20 years old. |
| | Metric 5: | Sample Size | Low | Distribution of samples is qualitative |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Low | Report provides results, but the underlying data sources are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | The report does not address variability or uncertainty. |

## Overall Quality Determination Low

**Study Citation:** Kozakova, L., Kralikova, R., SGEM (2009). POSSIBILITIES OF ASBESTOS WASTES DISPOSAL. 2:599-602.
**HERO ID:** 2578570
**Conditions of Use:** Disposal

**EXTRACTION**

| Parameter | Data |
|---|---|
| Description of release source: | There are two general forms of asbestos: friable and non-friable. Friable asbestos can be crumbled, pulverized or reduced to a powder by hand pressure when dry and is the most dangerous form. Non-friable asbestos cannot easily be pulverized or reduced to a powder. This form of asbestos is damaged to the extent that it can be crumbled or reduced to a powder by hand pressure must be handled and packaged like friable asbestos wastes. Resilient floor tile, roof felts, asphalt tiles, asphalts, mastics and transite roofing shingles, siding and piping are considered non-friable forms of asbestos, unless they are or will be damaged during demolition or renovation activities. In this context large demolitions are realised, frequently unnecessary and a big volume of wastes and dangerous dust is created. These are mainly hazardous wastes that require an adequate disposal. (1/5) |
| Waste treatment methods and pollution control: | Waste treatment methods and pollution control |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Methodology | Medium | Report uses high quality data that are not from frequently-used sources and there are no known quality issues. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | Medium | Data are from the Slovak Republic, an OECD country. |
| Metric 3: | Applicability | High | Data are for disposal of asbestos material, an in-scope occupational scenario. |
| Metric 4: | Temporal Representativeness | Medium | Report is based on data greater than 10 years old but no more than 20 years old and industry conditions that are expected to be representative of current industry conditions. |
| Metric 5: | Sample Size | N/A | N/A - This metric is not applicable to the data being extracted |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Kushner, L. (1988). Environmental projects: Volume 4. Asbestos survey. |
| **HERO ID:** | 6894315 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Description of release source: | (i) Asbestos used in underground piping.(2) Other underground occurrences of asbestos.(3) Asbestos use in gaskets, where equipment would have to bedisassembled to collect a sample.(4) Valve gland packings, sealants, lubricants or similar materialsused in equipment at the GDSCC.(5) Asbestos-wrapped piping and other concealed asbestos materials in walls, where wall materials would require removal or destruction to obtain samples.(6) Asbestos in flooring tiles, felts, or papers, where the integrityof the flooring would be disturbed if samples were taken.7) Asbestos in roofing tiles, felts, or papers, where the integrityof roofing would be disturbed if samples were taken. The secondasbestos survey, however, did include these asbestos uses.(8) Asbestos insulation materials inside of motors, active boilers, or other active equipment. The second asbestos survey, however, did include these asbestos uses.(9) Asbestos in concrete parking curbs or other preformed concrete items. |
| Waste treatment methods and pollution control: | nan |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Methodology | High | The report uses high quality data and techniques that are from frequently used sources. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | The data are from the United States. |
| Metric 3: | Applicability | High | The report is for an occupational scenario within the scope of the risk evaluation. |
| Metric 4: | Temporal Representativeness | Low | 1988- prior to latest PEL and more than 20 years old. |
| Metric 5: | Sample Size | N/A | Samples were not taken for the qualitative data provided. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | High | Assessment or report clearly documents its data sources, assessment methods, results, and assumptions. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Medium | The report provides only limited discussion of the variability and uncertainty in the results. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Lawrence, J., Tosine, H. M., Zimmermann, H. W., Pang, T. W. S. (1975). REMOVAL OF ASBESTOS FIBERS FROM POTABLE WATER BY COAGULATION AND FILTRATION. Water Research 9(4):397-400. |
| **HERO ID:** | 3585186 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Products not Described by Other Codes |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Waste treatment methods and pollution control: | Waste treatment methods and pollution control |
| Comments: | two coagulation/flocculation methods have been optimized for the removal of asbestiformfibres from potable water. |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Methodology | Medium | Report uses high quality data/techniques/methods that are not from frequently-used sources and there are no known quality issues. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | Medium | Data are from Canada, an OECD country. |
| Metric 3: | Applicability | High | Data are for disposal, an in-scope occupational scenario. |
| Metric 4: | Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| Metric 5: | Sample Size | Medium | Sample distribution characterized by limited statistics (assumed mean) but discrete samples not provided and distribution not fully characterized. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Medium | Methods, results, and assumptions are clearly documented, but underlying data sources are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Medium | Variability addressed by evaluating different WWT methods, but uncertainty is not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Lawrence, J., Zimmermann, H. W. (1976). Potable water treatment for some asbestiform minerals: optimization and turbidity data. Water Research 10(3):195-198. |
| **HERO ID:** | 3662078 |
| **Conditions of Use:** | Other: |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Waste treatment methods and pollution control: | Waste treatment methods and pollution control |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | The assessment or report uses high quality data and/or techniques or sound methods that are from frequently used sources. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | US & Canada |
| | Metric 3: | Applicability | High | The report is for an occupational scenario (Asbestos removal from drinking water) within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Low | 1975 - more than 20 years old |
| | Metric 5: | Sample Size | Medium | Distribution of samples is characterized by a range with uncertain statistics. It is unclear if analysis is representative |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Range of dosages were provided |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | Actual dosage graphs provided to help assess variability - but uncertainty was not discussed. |

## Overall Quality Determination — Medium

| | |
|---|---|
| **Study Citation:** | Lazaridis, M., Lazaridis, M. (2011). Indoor Air Pollution. 19:255-304. |
| **HERO ID:** | 2331208 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Description of release source: | The asbestos can be found in old houses where has been used as structural and insulation material for pipes and furnaces. Inaddition has been used for the production of materials for flooring materials, wall and roof materials, materials for thermal insulation, for the gloves production, as well as for electrical applications. |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Methodology | Low | The data, data sources, and/or techniques or methods used in the assessment or report are not specified. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | Low | unknown |
| | Metric 3: Applicability | Low | unknown occupational source - indoors |
| | Metric 4: Temporal Representativeness | Low | unknown though there is a reference for 1999. After PEL (1994) but more than 20 years old. |
| | Metric 5: Sample Size | Low | Distribution of samples is qualitative or characterized by no statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | Low | Assessment or report provides results, but the underlying methods, data sources, and assumptions are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Low | The report does not address variability or uncertainty. |

## Overall Quality Determination — Low

| | |
|---|---|
| **Study Citation:** | Lizanich, S. (1988). Encapsulation attractive alternative to expensive asbestos removal costs. Occupational Health and Safety 57(2):65-66, 69-70. |
| **HERO ID:** | 6867099 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Description of release source: | Asbestos containing materials in buildings, like fireproofing or pipe lagging. (1/4) |
| Waste treatment methods and pollution control: | Waste treatment methods and pollution control |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | Medium | The assessment or report uses high quality data and/or techniques or sound methods that are not from a frequently used source and associated information does not indicate flaws or quality issues. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | The data are from the United States and are representative of the industry being evaluated. |
| | Metric 3: | Applicability | High | The report is for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Low | The report is more than 20 years old. |
| | Metric 5: | Sample Size | N/A | No sample data. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Assessment or report clearly documents results, methods, and assumptions. Data sources are generally described but not fully transparent. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | N/A | No scope to address variability and uncertainty. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Manes, M., Rush, D. (2022). A comprehensive investigation of the impacts of discovery time and fire brigade response time on life safety and property protection in England. |
| **HERO ID:** | 10630488 |
| **Conditions of Use:** | Other: |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Description of release source: | Structure fires, response times for fire fighting teams range from 7.1 - 8.27 minutes. |
| Release frequency: | One day |
| Comments: | Asbestos was not mentioned, but the source can be used for estimating release duration for fire fighting events. |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | Reported fire fighting response times do not indicate any flaws and are expected to be accurate. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Medium | The data are from an OECD country other than the U.S. |
| | Metric 3: | Applicability | High | Fire fighting response time is directly applicable to estimation of release duration during fires. |
| | Metric 4: | Temporal Representativeness | High | Data are generally no more than 10 years old. |
| | Metric 5: | Sample Size | High | Sample data used to arrive at average response times for fires is provided. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | Assessment or report clearly documents its data sources, assessment methods, results, and assumptions. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | High | The report addresses variability and uncertainty in the results. Uncertainty is well characterized. |

## Overall Quality Determination — High

**Study Citation:** Manville Serv Corp, (1981). Asbestos baghouse collector sampling Manville Plant [878211131].
**HERO ID:** 4158185
**Conditions of Use:** Other:

**EXTRACTION**

| Parameter | Data |
|---|---|
| Waste treatment methods and pollution control: | Waste treatment methods and pollution control |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | Low | Report does not specify the methods used. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | Uninformative | The condition of use is unknown. |
| | Metric 4: | Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: | Sample Size | N/A | N/A - This metric is not applicable to the data being extracted |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Methods, results, and assumptions are clearly documented, but underlying data sources are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Uninformative

**Study Citation:** Manville Serv Corp, (1982). Asbestos baghouse collector sampling Nashua Plant - October 11, 1982 [878212081].
**HERO ID:** 4158188
**Conditions of Use:** Other:

**EXTRACTION**

| Parameter | Data |
|---|---|
| Waste treatment methods and pollution control: | Waste treatment methods and pollution control |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | Low | Report does not specify the methods used. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | Uninformative | The condition of use is unknown. |
| | Metric 4: | Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: | Sample Size | N/A | N/A - This metric is not applicable to the data being extracted |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Methods, results, and assumptions are clearly documented, but underlying data sources are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination — Uninformative

**Study Citation:** Manville Serv Corp, (1980). Asbstos baghouse collector sampling - Manville Plant [878211136].
**HERO ID:** 4158201
**Conditions of Use:** Other:

**EXTRACTION**

| Parameter | Data |
|---|---|
| Waste treatment methods and pollution control: | Waste treatment methods and pollution control |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | Medium | Report uses high quality data/techniques/methods that are not from frequently-used sources and there are no known quality issues. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | Low | Data are for asbestos product MFG, a non-legacy use, but may still be informative for other COU. |
| | Metric 4: | Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: | Sample Size | N/A | not quantitative data |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | McManus, K. P. (1981). Health hazard evaluation report no. HETA 81-309-936, US Air Force Recruiting Station, Bridgeport, Connecticut. |
| **HERO ID:** | 3970484 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Description of release source: | Friable insulation material. [PDF Pg. 3] |
| Waste treatment methods and pollution control: | Waste treatment methods and pollution control |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | Report uses high quality data/techniques/methods from frequently-used sources. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for Chemical Substances in Construction, Paint, Electrical, and Metal Products, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: | Sample Size | N/A | N/A - description of release source and pollution control. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | N/A | N/A - description of release source and pollution control. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Mesothelioma Cancer Alliance, (2018). A lurking danger: Proper disposal of residual asbestos critical to preventing disease. Solid Waste & Recycling 23(2):25. |
| **HERO ID:** | 6886507 |
| **Conditions of Use:** | Disposal |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Waste treatment methods and pollution control: | Waste treatment methods and pollution control |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | Medium | Report uses high quality data that are not from frequently-used sources and there are no known quality issues. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Medium | Data are from Canada, an OECD country. |
| | Metric 3: | Applicability | High | Data are for disposal of asbestos products, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | High | Data are no more than 10 years old. |
| | Metric 5: | Sample Size | N/A | N/A - This metric is not applicable to the data being extracted |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Low | Assessment results are provided but underlying methods, assumptions, and data sources are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Michiels, P. (2013). Dismantling the nuclear research reactor Thetis. :V002T03A032. |
| **HERO ID:** | 6870302 |
| **Conditions of Use:** | Disposal |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Description of release source: | Dismantling of a decommissioned nuclear reactor. |
| Waste treatment methods and pollution control: | Waste treatment methods and pollution control |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Methodology | High | Report uses high quality data/techniques/methods from frequently-used sources. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | Medium | Data are from Belgium, an OECD country. |
| Metric 3: | Applicability | High | Data are for disposal, an in-scope occupational scenario. |
| Metric 4: | Temporal Representativeness | High | Report is based on current industry conditions and data no more than 10 years old. |
| Metric 5: | Sample Size | N/A | N/A - Release source and pollution control methods. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | N/A | N/A - Release source and pollution control methods. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Mimides, T. M., Aggelides, S. M., Kaplanides, A. C. (1997). Refuse disposal of asbestos and other mineral fibres and environmental health hazards. 1-3:2011-2015. |
| **HERO ID:** | 3086854 |
| **Conditions of Use:** | Disposal |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Description of release source: | Wastes normally arise from lagging wastes, power stations, dock yards, hospitals, and schools. Materials containing asbestos may also be in wastes from demolition of locomotives, old water pipes, and buildings. (4/5) |
| Waste treatment methods and pollution control: | Waste treatment methods and pollution control |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Methodology | Medium | Report uses high quality data that are not from frequently-used sources and there are no known quality issues. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | Medium | Data are from Greece, an OECD country. |
| Metric 3: | Applicability | High | Data are for disposal of asbestos products, an in-scope occupational scenario. |
| Metric 4: | Temporal Representativeness | Medium | Report is based on data greater than 10 years old but no more than 20 years old and industry conditions that are expected to be representative of current industry conditions. |
| Metric 5: | Sample Size | N/A | N/A - This metric is not applicable to the data being extracted |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Medium

**Study Citation:** Montana Pollution Prevention Program, (1998). Pollution prevention reference guide for Montano residential construction.
**HERO ID:** 3981090
**Conditions of Use:** Disposal

**EXTRACTION**

| Parameter | Data |
|---|---|
| Description of release source: | Surfacing material sprayed or troweled on ceilings and walls, insulation around pipes, boilers, ducts, and tanks, and miscellaneous materials such as wallboard or floor tiles (13/178) |
| Waste treatment methods and pollution control: | Waste treatment methods and pollution control |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Methodology | Medium | Report uses high quality data that are not from frequently-used sources and there are no known quality issues. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | Data are from the U.S. |
| Metric 3: | Applicability | High | Data are for disposal of asbestos products, an in-scope occupational scenario. |
| Metric 4: | Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| Metric 5: | Sample Size | N/A | N/A - This metric is not applicable to the data being extracted |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Medium | Methods, results, and assumptions are clearly documented, but underlying data sources are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | (2017). Pollution prevention search results, envirofacts database. |
| **HERO ID:** | 3860453 |
| **Conditions of Use:** | Disposal |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Description of release source: | The first three sources:Source 1: GENERAL PARTS CO - RAYLOC (GENUINE PARTS CO), 700 N 500 E, PAYSON, UT 84651Asbestos (Friable) 336340: Motor Vehicle Brake System ManufacturingSource 2: AGRIUM US INC (AGRIUM INC), 201 FM RD 1551, BORGER, TX 79007Asbestos (Friable) 325311: Nitrogenous Fertilizer ManufacturingSource 3: AMERICAS STYRENICS LLC (AMERICAS STYRENICS LLC) 9901 HWY 18, SAINT JAMES, LA 70086. Asbestos (Friable) 325110: Petrochemical ManufacturingOther sources are 325181: Alkalies and Chlorine Manufacturing; 562211: Hazardous Waste Treatment and Disposal; 325311: Nitrogenous Fertilizer Manufacturing; 336340: Motor Vehicle Brake System Manufacturing; 325188: All Other Basic Inorganic Chemical Manufacturing; 324110: Petroleum Refineries; 325212: Synthetic Rubber Manufacturing; 562998: All Other Miscellaneous Waste; |
| Release quantity: | The first three sources:For Source 1 - Prior Year Release: In 2011 - 141,980.00For Source 2 - Prior Year Release: In 2013 - 1,100.00For Source 3 - Prior Year Release: In 2011 - 374.00 |
| Waste treatment methods and pollution control: | Waste treatment methods and pollution control |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Methodology | High | report uses high quality data |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | The data are from the United States |
| Metric 3: | Applicability | High | The report is for an occupational scenario within the scope of the risk evaluation. |
| Metric 4: | Temporal Representativeness | Medium | The report is generally more than 10 years but no more than 20 years old. |
| Metric 5: | Sample Size | Low | Distribution of samples is characterized by no statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Medium | Data sources are generally described but not fully transparent. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Low | The report does not address variability or uncertainty. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | NICNAS, (1999). Chrysotile asbestos: priority exisiting chemical no. 9. |
| **HERO ID:** | 3978350 |
| **Conditions of Use:** | Other: |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Description of release source: | In Australia, raw chrysotile emissions/release may arise from the manufacture of CAF sheets for production of gaskets and the manufacture of 'non-sag' epoxy resin.Raw chrysotile is used in Australia in the manufacture of CAF sheeting for gasket production (carried out by Richard Klinger Pty Ltd). Manufacturing of the raw material is carried out in Perth, while gasket processing (e.g. cutting) is performed at both Perth and Melbourne factories. Richard Klinger estimates that a maximum of 600 tonnes of CAF (510 tonnes of chrysotile) is produced in any one year. The volume of waste generated and sent to landfill is estimated at 35 tonnes per year, with an additional 30 tonnes recycled within the processing plant. Further, the plant's dust extraction system collects approximately 25 kg of general dust per week, of which a fraction is asbestos fibre, all of which is then recycled through the system. |
| Waste treatment methods and pollution control: | nan |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Methodology | High | Australian National Industrial Chemicals Notification and Assessment Scheme |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | Medium | Australia - OECD member |
| Metric 3: | Applicability | Uninformative | The data are for an occupational scenario (gasket manufacture) that is not within scope of the legacy asbestos risk evaluation. |
| Metric 4: | Temporal Representativeness | Low | 1999 more than 20 years old |
| Metric 5: | Sample Size | N/A | Qualitative information provided about release sources and disposal |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | High | Report clearly documents its data sources, assessment methods, results, and assumptions. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | N/A | Qualitative information provided about release sources and disposal |

## Overall Quality Determination — Uninformative

| | |
|---|---|
| **Study Citation:** | NIOSH, (2019). One fire fighter dies and one fire fighter burned during firefighting operations at a grass fire - Texas. |
| **HERO ID:** | 10630452 |
| **Conditions of Use:** | Other: |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Description of release source: | Grass fire, approximately 9 minute response time from fire fighting team |
| Release frequency: | One day |
| Comments: | Asbestos was not mentioned, but the source can be used for estimating release duration for fire fighting events. |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | Reported fire fighting response times do not indicate any flaws and are expected to be accurate. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from United States. |
| | Metric 3: | Applicability | High | Fire fighting response time is directly applicable to estimation of release duration during fires. |
| | Metric 4: | Temporal Representativeness | High | The report is generally no more than 10 years old. |
| | Metric 5: | Sample Size | N/A | Sample size is not applicable to the data extracted. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | Assessment or report clearly documents its data sources, assessment methods, results, and assumptions. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | The report provides only limited discussion of the variability and uncertainty in the results. |

## Overall Quality Determination — High

| | |
|---|---|
| **Study Citation:** | NIOSH, (2001). Volunteer fire fighter dies and another fire fighter is injured during wall collapse at fire at local business - Wisconsin. |
| **HERO ID:** | 10630473 |
| **Conditions of Use:** | Other: |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Description of release source: | Structure fire, approximately 10 minute response time from fire fighting team |
| Release frequency: | One day |
| Comments: | Asbestos was not mentioned, but the source can be used for estimating release duration for fire fighting events. |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | Reported fire fighting response times do not indicate any flaws and are expected to be accurate. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from United States. |
| | Metric 3: | Applicability | High | Fire fighting response time is directly applicable to estimation of release duration during fires. |
| | Metric 4: | Temporal Representativeness | Medium | Report is from an incident that occurred in 2001. |
| | Metric 5: | Sample Size | N/A | Sample size is not applicable to the data extracted. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | Assessment or report clearly documents its data sources, assessment methods, results, and assumptions. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | The report provides only limited discussion of the variability and uncertainty in the results. |

## Overall Quality Determination — High

| | |
|---|---|
| **Study Citation:** | NIOSH, (2022). Career captain and career firefighter die after running out of air during a search in a public library – California. |
| **HERO ID:** | 10630494 |
| **Conditions of Use:** | Other: |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Description of release source: | Structure fire, approximately 2 minute response time from fire fighting team |
| Release frequency: | One day |
| Comments: | Asbestos was not mentioned, but the source can be used for estimating release duration for fire fighting events. |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | Reported fire fighting response times do not indicate any flaws and are expected to be accurate. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from United States. |
| | Metric 3: | Applicability | High | Fire fighting response time is directly applicable to estimation of release duration during fires. |
| | Metric 4: | Temporal Representativeness | High | Report is from an incident that occurred in 2020. |
| | Metric 5: | Sample Size | N/A | Sample size is not applicable to the data extracted. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | Assessment or report clearly documents its data sources, assessment methods, results, and assumptions. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | The report provides only limited discussion of the variability and uncertainty in the results. |

## Overall Quality Determination — High

| | |
|---|---|
| **Study Citation:** | NIOSH, (2018). Volunteer assistant chief killed and one fire fighter injured by roof collapse in a commercial storage building - Indiana. |
| **HERO ID:** | 10630496 |
| **Conditions of Use:** | Other: |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Description of release source: | Structure fire, approximately 6 minute response time from fire fighting team |
| Release frequency: | One day |
| Comments: | Asbestos was not mentioned, but the source can be used for estimating release duration for fire fighting events. |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | Reported fire fighting response times do not indicate any flaws and are expected to be accurate. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from United States. |
| | Metric 3: | Applicability | High | Fire fighting response time is directly applicable to estimation of release duration during fires. |
| | Metric 4: | Temporal Representativeness | High | The report is generally no more than 10 years old. |
| | Metric 5: | Sample Size | N/A | Sample size is not applicable to the data extracted. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | Assessment or report clearly documents its data sources, assessment methods, results, and assumptions. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | The report provides only limited discussion of the variability and uncertainty in the results. |

## Overall Quality Determination — High

| | |
|---|---|
| **Study Citation:** | NIOSH, (2017). Career female fire fighter dies after becoming lost and running out of air in a residential structure fire - Pennsylvania. |
| **HERO ID:** | 10630507 |
| **Conditions of Use:** | Other: |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Description of release source: | Structure fire, approximately 4 minute response time from fire fighting team |
| Release frequency: | One day |
| Comments: | Asbestos was not mentioned, but the source can be used for estimating release duration for fire fighting events. |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | Reported fire fighting response times do not indicate any flaws and are expected to be accurate. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from United States. |
| | Metric 3: | Applicability | High | Fire fighting response time is directly applicable to estimation of release duration during fires. |
| | Metric 4: | Temporal Representativeness | High | The report is generally no more than 10 years old. |
| | Metric 5: | Sample Size | N/A | Sample size is not applicable to the data extracted. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | Assessment or report clearly documents its data sources, assessment methods, results, and assumptions. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | The report provides only limited discussion of the variability and uncertainty in the results. |

## Overall Quality Determination — High

| | |
|---|---|
| **Study Citation:** | NIOSH, (2022). Career lieutenant dies and four firefighters injured at a 3-story multi-family residential occupancy – Massachusetts. |
| **HERO ID:** | 10630526 |
| **Conditions of Use:** | Other: |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Description of release source: | Structure fire, approximately 2 minute response time from fire fighting team |
| Release frequency: | One day |
| Comments: | Asbestos was not mentioned, but the source can be used for estimating release duration for fire fighting events. |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Methodology | High | Reported fire fighting response times do not indicate any flaws and are expected to be accurate. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | Data are from United States. |
| Metric 3: | Applicability | High | Fire fighting response time is directly applicable to estimation of release duration during fires. |
| Metric 4: | Temporal Representativeness | High | The report is generally no more than 10 years old. |
| Metric 5: | Sample Size | N/A | Sample size is not applicable to the data extracted. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | High | Assessment or report clearly documents its data sources, assessment methods, results, and assumptions. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Medium | The report provides only limited discussion of the variability and uncertainty in the results. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | OECD, (2009). Emission scenario documents on coating industry (paints, lacquers and varnishes). |
| **HERO ID:** | 3827298 |
| **Conditions of Use:** | Disposal |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Description of release source: | Emissions occurring during process operations can be classified into the following categories:• Material loading emissions.• Heat-up losses.• Surface evaporation.• Filling losses.Main emissions to the air are expected to come from VOCs such as solvents. VOCs may be emitted during loading operations, or if the contents of mixers, dispersers or mills are exposed to the atmosphere. They may be emitted through the agitator shaft openings or around the edges of the vessel lids.Water used in the manufacturing process of the coatings, remains in the coatings formulation.The only origin of releases to water are cleaning operations.Several emission routes to soil are possible.• Deposition of dust particles in the workshop or outside the facility, if they are emitted via the exhaust system.• Adsorption of released substances onto particles in the air and following deposition.• Land spreading of sludge from sewage treatment works handling discharges from industrial sources.• Incineration of waste and deposition on soil of substances in flue gases. (pg 47-49) |
| Release or emission factors: | Release or emission factors |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Methodology | High | report uses high quality data |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | Medium | The data are from an OECD country |
| Metric 3: | Applicability | High | The report is for an occupational scenario within the scope of the risk evaluation. |
| Metric 4: | Temporal Representativeness | Medium | The report is generally more than 10 years but no more than 20 years old. |
| Metric 5: | Sample Size | Low | Distribution of samples is characterized by no statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Medium | Data sources are generally described but not fully transparent. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Low | The report does not address variability or uncertainty. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | OECD, (2009). Emission scenario document on adhesive formulation. |
| **HERO ID:** | 3827299 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Products not Described by Other Codes |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Description of release source: | Release sources associated with different processes: (1) Sealed mixing/transfer – Unloading from Tank Cars, Totes, Drums, or Sacks; Mixing (Room Temperature); Packaging or On-site storage. (Figure 2.1 on pg 26 of 168) (2) Unsealed Mixing/Transfer - Unloading from Tank Cars, Totes, Drums, or Sacks; Mixing (Room Temperature); Packaging or On-site storage. (Figure 2.2 on pg 28 of 168) (3) Heated Mixing/Transfer – Unloading from Drums or Sacks, Heated Mixing (<200 degC); Cooling (Injection Molding or Extrusion); Packaging or Forming of Hot Molten Product. (Figure 2.3 on 30 of 168) |
| Release quantity: | Section 4 of the ESD presents the environmental release assessment, which uses the general facility estimates to estimate of the quantity of chemical released from various points in the adhesive formulation process. Equations have been provided to determine the release amount for any facility. |
| Release or emission factors: | Release or emission factors |
| Release frequency: | As indicated in pg 65 of 168 (Table 4.2), the frequency of release during container cleaning is equal to the lesser of N(cont_empty_site_yr) or TIME(working_days,). Similar values are also indicated for other process operations. |
| Waste treatment methods and pollution control: | Waste treatment methods and pollution control |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Methodology | High | report uses high quality data |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | The data are from the United States |
| Metric 3: | Applicability | High | The report is for an occupational scenario |
| Metric 4: | Temporal Representativeness | Medium | The report is generally more than 10 years but no more than 20 years old. |
| Metric 5: | Sample Size | Low | Distribution of samples is characterized by no statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | High | report clearly documents its data sources |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | High | The report addresses variability and uncertainty in the results. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Oliver, L. C. (1998). Asbestos in building: Management and related health effects. Journal of Clean Technology, Environmental Toxicology, and Occupational Medicine 7(4):433-443. |
| **HERO ID:** | 3092160 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Description of release source: | friable asbestos through attrition (e.g., water damage) and airflow or the result of impact/disturbance (e.g., maintenance and repair work on insulated pipes and boiler); sanding asbestos-containing vinyl floor tile (nonfriable) (pg 3) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | Medium | Report uses high quality data/techniques/methods that are not from frequently-used sources and there are no known quality issues. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for construction materials, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: | Sample Size | N/A | description or release source data. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Methods, results, and assumptions are clearly documented, but underlying data sources are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | Variability addressed by describing releases for both friable and non-friable asbestos, but uncertainty is not addressed. |

## Overall Quality Determination Medium

**Study Citation:** OSHA, (2017). Substance and technical information for asbestos - Non-mandatory.
**HERO ID:** 3978183
**Conditions of Use:** Disposal

**EXTRACTION**

| Parameter | Data |
|---|---|
| Description of release source: | Waste includes:1. Empty asbestos shipping containers.2. Process wastes such as cuttings, trimmings, or reject materials.3. Housekeeping waste from wet-sweeping or HEPA-vacuuming.4. Asbestos fireproofing or insulating material that is removed from buildings.5. Asbestos-containing building products removed during building renovation or demolition.6. Contaminated disposable protective clothing. |
| Waste treatment methods and pollution control: | nan |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Methodology | High | The assessment or report uses high quality data and/or techniques or sound methods that are from frequently used sources (Department of Labor) and are generally accepted by the scientific community, and associated information does not indicate flaws or quality issues. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | The data are from the United States and are representative of the industry being evaluated. |
| Metric 3: | Applicability | High | The report is for an occupational scenario within the scope of the risk evaluation. |
| Metric 4: | Temporal Representativeness | Low | The report is more than 20 years old. The report captures operations, equipment, and worker activities that are expected to be outdated. |
| Metric 5: | Sample Size | N/A | n/a - no sampling data |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | High | Assessment or report clearly documents its data sources, assessment methods, results, and assumptions. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Low | The report does not address variability or uncertainty. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Ottaviani, M., Marconi, A., Magnatti, P. (1986). Asbestos Fiber Removal During Effluent Wastewater Treatment. Pilot Plant Evaluation. Studies in Environmental Science 29:335-343. |
| **HERO ID:** | 6899950 |
| **Conditions of Use:** | Disposal |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Waste treatment methods and pollution control: | Waste treatment methods and pollution control |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | Medium | Report uses high quality data that are not from frequently-used sources and there are no known quality issues. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Medium | Data are from Italy, an OECD country, |
| | Metric 3: | Applicability | High | Data are for disposal of asbestos material, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Data are greater than 20 years old. |
| | Metric 5: | Sample Size | Medium | Sample distribution characterized by limited statistics (concentrations, graph points) but discrete samples not provided and distribution not fully characterized. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | Uncertainty is addressed by mentioning contaminating factors in the study. Variability wasn't addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Paglietti, F., Malinconico, S., Di Molfetta, V., Bellagamba, S., Damiani, F., Gennari, F., De Simone, P., Sallusti, F., Giangrasso, M. (2012). Asbestos risk: From raw material to waste management: The Italian experience. Critical Reviews in Environmental Science and Technology 42(17):1781-1861. |
| **HERO ID:** | 3582178 |
| **Conditions of Use:** | Disposal |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Waste treatment methods and pollution control: | Waste treatment methods and pollution control |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | The assessment or report uses high quality data and/or techniques or sound methods that are from frequently used sources (e.g., European Union |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Medium | Italy - OECD member |
| | Metric 3: | Applicability | High | The report is for an occupational scenario (superfund site remediation) within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | High | 2012 - 10 years old |
| | Metric 5: | Sample Size | N/A | Qualitative information provided about treatment options |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | Assessment or report clearly documents its data sources, assessment methods, results, and assumptions. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | N/A | Qualitative information provided about treatment options |

## Overall Quality Determination — High

| | |
|---|---|
| **Study Citation:** | Paolini, V., Tomassetti, L., Segreto, M., Borin, D., Liotta, F., Torre, M., Petracchini, F. (2019). Asbestos treatment technologies. Journal of Material Cycles and Waste Management 21(2):205-226. |
| **HERO ID:** | 6861615 |
| **Conditions of Use:** | Disposal |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Waste treatment methods and pollution control: | Waste treatment methods and pollution control |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | report uses high quality data |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Medium | The data are from an OECD country other than the U.S., |
| | Metric 3: | Applicability | High | The report is for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | High | The report is generally no more than 10 years old. |
| | Metric 5: | Sample Size | N/A | N/A - This metric is not applicable to the data being extracted |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | report clearly documents its data sources |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | The report does not address variability or uncertainty. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Piper, S., Grant, M. (1986). NESHAPs (National Emissions Standards for Hazardous Air Pollutants) asbestos demolition and renovation inspection workshop manual. |
| **HERO ID:** | 6901133 |
| **Conditions of Use:** | Disposal |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Description of release source: | Asbestos mills;• Surfacing of roadways with asbestos-containing material;• Manufacture of products using commercial asbestos;• The demolition and/or renovation of buildings, structures,installations that contain friable asbestos material;• Restriction on the spraying of asbestos-containing materials;• Fabrication of certain asbestos-containing products;• Restriction on the use of insulating materials;• Waste disposal at asbestos mills;• Disposal of asbestos-containing waste generated duringmanufacturing, demolition, renovation, spraying, and fabricationoperations;• Closure of inactive waste disposal sites on plant property at mills,manufacturing, and fabricating sources; and• Active waste disposal sites. |
| Waste treatment methods and pollution control: | Waste treatment methods and pollution control |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Methodology | High | EPA study |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | US |
| Metric 3: | Applicability | High | The report is for an occupational scenario (Asbestos remediation) within the scope of the risk evaluation. |
| Metric 4: | Temporal Representativeness | Low | 1984 - prior to the most recent PEL and more than 20 years old. |
| Metric 5: | Sample Size | N/A | Qualitative information provided |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | High | Assessment or report clearly documents its data sources, assessment methods, results, and assumptions. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | N/A | Qualitative information provided |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Quaranta, N., Caligaris, M., Lopez, H., Unsen, M. (2010). Working scheme for safe management of construction and demolition wastes containing hazardous substances. WIT Transactions on Ecology and the Environment 129:521-532. |
| **HERO ID:** | 6773679 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Description of release source: | The demolition, repair or alteration of buildings located in an urban environment is characterized by the generation of a significant volume of residues, which are usually known as “debris”. |
| Waste treatment methods and pollution control: | Waste treatment methods and pollution control |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | Medium | The data, data sources, and/or techniques or methods used in the assessment or report are not specified. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Low | The data are from a non-OECD country. Argentina. |
| | Metric 3: | Applicability | High | The report is for an occupational scenario within the scope of the risk evaluation. Demolition. |
| | Metric 4: | Temporal Representativeness | Medium | The report is more than 10 years but no more than 20 years old. |
| | Metric 5: | Sample Size | Low | Distribution of samples is qualitative or characterized by no statistics. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Low | Assessment or report provides results, but the underlying methods, data sources, and assumptions are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | The report does not address variability or uncertainty. |

## Overall Quality Determination — Low

| | |
|---|---|
| **Study Citation:** | Radia, J. (1986). What are the solutions to asbestos removal?. American City & County 101(5):81. |
| **HERO ID:** | 3100907 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Description of release source: | pipe insulation, boiler insulation, sprayed ceilings |
| Waste treatment methods and pollution control: | Waste treatment methods and pollution control |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | Low | The assessment or report uses data or techniques or methods that are not consistent with the best available science. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | US |
| | Metric 3: | Applicability | High | The report is for an occupational scenario (exposure to building materials that contain asbestos) within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Low | 1986 Prior to the PEL and more than 20 years old |
| | Metric 5: | Sample Size | N/A | NA qualitative discussion of asbestos mitigation |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Low | The underlying methods, data sources, and assumptions are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | N/A | NA qualitative discussion of asbestos mitigation |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Raghuwanshi, R. (2017). A comparative analysis between demolition and deconstruction. :16-24. |
| **HERO ID:** | 10630633 |
| **Conditions of Use:** | Other: |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Description of release source: | Deconstruction and demolition of structures |
| Release frequency: | 7.4 days for deconstruction of structure and demolition takes 1/3-1/5 of that time (~1.85 days) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | The assessment uses high quality data and associated information does not indicate flaws or quality issues. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | The data are from the United States and are representative of the industry being evaluated. |
| | Metric 3: | Applicability | High | The report is for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | High | The report is generally no more than 10 years old. |
| | Metric 5: | Sample Size | Medium | Distribution of samples is characterized by a range with uncertain statistics. It is unclear if analysis is representative. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | Assessment or report clearly documents its data sources, assessment methods, results, and assumptions. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | The report provides only limited discussion of the variability and uncertainty in the results. |

## Overall Quality Determination — High

**Study Citation:** Reid, R. (1987). Asbestos in the building? – Examine these options. Occupational Hazards 49(7):39-43.
**HERO ID:** 3100909
**Conditions of Use:** Disposal

**EXTRACTION**

| Parameter | Data |
|---|---|
| Description of release source: | Asbestos abatement and removal from buildings or structures. |
| Waste treatment methods and pollution control: | Waste treatment methods and pollution control |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | Medium | The assessment or report uses high quality data and/or techniques or sound methods that are not from a frequently used source and associated information does not indicate flaws or quality issues. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | The data are from the United States and are representative of the industry being evaluated. |
| | Metric 3: | Applicability | High | The report is for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Low | The report is more than 20 years old. |
| | Metric 5: | Sample Size | N/A | Sample size is not relevant to the qualitative data provided. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Low | Assessment or report provides results, but the underlying methods, data sources, and assumptions are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | N/A | No scope to address variability and uncertainty. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Reis, C. M., Oliveira, C., Novais, S., Silva, P. (2016). Asbestos application in construction. 4:555-559. |
| **HERO ID:** | 6864351 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Description of release source: | Construction materials containing asbestos. |
| Waste treatment methods and pollution control: | Waste treatment methods and pollution control |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | Report uses high quality data/techniques/methods from frequently-used sources. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Medium | Data are from Portugal, an OECD country. |
| | Metric 3: | Applicability | High | Data are for Chemical Substances in Construction, Paint, Electrical, and Metal Products, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | High | Report is based on current industry conditions and data no more than 10 years old. |
| | Metric 5: | Sample Size | N/A | N/A - no sample data. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | N/A | N/A - no sample data. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Reitze, W. B., Holaday, D. A., Romer, H., Fenner, E. M. (1971). Control of asbestos fiber emissions from industrial and commercial sources. :100-103. |
| **HERO ID:** | 6925897 |
| **Conditions of Use:** | Other: |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Description of release source: | Open pit mining (pg 1):drillingblastingshovelinghandling roadwayswaste disposalMilling (pg 2):crushingore dryingmillingclassification air separationpackaging-solid waste disposalMFG (pg 2):carding, willowingweaving, spinning, twistingbag opening/emptying/disposal, bins, bobbins, spools |
| Waste treatment methods and pollution control: | Waste treatment methods and pollution control |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Methodology | Medium | Report uses high quality data/techniques/methods that are not from frequently-used sources and there are no known quality issues. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | Data are from the U.S. |
| Metric 3: | Applicability | Low | Data are for upstream, out-of-scope scenarios, but data may still be informative. |
| Metric 4: | Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| Metric 5: | Sample Size | N/A | qualitative data |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Medium | Methods, results, and assumptions are clearly documented, but underlying data sources are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Medium | Variability addressed by discussing varying control technologies but uncertainty is not addressed. |

## Overall Quality Determination — Medium

**Study Citation:** Reitze, W. B., Holaday, D. A., Romer, H., Fenner, E. M. (1971). Control of asbestos fiber emissions from industrial and commercial sources. :100-103.
**HERO ID:** 6925897
**Conditions of Use:** Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products

**EXTRACTION**

| Parameter | Data |
|---|---|
| Description of release source: | Asbestos cement (pg 2):dry and/or wet mix: bag opening/dumping/disposalpressing wet stock; moulding/forming wet furnishdrying and curingfinishing: cutting, grinding, sawing, planing, routingpackaging and shipping: bagging, boxingwarehousing raw material or finish productAsbestos containing building materials (pg 3):cutting calcium silicate products (pipe covering, block) with hand saw or band saw/table saw/saber sawdry mixing asbestos cementcutting cement products (tightly bound pipe board) with bandsaw, rotary sawsolid waste disposal: scrap from cutting and fitting of pipe covering, and block discarded asbestos cement; demolitionspray application |
| Waste treatment methods and pollution control: | Waste treatment methods and pollution control |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Methodology | Medium | Report uses high quality data/techniques/methods that are not from frequently-used sources and there are no known quality issues. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | Data are from the U.S. |
| Metric 3: | Applicability | High | Data are for construction materials, an in-scope occupational scenario. |
| Metric 4: | Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| Metric 5: | Sample Size | N/A | qualitative data |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Medium | Methods, results, and assumptions are clearly documented, but underlying data sources are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Medium | Variability addressed by discussing various control technologies but uncertainty is not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Reitze, W. B., Nicholson, W. J., Holaday, D. A., Selikoff, I. J. (1972). Application of sprayed inorganic fiber containing asbestos: occupational health hazards. American Industrial Hygiene Association Journal 33(3):178-191. |
| **HERO ID:** | 3084810 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Description of release source: | "Since most of the spraying is done before the building curtain walls are erected, some of the spray material may blow outside the site. The quantity that escapes depends on wind, height of building, skill of operator, material, and control measures used. Construction sites have been studied where grossly visible waste from a spray application covered the ground to a depth of 1 inch for a distance extending 100 feet from the site" (pg 8) |
| Waste treatment methods and pollution control: | nan |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Methodology | Medium | Report uses high quality information that are not from frequently-used sources and there are no known quality issues. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | Data are from the U.S. |
| Metric 3: | Applicability | High | Data are for asbestos use in the construction industry, an in-scope occupational scenario. |
| Metric 4: | Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| Metric 5: | Sample Size | Low | Distribution of samples is qualitative or characterized by no statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Medium | Methods, results, and assumptions are clearly documented, but underlying data sources are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Ryckman, M. D., Ryckman, D. W., Peters, J. L. (1983). ASBESTOS CONTROL PROGRAM FOR INSTITUTIONAL FACILITIES. Journal of Environmental Engineering 109(2):275-288. |
| **HERO ID:** | 3584930 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Description of release source: | Asbestos in ceiling material can be released from air movement, vibration, water damage, matrix deterioration, accidental impact, renovations, vandalism, and maintenance. (3/14) |
| Waste treatment methods and pollution control: | Waste treatment methods and pollution control |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Methodology | High | Report uses high quality methods and data from frequently-used sources. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | Data are from the U.S. |
| Metric 3: | Applicability | High | Data are for commercial use in building construction materials, an in-scope occupational scenario. |
| Metric 4: | Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| Metric 5: | Sample Size | N/A | N/A - This metric is not applicable to the data being extracted |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Medium | Methods, results, and assumptions are clearly documented, but underlying data sources are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Safety Health Environment International Consultants, (1994). Support: the asabestos exposure of workers in the Manville Diatomaceous Earth Plant also involved in cohort mortality study of diatomite industry with cover letter dated 121694. |
| **HERO ID:** | 3653704 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Description of release source: | mortar plantExperimental plantMixing plantBaghouses |
| Comments: | The intent of this study is to take a close look at those who may have been exposed to asbestos and should be removed from a separate study investigating silica-lung cancer mortality rates. The detailed assessment identified that a larger portion of the workforce at this site were exposed to Asbestos. the plan being investigated stopped handling asbestos in 1977. Note this is a recreated assessment of earlier exposure (1920-1940 and 1951-1977) and may not be representative of today |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Methodology | Medium | The assessment or report uses high quality data and/or techniques |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | US |
| Metric 3: | Applicability | High | The report is for an occupational scenario ( manufacture of asbestos containing building supplies) within the scope of the risk evaluation. |
| Metric 4: | Temporal Representativeness | Low | 1993 - more than 20 years old |
| Metric 5: | Sample Size | N/A | Qualitative information provided |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | High | Assessment or report clearly documents its data sources, assessment methods, results, and assumptions. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | N/A | Qualitative information provided |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Schempf, H., Mutschler, E., Chemel, B., Boehmke, S., Piepgras, C., Crowley, W. (1998). A robotic pipe-asbestos insulation removal system. Industrial Robot 25(3):196-204. |
| **HERO ID:** | 3583495 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Description of release source: | abatement activities |
| Waste treatment methods and pollution control: | Waste treatment methods and pollution control |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | Medium | The assessment or report uses high quality data and/or techniques or sound methods that are not from a frequently used source and associated information does not indicate flaws or quality issues. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | The data are from the United States and are representative of the industry being evaluated. |
| | Metric 3: | Applicability | High | The report is for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Low | The report is more than 20 years old. |
| | Metric 5: | Sample Size | N/A | No sample data. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | Assessment or report clearly documents its data sources, assessment methods, results, and assumptions. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | N/A | No scope to address variability and uncertainty. |

## Overall Quality Determination — High

| | |
|---|---|
| **Study Citation:** | Senitkova, I., Stevulova, N. (1999). Indoor pollution by asbestos and man-made mineral fibers. :613-618. |
| **HERO ID:** | 6863279 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Description of release source: | ACM in building materials degrading over time or with handling |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | Medium | Report uses high quality data/techniques/methods that are not from frequently-used sources and there are no known quality issues. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Medium | Data are from Slovakia, an OECD country. |
| | Metric 3: | Applicability | High | Releases from construction materials are within scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: | Sample Size | N/A | Sample size is not applicable to description of release source. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Methods, results, and assumptions are clearly documented, but underlying data sources are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | N/A | Variability and uncertainty are not applicable to description of release source. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Silvestri, S. (2012). Managing asbestos in Italy: Twenty years after the ban. New Solutions: A Journal of Environmental and Occupational Health Policy 22(4):489-496. |
| **HERO ID:** | 3531922 |
| **Conditions of Use:** | Disposal |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Waste treatment methods and pollution control: | Waste treatment methods and pollution control |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Methodology | High | report uses high quality data |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | Medium | The data are from an OECD country other than the U.S. |
| Metric 3: | Applicability | High | The report is for an occupational scenario within the scope of the risk evaluation. |
| Metric 4: | Temporal Representativeness | Medium | The report is generally more than 10 years but no more than 20 years old. |
| Metric 5: | Sample Size | N/A | N/A - This metric is not applicable to the data being extracted |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | High | report clearly documents its data sources |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Low | The report does not address variability or uncertainty. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | State of North Carolina Office of State Personnel, (2000). OSHA training for workers and their supervisors who remove intact resilient asbestos-containing flooring. |
| **HERO ID:** | 3981065 |
| **Conditions of Use:** | Disposal |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Description of release source: | Removal of intact roofing and floring |
| Waste treatment methods and pollution control: | Waste treatment methods and pollution control |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | OSHA training |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | US |
| | Metric 3: | Applicability | High | The report is for an occupational scenario (asbestos conatinaing flooring removal) within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Medium | 2000- after PEL but more than 20 years old |
| | Metric 5: | Sample Size | N/A | Qualitative information provided about emission releases and disposal |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Assessment or report clearly documents results, methods, and assumptions. Data sources are generally described but not fully transparent. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | N/A | Qualitative information provided about emission releases and disposal |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Straka, M., Cehlar, M., Khouri, S., Trebuna, P., Rosova, A., Malindzakova, M. (2016). Asbestos exposure and minimization of risks at its disposal by applying the principles of logistics. Przemysł Chemiczny 95(5):963-970. |
| **HERO ID:** | 3581375 |
| **Conditions of Use:** | Disposal |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Description of release source: | Asbestos can be released from asbestos-containing wastes from electrolysis, wastes from asbestos processing, asbestos-containing wastes from asbestos-cement manufacture, metallic packaging containing a dangerous solid porous matrix (e.g. asbestos), including empty pressure containers, asbestos-containing brake pads, discarded equipment containing loose asbestos, asbestos-containing insulation materials, asbestos-containing construction materials (pg 965) |
| Waste treatment methods and pollution control: | Waste treatment methods and pollution control |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | Medium | The assessment or report uses high quality data and/or techniques or sound methods that are not from a frequently used source and associated information does not indicate flaws or quality issues. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Medium | The data are from an OECD country other than the U.S. |
| | Metric 3: | Applicability | High | The report is for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | High | The report is generally no more than 10 years old. |
| | Metric 5: | Sample Size | N/A | No sample data. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | Report clearly documents its data sources. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | N/A | No scope to address variability and uncertainty. |

## Overall Quality Determination — High

| | |
|---|---|
| **Study Citation:** | TNRCC, (1996). TNRCC regulatory guidance: Asbestos wastes disposal. |
| **HERO ID:** | 3981064 |
| **Conditions of Use:** | Disposal |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Description of release source: | Friable asbestos in insulation, pipe wrapping, ceiling tiles, gaskets, packing, roofing, and shingles. (1/2) |
| Waste treatment methods and pollution control: | Waste treatment methods and pollution control |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Methodology | High | Report uses high quality methods and data from frequently-used sources. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | Data are from the U.S. |
| Metric 3: | Applicability | High | Data are for disposal of asbestos products, an in-scope occupational scenario. |
| Metric 4: | Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| Metric 5: | Sample Size | N/A | N/A - This metric is not applicable to the data being extracted |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | U.S. EPA, (2008). Comparison of the alternative asbestos control method and the NESHAP method for demolition of asbestos-containing buildings. |
| **HERO ID:** | 3970151 |
| **Conditions of Use:** | Disposal |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Description of release source: | demolitiondisposal at landfill. |
| Waste treatment methods and pollution control: | Waste treatment methods and pollution control |
| Comments: | In 2006 and 2007 the Environmental Protection Agency (EPA) conducted three tests to examine the cost and environmental effectiveness of Alternative Asbestos Control Method (AACM). Two tests were conducted in Fort Chafee, Arkansas and one was conducted in Forth Worth, Texas. The EPA discontinued testing the AACM due to technical deficiencies. The AACM remains unapproved and should not be used. |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Methodology | High | EPA report |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | US |
| Metric 3: | Applicability | High | The report is for an occupational scenario (Asbestos contaminated building demolition) within the scope of the risk evaluation. |
| Metric 4: | Temporal Representativeness | Medium | 2006-2007 more than 10 but less than 20 years old |
| Metric 5: | Sample Size | N/A | information provided was qualitative |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | High | data was obtained from EPA/contractor site actiivies. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | N/A | information provided was qualitative |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | U.S. EPA, (1985). Guidance for controlling asbestos-containing materials in buildings: 1985 edition. |
| **HERO ID:** | 6893665 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Waste treatment methods and pollution control: | Waste treatment methods and pollution control |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | Report uses high quality data/techniques/methods from frequently-used sources. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for Chemical Substances in Construction, Paint, Electrical, and Metal Products, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: | Sample Size | Medium | Sample distribution characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | Variability addressed by giving concentrations for multiple products but uncertainty is not addressed. |

## Overall Quality Determination — High

| | |
|---|---|
| **Study Citation:** | U.S. EPA, (2018). National emission standards for hazardous air pollutants for asbestos: Request for approval of an alternative work practice for asbestos cement pipe replacement. Federal Register 83 (80):18042-18051. |
| **HERO ID:** | 6908876 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Description of release source: | Certain ACM can readily release asbestos fibers when they aredisturbed or damaged. Asbestos fibers can then become entrained into the ambient air where they become available for inhalation |
| Waste treatment methods and pollution control: | Waste treatment methods and pollution control |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | The process description of asbestos-containing pipe removal is from a frequently used source (EPA FR notice). |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | The data are from the United States. |
| | Metric 3: | Applicability | High | The report is for an occupational scenario (Asbestos-cement pipe replacement) within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | High | The report captures operations, equipment, and worker activities expected to be representative of current conditions. The report is generally no more than 10 years old. |
| | Metric 5: | Sample Size | N/A | Qualitative process/control information provided. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | Assessment or report clearly documents its data sources, assessment methods, results, and assumptions. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | N/A | Qualitative process/control information provided. |

## Overall Quality Determination High

**Study Citation:** Verein Deutscher Ingenieure, (1982). Emission control: Extraction and processing of asbestos treatment of products containing asbestos.
**HERO ID:** 6906351
**Conditions of Use:** Other:

**EXTRACTION**

| Parameter | Data |
|---|---|
| Waste treatment methods and pollution control: | Waste treatment methods and pollution control |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | Medium | Report uses high quality data that are not from frequently-used sources and there are no known quality issues. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Medium | Data are from Germany, an OECD country. |
| | Metric 3: | Applicability | Medium | Data are for upstream, out-of-scope COUs, however data may still be applicable for in-scope COUs. |
| | Metric 4: | Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: | Sample Size | N/A | qualitative data |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Methods, results, and assumptions are clearly documented, but underlying data sources are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | Variability addressed by discussing various types of control technologies but uncertainty is not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Wagg, R. M. (1976). Safety measures when handling asbestos. 96(6):252-255. |
| **HERO ID:** | 3616658 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Description of release source: | Factories, electrical stations, institutions, warehouses, ships under construction and repair, and construction/demolition. (2/4) |
| Waste treatment methods and pollution control: | Waste treatment methods and pollution control |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Methodology | Medium | Report uses high quality data that are not from frequently-used sources and there are no known quality issues. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | Medium | Data are from the U.K., an OECD country. |
| Metric 3: | Applicability | High | The report is for an occupational scenario within the scope of the risk evaluation. |
| Metric 4: | Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| Metric 5: | Sample Size | N/A | No sample data. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Low | Assessment results are provided but underlying methods, assumptions, and data sources are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Medium | Variability is addressed by discussing different waste control methods. Uncertainty isn't addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | WHO, (1998). Chrysotile asbestos. |
| **HERO ID:** | 4140385 |
| **Conditions of Use:** | Other: |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Description of release source: | Possible emission sources are: (a) feeding of asbestos fibres into the mix; (b) blending the mix; and (c) cutting or machining end-products. (pg 50) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | Report uses high quality [data/techniques/methods] from frequently-used sources. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Medium | Data are not specific to a country. |
| | Metric 3: | Applicability | Medium | Data are for upstream uses of asbestos, which are not in scope but may still be informative. |
| | Metric 4: | Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: | Sample Size | N/A | description of release source. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Methods, results, and assumptions are clearly documented, but underlying data sources are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Ahrenholz, S. H. (1988). Health hazard evaluation report no. HETA 86-422-1891, City of Ames Municipal Power Plant, Ames, Iowa. |
| **HERO ID:** | 3970491 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Chemical concentration: | Insulation materials contained from below detectable levels (ND) up to 20% amosite, and 5-20% chrysotile asbestos. |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | Report uses high quality data/techniques/methods from frequently-used sources. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | The data are from the United States. |
| | Metric 3: | Applicability | High | The assessment is for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Low | More than 20 years old. |
| | Metric 5: | Sample Size | Medium | Distribution of samples is characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Assessment or report clearly documents results, methods, and assumptions. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | The assessment provides only limited discussion of the variability and uncertainty in the results. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | ATSDR, (2001). Toxicological profile for asbestos (Update, September 2001). |
| **HERO ID:** | 786664 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Production, import, or use volume: | Reported consumption of asbestos in the United States was 790 million pounds (359,000 metric tons) in 1980, 497 million pounds (226,000 metric tons) in 1984, 185 million pounds (84,000 metric tons) in 1987, 81 million pounds (35,000 metric tons) in 1991, 73 million pounds (33,000 metric tons) in 1994, and 46 million pounds (21,000 metric tons) in 1997. By 1998 and 1999, U.S. consumption of asbestos had declined to 34.8 million pounds (15,800 metric tons) per year. [PDF Pg. 166] |
| Life cycle description: | The 1999 domestic consumption pattern was 61% for roofing products, 19% for gaskets, and 13% for friction products (automobile clutch, brake, and transmission components). Roofing products, gaskets, and friction products will continue to be the only significant domestic markets for asbestos in the foreseeable future. Only chrysotile is presently used for manufacturing in the United States (USGS 1999b). Ninety-four percent of chrysotile consumed was grade 7, a short (3 $\mu$m) fiber. Only 0.4% of the asbestos used were long fibers (6–9.5 $\mu$m); these were mostly used in plastics (Chissick 1985; Jolicoeur et al. 1992; SRI 1982; USGS 1997, 1999b; U.S. Bureau of Mines 1992, 1994). [PDF Pg. 166] |
| Number of sites: | 87 sites in the U.S. that release asbestos [PDF Pg. 173]. |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Methodology | High | Methodology is known and expected to be accurate and cover all release sources at the site. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | High | The data are from the United States |
| | Metric 3: Applicability | High | Data are for construction materials, an in-scope occupational scenario. |
| | Metric 4: Temporal Representativeness | Low | The completed exposure or risk assessment is more than 20 years old. |
| | Metric 5: Sample Size | Medium | Distribution of samples is characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | Medium | Assessment or report clearly documents results, methods, and assumptions. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Medium | The assessment provides only limited discussion of the variability and uncertainty in the results. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Chrostowski, P. C., Foster, S. A., Anderson, E. L. (1991). Human health risks associated with asbestos abatement. Risk Analysis 11(3):465-481. |
| **HERO ID:** | 3082333 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Chemical concentration: | Asbestos concentrations in exposed friable asbestos ranged between 5-30% (Table IX) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | The assessment or report uses high quality data and/or techniques or sound methods that are from a frequently used source and are generally accepted by the scientific community, and associated information does not indicate flaws or quality issues. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | The data are from the United States and are representative of the industry being evaluated. |
| | Metric 3: | Applicability | High | The assessment is for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Low | The completed exposure or risk assessment is more than 20 years old. The assessment captures operations, equipment, and worker activities that are expected to be outdated. |
| | Metric 5: | Sample Size | N/A | N/A - concentration data not based on sampling |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | Assessment or report clearly documents its data sources, assessment methods, results, and assumptions |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | The assessment provides only limited discussion of the variability and uncertainty in the results. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Gibbs, G., Pigg, B. J., Nicholson, W. J., Morgan, A., Lippmann, M., Davis, J. M. G., Mossman, B. T., Mcdonald, J. C., Landrigan, P. J., Nicholson, W. J., Schreier, H. (1998). Task group on Environmental health criteria for chrysotile asbestos meeting, Geneva, Switzerland, 1-6 July 1996. Environmental Health Criteria 203:III-197. |
| **HERO ID:** | 7482318 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Production, import, or use volume: | "Annual world production of asbestos peaked at over 5 million tonnes in the mid-1970s but has since declined to a current level of about 3 million tonnes. Manufacturing of chrysotile products is undertaken in more than 100 countries, and Japan is the leading consumer country"... "The asbestos-cement industry is by far the largest user of chrysotile fibres, accounting for about 85% of all use. " (pg 25)Asbestos demand in the USA over time for various industries given in Table 2 of report; roofing products as highest demand for asbestos in most recent date given in table (pg 50) |
| Chemical concentration: | "Asbestos-cement products contain 10-15% of asbestos, mostly chrysotile, although limited amounts of crocidolite have been used in large diameter, high-pressure pipes" (pg 50) |
| Comments: | IPCS Environmental Health Criteria assessment for chrysotile asbestos |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Methodology | Medium | Assessment uses high quality information that is not from frequently-used sources and there are no known quality issues. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | Includes data from the U.S. |
| Metric 3: | Applicability | High | Data are for asbestos-containing cement industry primarily, which is an in-scope occupational scenario. |
| Metric 4: | Temporal Representativeness | Low | Assessment is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| Metric 5: | Sample Size | Medium | Sample distribution characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Medium | Methods, results, and assumptions are clearly documented, but underlying data sources are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Medium | Variability addressed by temporal changes, but uncertainty is not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Gunter, B. J. (1978). Health hazard evaluation report no. HHE 78-128-549, Nixon Power Plant, Colorodo Springs, Colorado. |
| **HERO ID:** | 3970523 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Process description: | Asbestos connections and small joints are sanded and buffed prior to gluing them onto fiberglass pipe. During the sanding and buffing of the asbestos connections, it is possible for air-borne asbestos fibers to be generated. This process was evaluated during this survey. [PDF Pg. 2] |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | Report uses high quality data/techniques/methods from frequently-used sources. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | The data are from the United States. |
| | Metric 3: | Applicability | High | Data are for Chemical Substances in Construction, Paint, Electrical, and Metal Products, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | The completed exposure or risk assessment is more than 20 years old. |
| | Metric 5: | Sample Size | N/A | Process description. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | Uncertainty is addressed by sampling method. Variability addressed by sampling areas an personal breathing zones. |

## Overall Quality Determination — High

**Study Citation:** KVB Inc, (1980). An inventory of carcinogenic substances released into the ambient air of California: Final report - Task II and Task IV.
**HERO ID:** 5443893
**Conditions of Use:** Other:

**EXTRACTION**

| Parameter | Data |
|---|---|
| Production, import, or use volume: | Production of asbestos in CA reached 78,390 tons in 1978. Of this, 19% was used for cement pipe, 16% for flooring, 9% for friction products, 4% for paper, 35% for roofing, 3% for cement sheets, 3% for packing and gaskets, 1% for insulation, 1% for textiles, and 8% other. (58/132) |
| Chemical concentration: | The dry-basis content of cement pipes is 15% asbestos. (68/132) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Methodology | High | Assessment uses high quality data from frequently-used sources. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | High | Data are from the U.S. |
| | Metric 3: Applicability | High | Data from the report encompass all conditions of use, which includes all in scope of the evaluation. |
| | Metric 4: Temporal Representativeness | Low | Assessment is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: Sample Size | Medium | Sample distribution characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | Medium | References are cited in-text, but the source ends before the bibliography. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Medium | Variability is addressed by including data from different manufacturers and use conditions. Uncertainty isn't' addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Longo, W. E., Egeland, W. B., Hatfield, R. L., Newton, L. R. (2002). Fiber release during the removal of asbestos-containing gaskets: a work practice simulation. Applied Occupational and Environmental Hygiene 17(1):55-62. |
| **HERO ID:** | 3080516 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Chemical concentration: | Gaskets removed in these studies contained 65 percent to 85 percent chrysotile asbestos. |
| Comments: | TABLE IPLM analysis of removed gaskets |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | The assessment or report uses high quality data and/or techniques or sound methods. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | The data are from the United States. |
| | Metric 3: | Applicability | High | The assessment is for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Low | The completed exposure or risk assessment is more than 20 years old. |
| | Metric 5: | Sample Size | Medium | Distribution of samples is characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Assessment or report clearly documents results, methods, and assumptions. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | The assessment provides only limited discussion of the variability and uncertainty in the results. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | OECD, (2009). Emission scenario document on plastic additives. |
| **HERO ID:** | 5079084 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Packaging, Paper, Plastic, Toys, Hobby Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Production, import, or use volume: | Provides % of polymers used for various end-use applications |
| Life cycle description: | Processing - plastics compounding and converting |
| Process description: | Provides descriptions for a variety of closed, partially open, and open compoundind and converting processing. Including the following compounding processes: tumbling, ball blending, gravity mixers, paddle mixers, intensive vortex mixers, banbury mixers, two roll mills, and extruder mixing. And the following converting processes: extrusion, injection molding, compression molding, extrusion blow molding, injection blow molding, film extrusion, extrusion coating, thermoforming, calendering, hand lay up, spray techniques, and filament winding.ESD also provides a break down of the % and volume of polymers used in each process in the UK. |
| Throughput: | Provides methodology for estimating throughput of polymers and additives |
| Number of sites: | 4000 sites in UK |
| Chemical concentration: | Provides conc. estimates based on additive function in various plastics, not chemical specific. |
| Comments: | Emission scenario document on plastic additives |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Methodology | High | Assessment uses high quality data/techniques/methods from frequently-used sources. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | Medium | This ESD was not developed by EPA, but another OECD-member country. |
| Metric 3: | Applicability | Medium | Data are for multiple in-scope occupational scenarios; however, data is general and not specific to a chemical. |
| Metric 4: | Temporal Representativeness | Low | Assessment from 2009 but is based on data greater than 20 years old. |
| Metric 5: | Sample Size | Medium | Sample distribution characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Medium | Uncertainty not addressed. Variability addressed by considering prevalence of various processing methods, additive functions, and plastics. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Paustenbach, D. J., Madl, A. K., Donovan, E., Clark, K., Fehling, K., Lee, T. C. (2006). Chrysotile asbestos exposure associated with removal of automobile exhaust systems (ca. 1945-1975) by mechanics: results of a simulation study. Journal of Exposure Science and Environmental Epidemiology 16(2):156-171. |
| **HERO ID:** | 3531296 |
| **Conditions of Use:** | Consumer Uses-Chemical Substances in Automotive, Fuel, Agriculture, Outdoor Use Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Process description: | In most cases, the mechanic removed most or all of the gaskets with his fingers or by prying them off with a screwdriver. Any residual gasket material left behind was scraped off with the screwdriver or pulled off by hand. It generally took less than 1min for the mechanic to remove each gasket. |
| Chemical concentration: | For cars containing asbestos gaskets, the content of asbestos in the exhaust system gaskets ranged from 9.5% to 80.1% for chrysotile as analyzed by XRD (Table 1). (P. 8/16) |
| Comments: | The purpose of this study was to characterize personal and bystander exposures to asbestos during the removal of automobile exhaust systems (ca. 1945–1975) containing asbestos gaskets. These data were used to estimate an 8-h time-weighted average (TWA) exposure for mechanics performing this type of automobile repair work.Table 1. Summary of asbestos concentration (percent by weight) in automobile exhaust gaskets and mufflers. |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | The assessment or report uses high quality data and/or techniques or sound methods. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | The study was conducted at a muffler shop in Santa Rosa,CA, USA. |
| | Metric 3: | Applicability | High | The assessment is for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Medium | More than 10 years but no more than 20 years old. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized. Sample size is sufficiently representative. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | Assessment or report clearly documents its data sources, assessment methods, results, and assumptions. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | The assessment provides only limited discussion of the variability and uncertainty in the results. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | U.S. EPA, (2004). Additives in plastics processing (compounding) – Generic scenario for estimating occupational exposures and environmental release – Draft. |
| **HERO ID:** | 6311218 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Packaging, Paper, Plastic, Toys, Hobby Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Production, import, or use volume: | If the type of plastic is not known, the total amount of plastic resin produced in the U.S. should be used from Table 1 (35,012 million kg/yr). |
| Life cycle description: | Plastics Compounding |
| Process description: | Polymer pellets/resins received, blending/compounding into masterbatch, extrusion/shaping, packaging |
| Throughput: | 250 days per year, based on five day work week andtwo weeks per year of operation shut down. Provides methodology for estimating throughput based on the amount of plastic produced, and the concentration of the chemical additive in the plastic |
| Number of sites: | Provides methodology for estimating number of sites based on chemical PV, the amount of plastic produced, and the concentration of the chemical additive in the plastic |
| Chemical concentration: | Provides conc. estimates based on additive function in various plastics, not chemical specific. |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Methodology | High | Assessment uses high quality data/techniques/methods from frequently-used sources. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | This GS is based on U.S. data |
| Metric 3: | Applicability | Uninformative | Plastic processing is not in-scope for the legacy asbestos risk evaluation. |
| Metric 4: | Temporal Representativeness | Medium | Assessment is generally based on data greater than 10 years old but no more than 20 years old and industry conditions that are expected to be representative of current industry conditions. |
| Metric 5: | Sample Size | Medium | Sample distribution characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Medium | Uncertainty not addressed. Variability addressed by considering multiple plastic and additive types. |

## Overall Quality Determination Uninformative

| | |
|---|---|
| **Study Citation:** | Abundo, M.,-L, Almaguer, D., Driscoll, R. (1994). Health hazard evaluation report no. HETA 93-1133-2425, Electrode Corporation, Chardon, Ohio. |
| **HERO ID:** | 3970520 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Process description: | Diaphragm, mercury cell, electrogalvanizing (EGL), and membrane gap cell (MGC) anodes and cathodes are manufactured in the fabrication area. The application of proprietary precious metal coatings (to improve conductivity and prevent corrosion) and the repair of anodes and cathodes, takes place in the servicing and finishing areas. Anodes constitute the largest number of structures handled by Electrode Corporation. Each type of anode has a different process line but follows a similar process flow (pdf page 3)Incoming crates of anodes are opened and counted in the shipping and receiving department. These crates are unpacked and evaluated in the diaphragm pre-coat area. Glanor anodes (a subset of diaphragm anodes) may become contaminated with asbestos during use, by the customer, in chemical cells where an asbestos diaphragm is used to separate the anode and cathode. (pdf page 4)The anodes are cleaned prior to evaluation because of the possibility of asbestos contamination. The anode washer is located in the pre-coat diaphragm area, a large open area, and is housed in a wooden shell. The washer is separated from the shipping and receiving department by a 12-foot sheet of plastic, but the plastic sheeting does not reach theceiling. Workers open and unpack crates of anodes, and then place the anodes in the anode washer. After washing, anodes requiring minor repairs are reworked prior to surface preparation (pdf page 4) |
| Chemical concentration: | 80 to 90% chrysotile asbestos |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | The assessment or report uses high quality data and/or techniques or sound methods that are from frequently used sources. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for use as Chemical Substances in Construction, Paint, Electrical, and Metal Products, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Data are greater than 20 years old (1993) |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized. Sample size is sufficiently representative. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | All metadata provided. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | Variability addressed by reporting range of chemical concentration found in multiple areas of the facility, but uncertainty is not addressed. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Albrecht, W. N. (1982). Health Hazard Evaluation Report, No. HETA-82-131-1098, U.S. Department of Justice, Washington, D.C. |
| **HERO ID:** | 3653569 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Process description: | Ceiling tiles - page 2 |
| Chemical concentration: | 5% chrysotile asbestos - page 3 |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | Sampling/analytical methodology is an approved NIOSH method. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | Medium | Data are for use of construction products (ceiling tiles in office space), which is similar to the in-scope occupational scenario of use of Chemical Substances in Construction, Paint, Electrical, and Metal Products |
| | Metric 4: | Temporal Representativeness | Low | Monitoring data are greater than 20 years old. |
| | Metric 5: | Sample Size | Low | Distribution of samples is qualitative or characterized by no statistics. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Data describes the concentration in ceiling tile material, but does not describe additional metadata such as total quantity of ceiling tile material in building. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | Variability and uncertainty of asbestos concentration in ceiling tile material is not discussed. |

## Overall Quality Determination — Medium

| | |
|---|---|
| **Study Citation:** | Almaguer, D., Matte, T. (1987). Health hazard evaluation report no. HETA 86-524-1851, Four Wheel Drive Corporation, Clintonville, Wisconsin. |
| **HERO ID:** | 3970490 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Process description: | brake shoe machining operation |
| Chemical concentration: | Bulk samples of brake shoe shavings contaminating the floor and equipment in that area contained 10 to 20% chrysotile asbestos. |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | Report uses high quality methods from frequently-used sources. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for bake component machining, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated (1987) |
| | Metric 5: | Sample Size | Medium | Sample distribution characterized by limited statistics (e.g., min and max) but discrete samples not provided and distribution not fully characterized. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Low | Assessment results are provided but underlying methods, assumptions, and data sources are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Almaguer, I.,.H. (1986). Health hazard evaluation report no. HETA 86-223-1742, Grundy Industries, Inc., Joliet, Illinois. |
| **HERO ID:** | 3970532 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Process description: | Asphalt, contained in a storage tank outside the building, is pumped through an enclosed system to an enclosed mixing tank inside the building. Bags containing 50 kilogram cakes of asbestos are opened and fed onto a conveyor system. A fluffing operation to agitate the fibers follows the fiber introduction and the fibers continue down the enclosed conveyor line to the mixing tank. After mixing, the fiber is encapsulated and little asbestos dust is generated. Approximately 1.3 pounds of chrysotile asbestos are added per gallon of asphalt.The asphalt and asbestos mixture is dispensed into containers, capped, labeled, and placed n pallets for transport (pdf page 2) |
| Chemical concentration: | 1.3 pounds of chrysotile asbestos are added per gallon of asphalt. |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Methodology | High | Report uses high quality data |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | Data are from the U.S. |
| Metric 3: | Applicability | High | Data are for use as a Chemical Substance in Construction, Paint, Electrical, and Metal Products, an in-scope occupational scenario. |
| Metric 4: | Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | High | The report addresses variability and uncertainty in the results. Uncertainty is well characterized. |

## Overall Quality Determination High

**Continued on next page . . .**

. . . continued from previous page

**Study Citation:** Anania, T. L., Price, J. H., Evans, W. A. (1978). Health hazard evaluation report no. HHE 77-34-417, Midwest Steel Division, National Steel Corporation, Portage, Indiana.
**HERO ID:** 3970508
**Conditions of Use:** Disposal

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|

**Study Citation:** Anania, T. L., Price, J. H., Evans, W. A. (1978). Health hazard evaluation report no. HHE 77-34-417, Midwest Steel Division, National Steel Corporation, Portage, Indiana.
**HERO ID:** 3970508
**Conditions of Use:** Disposal

**EXTRACTION**

| Parameter | Data |
|---|---|
| Process description: | 1) 80-inch Continuous Pickle Line Continuous pickling is a process for removing the oxide from the steel surface deposited during the hot rolling operation. The oxide is removed by passing the steel through a bath of hot sulfuric acid. The steel is then given a water spray rinse and passed through a hot air dryer prior to coiling with an oil coating to protect the surface.The 80-inch Pickle Line is 991 feet long and was designed to process product widths from 24 to 72 inches. The entry section of the line is designed with two right angle conveyors feeding the coils eye horizontal to two processors. After the processors and the oscillating upcut shears is a combination welder and flash trimmer. Next in line is the No. 1 looping pit which is 71 feet long by 13 feet wide by 16 1/2 feet deep. Following the looping pit and tension units is a rolling mill type scale breaker. This mill is driven by two 750 horsepower, 690/875 revolutions per minute, 250 volt DC motors through 4:1 reduction gears. Next in line is the No. 2 looping pit which is 59 feet long by 13 feet wide by 17 l/4 feet deep. Following the looping pit and master pinch rolls is the pickling tank which is sectionalized into four sections. The first and fourth sections are 90 1/2 feet long and the second and third are 89 feet long. All tanks are 7 feet 1 inch in depth. The width of all tanks is 9 feet 10 1/4 inches. The refractory lining is composed of 3 3/4 inch by 4 l/2 inch by 8 inch acid proof bricks. The steel tanks are lined with 1/4 inch of rubber. Each tank has five 16 feet covers and three 5 feet 6 1/2 inch inspection covers. There are two strip lifting mechanisms per acid tank.The rinse tank is 42 feet long by 9 feet 10 1/4 inches wide by 5 feet deep and is followed by the hot air dryers consisting of three centrifugal blowers, each driven by a 75 horsepower, 3,600 revolutions per minute, 440 volt AC motor. The air is heated by three 4000 maximum air temperature heat exchangers.Following two free loop looping pits the delivery section of the line consists of a side trimmer with scrap chopper and conveyor, exit shear, upcoiler and tension winding reel. The maximum coil O.D. for the upcoiler and tension winding reel is 90 inches and the minimum coil I.D. for the upcoiler is 18 inches. For the tension winding reel, the coil I.D.s are 24 and 28 inches.2) 52 inch Five Stand Cold Reduction MillThe mill consists of five four-high stands spaced on 14 feet centers. each housing weighing approximately 110 tons. The largest coil discharged from this mill can weigh approximately 90,000 pounds.Coils of 90 inch maximum O.D. are moved from the chain drive entry conveyor by a mandrel in the coil transfer unit which places them on the rolls of the coil positioner. Solenoid valve controlled hydraulic power accomplishes this transfer.Two driven saddle rolls in the coil positioner rotate the coil in order to transport the outer wrap through the coil opener into the straightener rolls. The straightener unit is removed from the pass line after straightening the head end of the strip and does not contact the strip during coil run off. After threading the strip through the stands at speeds up to 750 feet per minute and wrapping the mandrel, the mill may be accelerated to run speed up to a maximum of 6~000 feet per minute. Strip uniformity is insured by continuous dial readings of roll pressure, strip tension and gauge. Backup roll pressure is measured by pressductor cell force gauges, which provide independent readings of force on front and back roll chocks. Tension is measured with tensiometers, the force with which the tensiometer roll is deflected is measured on load cells and metered at the operators• stations. This mill is equipped with automatic gauge control, and the finished gauge is monitored by means of an x-ray gauge.3) 80 Inch Five Stand Cold Reduction MillThe 80 inch Five Stand Cold Reduction mill was designed to produce cold reduced low carbon high strength steel, and consists of five four-high stands spaced on 15 foot 6 inch centers, each housing weighing approximately 144 tons. Each stand is equipped with automatic work roll changing rigs.The 80 inch Five Stand Tandem Mill will reach a maximum speed of 5,000 FPM with 23 inch diameter work rolls. While other members of the crew are on mill floor level, the roller, or operator, is stationed in a glass enclosed, air conditioned, raised pulpit eight feet above the mill floor. The computer room is directly overhead of the operator's pulpit at a 20 foot level above the mill floor, and the electrical control room is on this same level.Strip uniformity is insured by the automatic gauge control system which recognizes gauge deviation from a preset reference gauge and maintains the thickness of the strip delivered from the mill to within plus or minus 2 l/2 percent, or .001 inch (whichever is least) of x-ray gauge measurement. Other features incorporated in the automatic gauge control are: programmed screw movement as a function of mill speed change, programmed screw movement during strip tailout, and preset stand drive motor overspeed during strip threading.4) Electrolytic Cleaning LineThe Electrolytic Cleaning Line is 309 feet long, operates at speeds up to 2,500 feet per minute and handles coils weighing up to 72,000 pounds coming directly from the two Five Stand Cold Reduction Mills . Both cold rolled and tin plate coils are cleaned on this line.At the entry end of the line, the head end of the strip is fed into a lap seam welder and welded to the tail of the previous coil to provide a continuous strip. There are no looping towers on this line and the unit must stop running to charge and discharge coils. After welding, the strip passes through an electrolytic alkali cleaner, scrubber, hot rinser, and hot air dryer to remove dirt, grease, oil, and residue from the strip to insure maximum cleanliness before entering the annealing furnace.The cleaned coil is discharged onto a 45 foot conveyor. Discharged coils can be removed for subsequent processing in either an eye horizontal or eye vertical position. Finished coils are provided up to 72,000 pounds 20 to 50 inches wide, and .0055 to .0780 inches gauge.5) 48 Inch Continuous Galvanize LineThe 48 inch Continuous Galvanize Line is 914 |

. . . continued from previous page

| | |
|---|---|
| **Study Citation:** | Anania, T. L., Price, J. H., Evans, W. A. (1978). Health hazard evaluation report no. HHE 77-34-417, Midwest Steel Division, National Steel Corporation, Portage, Indiana. |
| **HERO ID:** | 3970508 |
| **Conditions of Use:** | Disposal |

| Domain | Metric | EVALUATION Rating | Comments |
|---|---|---|---|
| Number of sites: | 1 | | |

| Domain | Metric | EVALUATION Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Methodology | High | NIOSH study |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | High | Data is from US. |
| | Metric 3: Applicability | High | The report is for an occupational scenario (steel processing) within the scope of the risk evaluation. |
| | Metric 4: Temporal Representativeness | Low | 1977 more than 20 yeas old |
| | Metric 5: Sample Size | N/A | Qualitative information provided. Process information |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | High | Information provided was derived from NIOSH site visit. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Low | The report does not address variability or uncertainty. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Anonymous, (1979). Asbestos hazards in schools subject of state, federal study. Texas Medicine 75(10):10. |
| **HERO ID:** | 3613414 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Number of sites: | 1,100 Texas School districtsOf the 25% of districts that responded to the survey, 83% showed no indication of asbestos use in buildings |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | Medium | Report uses high quality data/techniques/methods that are not from frequently-used sources and there are no known quality issues. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for construction materials, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: | Sample Size | Medium | Sample distribution characterized by limited statistics but discrete samples not provided and distribution not fully characterized. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Methods, results, and assumptions are clearly documented, but underlying data sources are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Anonymous, (2003). New Yorkers at risk from asbestos dust following World Trade Center collapse. Trends in Analytical Chemistry 22(5):VII-IX. |
| **HERO ID:** | 6865358 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Chemical concentration: | Dust found in the vicinity of the World Trade Center after 9/11 comprised of 0.2 -0.5 % chrysotile asbestos. |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | Medium | The study uses high quality data that are not from frequently used sources and associated information does not indicate flaws or quality issues. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | The data are from the United States. |
| | Metric 3: | Applicability | Low | The report is for a non-occupational scenario that is similar to an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Low | Though the study is from 2003 (less than 20 years old), the data is from the WTC collapse in 2001 (greater than 20 years old). |
| | Metric 5: | Sample Size | Medium | Distribution of samples is characterized by a range with uncertain statistics. It is unclear if analysis is representative. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Assessment documented results, noting that SEM, EDS, WDS and XRD methods were used, but specifics about the methodology were not provided. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | Variability and uncertainty of asbestos concentrations in dust near WTC after collapse are not addressed. |

## Overall Quality Determination — Low

**Study Citation:** Anonymous, (2009). Asbestosis-related disease continues to take lives. Safety Compliance Letter (2497):13.
**HERO ID:** 6907372
**Conditions of Use:** Other:

**EXTRACTION**

| Parameter | Data |
|---|---|
| Production, import, or use volume: | In 2006, approximately 2,200 metric tons of asbestos were still used in the U.S. (1/2) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | Low | Report does not specify the data used. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for consumption of asbestos for all industrial/commercial uses, which is in-scope. |
| | Metric 4: | Temporal Representativeness | Medium | Report is based on data greater than 10 years old but no more than 20 years old and industry conditions that are expected to be representative of current industry conditions. |
| | Metric 5: | Sample Size | Medium | Sample distribution characterized by limited statistics (production volume) but discrete samples not provided and distribution not fully characterized. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Low | Assessment results are provided but underlying methods, assumptions, and data sources are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Anonymous, (1990). Asbestos in the workplace: Employers beware. Canadian Occupational Safety 28(6):6, 9. |
| **HERO ID:** | 6909384 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Process description: | During encapsulation, sealants are applied which penetrate or cover the surface of the asbestos- containing material. During enclosure, a barrier is installed to enclose the asbestos material and protect it from disturbance and damage. The asbestos should be enclosed behind airtight walls and ceilings, and signs should be posted warning of the hazard. (1/2) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Methodology | Low | Report does not specify the data used. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | Medium | Data are from Canada, an OECD country. |
| | Metric 3: Applicability | High | Data are for managing asbestos in commercial construction materials, an in-scope occupational scenario. |
| | Metric 4: Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: Sample Size | N/A | N/A - This metric is not applicable to the data being extracted |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | Low | Assessment results are provided but underlying methods, assumptions, and data sources are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination — Low

| | |
|---|---|
| **Study Citation:** | Anttila, P., Heikkilä, P., Mäkelä, M., Schlünssen, V., Priha, E. (2009). Retrospective exposure assessment for carcinogenic agents in bitumen waterproofing industry in Finland and denmark. Annals of Occupational Hygiene 53(2):139-151. |
| **HERO ID:** | 2596391 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Chemical concentration: | The talc contained 5% of fibres, of which only 2% were asbestos fibres (pg 5) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | Medium | Report uses high quality data/techniques/methods that are not from frequently-used sources and there are no known quality issues. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Medium | Data are from Denmark and Finland, OECD countries. |
| | Metric 3: | Applicability | High | Data are for construction materials, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: | Sample Size | Medium | Sample distribution characterized by limited statistics (assumed mean) but discrete samples not provided and distribution not fully characterized. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination **Medium**

| | |
|---|---|
| **Study Citation:** | Archer, S. R., Blackwood, T. R. (1979). Status assessment of toxic chemicals : Asbestos. :34. |
| **HERO ID:** | 6865816 |
| **Conditions of Use:** | Other: |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Production, import, or use volume: | In 1974, a total of 102,071 metric tons of asbestos were extracted from mines in California, Vermont, Arizona, and North Carolina. (6/34) A total of 767,160 metric tons of asbestos were used in the manufacture of products in 1974. (22/34) |
| Process description: | Asbestos is often mined by trenching or open-pit methods, followed by underground mining by tunneling or blockcaving methods. Milling practice, essentially a dry screening operation, consists of multiple stages of crushing, screening, aspirating the fiber from the rock, sifting, recleaning the fiber, and grading. (14/34) |
| Number of sites: | A total of 659 plants fabricate asbestos into products. (6/34) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Methodology | High | Report uses high quality methods and data from frequently-used sources. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | High | Data are from the U.S. |
| | Metric 3: Applicability | Uninformative | Data are for milling and manufacture of asbestos products, which is not in scope. |
| | Metric 4: Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: Sample Size | Medium | Sample distribution characterized by limited statistics (production values) but discrete samples not provided and distribution not fully characterized. |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Uninformative

| | |
|---|---|
| **Study Citation:** | ARGCO, (2022). Gasket sheet red rubber 1/8”thk x 36”wide (sold by the foot). |
| **HERO ID:** | 11138832 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Throughput: | 1/8” thick x 36” wide x 50 ft lengthSold by the linear ft.1 linear ft = 5 sq ft = 3.5 lbs50 linear ft = 1 roll |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | Medium | The source high quality data that are not from a frequently used source and associated information does not indicate flaws or quality issues. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | The data are from the United States. |
| | Metric 3: | Applicability | Low | The report is for a non-occupational scenario that is similar to an occupational scenario within the scope of the risk evaluation, such as a consumer DIY scenario that is similar to a worker scenario. |
| | Metric 4: | Temporal Representativeness | High | The report is no more than 10 years old. |
| | Metric 5: | Sample Size | N/A | N/A - This metric is not applicable to the data being extracted |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Methods, results, and assumptions are clearly documented, but underlying data sources are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | The source does not address variability or uncertainty. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Armco Inc, (1979). Industrial hygiene survey-Assembly Dept. Area No.12-Torrance, California-National Supply Co. SI-79165, report no.1 final with attachment. |
| **HERO ID:** | 4158353 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Chemical concentration: | Brake shoe pads containing 40% asbestos. [PDF Pg. 3] |
| Comments: | Unknown in automotive brake pads. |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | Medium | Report uses high quality data/techniques/methods that are not from frequently-used sources and there are no known quality issues. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for Chemical Substances in Construction, Paint, Electrical, and Metal Products, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: | Sample Size | Low | Sample distribution is characterized by no statistics. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination **Medium**

| | |
|---|---|
| **Study Citation:** | Arthur D. Little Inc, (1992). Evaluation of asbestos release from hi-heat dum dum caulking during application and removal with cover letter dated 122392. :1-8. |
| **HERO ID:** | 4158399 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Process description: | Product Hi-Heat Dum Dum. Consisted of a linseed oil-base vehicle (resin) containing various solid fillers, including clay and the chrysotile variety of asbestos (added for its resiliency and bridging properties). 'Hi-Heat Dum Dum/46-F-7 is a heavy semi-plastic fibred coating, which acts as a joint sealer and pliable gasket for boilers, furnaces and dry kilns. Improves boiler efficiency by preventing heat loss. Retains its elasticity at consistent heat up to 175 F and intermittent heat to 350 F. May be used as a complete cover to eliminate excess fuel consumption and can be painted over in 24 hours.' |
| Throughput: | Throughput provided for the amount of material tested on during experimentation however does not provide actual working throughputs. Throughput for the experiment was 30 gallons of product. |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | Medium | Sampling/analytical methodology is not an approved OSHA/NIOSH method but is an acceptable methodology. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for industrial/commercial use in construction, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Monitoring data are greater than 20 years old. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Sample type and exposure type provided but missing nearly all other metadata. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | Variability addressed by sampling during applying product and removal of product, but uncertainty is not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | ATSDR, (2008). Letter health consultation: Former Stella Cardwell Hospital: Stella, Newton County, Missouri: EPA facility id: MON000704954. |
| **HERO ID:** | 3970343 |
| **Conditions of Use:** | Disposal |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Process description: | "Materials removed included asbestos containing pipe insulation, floor tile and mastic, transite siding, boiler insulation, and linoleum flooring and window caulk." (pg 4)"The soils from these areas were excavated and disposed of properly with other ACM." (pg 6) |
| Throughput: | "Approximately 24 tons of ACM were removed and disposed of properly during the project" (pg 4) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | Report uses high quality information that are from frequently-used sources and there are no known quality issues. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for disposal of asbestos materials, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Medium | Report is based on data greater than 10 years old but no more than 20 years old and industry conditions that are expected to be representative of current industry conditions. |
| | Metric 5: | Sample Size | N/A | Process description. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Methods, results, and assumptions are clearly documented, but underlying data sources are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | ATSDR, (2010). Health consultation: Former Arizona tanning company site (aka Santan Tannery): Santan Industrial Park, district 4, Gila River Indian Community Pinal County, Arizona: EPA facility ID: AZD074441676. |
| **HERO ID:** | 3970376 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Chemical concentration: | ”AWI collected bulk samples from the Former Arizona Tanning Company Processing/Storage Building. Of the materials sampled by AWI, three (3) were found to contain >1% asbestos by Polarized Light Microscopy (PLM ) laboratory analysis” (pg 15)Three sample results provided in table; samples were for roofing material and for floor tile with results showing 10, 30, and 65% chrysotile (pg 16) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Methodology | High | Report uses high quality data and information from frequently-used sources. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | High | Data are from the U.S. |
| | Metric 3: Applicability | High | Data are for asbestos in building materials, an in-scope occupational scenario. |
| | Metric 4: Temporal Representativeness | Medium | Report is based on data greater than 10 years old but no more than 20 years old and industry conditions that are expected to be representative of current industry conditions. |
| | Metric 5: Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | Medium | Methods, results, and assumptions are clearly documented, but underlying data sources are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination — High

| | |
|---|---|
| **Study Citation:** | ATSDR, (2014). Public comment release: Public health assessment: Former Gopher Ordnance Works: Rosemount, Dakota County: Minnesota: EPA facility ID: MND980613780. |
| **HERO ID:** | 3982204 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Chemical concentration: | Eighty-two percent (23 of 28) of the building remnant samples contained a range of 1 to 45 percent asbestos (pg 26); also has soil sampling concentrations on same page, not in scope |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | Report uses high quality data/techniques/methods from frequently-used sources. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for building materials, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | High | Report is based on current industry conditions and data no more than 10 years old. |
| | Metric 5: | Sample Size | Medium | Sample distribution characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Methods, results, and assumptions are clearly documented, but underlying data sources are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Baldwin, C. A., Beaulieu, H. J., Buchan, R. M., Johnson, H. H. (1982). Asbestos in Colorado schools. Public Health Reports 97(4):325-331. |
| **HERO ID:** | 3615183 |
| **Conditions of Use:** | Consumer Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Number of sites: | The report estimates that as many as 1124 public schools in Colorado may have friable asbestos present. (6/7) |
| Chemical concentration: | The percentage of chrysotile in sprayed materials ranged from less than 1 percent to 10 percent. Actinolite was frequently found with chrysolite in sprayed materials, but only in small amounts, ranging from less than 1 to 2 percent. In other asbestos-containing materials, the amount of chrysotile varied from less than 1 percent to 95 percent. Amosite content ranged from less than 1 to 60 percent of the materials, and crocidolite was found in very small quantities, from less than 1 to 2 percent. (4/7) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Methodology | High | Report uses high quality methods and data from frequently-used sources. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | High | Data are from the U.S. |
| | Metric 3: Applicability | Low | Data are for consumer use of construction materials, which is similar to commercial use of construction materials, an in-scope occupational scenario. |
| | Metric 4: Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: Sample Size | Medium | Sample distribution characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Medium | Variability is addressed by comparing sampling results to literature. Uncertainty isn't addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Balmes, J. R., Daponte, A., Cone, J. E. (1991). Asbestos-related disease in custodial and building maintenance workers from a large municipal school district. Annals of the New York Academy of Sciences 643(1):540-549. |
| **HERO ID:** | 3082254 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Number of sites: | On the basis of a survey of the nation's public schools, the EPA estimated in 1982 that approximately 8,600 schools had friable ACM in place. (p. 1) |
| Chemical concentration: | Exposed ceiling containing 15% chrysotile. |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Methodology | Low | Sampling/analytical methodology is not specified. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | High | Data are from the U.S. |
| | Metric 3: Applicability | High | Data are for existing asbestos in school construction, an in-scope occupational scenario. |
| | Metric 4: Temporal Representativeness | Low | Data are greater than 20 years old. |
| | Metric 5: Sample Size | Medium | Distribution of samples is characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | Low | Metadata not provided beyond "EPA survey". |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination — Low

| | |
|---|---|
| **Study Citation:** | Banks, A. J. (1991). Asbestos Removal in the Construction Industry. :76. |
| **HERO ID:** | 3102239 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Process description: | [PDF Pg. 21] REMOVAL: The ACM is treated with a water and wetting agent solution to minimize fiber release. If the material will not absorb the wetting agent, a dry removal using Type C respiratory protection is appropriate. EPA must approve all dry removal operations. Friable ACM must be disposed in leak tight containers, typically 6 mil polyethylene bags. Bags can be placed in 55 gallon drums for additional protection. Bags and drums must be labeled as specified by NESHAP or OSHA. Procedures for worker protection and decontamination must be strictly follow OSHA guidance. Airborne asbestos must be measured. EPA work area containment procedures must be followed for a safe removal and disposal.[PDF Pg. 21] ENCAPSULATION:Encapsulation is the spaying of ACM with a sealant. This may be a penetrant, which penetrates and hardens the asbestos material; or a bridging encapsulant, which covers the surface of the material with a protective coating. Both types of sealants are applied using airless spray equipment at low pressure. This is done to reduce fiber release during application.Encapsulation should use only granular, cementitious material. Material that is delaminated or deteriorated should not be encapsulated. The material will be pulled down by the additional weight if its de laminated. Deteriorated ACM may be blown off by sealant application. EPA has evaluated over 100 sealants, using five criteria; impact resistance, flame spread, smoke generation, toxic gas release during combustion, and adhesive strength. This study data is useful in selecting a sealant, but the sealant should be tested on site over several days to determine its effectiveness. The type of sealant and the type of material and substrate encapsulated should be recorded. This information in needed to avoid asbestos fiber release during later remodeling or demolition.[PDF Pg. 22] ENCLOSURE:Enclosure involves the construction of airtight walls and ceilings around the ACM. The purpose is install a barrier between the ACM and the building environment. Corrugated metal or PVC installed around ACM insulated piping is an example of an enclosure. A combination of encapsulation and enclosure are often required for maximum protection. The following are recommendations for constructing enclosures.Drills equipped with HEPA (High Efficiency Particulate Air) filtered vacuums should be used during installation to reduce fiber release.It must be ensured that underlying structures are capable of supporting new walls and ceilings. New construction materials should be impact resistant and assembled to be airtight. Gypsum panels taped at the seams, tongue and groove boards, and boards with spline joints are all acceptable. suspended ceiling with lay-in panels should not be used. All joints between walls and ceilings should be caulked.Lights recessed in ACM should be carefully removed to minimize fiber release. Plumbing lines, telephone cables, and computer cables should be relocated as necessary.Building records should be updated to note the presence of asbestos behind the enclosure to prevent accidental fiber release. These documents should be reviewed before beginning remolding or demolition. Signs noting that ACM is behind the enclosure should be posted. A part of an O&M program is the documentation of ACM in a building. |
| Chemical concentration: | Table 1-1 provides approximate concentration of Asbestos in different building products. Contents vary from 5% to 100%. |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Methodology | Medium | Report uses high quality [data/techniques/methods] that are not from frequently-used sources and there are no known quality issues. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | High | Data are from the U.S. |
| | Metric 3: Applicability | High | The report is for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: Sample Size | Medium | Distribution of samples is characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | |

**Continued on next page . . .**

. . . continued from previous page

**Study Citation:** Banks, A. J. (1991). Asbestos Removal in the Construction Industry. :76.
**HERO ID:** 3102239
**Conditions of Use:** Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products

| | | | EVALUATION | |
|---|---|---|---|---|
| Domain | | Metric | Rating | Comments |
| | Metric 6: | Metadata Completeness | Medium | Methods, results, and assumptions are clearly documented, but underlying data sources are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | Variability is addressed by comparing Asbestos content in different building products but uncertainty is not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Bates, L. (1986). Environmental management: Asbestos information centers. Environment: Science and Policy for Sustainable Development 28(2):42-43. |
| **HERO ID:** | 6876542 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Number of sites: | The EPA evaluation reported that nearlythirty-one thousand schools, with a totalarea of 169 million square feet, contain friable asbestos material (PDF pg 3) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | Medium | Report uses high quality data that are not from frequently-used sources and there are no known quality issues. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for construction materials, an in-scope occupational scenario |
| | Metric 4: | Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: | Sample Size | Low | Sample distribution is characterized by no statistics. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Methods, results, and assumptions are clearly documented, but underlying data sources are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Beddows, N. A. (1990). Concerns about indoor air quality warrant review of HVAC systems. Occupational Health and Safety 59(5):77-81, 87. |
| **HERO ID:** | 3615220 |
| **Conditions of Use:** | Consumer Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Number of sites: | A 1988 study by the Environmental Protection Agency reported that 733,000 public and commercial buildings contain asbestos, much of it used as fire protection in multi-story buildings. (2/5) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | Report uses high quality methods and data from frequently-used sources. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | Low | Data are for general exposure to asbestos in public and commercial buildings, which is similar to the in-scope occupational scenario commercial use of construction products. |
| | Metric 4: | Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: | Sample Size | Medium | Sample distribution characterized by limited statistics (number of sites) but discrete samples not provided and distribution not fully characterized. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Low | Assessment results are provided but underlying methods, assumptions, and data sources are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination — Low

| | |
|---|---|
| **Study Citation:** | Belanger, P. L., Elesh, E. (1979). Health hazard evaluation report no. HETA 78-73-612, Kentile Floors, Inc., Chicago, Illinois. |
| **HERO ID:** | 3970489 |
| **Conditions of Use:** | Other: |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Process description: | In the process room, chemical weighing and mixing is accomplished. The pigment operator measures the required quantities of pigments (from bulk materials) at a booth which has slot ventilation. The pigment is placed in a plastic bag and dropped into the hopper car. The hopper proceeds to the first of two scales, both of which have canopy exhaust ventilation, where the resin scale operator places a bag of asbestos onto a horizontal chute, splits it in both directions and pushes the bag into the hopper. Two additional chemicals are automatically metered and conveyed to the hopper. The hopper car is transferred to the second scale operator who loads the hopper with scrap tile. The hopper car is then conveyed to the Banbury mixer where the operator dumps the hopper load into one of two mixers inlet chute which are alternately charged and dumped onto a conveyor belt below. In addition, the mixer operator triggers a switch which dumps the other chemicals (plasticizer, limestone, polyvinyl chloride pellets, scrap tiles, and water) into the inlet chute. The materials are mixed for the prescribed time; after which, the load is released through the discharge chute. The mixture, when released, is hot (160-300°F) due to frictional mixing. The mixture is subsequently conveyed to the mil ls to be gauged, colored, waxed, polished, cut and packed. The mottle, once gauged, is crushed and added to the vinyl asbestos tile. (5/24) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Methodology | High | Report uses high quality methods and data from frequently-used sources. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | High | Data are from the U.S. |
| | Metric 3: Applicability | Uninformative | Data are for manufacture of asbestos products, which is not in scope. |
| | Metric 4: Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: Sample Size | N/A | N/A - This metric is not applicable to the data being extracted |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Uninformative

| | |
|---|---|
| **Study Citation:** | Blake, C. L., Dotson, G. S., Harbison, R. D. (2008). Evaluation of asbestos exposure within the automotive repair industry: a study involving removal of asbestos-containing body sealants and drive clutch replacement. Regulatory Toxicology and Pharmacology 52(3):324-331. |
| **HERO ID:** | 2599024 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Chemical concentration: | Bulk samples of seam sealant material were 5.6-28% asbestos. (5/8) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | Report uses high quality methods and data from frequently-used sources. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for commercial use of adhesives and sealants, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Medium | Report is based on data greater than 10 years old but no more than 20 years old and industry conditions that are expected to be representative of current industry conditions. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | The report provides only limited discussion of the variability and uncertainty in the results. Uncertainty is addressed in bulk sampling methods. Variability is addressed by sampling two car makes. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Blake, C. L., Johnson, G. T., Harbison, R. D. (2009). Airborne asbestos exposure during light aircraft brake replacement. Regulatory Toxicology and Pharmacology 54(3):242-246. |
| **HERO ID:** | 2594497 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Chemical concentration: | Chrysotile asbestos content of aircraft brakes typically ranges from 16-23% by weight. [PDF Pg. 1]Analysis performed using Polarized Light Microscopy indicated the presence of 10% by area chrysotile asbestos in each brake pad. [PDF Pg. 3] |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | Report uses high quality data/techniques/methods from frequently-used sources. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for Chemical Substances in Construction, Paint, Electrical, and Metal Products, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Medium | Report is based on data greater than 10 years old but no more than 20 years old and industry conditions that are expected to be representative of current industry conditions. |
| | Metric 5: | Sample Size | Medium | Sample distribution characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | Uncertainty is addressed by sampling methods for asbestos content. Variability is not addressed. |

## Overall Quality Determination — High

| | |
|---|---|
| **Study Citation:** | Boelter, F. W. (2003). Asbestos exposures from gasket removal - Author's reply. AIHA Journal 64(5):595-597. |
| **HERO ID:** | 3584902 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Chemical concentration: | Gaskets typically contain 60 to 80% asbestos. (P. 1/3) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | Medium | Sampling method is an approved NIOSH method, but the paper states that it wasn't followed properly. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | The data are from the United States |
| | Metric 3: | Applicability | High | The report is for an occupational scenario |
| | Metric 4: | Temporal Representativeness | Medium | More than 10 years but no more than 20 years old. |
| | Metric 5: | Sample Size | Medium | Distribution of samples is characterized by a range. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Data sources are generally described but not fully transparent. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | The report does not address variability or uncertainty |

## Overall Quality Determination — Medium

| | |
|---|---|
| **Study Citation:** | Boelter, F. W., Crawford, G. N., Podraza, D. M. (2002). Airborne fiber exposure assessment of dry asbestos-containing gaskets and packings found in intact industrial and maritime fittings. AIHA Journal 63(6):732-740. |
| **HERO ID:** | 3520465 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Products not Described by Other Codes |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Chemical concentration: | All of the gasket and packing material removed was fibrous. All materials were retained and tested to verify asbestos content. When old gasket material was determined to contain asbestos, content ranged from 40 to 80% chrysotile. There were no crocidolite gaskets encountered. |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | The assessment or report uses high quality data and/or techniques that are from frequently used sources. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | The data are from the United States. |
| | Metric 3: | Applicability | High | The report is for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Low | The report is more than 20 years old. |
| | Metric 5: | Sample Size | Medium | Distribution of samples is characterized by a range with uncertain statistics. It is unclear if analysis is representative. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | The assessment generally documents its data source, but the source of the asbestos concentration range is not clear. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | Uncertainty of asbestos concentrations in gaskets is vaguely described, but variability is not characterized. |

## Overall Quality Determination — Medium

| | |
|---|---|
| **Study Citation:** | Boelter, F. W., Spencer, J. W., Simmons, C. E. (2007). Heavy equipment maintenance exposure assessment: using a time-activity model to estimate surrogate values for replacement of missing data. Journal of Occupational and Environmental Hygiene 4(7):525-537. |
| **HERO ID:** | 3079629 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Chemical concentration: | Concentrations:Industrial/commercial pumps (Ref A-F): Packing: 20-60% Chrysotile, max of 80% crocidolite; Gaskets: 25-95% chrysotilePump fittings, check valves (Ref G): Gaskets: 65-75% chrysotileIndustrial maritime fittings (Ref H,I): Packing: 40-80% Chrysotile; Gaskets: 50-90% chrysotileValve fittings for boiler (Ref J): Gaskets: 60-75% chrysotileCommercial boiler (Ref K): Gasket: 50% ChrysotileHeavy machinery (Ref M): Gaskets: 3-85% chrysotile (Table I, pgs. 5-7/17) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Methodology | High | The assessment or report uses high quality data and/or techniques or sound methods that are from a frequently used source and are generally accepted by the scientific community, and associated information does not indicate flaws or quality issues. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | High | The data are from the United States and are representative of the industry being evaluated. |
| | Metric 3: Applicability | High | The report is for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: Temporal Representativeness | Low | The report uses data that is more than 20 years old. The report captures operations, equipment, and worker activities that are expected to be outdated. |
| | Metric 5: Sample Size | Medium | Distribution of samples is characterized by a range with uncertain statistics. It is unclear if analysis is representative. |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | High | Assessment or report clearly documents its data sources, assessment methods, results, and assumptions. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | High | The report addresses variability and uncertainty in the results. Uncertainty is well characterized. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Boelter, F. W., Xia, Y., Persky, J. D. (2016). A Bayesian model and stochastic exposure (dose) estimation for relative exposure risk comparison involving asbestos-containing dropped ceiling panel installation and maintenance tasks. Risk Analysis :1729-1741. |
| **HERO ID:** | 3520468 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Throughput: | Typical ceiling panel sizes include 24" × 24" and 24"× 48" (1/13) |
| Chemical concentration: | Ceiling panels contained 4.24% amosite, 3.25% amosite, and 1.50% chrysotile at site A. At site B, one panel had 1.0% amosite, and one panel had 1,25% amosite and 0.25% chrysotile. (3/13) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | Report uses high quality methods and data from frequently-used sources. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for commercial use in building construction materials, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | High | Report is based on current industry conditions and data no more than 10 years old. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | High | Uncertainty is addressed in bulk sampling methods. Variability is addressed by sampling at two sites. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Boelter, F., Simmons, C., Hewett, P. (2011). Exposure data from multi-application, multi-industry maintenance of surfaces and joints sealed with asbestos-containing gaskets and packing. Journal of Occupational and Environmental Hygiene 8(4):194-209. |
| **HERO ID:** | 2576853 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Chemical concentration: | friction and gasket material and debris form brake & clutch removal.The removed and replaced brake materials from all four pieces of equipment contained from 15% to 95% chrysotile asbestos. Bulk sample analysis for asbestos in brake debris collected from all four machines yielded either nondetectable or less than 1% chrysotile asbestos. Removed and replaced gasket materials positive for asbestos ranged from 3% to 85% chrysotile. |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Methodology | High | The methods used for the batch sampling were provided |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | Assumed US |
| Metric 3: | Applicability | High | The report is for an occupational scenario ( Heavy Duty vehicle mechanic) within the scope of the risk evaluation. |
| Metric 4: | Temporal Representativeness | Medium | 2003 - after PEL (1994) and more 10 and less than 20 years old |
| Metric 5: | Sample Size | Medium | Distribution of samples is characterized by a range . |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | High | The report clearly documents the approach used in the batch sampling. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Medium | The report provides only limited discussion of the variability and uncertainty in the results. |

## Overall Quality Determination — High

| | |
|---|---|
| **Study Citation:** | Bone, J. (1992). Custodial workers face asbestos hazards. Safety and Health 146(1):70-75. |
| **HERO ID:** | 6904976 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Life cycle description: | 3 school buildings, 54 acres of flat roof. 100 acres of floor tile |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | Medium | The assessment or report uses high quality data and/or techniques or sound methods that are not from a frequently used source and associated information does not indicate flaws or quality issues. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | The data are from the United States. |
| | Metric 3: | Applicability | Medium | The report is for an occupational scenario that is similar to an occupational scenario within the scope of the risk evaluation, in terms of the type of industry, operations, and work activities. |
| | Metric 4: | Temporal Representativeness | Low | The report is more than 20 years old. |
| | Metric 5: | Sample Size | N/A | n/a - no sampling data |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Assessment or report clearly documents results, methods, and assumptions. Data sources are generally described but not fully transparent. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | The report provides only limited discussion of the variability and uncertainty in the results. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Borcherding, C. H. (1976). Health hazard evaluation report no. HHE 75-192-330, Pittsburgh Plate Glass Ind., Mt, Zion, Illinois. |
| **HERO ID:** | 3970512 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Process description: | The rollers are fabricated by the following method:(l) 6 to 8 asbestos discs are nailed together (via nailing machine),(2) groups of discs are hydraulically pressed on a steel mandrel, (3) the assembled unit is then lathe turned to finished dimensions, (4) cullet(broken glass) slots are milled into the roller while mounted in thelathe, (5) completed ro1lers are stored in racks - outside the RollFabrication Room. |
| Comments: | Asbestos concentration in asbestos-containing rollers was not give in the document. |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | Report uses high quality data/techniques/methods from frequently-used sources. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for Chemical Substances in Construction, Paint, Electrical, and Metal Products, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: | Sample Size | N/A | N/A - Process description. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | N/A | N/A - Process description. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Borcina, D. M. (1967). Lead-asbestos anti-vibration pads in the United States. :311-317. |
| **HERO ID:** | 6917604 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Life cycle description: | ...use of lead-asbestos anti-vibration pads in building foundations and under certain types of machinery, |
| Number of sites: | p. 1 includes a partial list of users of asbestos anti-vibration pads |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | Medium | The assessment or report uses high quality data and/or techniques or sound methods that are not from a frequently used source and associated information does not indicate flaws or quality issues. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | The data are from the United States and are representative of the industry being evaluated. |
| | Metric 3: | Applicability | Low | The report is for a non-occupational scenario that is similar to an occupational scenario within the scope of the risk evaluation |
| | Metric 4: | Temporal Representativeness | Low | The report is more than 20 years old. The report captures operations, equipment, and worker activities that are expected to be outdated. |
| | Metric 5: | Sample Size | N/A | No sample data. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Assessment or report clearly documents results, methods, and assumptions. Data sources are generally described but not fully transparent. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | The report does not address variability or uncertainty. |

## Overall Quality Determination — Low

| | |
|---|---|
| **Study Citation:** | Bozzelli, J. W., Russell, J. F. (1982). Airborne asbestos levels in several school buildings before and after bulk asbestos removal. International Journal of Environmental Studies 20(1):27-30. |
| **HERO ID:** | 3584009 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Chemical concentration: | 5-20 % (P.2/5) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | The assessment or report uses high quality data and/or techniques . |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | The data are from the United States |
| | Metric 3: | Applicability | High | The report is for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Low | The report is more than 20 years old. |
| | Metric 5: | Sample Size | Medium | Distribution of samples is characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | Assessment or report clearly documents results, methods, and assumptions. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | The report does not address variability or uncertainty. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Bragg, G. M. (1987). Asbestos in the environment- an industry viewpoint. Environmental Technology Letters 8(6):289-296. |
| **HERO ID:** | 3647211 |
| **Conditions of Use:** | Other: |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Production, import, or use volume: | Three asbestos mills had production volumes of 39,103 tons/yr, 100,330 tons/yr, and 263,000 tons/yr (6/9). |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Methodology | Medium | Report uses high quality data that are not from frequently-used sources and there are no known quality issues. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | Medium | Data are from Canada, an OECD country. |
| | Metric 3: Applicability | Uninformative | Data are for mining and milling for manufacture of asbestos products. Such operations have ceased in the United States and are not under investigation in this risk evaluation. |
| | Metric 4: Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: Sample Size | High | Statistical distribution of samples is fully characterized (discrete PVs provided). |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | Medium | Methods, results, and assumptions are clearly documented, but underlying data sources are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Medium | Uncertainty isn't addressed. Variability is addressed by gathering data from 3 different mills. |

## Overall Quality Determination — Uninformative

| | |
|---|---|
| **Study Citation:** | Bragg, G. M. (1988). The basics of asbestos dust control. |
| **HERO ID:** | 6904663 |
| **Conditions of Use:** | Other: |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Process description: | Upstream, out of scope: Pg 8 has diagram of asbestos cement pipe MFG plant; pg 9 has description of that and asbestos cement sheets Pg 10 has diagram of friction product MFG Pg 11 has diagram of textile plants |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | Medium | Report uses high quality data/techniques/methods that are not from frequently-used sources and there are no known quality issues. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Medium | Data are from Canada, an OECD country. |
| | Metric 3: | Applicability | Uninformative | Data are for upstream uses (MFG of asbestos products), which is out of scope for the legacy asbestos risk evaluation. |
| | Metric 4: | Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: | Sample Size | N/A | Qualitative data without sampling data. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Methods, results, and assumptions are clearly documented, but underlying data sources are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Uninformative

| | |
|---|---|
| **Study Citation:** | Brophy, J., Parent, M. (1999). Documenting the asbestos story in Sarnia. New Solutions: A Journal of Environmental and Occupational Health Policy 9(3):297-316. |
| **HERO ID:** | 3079691 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Chemical concentration: | Pipe insulation was made of 55-60% amosite (2/20) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | Low | Report does not specify the data used. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Medium | Data are from Canada, an OECD country. |
| | Metric 3: | Applicability | High | Concentration data can be applied to industrial, commercial, or consumer use in construction materials, which is an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: | Sample Size | Medium | Sample distribution characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Methods, results, and assumptions are clearly documented, but underlying data sources are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Low

| | |
|---|---|
| **Study Citation:** | Brown, S. K. (1987). Asbestos exposure during renovation and demolition of asbestos-cement clad buildings. American Industrial Hygiene Association Journal 48(5):478-486. |
| **HERO ID:** | 1057177 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Life cycle description: | Because of the ages of the buildings involved, the extent of surface deterioration of roofing usually was severe: each sheet presented a loose surface layer enriched in asbestos compared with the original product. Asbestos concentrations during building demolition weremeasured only for the period of sheet handling. |
| Chemical concentration: | Four samples of asbestos-cement roof sheets were taken. Fiber contents were 32%, 25%, 22%, and 24%. (4/10) Dust concentrations accumulated during demolition were 0.006-3.7% chrysotile and 0.003-0.9% amosite. (8/10) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Methodology | High | Report uses high quality methods and data from frequently-used sources. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | Medium | Data are from Australia, an OECD country, |
| Metric 3: | Applicability | High | Data are for commercial use in building construction materials, an in-scope occupational scenario. |
| Metric 4: | Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | High | Uncertainty is addressed in the bulk sampling methodology. Variability is addressed by sampling at different sites. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Brown, S. K. (1988). Asbestos exposure to workers demolishing asbestos cement clad buildings. 1-2:344-350. |
| **HERO ID:** | 6864456 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Process description: | A series of work trials were carried out at several sites where 30 to 40 year old AC clad buildings were re-roofed or demolished. Roofreplacement was carried out by two to six men working on top of the roof who repetitively unfastened and removed small sections (20 to 40 m2) of old AC roofing and replaced it with steel roofing. Sheets were removed whole and were carried across the roof to be stacked or dropped into a bin at ground level. Trials were conducted for 2 to 6 hours during which 50 to 100 m2 of roofing was replaced. The buildings that were demolished were several large (90 m x 36 m) warehouses with corrugated AC roofing and flat AC sheet wall cladding. Most of these were demolished by removal of whole sheets from the structure by men confined to elevated platforms beneath the sheeting. In comparison to roof replacement, work conditions during demolition were more confined, involved closer handling of sheeting and were visibly more dusty, particularly as sheets were stacked on the platforms. Repetitive trials over shorter periods(30 to 60 minutes) were generally employed for these cases. In sometrials comparative measurements were made after sheeting had been wet with water or sealed on its weathered surface with an acrylic emulsion (28% by weight solids applied at 0.3L/m2). |
| Chemical concentration: | It is seen that the layer is enriched in asbestos fibre relative to the original product (usually 12 to 15 % w/w asbestos). |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Methodology | Medium | The assessment or report uses high quality data and/or techniques or sound methods that are not from a frequently used source and associated information does not indicate flaws or quality issues. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | Medium | The data are from an OECD country other than the U.S. |
| Metric 3: | Applicability | High | The report is for an occupational scenario within the scope of the risk evaluation. |
| Metric 4: | Temporal Representativeness | Low | The report is more than 20 years old. |
| Metric 5: | Sample Size | Medium | Distribution of samples is characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Medium | Assessment or report clearly documents results, methods, and assumptions. Data sources are generally described but not fully transparent. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Low | The report does not address variability or uncertainty. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Brown, S. K., Angelopoulos, M. (1991). Evaluation of erosion release and suppression of asbestos fibers from asbestos building products. American Industrial Hygiene Association Journal 52(9):363-371. |
| **HERO ID:** | 3583115 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Chemical concentration: | Static sampling of building air by recommended procedures while the building was occupied found fiber concentrations of 0.01 f/mL with only 4% of the counted fibers exhibiting the straight, needle-like morphology expected for amosite. (pg 369) |
| Comments: | Release from asbestos cement products that contain approximately 10-15% asbestos was low, butthat from Insulation Board IB2 and millboard (containing 30-73% asbestos) was high. (P. 8/10) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Methodology | High | Report uses high quality data and/or techniques or sound methods |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | Medium | Data are from an OECD country other than the U.S |
| | Metric 3: Applicability | Medium | Report is for an occupational scenario that is similar to an occupational scenario within the scope of the risk evaluation |
| | Metric 4: Temporal Representativeness | Low | The report is more than 20 years old. |
| | Metric 5: Sample Size | Medium | Distribution of samples is characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | High | Report clearly documents its data sources, assessment methods |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Low | The report does not address variability or uncertainty. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Brownlee, J. A., Lucas, J. H., Walls, K. J., Murphy, J. J., Dinardo, C. (1988). Achieving a transmission electron microscopy clearance criterion at asbestos abatement sites in New Jersery. |
| **HERO ID:** | 6904406 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Number of sites: | 79 schools (3/14) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | Report uses high quality methods and data from frequently-used sources. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for removal of asbestos products, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: | Sample Size | Medium | Sample distribution characterized by limited statistics (number of sites) but discrete samples not provided and distribution not fully characterized. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Assessment or report clearly documents results, methods, and assumptions. Data sources are generally described but not fully transparent. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | The report provides only limited discussion of the variability and uncertainty in the results. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Bryant, C. J. (1987). Health hazard evaluation report no. HETA-86-434-1833, Federal Office Building, Evansville, Indiana. |
| **HERO ID:** | 3970468 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Chemical concentration: | Polarized light microscopyU.S. District Court/Clerk of Courts Rm. 304 (Top of Filing Cabinet) 1% ChrysotileElectrical Room, Rm. 243, Fireproofing From Upper Surface of Ceiling Tiles 1 - 2% ChrysotileFireproofing Material Coming Through Ceiling Diffuser 5 - 7% ChrysotileBulk Sampling Non Detects Return Air Grille, In Hallway Outside Rm. 356 NDReturn Air Grille, In Hallway Outside Rm. 348 NDFireproofing Material, Men°s 3rd Floor Upper Surface of Ceiling Tiles NDWall Outside Judges Chambers, Rm. 310-I Material leaking from Wet Ceiling NDWall Outisde Rm. 313 B Material Leaking from Wet Ceiling NDDust Behind Pop Machine Across From Elevator ND Settled Dust in Fan Housing Return Air HVAC NDFilter Material From Supply HVAC NDFilter Material From Return HVAC NDFilter Material From District Court HVAC Unit NDFilter Material From Bankruptcy Court HVAC Unit ND |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Methodology | High | NIOSH study |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | USA |
| Metric 3: | Applicability | High | The report is for an occupational scenario (Federal office worker) within the scope of the risk evaluation. |
| Metric 4: | Temporal Representativeness | Low | 1986 - more than 20 years old |
| Metric 5: | Sample Size | Medium | Some of the asbestos concentrations are provided as a range, but no additional statistics are provided. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | High | This NIOSH report clearly documents its data sources, assessment methods, results, and assumptions. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Medium | Some of the asbestos concentrations are provided as a range, which could be helpful in assessing variability; nothing was provided concerning uncertainty. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Burdett, G. J., Jaffrey, S. A. M.,T (1986). Airborne asbestos concentrations in buildings. Annals of Occupational Hygiene 30(2):185-199. |
| **HERO ID:** | 274 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Life cycle description: | Artex plaster contains 1-5% chrysotileWarm-Air Heaters:Electric warm air night storage units 'Creda Constor' CS60 fan driven (containing 'Caposil' insulation (8-20% chrysotile/amosite). Also Creda CS45 units with chrysotile paper insulation.Electricaire warm air night storage unit 'Enviwarm' containing amosite and chrysotile in the insulation and heating element.'Revo' RE72 with Caposil base.'Dunlop Westaire' CSFH28 and CSFH 48 with possible asbestos and other asbestos-free units. |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Methodology | Medium | The assessment or report uses high quality data and/or techniques or sound methods that are not from a frequently used source and associated information does not indicate flaws or quality issues. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | The data are from the United States. |
| Metric 3: | Applicability | Medium | The report is for an occupational scenario that is similar to an occupational scenario within the scope of the risk evaluation, in terms of the type of industry, operations, and work activities. |
| Metric 4: | Temporal Representativeness | Low | The report is more than 20 years old. |
| Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized. Sample size is sufficiently representative. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Medium | Assessment or report clearly documents results, methods, and assumptions. Data sources are generally described but not fully transparent. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Medium | The report provides only limited discussion of the variability and uncertainty in the results. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Burr, G. A. (2003). Health hazard evaluation report no. HETA 2005-0369-3034, City of Cleveland Heights, Cleveland Heights, Ohio. |
| **HERO ID:** | 3970535 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Chemical concentration: | [PDF Pg. 13]Sprayed-on insulation on metal support beam, above the southtruck loading bay on the second level.: 5 - <10% Sprayed-on insulation on metal support on the south chuteassembly, second level.: 3 - <5%Insulation applied to interior surface of the west wall adjacent tothe south chute, beneath a window.: 3 - <5%Sprayed-on insulation on metal support beam, above north truckloading bay on the second level.: 3 - <5%Damage pipe insulation on main floor, between the truck loadingbays. This pipe lagging was severely damaged. Sample one oftwo.: 40 - <50%Damage pipe insulation on main floor, between the truck loadingbays. This pipe lagging was severely damaged. Sample two oftwo.: 20 - <30%Sprayed-on insulation on north wall of the main floor.: 5 - <10%Sprayed-on insulation from surface located between the loadingchutes on the main floor.: 3 - <5% |
| Comments: | Bulk samples were analyzed by polarized light microscopy according the 4th Edition of the NIOSH Manual of Analytical Methods, Method No. 9002. [PDF Pg. 14] |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | Report uses high quality data/techniques/methods from frequently-used sources. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for Chemical Substances in Construction, Paint, Electrical, and Metal Products, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Medium | Report is based on data greater than 10 years old but no more than 20 years old and industry conditions that are expected to be representative of current industry conditions. |
| | Metric 5: | Sample Size | Medium | Sample distribution characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | High | Uncertainty is addressed by sampling method. Variability addressed by sampling multiple bulk materials. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Burton, N. C., Buchta, T. M. (1993). Health hazard evaluation report no. HETA 91-215-2293, Internal Revenue Services Appeals Office, Omaha, Nebraska. |
| **HERO ID:** | 3647825 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Chemical concentration: | Review of industrial hygiene sampling data provided by GSA showed the presence of 3-10% chyrsotile (a form of asbestos fiber) in bulk samples of insulation material [1990 data] and no detectable levels of asbestos fibers in the office areas at the analytical limit of detection of 0.004 fibers per cubic centimeter of air [according to NIOSH analytical method 74001] (1992 data). [PDF Pg. 7] |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Methodology | High | Report uses high quality data/techniques/methods from frequently-used sources. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | High | Data are from the U.S. |
| | Metric 3: Applicability | High | Data are for Chemical Substances in Construction, Paint, Electrical, and Metal Products, an in-scope occupational scenario. |
| | Metric 4: Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: Sample Size | Medium | Sample distribution characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Medium | Uncertainty is addressed by bulk sampling methods. Variability is not addressed. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Butler, C., McCleery, R. E., Kiefer, M., Harper, M., Lee, E. G., Wallingford, K. (2014). Health hazard evaluation report: Evaluation of employee exposures to Libby amphibole asbestos during forest management activities in the Kootenai National Forest. :1-35. |
| **HERO ID:** | 7605003 |
| **Conditions of Use:** | Other: |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Chemical concentration: | Bulk samples of soil, duff, and bark were analyzed with polarized light microscopy according to NIOSH Method 9002 [NIOSH 2014].No asbestos was identified in any of the bulk or surface samples collected. [PDF Pg. 19] |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Methodology | High | Report uses high quality data/techniques/methods from frequently-used sources. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | High | Data are from the U.S. |
| | Metric 3: Applicability | Low | Data are for residual exposures to park rangers working close to an old vermiculite mine. |
| | Metric 4: Temporal Representativeness | High | Report is based on current industry conditions and data no more than 10 years old. |
| | Metric 5: Sample Size | Low | Sample distribution is described qualitatively. |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | CalEPA, (2003). Public health goal for Asbestos in drinking water. |
| **HERO ID:** | 3840043 |
| **Conditions of Use:** | Other: |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Life cycle description: | Heat resistant agent used in construction materials, clothing, disk brake pads, gaskets. Use in the US banned for spray-appliedsurfacing (1973, 1978, 1990); pipe and block insulation on facility components (1975); papers, flooring felt, and rollboard (1976); artificial embers and wallpatching compounds (1977). |
| Chemical concentration: | As per California Public Health Goals, inhalation unit risk is 6.3e-2 (ug/m3)^-1. No Significant Risk Level (NSRL) for inhalation is 100 fibers/day. In water, public health goal is 7 million fibers/L, which is the MCL value. |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | The assessment or report uses high quality data from frequently used sources. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | The data are from the United States. |
| | Metric 3: | Applicability | Low | The report is for drinking water standards regarding asbestos. However, inhalation unit risk may be useful. |
| | Metric 4: | Temporal Representativeness | Medium | The report is generally more than 10 years but no more than 20 years old. |
| | Metric 5: | Sample Size | N/A | Sample size not applicable to public health goals. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | Report clearly documents its data sources. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | The report does not address variability or uncertainty. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | CalEPA, (2001). Deconstruction training manual: Waste management reuse and recycling at Mather Field. |
| **HERO ID:** | 3981094 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Chemical concentration: | 5-95% in spray-on fireproofing (p. 22) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | Medium | The assessment or report uses high quality data and/or techniques or sound methods that are not from a frequently used source and associated information does not indicate flaws or quality issues |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | The data are from the United States and are representative of the industry being evaluated. |
| | Metric 3: | Applicability | High | The report is for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Low | The report is more than 20 years old. The report captures operations, equipment, and worker activities that are expected to be outdated. |
| | Metric 5: | Sample Size | N/A | N/A - data not based on sampling |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | Assessment or report clearly documents its data sources, assessment methods, results, and assumptions. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | The report provides only limited discussion of the variability and uncertainty in the results. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Campopiano, A., Casciardi, S., Fioravanti, F., Ramires, D. (2004). Airborne asbestos levels in school buildings in Italy. Journal of Occupational and Environmental Hygiene 1(4):256-261. |
| **HERO ID:** | 3520506 |
| **Conditions of Use:** | Consumer Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Number of sites: | 59 primary and secondary schools in Italy. (3/7) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | Assessment uses high quality data from frequently-used sources. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Medium | Data are from Italy, an OECD country. |
| | Metric 3: | Applicability | Low | Data are for consumer use of construction materials in schools, which is similar to commercial use of construction materials, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Assessment is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: | Sample Size | Medium | Sample distribution characterized by limited statistics (number of sites) but discrete samples not provided and distribution not fully characterized. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination — Medium

| | |
|---|---|
| **Study Citation:** | Camus, M. (2001). Exposure to commercial chrysotile - Mineralogy, modern products and exposures: Rapporteur's report. Canadian Mineralogist, Special Publication 5 :127-129. |
| **HERO ID:** | 6863393 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Production, import, or use volume: | Asbestos imports into the U.S ., which are mainly from Canada,ranged from a high of 693,674 tonnes in 1973 to a low of 14,300 tonnes in 1999. |
| Comments: | Contains information on worker exposures in the asbestos mining and processing industries |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Methodology | Medium | The assessment or report uses high quality data and/or techniques or sound methods that are not from a frequently used source and associated information does not indicate flaws or quality issues. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | High | The data are from the United States and are representative of the industry being evaluated. |
| | Metric 3: Applicability | Uninformative | The report is from an occupational or non-occupationalscenario that does not apply to any occupational scenario within the scope of the risk evaluation |
| | Metric 4: Temporal Representativeness | Low | The report is more than 20 years old. The report captures operations, equipment, and worker activities that are expected to be outdated. |
| | Metric 5: Sample Size | N/A | N/A - no sampling data |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | Medium | Assessment or report clearly documents results, methods, and assumptions. Data sources are generally described but not fully transparent. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Medium | The report provides only limited discussion of the variability and uncertainty in the results. |

## Overall Quality Determination Uninformative

| | |
|---|---|
| **Study Citation:** | Caplan, P. E. (1985). Preliminary Survey Report: Control Technology For Asbestos Removal Industry, Report No. CT-147-16a, Veterans Administration Hospital, Denver, Colorado. NIOSH(CT-147-16a):147-16. |
| **HERO ID:** | 3101588 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Process description: | [PDF Pg. 7-8]Several removal phases had already been completed before this survey was made. One phase had involved the removal of pipe lagging and contaminated soil from the crawl spaces beneath the hospital. This was described as a very difficult job.A previous phase had involved the removal of asbestos from hot boilers and pipes. This condition was necessary, since these hot systems needed to remain in operation during the removal period. Removal activities were interrupted between phases so that completed areas could be renovated and reoccupied before a new phase began. At the time of this visit, a new removal phase had just commenced. Workers, on ladders, were removing pipe lagging from above a false ceiling. They were also cleaning corridor ceiling pans which contained fiber glass insulation batting. Wet removal methods were used, including spraying of pipe lagging and cleaning of surfaces with wet rage. HEPA cleaning was also used. |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Methodology | High | Report uses high quality data/techniques/methods from frequently-used sources. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | High | Data are from the U.S. |
| | Metric 3: Applicability | High | Data are for Chemical Substances in Construction, Paint, Electrical, and Metal Products, an in-scope occupational scenario. |
| | Metric 4: Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: Sample Size | N/A | N/A - process description. |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Low | The report does not address variability or uncertainty. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Caplan, P. E. (1985). Preliminary Survey Report: Control Technology Of Asbestos Removal Industry, Report No. CT-147-17a, Baseline Junior High School, Boulder, Colorado. NIOSH(CT-147-17a):147-17. |
| **HERO ID:** | 3101590 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Process description: | removal of boiler insulation, pipe lagging, boiler ends and air duct insulation. |
| Number of sites: | 1 |
| Chemical concentration: | material contained 15-70% asbestos |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | NIOSH study |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | US |
| | Metric 3: | Applicability | High | The report is for an occupational scenario ( Asbestos removal from a school) within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Low | 1984- more than 20 years old |
| | Metric 5: | Sample Size | Medium | A range of concentrations was provided |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | NIOSH assessment clearly documents its data sources, assessment methods, results, and assumptions. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | The report provided range of concentrations which can be helpful in assessing variability, but nothing was provided related to uncertainty in the results. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Cardarelli, R., Chow, D. (2000). The good, the bad and the costly: asbestos abatement versus management. Hazardous Materials Management 12(5):28-28,30. |
| **HERO ID:** | 6903801 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Production, import, or use volume: | The most common type of asbestos is chrysotile, which accounts for over 90 percent of asbestos production in the world and represents over 95 percent of asbestos in buildings. |
| Process description: | A single-story building (50,000 square feet) had asbestos in the boiler room with sprayed-on fireproofing behind suspended ceilings over 60 percent of the building area (30,000 square feet) and pipe insulation and elbows in a 20,000 square foot area. Twenty bulk samples were collected and analyzed. Asbestos abatement was conducted while the building was fully occupied. |
| Number of sites: | 20% of building in North America contain asbestos. |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | Low | The data and data sources used for estimates are not specified. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Medium | The data are from an OECD country other than the U.S. |
| | Metric 3: | Applicability | High | The report is for an occupational scenario ( buildings that contain asbestos products) within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Low | The report is more than 20 years old. |
| | Metric 5: | Sample Size | Low | Simple estimate of homes with asbestos was provided without any supporting statistics. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Low | Report provides results, but the underlying methods, data sources, and assumptions are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | The report does not address variability or uncertainty. |

## Overall Quality Determination Low

**Study Citation:** CAREX Canada, (2016). Substance profile: Asbestos.
**HERO ID:** 3978366
**Conditions of Use:** Other:

**EXTRACTION**

| Parameter | Data |
|---|---|
| Production, import, or use volume: | When asbestos use hit its peak in 1973, US consumption totaled 801,000 tonnes (t) and the major markets in the US included asbestos cement pipes (192,000 t); flooring (176,000 t); roofing (72,000 t); friction products, such as automobile brakes and clutches (64,000 t); and packing and gaskets (24,000 t). Consumption of unmanufactured asbestos fiber in the United States was 343 t in 2015, down by 16% from 406 t in 2014. The chloralkali industry, which uses asbestos to manufacture semipermeable diaphragms accounted for an estimated 95% of domestic asbestos consumption during 2015. (pg 3 of 6) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Methodology | High | Report uses high quality data. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | High | The data are from the United States |
| | Metric 3: Applicability | Uninformative | Manufacturing is not in scope for the legacy risk evaluation. |
| | Metric 4: Temporal Representativeness | High | The report is generally no more than 10 years old. |
| | Metric 5: Sample Size | N/A | No sample data. |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | High | Report clearly documents its data sources. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | N/A | No scope to address variability and uncertainty. |

## Overall Quality Determination Uninformative

**Study Citation:** CAREX Canada, (2016). Substance profile: Asbestos.
**HERO ID:** 3978366
**Conditions of Use:** Other:

**EXTRACTION**

| Parameter | Data |
|---|---|
| Life cycle description: | Asbestos was used primarily for roofing, thermal and electrical insulation, cement pipe and sheets, flooring, gaskets, friction materials, coatings, plastics, textiles, paper, and other products. |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | Report uses high quality data. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Medium | The report is from an OECD country other than the U.S. |
| | Metric 3: | Applicability | High | The report is for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | High | The report is generally no more than 10 years old. |
| | Metric 5: | Sample Size | N/A | No sample data. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | Report clearly documents its data sources. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | N/A | No scope to address variability and uncertainty. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | CDM Federal Programs Corporation, (2015). Site-wide human health risk assessment. |
| **HERO ID:** | 3970083 |
| **Conditions of Use:** | Other: |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Chemical concentration: | Table 6-4 summarizes the expected surface soil concentrations at properties in OU4 and OU7 where soil removals have and have not been completed. As shown, for properties where a soil removal has been completed (Category #1), surface soils that remain "post-removal" should be a mixture of Bin A (non-detect for LA) and topsoil fill materials (which are also non-detect for LA). For properties where no soil removal had been deemed necessary prior to 2014 (Category #2), soil concentrations could be as high as Bin B2 across the total exposure area (Bin C concentrations would have triggered a soil removal). As discussed above, properties where yard soil concentrations are Bin B1 or Bin B2 have the potential to result in RME non-cancer HQs greater than 1, depending upon their spatial extent. Therefore, there may be properties in OU4 and OU7 where soil removal actions have not yet been completed that have the potential to result in elevated LA exposures if soils are disturbed. Beginning in 2014, the soil removal triggers were modified to conduct soil removals at properties with Bin B1 (depending upon their spatial extent) and Bin B2 (regardless of spatial extent) soil concentrations. Specifics on these modified soil triggers are presented in Amendment B (CDM Smith 2014c). Bin B1 (trace) surface soils are allowed to remain in place in SUAs and CUAs, provided that their spatial extent is less than 25% of the total exposure area. This decision was based on the finding that, if 75% or more of the total exposures area is Bin A and the remainder is Bin B1, the estimated area-wide RME non-cancer HQ will be about 0.6. For properties where soil removal is deemed necessary, but has not been performed (Category #3), the potential exposures and risks from soil disturbance activities will depend upon the nature and extent of the LA concentrations in soil present at the property. However, it is possible that Bin C concentrations may be present. Properties where yard soil concentrations are Bin C have the potential to result in area-wide RME non-cancer HQs greater than 1, even if their spatial extent is small. For properties where no soil information is available (Category #4), potential exposures and risks from soil disturbance activities cannot be determined. (pg 6-11) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Methodology | High | report uses high quality data |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | High | The data are from the United States |
| | Metric 3: Applicability | High | The report is for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: Temporal Representativeness | High | The report is generally no more than 10 years old. |
| | Metric 5: Sample Size | Low | Distribution of samples is qualitative |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | High | report clearly documents its data sources, assessment methods, results |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Low | The report does not address variability or uncertainty. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Cecchetti, G., Fruttero, A., Conti, M. E. (2005). Asbestos reclamation at a disused industrial plant, Bagnoli (Naples, Italy). Journal of Hazardous Materials 122(1-2):65-73. |
| **HERO ID:** | 3581705 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Process description: | The reclamation activities on the site consisted in collecting solid asbestos–cement materials, dismantling asbestos–cement slabs and tiles, cleaning up sprinklings of raw material containing asbestos on walls and hoppers, and packing both dangerous and non-dangerous waste material containing asbestos. (pg 67) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Methodology | High | Report uses high quality data. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | Medium | The data are from an OECD country other than the U.S. |
| Metric 3: | Applicability | High | The report is for an occupational scenario within the scope of the risk evaluation. |
| Metric 4: | Temporal Representativeness | Medium | The report is generally more than 10 years but no more than 20 years old. |
| Metric 5: | Sample Size | N/A | N/A - Process Description |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | High | Assessment or report clearly documents its data sources, assessment methods, results, and assumptions. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | N/A | N/A - Process Description |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Cely-García, M. F., Curriero, F. C., Sánchez-Silva, M., Breysse, P. N., Giraldo, M., Méndez, L., Torres-Duque, C., Durán, M., González-García, M., Parada, P., Ramos-Bonilla, J. P. (2016). Estimation of personal exposure to asbestos of brake repair workers. Journal of Exposure Science and Environmental Epidemiology 27(4):417-426. |
| **HERO ID:** | 3520524 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Chemical concentration: | 13 of the 18 pairs of brake products were asbestos free. The remaining 15 pairs had an asbestos content ranging from 5 to 15%. (4/10) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | Report uses high quality methods and data from frequently-used sources. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Medium | Data are from Colombia, an OECD country. |
| | Metric 3: | Applicability | High | The report is for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | High | Report is based on current industry conditions and data no more than 10 years old. |
| | Metric 5: | Sample Size | Medium | Sample distribution characterized by limited statistics (means, medians, standard deviations, ranges) but discrete samples not provided and distribution not fully characterized. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | Uncertainty is addressed in bulk sampling methods. Variability isn't addressed. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Cely-García, M. F., Sánchez, M., Breysse, P. N., Ramos-Bonilla, J. P. (2012). Personal exposures to asbestos fibers during brake maintenance of passenger vehicles. Annals of Occupational Hygiene 56(9):985-999. |
| **HERO ID:** | 2560364 |
| **Conditions of Use:** | Consumer Uses-Chemical Substances in Automotive, Fuel, Agriculture, Outdoor Use Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Production, import, or use volume: | In 2002, Colombia occupied 10th place among the world's asbestos producers with 8000 tons year−1 |
| Process description: | As Fig. 1 shows, the removal of the old brake liningfrom a shoe can involve the use of an unrivetingmachine, and/or the separation of the brake liningwith a chisel and hammer. Once the lining has beenremoved, the old shoe must be ground to prepare itfor a new lining. This process has the potential torelease large amounts of asbestos fibers into theworkplace air. |
| Number of sites: | Three brake repair shops located in Bogotá (Colombia) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Methodology | High | The assessment or report uses high quality data and/or techniques or sound methods that are from frequently used sources, NIOSH. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | Low | The data are from a non-OECD country, Colombia. |
| Metric 3: | Applicability | High | The report is for an occupational scenario within the scope of the risk evaluation. |
| Metric 4: | Temporal Representativeness | High | The report is less than 10 years old. |
| Metric 5: | Sample Size | N/A | Process description. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | High | Assessment or report clearly documents its data sources, assessment methods, results, and assumptions. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Medium | The report provides only limited discussion of the variability and uncertainty in the results. |

## Overall Quality Determination — High

| | |
|---|---|
| **Study Citation:** | Cely-García, M. F., Torres-Duque, C. A., Durán, M., Parada, P., Sarmiento, O. L., Breysse, P. N., Ramos-Bonilla, J. P. (2015). Personal exposure to asbestos and respiratory health of heavy vehicle brake mechanics. Journal of Exposure Science and Environmental Epidemiology 25(1):26-36. |
| **HERO ID:** | 3078032 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Process description: | Shop characteristics BRS1BRS2Type of vehicles servicedBusesBuses and trucks "%Vehicles that require brake maintenance~85%(35–40)~80%(15–20)Workers involved in brake repair1 Riveter2 Riveters who also work as brake mechanicsArea of the shop (covered area)~1000m^{2} (780m^{2} )~1400m^{2} (95m^{2} )Area of office and warehouseArea of ~80m^{2}Areaof ~84m^{2}"Location of office and warehouse "Located at ~10m from manipulation areaLocated at ~50m from manipulation areaDescription of manipulation area"Covered area of~ 7m^{2} Covered area of ~11m^{2} Surrounded by walls andIsolated with two walls and a fence" a big window with no glassManipulation equipment2Drills1Drill2 Countersinks with grinderstone1 Countersink with grinderstone2 Rivet machines1 Rivet machine1 Emery machine(with emery stone and emery disc)1 Electric circularsaw used outside the manipulation roomVentilation systemLocal ventilation system in each machine, constantly used by riveterNoneCleaning of the manipulation area activitiesAt the end of almost every workshiftSeldomRespiratory protection equipmentRiveter used a filtering face piece None during sampling campaignrespirator during almost all manipulation and cleaning activities |
| Number of sites: | 2 sites reviewed |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | The assessment or report uses high quality data and/or techniques or sound methods that are from frequently used sources |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Medium | Data are from Colombia, an OECD country. |
| | Metric 3: | Applicability | High | Data are for Industrial/Commercial Use: Chemical Substances in Construction, Paint, Electrical, and Metal Products, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | High | The report captures operations, equipment, and worker activities expected to be representative of current conditions. The report is generally no more than 10 years old |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | All metadata provided. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | Uncertainty is addressed in sampling/analytical methodology but variability is not addressed. |

## Overall Quality Determination — High

| | |
|---|---|
| **Study Citation:** | Chadwick, D. A., Buchan, R. M., Beaulieu, H. J. (1985). Airborne asbestos in Colorado public schools. Environmental Research 36(1):1-13. |
| **HERO ID:** | 3625598 |
| **Conditions of Use:** | Consumer Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Chemical concentration: | Bulk samples of sprayed-on asbestos material were 1-15% (2/13) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | Report uses high quality methods and data from frequently-used sources. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | Low | Data are for school and office workers exposures, which may be similar to commercial use of construction products. |
| | Metric 4: | Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: | Sample Size | Medium | Sample distribution characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | Variability is addressed by sampling at multiple facilities. Uncertainty isn't addressed. |

## Overall Quality Determination **Medium**

| | |
|---|---|
| **Study Citation:** | Chrostek, W. J. (1984). Health Hazard Evaluation Report No. HETA-84-029-1427, Jewish Family And Childrens Agency, Ardmore, Pennsylvania. NIOSH(HETA-89-029-1427):89-029. |
| **HERO ID:** | 3658724 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Number of sites: | 1, The Jewish Family and Children's Agency |
| Chemical concentration: | The ceiling material was found to contain 2-6% chrysotile asbestos. (4/7) |
| Comments: | The ceiling samples showed 1-2 percent chrysotile asbestos while the duct sample showed approximately five percent chrysotile asbestos. |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | Report uses high quality data from frequently-used sources. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for commercial use of building construction materials, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Methods, results, and assumptions are clearly documented, but underlying data sources are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | Uncertainty is addressed in sampling/analytical methodology. Variability is addressed by sampling different bulk materials. |

## Overall Quality Determination — High

| | |
|---|---|
| **Study Citation:** | Ciullo, P. A. (1996). The industrial minerals. Elsevier Elsevier(Elsevier):17-82. |
| **HERO ID:** | 6918343 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Production, import, or use volume: | Approximately 3.5 million metric tons of asbestos are produced annually. Major producers are the former Soviet Union (60%) and Canada (17%). Production and use in the United States is very minor due to health and liability concerns, although California hosts a short fiber chrysotile deposit considered to be the largest single mineral ore body in the world. Major asbestos applications worldwide are asbestos cement, friction products, roofing, insulation, flooring, plastics, and gaskets (p. 2) |
| Life cycle description: | nan |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Methodology | Medium | The assessment or report uses high quality data and/or techniques or sound methods that are not from a frequently used source and associated information does not indicate flaws or quality issues. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | The data are from the United States and are representative of the industry being evaluated. |
| Metric 3: | Applicability | High | The report is for an occupational scenario within the scope of the risk evaluation. |
| Metric 4: | Temporal Representativeness | Low | The report is more than 20 years old. The report captures operations, equipment, and worker activities that are expected to be outdated. |
| Metric 5: | Sample Size | N/A | n/a - no sampling data |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | High | Assessment or report clearly documents its data sources, assessment methods, results, and assumptions. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Medium | The report provides only limited discussion of the variability and uncertainty in the results. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Cowan, D. M., Cheng, T. J., Ground, M., Sahmel, J., Varughese, A., Madl, A. K. (2015). Analysis of workplace compliance measurements of asbestos by the U.S. Occupational Safety and Health Administration (1984-2011). Regulatory Toxicology and Pharmacology 72(3):615-629. |
| **HERO ID:** | 3520562 |
| **Conditions of Use:** | Other: |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Production, import, or use volume: | ””””Consumption quickly increased throughout World War I and World War II before peaking in the 1970s when between 700,000 and 800,000 metric tons of asbestos were consumed in the U.S. annually from 1970 to 1980 (Fig. 1). The USGS estimated that approximately 68 billion pounds of asbestos were consumed (i.e., production plus importation) in the U.S. from 1900 to 2011 (Virta, 2011)”” (pg 2)Graph provided for each year’s consumption of asbestos in the U.S. up to 2011 (pg 2)””As of 2013, the chloralkali and roofing-products industries consumed 98% of the total 2.3 million pounds of asbestos imported into the U.S.”” (pg 2)” |
| Comments: | Asbestos consumption data |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Methodology | Medium | Report uses high quality information that is not from frequently-used sources and there are no known quality issues. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | Data are from the U.S. |
| Metric 3: | Applicability | Medium | Includes data for consumption across all industries, including in-scope occupational scenarios. |
| Metric 4: | Temporal Representativeness | Medium | Report includes data that is less than 10 years old, but is primarily made up of data that is greater than 10 or 20 years old. Industry conditions expected to be representative of current industry conditions. |
| Metric 5: | Sample Size | N/A | N/A - This metric is not applicable to the data being extracted |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Medium | Methods, results, and assumptions are clearly documented, but underlying data sources are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Medium | Variability addressed by temporal variation, but uncertainty is not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Cralley, L. J., Cooper, W. C., Lainhart, W. S., Brown, M. C. (1968). Research on health effects of asbestos. Journal of Occupational Medicine 10(1):38-41. |
| **HERO ID:** | 3085005 |
| **Conditions of Use:** | Consumer Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Production, import, or use volume: | US consumption: 750,000 short tons annually (1958-1963) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | The assessment or report uses high quality data and/or techniques or sound methods that are from frequently used sources (journal article) and are generally accepted by the scientific community, and associated information does not indicate flaws or quality issues. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | The data are from the United States and are representative of the industry being evaluated. |
| | Metric 3: | Applicability | Low | The report is for a non-occupational scenario that is similar to an occupational scenario within the scope of the risk evaluation, such as a consumer DIY scenario that is similar to a worker scenario. |
| | Metric 4: | Temporal Representativeness | Low | The report is more than 20 years old. The report captures operations, equipment, and worker activities that are expected to be outdated. |
| | Metric 5: | Sample Size | N/A | N/A - no sampling data |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | Assessment or report clearly documents its data sources, assessment methods, results, and assumptions. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | The report does not address variability or uncertainty. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Crandall, M. S., Fleeger, A. K. (1989). Health hazard evaluation report no. HETA 88-372-1953, Barbados Ministry of Health, Bridgetown, Barbados. |
| **HERO ID:** | 3970543 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Number of sites: | 1 hospital and 1 sugar factory |
| Chemical concentration: | ”At Queen Elizabeth Hospital, one sample collected from a steam line to the presses in the laundry contained nearly 100% chrysotile asbestos. Another sample of this type of lagging from a steam line on the laundry boiler contained 70-80% chrysotile asbestos. A third sample of rope lagging, contained 95-98% amosite asbestos. A sample of the lagging covering a hot water tank, in the old boiler section of the laundry boiler room, contained 50-55% amosite. The other lagging sample, from the inner layer of the hot water tank in the hospital boiler room, contained 35-40% amosite. A sample of the thin, outer layer of lagging on this hot water tank was <1% amosite, and a sample of lagging at a ””T”” in a steam line from this boiler room also contained <1% amosite. (9/37)” |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Methodology | High | Report uses high quality data from frequently-used sources. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | Low | Data are from Barbados, a non-OECD country, |
| Metric 3: | Applicability | High | Data are for commercial use in building construction materials, an in-scope occupational scenario. |
| Metric 4: | Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | High | Uncertainty is addressed in the bulk sampling methodology. Variability is addressed by sampling at different sites. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Crump, K. S., Farrar, D. B. (1989). Statistical analysis of data on airborne asbestos levels collected in an EPA survey of public buildings. Regulatory Toxicology and Pharmacology 10(1):51-62. |
| **HERO ID:** | 3095858 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Life cycle description: | "It has been estimated that 20% of Federal, residential, and commercial buildings in the United States contain friable asbestos material (EPA, 1984)" (pg 1) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | Report uses high quality information that are not from frequently-used sources and there are no known quality issues. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | Medium | Data are for asbestos use in the construction industry, an in-scope occupational scenario, but it specifies prevalence as opposed to annual rate. |
| | Metric 4: | Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: | Sample Size | N/A | N/A - This metric is not applicable to the data being extracted |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Methods, results, and assumptions are clearly documented, but underlying data sources are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Cyr, A. (1984). Environmental impact assessment and findings of no significant impact for the proposed asbestos standard. |
| **HERO ID:** | 6886437 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Chemical concentration: | p.21-24Asbestos-cement pipe and sheet: 20-70% Friction materials: 30-80%Vinyl asbestos floor tiles: 8-30%Asbestos paper: 70-90%Textiles: 85-90%Gaskets and packings: 30-80% |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | The assessment or report uses high quality data and/or techniques or sound methods that are from frequently used sources (U.S. Department of Commerce) and are generally accepted by the scientific community, and associated information does not indicate flaws or quality issues. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | The data are from the United States and are representative of the industry being evaluated. |
| | Metric 3: | Applicability | High | The report is for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Low | The report is more than 20 years old. The report captures operations, equipment, and worker activities that are expected to be outdated. |
| | Metric 5: | Sample Size | N/A | n/a - no sampling data |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | Assessment or report clearly documents its data sources, assessment methods, results, and assumptions. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | The report does not address variability or uncertainty. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Damiran, N., Silbergeld, E. K., Frank, A. L., Lkhasuren, O., Ochir, C., Breysse, P. N. (2015). Exposure to airborne asbestos in thermal power plants in Mongolia. International Journal of Occupational and Environmental Health 21(2):137-141. |
| **HERO ID:** | 3520572 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Life cycle description: | Asbestos containing materials (ACM) are used in thermal insulation of piping systems, furnaces, and other products in coal-fired power plants in Mongolia (pg 137) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | The assessment or report uses high quality data and/or techniques or sound methods that are from frequently used sources. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Low | The data are from a non-OECD country. |
| | Metric 3: | Applicability | High | The report is for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | High | The report is generally no more than 10 years old. |
| | Metric 5: | Sample Size | N/A | No sample data. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | Report clearly documents its data sources. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | N/A | No scope to address variability and uncertainty. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Darcey, D. J., Alleman, T. (2004). Occupational and environmental exposure to asbestos. :17-33. |
| **HERO ID:** | 6865356 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Production, import, or use volume: | U.S. consumption of asbestos dropped from a high of 801,000 metric tons in 1973 to minimal amounts in 2000. (3/17) Use as a component of cement, concrete, paint, vinyl, and tar mixtures, accounts for 70% of current applications worldwide. (2/17) |
| Throughput: | 1.2 billion square feet of asbestos insulation is present in American buildings. (6/17) |
| Number of sites: | Asbestos insulation is present in 190,000 buildings. (6/17) |
| Chemical concentration: | Asbestos insulation averaged 14% in concentration. (6/17) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Methodology | High | Assessment uses high quality data from frequently-used sources. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | Data are from the U.S. |
| Metric 3: | Applicability | High | Data are for commercial use in construction materials, an in-scope occupational scenario. |
| Metric 4: | Temporal Representativeness | Medium | Report is based on data greater than 10 years old but no more than 20 years old and industry conditions that are expected to be representative of current industry conditions. |
| Metric 5: | Sample Size | Medium | Sample distribution characterized by limited statistics (percentages, throughputs, number of sites) but discrete samples not provided and distribution not fully characterized. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Medium | Variability is addressed by comparing consumption trends by year. Uncertainty isn't addressed. |

## Overall Quality Determination — High

| | |
|---|---|
| **Study Citation:** | Dave, S. K., Beckett, W. S. (2005). Occupational asbestos exposure and predictable asbestos-related diseases in India. American Journal of Industrial Medicine 48(2):137-143. |
| **HERO ID:** | 3079949 |
| **Conditions of Use:** | Other: |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Production, import, or use volume: | India imports nearly 100,000 metric tons of asbestos per year, and small-scale asbestos (chrysotile and tremolite) mining and milling contributes nearly 5%–10% of the total national usage (abstract)18,304 metric tons are mined in the states of Rajasthan and Andhra Pradesh (pg 1)estimated 76,904 tonnes of asbestos is imported each year. |
| Life cycle description: | [mined and imported] asbestos is used in making commercial products, including construction materials (asbestos-cement pipes, roofing sheets, and other materials) and asbestos containing textiles (pg 1) Asbestos added to cement pipe or ceiling tile makes a longer lasting product, and asbestos used as an insulator in textile gloves and other articles of clothes, may prevent burns in hazardous work environments. (pg. 2) |
| Number of sites: | 45 asbestos mining and milling units in operation (pg 1)In the past in India there have been nearly 673 small-scale asbestos mining and milling facilities (pg 6) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Methodology | High | Report uses high quality data/techniques/methods that are from frequently-used sources (journal article) and there are no known quality issues. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | Low | Data are from India, a non-OECD country. |
| | Metric 3: Applicability | Low | Data are for asbestos mining/milling, which is not in scope for asbestos legacy uses but may still be informative. |
| | Metric 4: Temporal Representativeness | Medium | Report is based on data greater than 10 years old but no more than 20 years old and industry conditions that are expected to be representative of current industry conditions. |
| | Metric 5: Sample Size | Medium | Sample distribution characterized by limited statistics (ranges, averages) but discrete samples not provided and distribution not fully characterized. |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | Medium | Methods, results, and assumptions are clearly documented, but underlying data sources are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Medium | The report provides only limited discussion of the variability but does not discuss uncertainty in the information. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Dave, S. K., Beckett, W. S. (2005). Occupational asbestos exposure and predictable asbestos-related diseases in India. American Journal of Industrial Medicine 48(2):137-143. |
| **HERO ID:** | 3079949 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Number of sites: | 33 large-scale asbestos manufacturing plants, (17 asbestos cement product manufacturing plants and 16 other than asbestos cement product plants). (pg 6) |
| Chemical concentration: | 5-10% is asbestos added to cement products (pg 4) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Methodology | High | Report uses high quality data/techniques/methods that are from frequently-used sources and there are no known quality issues. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | Low | Data are from India, a non-OECD country |
| | Metric 3: Applicability | High | Data are for construction materials, an in-scope occupational scenario. |
| | Metric 4: Temporal Representativeness | Medium | Report is based on data greater than 10 years old but no more than 20 years old and industry conditions that are expected to be representative of current industry conditions. |
| | Metric 5: Sample Size | Medium | Sample distribution characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | Medium | Methods, results, and assumptions are clearly documented, but underlying data sources are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Dechant, R., Piantanida, L. (1984). Reduction of exposure during asbestos lagging rip-out. American Industrial Hygiene Association Journal 45(8):B9. |
| **HERO ID:** | 3583823 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Process description: | The method uses a garden-type tank sprayer of 2 to 3 gallons capacity which is equipped with a pointed wand for insertion under asbestos pipe covering. The spray nozzle of the hand-operated sprayer is replaced with a 3' x 5/ 16" stainless steel or brass tube which has small holes drilled intermittently along the length. The tubing must be stiff and strong to withstand the stress of shoving it under pipe covering. A tip is brazed onto one end and ground to a point; an adaptor is brazed to the other end which is then fitted to the actuating valve of the sprayer. An industrial non-foaming wetting agent, such as Wyandotte's Pluronic L-62 LF, is mixed with water in the tank ( 1 / 2 oz. in one gallon of water). The wetting agent is essential to ensure complete absorption of water by the insulation.The pointed end of the wand/ tube is then inserted its full length under the fabric covering of the insulation through a small hole. The solution in the sprayer is pumped through the wand to soak the insulation along the 3' section. One gallon or less will usually saturate a three foot section of insulation with one insertion. |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Methodology | High | The assessment or report uses high quality data and/or techniques or sound methods that are from frequently used sources. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | High | The data are from the United States. |
| | Metric 3: Applicability | High | The report is for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: Temporal Representativeness | Low | The report is more than 20 years old. |
| | Metric 5: Sample Size | N/A | Process description. |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | Low | Assessment or report provides results, but the underlying methods, data sources, and assumptions are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | N/A | No scope to address variability and uncertainty. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Deucher, V. M., Moore, T. L., Hemlin, S. (2000). Access denied: Asbestos contamination as catalyst and hindrance to collection retrieval and preservation. Journal of the American Institute for Conservation 39(1):75-84. |
| **HERO ID:** | 6865379 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Products not Described by Other Codes |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Process description: | "Methods for decontaminating museum objects included disposal, washout (a low-pressure power wash amended with surfactant), HEPA vacuum, wet-wipe (using a cloth dampened with waterand surfactant), compressed air blown on or into the object, encapsulation/removal, sealing or removing asbestos as integral parts of the object, and no clean/test out, for objects too fragile to withstand decontamination. After an object had been decontaminated through the application of a single or in some cases a combination of cleaning methods, the object was ready for clearance testing, a procedure performed prior to releasing the objects from the asbestos containment. (7/11)" |
| Chemical concentration: | Half of the asbestos was 30-35% chrysotile, and the other half was 85-95% amosite. (4/11) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Methodology | Medium | Report uses high quality data that are not from frequently-used sources and there are no known quality issues. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | Data are from the U.S. |
| Metric 3: | Applicability | High | Data are for commercial use of museum artifacts, an in-scope occupational scenario. |
| Metric 4: | Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| Metric 5: | Sample Size | Medium | Sample distribution characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Medium | Methods, results, and assumptions are clearly documented, but underlying data sources are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Medium | Variability is addressed by listing multiple decontamination methods. Uncertainty isn't addressed. |

## Overall Quality Determination Medium

**Continued on next page . . .**

. . . continued from previous page

**Study Citation:** DOE, (1999). Advanced mixed waste treatment project: Appendices.
**HERO ID:** 3974977
**Conditions of Use:** Disposal

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|

**Study Citation:** DOE, (1999). Advanced mixed waste treatment project: Appendices.
**HERO ID:** 3974977
**Conditions of Use:** Disposal

**EXTRACTION**

| Parameter | Data |
|---|---|
| Process description: | Waste containers within the non-thermal treatment areas are managed in a manner to prevent container rupture or leakage and to minimize exposure of AMWTP facility personnel. Operating standards used in conducting non-thermal treatment activities include:- Wastes slated for direct supercompaction are first identified by item description codes, generator-supplied information, and real-time radiography (RTR) examination. Other wastes for supercompaction and macroencapsulation are sorted, segregated, and size reduced in the pretreatment lines prior to supercompaction and/or macroencapsulation. Waste characterization information is reviewed prior to processing in the nonthermal treatment units to ensure that only compatible wastes are treated.-All non-thermal treatment activities are performed by operating personnel trained to safely conduct the treatment and to respond to emergency incidents.-All treatment activities are conducted with the knowledge of a supervisor and according to specific treatment procedures.-Containers enter the non-thermal treatment areas through a combination of elevators, conveyors, and airlocks. Containers are lidded during compaction and after loading puck drums with waste and grout. Barcode readers throughout the facility verify waste container locations and destinations.- The presence of liquids in supercompaction feed drums is minimized by prior RTR screening and liquid removalin the pretreatment lines.-Special case waste is managed within the single case waste glovebox on a case-by-case basis, typically in smallquantities and in a timely manner to reduce waste accumulation.-No reactive (Hazardous Waste Number [HWN] D003) wastes are processed in the non-thermal treatment units. Waste streams potentially containing ignitable (HWN D001) wastes are processed in a manner to minimize reactions or fires (e.g., campaigning incompatible waste separately, using only low-sparking tools in thetreatment areas when processing potentially ignitable wastes).-The ventilation air is ultimately fed to banks of high efficiency particulate air (HEPA) filters and carbon filters prior to exhausting through the facility stack. The exhaust from the special case waste (SCW) glovebox is also fed through local carbon absorption units before exiting the facility stack.-Secondary waste streams generated in the treatment areas are treated within the facility.SupercompactorThe 55-gallon direct-feed waste drums or 55-gallon transfer containers from the pretreatment lines are routed to the supercompactor via the central conveyor system. Only waste drums whose waste to waste compatibility assessments show no incompatibilities are compacted in series. Barcode readers and the data management system (DMS)/waste tracking system (WTS) identify and control drums of incompatible waste from entering the compaction gloveboxes until the gloveboxes have been emptied, visually inspected, and cleaned (if required). To maximize the size reduction process, the data management system incorporates an optimization algorithm that automates the waste drum selectionfor puck drum filling to achieve maximum packing densities. The data management system optimizes puck filling based on fissile content, weight, or puck height. Automatic control sequences to retrieve, deliver, compact, and deposit the waste drum/puck into the puck drum are initiated from the central control room.At the supercompaction area interface point, a barcode reader identifies the waste drums before they are transferred, viaroller conveyor, through an airlock and into the supercompactor infeed glovebox. There are two stations within the infeed glovebox: the drum lidding station and the drum lid crimping/drum piercing station. A roller conveyor is used to move the waste drum from the glovebox entrance to the lidding position. Waste transfer containers from the pretreatment lines require lidding before compaction, since they remain open during transfer through Zone 3 process areas. At the lidding station, a drum handling mechanism is used to center and secure the open waste drum during thelidding process. Lids are automatically fed from outside of the containment into the glovebox using a special seal arrangement. The feeder device fits the lid directly onto the top of the drum.The drum handling mechanism transfers the lidded drum onto the compaction trolley at the drum lid crimping/drum piercing station, where a crimping head is lowered to fasten the lid into position, while at the same time piercing the drum to prevent over pressurization during compaction. After supercompactor feed drums have been lidded, crimped, and pierced, the drum handler arms are opened leaving the drum centrally located on the compaction trolley. The trolley moves the drum into the supercompactor glovebox to a position beneath the supercompactor.With the drum and trolley in position, the mold/bolster is lowered around the drum and engaged onto the trolley. The lower press plate of the supercompactor is mounted on the top of the trolley and acts as a guide for the mold, which controls the puck diameter during the compaction cycle. The compaction process proceeds in two phases. First, the main ram is lowered, initially powered by a low-force ram, which forces the air out of the top section of the drum at a preset pressure. After the first compaction phase, high-pressure fluid is supplied to the main high-force compaction ram and is maintained at a higher pressure for a set period of time (1 to 5 minutes, depending on the waste being compacted). Preset compaction pressures are used to control the compaction process. Both rams are fed from a hydraulic power pack situated outside the glovebox. The resultant force reduces the puck height (on average) to one fifth of the original drum height. On completion of the compaction cycle the mold and ram are raised, and the compaction trolley transfers the puck to the post compaction glovebox.All drums destined for direct supercompaction undergo RTR analysis at the waste storage facility (WSF) Type 1 module for the presence of liquids or prohibited waste. Those drums potentially containing liquid waste are transferred to the drum line to remove the liquid prior to compaction. Frequent releases of liquid from drums during compaction are not expected. When liquids are released, they are handled on a case-by-case basis. Sloped glovebox floors and a sump are provided to collect any liquids produced during the compaction process. The leak-tight base of the |

. . . continued from previous page

**Study Citation:** DOE, (1999). Advanced mixed waste treatment project: Appendices.
**HERO ID:** 3974977
**Conditions of Use:** Disposal

| EVALUATION | | |
|---|---|---|
| Domain | Metric | Rating | Comments |
| Throughput: | 65,000 cubic meters annually. | | |
| Number of sites: | 1 | | |
| Chemical concentration: | average weight fraction of stored waste 2.74 E-03maximum weight fraction of stored waste 4.5E-01Estimated stored waste 71,328 kgReportable quantity 0.454 kg | | |
| Comments: | This is for an advanced Mixed Waste Treatment Project - asbestos if only processed in the non thermal treatment operations.AMWTP Preliminary Safety Analysis Report (PSAR) (BNFL 1998d), which was produced by theBNFL Inc. | | |

| EVALUATION | | | |
|---|---|---|---|
| Domain | Metric | Rating | Comments |
| Domain 1: Reliability | | | |
| | Metric 1: Methodology | High | The report uses high quality data and techniques that are from frequently used sources. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | High | The data are from the United States. |
| | Metric 3: Applicability | High | The report is for an occupational scenario (hazardous waste treatment facility) within the scope of the risk evaluation. |
| | Metric 4: Temporal Representativeness | Low | The report is more than 20 years old. |
| | Metric 5: Sample Size | Medium | DOE Idaho National Engineering and Environmental Lab (INEEL) provided average and maximum weight fractions. |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | High | DOE INEEL/ BNFL assessment clearly documents its data sources. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Low | The report does not address variability or uncertainty. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Dow Corning, (1984). Industrial hygiene asbestos survey in _____. |
| **HERO ID:** | 4158331 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Process description: | Asbestos paper was used as a support pad during polycrystalline silicon production. The asbestos paper was torn from a roll hanging on the wall in the production area. [PDF Pg. 3] |
| Throughput: | Approximately 1.5-2 square feet of asbestos paper would be used for support pads. [PDF Pg. 3] |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | Medium | Report uses high quality data/techniques/methods that are not from frequently-used sources and there are no known quality issues. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for Chemical Substances in Construction, Paint, Electrical, and Metal Products, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: | Sample Size | Medium | Throughput is characterized by a range. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Methods, results, and assumptions are clearly documented, but underlying data sources are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | Variability addressed by a range of throughputs given but uncertainty is not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Drucker, E., Nagin, D., Michaels, D., Lacher, M., Zoloth, S. (1987). Exposure of Sheet-Metal Workers to Asbestos during the Construction and Renovation of Commercial Buildings in New York City. A Case Study in Social Medicine. Annals of the New York Academy of Sciences 502:230-244. |
| **HERO ID:** | 3094680 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Process description: | The asbestos, usually 1-3 inches in thickness, was applied either as a slurry, spread onto the girders to create a fibrous mat, or, more frequently, as a mixture of fibers and binders blown under pressure from large hoses onto the superstructure. As this phase of the construction was under way, members of other building trades worked on the partially completed lower floors. |
| Number of sites: | 1, A 45-story office building in lower Manhattan |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Methodology | High | The assessment or report uses high quality data and/or techniques or sound methods |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | High | The data are from the United States |
| | Metric 3: Applicability | High | The report is for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: Temporal Representativeness | Low | more than 20 years old. |
| | Metric 5: Sample Size | N/A | Process description. |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | Medium | Sources are generally described but not fully transparent |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Medium | The report provides only limited discussion of the variability and uncertainty in the results. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Dufresne, A., Dion, C., Frielaender, A., Audet, E., Perrault, G. (2009). Personal and static sample measurements of asbestos fibres during two abatement projects. Bulletin of Environmental Contamination and Toxicology 82(4):440-443. |
| **HERO ID:** | 2596477 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Chemical concentration: | Fire-proofing and insulation was 75-90% amosite for one material and 5-10% chrysotile for another. (1/4) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | Report uses high quality methods and data from frequently-used sources. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Medium | Data are from Canada, an OECD country. |
| | Metric 3: | Applicability | High | Data are for commercial use in building construction materials, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Medium | Report is based on data greater than 10 years old but no more than 20 years old and industry conditions that are expected to be representative of current industry conditions. |
| | Metric 5: | Sample Size | Medium | Sample distribution characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Dumortier, P., De Vuyst, P. (2012). Asbestos exposure during uncontrolled removal of sprayed-on asbestos. Annals of Occupational Hygiene 56(1):49-54. |
| **HERO ID:** | 2570018 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Chemical concentration: | Sprayed-on asbestos contains 5–95% asbestos with a binder and possibly various other components. (P. 1/6)The material contained ~90% amosite. (P. 2/6) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | The assessment or report uses high quality data . |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Medium | The data are from an OECD country, Belgium. |
| | Metric 3: | Applicability | High | The report is for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Medium | More than 10 years but no more than 20 years old. |
| | Metric 5: | Sample Size | Medium | Distribution of samples is characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Assessment or report clearly documents results, methods, and assumptions. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | The report does not address variability or uncertainty. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | DuPont, (1976). A study to measure the amount of asbestos fiber liberated during operating times of gas chromatographs. |
| **HERO ID:** | 4158363 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Chemical concentration: | Two insulation products were 30% and 25% amosite. (4/11) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | Report uses high quality methods and data from frequently-used sources. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for commercial use in construction materials, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Ebihara, I., Hirata, M., Hisanaga, N., Shibata, E., Sakai, K. (1997). Respiratory findings of construction workers exposed to asbestos dust. Advances in Environmental Control Technology Series :93-126. |
| **HERO ID:** | 6925874 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Chemical concentration: | p. 3Fiber-mixed cement board - 4-5%Fiber-mixed calcium silicate board - 14-22.5%Fiber-mixed asbestos cement board - 17%Fiber-mixed slug cement board - 0.5%Fiber-mixed slug plaster board - 4.5%Fiber-mixed cement calcium silicate board - 4.5%Asbestos cement calcium silicate board - 17%Asbestos cement board - 20.5%Asbestos perlite slug plaster board - 5%Asbestos slate - 5%Fly ash mixed slug cement board - 4.5%Calcium silicate board - 5% |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Methodology | Medium | The assessment or report uses high quality data and/or techniques or sound methods that are not from a frequently used source and associated information does not indicate flaws or quality issues: ”Advances in environmental control technology: Health and toxicology” |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | High | The data are from the United States and are representative of the industry being evaluated. |
| | Metric 3: Applicability | High | The report is for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: Temporal Representativeness | Low | The report is more than 20 years old. The report captures operations, equipment, and worker activities that are expected to be outdated. |
| | Metric 5: Sample Size | Medium | Distribution of samples is characterized by a range with uncertain statistics. It is unclear if analysis is representative. |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | Medium | Assessment or report clearly documents results, methods, and assumptions. Data sources are generally described but not fully transparent. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Medium | The report provides only limited discussion of variability of asbestos concentrations in different materials and and does not address uncertainty in the results. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | EC, (2012). Practical guidelines for the information and training of workers involved with asbestos removal or maintenance work. |
| **HERO ID:** | 3981018 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Chemical concentration: | Asbestos cement products (Asbestos content approx. 15 %),Sprayed asbestos (asbestos content up to 85 %),Loose asbestos lagging (asbestos content up to 100 %),Asbestos fabrics, tapes and cords (asbestos content highly variable, from 3-90%),Asbestos panels (asbestos content 5-50 %),Asbestos papers, cardboards, and gaskets (asbestos content 50-90 %),Asbestos-containing construction chemical products (asbestos content up to 20%),Asbestos-containing floor coverings (asbestos content 15-90 %) (P. 14/59) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | The assessment or report uses high quality data and/or techniques or sound methods that are from frequently used sources (e.g., European Union report) and are generally accepted by the scientific community, and associated information does not indicate flaws or quality issues. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Medium | The data are from an OECD country other than the U.S., and locality-specific factors (e.g., potential differences in regulatory occupational exposure or emission limits, industry/ process technologies) may impact exposures or releases relative to the U.S. |
| | Metric 3: | Applicability | High | The report is for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | High | The report captures operations, equipment, and worker activities expected to be representative of current conditions. The report is generally no more than 10 years old. |
| | Metric 5: | Sample Size | Medium | Distribution of samples is characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | Assessment or report clearly documents its data sources, assessment methods, results, and assumptions. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | The report provides only limited discussion of the variability and uncertainty in the results. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | ECHA, (2014). Committee for Risk Assessment (RAC) opinion on an Annex XV dossier proposing restrictions on chrysotile. |
| **HERO ID:** | 3970699 |
| **Conditions of Use:** | Other: |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Process description: | AAK uses chrysotile in two high-pressure electrolysis units for hydrogen production. Chrysotile is used in the gaskets and in the diaphragms in these units.At Dow the process consists of two subprocesses i.e., use of diaphragms containing chrysotile (exposure scenario entitled Use in diaphragm cells) and use of chrysotile fibres to maintain the diaphragms during their use in the process (Exposure scenario entitled Use as reconditioning agent).The diaphragms containing chrysotile are embedded in cells such that both the diaphragms and the chrysotile in them are unaccessible to employees. Furthermore, inside the diaphragms, the chrysotile fibres are embedded into a plastic matrix and operated as a wet process, which prevents chrysotile fibre release. The waste water and potential fibre releases in it are treated separately. The potential points of exposure are managed by the process design and where needed (e.g. maintenance activities), by the use of personal protective equipment (PPE). Bulk chrysotile is brought to the site as dry fibres. For transportation Dow uses specially designed Dow System Containers (DSC) to ensure safe process (in the dossier see Annex 2.1.). As exposure to dry fibres is considered dangerous, all handling of the dry chrysotile fibres is fully automated. The dry fibres are mixed with brine in an automated process to produce slurry, which is used to maintain diaphragms in cells while in operation. The process design i.e., automation and the use of robots, minimises the exposure. Furthermore, PPE is used where needed e.g. during any periodic cleaning or maintenance tasks. When diaphragms are worn out and need to be replaced, the chrysotile is washed out from the cells and the waste is heat-treated in a special oven, such that the fibre structures are destroyed. Dow reports the resulting waste to be non-hazardous and usable as filler in construction. |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Methodology | High | The assessment or report uses high quality data and/or techniques or sound methods that are from frequently used sources. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | Medium | The data are from an OECD country other than the U.S. |
| | Metric 3: Applicability | Uninformative | Asbestos use in processing is not in scope for the legacy risk evaluation. |
| | Metric 4: Temporal Representativeness | High | The report is generally no more than 10 years old. |
| | Metric 5: Sample Size | N/A | N/A - Process Description |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | Medium | Assessment or report clearly documents results, methods, and assumptions. Data sources are generally described but not fully transparent. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | N/A | N/A - Process Description |

## Overall Quality Determination Uninformative

| | |
|---|---|
| **Study Citation:** | Edwards, C. (1990). Asbestos in the workplace: Control and removal. Canadian Occupational Safety 28(6):6, 9. |
| **HERO ID:** | 6909348 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Process description: | During asbestos encapsulation, the ACM is coated with an agent to seal in the fibers. Sealants are applied which will penetrate or cover the surface of the material. During enclosure, a barrier is installed to enclose the ACM and protect it from disturbance and damage. The asbestos should be enclosed behind airtight walls and ceilings, and signs should be posted warning of the hidden hazard. |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | Medium | Report uses high quality data that are not from frequently-used sources and there are no known quality issues. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Medium | Data are from Canada, an OECD country. |
| | Metric 3: | Applicability | High | The report is for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: | Sample Size | N/A | N/A - This metric is not applicable to the data being extracted |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Low | Assessment results are provided but underlying methods, assumptions, and data sources are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination — Low

**Study Citation:** Egilman, D., Bird, T. (2016). Short fiber tremolite free chrysotile mesothelioma cohort revealed. American Journal of Industrial Medicine 59(3):196-199.
**HERO ID:** 3520615
**Conditions of Use:** Other:

**EXTRACTION**

| Parameter | Data |
|---|---|
| Chemical concentration: | Most Bakelite did not contain asbestos. At its peak, asbestos-containing Bakelite comprised 40% of the Bakelite produced by Union Carbide. The great bulk of non-asbestos Bakelite contained wood flour as afiller in lieu of asbestos. Asbestos-containing Bakelite fell into three classes of Bakelite which differed on the basis of the quantity and type of asbestos:General Purpose Bakelite contained less than 12% asbestos. The asbestos consisted of short fiber, usually purchased from the Carey-Canada Corporation.Heat Resistant Bakelite contained 25 to 30% asbestos (with one exception noted below). The asbestos consisted of short fiber asbestos, usually purchased from the Carey-Canada Corporation.High Impact Heat Resistant (only manufactured until the mid-1960's) consisted of 50% asbestos [EPA, 1990]. |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Methodology | High | The assessment or report uses high quality data and/or techniques or sound methods that are from frequently used sources. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | High | The data are from the United States. |
| | Metric 3: Applicability | Uninformative | The information is for processing which is not in scope for the legacy risk evaluation. |
| | Metric 4: Temporal Representativeness | Low | Information is from more than 20 years ago. |
| | Metric 5: Sample Size | Medium | Distribution of samples is characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | Medium | Assessment or report clearly documents results, methods, and assumptions. Data sources are generally described but not fully transparent. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Medium | Variability is addressed by including concentrations for different products but uncertainty is not addressed. |

## Overall Quality Determination Uninformative

| | |
|---|---|
| **Study Citation:** | EIA, (2018). Table HC10.14: Average square footage of single-family homes, 2015. |
| **HERO ID:** | 11138827 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Throughput: | 2,486 sq ft (single-family home)925sq ft (apartment unit)The data are applicable to the demolition, maintenance, and renovation OES and are used to calculate an estimate for the number of demolitions per year and waste per demolition |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | The assessment or report uses high quality data and/or techniques or sound methods that are from frequently used sources (EIA report) and are generally accepted by the scientific community, and associated information does not indicate flaws or quality issues. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | The data are from the United States. |
| | Metric 3: | Applicability | High | The data are applicable to the demolition, maintenance, and renovation OES and are used to calculate an estimate for the number of demolitions per year and waste per demolition. |
| | Metric 4: | Temporal Representativeness | High | The data is no more than 10 years old. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized. Sample size is sufficiently representative. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | Assessment or report clearly documents its data sources, assessment methods, results, and assumptions. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | The report provides only limited discussion of the variability and uncertainty in the results. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | EIA, (2018). Table HC10.7: Total square footage of apartment units, 2015. |
| **HERO ID:** | 11138828 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Throughput: | Apartment average square footage: 925 sq ft |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | Medium | The assessment or report uses high quality data and/or techniques or sound methods that are not from a frequently used source and associated information does not indicate flaws or quality issues. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | The data are from the United States and are representative of the industry being evaluated. |
| | Metric 3: | Applicability | High | The data are applicable to the demolition, maintenance, and renovation OES and are used to calculate an estimate for the number of demolitions per year and waste per demolition |
| | Metric 4: | Temporal Representativeness | High | The report is generally no more than 10 years old. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | Assessment or report clearly documents its data sources, assessment methods, results, and assumptions. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | The report provides only limited discussion of the variability and uncertainty in the results. |

## Overall Quality Determination — High

| | |
|---|---|
| **Study Citation:** | EIA, (2022). Table B10: Number of floors, number of buildings and floorspace, 2018. |
| **HERO ID:** | 11138829 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Throughput: | Average sq footage/building16293The data are applicable to the demolition, maintenance, and renovation OES and are used to calculate an estimate for the number of commercial demolitions per year and waste per demolition |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | The assessment or report uses high quality data and/or techniques or sound methods that are from frequently used sources (EIA report) and are generally accepted by the scientific community, and associated information does not indicate flaws or quality issues. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | The data are from the United States. |
| | Metric 3: | Applicability | High | The data are applicable to the demolition, maintenance, and renovation OES and are used to calculate an estimate for the number of demolitions per year and waste per demolition. |
| | Metric 4: | Temporal Representativeness | High | The data is no more than 10 years old. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized. Sample size is sufficiently representative. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | Assessment or report clearly documents its data sources, assessment methods, results, and assumptions. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | The report provides only limited discussion of the variability and uncertainty in the results. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Elias, J. D. (1981). Dry removal of asbestos. American Industrial Hygiene Association Journal 42(8):624-625. |
| **HERO ID:** | 3098756 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Process description: | Pg 2:1. area in question was inspected to determine extent of contamination2. area to be cleaned defined3. work area completely sealed off4. non-removable items covered with plastic sheeting5. ventilation (fans etc.) set up to maintain the work area at a negative pressure relative to the rest of the buildingPg 3:6. After dry removal began, area around the work site was monitored with a fibrous aerosol monitor. 7. disposal |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | The assessment or report uses high quality data and/or techniques or sound methods that are from frequently used sources. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Medium | Data are from Canada, an OECD country |
| | Metric 3: | Applicability | High | The report is for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: | Sample Size | N/A | Process description data |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Methods, results, and assumptions are clearly documented, but underlying data sources are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | N/A | Process description. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Equitable Environmental Health Inc, (1977). Dust exposures during the cutting and machining of asbestos/cement pipe additional studies prepared by Equitable Envir Health Inc. |
| **HERO ID:** | 4158239 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Process description: | Unloading was done with a palletized load using a fork lift. For laying pipes in trenches, one worker remained in the trench and another worked topside. The topside worker attached a clamp to the pipe, lubricated the end, then got into the trench to help guide it into place for coupling. Cutting was done with manual saws, snap cutting equipment, and abrasive discs. For hole cutting, 5/8 inch holes were drilled in a circulate pattern of about 6 inches in diameter, after which the central portion was knocked out with a hammer and the rough edges smoothed with a rasp. For removal of coupling, a hammer and chisel were used to make troughs in the coupling. Then, a crowbar was used to separate the coupling. (10/44) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Methodology | High | Report uses high quality methods and data from frequently-used sources. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | Data are from the U.S. |
| Metric 3: | Applicability | High | Data are for industrial use in construction materials, an in-scope occupational scenario. |
| Metric 4: | Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| Metric 5: | Sample Size | N/A | N/A - This metric is not applicable to the data being extracted |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Medium | Methods, results, and assumptions are clearly documented, but underlying data sources are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Medium | Variability is addressed by describing different pipe machining operations. Uncertainty isn't addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Evans, W. A. (1979). Health hazard evaluation report no. HHE-79-89-609, Herman Diamond Company, New York, New York. |
| **HERO ID:** | 3970480 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Process description: | Each cutter sits at a bench behind. a spinning polishing wheel. Regularly shaped diamonds can be clamped into holders with long arms and either manually placed against the spinning wheel, or held in a vise-like unit. Since fancy, irregularly shaped diamonds will not set in this holder, the cutters make a sticky paste to hold the stone. A cutter will tear off a piece of asbestos paper-approximately a square inch-from a roll and mix it with sugar and water in a jar. The cutter will remove this mixture as needed. (2/6) |
| Chemical concentration: | Analysis of a bulk sample of the material used for making the paste confirmed it was asbestos, containing an estimated 50 to 70% chrysotile. (5/6) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Methodology | High | Report uses high quality methods and data from frequently-used sources. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | Data are from the U.S. |
| Metric 3: | Applicability | High | Data are for commercial use in building construction materials, an in-scope occupational scenario. |
| Metric 4: | Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| Metric 5: | Sample Size | Medium | Sample distribution characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Medium | Methods, results, and assumptions are clearly documented, but underlying data sources are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Medium | Variability is addressed by taking bulk samples of the asbestos paper and settled dust. Uncertainty isn't addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Ewing, W. M. (1999). Further observations of settled asbestos dust in buildings. 1342:323-332. |
| **HERO ID:** | 5685 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Number of sites: | Sampling conducted in 66 buildings. (Page 1) |
| Chemical concentration: | The acoustical plaster contained chrysotile asbestos in a range of 5-15 percent.Building fireproofing that was sampled had 15% chrysotile in a matrix of gypsum and vermiculite. |
| Comments: | Sampling and analytical procedure employed is described in ASTM standard method D 5755-95 (page 1). Samples were collected and analyzed as described in ASTM Standard Test Method for Microvacuum Sampling and Indirect Analysis of Dust by Transmission Electron Microscopy for Asbestos Structure Number Concentrations (D 5755-95) or the earlier draft method prepared by the US EPA. More details are provided on page 2.Nearly all asbestos structures were chrysotile. (Page 3).Study states that a surface concentration of 1000 s/cm^2 is considered clean (Page 3). Surface is considered contaminated when concentration is above 100,000 s/cm^2 (Page 8). |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | The assessment or report uses high quality data and/or techniques or sound methods that are from frequently used sources |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Study and samples were conducted in the US. |
| | Metric 3: | Applicability | High | Data are for ceiling tiles, air-duct insulation. Study also has asbestos fireproofing. Samples are dust surface samples, and may be applicable to dermal exposure to dusts settled on surfaces during construction or demolition. |
| | Metric 4: | Temporal Representativeness | Low | Monitoring data are greater than 20 years old. |
| | Metric 5: | Sample Size | Medium | Distribution of samples is characterized by a range with uncertain statistics. It is unclear if analysis is representative. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | Assessment or report clearly documents its data sources, assessment methods, results, and assumptions. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | Addresses variability by sampling buildings with various levels of asbestos decomposition. Does not address uncertainty. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Ewing, W. M., Spain, W. H. (1984). Getting to the very fiber of industrial asbestos removal. Occupational Health and Safety (June):29-33, 60, 68. |
| **HERO ID:** | 3083601 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Production, import, or use volume: | ”much of the 800,000 tons of asbestos fiber used in the U.S. annually between 1970 and 1975 was incorporated into pipe lagging, fire-proofing and the like” (pg 1) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Methodology | Medium | Report uses high quality data/techniques/methods that are not from frequently-used sources and there are no known quality issues. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | High | Data are from the U.S. |
| | Metric 3: Applicability | High | Data are for construction materials, an in-scope occupational scenario. |
| | Metric 4: Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: Sample Size | Low | Sample distribution is characterized by no statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | Medium | Methods, results, and assumptions are clearly documented, but underlying data sources are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination — Medium

| | |
|---|---|
| **Study Citation:** | Eypert-Blaison, C., Romero-Hariot, A., Clerc, F., Vincent, R. (2017). Assessment of occupational exposure to asbestos fibers: Contribution of analytical transmission electron microscopy analysis and comparison with phase-contrast microscopy. Journal of Occupational and Environmental Hygiene 15(3):263-274. |
| **HERO ID:** | 4165916 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Number of sites: | 29 construction sites (abstract) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | Medium | Report uses high quality data/techniques/methods that are not from frequently-used sources and there are no known quality issues. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Medium | Data are from France, an OECD country. |
| | Metric 3: | Applicability | High | Data are for construction materials, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | High | Report is based on current industry conditions and data no more than 10 years old. |
| | Metric 5: | Sample Size | N/A | Number of sites |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Methods, results, and assumptions are clearly documented, but underlying data sources are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Faich, G. A. (1980). Asbestos hazard evaluation in Rhode Island schools. American Journal of Public Health 70(2):162-164. |
| **HERO ID:** | 3617468 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Number of sites: | Of 326 target schools, 24 (8 per cent) contained material confirmed in the laboratory to be spray-on asbestos. Overt hazards requiring major corrective measures were found in 4 (1 per cent)of the target schools (abstract) |

**EVALUATION**

| Domain | | Metric | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | Medium | The assessment or report uses high quality data and/or techniques or sound methods that are not from a frequently used source and associated information does not indicate flaws or quality issues. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | The data are from the United States and are representative of the industry being evaluated. |
| | Metric 3: | Applicability | High | The report is for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Low | The report is more than 20 years old. The report captures operations, equipment, and worker activities that are expected to be outdated. |
| | Metric 5: | Sample Size | Low | Distribution of samples is qualitative or characterized by no statistics. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | Assessment or report clearly documents its data sources, assessment methods, results, and assumptions. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | The report provides only limited discussion of the variability and uncertainty in the results. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Fajen, J. M., Hills, B. (1990). Health hazard evaluation report no. HETA 89-126-2057, Hagaman Finishing, Hagaman, New York. |
| **HERO ID:** | 3970519 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Chemical concentration: | Levels of amosite in insulation surrounding the dryers were 20-60%. (14/29) |
| Comments: | Table 2. |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | Report uses high quality methods and data from frequently-used sources. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for industrial use in building construction materials, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | Uncertainty is addressed in the bulk sampling methodology. Variability isn't addressed. |

## Overall Quality Determination — High

| | |
|---|---|
| **Study Citation:** | Fannick, N. (1983). Health hazard evaluation report no. HETA 83-03-1293, Russell-zuhl, Inc., New York City, New York. |
| **HERO ID:** | 3970522 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Process description: | NIOSH Recommendation [PDF Pg. 9]As only a small amount of asbestos is involved, NIOSH suggests the following procedure be used during repair of the pipe covering: A plastic drop-cloth be laid on the floor underneath the area to be repaired. One person perform the clean-up operation wearing a respirator approved for protection against asbestos particles. The fibrous glass batting carefully be wrapped around the damaged pipe and the duct tape carefully be applied. The drop-cloth . (along with any asbestos which may have dropped from the pipe) be thrown away after the repair work is finished. The person who performs the repair work should shower as soon as possible. Grinding, sanding or polishing of petrified wood slabs is an infrequent occurrence at this site. consideration should be given to the use of a respirator approved -for protection against dusts while these operations take place, since the dust generated contains a large percentage of quartz and some lead.As the silica dust which contaminates the rug may act as a secondary source of exposure, the rug should be vacuumed thoroughly. The silica particles are relatively large, and should easily be contained by the average ”bag” type of vacuum cleaner. Since the contamination of the floor covering will be an on-going occurrence, consideration should be given to replacing the rug with a flooring such as tile, which is easier to clean. |
| Chemical concentration: | The pipe insulation material was determined to be approximately 25% asbestos. [PDF Pg. 7] |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Methodology | High | Report uses high quality data/techniques/methods from frequently-used sources. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | High | Data are from the U.S. |
| | Metric 3: Applicability | High | Data are for Chemical Substances in Construction, Paint, Electrical, and Metal Products, an in-scope occupational scenario. |
| | Metric 4: Temporal Representativeness | Low | Report is based on data greater than 20 years old. |
| | Metric 5: Sample Size | Medium | Distribution of samples is characterized by a range with uncertain statistics. It is unclear if analysis is representative. |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | Medium | Assessment or report clearly documents results, methods, and assumptions. Data sources are generally described but not fully transparent. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Low | The report does not address variability or uncertainty of asbestos concentration in pipe insulation. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Faulring, G. M., Forgeng, W. D., Kleber, E. J., Rhodes, H. B. (1975). Detection of chrysotile asbestos in airborne dust from thermosetting resin grinding. Journal of Testing and Evaluation 3(6):482-490. |
| **HERO ID:** | 3583314 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Process description: | "Resin plaques were ground with a power-driven hand grinder simulating the fabricationoperations found in boat yards and the automobile industry. The grinding was carried out in a thoroughly cleaned, closed, room. The plaque was clamped to a bench in the center of the room. The edge was ground for a period of 4-5 min with the grinder rotating in a direction to throw the heavy particles toward the floor. (1/9)" |
| Chemical concentration: | Resin plaques contained 8-18% chrysotile. (1/9) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Methodology | High | Report uses high quality methods and data from frequently-used sources. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | High | Data are from the U.S. |
| | Metric 3: Applicability | High | Data are for commercial use in construction materials, an in-scope occupational scenario. |
| | Metric 4: Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: Sample Size | High | Statistical distribution of samples is fully characterized (discrete concentration values provided). |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Fergusen, R. P., Knutti, E. B. (1991). Health hazard evaluation report no. HETA-88-391-2156, Morton Salt Company, Weeks Island, Louisiana. |
| **HERO ID:** | 3970474 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Chemical concentration: | There was no bulk asbestos present near evaporators, dryers, pipe insulation, and pipes. There was 5-10% amosite in the boiler building siding, and 30-40% chrysotile in the boiler building siding. (23/38) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | Report uses high quality methods and data from frequently-used sources. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for industrial use in construction materials, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | Uncertainty is addressed in bulk sampling methods. Variability isn't addressed. |

## Overall Quality Determination — High

| | |
|---|---|
| **Study Citation:** | Ferguson, B. B. (1990). Assessment, management and abatement of asbestos. TAPPI proceedings :387-387. |
| **HERO ID:** | 6861594 |
| **Conditions of Use:** | Disposal |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Process description: | The document describes the steps of the asbestos abatement process as follows:1.Plant Surveys: Surveyed all 21 plants to determine the amount of asbestos to abate and removal costs.2.Development of engineering design and removal specifications3. Development of master operation and management plan.4. Development of O&M training5. Conducting O&M training at sites.6. Construction management.7. Removal of asbestos and on-site air monitoring during abatement.8. Final clearance air testing.9. Final project inspection.10. Disposal certification.11. Full project documentation. |
| Number of sites: | Asbestos survey was given to 21 locations. [PDF Pg. 3] |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Methodology | High | Report uses high quality data/techniques/methods from frequently-used sources. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | Data are from the U.S. |
| Metric 3: | Applicability | High | Data are for disposal, an in-scope, occupational scenario. |
| Metric 4: | Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| Metric 5: | Sample Size | Low | Sample distribution is characterized by no statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Medium | Methods, results, and assumptions are clearly documented, but underlying data sources are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Ferguson, R. P., Knutti, E. B. (1993). Health Hazard Evaluation Report HETA 88-391-2156, Morton Salt Company, Weeks Island, Louisiana. (Revised April 1993). NIOSH(HETA-88-391-2156):1-36. |
| **HERO ID:** | 3102308 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Chemical concentration: | Asbestos was not detected in any of the vacuum samples. Only one bulk sample (transite siding) contained asbestos (chrysotile/amosite) at concentrations up to 50% (pg 23) |
| Comments: | Health Hazard Evaluation |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | Report uses high quality data from frequently-used sources. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for concentrations in construction materials, which addresses an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: | Sample Size | Medium | Sample distribution characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | Uncertainty is addressed by analytical method. Variability is not addressed. |

## Overall Quality Determination — High

| | |
|---|---|
| **Study Citation:** | Finkelstein, M. M. (2015). Asbestos fibres in the lungs of an American mechanic who drilled, riveted, and ground brake linings: A case report and discussion. Annals of Occupational Hygiene 59(4):525-527. |
| **HERO ID:** | 3085859 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Process description: | To replace brakes, a garage owner would take the old shoes from the vehicle, find and match up the new linings, take the assembly to the brake lining machine where the old rivets were drilled out and the old lining was peeled off. Holes were drilled in the new lining and the lining was riveted to the shoe. The lining was then ground after machining the drums. Compressed air was used during the brake replacement process. (2/3) |
| Throughput: | Three or four brake replacements were performed daily at the shop. (2/3) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Methodology | Medium | Report uses high quality data that are not from frequently-used sources and there are no known quality issues. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | Medium | Data are from Canada, an OECD country. |
| | Metric 3: Applicability | High | The report is for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: Temporal Representativeness | High | Report is based on current industry conditions and data no more than 10 years old. |
| | Metric 5: Sample Size | Medium | Sample distribution characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | First, M. W., Love, D. (1982). Engineering control of asbestos. American Industrial Hygiene Association Journal 43(9):634-639. |
| **HERO ID:** | 3582527 |
| **Conditions of Use:** | Other: |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Process description: | High asbestos content caulking compound (putty tape) is manufactured by kneading asbestos fibers into a mixture of liquid polybutane, and talc dust. Bags of asbestos are opened and dumped into a mechanical conveying system that feed the putty mixing machines combined into a homogeneous plastics mass that can be extruded into tapes and other appropriate forms for easy application to vehicle housings. |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | Peer reviewed study performed by staff from Harvard School of Public Health and a consultant. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | The data are from the United States. |
| | Metric 3: | Applicability | Uninformative | Processing is not in scope for the legacy risk evaluation. |
| | Metric 4: | Temporal Representativeness | Low | 1982 - more than 20 years old. |
| | Metric 5: | Sample Size | N/A | Qualitative summary of process. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | Assessment or report clearly documents its data sources, assessment methods, results, and assumptions. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | N/A | Qualitative summary of process |

## Overall Quality Determination Uninformative

| | |
|---|---|
| **Study Citation:** | Fischbein, A., Rohl, A. N., Langer, A. M., Selikoff, I. J. (1979). Drywall construction and asbestos exposure. American Industrial Hygiene Association Journal 40(5):402-407. |
| **HERO ID:** | 3084320 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Process description: | Prior to applying the spackle, the compound is prepared by mixing half a bag of drywall taping mix with 2 gallons of water. The mixture is stirred for 60-90 seconds. After the taping compound has been applied to the wallboard and has dried, the surface is sanded either with a 5-foot pole or by hand. (3/7) |
| Chemical concentration: | Spackle compounds frequently contain 5-12% by weight of asbestos minerals. (2/7) Most products in the U.S. are 4-5%. (3/7) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Methodology | High | Report uses high quality methods and data from frequently-used sources. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | High | Data are from the U.S. |
| | Metric 3: Applicability | High | Data are for commercial use in construction materials, an in-scope occupational scenario. |
| | Metric 4: Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: Sample Size | Medium | Sample distribution characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Fischbein, A., Rohl, A. N., Langer, A. M., Selikoff, I. J. (1979). Drywall construction and asbestos exposure - reply. American Industrial Hygiene Association Journal 40(9):829-830. |
| **HERO ID:** | 3582532 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Chemical concentration: | spackling compounds contain 5-12% asbestos |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | Medium | As the author refers to the original article, it is not possible to accurately assess the data quality. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | US |
| | Metric 3: | Applicability | High | The report is for an occupational scenario (dry wall worker) within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Low | 1979 - more than 20 years old |
| | Metric 5: | Sample Size | Medium | A range of values was provided. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | The author clearly notes that the original assessment included the concentration data. To assess the clarity, methods, and assumptions we would need to consider the original report. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | Range of concentrations was provided that could help in assessing variability. Uncertainty was not mentioned. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Flanagan, D. M. (2016). 2015 Minerals yearbook. Asbestos [advance release]. |
| **HERO ID:** | 3840041 |
| **Conditions of Use:** | Other: |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Production, import, or use volume: | In 2015 the US imported 343 metric tons compared to global production of 2,030, 000 metric tons.In 2015 the US exported 517 metric tons of asbestos up from 279 metric tons in 2014 and 27 metric tons in 2013importation from Brazil of Asbestos (2015) 343 metric tonsYarn and threads from Mexico58 metric tonsAsbestos-cement products from China 45 metric tonsCrocidolite products from China 34 metric tonsquantities for other uses are not provided, but based on value, the following are significant:- Brake linings and pads for civil aviation, - Brake lining and pads, other- Gaskets packing and seals- building materials- other friction materials, |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Methodology | High | USGS study |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | High | US |
| | Metric 3: Applicability | High | Production and consumption of all products that contain asbestos |
| | Metric 4: Temporal Representativeness | High | 2015 - less than 10 year |
| | Metric 5: Sample Size | N/A | Import/export and production/consumption data |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | High | Report clearly documents its data sources, assessment methods, results, and assumptions. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | N/A | Import/export and production/consumption data |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Fowler, D. P. (2000). Exposures to asbestos arising from bandsawing gasket material. Applied Occupational and Environmental Hygiene 15(5):404-408. |
| **HERO ID:** | 3080855 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Chemical concentration: | chrysotile asbestos (80%)/neoprene gasket sheet (abstract) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | The assessment or report uses high quality data and/or techniques or sound methods that are from frequently used sources (journalarticle) and are generally accepted by the scientific community, and associated information does not indicate flaws or quality issues. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | The data are from the United States and are representative of the industry being evaluated. |
| | Metric 3: | Applicability | Medium | The report is for an occupational scenario that is similar to an occupational scenario within the scope of the risk evaluation, in terms of the type of industry, operations, and work activities. |
| | Metric 4: | Temporal Representativeness | Low | The report is more than 20 years old. The report captures operations, equipment, and worker activities that are expected to be outdated. |
| | Metric 5: | Sample Size | Low | Distribution of samples is qualitative or characterized by no statistics |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Assessment or report clearly documents results, methods, and assumptions. Data sources are generally described but not fully transparent. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | The report provides only limited discussion of the variability and uncertainty in the results. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Frank, A. L., Joshi, T. K. (2014). The global spread of asbestos. Annals of Global Health 80(4):257-262. |
| **HERO ID:** | 3077865 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Production, import, or use volume: | Asbestos us in the US is down from its peak of more than 700,000 tons of asbestos used in a year to something around 1000 tons, this figure is artificially low because it refers to raw asbestos fiber, but does not take into account the many asbestos products that may be brought into America after being manufactured in other settings. Products made in Mexico, China, and elsewhere enter the US marketplace. |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Methodology | High | Report uses sound methods, uses frequently used sources, and is generally accepted by the scientific community. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | High | Data are from the U.S. |
| | Metric 3: Applicability | High | Data are for Industrial/Commercial Use: Chemical Substances in Construction, Paint, Electrical, and Metal Products, an in-scope occupational scenario. |
| | Metric 4: Temporal Representativeness | Medium | Report is based on data greater than 10 years old but no more than 20 years old and industry conditions that are expected to be representative of current industry conditions. |
| | Metric 5: Sample Size | N/A | No sampling data |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | Medium | Methods, results, and assumptions are clearly documented, but underlying data sources are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination — Medium

| | |
|---|---|
| **Study Citation:** | Freeman, M. D., Kohles, S. S. (2012). Assessing specific causation of mesothelioma following exposure to chrysotile asbestos-containing brake dust. International Journal of Occupational and Environmental Health 18(4):329-336. |
| **HERO ID:** | 2554714 |
| **Conditions of Use:** | Other: |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Chemical concentration: | Brake linings are comprised of approximately 40– 70% asbestos. (2/9) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | Report uses high quality methods and data from frequently-used sources. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | Medium | The report is for an occupational scenario that is similar to an occupational scenario within the scope of the risk evaluation. (Braking and gear changing components in a variety of industrial and commercial machinery applications) |
| | Metric 4: | Temporal Representativeness | Medium | Report is based on data greater than 10 years old but no more than 20 years old and industry conditions that are expected to be representative of current industry conditions. |
| | Metric 5: | Sample Size | Medium | Sample distribution characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | High | Uncertainty is addressed by presenting confidence intervals and discussing under and overestimations. Variability is addressed by utilizing many studies from the industry. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Fujikawa, Y., Shimo, M., Yonehara, H., Tujimoto, T. (2011). The optimized risk management of the waste from TENORM and nuclear industries: How to harmonize risk from various sources. :497-502. |
| **HERO ID:** | 6877553 |
| **Conditions of Use:** | Disposal |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Production, import, or use volume: | From 1971 to 2001 it was estimated that total asbestos usage in Japan was 5.4x10+6 tons. |
| Life cycle description: | Disposal |
| Process description: | Manual demolition, combined with vitrification prior to burial at a landfill. |
| Chemical concentration: | 7.4 x 10-5 kg of asbestos/kg of waste3.0 10+13 f/kg of asbestosNote units not well defined but this makes the most sense. |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Methodology | Medium | The assessment uses high quality data form the Terazono et al report which is not a frequently used source and associated information does not indicate flaws or quality issues. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | Medium | Japan - and OECD member |
| Metric 3: | Applicability | High | The report is for an occupational scenario (disposal of hazardous waste) within the scope of the risk evaluation. |
| Metric 4: | Temporal Representativeness | Medium | 2010 - more than 10 and less than 20 years old |
| Metric 5: | Sample Size | Low | Distribution of samples is not characterized by statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Medium | Assessment clearly documents results, and assumptions. Data sources are generally described but not fully transparent. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Low | The report does not address variability or uncertainty for asbestos. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Gaensler, E. A. (1992). Asbestos exposure in buildings. Clinics in Chest Medicine 13(2):231-242. |
| **HERO ID:** | 3082156 |
| **Conditions of Use:** | Consumer Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Chemical concentration: | Table 1 shows a summary of percent asbestos in common building materials. Floor and tile sheets are 20%, cement pipes and sheets are 30%, corrugated paper pipe wrap is 80%, sprayed insulation is 50%, trowelled insulation is 70%, preformed pipe wrap is 50%, insulation board is 30%, and boiler insulation is 10% asbestos. (4/12) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Methodology | High | Report uses high quality methods and data from frequently-used sources. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | High | Data are from the U.S. |
| | Metric 3: Applicability | Low | Data are for consumer use of construction materials, which is similar to commercial use of construction materials, an in-scope occupational scenario. |
| | Metric 4: Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: Sample Size | Medium | Sample distribution characterized by limited statistics (percentages) but discrete samples not provided and distribution not fully characterized. |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination — Medium

| | |
|---|---|
| **Study Citation:** | GAO, (1992). Asbestos in federal buildings: Federal efforts to protect employees from potential exposure. |
| **HERO ID:** | 6904731 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Number of sites: | EPA estimated that about 14,000 of 35,000 facilities included in its 1984 survey contained friable asbestos materials. EPA also estimated that about 5,000 of these facilities had damaged materials. EPA focused on friable materials, such as sprayed-on materials, as the greatest and most immediate concern because fibers can be more easily released from such materials. [PDF Pg. 5] |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Methodology | High | Report uses high quality data/techniques/methods from frequently-used sources. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | High | Data are from the U.S. |
| | Metric 3: Applicability | High | Data are for Chemical Substances in Construction, Paint, Electrical, and Metal Products, an in-scope occupational scenario. |
| | Metric 4: Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: Sample Size | Medium | Distribution of samples is characterized by a range with uncertain statistics. It is unclear if analysis is representative. |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Low | The report does not address variability or uncertainty. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Garcia, E., Newfang, D., Coyle, J. P., Blake, C. L., Spencer, J. W., Burrelli, L. G., Johnson, G. T., Harbison, R. D. (2018). Evaluation of airborne asbestos exposure from routine handling of asbestos-containing wire gauze pads in the research laboratory. Regulatory Toxicology and Pharmacology 96:135-141. |
| **HERO ID:** | 6869530 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Production, import, or use volume: | Of the asbestos utilized commercially in the Unites States, approximately 98% was of the chrysotile asbestos type, while crocidolite composed 1.2% of the market with the remaining 0.8% split between amosite and anthophyllite; tremolite was used in low amounts (pg 1) |
| Chemical concentration: | Scenario 1: 75-85% chrysotile-type asbestos prior to testingScenario 2: 5% tremolite asbestos before testing, 2% after(pg 4) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | Medium | Report uses high quality data/techniques/methods that are not from frequently-used sources and there are no known quality issues. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for metal products (wire gauze), an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | High | Report is based on current industry conditions and data no more than 10 years old. |
| | Metric 5: | Sample Size | Medium | Sample distribution characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | General Motors, (1982). Die-cast operations benzo(a)pyrene plating operations asbestos nitrosamines with cover letter. |
| **HERO ID:** | 1231414 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Process description: | each die-cast machine automatically cycles, filling the die cavity, parts and sprues are ejected into quench bath and conveyed to trip press. sprues and flash returned to remelt furnaces. Each die is sprayed with a lubricant. |
| Number of sites: | 1 |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | Medium | Information provided was provided by the facility operators |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | US |
| | Metric 3: | Applicability | High | The report is for an occupational scenario (die-cast operator working in locations where asbestos is present in the facility) within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Low | 1981 - more than 20 years old |
| | Metric 5: | Sample Size | N/A | information provided was qualitative |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Assessment was based on facility operators information |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | N/A | information provided was qualitative |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Gibbs, G. W. (1975). Fibre release from asbestos garments. Annals of Occupational Hygiene 18(2):143-149. |
| **HERO ID:** | 3615432 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Furnishing, Cleaning, Treatment Care Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Chemical concentration: | Garments were 80-85% asbestos. (2/7) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | Report uses high quality methods and data from frequently-used sources. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Medium | Data are from Canada, an OECD country. |
| | Metric 3: | Applicability | High | Data are for industrial use in textiles, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: | Sample Size | Medium | Sample distribution characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Methods, results, and assumptions are clearly documented, but underlying data sources are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Gibson, S. M., Ogle, R. B. (1988). Technical and economic assessment for asbestos abatement within Facility 20470, Wright-Patterson Air Force Base, Ohio. |
| **HERO ID:** | 6886475 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Chemical concentration: | "These samples were representative of the friable insulation on the containment shell interior and debris that was located within the containment shell. A bulk sample was also taken from the exposed friable pipe insulation. Analysis of the samples confirmed the presence of 5 to 20% asbestos. The asbestos in the bulk samples was identified as chrysotile, except in the case of the friable pipe insulation; the latter was identified as the more hazardous type, amosite" (pg 19) |
| Comments: | Asbestos abatement project at Federal facility |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | Report uses high quality data and information from frequently-used sources. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for construction industry, which is an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Sample type provided but missing product information. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Giordano, R. J., Gardner, D. L., Taylor, C. A. (1987). Practical radiation, contamination and asbestos control techniques for decommissioning. |
| **HERO ID:** | 6891991 |
| **Conditions of Use:** | Other: |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Process description: | The asbestos was removed in three types of containments,full room, tent type, and glove bag. The full room containments were erected of Fasilon, a fire retardant, reinforced Herculite material, with frames consisting of either PVC pipe or wood with fire retardant paint. Negative air pressure was maintained using Micro-Trap HEPA filtered portable ventilation systems. A minimum of six (6) total air changes per hour was required, therefore, the number of units used depended upon the size of the area. Double chambered air locks with triple overlapping flaps were used as access control points for the containments. Areas within the containments including the air lock, were designated as asbestos work areas (AWAs).Tent containments were utilized inside of rooms or chambers, around vessels and pipes to prevent asbestos contamination of adjacent areas. Tent containments consisted of 6 mil Fasilon sheeting making up the walls, floors, and ceiling of the enclosure. Wood frames or existing structural members were utilized for support of the containment. All tent containments were constructed with double air-lock entry.Two (2) different types of glove bag containments were used. The first type was a single use type which was used for valves, joints3 and areas which. were hard to access. The second type used was a Canadian glove bag with a zip lock closure to allow for movement along straight runs of pipe without breaching the containment. The asbestos work area for a glove bag was defined as the area inside of the glove bag.Less water was used to wet the surface of the material being removed due to the potential of radiological contamination and the cost to process the wastewater. Alternatively a wetting agent was used with an encapsulant to help reduce airborne asbestos levels. The wetting agent used for all asbestos removal was BWE-5000. This wetting agent is a poly based surfactant manufactured by Better Working Environment, Inc., of Las Vegas. BWE-3000, an encapsulant from the same company, was used when asbestos removal was terminated to capture asbestos fibers and dry them to a hard plastic finish. |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Methodology | Medium | Documents were from the 1987 International Decommissioning Symposium ( nucelar facility decommissiong) |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | US |
| Metric 3: | Applicability | High | The report is for an occupational scenario (nuclear power plant decommissioning) within the scope of the risk evaluation. |
| Metric 4: | Temporal Representativeness | Low | 1987 - more than 20 years old |
| Metric 5: | Sample Size | N/A | Qualitative information provided |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | High | The articles clearly documented data sources, assessment methods, results, and assumptions. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | N/A | Qualitative information provided |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Gorman, T., Watterson, A. (2004). Confronting the continuing problem of asbestos in Scotland: Report on a Scottish public sector initiative for the 21st century. New Solutions: A Journal of Environmental and Occupational Health Policy 14(1):77-98. |
| **HERO ID:** | 6871598 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Production, import, or use volume: | "It has been reported that 140,000,000 square meters of insulatingboard, which contains amosite (brown asbestos), were used in the UK, most of which is still in place in buildings. An estimated 4.4 million buildings still contain asbestos. Of these, nearly two million are in the non-domestic sector: p. 4"In the 1970s, of 13,000 new schools built in the UK between 1945 and 1974, asbestos could be present within 8,700 school buildings. A 1980 survey by the Inner London Education Authority (ILEA) found that two-thirds of its school buildings contained asbestos." (p. 9) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Methodology | Medium | The assessment or report uses high quality data and/or techniques or sound methods that are not from a frequently used source and associated information does not indicate flaws or quality issues. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | Medium | The data are from an OECD country other than the U.S., and locality-specific factors (e.g., potential differences in regulatory occupational exposure or emission limits, industry/ processtechnologies) may impact exposures or releases relative to the U.S. |
| | Metric 3: Applicability | High | The report is for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: Temporal Representativeness | Medium | The report captures operations, equipment, and worker activities that are expected to be reasonably representative of current conditions. The report is generally more than 10 years but no more than 20 years old. |
| | Metric 5: Sample Size | N/A | The data is not reliant on sampling |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | High | Assessment or report clearly documents its data sources, assessment methods, results, and assumptions. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Medium | The report provides only limited discussion of the variability and uncertainty in the results. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Gościcki, J. W., Indulski, J. A. (1982). The Polish studies on occupational exposure to asbestos and its biological effects. Archivum Immunologiae et Therapiae Experimentalis 30(3-4):169-176. |
| **HERO ID:** | 3100631 |
| **Conditions of Use:** | Other: |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Production, import, or use volume: | In Poland, 100 thousand tons of asbestos were produced annually. Of this, 65% was cement products. (1/8) |
| Chemical concentration: | The dry mixture of asbestos cement is 10-13% asbestos. Friction products contain 43% of asbestos. (2/8) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Methodology | Medium | Report uses high quality data that are not from frequently-used sources and there are no known quality issues. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | Medium | Data are from Poland, an OECD country. |
| | Metric 3: Applicability | Uninformative | Data are for asbestos product manufacturing, which isn't in scope. |
| | Metric 4: Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: Sample Size | Medium | Sample distribution characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination — Uninformative

| | |
|---|---|
| **Study Citation:** | Grant, M. P. (2019). Evaluation of wildland fire fighters' exposures to asbestos during a prescribed burn. |
| **HERO ID:** | 7598689 |
| **Conditions of Use:** | Other: |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Process description: | The prescribed burn day had five parts: briefing and preparation, fire line construction, burn, mop-up, and decontamination. (P. 12/32) |
| Chemical concentration: | Chrysotile accounts for more than 99% of the world's mined asbestos. (P. 27/32) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | The assessment or report uses high quality data and/or techniques |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | The data are from the United States |
| | Metric 3: | Applicability | Medium | The report is for an occupational scenario that is similar to an occupational scenario. |
| | Metric 4: | Temporal Representativeness | High | The report is no more than 10 years old. |
| | Metric 5: | Sample Size | N/A | Process description |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Assessment or report clearly documents results. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | The report does not address variability or uncertainty. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Green, F. H. Y., Harley, R., Vallyathan, V., Althouse, R., Fick, G., Dement, J., Mitha, R., Pooley, F. (1997). Exposure and mineralogical correlates of pulmonary fibrosis in chrysotile asbestos workers. Occupational and Environmental Medicine 54(8):549-559. |
| **HERO ID:** | 7837 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Furnishing, Cleaning, Treatment Care Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Production, import, or use volume: | The average annual consumption of chrysotile at this factory was 3-4 million kg. This was typical at this plant for period from 1940 to 1975. (Page 2) |
| Chemical concentration: | Table 3 is Concentration of mineral fiber in lung tissue (Unites are fibres x 10^6/g of lung tissue) (Page 6)All fibres1.0<10 found in 14.3% of lung tissue10<100 found in 57.1% of lung tissue100<1000 found in 28.6% of lung tissueChrysotile1.0<10 found in 14.3% of lung tissue10<100 found in 64.3% of lung tissue100<1000 found in 21.4% of lung tissueTremolite<0.1 found in 16.7% of lung tissue0.1<1.0 found in 14.3% of lung tissue1.0<10 found in 26.2% of lung tissue10<100 found in 42.9% of lung tissueAmosite/crocidolite<0.1 found in 47.6% of lung tissue0.1<1.0 found in 23.8% of lung tissue1.0<10 found in 21.4% of lung tissue10<100 found in 7.1% of lung tissueAnthophyllite<0.1 found in 81.0% of lung tissue0.1<1.0 found in 7.1% of lung tissue1.0<10 found in 11.9% of lung tissueMullite<0.1 found in 26.2% of lung tissue0.1<1.0 found in 9.5% of lung tissue1.0<10 found in 42.9% of lung tissue10<100 found in 21.4% of lung tissueOther<0.1 found in 26.2% of lung tissue0.1<1.0 found in 16.7% of lung tissue1.0<10 found in 50% of lung tissue10<100 found in 7.1% of lung tissue |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Methodology | High | Provides information about the sampling/analytical methodology but never states whether or not it is related to an EPA/NIOSH method. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | High | The data are from the United States and are representative of the industry being evaluated. |
| | Metric 3: Applicability | High | The report is for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: Temporal Representativeness | Low | The report is more than 20 years old. |
| | Metric 5: Sample Size | Medium | Distribution of samples is characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | Medium | Sample type, exposure type, worker activity, exposure duration, particle size characterization, and concentration data are provided. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Medium | Addresses variability by looking at workers over many years but does not address uncertainty. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Guidotti, T. L. (1988). Quantitative risk assessment of exposure to airborne asbestos in an office building. Canadian Journal of Public Health 79(4):249-254. |
| **HERO ID:** | 3095120 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Chemical concentration: | 1-50% (Table 1, pg 3) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | Medium | Report uses high quality data/techniques/methods that are not from frequently-used sources and there are no known quality issues. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Medium | Data are from Canada, an OECD country. |
| | Metric 3: | Applicability | High | Data are for construction materials, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: | Sample Size | Medium | Sample distribution characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Methods, results, and assumptions are clearly documented, but underlying data sources are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Hall, R. M., Boudreau, Y. (1999). Health hazard evaluation report no. HETA 98-0124-2743, Yankton Siox Tribe- Marty Indian School, Marty, South Dakota. |
| **HERO ID:** | 3970539 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Chemical concentration: | Bulk samples of pipe insulation obtained from utility tunnels at the school contained 40 – 50% chrysotile asbestos (p. 3) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | The assessment or report uses high quality data and/or techniques or sound methods that are from frequently used sources (e.g., European Union or OECD reports, NIOSH HHEs, journalarticles, Kirk-Othmer) and are generally accepted by the scientific community, and associated information does not indicate flaws or quality issues. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | The data are from the United States and are representative of the industry being evaluated. |
| | Metric 3: | Applicability | High | The report is for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Low | The report is more than 20 years old. The report captures operations, equipment,and worker activities that are expected to be outdated. |
| | Metric 5: | Sample Size | Low | Distribution of samples is qualitative or characterized by no statistics. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | Assessment or report clearly documents its data sources, assessment methods, results, and assumptions. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | The report does not address variability or uncertainty. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Harries, P. G. (1971). Asbestos dust concentrations in ship repairing: A practical approach to improving asbestos hygiene in naval dockyards. Annals of Occupational Hygiene 14(3):241-254. |
| **HERO ID:** | 3084877 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Chemical concentration: | Pipes and machinery have been insulated with moulded sections containing from 15-90 per cent amosite asbestos. (P. 1/14)The materials removed included pipe sections of 90 per cent amosite asbestos, sections of calcium silicate and 15 per cent asbestos, asbestos cloth and cement. (P. 4/14) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | The assessment or report uses high quality data |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Medium | The data are from an OECD country. |
| | Metric 3: | Applicability | High | The report is for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Low | The report is more than 20 years old. |
| | Metric 5: | Sample Size | Low | Distribution of samples is qualitative or characterized by no statistics. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Assessment or report clearly documents results, methods, and assumptions. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | The report does not address variability or uncertainty. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Hatfield, R., Longo, W., Newton, L., Templin, J. (2003). Asbestos exposure from gasket removal. AIHA Journal 64(5):595; author reply 595-7. |
| **HERO ID:** | 3530953 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Chemical concentration: | gaskets typically contain 60 to 80% asbestos |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | The assessment or report uses high quality data |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | The data are from the United States |
| | Metric 3: | Applicability | High | The report is for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Medium | More than 10 years but no more than 20 years old. |
| | Metric 5: | Sample Size | Low | Distribution of samples is qualitative or characterized by no statistics. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Low | Assessment or report provides results, but the underlying methods, data sources, and assumptions are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | The report does not address variability or uncertainty. |

## Overall Quality Determination — Medium

| | |
|---|---|
| **Study Citation:** | Hawkins, J. W., Hayes, D. C., Istone, W. K., Schmidt, A. F. (1987). Asbestos abatement. Part 1: Sampling and identification. Tappi Journal 70(12):233-235. |
| **HERO ID:** | 3585539 |
| **Conditions of Use:** | Other: |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Throughput: | Between 1900 and 1980, some 30 million tons of asbestoswere put in place. Since the 1970s however, asbestos usehas declined to a point where the United States only processes about 200,000 tons/year in hundreds of different products. |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | Medium | The assessment or report uses high quality data and/or techniques or sound methods that are not from a frequently used source and associated information does not indicate flaws or quality issues. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | The data are from the United States. |
| | Metric 3: | Applicability | Low | The use information is about general asbestos use from 1900-1980 and may not apply to the legacy risk evaluation. |
| | Metric 4: | Temporal Representativeness | Low | The report is more than 20 years old. The report captures operations, equipment, and worker activities that are expected to be outdated. |
| | Metric 5: | Sample Size | Medium | Distribution of samples is characterized by a range with uncertain statistics. It is unclear if analysis is representative |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Assessment or report clearly documents results, methods, and assumptions. Data sources are generally described but not fully transparent. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | The report does not address variability or uncertainty. |

## Overall Quality Determination — Low

| | |
|---|---|
| **Study Citation:** | Hawkins, J. W., Haynes, D. C., Istone, W. K., Schmidt, A. F. (1988). ASBESTOS .2. ABATEMENT REMOVAL PROGRAMS. Tappi Journal :199-200. |
| **HERO ID:** | 6864225 |
| **Conditions of Use:** | Other: |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Process description: | The asbestos materials are commonly sprayed with water that contains a wetting agent to enhance the penetration. Dry removal is done on select cases only, such as computer rooms and electrical rooms. The friable asbestos is removed by scraping the material from the substrate with the appropriate mechanical equipment. When removed, the material is packed into properly labeled, 6-mil-thick (minimum), sealable plastic bags prior to starting the next section of work. The thickness and density of lagging materials in pipe insulation seldom allows removal in an entirely wet state. The covering over the pipe insulation is cut along the top seam to allow the asbestos insulation to be wetted before removal. Once the asbestos has been wetted, the fasteners are cut and the insulation is removed immediately and placed in polyethylene bags. (2/2) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | Medium | Report uses high quality data that are not from frequently-used sources and there are no known quality issues. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for demolition of asbestos products, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: | Sample Size | N/A | N/A - This metric is not applicable to the data being extracted |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Low | Assessment results are provided but underlying methods, assumptions, and data sources are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Hawkins, J. W., Haynes, D. C., Istone, W. K., Schmidt, A. F. (1988). ASBESTOS .2. ABATEMENT REMOVAL PROGRAMS. Tappi Journal :199-200. |
| **HERO ID:** | 6864225 |
| **Conditions of Use:** | Disposal |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Process description: | ”Asbestos can be disposed of only at certified landfills registered to handle asbestos. When disposing of asbestos, arrangements should be made prior to delivery to the landfill. By law, the contractor has 24 hours to unload the asbestos and have it buried once it leaves the projectsite. (2/2)” |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | Medium | Report uses high quality data that are not from frequently-used sources and there are no known quality issues. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for disposal of asbestos products, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: | Sample Size | N/A | N/A - This metric is not applicable to the data being extracted |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Low | Assessment results are provided but underlying methods, assumptions, and data sources are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Heikkilä, P., Kauppinen, T. (1992). Occupational exposure to carcinogens in Finland. American Journal of Industrial Medicine 21(4):467-480. |
| **HERO ID:** | 1233885 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Production, import, or use volume: | 1987 import of raw asbestos was 1,000 t. 1987import of asbestos products was 2,250 t. |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Methodology | High | Report uses high quality data/techniques/methods from frequently-used sources. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | Medium | Data are from Finland, an OECD country. |
| | Metric 3: Applicability | High | Data are for construction, paint, electrical, and metal products, an in-scope occupational scenario. |
| | Metric 4: Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: Sample Size | Low | Sample distribution is characterized by no statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Medium | Variability addressed by giving imports of both raw asbestos and asbestos-containing products but uncertainty is not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Hervin, R. L. (1977). Health hazard evaluation report no. HETA-77-102-434, Terminal B, Trans World Airlines, Inc., Kansas City, Missouri. |
| **HERO ID:** | 3970469 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Process description: | Insulation used on the structural underside of the public service level floor or ceilings of the ramp level of Terminal B |
| Chemical concentration: | 25% and 45% asbestos (page 1, 2, and 4) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | Sampling/analytical methodology is an approved NIOSH method. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for Chemical Substances in Construction, Paint, Electrical, and Metal Products (specifically insulation), an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Monitoring data are greater than 20 years old. |
| | Metric 5: | Sample Size | Low | Distribution of asbestos content in insulation samples is not characterized. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Includes sample type but missing additional metadata. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | The monitoring study does not address variability or uncertainty of asbestos concentration in insulation. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Hibbert, L. (2011). Asbestos lies hidden in many older buildings and plants - posing a hidden danger to maintenance workers. Professional Engineering 24(1):18. |
| **HERO ID:** | 3585409 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Process description: | Even before any asbestos could be stripped, a huge containment structure was built around each heat exchanger, providing a controlled environment within which to carry out the physically demanding work. Powerclad sheeting was used to protect the asbestos from the environment and provide some element of containment if any of the material fell to the ground.The stripping process takes place within an airtight structure that is built within the contained housing. At one end of the airtight structure is an airlock, and at the other is a negative pressure unit which is used to remove any residual fibres via a Hepa filter while stripping is being carried out. But before any work is carried out, a smoke test is undertaken to ensure that the structure is airtight. Once this is done, the asbestos is injected with a substance that helps bind it, so that it comes off in lumps rather than fibres. The job is done by workers kitted out in full respiratory equipment. First, a bulk strip from top to bottom of the heat exchanger is carried out, with as much as 150 tonnes of asbestos being removed within 10 days. Then a fine clean is carried out. Every part of the heat exchanger is taken back to bare metal using manual methods and a dustless grit blasting machine known as a quill falcon. This is a slow process. taking up to six weeks, as it often involves cleaning around hard-to-get-at fittings such as welds and pipes. Then the structure is washed down, where the odd fibres are picked up, and there is a visual inspection by an independent firm. If the work is passed, a stage-two clearance is then issued and the job progresses. Then air samples are run for a set number of hours, with the filter papers taken away for assessment. If the fibres on the filters are below acceptable levels, then a stage-three clearance is awarded. The containment tenting is then removed, and a final check is carried out, before the structure can be deemed to be asbestos free. [PDF Pg. 4] |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Methodology | Medium | Report uses high quality data/techniques/methods that are not from frequently-used sources and there are no known quality issues. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | Medium | Data are from the United Kingdom, an OECD country. |
| | Metric 3: Applicability | High | Data are for deconstruction of asbestos containing materials, an in-scope occupational scenario. |
| | Metric 4: Temporal Representativeness | Medium | Report is based on data greater than 10 years old but no more than 20 years old and industry conditions that are expected to be representative of current industry conditions. [2011] |
| | Metric 5: Sample Size | N/A | N/A - Process description. |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | Medium | Methods, results, and assumptions are clearly documented, but underlying data sources are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | N/A | N/A - Process description. |

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| | |
|---|---|
| **Study Citation:** | Hibbert, L. (2011). Asbestos lies hidden in many older buildings and plants - posing a hidden danger to maintenance workers. Professional Engineering 24(1):18. |
| **HERO ID:** | 3585409 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

| | | EVALUATION | |
|---|---|---|---|
| Domain | Metric | Rating | Comments |
| **Overall Quality Determination** | | **Medium** | |

| | |
|---|---|
| **Study Citation:** | Hollett, B. A. (1985). Walk-Through Survey Report No. CT-147-14a: Control Technology For Asbestos Removal Industry At Tarrallton Elementary School, Norfolk, Virginia. NIOSH(CT-147-14a):147-14. |
| **HERO ID:** | 3101528 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Process description: | The Tarrallton school project involved removal of sprayed on ceilings. It was divided into three areas/phases to provide better containment area air flow patterns for ventilation controls. The removal in Phase 2 had been complicated by unexpected difficulty in wetting and removing some portions of the asbestos which had been painted over, effectively sealing the asbestos from water. The first two removal phases had been completed and the third phase containment barriers were being set up at the time of our walk-through on the 26th. Workers hanging polyethylene were wearing high-efficiency half-face respirators as a precaution. The third phase removal activity was scheduled to begin the morning of the 27th. It was delayed briefly while lighting fixtures were removed and bagged. Two teams of two men on mobile scaffolding began removal in one classroom as soon as the light fixtures wereremoved. Wetting was done in stages ahead of the removal work. The sprayed on ceiling material came off in cakes and appeared to be well controlled. This decontamination facility was a three compartment walk-through shower/decontamination unit, constructed from two by four framing and opaque plastic. This initial removal work was performed in RACAL powered air purifying respirators (PAPR) with full-face masks. The workers woredisposable contamination control garments. The NIOSH investigator who entered the site borrowed a PAPR from the contractor. A Virginia Bureau of Occupational Health (BOH) inspector visited the site and monitored while NIOSHwas there. It is BOH practice to try to visit each site on initial startup and again during cleanup.. (P. 6/11) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Methodology | High | The assessment or report uses high quality data and/or techniques or sound methods. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | High | The data are from the United States |
| | Metric 3: Applicability | High | The report is for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: Temporal Representativeness | Low | The report is more than 20 years old. |
| | Metric 5: Sample Size | N/A | Process description. |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | Medium | Assessment or report clearly documents results, methods, and assumptions. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Low | This metric does not have an unacceptable criterion. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Hollett, B. A. (1985). Walk-Through Survey Report: Control Technology For Asbestos Removal Industry, Report No. CT-147-11a, Columbus East High School, Columbus, Indiana. NIOSH:147-11. |
| **HERO ID:** | 3101586 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Chemical concentration: | Fireproofing spray insulation was judged ”moderately friable” and was found to contain approximately 30-60% chrysotile asbestos. [PDF Pg. 4] |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | Report uses high quality data/techniques/methods from frequently-used sources. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for Chemical Substances in Construction, Paint, Electrical, and Metal Products, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: | Sample Size | Medium | Sample distribution characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | Uncertainty is addressed by a range given to the concentration. Variability is not addressed. |

## Overall Quality Determination — High

| | |
|---|---|
| **Study Citation:** | Hollett, B. A., Caplan, P. E., Cooper, T. C., Froehlich, P. A. (1987). In-depth survey report: Control technology for asbestos removal at Bloom Middle School, Cincinnati, Ohio. |
| **HERO ID:** | 3099230 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Process description: | Preparation:The contract for asbestos removal in Bloom Middle School required the use of glove bags as the primary control in lieu of total room containment and ventilation It also required the installation of poly barriers in stairways and hallways to separate the work area from the rest of the building Decontamination showers were not required TM floors under the pipe being cleaned were usually covered with poly to facilitate cleanup The removal contractor enclosed all of the piping in an envelope fabricated from poly sheeting and duct tape before starting the removal. A length of poly sheeting was brought up from under the pipe, folded over the pipe lagging, the edges were rolled together and stapled to the top of the lagging forming a cylinder or envelope enclosing the lagging Duct tape was used to seal the longitudinal seam The envelope was made much larger than the diameter of the lagging to facilitate working inside it the first day, but on subsequent days it was constructed to be merely a loose fit around the lagging The surface of the lagging was misted with amended water (water containing wetting agents, penetrants, and/or other agents to enhance the wetting-down process) to control surface dust before enclosing it in the poly. Removal:During the first day the glove bags were hung at widely separated, predetermined intervals as part of an extended envelope. The lagging was removed 1n the envelope, then transferred to the bags through the poly envelope Workers reached through openings they cut in the top of the envelope rather than using the gloves 1n the bags to accomplish the removal and transfer of the lagging to the bags The glove bag was used as a receptacle rather than as a glove bag The tools for cutting metal bands and lagging were inserted, operated, and transferred between hags through breaches in the enclosure. The lagging was wetted as it was removed from the pipe Water sprayers (hand-pumped garden sprayers having a 2- to 3-gallon capacity) fitted with 30” hoses; were elevated to the working level, and were often hung from the pipes This technique required workers on ladders and platforms to climb down periodically to fill the sprayer with amended water and pump up the pressure The pipe was washed with water and rags after the lagging was removed It appeared that glove bag removal was a new technique for this crew and that they had little previous experience with it Therefore, on the second day workers were 1nstt”Ucted by the NIOSH survey team on improved procedures to enclose and remove the lagging with1n the glove bags and to transfer contaminated tools to the next glove bag, i. e. , the tools for cutting metal bands and lagging were placed inside the glove bag and the bag was hung from the pipe Bags were taped to form a seal along the length of pipe and then the bag ends (sleeves) were taped to the poly-jacketed pipe The lagging was wetted as it was removed from the pipe Contaminated tools were transferred to new bags from the previously used bag, inside an inverted glove which was tied closed and cut off workers were cautioned of the need for increased wetting It was suggested that by using longer hoses, the pressure vessels could remain on the floor and be serviced by a worker on the floor level, thereby eliminating the need for frequent climbs from ladders and scaffolds to accomplish this task Decontamination:The spilled material was removed from the floor with a portable REPA vacuum cleaner After the work was finished in an area, the poly was removed from the floor and the floor was wet mopped Bags of waste were removed from the enclosure prior to post-removal air sampling. The poly seals on windows, vents, and doors were kept in place to minimize the interaction with the surrounding areas and activities. |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Methodology | High | The assessment or report uses high quality data and/or techniques or sound methods that are from frequently used sources. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | The data are from the United States and are representative of the industry being evaluated. |
| Metric 3: | Applicability | High | The report is for an occupational scenario within the scope of the risk evaluation. |
| Metric 4: | Temporal Representativeness | Low | The report is more than 20 years old. |
| Metric 5: | Sample Size | N/A | No sample data. |

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| | |
|---|---|
| **Study Citation:** | Hollett, B. A., Caplan, P. E., Cooper, T. C., Froehlich, P. A. (1987). In-depth survey report: Control technology for asbestos removal at Bloom Middle School, Cincinnati, Ohio. |
| **HERO ID:** | 3099230 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

| | | | EVALUATION | |
|---|---|---|---|---|
| Domain | | Metric | Rating | Comments |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Assessment or report clearly documents results, methods, and assumptions. Data sources are generally described but not fully transparent. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | N/A | Process Description. |

## Overall Quality Determination — High

| | |
|---|---|
| **Study Citation:** | Hollett, B. A., Caplan, P. E., Cooper, T. C., Froehlich, P. A. (1987). In-Depth Survey Report: Control Technology for Asbestos Removal at Sands Elementary School, Cincinnati, Ohio, Report No. CT-147-19B. Division of Physical Sciences and Engineering(CT-147-19B):147-19. |
| **HERO ID:** | 3099459 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Process description: | Preparation - site is cleaned, cleared of movable materials and isolated by sealing off all access with plastic sheeting. Surfaces not involved in removal are sealed with plastic. Entrance and egress control points are established with showers and changing rooms and waste handling.Removal - asbestos containing material is wetted, removed, collected and removed from area. containment enclosure is maintained as negative pressure and exhausted outside the building through HEPA filters.Removal of pipe lagging using glove bags that seal around the material being removed. workers manipulate tools inside the bag to remove the lagging using long gloves sealed into the body of the bag.Decontamination - Asbestos fibers remaining after the removal operations are completed are removed cleaning and settling periods combine with continuous air filtration. Additional details are provided in the reference. |
| Number of sites: | 1 |
| Chemical concentration: | Pipe lagging contained 5% of Chrysotile AsbestosTeachers lunch room air seal lagging - 30-40 % Chrysotile asbestosJoint cements and pipe lagging in boys bathroom 10-15% Chrysotile. (P. 8/49) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Methodology | High | NIOSH study |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | From US |
| Metric 3: | Applicability | High | The report is for an occupational scenario (asbestos removal from a school) within the scope of the risk evaluation. |
| Metric 4: | Temporal Representativeness | Low | 1985 - more than 20 years old |
| Metric 5: | Sample Size | Medium | Range of concentrations provided |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | High | NIOSH Assessment clearly documents data sources, results, and assumptions. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Medium | Report provides a range of concentrations that can be useful in assessing variability, but nothing on uncertainty. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Hollett, B. A., Caplan, P. E., Cooper, T. C., Froehlich, P. A. (1987). In-depth survey report: Control technology for asbestos removal at Washburn Elementary School, Cincinnati, Ohio. |
| **HERO ID:** | 3099460 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Process description: | asbestos removal (pg 7-11):Preparation: furniture/furnishings removed (where possible), floors cleaned, all air ducts, holes, and windows sealed with polyethylene sheeting and duct tape, doors hung with two-sheet poly baffle, surfaces not involved in removal sealed with poly sheeting, light fixtures removed, entrance/egress contamination control facilities established (one with showers and change rooms and other for waste handlingRemoval: wetted, debris collected and removed from area in small incrementsdecontamination: multiple cleaning and settling periods combined with continuous air filtrationEnd of pg 11-pg 13 describes process when using glovebags, similar process |
| Throughput: | 1230 linear feet of asbestos pipe lagging removed from 13 major rooms in elementary school (pg 7) |
| Number of sites: | Asbestos pipe and/or boiler lagging was found in 76 of 84 public school ”facilities” surveyed by Cincinnati Public School Board (pg 6); 7 had asbestos acoustical plaster, 2 had asbestos fireproofing, 1 had asbestos acoustical ceiling tile (pg 7) |
| Chemical concentration: | asbestos boiler packing: 45% chrysotile and 53% cellulose (pg 7)pipe lagging: 20-25% chrysotile, 3-5% cellulose and other fibers, remainder non-fibrous material; no other asbestos forms identified (pg 7) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | Report uses high quality data/techniques/methods from frequently-used sources. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for construction materials, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: | Sample Size | Medium | Sample distribution characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | Variability addressed by discussing concentrations for different insulation types and process descriptions with and without glovebags but uncertainty is not addressed. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Hollett, B. A., Caplan, P. E., Cooper, T. C., Froehlich, P. A. (1987). In-Depth Survey Report: Control Technology for Asbestos Removal at Winton Place Elementary School, Cincinnati, Ohio, Report No. CT-147-19D. Division of Physical Sciences and Engineering(CT-147-19D):147-19. |
| **HERO ID:** | 3099463 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Process description: | Preparation–The site is cleaned, cleared of all movable materials, and isolated by sealing off all access with plastic sheeting taped to windows, air vents, doors, etc. Surfaces not involved in the removal are covered and sealed with plastic sheeting (usually polyethylene, commonly called ”poly”) and the lighting fixtures are removed Two entrance and egress contamination control facilities are established one with showers and change rooms for personnel and the other for waste material handling.Removal–The asbestos-containing materials are wetted (saturated, if possible) as they are removed from the structures they cover, then the wet debris is collected and removed from the area, Work is accomplished in small increments to avoid accumulation of waste. In order to contain the fibers and to prevent contaminating the outside air, the containment enclosure is maintained undernegative pressure and is e:lmausted outside the building through HEPA filters. Air should be exhausted in sufficient quantity and with consideration of the flow patterns within the enclosure to optimize the benefits of dilution air in reducing fiber concentration w1th1n the enclosure. The EPA recommends four air changes per hour, however, some contractors use tw1c~ this amount Whenlarge air volumes cannot be exhausted, a portion of the air cleaning may be performed by recirculating it through HEPA filters inside the work area Sometimes local pickup at the point of release is used Work should begin at the point furthest from the exhaust and proceed toward the exhaust The workers inside the containment must wear appropriate, approved respiratory protection, and protective clothing.Decontamination–The asbestos fibers remaining after the removal operations are completed must be removed from surfaces and from the air This usually requires multiple cleaning and settling periods combined with continuous air filtration All contaminated waste must be disposed of in accordance with EPA and local government regulations. |
| Chemical concentration: | Pipe lagging samplesGirls restroom: 5% chrysotileBoys restroom: 20% chrysotileRoom 14: 5-7% chrysotile |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Methodology | High | Report uses high quality [data/techniques/methods] from frequently-used sources. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | Data are from the U.S. |
| Metric 3: | Applicability | High | The data are for an occupational scenario within the scope of the risk evaluation. |
| Metric 4: | Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| Metric 5: | Sample Size | Low | Sample distribution is characterized by no statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Medium | Variability addressed by sampling in multiple rooms of the school but uncertainty is not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Hollett, B. A., Froehlich, P. A., Caplan, P. E., Cooper, T. C., Shulman, S. A. (1990). An Evaluation of Glove Bag Containment in Asbestos Removal. NIOSH(IA):88-22. |
| **HERO ID:** | 3646359 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Process description: | First, the removal site is cleaned and isolated. Entrance and egress are established, and surfaces are taped off with plastic sheets. The ACM is wetted, then is removed through cutting, scraping, and brushing with hand tools. The wet debris is collected, placed in bags and labeled. Work is completed in small increments to avoid accumulation of waste. After removal, the site is cleaned multiple times. (33/136) |
| Chemical concentration: | Bulk sample analysis of the pipe lagging ranged from 1% to 40% chrysotile. (30/136) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Methodology | High | Report uses high quality methods and data from frequently-used sources. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | Data are from the U.S. |
| Metric 3: | Applicability | High | Data are for demolition of asbestos products, an in-scope occupational scenario. |
| Metric 4: | Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| Metric 5: | Sample Size | Medium | Sample distribution characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Medium | Variability is addressed by sampling at 4 sites. Uncertainty isn't addressed. |

## Overall Quality Determination — High

| | |
|---|---|
| **Study Citation:** | Hollins, D. M., Paustenbach, D. J., Clark, K., Mangold, C. A. (2009). A visual historical review of exposure to asbestos at Puget sound naval shipyard (1962-1972). Journal of Toxicology and Environmental Health, Part B: Critical Reviews 12(2):124-156. |
| **HERO ID:** | 2595959 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Life cycle description: | During the 1960s and 1970s at Pugent Sound Naval Shipyard, asbestos-containing insulation products such as blankets, felts, and pads were fabricated [and subsequently used in ships] at the shipyard (pg 5) |
| Process description: | Thermal insulation materials for Naval and U.S. Maritime Commission ship applications were generally placed into three categories: insulating, lagging, and fastening materials. Products such as felt, thermal block insulation, pipe covering, and high-temperature insulation cement were classified as insulating materials. Lagging materials were applied over the insulating materials, and included products such as cloth, millboard, and finishing cement. Coatings, such as mastics or adhesives, were considered fastening materials, and were used for securing lagging to the insulating material (pg 4)[thermal insulation pipe covering] was typically affixed on pipes using iron wire or metal bands and wrapped with asbestos cloth. In order to create a smooth surface and to fill cracks and joints, dry asbestos cement was mixed with water, and spread it into those areas where the rigid insulation did not fit tightly (pg 4)[asbestos felt] was often wrapped or fitted around irregular shaped piping or equipment, such as valves and turbines (pg 5)preformed half-rounds (a term applied to molded asbestos insulation that was applied to straight runs of pipe) were custom cut into pieces known as gores, creating sections that looked like orange slices. Each gore was held in place by wire. (pg 5) |
| Throughput: | FLETCHER-Class destroyer: 48 tons of asbestos-containing insulation; 34.4 tons of asbestos containing products (i.e., asbestos felt, cloth, twine, yarn, insulating cement, and amosite sectional pipe covering) in machinery spaces, remaining 13.6 tons located in other ship areas; 1/3 of all amosite or amosite-bearing insulation products located in engine and machinery spaces (pg 3) |
| Chemical concentration: | weight percent of friable asbestos or asbestos-containing insulation products generally varied between 80% and 99% aboard various classes of U.S. naval vessels from World War II until the 1970s (pg 3)Asbestos cloth insulation contained approximately 80–95% asbestos (based on type of grade) and was woven from long chrysotile fibers (pg 4)coatings could contain chrysotile asbestos at concentrations ranging from 0.5 to 2% (pg 4)For straight runs, bends, and elbows of piping and valves, thermal insulation pipe covering was used, and its chrysotile and/or amosite content generally ranged from 6 to 94% (pg 4)military standards specifications required that asbestos felt contain no less than 95% amosite for the plain type and no less than 90% amosite for the water-repellant type (pg 5) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | Medium | Report uses high quality data/techniques/methods that are not from frequently-used sources and there are no known quality issues. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for construction materials, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: | Sample Size | Medium | Sample distribution characterized by limited statistics (ranges, averages) but discrete samples not provided and distribution not fully characterized. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Methods, results, and assumptions are clearly documented, but underlying data sources are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | | |

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| | |
|---|---|
| **Study Citation:** | Hollins, D. M., Paustenbach, D. J., Clark, K., Mangold, C. A. (2009). A visual historical review of exposure to asbestos at Puget sound naval shipyard (1962-1972). Journal of Toxicology and Environmental Health, Part B: Critical Reviews 12(2):124-156. |
| **HERO ID:** | 2595959 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

| | | | **EVALUATION** | |
|---|---|---|---|---|
| Domain | | Metric | Rating | Comments |
| | Metric 7: | Metadata Completeness | Medium | Variability is addressed by evaluating different types of asbestos materials, but uncertainty is not addressed. |

## Overall Quality Determination — Medium

| | |
|---|---|
| **Study Citation:** | Hopper, L. J. (1993). Removal of asbestos. The Structural Engineer 71(17):316. |
| **HERO ID:** | 6913906 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Process description: | During removal of asbestos, adjacent areas are protected by sealing the work area with polyethylene sheeting, completely sealed and with air lock access and subject to smoke testing to ensure airtightness. The work area is then subject to a lowering of air pressure, relative to surrounding areas, by means of filtered extractors. The purpose of this is to eliminate any possibility of contaminating the adjacent areas with asbestos fibers. (1/2) Years later, more asbestos was found and an order included a complete covering of the ceiling with a heavy cotton fabric, adhered with a polymer coating, to ensure encapsulation of asbestos that was found impossible to remove, the coating to be finished with a white emulsion. In addition, to improve safety and access at high level, a scaffolded decking was constructed in each subdivided area and demounted/re-erected as each area was completed. Another independent analyst company was used to carry out air-monitoring and clearance inspection. (2/2) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Methodology | Low | Report does not specify the data used. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | High | Data are from the U.S. |
| | Metric 3: Applicability | High | Data are for asbestos disposal, an in-scope occupation al scenario. |
| | Metric 4: Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: Sample Size | N/A | N/A - This metric is not applicable to the data being extracted |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | Low | Assessment results are provided but underlying methods, assumptions, and data sources are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination **Low**

| | |
|---|---|
| **Study Citation:** | Horner, R. (1990). Removal of vinyl asbestos floor tile. US Department of Agriculture. Forest Service. Engineering Field Notes (Print) 22:31-33. |
| **HERO ID:** | 6865657 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Process description: | Two days before tile removal, the entire area was wiped with water to eliminate any excess airborne non asbestos fibers. The ceiling, doors, air vents, and radiators were polyed. A decontamination area also was set up at the entry. It consisted of two overlapping sheets of plastic, 4 feet of space, and two more sheets of overlapping plastic. This created a dead air space between the plastic sheets. The floor was flooded to aid in loosening the tile. One day before removal. Delta Industrial ran background air samples on the removal area and adjacent areas to determine a reference level. Again, the floor was soaked with water. On the day of removal. the air supply vents to the removal area were turned off. as well as any electrical outlets in or near the floor. All the equipment needed for the removal was placed inside the abatement area. For protection, workers wore half-mask respirators and disposable suits. Removal began by wetting the tile with a wetting agent. Tiles were then removed by using wide wood chisels and hammers to pry them up without breakage. The tiles were wet down as they were removed and then boxed and bagged for disposal. Work area and personal breathing zone samples were collected. as well as adjacent area samples. After all the tiles were bagged, the excess water was mopped up off the floor. The floor was then encapsulated with a commercial asbestos product to lock down any loose asbestos fibers. Contaminated suits were removed in the decontamination space and bagged. After the encapsulant had dried, aggressive air samples were taken. (P. 2/3) |
| Chemical concentration: | 5 percent chrysotile asbestos. (P. 1/3) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | Medium | The assessment or report uses high quality data and/or techniques or sound methods that are not from a frequently used source. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | The data are from the United States |
| | Metric 3: | Applicability | High | The report is for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Low | No actual date is provided in the document. Reports is from 1990. So, it is older than 20 years. |
| | Metric 5: | Sample Size | N/A | No sample data. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Assessment or report clearly documents results, methods, and assumptions. Data sources are generally described but not fully transparent. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | N/A | No scope to address variability and uncertainty. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Howell, D. (2020). Asbestos abatement in pipeline repair. Pipeline and Gas Journal 247(1):45-47. |
| **HERO ID:** | 6892212 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Chemical concentration: | These predecessor pipelines have a 90% chance of having 10%-50% chrysotile asbestos in their coal tar or felt type coating. |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | The assessment or report uses high quality data and/or techniques or sound methods that are from frequently used sources. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | The data are from the United States. |
| | Metric 3: | Applicability | High | The report is for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | High | The report is generally no more than 10 years old. |
| | Metric 5: | Sample Size | Medium | Distribution of samples is characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Assessment or report clearly documents results, methods, and assumptions. Data sources are generally described but not fully transparent. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | The report does not address variability or uncertainty. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | HUD, (2022). Distribution of apartments by size of property. |
| **HERO ID:** | 11138830 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Throughput: | Building data used to estimate number of demolitions per year11.9 apartments per multifamily residential property |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | Medium | The assessment or report uses high quality data and/or techniques or sound methods that are not from a frequently used source and associated information does not indicate flaws or quality issues. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | The data are from the United States. |
| | Metric 3: | Applicability | High | This data is relevant to the Maintenance, Renovation, and Demolition OES and is used to estimate the number of demolitions per year, which informs release estimates and exposure frequency. |
| | Metric 4: | Temporal Representativeness | High | The report is generally no more than 10 years old. |
| | Metric 5: | Sample Size | N/A | N/A - This metric is not applicable to the data being extracted |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Assessment or report clearly documents results, methods, and assumptions. Data sources are generally described but not fully transparent. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | The report does not address variability or uncertainty. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Huncharek, M. (1991). Occult asbestos exposure. American Journal of Industrial Medicine 20(5):713-714. |
| **HERO ID:** | 3082471 |
| **Conditions of Use:** | Consumer Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Chemical concentration: | Multiple samples of insulating material from a classroom and other parts of a school were analyzed, which showed chrysotile asbestos composing 5-30% of various bulk samples. Two samples of pipe insulation also contained amosite (10% and 30%). (1/2) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Methodology | Medium | Report uses high quality data that are not from frequently-used sources and there are no known quality issues. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | High | Data are from the U.S. |
| | Metric 3: Applicability | Low | Data are for consumer use of construction materials, which is similar to commercial use of construction materials, an in-scope occupational scenario. |
| | Metric 4: Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: Sample Size | Medium | Sample distribution characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Huncharek, M., Capotorto, J. (1988). Asbestos related lung disease in maintenance workers. British Journal of Industrial Medicine 45(3):203-204. |
| **HERO ID:** | 3082992 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Number of sites: | 30,000 school buildings across U.S. contain friable asbestos (pg 2) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | Medium | Report uses high quality data/techniques/methods that are not from frequently-used sources and there are no known quality issues. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | Low | Data are for school buildings, which is related to construction materials but it mostly gen pop |
| | Metric 4: | Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: | Sample Size | N/A | Number of sites info |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Low | Assessment results are provided but underlying methods, assumptions, and data sources are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination — Low

| | |
|---|---|
| **Study Citation:** | Hunsinger, R. B., Roberts, K. J., Lawrence, J. (1980). CHRYSOTILE ASBESTOS FIBER REMOVAL DURING POTABLE WATER-TREATMENT - PILOT-PLANT STUDIES. Environmental Science and Technology 14(3):333-336. |
| **HERO ID:** | 3583339 |
| **Conditions of Use:** | Disposal |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Process description: | typical water treatment methodsCoagulationFlocculationSedimentationfiltration |
| Number of sites: | 1 |
| Chemical concentration: | Note - these are artificially spiked, so they do not necessarily represent actual concentrations. Feed water Post Sed Dual Med Filter SandRun 2 4.02 1.5 0.31 0.3 0.73Run 3 0.81 0.23 0.24 0.56Run 4 7.8 1.4 0.07 <0.05 0.06Run 12 17 17 0.14 0.08 0.03Run 13 2.3 5.4 1.6 <0.05 1.9Run 14 3.4 0.8 <0.05 <0.0 5 <0.05Run 15 6.9 1.4 <0.05 <0.05 <0.05 |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Methodology | High | The assessment or report uses high quality data and/or techniques - though it should be noted that the samples are spiked with Asbesto and do not represent actual concentrations. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | Medium | Canada - and OECD member |
| | Metric 3: Applicability | Medium | The report is for an scenario (drinking water processing) similar to scenarios within the scope of the risk evaluation. |
| | Metric 4: Temporal Representativeness | Low | 1976 - prior to the most recent PEL and more than 20 years old. |
| | Metric 5: Sample Size | High | Summary statistics were not provided, but results from individual runs were provided and can be used to create summary statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | High | Assessment or report clearly documents its data sources, assessment methods, results, and assumptions. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Medium | Results from individual runs were provided and can be used to assess variability. Uncertainty not discussed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | IARC, (2010). Painting, firefighting, and shiftwork. 98:804-804 pages. |
| **HERO ID:** | 1104469 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Chemical concentration: | In the early twentieth century, asbestos was used as a filler to improve the technical properties of paints, particularly those used in shipyards and those applied to bridges. The paints may have contained up to about 20% asbestos. Usage decreased after about 1950, although specialist textured paints or coatings continued to be widely used in home decoration until the early 1990s. These paints contained approximately 5% chrysotile asbestos.Example of formulation of vinyl acetate-based masonry paint for interior use: Talc 9.1 %; example of formulation of metal paints Talc as filler 11.5% |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Methodology | High | WHO IARC monograph |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | Medium | OECD member countries |
| Metric 3: | Applicability | High | The report is for an occupational scenario ( paint manufacture) within the scope of the risk evaluation. |
| Metric 4: | Temporal Representativeness | Medium | 2010 - more than 10 but less than 20 years |
| Metric 5: | Sample Size | Low | Distribution of samples is qualitative or characterized by no statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | High | Assessment or report clearly documents its data sources, |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Low | The report does not address variability or uncertainty. |

## Overall Quality Determination Medium

**Study Citation:** IARC, (2010). Painting, firefighting, and shiftwork. 98:804-804 pages.
**HERO ID:** 1104469
**Conditions of Use:** Other:

**EXTRACTION**

| Parameter | Data |
|---|---|
| Chemical concentration: | During a leather factory fire in Merseyside, United Kingdom, in 1994, most of the fallout arose from asbestos bitumen roof paper containing roughly 50% chrysotile. A low number of asbestos fibers were found on firefighter tunics (0.0029 f/cm3; range 0.0011–0.0043 f/cm3), and none was found on the firefighters'raincoats or policemen's uniforms. [A fire hose spray may have washed out airborne asbestos.]Thermal protective clothing, gloves and helmets that contain asbestos usually contain chrysotile asbestos. In the United Kingdom the helmet covers for navy firefighters, which completely enclose their head and shoulders, used to be made of chrysotile asbestos. Breathing zone samples from users of both new and old helmets with unlined asbestos cloth covers were analyzed and had fiber concentrations of 2.30 f/cm3 and 1.38 f/cm3, respectively. |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Methodology | High | WHO IARC monograph |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | Medium | OECD members |
| Metric 3: | Applicability | High | The report is for an occupational scenario (Firefighting) within the scope of the risk evaluation. |
| Metric 4: | Temporal Representativeness | Medium | 2010 - more than 10 and less than 20 years old |
| Metric 5: | Sample Size | Medium | Distribution of samples is characterized by a range, uncertainity statistics not provided |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | High | Assessment or report clearly documents its data sources, |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Low | The report does not address variability or uncertainty. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | IARC, (2012). ARC Monographs on the evaluation of carcinogenic risks to humans: Asbestos (Chrysotile, amosite, crocidolite, tremolite, actinolite, and anthophyllite). |
| **HERO ID:** | 3970851 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Production, import, or use volume: | USGS: Uses of talc:ceramics: 31%,paer: 21%,paint: 19%,roofing: 8%,plastics: 5%,rubber: 4%,cosmetics: 2%,other: 10% (p. 13) |

**EVALUATION**

| Domain | | Metric | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | The assessment or report uses high quality data and/or techniques or sound methods that are from frequently used sources (IARC) and are generally accepted by the scientific community, and associated information does not indicate flaws or quality issues. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | The data are from the United States and are representative of the industry being evaluated. |
| | Metric 3: | Applicability | High | The report is for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Medium | The report captures operations, equipment, and worker activities that are expected to be reasonably representative of current conditions. The report is generally more than 10 years but no more than 20 years old. |
| | Metric 5: | Sample Size | N/A | N/A - no sampling data |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | Assessment or report clearly documents its data sources, assessment methods, results, and assumptions. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | The report does not address variability or uncertainty. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | IHC World, (2023). ABC of safety in the biological sciences: General guidelines for the disposal of laboratory chemicals via waste disposal authorities/companies. |
| **HERO ID:** | 11145836 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Products not Described by Other Codes |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Process description: | Description of how vermiculite is used to absorb lab chemicals before disposal (usually by incineration) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | Medium | The assessment or report uses high quality data and/or techniques or sound methods that are not from a frequently used source and associated information does not indicate flaws or quality issues. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | The data are from the United States and are representative of the industry being evaluated. |
| | Metric 3: | Applicability | High | The report is for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Medium | The report captures operations, equipment, and worker activities that are expected to be reasonably representative of current conditions. The report is more than 10 years but no more than 20 years old. |
| | Metric 5: | Sample Size | N/A | N/A - This metric is not applicable to the data being extracted |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | Assessment or report clearly documents its data sources, assessment methods, results, and assumptions. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | The report does not address variability or uncertainty. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | III, (2022). Facts + Statistics: Fire - Catastrophes \| Homeowners. |
| **HERO ID:** | 11138825 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Number of sites: | Average of 489,600 of structure fires each year over past 2012 - 2021. |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | Medium | The assessment or report uses high quality data and/or techniques or sound methods that are not from a frequently used source and associated information does not indicate flaws or quality issues. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | The data are from the United States |
| | Metric 3: | Applicability | High | The report is for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | High | The report captures operations, equipment, and worker activities expected to be representative of current conditions. The report is generally no more than 10 years old. |
| | Metric 5: | Sample Size | N/A | N/A - This metric is not applicable to the data being extracted |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Assessment or report clearly documents results, methods, and assumptions. Data sources are generally described but not fully transparent. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | The report provides only limited discussion of the variability and uncertainty in the results. |

## Overall Quality Determination — High

| | |
|---|---|
| **Study Citation:** | Iowa DOT, (1997). Let me shingle your roadway: Interim report for Iowa DOT research project HR-2079. |
| **HERO ID:** | 3981082 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Chemical concentration: | Bituminous shingles: usually less than 20% asbestos, and typically two to three percent asbestos (p. 6) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | Low | The data, data sources, and/or techniques or methods used in the assessment or report are not specified. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | The data are from the United States. |
| | Metric 3: | Applicability | High | The report is for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Low | The report is more than 20 years old. |
| | Metric 5: | Sample Size | Low | Distribution of samples is characterized by no statistics. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Low | Assessment or report provides results, but the underlying methods, data sources, and assumptions are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | The report provides only limited discussion of the variability and uncertainty in the results. |

## Overall Quality Determination — Low

**Study Citation:** IPCS, (1986). Asbestos and other natural mineral fibres. Environmental Health Criteria :194.
**HERO ID:** 81716
**Conditions of Use:** Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products

**EXTRACTION**

| Parameter | Data |
|---|---|
| Production, import, or use volume: | The world production of asbestos increased by 50% between 1964 and 1973, when it reached a level of nearly 5 million tonnes. The projected world demand for asbestos, based on historical consumption figures and usage patterns through the mid-1970s, indicates more than a doubling by the year 2000. However, world production figures for the period 1979-83 showed a decline in production. The only substantial increase in asbestos demand seems to be occurring in developing countries, and in some European countries. ——————————————————————————Afghanistan 4000 (1979)Argentina 1371 (1979) 1261 (1980) 1280 (1981) 1218 (1982) 1350 (1983) Australia - Chrysotile 79 721 (1979) 92 418 (1980) 45 494 (1981) 18 587(1982) 20 000 (1983)Brazil 138 457 (1979) 170 403 (1980) 138 417 (1981) 145 998 (1982) 158 855 (1983)Bulgaria 600 (1979) 700 (1980) 400 (1981) 600 (1982) 700 (1983)Canada - Chrysotile 1 492 719 (1979) 1 323 053 (1980) 1 121 845 1981) 834 249 (1982) 820 000 (1983)China 140 000 (1979)131 700 (1980) 106 000 (1981) 110 000 (1982) 110 000 (1983)Cyprus - Chrysotile 35 472 (1979) 35 535 (1980) 24 703 (1981) 18 997 (1982) 17 288 (1983)Czechoslovakia 564 (1979) 617 (1980) 388 (1981) 342 (1982) 325 (1983)Egypt 238(1979) 316 (1979) 325 (1980) 310 (1981) 325 (1983)India - Amphibole 32 094 (1979) 33 716 (1980)27 521 (1981) 19 997 (1982) 17 288 (1983)Italy 143 931 (1979) 157 794 (1980) 137 000 (1981) 116 410 (1982) 139 054 (1983)Japan - Chrysotile 3362 (1979) 3897 (1980) 3950 (1981) 4135 (1982) 4000 (1983)Korea, Republic of 14 804 (1979) 9854 (1980) 14 084 (1981) 15 933 (1982)12 506 (1983)Mozambique 789(1979) 800 (1980) 800 (1981) 800 (1982) 800 (1983)South Africa - Amosite 39 058 (1979)51 646 (1980) 56 834 (1981) 43 457 (1982) 40 656 (1983) - Crocidolite 118 301(1979) 119 148 (1980) 102 337 (1981) 87 263 (1982) 87 439 (1983) - Chrysotile 91 828 (1979)106 940 (1981) 76 772 (1982) 81 140 93 016 (1983)Swaziland - Chrysotile 34 294 (1979) 32 833 (1980) 35 264 (1981) 30 145 (1982) 28 287 (1983)Taiwan 2957 (1979) 683 (1980) 2317 (1981) 2392 (1982) 2819Turkey 38 967(1979) 8882 (1980) 2833 (1981) 23 283 (1982) 22 596 (1983)USA 93 354(1979) 80 079 (1980) 75 618(1981) 63 515 (1982) 69 906 (1983)USSR 2 020 000 (1979) 2 070 000 (1980) 1 105 000 (1981) 2 180 000 (1982) 2 250 000Yugoslavia 9959 (1979)10 468 (1980) 12 206 (1981) 10 748 (1982) 9663 (1983)Zimbabwe - Chrysotile 259 891(1979) 250 949 (1980) 247 503 (1981)197 682 (1982) 153 221 (1983)World Total 4 800 000 (1979) 4 700 000 (1980) 4 300 000 (1981) 4 000 000 (1982) 4 100 000 (1983) |
| Process description: | Asbestos ore is usually mined in open-pit operations which includes drilling, blasting, loading broken rock, and transporting ore to the primary crusher or waste to dumps, unloading ore from the open pit, primary crushing, screening, secondary crushing, conveying and stockpiling wet ore. A drying step follows, which involves conveying the ore to the dryer building, screening, drying, tertiary crushing, conveying ore to dry-rock storage building, and dry-rock storage. The next step is the milling of the ore. |
| Chemical concentration: | % weight——————————————————————————1. Asbestos-cement building products 10 - 15% type: C, A, Cr2. Asbestos-cement pressure, sewage, and drainage pipes 12 - 15% type: C, Cr & A 3. Fire-resistant insulation boards 25 - 40% type: A & C 4. Insulation products including spray 12 - 100% type: A, C & Cr 5. Jointings and packings 25 - 85 % type: C & Cr6. Friction materials 15 - 70% type: C 7. Textile products not included in (6) 65 - 100% type: C & Cr 8. Floor tiles and sheets 5 - 7.5% type: C 9. Moulded plastics and battery boxes55 - 70% type: C & Cr10. Fillers and reinforcements and products made thereof (felts, millboard, paper, filter pads for wines and beers, underseals, mastics, adhesives, coatings, etc.) 25 - 98% type: C & Cr |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Methodology | High | WHO study |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | Medium | US, OECD and NonOECD member countries |
| Metric 3: | Applicability | High | The report is for an occupational scenario (asbestos processing and product manufacture) within the scope of the risk evaluation. |
| Metric 4: | Temporal Representativeness | Low | 1986 - more than 20 years old |
| Metric 5: | Sample Size | Low | Distribution of samples is qualitative or characterized by no statistics. |

**Continued on next page . . .**

. . . continued from previous page

**Study Citation:** IPCS, (1986). Asbestos and other natural mineral fibres. Environmental Health Criteria :194.
**HERO ID:** 81716
**Conditions of Use:** Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products

| | | EVALUATION | | |
|---|---|---|---|---|
| Domain | | Metric | Rating | Comments |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | Assessment or report clearly documents its data sources, assessment methods, results, and assumptions |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | The report does not address variability or uncertainty. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | IT Corporation, (1993). Asbestos release during building demolition activities. |
| **HERO ID:** | 3970150 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Chemical concentration: | Fort Bliss, TX: 15-20% Chrysotile asbestos. (P. 6/8) Fort Wainwright school: vinyl asbestos tile (between 3 and 7% chrysotile) and asbestos-containing roofing material (as high as 20% chrysotile). (P. 7/8) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Methodology | High | The assessment or report uses high quality data. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | The data are from the United States. |
| Metric 3: | Applicability | High | The report is for an occupational scenario within the scope of the risk evaluation. |
| Metric 4: | Temporal Representativeness | Low | The report is more than 20 years old. |
| Metric 5: | Sample Size | Medium | Distribution of samples is characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Medium | Assessment or report clearly documents results, methods, and assumptions. Data sources are generally described but not fully transparent. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Medium | Variability is addressed by comparing asbestos concentrations in different products but uncertainty is not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Jacko, M. G., Rhee, S. K. (2000). Brake linings and clutch facings. |
| **HERO ID:** | 9038065 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Process description: | "Friction materials serve in a variety of ways to control the acceleration and deceleration of vehicles and machines. The friction materials may be resin- or rubber-bound composites based on asbestos, metallic fibers, or a combination of other fibers. Trucks and off-highway vehicles usually have very large drum brakes; only a few have front disk brakes. These friction couples usually operate at higher friction levels and temperatures than those of passenger cars. Large aircraft are equipped exclusively with disk brakes that contain multiple rotor and stator arrangements having the most popular friction couple consisting of a sintered friction material sliding against a high temperature resistant steel. The newer aircraft brakes consist of carboncomposites serving as both the rotor and the stator. (1/13)" |
| Chemical concentration: | Prior to the mid-1970s, the most common type of friction materials in use in brakes and clutches for normal duty for original equipment installations and for the aftermarket were termed organics. These materials usually contained about 30–40 wt % of organic components and were asbestos-based. (2/13) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | Report uses high quality methods and data from frequently used sources. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for commercial use in brakes and friction materials, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Medium | Report contains data that is older than 20 years old and data that is less than 20 years old, but no data is less than 10 years old. |
| | Metric 5: | Sample Size | Medium | Sample distribution characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Jacobs, N. F. B., Towle, K. M., Finley, B. L., Gaffney, S. H. (2019). An updated evaluation of potential health hazards associated with exposures to asbestos-containing drywall accessory products. Critical Reviews in Toxicology 49(5):430-444. |
| **HERO ID:** | 6874464 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Chemical concentration: | The asbestos content of drywall finishing products (e.g. joint compound, texture, and tape) historically ranged from approximately three to 15% chrysotile by weight. It has beensuggested that, when joint compound products were first introduced, formulations contained 10–15% asbestos, and that the asbestos concentrations decreased with time (CPSC 1977b). Only the chrysotile form of asbestos was intentionally added as an ingredient in joint compound formulations; amphibole fibers (e.g. tremolite, amosite, crocidolite) were not used as ingredients in joint compounds (Phelka and Finley 2012). However, industrial talc was also used in somejoint compound formulations, and some chrysotile asbestos and industrial talc deposits contained trace levels of tremolite asbestos (Fiume et al. 2015). [PDF Pg. 3]Latex-based textured paints contained limestone, lesser amounts of mica, and 1–5% chrysotile asbestos (Anderson and Farino 1982; Anderson et al. 1982). [PDF Pg. 4]Specifically, Fischbein et al. (1979) reported that four of 15 industrial taping and spackling compounds contained tremolite structures at concentrations ranging from 1 to 2% (Sterling Ready Mix, Sterling All-Purpose) to 8–12% (S-C-L Taping Compound) (Fischbein et al. 1979). Rohl et al. (1975) reported that one of the 15 consumer products under evaluation (Metro spackling putty) contained 4–6% tremolite structures (Rohl 1975). [PDF Pg. 5] |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | Report uses high quality data/techniques/methods from frequently-used sources. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for Chemical Substances in Construction, Paint, Electrical, and Metal Products, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | The report is less than 10 years old but most of the information is from more than 20 years ago. |
| | Metric 5: | Sample Size | Medium | Sample distribution characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | Variability addressed by describing asbestos concentrations over the years but uncertainty is not addressed. |

## Overall Quality Determination — High

| | |
|---|---|
| **Study Citation:** | Jung, H. S., Cha, J., Kim, S., Lee, W., Lim, H., Kim, H. (2015). Evaluating the efficiency of an asbestos stabilizer on ceiling tiles and the characteristics of the released asbestos fibers. Journal of Hazardous Materials 300:378-386. |
| **HERO ID:** | 3090049 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Chemical concentration: | asbestos concentrations from the ceiling tiles treated with organic/synthetic resins (0.0028f-PCM/cc) were lower than those of the tiles treated with an inorganic material (0.0056f-PCM/cc). |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Methodology | High | Report uses high quality data |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | Medium | The data are from an OECD country other than the U.S |
| | Metric 3: Applicability | High | The report is for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: Temporal Representativeness | High | The report is generally no more than 10 years old. |
| | Metric 5: Sample Size | Low | Distribution of samples is characterized by no statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | High | report clearly documents its data sources |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Low | The report does not address variability or uncertainty. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Jung, S. H., Kim, H. R., Koh, S. B., Yong, S. J., Chung, M. J., Lee, C. H., Han, J., Eom, M. S., Oh, S. S. (2012). A decade of malignant mesothelioma surveillance in Korea. American Journal of Industrial Medicine 55(10):869-875. |
| **HERO ID:** | 3531005 |
| **Conditions of Use:** | Other: |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Production, import, or use volume: | The average amount of asbestos imported to Korea from 1976 to 1990 was approximately 63,000 tons/year. (4/7) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Methodology | High | Report uses high quality methods and data from frequently-used sources. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | Medium | Data are from Korea, an OECD country. |
| | Metric 3: Applicability | Uninformative | Data are for the import of asbestos, which isn't in scope. |
| | Metric 4: Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: Sample Size | Low | Distribution of samples is qualitative or characterized by no statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Medium | Uncertainty is addressed in a discussion paragraph mentioning limits and improvements upon the study. Variability is not addressed. |

## Overall Quality Determination Uninformative

| | |
|---|---|
| **Study Citation:** | Kaiser, E. A. (1993). Health hazard evaluation report no. HETA-91-349-2311, Rhode Island Department of Education, Providence, Rhode Island. |
| **HERO ID:** | 3970476 |
| **Conditions of Use:** | Consumer Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Chemical concentration: | The results of the PLM analysis on the three (3) bulk samples indicated that chrysotile asbestos was present at between 30% and 50%. (17/33) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | Report uses high quality methods and data from frequently-used sources. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | Low | Data are for consumer use of construction materials, which is similar to commercial use of construction materials, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: | Sample Size | Medium | Sample distribution characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | Uncertainty is addressed in bulk sampling methods. Variability isn't addressed. |

## Overall Quality Determination — Medium

| | |
|---|---|
| **Study Citation:** | Kakooei, H., Normohammadi, M. (2014). Asbestos exposure among construction workers during demolition of old houses in Tehran, Iran. Industrial Health 52(1):71-77. |
| **HERO ID:** | 3531012 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Process description: | As we know the choice of choosing a demolition method depends the project conditions, site construction, sensitivity of the neighborhood and availability of equipment. Regarding to the sites situation that was small with congested space, demolition at each site was carried out by human operatives. In this case, humanoperatives are used in the demolition process using hand tools, simple electrically or pneumatically powered tools such as picks, hummer, wire cutting and welding cutters (Fig. 1). The number of workers per demolition practices were approximately 3–5 persons. (P. 2/7) |
| Number of sites: | four demolition sites. (P. 2/7) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Methodology | High | The assessment or report uses high quality data and/or techniques or sound methods that are from frequently used sources. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | Low | The data are from a non-OECD country, Iran. |
| Metric 3: | Applicability | High | The report is for an occupational scenario within the scope of the risk evaluation. Demolition. |
| Metric 4: | Temporal Representativeness | Medium | More than 10 years. Samples were collected from April 2010 tillJune 2011. |
| Metric 5: | Sample Size | N/A | Process description. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Medium | Data sources are generally described but not fully transparent. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | High | The report addresses variability and uncertainty in the results. |

## Overall Quality Determination — Medium

| | |
|---|---|
| **Study Citation:** | Kakooei, H., Sameti, M., Kakooei, A. A. (2007). Asbestos exposure during routine brake lining manufacture. Industrial Health 45(6):787-792. |
| **HERO ID:** | 3531014 |
| **Conditions of Use:** | Other: |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Process description: | Friction material production involves material preparation resulting in the mixing of dry components, performing this mixture in cold presses, hot pressing and curing then preformed pieces, and cutting, grinding, drilling as well as finishing. In the dry brake lining production after the mixing of asbestos fibers and other raw materials such as toluene, sulphur, ferrous oxide, carbon black, graphite, lead and etc., the compounded materials are charged into molds at steam process. Brake lining production require large numbers of finishing machines such as grinding, drilling, and cutting equipment to make the end products. (2/6) |
| Number of sites: | 26 brake lining plants in Iran. (2/6) |
| Chemical concentration: | The chrysotile asbestos contents of the brake lining usually ranged from 35% to 65%. (1/6) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Methodology | High | Report uses high quality methods and data from frequently-used sources. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | Low | Data are from Iran, a non-OECD country. |
| | Metric 3: Applicability | Medium | Data are for concentration of asbestos in brake materials, which may be useful for the legacy asbestos risk evaluation. |
| | Metric 4: Temporal Representativeness | Medium | Report contains data that is older than 20 years old and data that is less than 20 years old, but no data is less than 10 years old. |
| | Metric 5: Sample Size | Medium | Sample distribution characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | Medium | Assessment or report clearly documents results, methods, and assumptions. Data sources are generally described but not fully transparent. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Low | The report does not address variability or uncertainty of asbestos concentration range. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Karadagli, F. (2011). Comparative Assessment of Asbestos-Containing and Alternative Materials in Turkish Industrial Facilities. Indoor and Built Environment 20(4):471-478. |
| **HERO ID:** | 3086691 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Chemical concentration: | In table 2 for plant 1, chrysotile asbestos content varied from ND to 35%. In table 3 for plant 1, chrysotile asbestos content varied from ND to 33%. In table 4 for plant 2, chrysotile asbestos content varied from ND to 31%. In table 5 for plant 2, asbestos content was ND. |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | Medium | The assessment or report uses high quality data and/or techniques or sound methods that are not from a frequently used source and associated information does not indicate flaws or quality issues. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Medium | The data are from an OECD country other than the U.S. |
| | Metric 3: | Applicability | High | The report is for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Medium | The report is generally more than 10 years but no more than 20 years old. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | Assessment or report clearly documents its data sources, assessment methods, results, and assumptions. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | High | Variability is addressed by taking multiple samples at different plants and uncertainty is addressed by using multiple methods to determine asbestos content. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Kelse, J. W. (2007). Asbestos, health risk, and tremolitic talc. |
| **HERO ID:** | 3974886 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Products not Described by Other Codes |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Chemical concentration: | OSHA cited two mortality studies of upstate New York talc workers as evidence of a ”same as” health effect for nonasbestiform amphiboles. Upstate New York talc does contain a high concentration of nonasbestiform amphiboles (tremolite in particular). Based on transmission electron microscopy (TEM) asbestos analysis of three samples , asbestos concentrations ranged from <0.0141 fibers/cc to 0.0175 fibers/cc. Total fibers ranged between 98 to 103.5 (pg 45 of 86).Table 2 (pg 62 of 86) presents the concentrations of all asbestiform mineral fibers of different samples. Concentrations ranged from 60 to 2961 fiber/mg for aspect ratio >=5;1.Using phase contrast microscopy (PCM), the total fiber concentrations in air ranged from 0.3840 to 8.9407 fibers/cc (pg 79 of 86). |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Methodology | Medium | report uses high quality data that are not from a frequently used source and associated information does not indicate flaws or quality issues. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | The data are from the United States and are representative of the industry being evaluated. |
| Metric 3: | Applicability | High | The report is for an occupational scenario within the scope of the risk evaluation. |
| Metric 4: | Temporal Representativeness | Medium | The report is generally more than 10 years but no more than 20 years old. |
| Metric 5: | Sample Size | Low | Distribution of samples is characterized by no statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | High | report clearly documents its data sources, |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Low | The report does not address variability or uncertainty. |

## Overall Quality Determination — Medium

| | |
|---|---|
| **Study Citation:** | Kern, D. G., Frumkin, H. (1990). Asbestos-related disease in the jewelry industry. Journal of Occupational Medicine 32(2):87. |
| **HERO ID:** | 3082615 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Products not Described by Other Codes |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Process description: | Our patients had hand-mixed asbestos powder, plaster of paris, and water to form soldering boards. (p. 1) |
| Chemical concentration: | Soldering boards from the two work sites were found to contain from 25% to 45% chrysotile asbestos. |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Methodology | Low | Sampling/analytical methodology is not specified. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | High | Data are from the U.S. |
| | Metric 3: Applicability | Uninformative | Data are for jewelry making, which is not in-scope or similar to an in-scope occupational scenario. |
| | Metric 4: Temporal Representativeness | Low | The report is far more than 20 years old. The report captures worker activities that are outdated. |
| | Metric 5: Sample Size | Low | Sample distribution is described qualitatively. |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | Low | Sample distribution is characterized by no statistics. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Uninformative

| | |
|---|---|
| **Study Citation:** | Kern, D. G., Frumkin, H. (1988). Asbestos-related disease in the jewelry industry: Report of two cases. American Journal of Industrial Medicine 13(3):407-410. |
| **HERO ID:** | 3083016 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Process description: | In the process, he hand-mixed asbestos powder, plaster of paris,and water, and shaped the resulting mud into 15 x 15 X 3-cm patties. He then made surface impressions in the mud to hold jewelry pieces for soldering. In preparing for a new soldering job, he routinely rubbed together two forms to obliterate pre-existingimpressions and rewet their surfaces before making fresh indentations. When asbestos powder was unavailable, he obtained it by hand grinding asbestos sheets. (P. 1/4) |
| Chemical concentration: | Each patient was able to provide us with a soldering form of the type he had routinely made. On analysis by polarized light microscopy with dispersion staining, in accordance with Environmental Protection Agency guidelines, the forms werefound to contain from 25 % to 45 % chrysotile asbestos. (P. 4/4) |

**EVALUATION**

| Domain | | Metric | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | Low | The data, data sources, and/or techniques or methods used in the assessment or report are not specified. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | The data are from the United States. |
| | Metric 3: | Applicability | Medium | The report is for an occupational scenario that is similar to an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Low | The report is more than 20 years old. |
| | Metric 5: | Sample Size | Low | Distribution of samples is qualitative or characterized by no statistics. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Low | Assessment or report provides results, but the underlying methods, data sources, and assumptions are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | The report does not address variability or uncertainty. |

## Overall Quality Determination — Low

| | |
|---|---|
| **Study Citation:** | Keyes, D. L., Chesson, J., Ewing, W. M., Faas, J. C., Hatfield, R. L., Hays, S. M., Longo, W. E., Millette, , J. R. (1991). EXPOSURE TO AIRBORNE ASBESTOS ASSOCIATED WITH SIMULATED CABLE INSTALLATION ABOVE A SUSPENDED CEILING. American Industrial Hygiene Association Journal 52(11):479-484. |
| **HERO ID:** | 3581248 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Chemical concentration: | Friable fireproofing was 15-20% chrysotile, 45-55% vermiculite, and 20-40% binder. (3/7) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | Report uses high quality methods and data from frequently-used sources. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for commercial use in construction materials, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: | Sample Size | Medium | Sample distribution characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Kingsley, I. (1976). Health hazard evaluation report no. HHE 76-40-341, 919 Third Garage Company, New York, New York. |
| **HERO ID:** | 3970497 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Chemical concentration: | The bulk sample of insulation taken from an exposed beam revealed an asbestos content of 10 to 15%. |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | Report uses high quality methods and data from frequently-used sources. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Product concentration data are for construction materials that are in-scope of the legacy asbestos risk evaluation. |
| | Metric 4: | Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: | Sample Size | Medium | Sample distribution characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Methods, results, and assumptions are clearly documented, but underlying data sources are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | Uncertainty is addressed in bulk sampling methods, but variability is not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Kinsey, J. S., Keen, R. C., Mumford, C. J. (1977). A preliminary survey of the hazards to operators engaged in the disposal of asbestos waste. Annals of Occupational Hygiene 20(1):85–89. |
| **HERO ID:** | 3615457 |
| **Conditions of Use:** | Disposal |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Production, import, or use volume: | 99% of asbestos is disposed of by landfill operations (pg 1). Provides amounts of each form of asbestos waste in UK in 1974, with largest aount coming from ”Off-cuts, broken pieces and rejects of materials” (pg 2) |
| Process description: | ”Some firms collected fine dusts in 200 gauge polythene bags, as recommended, but others dispatched fine dust in lightweight paper bags mixed with other materials which burst on tipping, releasing clouds of dust. High density material was generally tipped loose. No vehicle was cleaned after use as recommended. Generally all material was covered promptly but dust was emitted due to manipulation of the waste by the machinery on site.” (pg 3) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Methodology | Medium | Report uses high quality information that are not from frequently-used sources and there are no known quality issues. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | Medium | Data are from Great Britain, an OECD country. |
| | Metric 3: Applicability | High | Data are for asbestos disposal, an in-scope occupational scenario. |
| | Metric 4: Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: Sample Size | N/A | N/A - This metric is not applicable to the data being extracted |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | Medium | Methods, results, and assumptions are clearly documented, but underlying data sources are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Medium | Variability addressed by examining different sites across U.K., but uncertainty is not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Klim, J. P. (1990). Asbestos in the work place. :209-211. |
| **HERO ID:** | 6859493 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Number of sites: | 733,000 buildings containing asbestos in the US (based on the EPA 1988 Building Survey) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | Medium | The assessment or report uses high quality data and/or techniques or sound methods that are not from a frequently used source and associated information does not indicate flaws or quality issues. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | The data are from the United States and are representative of the industry being evaluated. |
| | Metric 3: | Applicability | High | The report is for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Low | The report is more than 20 years old. The report captures operations, equipment, and worker activities that are expected to be outdated. |
| | Metric 5: | Sample Size | N/A | N/A - no sampling data |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | Assessment or report clearly documents its data sources, assessment methods, results, and assumptions. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | The report provides only limited discussion of the variability and uncertainty in the results. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Kominsky, J. R. (1979). Health Hazard Evaluation Determination, Report No. HHE-78-119-637, Texaco, Inc., Bayonne Terminal, Bayonne, New Jersey. NIOSH(HHE-78-119-637):78-119. |
| **HERO ID:** | 3651835 |
| **Conditions of Use:** | Other: |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Process description: | The operations in the Compound Department consist of blending chemical additives with lubricating oils. The blending process takes place in kettles (with capacities ranging from 1300 to 5100 gallons) at temperatures between 100 to 200°F. Agitation of the blend is effected by air movement through the kettles. During the workday, operators may add different numbers of additives to different kinds of lubricating oils. The chemical additives impart special properties to the lubricating oil. Included are low viscosity index (butene polymers), detergent and suspended properties (metallic stearate soaps), oxidation stability (calcium stearate), and reduced foaming tendency (silicone compounds) . Many of the antioxidants used are substituted phenolic compounds such as 2,6, di-tert-butyl-4-methyphenol. |
| Number of sites: | 1 |
| Comments: | Primary focus of this study was not asbestos but exposure to hazardous organic chemicals. |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Methodology | High | The evaluation uses high quality data and techniques that are from frequently used sources. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | High | The data are from the United States. |
| | Metric 3: Applicability | Uninformative | The process description is for an occupational scenario (petrochemical processing) that is not within the scope of the risk evaluation. |
| | Metric 4: Temporal Representativeness | Low | 1979 - more than 20 years old |
| | Metric 5: Sample Size | N/A | Qualitative data provided |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | High | Assessment or report clearly documents its data sources, assessment methods, results, and assumptions. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | N/A | Qualitative data provided |

## Overall Quality Determination Uninformative

| | |
|---|---|
| **Study Citation:** | Kominsky, J. R., Freyberg, D. W., Brackett, K. A. (1993). Evaluation of Three Cleaning Methods for Removing Asbestos from Carpet: Determination of Airborne Asbestos Concentrations Associated with Each Method. (23):90. |
| **HERO ID:** | 3649689 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Furnishing, Cleaning, Treatment Care Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Chemical concentration: | 1.6 billion asbestos structures per sq ft of carpet (Abstract); range: 1.1-2 billion s/ft2 (Table 2, pg 6)Table 2 (pg 6):After 1st cleaning: 0.85-2.1 billion s/ft2; After 2nd cleaning: 0.88-1.4 billion s/ft21-5% chrysotile in acoustical ceiling material, 35-40% amosite in fireproofing (pg 2) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | Report uses high quality data/techniques/methods from frequently-used sources. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for furnishings (carpet), an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: | Sample Size | Medium | Sample distribution characterized by limited statistics (mean, 95% CI) but discrete samples not provided and distribution not fully characterized. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | Variability addressed by testing multiple carpet cleaning types. Uncertainty is not addressed. |

## Overall Quality Determination — High

| | |
|---|---|
| **Study Citation:** | Kominsky, J. R., Freyberg, R. W. (1991). Asbestos Fiber Reentrainment during Dry Vacuuming and Wet Cleaning of Asbestos-Contaminated Carpet. (11):56. |
| **HERO ID:** | 3649688 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Furnishing, Cleaning, Treatment Care Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Process description: | The carpet was vacuumed or wet cleaned for a period of approximately 65 min to allow the collection of a sufficient volume of air to attain an analytical sensitivity of 0.005 s/cm3 of air. The carpet was cleaned in two directions, the second direction at a 90° angle to the first.Both dry vacuuming and wet cleaning of carpet artificially contaminated with asbestos fibers resulted in a statistically significant increase in airborne asbestos concentrations. The increase did not vary significantly with the type of cleaning method (wet or dry) or with the two levels of asbestos contamination applied to the carpet.Although this research revealed significant increases in airborne asbestos concentrations during cleaning activities in a controlled study under artificial, simulated conditions, it is not known if such increases occur in real-world custodial operations. |
| Chemical concentration: | Reference for the following was not provided in the text.Carpet concentrations range from 8,000 to 2 billion structures per ft^2Bulk samples varied from 30 million to 4 billion structures/ft^2 |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Methodology | High | The assessment or report uses high quality data that are from frequently used sources. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | The data are from the United States. |
| Metric 3: | Applicability | High | The report is for an occupational scenario (asbestos concentration in contaminated carpet) within the scope of the risk evaluation. |
| Metric 4: | Temporal Representativeness | Low | Data more than 20 years old. |
| Metric 5: | Sample Size | Medium | Distribution of samples is characterized by a range with uncertain statistics. It is unclear if analysis is representative. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | High | Assessment or report clearly documents its data sources, assessment methods, results, and assumptions. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | High | The study address variability by collecting data from multiple carpet types, and uncertainty is addressed by the sampling methodology. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Kominsky, J. R., Freyberg, R. W., Chesson, J., Cain, W. C., Powers, T. J., Wilmoth, R. C. (1990). Evaluation of two cleaning methods for the removal of asbestos fibers from carpet. American Industrial Hygiene Association Journal 51(9):500-504. |
| **HERO ID:** | 3582814 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Furnishing, Cleaning, Treatment Care Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Process description: | Carpet was vacuumed or wet cleaned for 65 minutes in 2 directions , the second at a 90 degree angle to the first. [PDF Pg. 3] |
| Chemical concentration: | Artificially contaminated carpet with 9.3E4 and 9.3E4 asbestos structures/m^2. [PDF Pg. 1]Asbestos levels based on ACM building: 7.52E8 - 1.88E8 structures/m^2. [PDF Pg. 3] |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | Report uses high quality data/techniques/methods from frequently-used sources. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for furnishing, cleaning, and treatment care products, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Medium | Report is based on data greater than 10 years old but no more than 20 years old and industry conditions that are expected to be representative of current industry conditions. |
| | Metric 5: | Sample Size | Medium | Sample distribution characterized by a range. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | Variability is addressed by using two fiber concentrations in carpet; uncertainty is not addressed. |

## Overall Quality Determination — High

| | |
|---|---|
| **Study Citation:** | Kominsky, J., Freyburg, R. (1989). Evaluation of airborne asbestos concentrations before and during an O & M [operations and maintenance] activity: a case study. |
| **HERO ID:** | 28064 |
| **Conditions of Use:** | Disposal |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Throughput: | 57 ft2 of insulation was removed. (13/34) |
| Chemical concentration: | Analysis of insulation removal debris revealed 42% chrysotile, 33% amosite, and 10% crocidolite. (14/34) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Methodology | High | Report uses high quality data from frequently-used sources. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | High | Data are from the U.S. |
| | Metric 3: Applicability | High | Data are for asbestos removal, an in-scope occupational scenario. |
| | Metric 4: Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: Sample Size | Medium | Sample distribution characterized by limited statistics (concentration, throughput) but discrete samples not provided and distribution not fully characterized. |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Koppers Indus Hygiene Sec, (1981). Industrial hygiene survey of the Garwood, New Jersey plant with cover memo. |
| **HERO ID:** | 1481349 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Chemical concentration: | A sample of Narvon Talc resulted in non-detections of both Amosite and Chrysotile asbestos. |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | Report uses high quality data/techniques/methods from frequently-used sources. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for Chemical Substances in Construction, Paint, Electrical, and Metal Products, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Koustas, R. N. (1991). CONTROL OF INCIDENTAL ASBESTOS EXPOSURE AT HAZARDOUS-WASTE SITES. Journal of the Air and Waste Management Association (1990-1992) 41(7):1004-1009. |
| **HERO ID:** | 3584160 |
| **Conditions of Use:** | Disposal |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Process description: | Although asbestos is being phased out of most consumer products, it is still used commercially in specialty paper products, such as gasket material; certain building materials, such as roofing felts and shingles; and friction products, such as elevator brake shoe lining and automobile clutch disks. Rock containing the asbestos mineral is mined with explosives. The blasted rock and rubble go through a series of crushers and screeners. The asbestos material is separated from the rock for further processing, and the waste rock, or tailings, are disposed of in on-site waste piles. Mined asbestos was usually further processed and mixed with other material, such as cement or paper, or was used as a binder or reinforcer. For example, asbestos was often mixed with dry cement and water. This ”mud” mixture was trowelled on to pipe fittings, such as elbows and valves, and trowelled onto equipment, such as residential boilers. Canvas-wrapped corrugated cardboard impregnated with asbestos, commonly called air-cell insulation, was often used to insulate straight pipe runs. All mixtures of asbestos with another material, such as concrete or paper, are examples of ACM. If ACM was used as a material of construction it also may be known as Asbestos Containing Building Material (ACBM). (pg 1005) |
| Number of sites: | 33 (Table 1 pg 1005) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | report uses high quality data |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | The data are from the United States |
| | Metric 3: | Applicability | High | The report is for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Low | The report is more than 20 years old. |
| | Metric 5: | Sample Size | N/A | N/A - This metric is not applicable to the data being extracted |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | report clearly documents its data sources |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | The report does not address variability or uncertainty. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Kramkowski, R. S., Daniels, W. J. (1984). Health Hazard Evaluation Report No. HETA-83-450-1468, George Rogers Clark National Historical Park, Vincennes, Indiana. NIOSH(HETA-83-450-1468):83-450. |
| **HERO ID:** | 3652542 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Chemical concentration: | All five bulk insulation material samples contained chrysotile asbestos ranging from 20% to 50%, three of the bulk samples also contained crocidolite asbestos ranging from 10% to 30%, and one sample also contained amosite asbestos ranging from 1% to 2%. (8/14) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Methodology | High | Report uses high quality methods and data from frequently-used sources. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | Data are from the U.S. |
| Metric 3: | Applicability | High | Data are for commercial use in construction materials, an in-scope occupational scenario. |
| Metric 4: | Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Medium | Variability is addressed by sampling different materials around the site. Uncertainty isn't addressed. |

## Overall Quality Determination — High

| | |
|---|---|
| **Study Citation:** | Kronoveter, K. (1983). Health Hazard Evaluation Report No. HETA-83-358-1362, George H. Fallon Federal Office Building, Baltimore, Maryland. NIOSH(HETA-83-358-1362):83-358. |
| **HERO ID:** | 3652533 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Chemical concentration: | Two bulk samples of the fireproofing material contained an estimated 5 to 20% chrysotile asbestos. [PDF Pg. 3] |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | Report uses high quality data/techniques/methods from frequently-used sources. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for Chemical Substances in Construction, Paint, Electrical, and Metal Products, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: | Sample Size | Medium | Sample distribution characterized by a range. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | Variability addressed by looking at the concentration of two samples of fireproofing material but uncertainty is not addressed. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Kushner, L. (1988). Environmental projects: Volume 4. Asbestos survey. |
| **HERO ID:** | 6894315 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Production, import, or use volume: | 70% of asbestos is used in the US as construction materials.Consumption peaked in 1973 at 800,000 metric tons. |
| Number of sites: | 1 self-sufficient site (93 buildings including 7 communication dish antennas) - this study focused on 12 primary buildings. |
| Chemical concentration: | Table 2spray applied insulation material 1-95%pre-formed thermal insulating products - 85% Magnesia 15% asbestos - Calcium Silicate 6-8%Textiles - Cloth 100% - Fire Blankets 90-95% - Felts 50-95% - Sheets 50-95% - Rope 80-100% - Tubing 80-85 % - Curtains 60-65%Concrete products - extrusion panels corrugated 8 % - extrusion panels flat 20-45% - extrusion panels flexible 40-50% - extrusion panels flex perforated 30-50% - extrusion panels laminated 35-50% - extrusion panels roof tiles 20-30% - clapboard 12-15% - clapboard siding shingles 12-14% - clapboard roofing shingles 20-32% - pipe 20-15%Paper products - corrugated high temp 90% - corrugated mod temp 35-70% - indented 98% - millboard 80-85%Roofing felt - smooth 10-15% - mineral 10-15% - shingles 1% - pipeline 10%Asbestos containing compounds - caulking 30% - joint compounds 5-25% - roofing asphalt 5% - mastics 5-25% - asphalt tile cement 13-25% - roof putty 10-25% - plaster 2-10% - spackles 3-5% - Sealant 50-55% - cement insulation 20-100% - cement finishing 55% - cement magnesia 15%Asbestos ebony products 50%Flooring - vinyl/asbestos tile 21% - asphalt/asbestos tile 26-33% - sheet 30%Wall covering - vinyl wallpaper 6-8%Paints & Coatings - roof coating 4-7% - air tight 15%.....Appendix B provides results from building-specific bulk sampling for Chrysotile and Amosite (using PLM EPA method 600/M-82-020). Unfortunately the sample ID does not indicate the source. |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Methodology | High | The report uses high quality data and techniques that are from frequently used sources. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | The data are from the United States. |
| Metric 3: | Applicability | High | The report is for an occupational scenario within the scope of the risk evaluation. |
| Metric 4: | Temporal Representativeness | Low | 1988- prior to latest PEL and more than 20 years old. |
| Metric 5: | Sample Size | Medium | Distribution of samples is characterized by a range with uncertain statistics. It is unclear if analysis is representative. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | High | Assessment or report clearly documents its data sources, assessment methods, results, and assumptions. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Medium | Range of concentrations provided that could help assess variability, nothing provided concerning measurement uncertainty. |

## Overall Quality Determination — High

| | |
|---|---|
| **Study Citation:** | Kut, D. (1970). Air ducts. International Series of Monographs in Heating, Ventilation and Refrigeration, vol. 7 :147-176. |
| **HERO ID:** | 6907134 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Life cycle description: | The materials most commonly employed for duct construction are galvanized mild steel, asbestos cement, brick, or concrete. |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | Medium | The assessment or report uses high quality data and/or techniques or sound methods that are not from a frequently used source and associated information does not indicate flaws or quality issues. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | The data are from the United States and are representative of the industry being evaluated. |
| | Metric 3: | Applicability | Low | The report is for an occupational scenario within the scope of the risk evaluation but asbestos is not used for these uses any more. |
| | Metric 4: | Temporal Representativeness | Low | The report is more than 20 years old. |
| | Metric 5: | Sample Size | N/A | No sample data. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Assessment or report clearly documents results, methods, and assumptions. Data sources are generally described but not fully transparent. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | N/A | No scope to address variability and uncertainty. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Landrigan, P. J., Diliberti, J. H., Graef, J. W., Jackson, R. I., Nathenson, G. (1987). American Academy of Pediatrics Committee on Environmental Hazards: Asbestos exposure in schools. Pediatrics 79(2):301-305. |
| **HERO ID:** | 3083143 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Life cycle description: | Asbestos was used as a spray-on material in the construction of school ceilings, (primarily from 1950-1970). Also used in insulating materials for pipes, boilers, and structural beams in school. [PDF pg. 1] |
| Number of sites: | The EPA estimated that more than 8,500 schools in the nation had friable asbestos |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | The assessment or report uses high quality data and/or techniques or sound methods that are from a frequently used source (journalarticles) and are generally accepted by the scientific community, and associated information does not indicate flaws or quality issues. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | The data are from the United States and are representative of the industry being evaluated |
| | Metric 3: | Applicability | High | The report is for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Low | The report is more than 20 years old. The report captures operations, equipment, and worker activities that are expected to be outdated. |
| | Metric 5: | Sample Size | N/A | N/A - data not dependent on sampling |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | Assessment or report clearly documents its data sources, assessment methods, results, and assumptions. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | The report provides only limited discussion of the variability in asbestos sources, no variability addressed with number of sites estimates. No discussion on uncertainty of results. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Lange, J. H. (2006). Type and amount of asbestos in floor tile and mastic. Bulletin of Environmental Contamination and Toxicology 77(6):807-809. |
| **HERO ID:** | 3531066 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Chemical concentration: | Samples of floor tile ranged from 2-17%. Samples of mastic ranged from not detected to 15%. (2/3) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | Report uses high quality methods and data from frequently-used sources. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for commercial use in construction materials, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Medium | Report contains data that is older than 20 years old and data that is less than 20 years old, but no data is less than 10 years old. |
| | Metric 5: | Sample Size | Medium | Sample distribution characterized by limited statistics (number of samples, flooring area) but discrete samples not provided and distribution not fully characterized. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | High | Uncertainty is addressed in the results and discussion section. Variability is addressed by compiling data from multiple studies. |

## Overall Quality Determination **High**

| | |
|---|---|
| **Study Citation:** | Lange, J. H. (2002). Impact of asbestos concentrations in floor tiles on exposure during removal. International Journal of Environmental Health Research 12(4):293-300. |
| **HERO ID:** | 3531070 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Chemical concentration: | Each abatement project (building or school) had a different percentage of asbestos in floor tile (10–15 and 3–5%). [PDF Pg. 3] |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | Report uses high quality data/techniques/methods from frequently-used sources. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for Chemical Substances in Construction, Paint, Electrical, and Metal Products, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. (2002) |
| | Metric 5: | Sample Size | Medium | Sample distribution characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | Variability addressed by a range of concentration of asbestos in floor tile given but uncertainty is not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Lange, J. H. (2001). Occupational exposure during removal of windows with lead-based paint and asbestos caulking. Bulletin of Environmental Contamination and Toxicology 66(2):146-149. |
| **HERO ID:** | 82307 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Chemical concentration: | window caulking - greater than 1% asbestos |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | The assessment or report uses high quality data and/or techniques or sound methods that are from frequently used sources. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | The data are from the United States and are representative of the industry being evaluated. |
| | Metric 3: | Applicability | High | The report is for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Low | The report is more than 20 years old. |
| | Metric 5: | Sample Size | N/A | No sample data. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | Assessment or report clearly documents its data sources, assessment methods, results, and assumptions. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | N/A | No scope to address variability and uncertainty. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Lange, J. H., Bules, M., Lindquist, J., Gray, M., Ivarone, C. (2000). A survey of publicly funded asbestos abatement projects in the county of Erie, Pennsylvania, USA, during the time period 1996-1999. Indoor and Built Environment 9(6):342-347. |
| **HERO ID:** | 3541600 |
| **Conditions of Use:** | Consumer Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Throughput: | Area of abatement work was between 55-3200 linear feet or 2-44200 square feet (different sites reported different units) (3/6) |
| Number of sites: | 22 sites that conducted abatement operations (2/6) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | Medium | Report uses high quality data that are not from frequently-used sources and there are no known quality issues. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | Low | Data are for consumer use in construction materials, which is similar to the in-scope occupational scenario commercial use of construction materials. |
| | Metric 4: | Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete throughput values provided). |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | Uncertainty isn't addressed. Variability is addressed by gathering data from different facility types (schools, hospital, businesses). |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Lange, J. H., Thomulka, K. W. (2000). Air sampling during asbestos abatement of floor tile and mastic. Bulletin of Environmental Contamination and Toxicology 64(4):497-501. |
| **HERO ID:** | 3080795 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Chemical concentration: | 3-7% chrysotile asbestos |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | The assessment or report uses high quality data and/or techniques or sound methods that are from frequently used sources. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | The data are from the United States and are representative of the industry being evaluated. |
| | Metric 3: | Applicability | High | The report is for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Low | The report is more than 20 years old. |
| | Metric 5: | Sample Size | N/A | No sample data. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | Assessment or report clearly documents its data sources, assessment methods, results, and assumptions. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | N/A | No scope to address variability and uncertainty. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Lange, J. H., Thomulka, K. W. (2000). An evaluation of personal airborne asbestos exposure measurements during abatement of dry wall and floor tile/mastic. International Journal of Environmental Health Research 10(1):5-19. |
| **HERO ID:** | 3091821 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Chemical concentration: | The asbestos content for floor tile, mastic and dry wall was 2–7%, 1–3% and 25–35%, respectively |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | The assessment or report uses high quality data and/or techniques or sound methods that are from frequently used sources (journal article) and are generally accepted by the scientific community, and associated information does not indicate flaws or quality issues. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | The data are from the United States and are representative of the industry being evaluated. |
| | Metric 3: | Applicability | High | The report is for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Low | The report is more than 20 years old. The report captures operations, equipment, and worker activities that are expected to be outdated. |
| | Metric 5: | Sample Size | Medium | Distribution of samples is characterized by a range with uncertain statistics. It is unclear if analysis is representative. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | Assessment or report clearly documents its data sources, assessment methods, results, and assumptions. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | The report provides only limited discussion of the variability and uncertainty in the results. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Lange, J. H., Thomulka, K. W. (2000). Area and personal airborne exposure during abatement of asbestos-containing roofing material. Bulletin of Environmental Contamination and Toxicology 64(5):673-678. |
| **HERO ID:** | 3531083 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Process description: | Roof materials were abated by cutting out sections with a power saw. Work employed wet methods (HEI, 1991, OSHA, 1996). Water from a hose was used to wet the roof before abatement and when cuts were undertaken. Roof material was removed and placed into a chute (about 3 foot diameter). The chute was also periodically wetted and was connected into a dumpster. This dumpster was sealed, except the entering chute, with plastic and water from the hose was periodically applied to the dumpster via the chute to maintain material in a wet condition. However, due to the consistency of this roofing material wetting was not effective and some emissions occurred. |
| Chemical concentration: | Roof materials were identified as ACM by Polarized Light Microscopy and was estimated to be 5 - 10% chrysotile. |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | The assessment or report uses high quality data and/or techniques or sound methods that are from frequently used sources. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | The data are from the United States. |
| | Metric 3: | Applicability | High | The report is for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Low | The report is more than 20 years old. |
| | Metric 5: | Sample Size | N/A | No sample data. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Assessment or report clearly documents results, methods, and assumptions. Data sources are generally described but not fully transparent. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | N/A | No scope to address variability and uncertainty. |

## Overall Quality Determination — High

| | |
|---|---|
| **Study Citation:** | Lange, J. H., Thomulka, K. W. (2001). Personal exposure to asbestos during removal of asbestos-containing window caulking and floor tile/pipe insulation. Fresenius Environmental Bulletin 10(8):688-691. |
| **HERO ID:** | 3585971 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Chemical concentration: | Window caulking: 2-5% chrysotile [PDF Pg. 1]Floor tile: 2-5% chrysotilePipe insulation: 25% chrysotile |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | Report uses high quality data/techniques/methods from frequently-used sources. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for construction, paint, electrical, and metal products, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: | Sample Size | Medium | Sample distribution characterized by a range. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Lange, J. H., Thomulka, K. W. (2002). Airborne exposure concentrations during asbestos abatement of ceiling and wall plaster. Bulletin of Environmental Contamination and Toxicology 69(5):712-718. |
| **HERO ID:** | 3585972 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Process description: | Removal was conducted by breaking the plaster, scraping with a metal scraper, wire brushing, and cutting mesh pieces. Wet methods were employed by using a garden hose to moisten the ACM. Water was liberally applied to plaster on walls and the ground. All materials to be removed were well saturated with water. (2/7) |
| Chemical concentration: | The removed plaster was reported to be 10-15% chrysotile. (2/7) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Methodology | High | Report uses high quality data from frequently-used sources. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | High | Data are from the U.S. |
| | Metric 3: Applicability | High | Data are for asbestos abatement, an in-scope occupational scenario. |
| | Metric 4: Temporal Representativeness | Low | The report is more than 20 years old. |
| | Metric 5: Sample Size | Medium | Sample distribution characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Low | The report does not address variability or uncertainty. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Lange, J. H., Thomulka, K. W., Lee, R. J., Dunmyre, G. R. (1995). Evaluation of lift and passive sampling methods during asbestos abatement activities. Bulletin of Environmental Contamination and Toxicology 55(3):325-331. |
| **HERO ID:** | 3585973 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Process description: | Removal of floor tile, boiler/pipe insulation EPA methodsFloor mastic removed by HEPA shot-blaster machine.Corners removed by scrape and lift techniques and mastic remover |
| Number of sites: | 1 elementary school |
| Chemical concentration: | Floor tile/Mastic and boiler/pipe insulation 3 - 30% |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Methodology | High | The assessment or report uses high quality data |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | US |
| Metric 3: | Applicability | High | The report is for an occupational scenario ( Remediation at a school) within the scope of the risk evaluation. |
| Metric 4: | Temporal Representativeness | Low | 1995 - more than 20 years old |
| Metric 5: | Sample Size | N/A | Qualitative information provided about the process |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | High | Assessment or report clearly documents its data sources |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | N/A | Qualitative information provided about the process |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Lange, J. H., Thomulka, K. W., Sites, S. L. M. (2003). Airborne concentrations of asbestos during removal of pipe/boiler insulation using glovebags with and without containments. Fresenius Environmental Bulletin 12(5):431-435. |
| **HERO ID:** | 3586138 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Chemical concentration: | 45% asbestos in insulation, 13% in tile (both chrysotile) (pg 2) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | Report uses high quality data/techniques/methods from frequently-used sources. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for construction materials, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Medium | Report is based on data greater than 10 years old but no more than 20 years old and industry conditions that are expected to be representative of current industry conditions. |
| | Metric 5: | Sample Size | Medium | Sample distribution characterized by limited statistics (assumed means) but discrete samples not provided and distribution not fully characterized. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Methods, results, and assumptions are clearly documented, but underlying data sources are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination — Medium

| | |
|---|---|
| **Study Citation:** | Lange, J. H., Thomulka, K. W., Sites, S. S., Priolo, G., Buja, A., Mastrangelo, G. (2005). Personal exposure during abatement of various asbestos-containing materials in the same work area. Bulletin of Environmental Contamination and Toxicology 74(6):1034-1036. |
| **HERO ID:** | 3531087 |
| **Conditions of Use:** | Disposal |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Chemical concentration: | Floor tiles were 5% chrysotile, plaster was 3%, pipe insulation was 65%,, fitting insulation was 70%, boiler insulation was 65%, caulking was 10%. (3/3) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | Report uses high quality data from frequently-used sources. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for asbestos abatement, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Medium | Report is based on data greater than 10 years old but no more than 20 years old and industry conditions that are expected to be representative of current industry conditions. |
| | Metric 5: | Sample Size | Medium | Sample distribution characterized by limited statistics (concentrations) but discrete samples not provided and distribution not fully characterized. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | Variability is addressed by sampling similar materials at 5 sites. Uncertainty isn't addressed. |

## Overall Quality Determination — High

| | |
|---|---|
| **Study Citation:** | Lange, J. H., Wang, M., Buja, A., Mastrangelo, G. (2005). Area and personal exposure measurements during asbestos abatement of a crawl space and boiler room. Bulletin of Environmental Contamination and Toxicology 74(2):388-390. |
| **HERO ID:** | 3531088 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Chemical concentration: | Pipe insulation is generally around 35-60% asbestos. (1/3) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | Report uses high quality methods and data from frequently-used sources. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | The report is for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Medium | Report is based on data greater than 10 years old but no more than 20 years old and industry conditions that are expected to be representative of current industry conditions. |
| | Metric 5: | Sample Size | N/A | No sample data. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | N/A | No scope to address variability and uncertainty. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Lawrence, J., Tosine, H. M., Zimmermann, H. W., Pang, T. W. S. (1975). REMOVAL OF ASBESTOS FIBERS FROM POTABLE WATER BY COAGULATION AND FILTRATION. Water Research 9(4):397-400. |
| **HERO ID:** | 3585186 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Products not Described by Other Codes |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Chemical concentration: | The concentration of asbestos fibres in the raw lakewater was 12.3 × 10^6 fibre L |
| Comments: | The most effective method, involving chemical coagulation with iron salts and polyelectrolytes followed by filtration, resulted in better than 99.8% fibre removal from water containing 12 x l0^6 fibres l-1. |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | Medium | Report uses high quality data/techniques/methods that are not from frequently-used sources and there are no known quality issues. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Medium | Data are from Canada, an OECD country. |
| | Metric 3: | Applicability | High | Data are for disposal, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: | Sample Size | Medium | Sample distribution characterized by limited statistics (assumed mean) but discrete samples not provided and distribution not fully characterized. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Methods, results, and assumptions are clearly documented, but underlying data sources are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | Variability addressed by evaluating different WWT methods, but uncertainty is not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Lawrence, J., Zimmermann, H. W. (1976). Potable water treatment for some asbestiform minerals: optimization and turbidity data. Water Research 10(3):195-198. |
| **HERO ID:** | 3662078 |
| **Conditions of Use:** | Other: |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Chemical concentration: | TEM:Silver Bay Minnesota 1.2 x 10^7 f/LThetford/drummondville Quebec 1 x10^9 f/Lused in study: 1.3x10^9 f/L |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | TEM |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | US & Canada |
| | Metric 3: | Applicability | High | The report is for an occupational scenario (removal of asbestos from drinking water) of within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Low | 1975 - more than 20 years old |
| | Metric 5: | Sample Size | Medium | Statistics were not provided, but actual values were presented. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | Assessment or report clearly documents its data sources, assessment methods, results, and assumptions. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | Neither variability or uncertainty were discussed in this report. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Lee, J. G., Lee, K. H., Choi, H., Moon, H. L., Byeon, S. H. (2012). Total dust and asbestos concentrations during asbestos-containing materials abatement in Korea. International Journal of Environmental Research 6(4):849-852. |
| **HERO ID:** | 2635206 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Number of sites: | four office buildings |
| Chemical concentration: | Asbestos was most commonly used in slate roof tiles (containing 8-14 % asbestos) as a building exterior material. Baumlite boardmaterials contained about 10 % asbestos as an interior material and ceiling textile materials contained about 3-6 % asbestos. |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | The assessment or report uses high quality data and/or techniques or sound methods. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Medium | The data are from an OECD country other than the U.S. |
| | Metric 3: | Applicability | High | The report is for an occupational scenario within the scope of the risk evaluation. Abatement. |
| | Metric 4: | Temporal Representativeness | Medium | more than 10 years but no more than 20 years old. |
| | Metric 5: | Sample Size | Medium | Distribution of samples is characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Assessment or report clearly documents results, methods, and assumptions. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | The report provides only limited discussion of the variability and uncertainty in the results. |

## Overall Quality Determination — Medium

| | |
|---|---|
| **Study Citation:** | Lee, K. H., Yoon, H. S., Choi, S. J., Kang, D. (2009). Asbestos exposure and malignant mesothelioma in Korea. Asian Pacific Journal of Cancer Prevention 10(4):707-710. |
| **HERO ID:** | 3079147 |
| **Conditions of Use:** | Other: |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Production, import, or use volume: | "According to the Ministry of Labor in Korea, approximately 10,000 tons of asbestos were produced annually between 1978 and 1983. Importation of asbestos raw materials gradually decreased between 1996 and 2005, and only 6,500 ton of asbestos raw materials were imported in 2005. (1/4)" |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Methodology | High | Assessment uses high quality data from frequently-used sources. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | Medium | Data are from Korea, an OECD country. |
| | Metric 3: Applicability | Uninformative | Data are for manufacture of asbestos products, which is not in scope. |
| | Metric 4: Temporal Representativeness | Medium | Report is based on data greater than 10 years old but no more than 20 years old and industry conditions that are expected to be representative of current industry conditions. |
| | Metric 5: Sample Size | Medium | Sample distribution characterized by limited statistics (production values) but discrete samples not provided and distribution not fully characterized. |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Medium | Variability is addressed by comparing trends over many years. Uncertainty isn't addressed. |

## Overall Quality Determination — Uninformative

| | |
|---|---|
| **Study Citation:** | Lee, S. A. (1981). Health hazard evaluation report no. HETA 81-293-983, Bulk Mail Center, Pittsburgh, Pennsylvania. |
| **HERO ID:** | 3970517 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Chemical concentration: | Six bulk samples of brake, clutch, and sheet rock materials from the mail center were found to contain 20-75% chrysotile asbestos. [PDF Pg. 3] |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | Report uses high quality data/techniques/methods from frequently-used sources. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for Chemical Substances in Construction, Paint, Electrical, and Metal Products, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: | Sample Size | Medium | Sample distribution characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Leonelli, C., Veronesi, P., Boccaccini, D. N., Rivasi, M. R., Barbieri, L., Andreola, F., Lancellotti, I., Rabitti, D., Pellacani, G. C. (2006). Microwave thermal inertisation of asbestos containing waste and its recycling in traditional ceramics. Journal of Hazardous Materials 135(1-3):149-155. |
| **HERO ID:** | 3531118 |
| **Conditions of Use:** | Disposal |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Production, import, or use volume: | 99% of the world's current asbestos production is chrysotile.It is estimated that the amount of Asbestos Containing Waste in Italy can reach 30 million tons, i.e. 18 million m3, of which ∼8 million m3 are asbesto |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Methodology | Medium | Report uses high quality methods that are not from frequently-used sources and there are no known quality issues. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | Medium | Data are from Italy, an OECD country. |
| Metric 3: | Applicability | Uninformative | Data are for a scientific study on novel asbestos disposal techniques which is not in-scope or similar to an in-scope occupational scenario. |
| Metric 4: | Temporal Representativeness | Medium | Report is based on data greater than 10 years old but no more than 20 years old and industry conditions that are expected to be representative of current industry conditions. |
| Metric 5: | Sample Size | Low | Sample distribution is characterized by no statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Medium | Methods, results, and assumptions are clearly documented, but underlying data sources are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Medium | Variability is addressed by running different length microwave runs on the asbesto but uncertainty are not addressed. |

## Overall Quality Determination Uninformative

| | |
|---|---|
| **Study Citation:** | Levin, J. L., Stocks, J. M., Shepherd, J. R., Fagan, M. F., Dodson, R. F. (1992). Asbestos exposures: known and underrecognized sources. American Journal of Industrial Medicine 22(4):607-608. |
| **HERO ID:** | 3082286 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Chemical concentration: | Actual availability of one of these clutch assembly linings resulted in analysis confirming the presence of 10-12% chrysotile asbestos. (p. 1) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | Low | Methods used in the assessment or reportare not specified. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for braking and gear-changing (clutch components), an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Data are more than 20 years old. |
| | Metric 5: | Sample Size | Low | Distribution of samples is qualitative or characterized by no statistics. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Low | Assessment or report provides results, but the underlying methods, data sources, and assumptions are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Low

| | |
|---|---|
| **Study Citation:** | Lewis FA (1980). Health hazard evaluation report no. HHE 79-141-711, Fischer % Porter Company, Warminster, Pennsylvania. |
| **HERO ID:** | 3970518 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Chemical concentration: | Bulk samples of the insulation inside a Q-hut was ~50% asbestos by volume. (11/11) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | Report uses high quality data from frequently-used sources. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for commercial use of building construction materials, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: | Sample Size | Medium | Statistical distribution of samples is characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Methods, results, and assumptions are clearly documented, but underlying data sources are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Lewis, F. A. (1980). Health Hazard Evaluation Determination, Report No. HHE-79-141-711, Fischer and Porter Company, Warminster, Pennsylvania. NIOSH:79-141. |
| **HERO ID:** | 3653519 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Chemical concentration: | Bulk sample of insulation was ~50% asbestos by volume. [PDF Pg. 11] |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | Report uses high quality data/techniques/methods from frequently-used sources. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for Chemical Substances in Construction, Paint, Electrical, and Metal Products, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: | Sample Size | Low | Sample distribution is characterized by no statistics. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Lewis, N. J., Curtis, M. F. (1990). Occupational health and hygiene following a fire in a warehouse with an asbestos cement roof. Journal of the Society of Occupational Medicine 40(2):53-54. |
| **HERO ID:** | 3096039 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Chemical concentration: | Corrugated asbestos cement containing approximately 10 per cent chrysotile asbestos. |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | Medium | The assessment or report uses high quality data and/or techniques or sound methods that are not from a frequently used source and associated information does not indicate flaws or quality issues. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Medium | Report is from U.K. |
| | Metric 3: | Applicability | High | The report is for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Low | The report is more than 20 years old. |
| | Metric 5: | Sample Size | N/A | N/A - asbestos concentration in roofing tile |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Assessment or report clearly documents results, methods, and assumptions. Data sources are generally described but not fully transparent |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | N/A | No scope to address variability and uncertainty. |

## Overall Quality Determination **Medium**

| | |
|---|---|
| **Study Citation:** | Lim, J. W., Koh, D., Khim, J. S., Le, G. V., Takahashi, K. (2011). Preventive measures to eliminate asbestos-related diseases in singapore. Safety and Health at Work 2(3):201-209. |
| **HERO ID:** | 3078487 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Production, import, or use volume: | 108,545 metric tons of asbestos used in Singapore during the observed period of 1970-2007 with an annual mean consumption of 1.06 kg per capita per year (pg. 1-2) |
| Life cycle description: | Asbestos was also used as an insulating material in shipyard industries, buildings and power stations, as well asin friction materials for clutch plates, brake linings, and gasketsof heavy vehicles. In addition, the construction industry widelyused asbestos in a variety of building materials including floorand ceiling tiles, asbestos-cement pipes or sheets, refuse chutes,and fire-resistant structures. It was also used in pipe lagging, asheat insulation materials, and in cladding or sprayed-on materials located on beams and between walls. (pg. 2) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Methodology | High | Report is from a frequently used source and associated information does not indicate flaws or quality issues. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | Low | Singapore, a non-OECD country. |
| | Metric 3: Applicability | High | The report is for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: Temporal Representativeness | Medium | The report is generally more than 10 yearsbut no more than 20 years old. |
| | Metric 5: Sample Size | Medium | Characterized by total and mean with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | High | Assessment or report clearly documents its data sources, assessment methods, results, andassumptions. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | N/A | N/A- only production volume and life cycle description extracted. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Liu, J. Y., Li, P. F. (2013). The application of self-designed machinery to remove ACM and DCM in the chimney. :43-48. |
| **HERO ID:** | 6870269 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Process description: | ACM remaining at chimney: asbestos flue guide plates (Platform 7 to Platform 1, total: 16 nos.), asbestos sampling port gaskets (Platform 2 to Platform 1, total: 8 nos.), asbestos door sealants (G/F, total: 4 nos.) and asbestos ventilation louvers (between Platform 7 and Platform 6, total: 6 nos.).The principle of the demolition procedure for the chimney flues is that they will be cut into small pieces of manageable size (e.g., 1.2 m × 0.8 m) by flame-cutting or any other appropriate method with the assistance of hand-held tools on the spot by operatives who will work from intermediate working platforms between chimney platform levels.Concerning demolition of concrete chimney wall after clearance of ACM/DCM, the principle is that the upper portions of the chimney will be cut into pieces by hand-held tools on the spot by operatives who will work from working platforms inside the chimney. Hydraulic breakers will be an option for use for the remaining lower portions of the chimney.The demolished concrete debris will then be broken down and removed by hydraulic excavators and loaded on to trucks for transportation to the designated disposal site. Duringthe demolition work, water sprays will be used to suppress excessive dust generated by the processes |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | Medium | The assessment or report uses high quality data and/or techniques or sound methods that are not from a frequently used source and associated information does not indicate flaws or quality issues. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Low | The data are from a non-OECD country. |
| | Metric 3: | Applicability | High | The report is for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Medium | The report captures operations, equipment, and worker activities expected to be reasonably representative of current conditions. The report is generally no more than 10 years old. |
| | Metric 5: | Sample Size | N/A | n/a - no sampling data |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Assessment or report clearly documents results, methods, and assumptions. Data sources are generally described but not fully transparent. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | The report does not address variability or uncertainty. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Liukonen, L. R., Weir, F. W. (2005). Asbestos exposure from gaskets during disassembly of a medium duty diesel engine. Regulatory Toxicology and Pharmacology 41(2):113-121. |
| **HERO ID:** | 3531131 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Process description: | The mechanic removed the gaskets with a scraper. Any remaining residue was cleaned from the surface using either a rotary wire brush or a 3M brand Scotch Brite pad on a hand held air-operated grinder. Gasket scraps were allowed to fall to the floor until normal work area cleanup was done by the mechanic, usually at the end of each work interval, such as at the end of the day . (4/9) |
| Chemical concentration: | Gaskets contained 0-70% chrysotile. (7/9). Table 2- Asbestos content of gaskets |
| Comments: | I believe this article is in scope because it covers gasket use in general diesel engines, not automobile engines. |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Methodology | High | Report uses high quality data from frequently-used sources. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | High | Data are from the U.S. |
| | Metric 3: Applicability | High | Data are for commercial use of chemical substances in metal products, an in-scope occupational scenario. |
| | Metric 4: Temporal Representativeness | Medium | Report is based on data greater than 10 years old but no more than 20 years old and industry conditions that are expected to be representative of current industry conditions. |
| | Metric 5: Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | High | Uncertainty is addressed in the study's methods. Variability is addressed by sampling gaskets from different parts of the disassembly. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Lucas, C. (1981). Health hazard evaluation report no. HETA 81-209-891, Pilgrim Glass Company, Ceredo West Virginia. |
| **HERO ID:** | 3970486 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Process description: | Pilgrim Glass Company's plate press line in the Hot Metal Shop:"The gatherer uses a long-handled rod to extract about 4 lbs of molten glass from the continuous tank furnace and drops it on to a press. The presser forms the plate. Next carry-in person #1 transfers the plate to a carbon holder using a scoop. Carry-in #2, using asbestos gloves, stacks the plates in columns of 3 with 4 small irregular shaped pieces of 1/4 inch asbestos mill board separating each plate. Carry-in #2 removes his gloves to transfer the column of 3 plates to the hot end of the #2 lehr using a long-handled paddle. The lehr is a temperature controlled enclosed conveyor belt used to slow the cooling of newly formed glassware. This slow cool process prevents the glass from cracking. The lehr's inlet temperature of 9000F drops 500F for every 6 feet the belt moves. Resident time in the lehr is 2 hour and 45 minutes. At the cold end of the lehr (800F) a separator removes and prepares the plate for shipping. The small 2 to 5 inch irregular shaped pieces of asbestos mill board are dropped into a 3 foot sauare cardboard box. When the box is full it is returned to the beginning of the plate press line to be reused in the plate stacking process. These asbestos pieces are used until they deteriorate or are lost. About once a month the foreman's helper must break new pieces of asbestos mill board by hand. He performs this task outside in open air. The mill board is received in 42 x 48 inch sheets. (pg 4)" |
| Throughput: | 900 thirteen inch plates in one 8-hour shift (pg 4) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Methodology | High | Report uses high quality data/techniques/methods from frequently-used sources. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | High | Data are from the U.S. |
| | Metric 3: Applicability | High | Data are for construction materials, an in-scope occupational scenario. |
| | Metric 4: Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: Sample Size | Medium | Sample distribution characterized by limited statistics (assumed mean for throughput data) but discrete samples not provided and distribution not fully characterized. |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | Medium | Methods, results, and assumptions are clearly documented, but underlying data sources are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Lundgren, D. A., Vanderpool, R. W., Liu, B. Y. H. (1991). Asbestos fiber concentrations resulting from the installation, maintenance and removal of vinyl-asbestos floor tile. Particle & Particle Systems Characterization 8(3):233-236. |
| **HERO ID:** | 3582228 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Process description: | The existing polish was removed in a 10-minute time period using a commercial liquid stripping agent. Immediately afterwards, the floor was cleaned, over a 9-minute period, using a liquid cleaning solution. The floor was then allowed to dry for approximately 20 minutes. The floor was then waxed during a 9-minute time period using a commercial polish. Following a 30-minute drying time, the floor surface was buffed for approximately 15 minutes using an upright drum-type rotary buffer. [PDF Pg. 1]Tile removal by cold techniques involved placing blocks of dryice in contact with the tile surface to freeze the underlying adhesive. Depending on the condition of the tile and strength of theadhesive bond, the individual tiles were removed by hand orcarefully scraped up with a removal tool that resembled a heavyduty wall scraper. [PDF Pg. 1]Hot removal techniques were then used on the second sectionof flooring. This technique involved the use of heat guns (BoschTools, Model # 1942) to heat the tile's underlying adhesive afterwhich the tile could be removed by the use of a scraper to prythe tile from the underlying surface. [PDF Pg. 1]The installation process began by laying down a coat ofadhesive to the entire test area. Following a short time periodto allow the adhesive to "set up" the workman began layingdown 1 ft. square vinyl-asbestos floor tiles. Installation of thetiles was completed in 80 minutes. As in the removal, both personnel and static air sampling were performed during the tile installation. [PDF Pg. 2] |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Methodology | High | Report uses high quality data/techniques/methods from frequently-used sources. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | High | Data are from the U.S. |
| | Metric 3: Applicability | High | Data are for construction, paint, electrical, and metal products, an in-scope occupational scenario. |
| | Metric 4: Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: Sample Size | N/A | Sample size is not applicable to process description information extracted. |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | N/A | Variability and uncertainty are not applicable to process description information extracted. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Macdonald, B. (2004). Managing the asbestos risk. Health Estate Journal 58(2):29-31. |
| **HERO ID:** | 3531147 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Life cycle description: | Asbestos sources: sprayed asbestos and asbestos loose packing- generally used as fire breaks in ceiling voids; moulded or preformed lagging-generally used in thermal insulation of pipes and boilers; sprayed asbestos- generally used as fire protection in ducts, firebreaks, panels, partitions, soffit boards, ceiling panels, and around structural steel work; insulating boards used for fire protection, thermal insulation, partitioning and ducts, some ceiling tiles; millboard, paper, and paper products used for insulation of electrical equipment; asbestos cement products, which can be fully compressed into flat or corrugated sheets. [PDF pg. 1] |
| Number of sites: | HSE estimates that up to 500,000 commercial, industrial and public buildings have asbestos material in them. [U.K.](1/3) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Methodology | High | The assessment or report uses high quality data and/or techniques or sound methods that are from frequently used sources (e.g., journal articles) and are generally accepted by the scientific community, and associated information does not indicate flaws or quality issues. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | Medium | Data are from the U.K., an OECD country. |
| | Metric 3: Applicability | High | Data are for commercial use in construction materials, which is in-scope occupational scenario. |
| | Metric 4: Temporal Representativeness | Medium | Report contains data that is older than 20 years old and data that is less than 20 years old, but no data is less than 10 years old. |
| | Metric 5: Sample Size | Medium | Sample distribution characterized by limited statistics (number of sites) but discrete samples not provided and distribution not fully characterized. |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | Medium | Methods, results, and assumptions are clearly documented, but underlying data sources are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Madl, A. K., Devlin, K. D., Perez, A. L., Hollins, D. M., Cowan, D. M., Scott, P. K., White, K., Cheng, T. J., Henshaw, J. L. (2015). Airborne asbestos exposures associated with gasket and packing replacement: a simulation study of flange and valve repair work and an assessment of exposure variables. Regulatory Toxicology and Pharmacology 71(1):35-51. |
| **HERO ID:** | 3015760 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Process description: | "The mechanic performed tasks associated with flange gasket replacement or complete valve overhaul on a steel work bench with approximate dimensions of 1.5 m long by 0.6 m wide by 0.9 m tall. Flanges and valves were secured to the table with table-mounted vices, as appropriate. Flange gasket work involved the removal and/or installation of the associated flange gaskets. To simulate a complete gasket replacement, the mechanic then fabricated a replacement gasket from sheet gasket material and installed the new gasket onto the flange. Valve overhaul work involved the replacement of valve packing material, replacement of bonnet gaskets internal to the valve, aswell as replacement of the affiliated flange gaskets. For each valve overhaul, the existingbonnet gasket was removed and a replacement gasket was fabricated prior to installation. The bonnet surface was cleaned using a scraper and hand wire brush and a new bonnet gasket was fabricated from sheet gasket material and installed into the valve. (4/17)" |
| Chemical concentration: | The asbestos bulk content of the gaskets removed from the flanges and valve bonnets ranged from 45% to 95% chrysotile, and the bulk content of the gasket material installed ranged from 50% to 80% chrysotile. In addition, the asbestos bulk content of the packing material removed from and installed in the valves ranged from 80% to 90% and 40% to 85% chrysotile, respectively. (9/17) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Methodology | High | Report uses high quality methods and data from frequently-used sources. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | Data are from the U.S. |
| Metric 3: | Applicability | High | Data are for commercial use in packing and gaskets, an in-scope occupational scenario. |
| Metric 4: | Temporal Representativeness | High | Report is based on current industry conditions and data no more than 10 years old. |
| Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | High | Uncertainty is addressed in bulk sampling methods. Variability is addressed by sampling multiple packing and valves and sampling during removal and installation. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Madl, A. K., Gaffney, S. H., Balzer, J. L., Paustenbach, D. J. (2009). Airborne asbestos concentrations associated with heavy equipment brake removal. Annals of Occupational Hygiene 53(8):839-857. |
| **HERO ID:** | 2591959 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Process description: | The brake removal process was similar for all pieces of equipment, with slight differences only in the work practices exhibited by each mechanic. The mechanics worked on each piece of equipment oneat a time. To disassemble the brakes, the external brake housing was first removed from the tractor or loader backhoe using a manual or power wrench to loosen bolts holding the housing in place. On four occasions (Eq1, Eq9, Eq10, and Eq12), a blowtorch had to be applied to facilitate loosening of the externalhousing bolts. Once the external housing was removed, the entire brake assembly was removed from the vehicle. At this point, the mechanic at the Stockton facility would blow out the assembly and work area with compressed air and then repeat the entire processfor the second brake housing. Once both complete assemblies were removed, he performed bench work, which entailed disassembling the drum linings from both brake assemblies. Using a slightly different order than the Stockton mechanic, the mechanic in BigRock, IL, completed the entire brake removal process on the first assembly before beginning the process on the second one. (P. 6/19) |
| Chemical concentration: | Asbestos content in automobile brakes is generally between 30 and 50%. (P. 2/19)historical studies have shown that brake wear debris collected from an automobile dynamometer or drum brakes contains on average between 0.02 and 4.5% asbestos, with the majority of wear debris samples containing ,1% chrysotile. (P. 2/19)In summary, the asbestos content of the brake lining averaged 19% chrysotile by weight (range: 1–39%) as measuredby XRD and 20% chrysotile by area (range: 0.5– 70%) as measured by PLM (Table 2). (P. 9/19) |
| Comments: | Table 1. Summary of equipment tested and bulk sample asbestos concentrations of brake linings and wear debris. |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Methodology | High | The assessment or report uses high quality data and/or techniques or sound methods. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | The data are from the United States. |
| Metric 3: | Applicability | High | The report is for an occupational scenario within the scope of the risk evaluation. Braking and gear-changing (clutch) components in a variety of industrial and commercial machinery. |
| Metric 4: | Temporal Representativeness | Medium | More than 10 years but no more than 20 years old. |
| Metric 5: | Sample Size | Medium | Distribution of samples is characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | High | Assessment or report clearly documents its data. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Medium | The report provides only limited discussion of the variability and uncertainty in the results. |

## Overall Quality Determination — High

| | |
|---|---|
| **Study Citation:** | Maine Labpack, (2023). Hazardous waste guide: Vermiculite. |
| **HERO ID:** | 11145849 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Products not Described by Other Codes |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Process description: | Vermiculite used to cushion hazardous materials during shipment |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | Low | The data, data sources, and/or techniques or methods used in the assessment or report are not specified. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | The data are from the United States and are representative of the industry being evaluated. |
| | Metric 3: | Applicability | High | The report is for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | High | The data is generally no more than 10 years old. |
| | Metric 5: | Sample Size | N/A | N/A - This metric is not applicable to the data being extracted |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Data sources are generally described but not fully transparent. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | The report provides only limited discussion of the variability and uncertainty in the results. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Manville Serv Corp, (1981). Analytical results for fiber-on-filter counts and bulk asbestos prepared by Biospherics Inc. |
| **HERO ID:** | 4158180 |
| **Conditions of Use:** | Other: |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Chemical concentration: | Bulk sample C was 80% chrysotile. (5/6) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | Report uses high quality methods and data from frequently-used sources. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | Low | The condition of use isn't specified. Only sample results are given. |
| | Metric 4: | Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: | Sample Size | Low | Asbestos concentration data only provided for sample C. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Methods, results, and assumptions are clearly documented, but underlying data sources are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | The report does not address variability or uncertainty. |

## Overall Quality Determination — Low

| | |
|---|---|
| **Study Citation:** | Manville Serv Corp, (1980). CAL/OSHA industrial hygiene survey at Pittsburg Plant November 27, 1979. |
| **HERO ID:** | 4158232 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Chemical concentration: | asbestos concentration ranged between <0.5% - 5% asbestos (p. 8) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | Medium | The assessment or report uses high quality data and/or techniques or sound methods that are not from a frequently used source and associated information does not indicate flaws or quality issues. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | The data are from the United States and are representative of the industry being evaluated. |
| | Metric 3: | Applicability | Medium | The report is for an occupational scenario that is similar to an occupational scenario within the scope of the risk evaluation, in terms of the type of industry, operations, and work activities. |
| | Metric 4: | Temporal Representativeness | Low | The report is more than 20 years old. The report captures operations, equipment, and worker activities that are expected to be outdated. |
| | Metric 5: | Sample Size | Medium | Distribution of samples is characterized by a range with uncertain statistics. It is unclear if analysis is representative. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | Assessment or report clearly documents its data sources, assessment methods, results, and assumptions. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | The report does not address variability or uncertainty. |

## Overall Quality Determination Medium

**Study Citation:** Manville Serv Corp, (1973). Examination of tremolite migration.
**HERO ID:** 4158242
**Conditions of Use:** Other:

**EXTRACTION**

| Parameter | Data |
|---|---|
| Chemical concentration: | CYCLO-FIL papers contained 20-30% tremolite and CYCLO-SORB papers contained 2-5% tremolite by volume. (5/12) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | Medium | Report uses high quality data that are not from frequently-used sources and there are no known quality issues. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | Uninformative | Data are for food packaging, which isn't in scope. |
| | Metric 4: | Temporal Representativeness | Low | Assessment is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Methods, results, and assumptions are clearly documented, but underlying data sources are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | Uncertainty is addressed by sampling methodology. Variability isn't addressed. |

## Overall Quality Determination Uninformative

| | |
|---|---|
| **Study Citation:** | Manville Serv Corp, (1979). Florida power and light job survey [878211106]. |
| **HERO ID:** | 4158249 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Process description: | Two operators were in the enclosed "Penthouse" area removing two inch Thermobestos from the piping and equipment. The first operation was to spray the insulation with a fine spray of water to keep the dust to a minimum. The wires were cut and the two inch insulation was removed and asided into plastic bags. The insulation was broken apart after the bags were closed. The closed and tagged bags were removed by the third member of the crew and the bags were positioned near the edge of the fifth floor. We had a metal box (five feet x five feet x one foot) raised to the fifth floor and approximately ten tags were placed in the box and lowered to the ground level and asided to large dump cart. The cart was used for only asbestos and was going to a dump that had been designated by the Environmental Protection Agency. [PDF Pg. 4] |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Methodology | High | Report uses high quality data/techniques/methods from frequently-used sources. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | High | Data are from the U.S. |
| | Metric 3: Applicability | High | Data are for Chemical Substances in Construction, Paint, Electrical, and Metal Products, an in-scope occupational scenario. |
| | Metric 4: Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: Sample Size | N/A | N/A - process description. |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | Medium | Methods, results, and assumptions are clearly documented, but underlying data sources are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | N/A | N/A - process description. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Manville Serv Corp, (1978). Florida power and light job survey [878211550]. |
| **HERO ID:** | 4158250 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Chemical concentration: | J-spray: 15% asbestos by volume (p. 4) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | Medium | The assessment or report uses high quality data and/or techniques or sound methods that are not from a frequently used source and associate information does not indicate flaws or quality issues. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | The data are from the United States. |
| | Metric 3: | Applicability | High | The report is for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Low | The report is more than 20 years old. |
| | Metric 5: | Sample Size | N/A | N/A - This metric is not applicable to the data being extracted |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | Assessment or report clearly documents its data sources, assessment methods, results, and assumptions. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | The report does not address variability or uncertainty. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Manville Serv Corp, (1973). Lack of food contamination by contact with paper due to shipping. |
| **HERO ID:** | 4158256 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Packaging, Paper, Plastic, Toys, Hobby Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Life cycle description: | Paper manufactured with tremolitic talc for purposes of food and drug packaging. |
| Chemical concentration: | 95 unit weights of talc for every 5 unit weights of tremolite (p. 5)talc content of paper: 0.25 - 1% (p. 9) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | Medium | The assessment or report uses high quality data and/or techniques or sound methods that are not from a frequently used source and associated information does not indicate flaws or quality issues. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | The data are from the United States. |
| | Metric 3: | Applicability | Medium | The report is for an occupational scenario that is similar to an occupational scenario within the scope of the risk evaluation (source mentions drug packaging in addition to food packaging). |
| | Metric 4: | Temporal Representativeness | Low | The report is more than 20 years old. The report captures operations, equipment, and worker activities that are expected to be outdated. |
| | Metric 5: | Sample Size | Medium | Data measurements for talc content in paper provided. However, tremolite:talc ratio not confirmed by data measurements. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Assessment or report clearly documents results, methods, and assumptions. Data sources are generally described but not fully transparent. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | The report does not address variability or uncertainty. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Manville Serv Corp, (1982). Martin Marrietta Corporation - Office Facilities phase I Littleton Systems Center Southpark - Littleton Colorado. |
| **HERO ID:** | 4158260 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Process description: | The floor area was roped off in a 40'x20' section with asbestos caution signs posted by each corner. Natural Monsanto polyethylene sheeting, six mil thick, was unfolded and spread on the floor; The portion of the job monitored consisted of removing "1" inch thick insulation from a "1" inch diameter steam line. The job was twenty feet high and required a scissor type scaffolding to reach. The stage of the scaffold was "80" inches x "28" inches and had safety bars around the perimeter "36" inches high. The operators placed a steel fifty-five gallon drum on the stage and lined it with a four mil polyethylene bag.The insulation was sprayed with a fine mist of water prior to cutting into the canvas jacketing. The jacketing was removed and asided into the drum. Next, the wires were snipped and the insulation was removed and placed In the drums. Martin Marietta personnel requested the pipes be wiped with a damp cloth to remove any excess dust after the Insulation was removed. This operation was accomplished and the cloths asided into the drums. The bags were sealed In the full drums and a caution asbestostag was put Inside the drum. The cover was secured with a screw type clamp and a caution asbestos tag was taped to the cover. The floor was squeezed and wet mopped at the end of the day. [PDF Pg. 4] |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Methodology | Medium | Report uses high quality data/techniques/methods that are not from frequently-used sources and there are no known quality issues. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | High | Data are from the U.S. |
| | Metric 3: Applicability | High | Data are for Chemical Substances in Construction, Paint, Electrical, and Metal Products, an in-scope occupational scenario. |
| | Metric 4: Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: Sample Size | N/A | N/A - Process description. |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | N/A | N/A - Process description. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Manville Serv Corp, (1980). Routine evaluation of fibre concentration on asbestos cement working environment proposal of an alternative limit prepared by Instituto Medicina del Lavoro Univ Cattolica. |
| **HERO ID:** | 4158291 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Production, import, or use volume: | Asbestos cement production in Italy in 1980 was approximately 1 million tons (pg 4) |
| Chemical concentration: | 7-15% total asbestos in cement piping product (pg 5). Final piping product is about 12% chrysotile and 3% crocidolite (pg 6). |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | Medium | Report uses high quality data/techniques/methods that are not from frequently-used sources and there are no known quality issues. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Medium | Data are from Italy, an OECD country. |
| | Metric 3: | Applicability | High | Data are for construction materials, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Report is based on data greater than 20 years old. |
| | Metric 5: | Sample Size | Medium | Sample distribution characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Low | Assessment or report provides results, but the underlying methods, data sources, and assumptions are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination — Low

| | |
|---|---|
| **Study Citation:** | Manville Serv Corp, (1980). Study on exposure to asbestos fibres in working conditions at the Locomotive Deposit Workshop of the National Railways. |
| **HERO ID:** | 4158304 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Process description: | The processes are:1) Sanding of chimney contactors2) Resolution of the rheostat resistances 3) Insulation of the diesel motor effluent line4) Asbestos boards cutting5) Preparation of asbestos cords6) Bearing setting for application of ”white metal”7) Substitution of the brakes’ pellets8) Taping of the high voltage cable 9) Sanding of the ’skies” above the rheostats 10) Stripping of the air-heating resistance 11) Disassembling of the conveyors 12) Disassembling of the cooling air-breathings of the rheostat13) Rheostats’ disassembling |
| Chemical concentration: | Brake pellets were 20-50% chrysotile or crocidolite. (6/14) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Methodology | Medium | Report uses high quality data that are not from frequently-used sources and there are no known quality issues. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | Medium | Data are from Italy, an OECD country. |
| Metric 3: | Applicability | High | Data are for industrial use in construction materials, an in-scope occupational scenario. |
| Metric 4: | Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| Metric 5: | Sample Size | Medium | Sample distribution characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Medium | Methods, results, and assumptions are clearly documented, but underlying data sources are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination — Medium

| | |
|---|---|
| **Study Citation:** | Marr, W. T. (1964). Asbestos exposure during naval vessel overhaul. American Industrial Hygiene Association Journal 25:264-268. |
| **HERO ID:** | 3085090 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Production, import, or use volume: | Chrysotile, the fibrous form of serpentine, comes from Canada and constitutes about 95% of the total world production of asbestosThe world's consumption of asbestos has increased from 500,000 tons in 1942 to 2,400,000 tons in 1961 |
| Process description: | Asbestos cloth on roller at cutting table measured out and then cut with rotary hand cutter; another employee then stitches the cloth; then fiberglass stuffed into cloth opening... Installation of asbestos pads and cloth on equipment using adhesive and wiring |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Methodology | High | Report uses high quality information from frequently-used sources. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | High | Data are from the U.S. |
| | Metric 3: Applicability | High | Data are for assembling and installing asbestos insulation for equipment on ships, an in-scope occupational scenario. |
| | Metric 4: Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: Sample Size | N/A | N/A - This metric is not applicable to the data being extracted |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | Medium | Methods, results, and assumptions are clearly documented, but underlying data sources are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Martins, C., Santos, P., Palhinha, P., Serra e Silva, L. (2012). Safety and health in construction: Asbestos. :357-364. |
| **HERO ID:** | 6865198 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Production, import, or use volume: | It is estimated that in Portugal there are about 600,000 hectares of asbestos cement roof sheets. It is known that there are approximately 113,961 tons of asbestos in Portugal. (1/8) |
| Process description: | There are two main asbestos removal methods: dry and wet. There are several techniques for accomplishing the wetting of asbestos materials: by injection, spray, or submersion using water or aqueous solution. Dry removal can be used when the material isn't friable, or in confined spaces. This removal should be performed by suction. (4/8) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Methodology | High | Report uses high quality methods and data from frequently-used sources. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | Medium | Data are from Portugal, an OECD country, |
| Metric 3: | Applicability | High | Data are for demolition of asbestos products, an in-scope occupational scenario. |
| Metric 4: | Temporal Representativeness | Medium | Report is based on data greater than 10 years old but no more than 20 years old and industry conditions that are expected to be representative of current industry conditions. |
| Metric 5: | Sample Size | N/A | No sample data. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | N/A | No scope to address variability and uncertainty. |

## Overall Quality Determination — High

| | |
|---|---|
| **Study Citation:** | Mccoy, M. J., Lewis, R. C., Mowat, F. S. (2021). Airborne concentrations of chrysotile asbestos during operation of industrial crane controls and maintenance of associated arc chutes. Toxicology and Industrial Health 37(3):124-133. |
| **HERO ID:** | 7460196 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Chemical concentration: | Products (e.g. asphalt roofing products, automotive brakes, floortiles, insulation coatings and mastics, and phenolic molding materials) containing upward of 65% chrysotile asbestos by weight in some instances. [PDF Pg. 2]Cementitious mill-style arc chutes (see Figure 1), which containedapproximately 36% chrysotile asbestos by weight. [PDF Pg. 2] |
| Comments: | Concentrations were determined by the transmission electron microscopy (TEM) Chatfield method. [PDF Pg. 2] |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | Report uses high quality data/techniques/methods from frequently-used sources. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for Chemical Substances in Construction, Paint, Electrical, and Metal Products, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | High | Report is based on current industry conditions and data no more than 10 years old. |
| | Metric 5: | Sample Size | Medium | Distribution of samples is characterized by a range with uncertain statistics. It is unclear if analysis is representative. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | Uncertainty is addressed by sampling methods. Variability is not addressed. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Mckenna, J. (2016). Working safely with asbestos cement. Journal of the New England Water Works Association 130(4):266-271. |
| **HERO ID:** | 6897563 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Chemical concentration: | AC pipe was typically made by adding chrysotile and/or crocidolite asbestos, ranging from 10 to 75 percent, to Portland cement, water and silica. |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | Report uses high quality data/techniques/methods from frequently-used sources. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for Chemical Substances in Construction, Paint, Electrical, and Metal Products, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | High | Report is based on current industry conditions and data no more than 10 years old. |
| | Metric 5: | Sample Size | N/A | N/A - No sample data. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | N/A | No scope to address variability and uncertainty. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | McManus, K. P. (1981). Health hazard evaluation report no. HETA 81-309-936, US Air Force Recruiting Station, Bridgeport, Connecticut. |
| **HERO ID:** | 3970484 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Chemical concentration: | Bulk sprayed-on insulation material contained 30-60% chrysotile asbestos. [PDF Pg. 3] |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Methodology | High | Report uses high quality data/techniques/methods from frequently-used sources. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | High | Data are from the U.S. |
| | Metric 3: Applicability | High | Data are for Chemical Substances in Construction, Paint, Electrical, and Metal Products, an in-scope occupational scenario. |
| | Metric 4: Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: Sample Size | Medium | Sample distribution characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Mehlman, M. A. (1991). Dangerous and cancer-causing properties of products and chemicals in the oil-refining and petrochemical industries. Part IX: Asbestos exposure and analysis of exposures. Annals of the New York Academy of Sciences, vol. 643, no. 1 :368-389. |
| **HERO ID:** | 3082300 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Production, import, or use volume: | In 1988, 71,000 tons of asbestos were used. 12,000 tons were used in asbestos-cement pipe, 4,000 tons were used in insulation, and 10,000 tons were used in packing and gaskets. Table 3 provides previous decades PV. (Table 3, pg. 6/23) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Methodology | High | Report uses high quality methods and data from frequently-used sources. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | High | Data are from the U.S. |
| | Metric 3: Applicability | High | Data are for industrial use in construction materials, an in-scope occupational scenario. |
| | Metric 4: Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: Sample Size | Medium | Sample distribution characterized by limited statistics (annual average) but discrete samples not provided and distribution not fully characterized. |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Medium | Variability is addressed by including data from 30 years. Uncertainty isn't addressed. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Michelsen, T. (2011). Roofing materials. |
| **HERO ID:** | 9109840 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Process description: | Built-up roofing (BUR) is a continuous-membrane covering manufactured on-site from alternate layers of bitumen and felts, which are topped with surfacings. Application methods depend on the type and slope of the deck, the types of insulation and roofing membrane, as well as the fastening method. The rates presented in Table 2 range from 0.3-1.6 L/m3 for cold applied, and 0.95-19.5 kg/m3 for hot applied. (3/21) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Methodology | High | Report uses high quality methods and data from frequently-used sources. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | High | Data are from the U.S. |
| | Metric 3: Applicability | Uninformative | Data are for asbestos-free roofing materials, which aren't in scope. |
| | Metric 4: Temporal Representativeness | Medium | Report contains data that is older than 20 years old and data that is less than 20 years old, but no data is less than 10 years old. |
| | Metric 5: Sample Size | N/A | N/A - This metric is not applicable to the data being extracted |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Medium | Variability is addressed by discussing different types of roofing application. Uncertainty isn't addressed. |

## Overall Quality Determination — Uninformative

**Study Citation:** Michiels, P. (2013). Dismantling the nuclear research reactor Thetis. :V002T03A032.
**HERO ID:** 6870302
**Conditions of Use:** Disposal

**EXTRACTION**

| Parameter | Data |
|---|---|
| Process description: | [PDF Pg. 2]The work involves:- confining high activated material; - decontamination of vessels, rooms, floors;- cutting the material of reactor utilities;- separating asbestos- elimination of treated material as free release or restrictedrelease or nuclear waste[PDF Pg. 4-5]- asbestos clean-up after nuclear decommissioningThe ventilation circuits and few other materials are asbestos contaminated but not nuclear contaminated. After nuclear decommissioning, ventilation is stopped and the complete Thetis building is provided with a new ventilation and a tent according the asbestos prevailing rules. Wipe samples will verify the absence of nuclear contamination. The asbestos material will be packed in drums according to nuclear rules but if the definitive measuring device releases the drums then the waste will be conditioned in accordance the asbestos rules. |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Methodology | High | Report uses high quality data/techniques/methods from frequently-used sources. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | Medium | Data are from Belgium, an OECD country. |
| Metric 3: | Applicability | High | Data are for disposal, an in-scope occupational scenario. |
| Metric 4: | Temporal Representativeness | High | Report is based on current industry conditions and data no more than 10 years old. |
| Metric 5: | Sample Size | N/A | N/A - Process Description. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | N/A | N/A - Process Description. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Millette, , J. R., Harmon, A., Few, P., Turner, W. L., Jr, Boltin, W. R. (2009). Analysis of amphibole asbestos in chrysotile-containing ores and a manufactured asbestos product. Microscope 57(1):19-22. |
| **HERO ID:** | 6897208 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Chemical concentration: | A sheet gasket sample was found to contain a small amount of tremolite (less than 1%) in addition to the principal component ofapproximately 90% chrysotile asbestos. (p. 1/4) |

**EVALUATION**

| Domain | | Metric | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | The assessment or report uses high quality data and/or techniques or sound methods that are from frequently used sources (journal article) and are generally accepted by the scientific community, and associated information does not indicate flaws or quality issues. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | The data are from the United States and are representative of the industry being evaluated. |
| | Metric 3: | Applicability | Medium | The report is for an occupational scenario that is similar to an occupational scenario within the scope of the risk evaluation, in terms of the type of industry, operations, and work activities. |
| | Metric 4: | Temporal Representativeness | Medium | The report captures operations, equipment, and worker activities that are expected to be reasonably representative of current conditions. The report is generally more than 10 years but no more than 20 years old. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized. Sample size is sufficiently representative. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | Assessment or report clearly documents its data sources, assessment methods, results, and assumptions. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | The report provides only limited discussion of the variability and uncertainty in the results. |

## Overall Quality Determination — High

| | |
|---|---|
| **Study Citation:** | Miyamoto, K. (2011). An Exploration of Measures Against Industrial Asbestos Accidents. :19-46. |
| **HERO ID:** | 6859599 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Production, import, or use volume: | From 1971 to 2001, the Japanese asbestos industry produced a cumulative total of over 43.42 million metric tons, of construction materials containing asbestos, with an estimated scrap or disposal rate of 5%, or 2.17 million tons, at the time of use. By the association's estimates, existing structures incorporate 41.25 million tons, of construction materials containing asbestos, with an estimated 5.41 million tons of asbestos being utilized. (14/28, Table 2.5) In 2003, the US consumed 4634 metric tons of asbestos. (18/28) |
| Number of sites: | 211 ship building operations, 128 ceramics operations, 88 transportation businesses, 81 machinery and equipment manufacturing operations, and 69 chemical manufacturers. A total of 2514 businesses reported workers accidents involving asbestos in Japan in 2006. (6/28) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Methodology | Medium | Report uses high quality data that are not from frequently-used sources and there are no known quality issues. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | Medium | Data are from Japan, an OECD country, |
| | Metric 3: Applicability | High | Data are for industrial use in construction materials, an in-scope occupational scenario. |
| | Metric 4: Temporal Representativeness | Medium | Report contains data that is older than 20 years old and data that is less than 20 years old, but no data is less than 10 years old. |
| | Metric 5: Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Medium | Variability is addressed by comparing asbestos consumption by year and by country. Uncertainty isn't addressed. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Mlynarek, S. P., Van Orden, D. R. (2012). Asbestos exposure from the overhaul of a Pratt & Whitney R2800 engine. Regulatory Toxicology and Pharmacology 64(2):189-194. |
| **HERO ID:** | 2561011 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Process description: | Engine Overhaul:The overhaul was performed over a three week period. The first week of work on this project was spent disassembling the R2800 engine. The piston engine was stored in a large metal ‘‘can’’ and was removed from its can on day 1 and brought into the facility with a forklift late that day. Broadly, the disassembly process began with removal of the air foils, intake and exhaust tubes, the ignition wiring, distributors, magneto, wiring harness, and all miscellaneous exterior parts. Next, the eighteen cylinders were removed. The nose section was then separated from the power section and disassembled. The power section was then separated from the supercharger (blower) section, and disassembly of the interiors of these sections proceeded separately. Once removed from the power section, the cylinders were disassembled separately. Part of this work was done in a separate disassembly building using a specialized machine to remove the pistons. The cylinders and their components were then returned to the assembly building for sandblasting, painting, and reassembly. The third week of the overhaul was spent in reassembling the engine. During the second week, no sandblasting, scraping, gasket removal or other work of any sort was done to any of the disassembled components, except that all the appropriate large, exterior pieces (e.g., the housings for the nose section, power section, and supercharger) were painted. Painting of these components is a normal part of an overhaul, and presents no opportunity for asbestos exposure. Reassembly proceeded in reverse from disassembly. The interior gears, shafts, and other components of the nose, power, and supercharger (blower) sections were reinstalled, the power section was joined to the supercharger section, and the nose section was joined to the combined power-supercharger sections. The cylinders were painted and reassembled separately, then reinstalled on the engine, followed by the distributors, magneto, wiring harness, intake and exhaust tubes, the ignition wiring, the air foils, and all miscellaneous exterior parts.Cylinder Change:This job consists of removing any wiring, intake or exhaust tubes, air foils, and anything else that would interfere with the cylinder removal, removing the valve rocker arm covers, removing the push rods, and removing the cylinder itself. A replacement cylinder is then installed, followed by reassembly of the above components. The gaskets on the rocker arm cover-cylinder face are changed, and also the gaskets on the push rods, intake/exhaust tubes, and any other gaskets encountered. The first cylinder change was performed on cylinder number 14 during the first week of this project, and the second was on cylinder number 6 during the second week.Clutch Rebuild:Mechanical clutches often contain asbestos-containing facings. Each of the two clutches had a high ratio and a low ratio section. The job consisted of disassembly and separation of the high and low ratio sections of both clutches and removal of the facings from each of the four sections. New facings were then installed and the clutch was reassembled. The clutch disassembly was done during the first week. The components were left on a table in the facility away from the overhaul area. Installation of the new facings and reassembly of the clutch was done during of the second week of this project.Ignition System Rebuild:A complete engine overhaul would include inspection and rebuilding of the ignition system including the magneto, two distributors, the air pumps within the distributors, and all subcomponents. This was done on during the second week using these parts from the R2800-30W that was being overhauled. |
| Number of sites: | 1 location reviewed: Anderson Aeromotive in Idaho |
| Chemical concentration: | Summary of the bulk samples collected in this study.Component No. samples Samples containing asbestos Range of asbestos content Overhaul: ignition System 15 1 25–35% Chrysotile Overhaul: nose section 25 12 20–70% ChrysotileOverhaul: power section 12 3 30–50% Chrysotile Overhaul: cylinders 36 9 20–50% Chrysotile; 25–35% chrysotile and 20–30% amosite Overhaul: supercharger section 64 38 20–55% Chrysotile Service: clutch rebuild 6 6 25–35% Chrysotile Service: cylinder change 14 4 25–50% ChrysotileService: ignition rebuild 11 0 None detectedTable 1, pg 5/6 |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Methodology | High | Report uses high quality data from frequently-used sources. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | Data are from the U.S. |
| Metric 3: | Applicability | High | Data are for ”Industrial Uses: Chemical Substances in Construction, Paint, Electrical, and Metal Products”, which is similar to the in-scope occupational scenario. |

**Continued on next page . . .**

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**Study Citation:** Mlynarek, S. P., Van Orden, D. R. (2012). Asbestos exposure from the overhaul of a Pratt & Whitney R2800 engine. Regulatory Toxicology and Pharmacology 64(2):189-194.
**HERO ID:** 2561011
**Conditions of Use:** Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products

| | | | EVALUATION | |
|---|---|---|---|---|
| Domain | | Metric | Rating | Comments |
| | Metric 4: | Temporal Representativeness | Medium | The study itself is 10 years old, data contained in study is generally between 10 and 20 years old |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Assessment or report clearly documents results, methods, and assumptions. Data sources are generally described but not fully transparent. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | Variability addressed by discussing the different types of engines (Example, those with mechanical clutches tend to have have asbestos facings, but others do not) but uncertainty is not addressed. |

## Overall Quality Determination — High

| | |
|---|---|
| **Study Citation:** | Moore, B. (2001). Asbestos: Fire risks. Safety and Health Practitioner 19(1):28-29. |
| **HERO ID:** | 6882231 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Chemical concentration: | Asbestos cement corrugated sheet, tiles, pipe rainwater goods: 10-12% chrysotile;Asbestos cellulose boards for interior linigs, soffit linings, fire door construction: 7-8% chrysotile;Fire protection and internal lining boards used for ceilings, partitions, soffit linings: 15-25% amosite or chrysotile;Acoustic and fire protection sprays: 5-55% and up to 90% any type of asbestos;Lagging of boilers and pipes: 5-55% crocidolite and amosite;Bituminous roofing: 5-10% chrysotileBituminous damp proof course: 5-10% chrysotileBituminous corrosion protection of corrugated steel sheet, sound insulation and anti-drumming compounds: 5-10% chrysotile; Bitumen, pitch or resin based sealants, adhesives, textured, coatings, pipes: 3-5% chrysotileResin or plastic based floor tiles and cladding sheet: 5% chrysotile and 15-25% amosite;Vinyl flooring back with asbestos felt: 5-15% chrysotile |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Methodology | Low | The data, data sources, and/or techniques or methods used in the assessment or report are not specified. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | Medium | Data are from the UK, an OECD country. |
| | Metric 3: Applicability | High | Data are for construction materials, an in-scope occupational scenario. |
| | Metric 4: Temporal Representativeness | Medium | Report is based on data greater than 10 years old but no more than 20 years old and industry conditions that are expected to be representative of current industry conditions. |
| | Metric 5: Sample Size | Medium | Sample distribution characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | Medium | Methods, results, and assumptions are clearly documented, but underlying data sources are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Morinaga, K., Kohyama, N., Yokoyama, K., Yasui, Y., Hara, I., Sasaki, M., Suzuki, Y., Sera, Y. (1989). Asbestos fibre content of lungs with mesotheliomas in Osaka, Japan: A preliminary report. :438-443. |
| **HERO ID:** | 3082860 |
| **Conditions of Use:** | Consumer Uses-Chemical Substances in Products not Described by Other Codes |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Production, import, or use volume: | USA exported 10,031 tons of asbestos to Japan in 1965 and 10,780 tons in 1985 (pg 439). Annual US consumption of asbestos from 1890 to 1986 was higher than that in Japan (pg 439, Figure 1) with the peak consumption of around 70,000 tons between 1954 and 1980. |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Methodology | Low | Data sources in the report are not specified. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | Medium | The data are from an OECD country other than the U.S. |
| | Metric 3: Applicability | Low | The report is for a non-occupational scenario that is similar to an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: Temporal Representativeness | Low | The report is more than 20 years old. |
| | Metric 5: Sample Size | Low | Distribution of samples is characterized by no statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | Low | The report provides results, but the underlying data sources are not fully transparent |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Low | The report does not address variability or uncertainty. |

## Overall Quality Determination Low

| | |
|---|---|
| **Study Citation:** | Moseley, C. L. (1980). Health hazard evaluation report no. HHE-79-136-668, Shoreham Nuclear Power Plant, Shoreham, Long Island, New York. |
| **HERO ID:** | 3970482 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Chemical concentration: | Asbestos fibers were also detected in the settled dust sample (1-5% chrysotile). Novatex (pipe-wrapping) (p. 1) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | The assessment or report uses high quality data and/or techniques or sound methods that are from frequently used sources (NIOSH HHEs) and are generally accepted by the scientific community, and associated information does not indicate flaws or quality issues. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | The data are from the United States and are representative of the industry being evaluated. |
| | Metric 3: | Applicability | High | The report is for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Low | The report is more than 20 years old. The report captures operations, equipment, and worker activities that are expected to be outdated. |
| | Metric 5: | Sample Size | Medium | Distribution of samples is characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Assessment or report clearly documents its data sources, assessment methods, results, and assumptions. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | The report provides only limited discussion of the variability and uncertainty in the results. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Moss, C. E., Hurell, J. J., Jr (1994). Health hazard evaluation report no. HETA 92-0319-2459, Howard University, Washington, D.C.. |
| **HERO ID:** | 3970516 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Chemical concentration: | Percent amosite asbestos in steam pipe lagging. [PDF Pg. 17]Room G-024 - Heating Equipment room. Sample collected fromsteam-pipe lagging: 20-25%South Entrance to North Wing. Particles of pipe lagging collectedon ground: 30-35%Room 1026 - Civil Engineering Department Office. Pipe laggingparticles collected from carpet: 40-50%Room 1028 - Photocopy room. Pipe lagging particles collectedfrom carpet: 34-40%Room 1026 - Civil Engineering Department Office. Samplecollected from pile of debris on floor: none detected.Percent amosite in carpeting. [PDF Pg. 18]The need for immediate action was further supported by the finding that debris on the carpet contained 34-50% asbestos. |
| Comments: | Polarized light microscopy (PLM) was used to analyze the bulk material samples according to NIOSH Method 9002. [PDF Pg. 10] |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Methodology | High | Report uses high quality data/techniques/methods from frequently-used sources. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | Data are from the U.S. |
| Metric 3: | Applicability | High | Data are for Chemical Substances in Construction, Paint, Electrical, and Metal Products, an in-scope occupational scenario. |
| Metric 4: | Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| Metric 5: | Sample Size | Medium | Sample distribution characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | High | Uncertainty is addressed by sampling methods. Variability addressed by sampling pipe lagging from multiple areas. |

## Overall Quality Determination **High**

| | |
|---|---|
| **Study Citation:** | Mowat, F., Bono, M., Lee, R. J., Tamburello, S., Paustenbach, D. (2005). Occupational exposure to airborne asbestos from phenolic molding material (Bakelite) during sanding, drilling, and related activities. Journal of Occupational and Environmental Hygiene 2(10):497-507. |
| **HERO ID:** | 3531218 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Chemical concentration: | The phenolic resin contained 31% chrysotile asbestos by weight. (3/12) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | Report uses high quality methods and data from frequently-used sources. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for industrial use in construction materials, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Medium | Report is based on data greater than 10 years old but no more than 20 years old and industry conditions that are expected to be representative of current industry conditions. |
| | Metric 5: | Sample Size | Medium | Sample distribution characterized by limited statistics (concentration) but discrete samples not provided and distribution not fully characterized. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Mowat, F., Weidling, R., Sheehan, P. (2007). Simulation tests to assess occupational exposure to airborne asbestos from asphalt-based roofing products. Annals of Occupational Hygiene 51(5):451-462. |
| **HERO ID:** | 3531219 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Process description: | application of asbestos-containing fibered roof coatings and plastic cements followed by scraping/sanding either shortly after or after roof substrates were cured (simulating product that had been on rooftop for several months); product removal from tools and clothing (abstract); details pg 2-4 |
| Chemical concentration: | asphalt-based roof coatings are typically composed of 5–10% asbestos, and the more viscous roofing cements typically contain 15–20% asbestos... more fluid coating-like materials contained 5–20% asbestos, while heavy mastics contained 15–45% asbestos (pg 1)Table 1 (pg 3) presents chrysotile asbestos content for the 5 products tested, ranging from 3.04-15.5% |

**EVALUATION**

| Domain | | Metric | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | Medium | Report uses high quality data/techniques/methods that are not from frequently-used sources and there are no known quality issues. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for construction materials, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Medium | Report is based on data greater than 10 years old but no more than 20 years old and industry conditions that are expected to be representative of current industry conditions. |
| | Metric 5: | Sample Size | Medium | Sample distribution characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | Variability addressed by providing asbestos concentrations for roof coatings of varying viscosities but uncertainty is not addressed. |

## Overall Quality Determination — High

| | |
|---|---|
| **Study Citation:** | MSHA, (2022). Mine Data Retrieval System (MSHA): Asbestos. |
| **HERO ID:** | 10259534 |
| **Conditions of Use:** | Other: |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Life cycle description: | Mining of talc and vermiculite |
| Number of sites: | All asbestos mines are ”Abandoned”. As of 2022, there are 12 active talc mines and 2 active vermiculite mines in the United States. |

**EVALUATION**

| Domain | | Metric | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | Data on active and abandoned mines is reported from the Mine Safety and Health Administration database, which is a frequently used source with respect to occupational data in the mining industry. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | The data are from the United States and are representative of the industry being evaluated. |
| | Metric 3: | Applicability | High | The report is for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | High | The report captures operations, equipment, and worker activities expected to be representative of current conditions. The report is generally no more than 10 years old. |
| | Metric 5: | Sample Size | High | The status of all known asbestos, vermiculite, and talc mines are provided. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Assessment or report clearly documents results, methods, and assumptions. Data sources are generally described but not fully transparent. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | N/A | Variability and uncertainty with respect to mine activity status is not applicable. |

## Overall Quality Determination — High

| | |
|---|---|
| **Study Citation:** | MSSM, (1982). Disability compensation for asbestos associated disease in the United States. :710. |
| **HERO ID:** | 6895826 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Production, import, or use volume: | from 1890 to 1970 some 25 million tons of asbestos was used in the US approximately 2/3rds for construction. 10,00-20,000 tons of asbestos were applied annually as thermal insulation to pipes, boilers , and other high temp equipment in factories, refineries, power plants and homes. 40,000 tons were used annually in fireproofing. |
| Chemical concentration: | Fireproofing contains 10-20% asnestos |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Methodology | High | US Department of Labor study |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | Predominately US though some data from UK was included ( UK is an OECD member) |
| Metric 3: | Applicability | High | The report is for an occupational scenario (construction materials) within the scope of the risk evaluation. |
| Metric 4: | Temporal Representativeness | Low | 1982 - more than 20 years old |
| Metric 5: | Sample Size | Medium | approximate range of asbestos concentration provided for fireproof material |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | High | Assessment or report clearly documents its data sources, assessment methods, results, and assumptions. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Medium | The report provides some range data that can be useful to assess variability but nothing was provided about uncertainty in the results |

## Overall Quality Determination — High

| | |
|---|---|
| **Study Citation:** | Mukerjee, S., Mukerjee, D., Powers, T. J., Wassermann, O. (1991). Strategy to reduce risk of asbestos in the United States. Journal of Clean Technology and Environmental Sciences 1(3-4):193-207. |
| **HERO ID:** | 3586006 |
| **Conditions of Use:** | Consumer Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Number of sites: | There are 3.5 million buildings in the United States that are included in one of three classes: government buildings, private nonresidential buildings, and residential apartments. About 733,000 of these buildings (20%) contain friable asbestos. (3/16) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | Report uses high quality methods and data from frequently-used sources. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | Low | Data are for office buildings, which is similar to commercial use of construction products. |
| | Metric 4: | Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: | Sample Size | Medium | Sample distribution characterized by limited statistics (number of sites) but discrete samples not provided and distribution not fully characterized. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Mundt, D. J., van Wijngaarden, E., Mundt, K. A. (2007). An assessment of the possible extent of confounding in epidemiological studies of lung cancer risk among roofers. Journal of Occupational and Environmental Hygiene 4:163-174. |
| **HERO ID:** | 3088227 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Production, import, or use volume: | "Asbestos has been used historically as filler in asphalt,(2) between 1965 and 2000, on average about 12% of asbestos available for end-use in the United States was used in roofing products. In 1994, it was estimated that 20% of BUR felts and over 90% of flashings, coatings, cements and mastics on commercial low-sloped roof jobs contained asbestos." (pg 7) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Methodology | High | The assessment or report uses high quality data and/or techniques or sound methods that are from frequently used sources. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | High | Data are from the U.S. |
| | Metric 3: Applicability | High | The report is for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: Sample Size | Low | Distribution of samples is qualitative or characterized by no statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | Medium | Methods, results, and assumptions are clearly documented, but underlying data sources are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Murbach, D., Chapman, P., Madl, A., Paustenbach, D. (2006). Evaluation of background exposures to airborne asbestos on maritime shipping vessels (1972-1992). Epidemiology 17(6):S462-S462. |
| **HERO ID:** | 3586150 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Number of sites: | 53 Ships (including tankers and cargo ships) |
| Chemical concentration: | 245 Bulk samples of insulation 50% were found to contain asbestos above 1% Amosite 1-61%Chrysotile 1-100%Crocidolite 3-10% |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | Medium | The assessment or report uses high-quality data and techniques (PCM and TEM), but the use of NIOSH methods is not documented. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from US shipping vessels. |
| | Metric 3: | Applicability | High | The report is for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Medium | The report is generally more than 10 years, but no more than 20 years old. |
| | Metric 5: | Sample Size | Medium | Distribution of samples is characterized by a range with uncertain statistics. It is unclear if analysis is representative. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | Assessment or report clearly documents its data sources, assessment methods, results, and assumptions. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | Uncertainty is vaguely characterized, and variability is not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Murphy, R. L. H., Ferris, B. G., Jr, Burgess, W. A., Worcester, J., Gaensler, E. A. (1971). Effects of low concentrations of asbestos: clinical, environmental, radiologic and epidemiologic observations in shipyard pipe coverers and controls. New England Journal of Medicine 285(23):1271-1278. |
| **HERO ID:** | 144 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Chemical concentration: | Asbestos blocks were wired to pipes. The blocks were smoothed cement containing 15% asbestos and 85% magnesia and covered with asbestos cloth. (Page 2). |
| Comments: | Amosite was called for most frequently because of its low thermal conductivity, light weight and strength. Chrysotile was used to a lesser extent, and crocidolite was never used. (page 2) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | Medium | The assessment or report uses high quality data and/or techniques or sound methods that are not from a frequently used source and associated information does not indicate flaws or quality issues. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data is from the United States. |
| | Metric 3: | Applicability | High | The data is for exposure to asbestos from cement used and from asbestos in fibrous form. |
| | Metric 4: | Temporal Representativeness | Low | Data is from sampling dated from 1945 to 1966 which is over 20 years old. |
| | Metric 5: | Sample Size | Medium | Distribution of samples is characterized by a range with uncertain statistics. It is unclear if analysis is representative. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Assessment or report clearly documents its data sources, assessment methods, results, and assumptions. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | Variability is addressed by sampling across different years along with multiple samples in different site locations. Uncertainty is not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Murphy, R. L., Levine, B. W., Al-Bazzaz, F. J., Lynch, J. J., Burgess, W. A. (1971). Floor tile installation as a source of asbestos exposure. American Review of Respiratory Disease 104(4):576-580. |
| **HERO ID:** | 3084874 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Products not Described by Other Codes |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Chemical concentration: | An investigation of the work process revealed that under simulated conditions of work, asbestos dust concentrations as large as 1.3 fibers per ml were found in air samples passed through membrane filters worn by a person engaged in sanding vinyl asbestos. |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | Low | The data, data sources, and/or techniques or methods used in the assessment or report are not specified. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | The data are from the United States |
| | Metric 3: | Applicability | High | The report is for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Low | The report is more than 20 years old. |
| | Metric 5: | Sample Size | Low | Distribution of samples is characterized by no statistics. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Low | Report provides results, but the underlying methods, data sources, and assumptions are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | The report does not address variability or uncertainty. |

## Overall Quality Determination Low

| | |
|---|---|
| **Study Citation:** | Nam, I. S., Oh, H. J., Kim, J. M., Yang, J. H., Kim, J. S., Sohn, J. R. (2015). Comparison of risk assessment criteria and distribution of asbestos-containing materials in school building. International Journal of Environmental Research 9(4):1341-1350. |
| **HERO ID:** | 3584319 |
| **Conditions of Use:** | Consumer Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Number of sites: | 15 school buildings (2/10) |
| Chemical concentration: | ACMs contained 2-5 % chrysotile and 2-3% amosite in 60 textile ceilings. Chrysotile was contained from 5% to 8% in the baumlite material of toilet stalls, but asbestos was not detected in floor tiles of schools. (6/10) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Methodology | High | Report uses high quality methods and data from frequently-used sources. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | Medium | Data are from Korea, an OECD country. |
| | Metric 3: Applicability | Low | Data are for school and office workers exposures, which is similar to commercial use of construction products. |
| | Metric 4: Temporal Representativeness | High | Report is based on current industry conditions and data no more than 10 years old. |
| | Metric 5: Sample Size | Medium | Sample distribution characterized by limited statistics (averages, number of samples) but discrete samples not provided and distribution not fully characterized. |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Medium | Variability is addressed by sampling at multiple facilities. Uncertainty isn't addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | (1977). Hazardous Wastes-a Risk-benefit Framework Applied To Cadmium And Asbestos. |
| **HERO ID:** | 1263623 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Production, import, or use volume: | 718,707 tons domestic use307,022 Construction105,244 Felt and paper76,839 Floor tiles70,092 Friction products27,963 Packing and Gaskets17,718 Insulation 7,008 Textiles106,823 Other |
| Throughput: | 15 million metric tons of solid waste incinerated annually |
| Number of sites: | Total 659construction 48Floor tile 18Friction products 30Paper and felt 29Textiles 34Gaskets, packing and insulation 300other 200 |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Methodology | Medium | Information provided was derived from multiple reputable sources. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | High | US |
| | Metric 3: Applicability | High | The report is for an occupational scenario ( Asbestos product manufacture and disposal) within the scope of the risk evaluation. |
| | Metric 4: Temporal Representativeness | Low | 1977 - more than 20 years old |
| | Metric 5: Sample Size | Low | Distribution of samples is qualitative or characterized by no statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | High | Assessment or report clearly documents its data sources. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Low | The report does not address variability or uncertainty. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | (1977). IARC monographs on the evaluation of the carcinogenic risk of chemicals to man: asbestos. 14:1-106. |
| **HERO ID:** | 3084507 |
| **Conditions of Use:** | Other: |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Production, import, or use volume: | 5000 million kg had been mimed by 1930 (cumulative worldwide total) (pg 26)Table 8 (pg 26) presents worldwide production values for 1960, 1970, and 1973-76. Range is 2210-5178 million kg"Most asbestos is used in the construction industry, in general, accounting for two thirds of the usage" (pg 26)Table 9 (pg 28) presents 1974 U.S. PVs by end use for 12 uses as well as for "other" |
| Chemical concentration: | Table 13 (pg 36) presents concentration ranges for various asbestos products, ranging from 5-98% |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Methodology | High | Report uses high quality data/techniques/methods from frequently-used sources (IARC Monograph). |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | Medium | Data are for various countries, including the U.S. and other OECD countries, as well as non-OECD countries. |
| Metric 3: | Applicability | High | Data are for various in-scope occupational scenarios. |
| Metric 4: | Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| Metric 5: | Sample Size | Medium | Sample distribution characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Medium | Variability addressed by evaluating various years/industries. Uncertainty is not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | (1991). Environmental toxins and children : exploring the risks : hearing before the Select Committee on Children, Youth, and Families, One Hundred First Congress, second session. |
| **HERO ID:** | 6866460 |
| **Conditions of Use:** | Consumer Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Number of sites: | Up to 700,000 public and commercial buildings and 44,000 schools contain cancer-causing asbestos that may require removal. (145/180) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | Report uses high quality methods and data from frequently-used sources. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | Low | Data are for consumer use in construction materials, which is similar to the in-scope occupational scenario commercial use of construction materials. |
| | Metric 4: | Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: | Sample Size | Medium | Sample distribution characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | NCBI, (2021). PubChem: Chrysotile. |
| **HERO ID:** | 7594560 |
| **Conditions of Use:** | Other: |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Life cycle description: | Chrysotile asbestos, also called white asbestos, is one of six types of the mineral fiber asbestos. Its use has been banned in 50 countries, including the European Union. However, it is still used in developing countries in asbestos cement building materials. Exposure to chrysotile asbestos can increase the risk of lung disease. An overview is available from the World Health Organization. Chrysotile asbestos is white to grayish green thin, flexible curved fiber. It can also be slightly tan colored. Chrysotile asbestos is the most common form of asbestos. It is slightly soluble in water. Asbestos minerals in general do not have an odor or taste. Chrysotile asbestos is mined from deposits in Russia, China, Brazil, Kazakhstan and Canada. USE: Chrysotile asbestos is still used in some parts of the world in cement building materials. Chrysolite fibers had been used in paper and plastic products. [PDF Pg. 14] |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Methodology | High | Report uses high quality data/techniques/methods from frequently-used sources. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | High | Data are from the U.S. |
| | Metric 3: Applicability | High | Data are general and applicable to all in-scope occupational scenarios. |
| | Metric 4: Temporal Representativeness | High | Report is based on current industry conditions and data no more than 10 years old. |
| | Metric 5: Sample Size | N/A | N/A - Life cycle description, particle size characterization, and physical form. |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | N/A | N/A - Life cycle description, particle size characterization, and physical form. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | NCDOL, (2013). A guide to asbestos for industry. |
| **HERO ID:** | 3982247 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Chemical concentration: | Insulation can contain 6-15% asbestos. Cement products can be 8-50% asbestos. Paper products can be 35-90% asbestos. Roofing can be 1-15% asbestos. Building textiles can be 50-100% asbestos. |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | Report uses high quality methods and data from frequently-used sources. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for commercial use in construction materials, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | High | Report is based on current industry conditions and data no more than 10 years old. |
| | Metric 5: | Sample Size | Medium | Sample distribution characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | Variability is addressed by including the bulk concentrations for different types of building materials. Uncertainty isn't addressed. |

## Overall Quality Determination — High

| | |
|---|---|
| **Study Citation:** | NFPA, (2022). US Fire Department Profile 2020. |
| **HERO ID:** | 11133512 |
| **Conditions of Use:** | Other: |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Number of sites: | All-career departments: 2,785Mostly-career departments: 2,459All-volunteer departments: 18,873Mostly-volunteer departments: 5,335 |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | Statistics are provided from the National Fire Protection Association and are expected to be accurate. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | The data are from the United States and are representative of the industry being evaluated. |
| | Metric 3: | Applicability | High | The report is for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | High | Data are from 2020. |
| | Metric 5: | Sample Size | High | Sample size is sufficiently representative. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | Assessment or report clearly documents its data sources, assessment methods, results, and assumptions. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | High | Uncertainty and variability are well characterized. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Nicholson, W. J. (1998). Global analysis of occupational and environmental exposure to asbestos. People and Work: Research Reports, vol. 19 :1-5. |
| **HERO ID:** | 6873918 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Production, import, or use volume: | import and production volume:1994: 29,000 tonnes (Table 3) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | Medium | The assessment or report uses high quality data and/or techniques or sound methods that are not from a frequently used source and associated information does not indicate flaws or quality issues. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Medium | The data are from an OECD country other than the U.S., and locality-specific factors (e.g., potential differences in regulatory occupational exposure or emission limits, industry/ processtechnologies) may impact exposures or releases relative to the U.S. |
| | Metric 3: | Applicability | Uninformative | The report is from an occupational or non-occupationalscenario that does not apply to any occupational scenario within the scope of the risk evaluation |
| | Metric 4: | Temporal Representativeness | Low | The report is more than 20 years old. The report captures operations, equipment, and worker activities that are expected to be outdated. |
| | Metric 5: | Sample Size | N/A | n/a - no sampling data |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | Assessment or report clearly documents its data sources, assessment methods, results, and assumptions. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | The report provides only limited discussion of the variability and uncertainty in the results. |

## Overall Quality Determination Uninformative

| | |
|---|---|
| **Study Citation:** | Nicholson, W. J., Rohl, A., Fischbein, S. A., Selikoff, I. J. (1975). Occupational and community asbestos exposure from wallboard finishing compounds. Bulletin of the New York Academy of Medicine 51(10):1180-1181. |
| **HERO ID:** | 3583525 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Chemical concentration: | An analysis of consumer spackling compounds showed that three contained from 6 to 10% chrysotile. (2/2) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | Medium | Report uses high quality data that are not from frequently-used sources and there are no known quality issues. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for commercial use of building construction materials, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: | Sample Size | Medium | Sample distribution characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Low | Assessment results are provided but underlying methods, assumptions, and data sources are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Medium

**Study Citation:** NICNAS, (1999). Chrysotile asbestos: priority exisiting chemical no. 9.
**HERO ID:** 3978350
**Conditions of Use:** Other:

**EXTRACTION**

| Parameter | Data |
|---|---|
| Production, import, or use volume: | peak production in Australia occurred in 1970s at 400,000 tons, importation peaked at 15,000 tons in 1985 just after production in Australia ceased in 1983. |
| Process description: | Manufacture of compressed asbestos fibre sheeting (CAF) and gasketsCompressed asbestos fibre (CAF) sheeting, using raw chrysotile, is manufactured in Australia. The majority of the CAF sheeting is then exported and the remainder processed into finished cut gaskets (for use in industrial applications).Bags of raw chrysotile are inspected to ensure there are no broken bags. If broken, the bags are sealed by operators and immediately consumed in the manufacturing process. Where necessary, the surrounding area is vacuumed using high efficiency cleaners. The polyethylene bag is removed from the raw chrysotile using a debagging machine, which is enclosed and under negative pressure. The machine disposes of the chrysotile containing bag automatically into a fresh sealed plastic bag. The sealed bag is then removed from the machine manually.The production of CAF sheets is a closed process. The chrysotile fibres are transferred under negative pressure through conduits attached to the bagging machine to the hammer mill, where the fibres are milled and introduced into a mixing machine via a closed loop system. The fibres are then encapsulated by combining with various grades of rubber to form a wet mash, which is then passed through a calendering machine to form CAF sheets.The CAF sheets are then printed and trimmed using knife action tooling, for example, a guillotine. The CAF sheets are cut to size using knife bladed tools. For spiral wound gasket production, imported rolls of asbestos filler material are slit using a rotary die block. The slit material is then wound between alternate layers of stainless steel. The finished goods are stored prior to packing for distribution to customers.Gasket off-cuts also undergo secondary manufacturing. These off-cuts are recycled for further use.Gasket cutting from CAF is carried out by other workshops.Manufacture of Epoxy resin adhesivesChrysotile is used as a 'non-sag' additive in the formulation of an epoxy resin adhesive for affixing marble and granite panels to the walls of buildings.Chrysotile is imported in compressed form in 15 kg paper bags, wrapped in plastic. Approximately 500 bags are imported in a shipping container which is stored on site.The liquid ingredients are first added to the mixer. Bags containing chrysotile are manually opened, the chrysotile weighed and then added to the mixing vessel. A lid is placed on the vessel which is exhaust ventilated. Mixing takes approximately one hour. The product is a thick paste and is mechanically forced out of the vessel using a plunger. The product is produced in batches for approximately 50% of the year. It is packaged in 2, 4 or 20 litre plastic buckets.Any spills or loose asbestos released during cutting are collected during vacuuming and waste is disposed of in drums to a licensed contractor. |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Methodology | High | Australian National Industrial Chemicals Notification and Assessment Scheme |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | Medium | Australia - OECD member |
| | Metric 3: Applicability | Uninformative | The data are for an occupational scenario (gasket manufacture) that is not within scope of the legacy asbestos risk evaluation. |
| | Metric 4: Temporal Representativeness | Low | 1999 more than 20 years old |
| | Metric 5: Sample Size | N/A | Qualitative information provided about process |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | High | Report clearly documents its data sources, assessment methods, results, and assumptions. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | N/A | Qualitative information provided about process |

**Continued on next page . . .**

. . . continued from previous page

**Study Citation:** NICNAS, (1999). Chrysotile asbestos: priority exisiting chemical no. 9.
**HERO ID:** 3978350
**Conditions of Use:** Other:

| | | EVALUATION | |
|---|---|---|---|
| Domain | Metric | Rating | Comments |
| **Overall Quality Determination** | | **Uninformative** | |

| | |
|---|---|
| **Study Citation:** | NIH, (2016). Report on carcinogens: Asbestos. |
| **HERO ID:** | 3982328 |
| **Conditions of Use:** | Other: |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Production, import, or use volume: | U.S. asbestos consumption declined from a maximum of 803,000 metric tons (1.8 billion pounds) in 1973 to 715 metric tons (1.6 million pounds) in 2009 (USGS 2009, 2010). [PDF Pg. 2] |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Methodology | High | Report uses high quality [data/techniques/methods] from frequently-used sources. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | High | Data are from the U.S. |
| | Metric 3: Applicability | High | Data are for all conditions of use. |
| | Metric 4: Temporal Representativeness | Low | Actual data is more than 20 years old. |
| | Metric 5: Sample Size | Low | Sample distribution is characterized by no statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Medium | Variability addressed by use volumes from multiple years but uncertainty is not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | NIOSH, (1984). Health hazard evaluation report: HETA-82-102-1464. University Of Cincinnati, Cincinnati, Ohio. 82-102-1464:1-35. |
| **HERO ID:** | 3646739 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Number of sites: | 1 (Department of Electrical and Computer Engineering, University of Cincinnati Semi-conductor laboratory, Cincinnati, Ohio) |
| Chemical concentration: | Analysis of the three bulk samples collected from the internal walls of fume hoods showing signs of deterioration indicate an asbestos content of 20 to 50% chrysotile. [PDF Pg. 14] |
| Comments: | Sample collected with PL Microscopy. |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Methodology | High | Report uses high quality data/techniques/methods from frequently-used sources. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | High | Data are from the U.S. |
| | Metric 3: Applicability | High | Data are for Chemical Substances in Construction, Paint, Electrical, and Metal Products, an in-scope occupational scenario. |
| | Metric 4: Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: Sample Size | Medium | Distribution of samples is characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | NIOSH, (1980). Health hazard evaluation determination report no HE 79-141-711 Fischer and Porter Company Warminster Pennsylvania. |
| **HERO ID:** | 4158116 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Chemical concentration: | Bulk sample: 50% asbestos by volume |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | The assessment or report uses high quality data and/or techniques or sound methods that are from frequently used sources. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | The data are from the United States and are representative of the industry being evaluated. |
| | Metric 3: | Applicability | High | The report is for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Low | The report is more than 20 years old. |
| | Metric 5: | Sample Size | N/A | No sample data. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Assessment or report clearly documents results, methods, and assumptions. Data sources are generally described but not fully transparent. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | The report does not address variability or uncertainty. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Nolan, R. P., Langer, A. M. (2001). Concentration and type of asbestos fibers in air inside buildings. Canadian Mineralogist, special issue 5 :39-51. |
| **HERO ID:** | 6874316 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Number of sites: | EPA in 1984 estimates 10% of 3.2 million commercial, non-residential buildings contain asbestos (p. 2)12 sites sampled (p. 5) |
| Chemical concentration: | Fireproofing contains 25% amosite asbestos (p. 2) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | Medium | The assessment or report uses high quality data and/or techniques or sound methods that are not from a frequently used source and associated information does not indicate flaws or quality issues. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Medium | The data are from an OECD country other than the U.S ., and locality-specific factors (e.g., potential differences in regulatory occupational exposure or emission limits, industry/ processtechnologies) may impact exposures or releases relative to the U.S. |
| | Metric 3: | Applicability | High | The report is for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Low | The report is more than 20 years old. The report captures operations, equipment, and worker activities that are expected to be outdated. |
| | Metric 5: | Sample Size | Medium | Distribution of samples is characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Assessment or report clearly documents results, methods, and assumptions. Data sources are generally described but not fully transparent. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | The report provides only limited discussion of the variability and uncertainty in the results. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Novick, L. F., Rice, C., Freedman, M. A., Jillson, D. (1981). ASBESTOS IN VERMONT SCHOOLS - FINDINGS OF A STATEWIDE ON-SITE INVESTIGATION. American Journal of Public Health 71(7):744-746. |
| **HERO ID:** | 3583553 |
| **Conditions of Use:** | Consumer Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Number of sites: | Asbestos materials were found in 251 schools in Vermont. (1/3) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | Report uses high quality methods and data from frequently-used sources. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | Low | Data are for consumer use of construction materials, which is similar to commercial use of construction materials, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: | Sample Size | Medium | Sample distribution characterized by limited statistics (number of sites) but discrete samples not provided and distribution not fully characterized. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Oberta, A. F. (2005). Standards for asbestos control: A holistic approach to managing a health hazard. Standardization News 33(5):20-23. |
| **HERO ID:** | 6865544 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Chemical concentration: | According to a publication of an asbestos producer's trade association, 85 to 90 percent of the chrysotile (the most common form of asbestos) fiber is used in cement products. [PDF Pg. 4] |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | Medium | Report uses high quality data/techniques/methods that are not from frequently-used sources and there are no known quality issues. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for Chemical Substances in Construction, Paint, Electrical, and Metal Products, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Medium | Report is based on data greater than 10 years old but no more than 20 years old and industry conditions that are expected to be representative of current industry conditions. |
| | Metric 5: | Sample Size | Medium | Distribution of samples is characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Methods, results, and assumptions are clearly documented, but underlying data sources are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | The report does not address variability or uncertainty. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Oberta, A. F. (2005). Operations and maintenance-living with asbestos. ASTM International Manual Series :87-97. |
| **HERO ID:** | 6881657 |
| **Conditions of Use:** | Other: |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Process description: | After a task order or work order is issued, the participants review the procedure, assemble the necessary equipment and materials, and prepare the work site. Area preparation is not as extensive as for an abatement project, but items must still be protected from contamination by water and debris. Some procedures and regulations for using glove bags, for example, require "pre-cleaning" the work area and placing a layer of 6-mil (0.15 mm) plastic underneath the glove bag during the work. During the work, workers use water to wet debris and remove and/or repair asbestos insulation. After the work, the area must be thoroughly cleaned, and air samples are taken for final clearance. (3/11) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Methodology | High | Report uses high quality methods and data from frequently-used sources. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | Data are from the U.S. |
| Metric 3: | Applicability | High | Data are for demolition of asbestos products, an in-scope occupational scenario. |
| Metric 4: | Temporal Representativeness | Medium | Report is based on data greater than 10 years old but no more than 20 years old and industry conditions that are expected to be representative of current industry conditions. |
| Metric 5: | Sample Size | N/A | N/A - This metric is not applicable to the data being extracted |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Medium | Variability is addressed by listing different removal procedures. Uncertainty isn't addressed. |

## Overall Quality Determination — High

| | |
|---|---|
| **Study Citation:** | Oberta, A. F., Fischer, K. E. (1999). Negative exposure assessments for asbestos floor tile work practices. American Society for Testing and Materials Special Technical Publication, no. 1342 :193-208. |
| **HERO ID:** | 6874239 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Chemical concentration: | [PDF Pg. 4]1996 Floor Tile: 14% chrysotile by PLM method; 13-16% chrysotile by TEM method.1996 Mastic: 8% chrysotile by PLM method.1990 Floor tile: 5-15% chrysotile by PLM method.1990 Mastic: 30-50% chrysotile by PLM. |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | Medium | Report uses high quality data/techniques/methods that are not from frequently-used sources and there are no known quality issues. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for Chemical Substances in Construction, Paint, Electrical, and Metal Products, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: | Sample Size | Medium | Sample distribution characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | High | Variability is addressed by measuring floor tile and mastic concentrations from 1990 and 1996. uncertainty addressed by using PLM and TEM methods. |

## Overall Quality Determination **High**

| | |
|---|---|
| **Study Citation:** | Obminski, A. (2020). Asbestos in building and its destruction. Construction and Building Materials 249(Elsevier):118685. |
| **HERO ID:** | 6884598 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Chemical concentration: | Percentage of asbestos in the handled insulation, panels, corrugated sheets, pipe wrapping, ceilings, and boards was 13 to >90%. Table 7 has more individual data for each material. (7/14) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Methodology | High | Report uses high quality methods and data from frequently-used sources. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | Medium | Data are from Poland, an OECD country. |
| | Metric 3: Applicability | High | Data are for commercial use in building construction materials, an in-scope occupational scenario. |
| | Metric 4: Temporal Representativeness | High | Report is based on current industry conditions and data no more than 10 years old. |
| | Metric 5: Sample Size | Medium | Sample distribution characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | High | Uncertainty is addressed in a paragraph regarding measurement uncertainty. Variability is addressed by sampling many asbestos containing materials. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | OECD, (2009). Emission scenario document on adhesive formulation. |
| **HERO ID:** | 3827299 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Products not Described by Other Codes |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Production, import, or use volume: | The total U.S. adhesive production in 1999 was estimated at approximately 15 billion pounds, and was anticipated to grow by 2 billion pounds by 2004 (pg 21 of 168) |
| Process description: | This ESD focuses on the formulation of an adhesive product. Adhesives are formulated by mixing together volatile and nonvolatile chemical components, such as binders and components in sealed, unsealed, or heated processes. The specific formulation process used depends on the type of adhesive being produced (pg 24 of 168). Because many adhesives are designed to set or react when exposed to ambient conditions, most are formulated in a sealed process. Typically, solid or liquid adhesive binders and components are unloaded from transport containers (tank trucks, totes, drums, sacks) either directly into the mixing equipment or into intermediate storage tanks. If the component is in the solid/powdered form, it is assumed that some amount of the component will be lost during the transfer as dusts released into the workspace air that will be subsequently vented to the air outside of the facility or settle out within the workspace. Dusts that collect on vent filters or within the workspace are collected and disposed. In a sealed process, the mixing occurs with no direct contact from the workers in closed vessels. Typically, a high-speed dispenser combines the components using precise settings to avoid overstirring, which may adversely affect the viscosity and other properties of the adhesive. It is assumed that the sealed system captures the volatile components released during the mixing process and vents them through a stack to air outside the facility (pg 24 of 168). Adhesives may also be formulated in an unsealed process in which the tanks and transfer operations are open. It is expected that solution adhesives containing low-volatility solvents (i.e., water-based adhesive dispersions) or other components that are relatively stable under ambient conditions are formulated using open mixing tanks and transfer operations (pg 27 of 168). Adhesives may also be formulated in an unsealed process in which the components are melted and mixed into a molten liquid adhesive product, and subsequently extruded, poured, or otherwise formed into a solid hot-melt adhesive product when cooled (pg 29 of 168). |
| Throughput: | Table 3.2 (pg 43 of 168) shows the average annual facility production rate of adhesives which is 17 million kg/site-yr for large 50 sites and 1.6 million kg/site-yr for other 542 sites. |
| Number of sites: | According to the 2003 County Business Patterns data, 592 establishments within the United States were classified within the NAICS code of 32552 and employed a total of 21,048 workers (pg 21 of 168) |
| Chemical concentration: | Table 3-3 (pg 50 of 168) presents the general formulation data for adhesive products as follows (as weight fraction of adhesive components): Elastomer or adhesive products - 0.11-0.85; Solvent - 0.01-0.75; Viscosity control - 0.002-0.4; Pigment - 0.02-0.36; Tackifier - 0.02-0.35; Filler - 0.33-0.35; plasticizer - 0.01-0.2; Stabilizer - 0.01-0.03; Preservative - 0.001-0.01; Antioxidant - 0.001-0.01; Surfactant - 0.001-0.005 |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Methodology | High | report uses high quality data |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | The data are from the United States |
| Metric 3: | Applicability | High | The report is for an occupational scenario |
| Metric 4: | Temporal Representativeness | Medium | The report is generally more than 10 years but no more than 20 years old. |
| Metric 5: | Sample Size | Low | Distribution of samples is characterized by no statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | High | report clearly documents its data sources |
| Domain 4: Variability and Uncertainty | | | |

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| | |
|---|---|
| **Study Citation:** | OECD, (2009). Emission scenario document on adhesive formulation. |
| **HERO ID:** | 3827299 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Products not Described by Other Codes |

| | | | EVALUATION | |
|---|---|---|---|---|
| Domain | | Metric | Rating | Comments |
| | Metric 7: | Metadata Completeness | Low | The report does not address variability or uncertainty. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Oehlert, G. W., Lee, R. J., Vanorden, D. (1995). STATISTICAL-ANALYSIS OF ASBESTOS FIBER COUNTS. Environmetrics 6(2):115-126. |
| **HERO ID:** | 3583209 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Number of sites: | 921 asbestos measurements at 177 public schools. These data are part of a larger set which also included 28 commercial buildings, 78 university buildings and 32 public buildings |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | Medium | The assessment or report uses high quality data and/or techniques or sound methods that are not from a frequently used source and associated information does not indicate flaws or quality issues. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | The data are from the United States and are representative of the industry being evaluated. |
| | Metric 3: | Applicability | High | The report is for an occupational scenario within the scope of the risk evaluation. (Asbestos removal) |
| | Metric 4: | Temporal Representativeness | Low | The report is more than 20 years old. The report captures operations, equipment, and worker activities that are expected to be outdated. |
| | Metric 5: | Sample Size | Medium | Distribution of samples is characterized by a range with uncertain statistics. It is unclear if analysis is representative. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Assessment or report clearly documents results, methods, and assumptions. Data sources are generally described but not fully transparent. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | The report provides only limited discussion of the variability and uncertainty in the results. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Okawa, M. T. (1972). Health hazard evaluation report no. HHE 72-24, Filtering Materials Corporation, Richmond, California. |
| **HERO ID:** | 3970513 |
| **Conditions of Use:** | Other: |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Process description: | Sparkolloid Area-> Batching Area->Extractor->Die cutting-> FiberizerSparkolloid Area: One small mixing operation is located in this area of the plant. Diatomaceous earth is combined with other materials tomake a powdered filtering substance. The ingredients are loaded by hand into barrels and mixed by a machine which rotates them. During the hand loading and bagging sequences of the operation, dust can be generated. (page 4)Batching area: The first step in the filter manufacturing process takes place in this area of the plant. Raw cellulose and asbestos fibers are mixed in a large holding tank. Water, hydrochloric acid, and organic resins are added to the mix. This slurry is then pumped to the extractor machine. The asbestos portion of the solid fraction of the slurry ranges from 0 to 100 per cent (page 4)Extractor: The liquid portion of the slurry is removed by the extractor. At the same time, the solid portion is laid into sheets by the extractor and dried by flame heat. The sheets are cut and stacked in different sizes during the last step of the extractor operation. (page 4)Die Cutting : The sheets of filter material are cut to customers' specifications by the "die cutter" who operates the die cutting machine manually. The machine is enclosed partially and local exhaust ventilation is available. After the filters are cut, they are inspected, branded, and packed for shipment. (page 5)Fiberizer: The waste materials are reclaimed instead of being discarded. The waste asbestos filters are loaded manually into a fiberizer where they are shredded and loaded into sacks. The potential for excess airborne asbestos dust is greatest in the fiberizer area . The machine is run from 5 to 10 days per month. One worker operates the fiberizer and another one assists him by bagging the shredded material. (page 5) |
| Chemical concentration: | The asbestos portion of the solid fraction of the slurry ranges from 0 to 100 per cent (page 4) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Methodology | High | The assessment or report uses high quality data and/or techniques or sound methods that are from frequently used sources. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | High | The data are from the United States. |
| | Metric 3: Applicability | Uninformative | Data are for manufacture of filter materials, which is not in-scope for the legacy asbestos risk evaluation. |
| | Metric 4: Temporal Representativeness | Low | The report is more than 20 years old. |
| | Metric 5: Sample Size | Medium | Distribution of samples is characterized by a range with uncertain statistics. It is unclear if analysis is representative. |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | High | Assessment or report clearly documents its data sources, assessment methods, results, and assumptions. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Medium | The report provides only limited discussion of the variability and uncertainty in the results. |

## Overall Quality Determination Uninformative

| | |
|---|---|
| **Study Citation:** | Olin Chemicals, (1993). Industrial hygiene survey at Olin Chemical Plant. |
| **HERO ID:** | 4158386 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Process description: | use of insulation in production areas - page 3 |
| Chemical concentration: | 40% and 45% amosite asbestos concentration - table II page 6 |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | Low | Sampling/analytical methodology is not specified. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for Chemical Substances in Construction, Paint, Electrical, and Metal Products (specifically insulation), an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Monitoring data are greater than 20 years old.(1987) |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Sample type and exposure type provided but missing sample duration, worker activities, exposure duration, and exposure frequency |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | Uncertainty is addressed in sampling/analytical methodology but variability is not addressed. |

## Overall Quality Determination **Medium**

| | |
|---|---|
| **Study Citation:** | Oliver, L. C. (1998). Asbestos in building: Management and related health effects. Journal of Clean Technology, Environmental Toxicology, and Occupational Medicine 7(4):433-443. |
| **HERO ID:** | 3092160 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Production, import, or use volume: | over 90% of the asbestos solid in the U.S. has been chrysotile (pg 5) |
| Number of sites: | EPA survey: Approximately 20% (733,000) of building in U.S. contain friable asbestos; asbestos is in sprayed-on or trowelled-on form in 5% of buildings, and in pipe and boiler insulation in 16% of buildings; of the asbestos identified, 70% was in pipe and boiler insulation, 14% in sprayed-on or trowelled-on material, and 3% in ceiling tile (pg 3) |
| Chemical concentration: | Pg 2:floor tile: 20%; corrugated pipe wrap: 80%; preformed pipe wrap: 50%; sprayed-on and trowelled-on insulation: 50 and 70% respectively;boiler insulation: 10% |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Methodology | Medium | Report uses high quality data/techniques/methods that are not from frequently-used sources and there are no known quality issues. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | Data are from the U.S. |
| Metric 3: | Applicability | High | Data are for construction materials, an in-scope occupational scenario. |
| Metric 4: | Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| Metric 5: | Sample Size | Medium | Sample distribution characterized by limited statistics (assumed means) but discrete samples not provided and distribution not fully characterized. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Medium | Methods, results, and assumptions are clearly documented, but underlying data sources are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Medium | Variability is addressed by providing data for different types of asbestos construction materials but uncertainty is not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | OU, (2022). Weight of wall and partitions in (psf). |
| **HERO ID:** | 11138833 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Throughput: | Asbestos-Cement 4 (psf)Slate roofing - 15 lb/sq ftWood shingle/shake - 3 lb/sq ft |

**EVALUATION**

| Domain | | Metric | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | Medium | The assessment or report uses high quality data and/or techniques or sound methods that are not from a frequently used source and associated information does not indicate flaws or quality issues. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | The data are from the United States. |
| | Metric 3: | Applicability | High | The data are for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | High | The data is generally no more than 10 years old. |
| | Metric 5: | Sample Size | N/A | N/A - This metric is not applicable to the data being extracted |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Low | Assessment or report provides results, but the underlying methods, data sources, and assumptions are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | The report does not address variability or uncertainty. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Paglietti, F., Malinconico, S., Di Molfetta, V., Bellagamba, S., Damiani, F., Gennari, F., De Simone, P., Sallusti, F., Giangrasso, M. (2012). Asbestos risk: From raw material to waste management: The Italian experience. Critical Reviews in Environmental Science and Technology 42(17):1781-1861. |
| **HERO ID:** | 3582178 |
| **Conditions of Use:** | Disposal |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Process description: | Superfund site remediationCleaning process- Goods on pallets were placed in area 1 and subsequently cleaned of the dust that had deposited on them using special aspiration equipment fitted with absolute HEPA filters and eventually their protective PVC wrapping was removed.- In area 2 the pallets were encapsulated.- In area 3 they were re-wrapped.- In area 4 they underwent provisional stacking awaiting analysis by the competent bodies.- Area 5 was used to stack goods that were no longer contaminated and could be retrieved for use (sale) pending collection and transfer to their final destination.- Remediation wastewater was filtered before being released into the sewer system.Remediation of asbestos concrete manufacture plant- first removal of hazardous and nonhazardous waste (piles and bags containing asbestos powder) located inside the buildings;- Removal and disposal of asbestos wastes from the industrial cycle, cemented using industrial devices;- Removal and disposal of all the silos and machinery present inside the plant heavily contaminated by asbestos dust;- Removal and disposal of all horizontal and vertical partitions and roofing in asbestos concrete material (Eternit);- Removal and disposal of asbestos pipelines;- Emergency action on asbestos contaminated soil using special capping techniques. For the unpaved yard area, inside the plant perimeter, the following were performed: Soil leveling; Building of a retaining wall along the perimeter about 50 cm high with a linked HDPE layer; Installation of drainage pipes to manage the surface water flow; Placement of a proper gravel layer to allow the transit of light mechanical transport vehicles.- Decontamination of the whole area;- Final encapsulation.During all operational phases, the following complementary operations were carried out for each single subarea:- Decontamination of workers using a dedicated four-step decontamination unit (contaminated equipment area, shower area, air lock, and clean area);- Decontamination of materials removed using a special three-step decontamination unit (bag washing area, packing area, removal area);- Decontamination of polluted wastewaters used to clean devices, materials, packaging, and workers using a specific treatment and collection unit;- Campaign of environmental and personal monitoring of airborne asbestos fibers using various fixed and portable samplers, at low and high flow rates, and subsequent analysis with SEM and PCOM techniques; - Formal validation of all the work by public surveillance bodies.For Marine Area:- In order to carry out operations in safety conditions, a preliminaryinvestigation was conducted to identify any buried, unexploded military devices.- A ban was imposed on swimming in the area.- Dedicated mechanical devices (underwater excavator, air suction systems) and of specialized divers was decided.- A mobile underwater barrier of big bags filled with sand and marker buoys was set up to be gradually moved around the remediation area.- Residual banks were removed using an underwater excavator.- Local on site inspection and removal of any remaining small-size materials.- Removal of all the sediments using a manual aspiration pipe around the piles already submitted to mechanical removal and all over the site.- Environmental monitoring of asbestos fibers by atmospheric dispersion analysis with PCOM (for personal sampling in working areas) and SEM (for environmental sampling).- Specific monitoring planning through biological and environmental assessments of the marine environment (VEGAM project). |
| Number of sites: | Italy 57 superfund sites - 10 sites where asbestos is the primary pollutant of concern |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | The assessment or report uses high quality data and/or techniques or sound methods that are from frequently used sources: European Union |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Medium | Italy - OECD member |
| | Metric 3: | Applicability | High | The report is for an occupational scenario (super fund remediation) within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | High | 2012 - after PEL and 10 years old. |
| | Metric 5: | Sample Size | N/A | Information provided concerns process and number of sites. |

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|---|---|
| **Study Citation:** | Paglietti, F., Malinconico, S., Di Molfetta, V., Bellagamba, S., Damiani, F., Gennari, F., De Simone, P., Sallusti, F., Giangrasso, M. (2012). Asbestos risk: From raw material to waste management: The Italian experience. Critical Reviews in Environmental Science and Technology 42(17):1781-1861. |
| **HERO ID:** | 3582178 |
| **Conditions of Use:** | Disposal |

| | | EVALUATION | |
|---|---|---|---|
| Domain | Metric | Rating | Comments |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | High | Assessment or report clearly documents its data sources, assessment methods, results, and assumptions. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | N/A | Information provided concerns process and number of sites. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Paglietti, F., Malinconico, S., Di Molfetta, V., Giangrasso, M. (2012). Guidelines for asbestos remediation at Italian superfund sites. Journal of Environmental Science and Health, Part C: Environmental Carcinogenesis & Ecotoxicology Reviews 30(3):253-286. |
| **HERO ID:** | 3541115 |
| **Conditions of Use:** | Other: |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Production, import, or use volume: | "From 1970 to 2008 the use of asbestos in the world fell from around 5 million metric tons per year to 2.1 million metric tons [2-4]. The current leading producer of asbestos worldwide is Russia, which has mines rich enough in asbestos deposits to last for more than 100 years at current output levels [5]. Most of the 925,000 tons of asbestos extracted annually in Russia are exported. The others main producers of asbestos are China, Kazakhstan, Brazil, Canada, Zimbabwe, and Colombia. These 7 countries account for about 96% of world asbestos production. More than 85% of world production of asbestos is used today to manufacture products in Asia and Eastern Europe [3]." (pg 3) |
| Comments: | Primarily guidelines and regulations for asbestos remediation in Italy |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Methodology | Medium | Report uses high quality information that are not from frequently-used sources and there are no known quality issues. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | Medium | Data are from Italy, an OECD country. |
| Metric 3: | Applicability | High | Data are for manufacturing and disposal occupational exposure scenarios, which are in-scope occupational scenarios. |
| Metric 4: | Temporal Representativeness | Medium | Report is based on data greater than 10 years old but no more than 20 years old and industry conditions that are expected to be representative of current industry conditions. |
| Metric 5: | Sample Size | N/A | N/A - This metric is not applicable to the data being extracted |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Medium | Methods, results, and assumptions are clearly documented, but underlying data sources are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Paglietti, F., Malinconico, S., Di Molfetta, V., Giangrasso, M. (2012). Guidelines for asbestos remediation at Italian superfund sites. Journal of Environmental Science and Health, Part C: Environmental Carcinogenesis & Ecotoxicology Reviews 30(3):253-286. |
| **HERO ID:** | 3541115 |
| **Conditions of Use:** | Disposal |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Process description: | "Waste containing asbestos must be deposited directly in the disposal site in specially and exclusively dedicated cells, avoiding the crushing of materials. The cells must be built using systems that entail the creation of sectors or pits. They must be spaced to allow vehicles to pass without causing the crushing of waste containing asbestos" as regulatory description of asbestos disposal in Italy (pg 13) |
| Comments: | Primarily guidelines and regulations for asbestos remediation in Italy |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | Medium | Report uses high quality information that are not from frequently-used sources and there are no known quality issues. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Medium | Data are from Italy, an OECD country. |
| | Metric 3: | Applicability | High | Data are for manufacturing and disposal occupational exposure scenarios, which are in-scope occupational scenarios. |
| | Metric 4: | Temporal Representativeness | Medium | Report is based on data greater than 10 years old but no more than 20 years old and industry conditions that are expected to be representative of current industry conditions. |
| | Metric 5: | Sample Size | N/A | N/A - This metric is not applicable to the data being extracted |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Methods, results, and assumptions are clearly documented, but underlying data sources are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Palluzi, R. P. (1988). Asbestos removal need not be daunting. Chemical Engineering 95(12):95-99. |
| **HERO ID:** | 6867199 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Process description: | Asbestos removal plan1.) physical survey to estimate asbestos amount and type2.) develop a hazard assessment for each area3.) develop plan and timeline for removal4.) hire contractor5.) perform ambient air monitoring during removal |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | The assessment or report uses high quality data and/or techniques or sound methods that are from frequently used sources (journalarticles) and are generally accepted by the scientific community, and associated information does not indicate flaws or quality issues. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | The data are from the United States and are representative of the industry being evaluated. |
| | Metric 3: | Applicability | High | The report is for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Low | The report is more than 20 years old. The report captures operations, equipment, and worker activities that are expected to be outdated. |
| | Metric 5: | Sample Size | N/A | n/a - no sampling conducted |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | Assessment or report clearly documents its data sources, assessment methods, results, and assumptions. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | The report provides only limited discussion of the variability and uncertainty in the results. |

## Overall Quality Determination **High**

| | |
|---|---|
| **Study Citation:** | Panahi, D., Kakooei, H., Marioryad, H., Mehrdad, R., Golhosseini, M. (2011). Evaluation of exposure to the airborne asbestos in an asbestos cement sheet manufacturing industry in Iran. Environmental Monitoring and Assessment 178(1-4):449-454. |
| **HERO ID:** | 2581637 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Production, import, or use volume: | PV is listed but is for Iran not the US. In 2007, Iran imported 55,000 tons of Chrysotile asbestos per year and asbestos cement plants contribute nearly 94% of the total national usage. 30,000 tons of chrysotile is annually used to produce asbestos cement sheets.(pages 1 and 2 of 6)The Iran factory studied produced 60,000 tons of asbestos cement sheets annually (page 2 of 6). Iran uses 3-4% of global asbestos (page 4 of 6). |
| Process description: | Asbestos cement sheets were manufactured by a wet process. The factor had the following major processes:1) feeding of raw materials (20% chrysotile, 80% cement)2) mixing - mix is weighted and water is added to make slurry. 3) molding of sheets - mix is charged into molds4) Unloading car5) cutting6) drilling7) sheet storageThe AC sheets are manufactured by mixing chrysotile fibers and cement in a wet process. In the process, the mixture is weighted, and water is added to the mixture for making slurry. The mixture is charged into molds during the steam process. Asbestos cement sheets production requires large numbers of finishing machines such as cutting and drilling equipment to make the end products. At the end of the process, AC products are transported by lift truck. (page 2 of 6) |
| Chemical concentration: | Scanning electron microscopy (SEM) demonstrated that fibrous particles consisted of 55.89% Chrysotile and 44.11% Amphiboles. (page 5 of 6) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | The assessment or report uses high quality data and/or techniques or sound methods that are from frequently used sources |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Low | Data are from Iran, a non-OECD country. |
| | Metric 3: | Applicability | High | Data are for industrial use of asbestos in cement manufacturing. |
| | Metric 4: | Temporal Representativeness | Medium | Data and sources of information are greater than 10 years old but not more than 20 years old. |
| | Metric 5: | Sample Size | N/A | Qualitative information |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | Assessment or report clearly documents its data sources, assessment methods, results, and assumptions. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | The report provides only limited discussion of the variability and uncertainty in the results. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Park, D. (2008). Trends in occupational asbestos exposure and asbestos consumption over recent decades in Korea (vol 14, pg 18, 2008). International Journal of Occupational and Environmental Health 14(2):93-93. |
| **HERO ID:** | 3581867 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Number of sites: | 1,555 sites are involved in the primary asbestos industry and 534 sites are involved in secondary asbestos industries in Korea. (Table 3, pg. 7/8) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | Report uses high quality methods and data from frequently-used sources. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Medium | Data are from Korea, an OECD country. |
| | Metric 3: | Applicability | High | Data are for industrial use in construction materials, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Medium | Report contains data that is older than 20 years old and data that is less than 20 years old, but no data is less than 10 years old. |
| | Metric 5: | Sample Size | Medium | Sample distribution characterized by limited statistics (number of sites) but discrete samples not provided and distribution not fully characterized. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | Variability is addressed by taking surveys and comparing data to literature. Uncertainty isn't addressed. |

## Overall Quality Determination — High

| | |
|---|---|
| **Study Citation:** | Park, D., Choi, S., Ryu, K., Park, J., Paik, N. (2008). Trends in occupational asbestos exposure and asbestos consumption over recent decades in Korea. International Journal of Occupational and Environmental Health 14(1):18-24. |
| **HERO ID:** | 3079461 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Production, import, or use volume: | After a short dip in ACM consumption in 1998, the use of total ACM, including cement and fiber products, continued to rise (9,116 tons in 1996 and 47,967 tons in 2005). (3/8) |
| Number of sites: | To date, 12 sites have reported exposure levels in the secondary asbestos industry. (6/8) |
| Chemical concentration: | In Korea, industrial friction materials are prohibited to have asbestos concentrations over 0.1%. (3/8) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Methodology | High | Report uses high quality methods and data from frequently-used sources. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | Medium | Data are from Korea, an OECD country. |
| | Metric 3: Applicability | High | Data are for industrial use in building construction materials, an in-scope occupational scenario. |
| | Metric 4: Temporal Representativeness | Medium | Report is based on data greater than 10 years old but no more than 20 years old and industry conditions that are expected to be representative of current industry conditions. |
| | Metric 5: Sample Size | Medium | Sample distribution characterized by limited statistics (reported volumes/sites) but discrete samples not provided and distribution not fully characterized. |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Medium | Uncertainty is addressed by discussing study limitations. Variability is not addressed. |

## Overall Quality Determination — High

| | |
|---|---|
| **Study Citation:** | Parker, J. E. (1984). Preliminary regulatory impact and regulatory flexibility analysis of the proposed revisions to the standard for regulating occupational exposure to asbestos. |
| **HERO ID:** | 6902122 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Production, import, or use volume: | Domestic Production Metric Tons1971 119, 000 1972 12,000 IS73 137,000 1974 103,000 1975 91,000 1976 104,000 1977 92,256 1978 93,097 1979 93,354 1980 80,079 1981 75,618 Exports Metric Tons1971 49,000 1972 54,000 IS73 60,000 1974 56,000 1975 46,000 1976 54, 000 1977 34,869 1978 45,3801979 43,2911980 48,671 1981 64,419 Imports Metric Tons1971 620,000 1972 670,000 IS73 721,0001974 706,000 1975 523,000 1976 596,000 1977 550,693 1978 570,000 1979 513,084 1980 327,2961981 337,618 Consumption Metric tons1971 699,0001972 748,000IS73 804,0001974 779,0001975 572,0001976 659,OOO1977 609,1571978 618,7061979 560,6001980 358,7001981 348,800Johns-Manville Corporation has estimated that 75 to 80 percent of asbestos products are purchased by theconstruction industryDetailed demand patterns from 1969-1982 for 10 different product lines are provided in table II-4, which is followed by comprehensive summaries for each product line ( Adobe page 72-108) |
| Process description: | The production processes in secondary manufacturing aresimilar to those in the end processes of primary manufacturing,namely, sawing, cutting, grinding, punching, and drillingoperations. |
| Number of sites: | Primary ManufacturingPlantsAsbestos-Cement Pipe9Asbestos-Cement Sheet5floor Tile14Secondary FabricatorsCement Sheets1,076Shipbuilding and Repair38ConstructIon Installation of New Materials - Asbestos-Cement Pipe546 - Asbestos-Cement Sheet177 - Roofing Felts250Repair and Maintenance Drywall removal, renovation, demolition1,296 Repair and maintenance3,887 Repair and maintenance involving asbestos removal1,485Asbestos Paper22Gaskets, Seals and Packings26Paintings, Coatings and Sealants5Textiles5-Wet Process2-Dry Process3Secondary FabricatorsPaper Products1,076Packings and Gaskets1,076Textiles1,076 |
| Chemical concentration: | Coatings and Sealants 10-12%Roofing Felt 85-87%Cement Sheets 12-25%Cement Pipe 15-25 %Tile 5-20%Flooring Felt 85%Textiles 75-100% |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Methodology | High | OSHA regulatory impact study |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | US |
| Metric 3: | Applicability | High | The report is for an occupational scenario within the scope of the risk evaluation. |
| Metric 4: | Temporal Representativeness | Low | 1984 - more than 20 years old |
| Metric 5: | Sample Size | Low | Distribution of samples is qualitative or characterized by no statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Low | Due to the breadth of the the assessment, results are provided and clearly referenced, but the underlying methods, data sources, and assumptions are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Low | The report does not address variability or uncertainty. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Parrish, R. G., Hartle, R., Groth, D. (1985). Health hazard evaluation report no. HETA 83-044-1596, General Lectric Plant, Evendale, Ohio. |
| **HERO ID:** | 3970521 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Process description: | The local age heat treatment process was first located in Building 800 across from the nitride area and was used on the X-211 engine. On this engine the combustor, collector, and tubing were heat treated. The process involved cutting fire brick and shaping it to conform to the part(s) to be heated. Nichrome wire was used as the heating element and was inserted in the contoured section of the fire brick. This ”furnace” was held to the part being heat treated by a tack-welded nichrome wire. Next, a number 20 chromalloy thermacouple with asbestos coating was tack-welded to the part to monitor the temperature during heating and cooling. After being cut to size, back-up insulation material was placed so as to cover the furnace. This insulation, which came in peach-colored sheets, was manufactured by the Johns Manville Company, and was thought to be composed of asbestos. Next. loose bulkinsulation material, greyish-white in color, and also thought to beasbestos, was used to fill in around the furnace and back-upinsulation. The bulk insulation was stored in cardboard boxes and was placed by hand or with shovels on top of the back-up insulation material to a depth of several inches. Finally, an asbestos blanket was used to cover the loose bulk insulation.These materials were used from 1956 until mid 1958 when an olive-green colored material was added to the loose bulk insulation. This came in bulk containers also and was thought to have been fibrous glass. In 1959, the heat treatment area was moved to the southeast area of Building 700. Large X-211 parts were treated there. In about 1961, the heat treatment area was moved again, this time to the J6 area of Building 700.From 1959 until 1966, the materials used for heat treatment wereidentical to those used in Building 800, as described above. About1965 or 1966, vermiculite became the major loose, bulk-insulatingfiller. It was stored in garbage cans. Fiberfrax was introduced in1965 or 1966 as the blanket covering the bulk insulation. After 1975, the use of loose insulation was discontinued with the replacement of nichrome wire heating coils with a quartz lamp. [PDF Pg. 4-5] |
| Chemical concentration: | Of 11 settled dust and material samples collected and analyzed forasbestos. only one contained asbestos (20-25% chrysotile). This sample was obtained from an overhead cold water insulation jacket located at the current heat treatment area to assess the possibility that settled dust samples contained asbestos from sources other than process materials. [PDF Pg. 9] |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | Report uses high quality data/techniques/methods from frequently-used sources. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for Chemical Substances in Construction, Paint, Electrical, and Metal Products, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: | Sample Size | Low | Sample distribution characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

**Continued on next page . . .**

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| | |
|---|---|
| **Study Citation:** | Parrish, R. G., Hartle, R., Groth, D. (1985). Health hazard evaluation report no. HETA 83-044-1596, General Lectric Plant, Evendale, Ohio. |
| **HERO ID:** | 3970521 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

| | | EVALUATION | |
|---|---|---|---|
| Domain | Metric | Rating | Comments |
| **Overall Quality Determination** | | **Medium** | |

| | |
|---|---|
| **Study Citation:** | Paustenbach, D. J., Sage, A., Bono, M., Mowat, F. (2004). Occupational exposure to airborne asbestos from coatings, mastics, and adhesives. Journal of Exposure Analysis and Environmental Epidemiology 14(3):234-244. |
| **HERO ID:** | 3531298 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Life cycle description: | These liquid products were used either to adhere insulation to pipes and boilers or to cover the insulation so as to protect itfour asbestos-containing products, a coating, two mastics, and an adhesive (abstract) |
| Throughput: | For each replicate of the Sealfas 41-96 application test, 32 ft2 of material was covered using an average of 4.08 kg of the product per replicate. For C.I. Mastic 60-25, 8 ft2 of material was covered using an average of 4.08 kg of product per replicate. In the Fibrous Adhesive 81-27 application test, 4.31 kg of the test compound was used to cover 64 ft2 of substrate per replicate. (p. 4) |
| Chemical concentration: | Asbestos content (Table 1)Coating: 1%Mastic: 8-9%Fibrous Adhesive: 9% |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | The assessment or report uses high quality data and/or techniques or sound methods that are from frequently used sources (journalarticles) and are generally accepted by the scientific community, and associated information does not indicate flaws or quality issues. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | The data are from the United States and are representative of the industry being evaluated. |
| | Metric 3: | Applicability | High | The report is for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Medium | The report captures operations, equipment, and worker activities that are expected to be reasonably representative of current conditions. The report is generally more than 10 years but no more than 20 years old. |
| | Metric 5: | Sample Size | Medium | Distribution of samples is characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | Assessment or report clearly documents its data sources, assessment methods, results, and assumptions. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | High | The report addresses variability and uncertainty in the results. Uncertainty is well characterized. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Perez, A. L., Nelson, M. L., Cheng, T. J., Comerford, C. E., Scott, P. K. (2018). A meta-analysis of airborne asbestos fiber concentrations from work with or around asbestos-containing floor tile. International Journal of Occupational and Environmental Health 24(3-4):134-148. |
| **HERO ID:** | 6867245 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Process description: | Raw asbestos fiber, pigment, and filler are mixed dry to form a cohesive mass to which liquid constituents are added if required. Although the mixture is exothermic (it generates heat during mixing), it may need to be heated further in order to reach a temperature of at least 300"F at which point it is fed into a two rollmil where it is pressed into a slab or desired thickness. The slab isthen passed through calenders, machines with rollers, where it acquires a uniform finished thickness (Krusell and Cogley 1982). Embossing, pigmenting, and other surface decoration is done while the material is still soft. The tile is then cooled using one of three processes: immersion in water, spraying with water, or placing in a refrigeration unit. In order to minimize shrinkage after cutting, the tile is allowed to air cool before it is cut into squares and waxed. [PDF Pg. 1] |
| Chemical concentration: | Typical concentrations of asbestos in vinyl floor tiling are 5-25% [PDF Pg. 1] |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | Report uses high quality data/techniques/methods from frequently-used sources. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for Chemical Substances in Construction, Paint, Electrical, and Metal Products, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: | Sample Size | Medium | Sample distribution characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | Variability addressed by giving a range of average concentrations of asbestos in products but uncertainty is not addressed. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Perez, A. L., Nelson, M. L., Cheng, T. J., Comerford, C. E., Scott, P. K. (2018). A meta-analysis of airborne asbestos fiber concentrations from work with or around asbestos-containing floor tile. International Journal of Occupational and Environmental Health 24(3-4):134-148. |
| **HERO ID:** | 6867245 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Process description: | Asbestos-cement pipe is made of a mixture of Portland cement (42 to 53 percent by weight), asbestos fibers (15 to 25 percent by weight), and silica (34 to 40 percent by weight). These materials are combined with water and processed into a pliable mass that is wound around a steel cylinder and then compressed and cut into 10 or 13-foot lengths. The product then goes through a curing process, known as autoclaving, that involves immersion in water orpressurized steam.to enhance corrosion resistance to high sulfate soils and waters. Cured pipes then undergo a finishing process that includes machining the ends and, optionally, lining the pipe with gilsonite coatings, asphalt-based coatings, or other coatings to protect the pipe from acidic or corrosive fluids (ICF 1985). [PDF Pg. 28] |
| Chemical concentration: | Asbestos-cement pipe is made of a mixture of Portland cement (42 to 53percent by weight), asbestos fibers (15 to 25 percent by weight), and silica(34 to 40 percent by weight). [PDF Pg. 28] |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Methodology | High | Report uses high quality data/techniques/methods from frequently-used sources. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | High | Data are from the U.S. |
| | Metric 3: Applicability | High | Data are for Chemical Substances in Construction, Paint, Electrical, and Metal Products, an in-scope occupational scenario. |
| | Metric 4: Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: Sample Size | Medium | Sample distribution characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Medium | Variability addressed by giving a range of average concentrations of asbestos in products but uncertainty is not addressed. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Perez, A. L., Nelson, M. L., Cheng, T. J., Comerford, C. E., Scott, P. K. (2018). A meta-analysis of airborne asbestos fiber concentrations from work with or around asbestos-containing floor tile. International Journal of Occupational and Environmental Health 24(3-4):134-148. |
| **HERO ID:** | 6867245 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Process description: | Asbestos Diaphragms are employed in the chlor-alkali industry for the production of chlorine and other primary products such as caustic soda. There are presently three types of electrolytic cells in commercial use; asbestos diaphragm cells, mercury cells, and membrane cells (Kirk-Othmer 1985). All electrolytic cells operate on the same principle – an electric current decomposes a solution of brine into (1) chlorine, liberated at the anode (positive electrode) and (2) caustic soda and hydrogen, liberated at the cathode (negative electrode). The ratio of chlorine to caustic soda produced during the process is 1:1.1 by weight (Chemical Week 1982). Most of the chlorine produced in the United States is made using electrolytic cells (Kirk-Othmer 1985). [PDF Pg. 8] |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Methodology | High | Report uses high quality data/techniques/methods from frequently-used sources. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | High | Data are from the U.S. |
| | Metric 3: Applicability | High | Data are for Chemical Substances in Construction, Paint, Electrical, and Metal Products, an in-scope occupational scenario. |
| | Metric 4: Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: Sample Size | N/A | N/A - process description. |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | N/A | N/A - process description. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Perkins, R. A., Hargesheimer, J., Fourie, W. (2007). Asbestos release from whole-building demolition of buildings with asbestos-containing material. Journal of Occupational and Environmental Hygiene 4(12):889-894. |
| **HERO ID:** | 1079550 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Process description: | The most economical method of demolishing one- or two-story buildings is by using heavy equipment to push down the building and move the material inward. For buildings taller than one or two stories, a crane and wrecking ball generally are used to initiate the process. (P. 2/7) |
| Number of sites: | two whole-building demolition projects in the Fairbanks,Alaska, area. (P. 3/7) |
| Chemical concentration: | Friable materials contain more than 1% asbestosand when dry, can be crumbled, pulverized, or reduced topowder by hand pressure. (P. 2/7) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Methodology | High | The assessment or report uses high quality data. Peer reviewed journal. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | High | The data are from the United States |
| | Metric 3: Applicability | High | The report is for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: Temporal Representativeness | Medium | The report is more than 10 year but no more than 20 years old. |
| | Metric 5: Sample Size | N/A | Process description. |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | Medium | Assessment or report clearly documents results. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Medium | The report provides only limited discussion of the variability and uncertainty in the results. |

## Overall Quality Determination — High

| | |
|---|---|
| **Study Citation:** | Petrovic, E. K. (2017). Persisting issues with the most recognized building material health risks: lead and asbestos. Woodhead Publishing series in composites science and engineering :155-174. |
| **HERO ID:** | 6698258 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Chemical concentration: | sprayed asbestos varies between 5% and 95% asbestos content (13/20) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | Report uses high quality methods and data from frequently-used sources. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Medium | Data are from New Zealand, an OECD country. |
| | Metric 3: | Applicability | High | Data are for industrial, commercial, and consumer use in construction products. Industrial and commercial uses are in scope. |
| | Metric 4: | Temporal Representativeness | High | Report is based on current industry conditions and data no more than 10 years old. |
| | Metric 5: | Sample Size | Medium | Sample distribution characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Phelka, A. D., Finley, B. L. (2012). Potential health hazards associated with exposures to asbestos-containing drywall accessory products: A state-of-the-science assessment. Critical Reviews in Toxicology 42(1):1-27. |
| **HERO ID:** | 2569844 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Chemical concentration: | [PDF Pg. 5] given in % by weight compositions of Chrysotile asbestos.Perf-A-Tape Cement: 8-15%Pre-mix Joint Compound, Dual Purpose: 8%3-Purpose Joint Compound: 11%Joint Cement: 7%Finishing Compound: 5%One Day Joint Compound: 2.5%Typical Joint Compound: 3-6%Joint Cement (1967): 5.5%Ready Mix Joint Compound (1969): 2.5%Additional historical compositions given in Table 2 on PDF Pg. 8-10. |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Methodology | High | Report uses high quality data/techniques/methods from frequently-used sources. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | High | Data are from the U.S. |
| | Metric 3: Applicability | High | Data are for Chemical Substances in Construction, Paint, Electrical, and Metal Products, an in-scope occupational scenario. |
| | Metric 4: Temporal Representativeness | High | Report is based on current industry conditions and data no more than 10 years old. (2012) |
| | Metric 5: Sample Size | Low | Sample distribution is described qualitatively. |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Medium | Variability addressed by concentrations of asbestos in multiple products but uncertainty is not addressed. |

## Overall Quality Determination — High

| | |
|---|---|
| **Study Citation:** | Piacitelli, L. (1983). Health hazard evaluation report no. HETA-83-112-1309, Saint Francis High School, Morgantown, West Virginia. |
| **HERO ID:** | 3970481 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Process description: | Asbestos stripping procedures (pg 7-8 of 12): 1. Notify EPA of intention to remove, demolish or renovate asbestos at least 20 days prior to commencement. 2. Survey the job and draw up an operational plan considering: a) The means for sealing off the work area. b) Method of transporting asbestos waste from the work area, through the barriers to transportation. c) Identify locations and provisions for change of rooms, toilet, and showering facilities . d) Choice of protective equipment e) Contamination control procedures. f) Identification of sanitary land fill. g) Ventilation openings, drains, etc., to be sealed or filtered. h) Water and electrical services. i) Monitoring facilities and frequency of sampling. j) Identification of the equipment to be covered/removed. k) Provisions for maintenance. 1) Security system. 3. Air sampling to determine background fiber levels. 4. Begin operation by removing designated equipment. Cover remaining equipment and hard-to-clean surfaces with PVC or polyethylene sheet. Seal openings, such as windows, doors, ventilation systems, etc. 5. Seal off the area with PVC or polyethylene sheet. Overlap joints and heat seal or tape. If the area to be stripped is large, it should be compartmentalized. Access into the work zone must be through an airlock system which may be incorporated into the changing and washing facilities. The work area should be kept below atmospheric pressure with an exhaust fan equipped with an absolute filter. Floors should also be covered. 6. The barrier, airlock system should be constructed so that the worker passes from the work zone into successively cleaner areas, e.g., work zone to vacuum area to asbestos clothing change room to shower room to personal clothing change room to external unrestricted area. 7. Asbestos removal: Water spraying with respraying as required if dust occurs during the removal of the material by dislodgement and scraping. The water should be amended with a wetting agent. Dry stripping requires EPA approval. (40 CFR 61.22(d)(ii). 8. Air sampling inside and outside the work zone should be conducted to ensure that the barriers are effective and to confirm the suitability of the respirators. 9. The asbestos stripped should be caught and not allowed to fall to the floor, if possible. Asbestos should be bagged and labeled according to OSHA regulations using 6 mil or heavier plastic bags. The use of SS gallon drums is strongly recommended as secondary containment for the bags. The material should not be allowed to accumulate, and none should be left unbarrelled at the end of the day. Bags and drums must be wiped down before removal. 10. All of the surfaces should be washed down or vacuumed after stripping and removal is completed. Work should progress from the top to the bottom. 11. It is virtually impossible to remove all of the asbestos and once the stripping is completed, but before the barriers are removed, the surfaces should be coated with a sealant. An emulsion-type paint is acceptable. 12. Air sampling should be performed before removal of the barriers and thereafter over an extended period of time to ensure that effective control has been provided. 13. Dismantle the barriers and dispose of in a landfill. |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Methodology | High | report uses high quality data |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | High | The data are from the United States |
| | Metric 3: Applicability | High | The report is for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: Temporal Representativeness | Low | The report is more than 20 years old. |
| | Metric 5: Sample Size | N/A | N/A - This metric is not applicable to the data being extracted |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | High | report clearly documents its data sources |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Low | The report does not address variability or uncertainty. |

**Continued on next page . . .**

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| | |
|---|---|
| **Study Citation:** | Piacitelli, L. (1983). Health hazard evaluation report no. HETA-83-112-1309, Saint Francis High School, Morgantown, West Virginia. |
| **HERO ID:** | 3970481 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

| | | EVALUATION | |
|---|---|---|---|
| Domain | Metric | Rating | Comments |
| **Overall Quality Determination** | | **Medium** | |

| | |
|---|---|
| **Study Citation:** | Piacitelli, L. (1983). Health hazard evaluation report no. HETA 83-106-1311, West Virginia Geological and Economic Survey, Morgantown, West Virginia. |
| **HERO ID:** | 3970500 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Process description: | Asbestos removal: Water spraying with respraying as required if dust occurs during removal of the material by dislodgement and scraping. The water should be amended with a wetting agent.The asbestos stripped should be caught and not allowed to fall to the floor, if possible. Asbestos should be bagged and labeled according to OSHA regulations using 6 mil or heavier plastic bags. The use of 55 gallon drums is strongly recommended as a secondary containment for the bags. Material should not be allowed to accumulate and none should be left unbarrelled at the end of the day. Bags and drums must be wiped down before removal.All of the surfaces should be washed down or vacuumed after stripping and removal is completed, Work should progress from the top to the bottom. [PDF Pg. 8] |
| Chemical concentration: | The bulk samples of insulation from the hot water heating systemcontained asbestos, including the hot water pipes carrying heat tothe individual offices. Also, the remaining ducts to the air handlerare insulated with material containing asbestos. The spackledceiling in the lobby also contains asbestos. Neither the plain wallboard (Room 128) nor the decorative wall board (Room 104) contains asbestos. |
| Comments: | Bulk samples of the insulation were collected. The samples were analyzed by polarized light microscopy. [PDF Pg. 4] |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Methodology | High | Report uses high quality data/techniques/methods from frequently-used sources. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | High | Data are from the U.S. |
| | Metric 3: Applicability | High | Data are for Chemical Substances in Construction, Paint, Electrical, and Metal Products, an in-scope occupational scenario. |
| | Metric 4: Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: Sample Size | Low | Sample distribution is characterized by no statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Medium | The report does mention that both amosite and chrysotile forms of asbestos were detected in the insulation. However, the report does not address variability or uncertainty regarding frequency of detection. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Pierce, J. S., Jiang, G. C. T., Finley, B. L. (2008). A state of the science review of the potential health hazards associated with asbestos in shielded metal arc welding rods in the United States. Toxicological and Environmental Chemistry 90(5):917-956. |
| **HERO ID:** | 6915862 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Number of sites: | various number of sites data in Table II (pg 17-20) |
| Chemical concentration: | Historically, small amounts of chrysotile asbestos (on average between 1% and 2% by weight) were incorporated into the flux of certain classifications of commercially produced general arc welding electrodes, in particular, those used in overhead welding (pg 3)It has been suggested that, due to shortages of commercially made welding rods during World War II, one Australian establishment manufactured their own quasi arc electrodes that were wrapped in a material containing 80% crocidolite asbestos (pg 8)The newly manufactured rods contained 3.5–14% cationic fiber by weight, which was comprised of roughly 20% Canadian ‘‘Grade 7’’ chrysotile asbestos (pg 11) |
| Comments: | has process description info for incorporating asbestos into electrodes throughout, which is out of scope (upstream of USE).has concentration data for automobile brakes (pg 15) which are out of scope. |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | Medium | Report uses high quality [data/techniques/methods] that are not from frequently-used sources and there are no known quality issues. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for welding/building materials, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Report is greater than 10 and less than 20 years old, however, most data cited is historical data >20 years old and is expected to be outdated. |
| | Metric 5: | Sample Size | Medium | Sample distribution characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Methods, results, and assumptions are clearly documented, but underlying data sources are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | Variability addressed by providing data over multiple periods of years, but uncertainty is not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Piper, S., Grant, M. (1986). NESHAPs (National Emissions Standards for Hazardous Air Pollutants) asbestos demolition and renovation inspection workshop manual. |
| **HERO ID:** | 6901133 |
| **Conditions of Use:** | Disposal |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Process description: | There are four general control measures to reduce asbestos exposure risk:• removal;• enclosure;• encapsulation; and• maintenance and reassessment program. Typical removal process:material wetting ( surfactants enhance wetting but are not required)material removal (stripping)unit or section cutting or disjoininglocal exhaust ventilation/collection systemwaste handling and cleanup (dry vacuuming, wet vacuuming, wetmopping, sweeping, hand wiping, etc.); andwaste disposal. Enclosure consists of constructing an air-tight barrier between the Friable Asbestos Material (left intact) and the building occupants. Encapsulation consists of applying a penetrating or bridging sealant to the Friable Asbestos Material (left intact) to render it nonfriable. Maintenance and Reassessment consists of special housekeeping procedures, maintenance precautions, and inspection procedures to minimize the exposure risk. |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Methodology | High | EPA study |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | US |
| Metric 3: | Applicability | High | The report is for an occupational scenario (Asbestos remediation) within the scope of the risk evaluation. |
| Metric 4: | Temporal Representativeness | Low | 1984 - prior to the most recent PEL and more than 20 years old. |
| Metric 5: | Sample Size | N/A | Qualitative information provided |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | High | Assessment or report clearly documents its data sources, assessment methods, results, and assumptions. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | N/A | Qualitative information provided |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Pira, E., Donato, F., Maida, L., Discalzi, G. (2018). Exposure to asbestos: past, present and future. Journal of Thoracic Disease 10(S2):S237-S245. |
| **HERO ID:** | 6859559 |
| **Conditions of Use:** | Other: |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Production, import, or use volume: | Asbestos use dropped from 803,000 tons in 1973 to 15,000 tons in 2000. (2/9) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Methodology | High | Report uses high quality methods and data from frequently-used sources. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | Medium | Data are from Italy, an OECD country. |
| | Metric 3: Applicability | Medium | Data is for ”use” of asbestos with no specifics, so this may be in scope. |
| | Metric 4: Temporal Representativeness | Low | Information is more than 20 years old. |
| | Metric 5: Sample Size | Low | Distribution of samples is qualitative or characterized by no statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Low | The report does not address variability or uncertainty. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Polakoff, P. L. (1984). Have we really stopped exposing workers to asbestos?. Occupational Health and Safety 53(9):61-62. |
| **HERO ID:** | 3083561 |
| **Conditions of Use:** | Other: |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Production, import, or use volume: | More than a million tons of friable asbestos are in place in buildings, ships, factories, refineries, power plants, and other facilities. (2/2) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | Low | The data, data sources, and/or techniques or methods used in the assessment or report are not specified. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for consumption of asbestos for all industrial/commercial uses, which is in-scope. |
| | Metric 4: | Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: | Sample Size | Low | Sample distribution is characterized by no statistics. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Low | Assessment results are provided but underlying methods, assumptions, and data sources are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination — Low

| | |
|---|---|
| **Study Citation:** | Price, B., Ware, A. (2007). Mesothelioma: Risk apportionment among asbestos exposure sources (vol 25, pg 937, 2005). Risk Analysis 27(3):787-787. |
| **HERO ID:** | 3582367 |
| **Conditions of Use:** | Other: |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Production, import, or use volume: | Asbestos use in the U.S. peaked at around 800,000 metric tons/year in 1972, and has decreased to 20,000 in 2000. (2/7) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Methodology | Medium | Report uses high quality data that are not from frequently-used sources and there are no known quality issues. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | High | Data are from the U.S. |
| | Metric 3: Applicability | Medium | Data are for all consumption of asbestos, which includes in and out-of scope uses. |
| | Metric 4: Temporal Representativeness | Medium | Report is based on data greater than 10 years old but no more than 20 years old and industry conditions that are expected to be representative of current industry conditions. |
| | Metric 5: Sample Size | Medium | Distribution of samples is characterized by a range with uncertain statistics. It is unclear if analysis is representative. |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Medium | Variability is addressed in the graph presenting consumption since 1930. Uncertainty is not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Prust, R. S. (1979). Future problems to be anticipated: Demolition, repair, and disposal. Annals of the New York Academy of Sciences 330(1):545-548. |
| **HERO ID:** | 6868545 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Life cycle description: | not really an LC description, just discusses uses in building materials and subsequent abatement |
| Chemical concentration: | sprayed-on asbestos ceilings: 1-30% asbestos, 7% on average (pg 2) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | Medium | Report uses high quality data/techniques/methods that are not from frequently-used sources and there are no known quality issues. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for construction materials, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: | Sample Size | Medium | Sample distribution characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Methods, results, and assumptions are clearly documented, but underlying data sources are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | Variability addressed in discussion of how to handle asbestos materials in buildings (abatement vs. leave undisturbed), but uncertainty is not addressed. |

## Overall Quality Determination — Medium

| | |
|---|---|
| **Study Citation:** | Quinn, M. M., Kriebel, D., Buiatti, E., Paci, E., Sini, S., Vannucchi, G., Zappa, M. (1987). An asbestos hazard in the reprocessed textile industry. American Journal of Industrial Medicine 11(3):255-266. |
| **HERO ID:** | 3083182 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Products not Described by Other Codes |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Process description: | The article provides description for the reprocessed textile industry. Wool is the main fiber. Textile reprocessing is performed in four main steps, each usually carried out in a separate establishment. Rags are sorted in a cernita, wool is separated fromcellulose fibers in a carbonizzo, material is dyed in a tintoria, and wool cloth is shredded into fiber masses ready for carding in a stracciatura (pg 256). |
| Chemical concentration: | women's wool coats contained 8% asbestos (pg 265) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | The report uses high quality data and sound methods thatare from frequently used sources. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Medium | The data are from an OECD country other than the U.S. |
| | Metric 3: | Applicability | High | The report is for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Low | The report is more than 20 years old. |
| | Metric 5: | Sample Size | N/A | Process description. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | Report clearly documents its data sources |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | The report does not address variability or uncertainty. |

## Overall Quality Determination — Medium

| | |
|---|---|
| **Study Citation:** | Racine, W. P. (2010). Emissions concerns during renovation in the healthcare setting: asbestos abatement of floor tile and mastic in medical facilities. Journal of Environmental Management 91(7):1429-1436. |
| **HERO ID:** | 2586623 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Process description: | [PDF Pg. 3]Chemical Stripping Methodology: In this operation, the asbestos abatement contractor typically removes the movable furniture and materials from a room or group of rooms. Then, polyethylene plastic sheeting is taped to the walls from the floor to a height of approximately 4800 . The purpose of this is to protect the wall covering from dirt, dust, and splashing. The contractor then covers any remaining appurtenances and seals all means of air ingress and egress into the area thus creatinga containment zone. Because of the potential for asbestos emission, air filtration devices are positioned in or near the area so that any emission within the abatement area flows across high-efficiency particulate air (HEPA) filters before being discharged into the environment thus trapping any errant fibers. Once the containment zone is erected, the contractor assures that the work environment is under negative pressure. Then, the contractor mists the floor with amended water to decrease the dust load and uses spud bars to lift the floor tile off the floor. The floor tile is then placed into disposal bags and loaded into a dumpster for delivery to an appropriately licensed landfill. Following this, the contractor liberally spreads a chemical mastic removal liquid onto the floor, waits for a period of time, and uses a low-speed buffer (175e1000 rpm) with a soft stripping pad to agitate the mastic remover over the floor. Peat moss, sawdust, or other absorbent is then applied to the surface, mixed together to form a semi-solid, and manually scooped into disposal bags. The floor is then wetmopped and allowed to air dry.Wet Grinding Methodology: The wet grinding methodology shares similar preparatory phases with the chemical stripping method. Both methods require the erection of a work area separated by plastic barriers to exclude the work area from the rest of the facility. The exception is that walls are covered from floor to ceiling to inhibit fibers from plating out onto vertical surfaces. The mode of floor tile removal is similar as well. The difference resides in the removal of the floor tile mastic.At the start of the floor tile mastic removal activity, the floor isliberally covered with water and a small amount of fine sand. A lowrpm floor tile buffer is then fitted with a hard steel mesh disc andapplied to the sand and water mixture. Some technique is required to adequately clean near edges and oftentimes, doors must beremoved to sufficiently clean the jamb area. Those areas notreachable by the buffer such as corners, must be hand scraped using a wire brush or scratch pad. This process also generates a sludge, which is a mixture of the water, sand, and the mastic compound. The sludge is then collected and containerized similar to the chemical stripping methodology. The floor is then wet-mopped twice to remove the sand and grindings and allowed to air dry. The perception is that implementing this methodology costs more, emits more fibers, takes more time, and is generally more difficult. |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | Report uses high quality data/techniques/methods from frequently-used sources. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for Chemical Substances in Construction, Paint, Electrical, and Metal Products, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Medium | Report is based on data greater than 10 years old but no more than 20 years old and industry conditions that are expected to be representative of current industry conditions. |
| | Metric 5: | Sample Size | N/A | N/A - Process Description. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | | |

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| | |
|---|---|
| **Study Citation:** | Racine, W. P. (2010). Emissions concerns during renovation in the healthcare setting: asbestos abatement of floor tile and mastic in medical facilities. Journal of Environmental Management 91(7):1429-1436. |
| **HERO ID:** | 2586623 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

| | | EVALUATION | |
|---|---|---|---|
| Domain | Metric | Rating | Comments |
| | Metric 7: Metadata Completeness | N/A | N/A - Process Description. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Ramos, H. (1974). Health hazard evaluation report no. HETA-74-45-150, TrimTex Division of William E. Wright Company, Williamsport, Pennsylvania. |
| **HERO ID:** | 3970478 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Furnishing, Cleaning, Treatment Care Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Process description: | Thirteen braiding machines were using asbestos yarn during the survey. The construction of asbestos braid may be classified into two major classifications - the filler and the cover. The braid filler contains five ends of asbestos yarn and seven ends of fiberglass yarn. The twelve yarns are intertwined and covered with sixteen ends of fiberglass yarn. The purpose for intermingling and intertwining of the yarns is to produce a strong braid . A braid operator keeps the braiding machine operating and replaces consumed yarn with new yarn bobbins. The braid from the machine is fed to a holding spool . Braid spools from the braiding machine are further processed in the spooling room. In the hand spooling operation, which requires one operator, the braid is examined for defects and measured as it is transferred from one spool to another. Should a defect be detected the segment is removed . Both the braiding and spooling are continuous operations. However, asbestos yarn is used only on special orders. [PDF Pg. 2] |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Methodology | High | Report uses high quality data/techniques/methods from frequently-used sources. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | High | Data are from the U.S. |
| | Metric 3: Applicability | Uninformative | The report is from an occupational scenario that does not apply to any occupational scenario within the scope of the risk evaluation. |
| | Metric 4: Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: Sample Size | N/A | N/A - Process description. |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | N/A | N/A - Process description. |

## Overall Quality Determination Uninformative

| | |
|---|---|
| **Study Citation:** | Rangé, J. (1998). Working with asbestos in Brazil. International Journal of Occupational and Environmental Health 4(1):56-58. |
| **HERO ID:** | 3615262 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Number of sites: | 27 Cement manufacture facilities in Brazil |
| Chemical concentration: | Asbestos cement = 92% cement and 8% asbestos |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | Low | This is comment/response from an earlier article - so the information provided by industry is questionable. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Low | Brazil - non OECD member |
| | Metric 3: | Applicability | High | The report is for an occupational scenario (asbestos cement manufacture) within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Low | 1998 - more than 20 years old |
| | Metric 5: | Sample Size | Low | No statistical data provided. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Low | Data source unknown |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | neither uncertainty nor variability were noted. |

## Overall Quality Determination Low

| | |
|---|---|
| **Study Citation:** | Rasmussen, P.,atE, Levesque, C., Niu, J., Gardner, H. D., Nilsson, G., Macey, K. (2019). Characterization of airborne particles emitted during application of cosmetic talc products. |
| **HERO ID:** | 6880377 |
| **Conditions of Use:** | Consumer Uses-Chemical Substances in Products not Described by Other Codes |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Chemical concentration: | "Talc used in cosmetics (cosmetic grade talc) should be free of asbestos and not contain any detectable fibrous amphibole or free crystalline silica" (pg 1) |
| Comments: | States that asbestos not present in talc products for cosmetics |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Methodology | High | Report uses high quality information from frequently-used sources. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | Medium | Data are from Canada, an OECD country. |
| Metric 3: | Applicability | Uninformative | Data are for FDA cosmetic use, which is not in-scope or similar to an in-scope occupational scenario. |
| Metric 4: | Temporal Representativeness | High | Report is based on current industry conditions and data no more than 10 years old. |
| Metric 5: | Sample Size | N/A | no quantitative data |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Medium | Assumptions and information are clearly documented, but underlying data sources are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination — Uninformative

| | |
|---|---|
| **Study Citation:** | Reed, L. D. (1985). Health hazard evaluation report no. HETA 84-321-1590, Asbestos Shingle Tear-Off, Rockford, Illinois. |
| **HERO ID:** | 3970496 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Process description: | The tear-off operation was performed by 7 workers on May 12, 1984. During the 3-hour procedure, old asbestos shingles were removed from the roof using long-handled wedges. The loosened shingles and debris were then shoveled from the roof and moved by wheelbarrow to trucks for discarding. During the tear-off operation, several other workers were applying a new asphalt-shingle roof to adjacent and previously cleared portions of the building. [PDF Pg. 4] |
| Chemical concentration: | A bulk sample of the asbestos shingle was analyzed by a NIOSH contract laboratory and was found to contain 30% chrysotile asbestos. |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | Report uses high quality data/techniques/methods from frequently-used sources. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | The report is for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized. Sample size is sufficiently representative. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Reid, R. (1987). Asbestos in the building? – Examine these options. Occupational Hazards 49(7):39-43. |
| **HERO ID:** | 3100909 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Life cycle description: | EPA categorizes asbestos in buildings in three forms: as surface material sprayed or trawled on ceilings and walls; as insulation around hot and cold pipes, ducts, boilers, and tanks; and in miscellaneous products such as ceiling tiles, floor tiles, and wallboards. |
| Number of sites: | EPA estimates that one in every five buildings contains friable asbestos, with the heaviest concentration in structures built between the 1950's and mid-1970's. More specifically, the Environmental Protection Agency (EPA) estimates that more than 730,000 commercial and public buildings in the United States contain friable (easily crumbled or crushed) asbestos. |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Methodology | Medium | The assessment or report uses high quality data and/or techniques or sound methods that are not from a frequently used source and associated information does not indicate flaws or quality issues. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | The data are from the United States and are representative of the industry being evaluated. |
| Metric 3: | Applicability | High | The report is for an occupational scenario within the scope of the risk evaluation. |
| Metric 4: | Temporal Representativeness | Low | The report is more than 20 years old. |
| Metric 5: | Sample Size | Low | Number of buildings containing friable asbestos is provided with no statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Low | Assessment or report provides results, but the underlying methods, data sources, and assumptions are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Low | The report does not address variability or uncertainty. |

## Overall Quality Determination — Low

| | |
|---|---|
| **Study Citation:** | Reisch, M. (1990). More workers at risk from asbestos exposure. Chemical & Engineering News 68(27):10. |
| **HERO ID:** | 3584177 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Production, import, or use volume: | more than 30 million tons of asbestos, most of it for insulation and fireproofing, was used in the U.S. between 1900 and 1980 |
| Number of sites: | It is estimated 20% of all existing U.S. residential and industrial buildings contain the lethal fibers. |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | Low | Report does not specify the data/techniques/methods used. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for construction materials, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: | Sample Size | Medium | Sample distribution characterized by limited statistics (minimum, mean) but discrete samples not provided and distribution not fully characterized. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Low | Assessment results are provided but underlying methods, assumptions, and data sources are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination — Low

| | |
|---|---|
| **Study Citation:** | Reitze, W. B., Holaday, D. A., Romer, H., Fenner, E. M. (1971). Control of asbestos fiber emissions from industrial and commercial sources. :100-103. |
| **HERO ID:** | 6925897 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Production, import, or use volume: | 800,000 tons used in thousands of different products in US (pg 1) |
| Process description: | spray application of asbestos insulation: A commercially prepared dry mix is emptied into a hopper and pneumatically conveyed to a nozzle. At the nozzle the material is mixed with water and the resultant material sprayed upon the surface to be fire proofed; In another application method the material is mixed with water and the slurry is pumped to the point of application. (pg 3) |
| Chemical concentration: | steam pipe and boiler insulation: 5-15% (pg 2) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | Medium | Report uses high quality data/techniques/methods that are not from frequently-used sources and there are no known quality issues. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for construction materials, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: | Sample Size | Medium | Sample distribution characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Methods, results, and assumptions are clearly documented, but underlying data sources are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Reitze, W. B., Nicholson, W. J., Holaday, D. A., Selikoff, I. J. (1972). Application of sprayed inorganic fiber containing asbestos: occupational health hazards. American Industrial Hygiene Association Journal 33(3):178-191. |
| **HERO ID:** | 3084810 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Production, import, or use volume: | over 40,000 tons of inorganic fibrous insulation containing asbestos used in 1970 |
| Process description: | There are two principal methods of applying sprayed mineral fiber. In the dry method, dry materilal is dumped from a paper shipping bag into a large hopper, where the material is agitated and subsequently blown into a 2- or 4-inch hose (Figure 1). The hose conveys the dry material to a nozzle at the actual site of application (Figure 2). As the dry material leaves the nozzle, it passes through the focus of a ring of fine water jets. Mixing takes place at this focal point, which is usually 4 to 8 inches from the end of the nozzle. The operator is able to control the air, material, and water mix, with valves at the nozzle. The wet method differs in that the material is premixed with water in the hopper, and the resulting slurry is pumped to the nozzle and sprayed upon the surface to be coated. The nozzle used is similar to that used to apply plaster. |
| Throughput: | ”A thirty-story building may use 200 tons, while the World Trade Center complex being built for the New York Port Authority will use 5000 tons on the twin 1 10-story towers (above the fortieth floor, only non-asbestos-containing spray materials were used). The sixty-story Chase Manhattan Bank Building is fireproofed with 1,500,000 square feet of sprayed mineral fiber””; ””The Holland-American ocean liner Rotterdam contains 400,000 square feet of sprayed mineral fiber used for fire protection, thermal insulation, and sound and condensation control”. |
| Chemical concentration: | ”material used for fireproofing in building construction usually is a blend of 5 to 30% asbestos fiber (chrysotile), mineral wool, clay binders (as bentonite), adhesives, synthetic resins, and other proprietary agents such as oils”; ”materials used for thermal insulation on turbines contain nearly 100% asbestos fiber (often amosite or amosite and crocidolite) plus the usual binders and adhesives”; ”material used for acoustical and decorative purposes may contain a greater percentage of mineral wool and little or no asbestos fiber”; ”Some materials are applied as a sprayed slurry (commonly known as cementitious spray) and will often contain vermiculite, gypsum, and shorter asbestos fibers” |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Methodology | Medium | Report uses high quality information that are not from frequently-used sources and there are no known quality issues. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | High | Data are from the U.S. |
| | Metric 3: Applicability | High | Data are for asbestos use in the construction industry, an in-scope occupational scenario. |
| | Metric 4: Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: Sample Size | Medium | Sample distribution characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | Medium | Methods, results, and assumptions are clearly documented, but underlying data sources are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Medium | Variability addressed by range of asbestos concentrations and use rates in buildings, but uncertainty is not addressed. |

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| | |
|---|---|
| **Study Citation:** | Reitze, W. B., Nicholson, W. J., Holaday, D. A., Selikoff, I. J. (1972). Application of sprayed inorganic fiber containing asbestos: occupational health hazards. American Industrial Hygiene Association Journal 33(3):178-191. |
| **HERO ID:** | 3084810 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

| | | **EVALUATION** | |
|---|---|---|---|
| Domain | Metric | Rating | Comments |
| **Overall Quality Determination** | | **Medium** | |

| | |
|---|---|
| **Study Citation:** | Remington, D. (1989). Report on asbestos: Putting it into perspective. Canadian Occupational Safety 27(3):12-15. |
| **HERO ID:** | 6907423 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Process description: | When disturbed, the asbestos fiber shreds lengthwise into long, needle-like fibers which, when inhaled, cling to and become embedded in lung tissues. (1/4) |
| Chemical concentration: | 12-15% asbestos in cement products (1/4) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | Medium | Report uses high quality data that are not from frequently-used sources and there are no known quality issues. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Medium | Data are from Canada, an OECD country. |
| | Metric 3: | Applicability | High | Data are for commercial use in construction materials, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: | Sample Size | Medium | Sample distribution characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Low | Assessment results are provided but underlying methods, assumptions, and data sources are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination — Low

| | |
|---|---|
| **Study Citation:** | Reynolds, S. J., Kreiger, R. A., Bohn, J. A., Fish, D., Marxhausen, T., McJilton, C. (1994). Factors affecting airborne concentrations of asbestos in a commercial building. American Industrial Hygiene Association Journal 55(9):823-828. |
| **HERO ID:** | 3097354 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Number of sites: | Literature review summarized 429 public and commercial buildings sampled for asbestos. [PDF Pg. 1] |
| Chemical concentration: | Friable spray on material contained 10-20% chrysotile. |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | Report uses high quality data/techniques/methods from frequently-used sources. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for construction, paint, electrical, and metal products, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Medium | Report is based on data greater than 10 years old but no more than 20 years old and industry conditions that are expected to be representative of current industry conditions. |
| | Metric 5: | Sample Size | Low | Sample distribution is characterized by no statistics. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Richter, E. D., Chlamtac, N., Berman, T., Laster, R. (2001). A review of environmental and occupational exposure to asbestos in Israel. Public Health Reviews 29(2-4):247-264. |
| **HERO ID:** | 3080446 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Products not Described by Other Codes |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Production, import, or use volume: | 10,000 tons of asbestos (chrysotile and crocidolite) imported to Israel in 1976, under 3,000 tons by 1993 and less than 50 tons by 1999 (p. 3) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | Medium | The assessment or report uses high quality data that are not from a frequently used source and associated information does notindicate flaws or quality issues. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Medium | Data are from Israel, an OECD country. |
| | Metric 3: | Applicability | Uninformative | Data are for import of asbestos for the purpose of manufacturing, which is out of scope for the legacy asbestos risk evaluation. |
| | Metric 4: | Temporal Representativeness | Low | Data greater than 20 years old. |
| | Metric 5: | Sample Size | N/A | Sample size is not applicable to import quantity estimates. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Assessment or report clearly documents results, methods, and assumptions. Data sources are generally described but not fully transparent. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | Variability and uncertainty of import quantity not described. |

## Overall Quality Determination Uninformative

| | |
|---|---|
| **Study Citation:** | Rodelsperger, K., Woitowitz H-J, Krieger, H. G. (1980). Estimation of exposure to asbestos-cement dust on building sites. IARC Scientific Publications 30(30):845-853. |
| **HERO ID:** | 3101344 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Production, import, or use volume: | in the Federal Republic of Germany about 100,000 to 120,000tons of asbestos are processed into about 1.2 million tons of asbestos-cement products, which are handled by workers on building sites. [PDF Pg. 2] |
| Number of sites: | 6,000 roofing companies handle asbestos-cement sheets. [PDF Pg. 2] |
| Chemical concentration: | The chrysotile content of fine dust from asbestos-cement was found to be 10% [PDF Pg. 3]. |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Methodology | High | Report uses high quality data/techniques/methods from frequently-used sources. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | Medium | Data are from Germany, an OECD country. |
| Metric 3: | Applicability | High | Data are for Chemical Substances in Construction, Paint, Electrical, and Metal Products, an in-scope occupational scenario. |
| Metric 4: | Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| Metric 5: | Sample Size | Low | Sample distribution is characterized by no statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Roh, S., Park, S., Tae, G., Song, J. (2016). A case of laryngeal cancer induced by exposure to asbestos in a construction site supervisor. 28:34. |
| **HERO ID:** | 3531387 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Chemical concentration: | Celling material was 4-6% white asbestos, flooring material was 5-15% white asbestos, insulation was 25-30% white asbestos, wall material was 10-15% white asbestos, and outer wall material was 10% white asbestos. (4/6) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Methodology | High | Report uses high quality methods and data from frequently-used sources. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | Medium | Data are from Korea, an OECD country. |
| | Metric 3: Applicability | High | Data are for commercial use in building construction materials, an in-scope occupational scenario. |
| | Metric 4: Temporal Representativeness | High | Report is based on current industry conditions and data no more than 10 years old. |
| | Metric 5: Sample Size | Medium | Sample distribution characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Rousmaniere, P., Raj, N. (2007). Shipbreaking in the developing world: Problems and prospects. International Journal of Occupational and Environmental Health 13(4):359-368. |
| **HERO ID:** | 3541792 |
| **Conditions of Use:** | Other: |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Process description: | Cranes are used to move very heavy pieces of ships, but workers would have continued, as in the past, to perform much of the moving of parts. From time to time the ship's hull, as it was being dismantled, would be drawn further ashore at very high tides. As parts were removed from the ship they would have been transported to stores and sheds owned by independent contractors, who prepare such parts for distribution into the Indian economy. (4/11) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | Medium | Report uses high quality data that are not from frequently-used sources and there are no known quality issues. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Low | Data are from India, a non-OECD country. |
| | Metric 3: | Applicability | High | Data are for demolition of asbestos products, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Medium | Report is based on data greater than 10 years old but no more than 20 years old and industry conditions that are expected to be representative of current industry conditions. |
| | Metric 5: | Sample Size | N/A | Process description. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination — Medium

| | |
|---|---|
| **Study Citation:** | Ruhe, R. L. (1983). Health Hazard Evaluation Report No. HETA-83-189-1368, Goodyear Aerospace Corporation, Akron, Ohio. NIOSH(HETA-83-189-1368):83-189. |
| **HERO ID:** | 3656253 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Chemical concentration: | Insulation contained 60-85% amosite asbestos and >1% chrysotile asbestos. (9/14) |
| Comments: | TABLE IResults of Bulk Insulation Samples Collected for Asbestos |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | Report uses high quality methods and data from frequently-used sources. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for industrial use in construction materials, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: | Sample Size | Medium | Sample distribution characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | High | Uncertainty is addressed by the bulk sampling methodology. Variability is addressed by sampling different insulation throughout the building. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Rushworth, D. H. (2005). The Navy and asbestos thermal insulation. Naval Engineers Journal 117(2):35-48. |
| **HERO ID:** | 3584926 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Production, import, or use volume: | Most chrysotile and all amosite asbestos fibers were imported. (Virta Undated) U.S. production of asbestos fiber never supplied more than about 20% of the nation's total asbestos demandsand the best grades needed for fabrication of most insulation products came from elsewhere (p. 5)In the year 2000, however, 15,000 metric tons were consumed (p. 10) |
| Life cycle description: | Table 1 - in 1972 the following materials contained asbestos: Molded block, tape, cement, paper, cloth, and board |
| Throughput: | Each WWII USS Fletcher class destroyer bore nearly 30 long tons of thermal insulation on her pipes and machinery. The next-generation, USS Gearing class, carried just over 24 long tons pership despite having the identical power plant as Fletcher because more efficient and lighter materials became available. At the extreme, the USS Iowa class battleships carried nearly 465 longtons of thermal insulation. Ships intermediate in size between destroyers and battleships carried intermediate amounts of the material. (p. 2)Amosite was 86% of the asbestos used (p. 3)The quantity of insulation in Navy ships of the 1970's ranged from about three long tons in a tugboat, about long 39 tons in a new DDG, and about 55 long tons in a nuclear powered cruiser (p. 10) |
| Chemical concentration: | Except for the lowest value in Figure 1 (1943, 59%), the weight percent of asbestos or asbestos-containing insulation varied between 80% and 99% (p. 4) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | The assessment or report uses high quality data and/or techniques or sound methods that are from frequently used sources (journalarticles) and are generally accepted by the scientific community, and associated information does not indicate flaws or quality issues. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | The data are from the United States and are representative of the industry being evaluated. |
| | Metric 3: | Applicability | High | The report is for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Medium | The report captures operations, equipment, and worker activities that are expected to be reasonably representative of current conditions. The report is generally more than 10 years but no more than 20 years old. |
| | Metric 5: | Sample Size | Medium | Distribution of samples is characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | Assessment or report clearly documents its data sources, assessment methods, results, and assumptions. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | The report provides only limited discussion of the variability and uncertainty in the results |

## Overall Quality Determination High

**Continued on next page . . .**

**. . . continued from previous page**

| | |
|---|---|
| **Study Citation:** | Rushworth, D. H. (2005). The Navy and asbestos thermal insulation. Naval Engineers Journal 117(2):35-48. |
| **HERO ID:** | 3584926 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|

| | |
|---|---|
| **Study Citation:** | Ryckman, M. D., Ryckman, D. W., Peters, J. L. (1983). ASBESTOS CONTROL PROGRAM FOR INSTITUTIONAL FACILITIES. Journal of Environmental Engineering 109(2):275-288. |
| **HERO ID:** | 3584930 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Production, import, or use volume: | The EPA estimates that since the beginning of 1900, over 30,000,000 tons of asbestos fibers have been used in the United States, at an average annual usage rate of 750,000 tons. (1/14) |
| Chemical concentration: | Bulk sample analysis determined that one locations' ceiling material contained 30-60% chrysotile. (8/14) In another study, spray-on fireproofing containing asbestos ranged from 30% to 50% amosite and 2% to 3% chrysotile. HVAC filter media prior to decontamination contained 2% to 10% amosite asbestos. (11/14) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Methodology | High | Report uses high quality methods and data from frequently-used sources. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | High | Data are from the U.S. |
| | Metric 3: Applicability | High | Data are for commercial use in building construction materials, an in-scope occupational scenario. |
| | Metric 4: Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: Sample Size | Medium | Sample distribution characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | Medium | Methods, results, and assumptions are clearly documented, but underlying data sources are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Medium | Variability is addressed by sampling bulk material from different types of materials. Uncertainty isn't addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Ryer, F. H. (1978). AIR POLLUTION EXPOSURES TO FIVE TARGET HEALTH HAZARDS. American Industrial Hygiene Association Journal 11(11):928-931; 1978. |
| **HERO ID:** | 3659698 |
| **Conditions of Use:** | Other: |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Number of sites: | 7716 employers affected (Table 1, pg 2) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | Report uses high quality data from frequently-used sources (OSHA) |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | Low | OES not specified. |
| | Metric 4: | Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: | Sample Size | N/A | Number of sites data |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Low | Assessment results are provided but underlying methods, assumptions, and data sources are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Low

| | |
|---|---|
| **Study Citation:** | Safety Health Environment International Consultants, (1994). Support: the asabestos exposure of workers in the Manville Diatomaceous Earth Plant also involved in cohort mortality study of diatomite industry with cover letter dated 121694. |
| **HERO ID:** | 3653704 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Number of sites: | 2 Grefco and Manville |
| Chemical concentration: | Note the asbestos content of this products can vary over time.Sil-O-Cel blocks contains fibers but content not noted.CelCote contains fbers but content not notedSil-O-Cel plastic insulating cements 8% asbestosSil-O-Cel Hard Finish Cement 5-35% asbestosFilter Cel lime blocks 2-10% asbestosOne coat plastic and hard finish cements 5-35% asbestosOne coat plastics for metal 5% asbestosPlastic protective cement 5% asbestosSil O Cel powdcer 3-35% asbestosnote asbestos was not used in the plant in the 1940s- asbestos use resumed in the 1950sFibra-Flo content not providedPrecoast Sorb-Cel content not providedDiasel M 10% asbestosCoalinga content not provided |
| Comments: | The intent of this study is to take a close look at those who may have been exposed to asbestos and should be removed from a separate study investigating silica-lung cancer mortality rates. The detailed assessment identified that a larger portion of the workforce at this site were exposed to Asbestos. the plan being investigated stopped handling asbestos in 1977. Note this is a recreated assessment of earlier exposure (1920-1940 and 1951-1977) and may not be representative of today |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Methodology | Medium | The assessment or report uses high quality data and/or techniques |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | US |
| Metric 3: | Applicability | High | The report is for an occupational scenario ( manufacture of asbestos containing building supplies) within the scope of the risk evaluation. |
| Metric 4: | Temporal Representativeness | Low | 1993 - more than 20 years old |
| Metric 5: | Sample Size | Medium | Range of concentrations are provided |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | High | Assessment or report clearly documents its data sources, assessment methods, results, and assumptions. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Medium | Range of concentrations can be helpful in assessing variability, but nothing about uncertainty. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Sakai, K., Hisanaga, N., Shibata, E., Ono, Y., Takeuchi, Y. (2006). Asbestos exposures during reprocessing of automobile brakes and clutches. International Journal of Occupational and Environmental Health 12(2):95-105. |
| **HERO ID:** | 3079817 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Production, import, or use volume: | In 1982, approximately 17,500 tons of asbestoswere used for manufacturing brake linings, clutch facings,and disk pads. (P. 2/12) |
| Process description: | Figure 1 illustrates the sequence of operations duringthe reprocessing of automobile brakes and clutches.The main process consisted of four steps:Step 1. Stripping used brakes and clutches to piecesStep 2. Cleaning the brake shoes and clutch disksStep 3. Reassembling brakes and clutchesStep 4. Visual check and packing. (P. 4/12) |
| Number of sites: | three small-scale factories [in Japan] pg. 2/12 |
| Chemical concentration: | The chrysotile contents of these brake linings and clutch facings usually ranged from 40% to 60%. (P. 2/12) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Methodology | High | Peer reviewed and published paper in International Journal of Occupational and Environmental Health |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | Medium | The data are from an OECD country, Japan. |
| | Metric 3: Applicability | High | The report is for an occupational scenario within the scope of the risk evaluation. Processing of automobile components-Brake pads. |
| | Metric 4: Temporal Representativeness | Low | More than 20 years old data. |
| | Metric 5: Sample Size | Medium | Distribution of samples is characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | High | Assessment or report clearly documents its data sources, assessment methods, results, and assumptions. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Medium | The report provides only limited discussion of the variability and uncertainty in the results. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Salisbury, S., Koenig, J. (1989). Health hazard evaluation report no. HETA 87-0379-1977, Keebler Company, Atlanta, Georgia. |
| **HERO ID:** | 3097748 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Chemical concentration: | ”insulation material collected by NIOSH during the initial survey had been analyzed and was found to contain asbestos, ranging from 20-95% amosite and 5-15% chrysotile.”PDF Pg. 3 |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | Report uses high quality data/techniques/methods from frequently-used sources. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for construction, paint, electrical, and metal products, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: | Sample Size | Medium | Concentrations are given in a range. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | Variability addressed by giving ranges of asbestos concentrations in insulation by asbestos type but uncertainty is not addressed. |

## Overall Quality Determination — High

| | |
|---|---|
| **Study Citation:** | Sallemi, B. M. (2012). A life-time mortality risk analysis and cost benefit analysis associated with asbestos exposure from the collapse of the World Trade Center on 9/11: Does the cost of US-EPA's residential dust clean-up in lower Manhattan exceed its benefit?. |
| **HERO ID:** | 6897672 |
| **Conditions of Use:** | Other: |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Chemical concentration: | textile workers were reported to have been exposed to a dust comprised of 80% asbestos, while workers employed in the shipyards were exposed to a dust with as little as 15% asbestos (pg 17)The authors have stated that PCM sized fibers elutriated from textile dusts were 100% asbestos, meaning that the PCM and TEM data would be identical. Alternatively, 2/3 of the total dust elutriated from mining and milling operations was either non-asbestos, or non-asbestiform, while only 1/3 of the fibers were asbestos via TEM. (pg 36) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Methodology | Medium | Report uses high quality data that are not from frequently-used sources and there are no known quality issues. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | High | Data are from the U.S. |
| | Metric 3: Applicability | Low | Data are for upstream out-of-scope uses, but data may still be informative. |
| | Metric 4: Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: Sample Size | Low | Sample distribution is characterized by no statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | Medium | Methods, results, and assumptions are clearly documented, but underlying data sources are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Medium | Variability addressed by providing asbestos concentrations in dust for multiple industries and using different methods, but uncertainty is not addressed. |

## Overall Quality Determination — Low

| | |
|---|---|
| **Study Citation:** | Sallemi, B. M. (2012). A life-time mortality risk analysis and cost benefit analysis associated with asbestos exposure from the collapse of the World Trade Center on 9/11: Does the cost of US-EPA's residential dust clean-up in lower Manhattan exceed its benefit?. |
| **HERO ID:** | 6897672 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Chemical concentration: | A majority of the initial results were analyzed using polarized light microscopy, and returned results showing that the asbestos content of the settled dust and debris was less than 1% asbestos by weight. (pg 94) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | Medium | Report uses high quality data/techniques/methods that are not from frequently-used sources and there are no known quality issues. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for construction materials (9/11 cleanup), an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Medium | Report is based on data greater than 10 years old but no more than 20 years old and industry conditions that are expected to be representative of current industry conditions. |
| | Metric 5: | Sample Size | Medium | Sample distribution characterized by limited statistics (means, maximums) but discrete samples not provided and distribution not fully characterized. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Sanderson, W. T., Ferguson, R. P. (1987). Health Hazard Evaluation Report No. MHETA-85-226-1839, Freshlabs, Inc., Warren, Michigan. Division of Physical Sciences and Engineering(CT-147-19D):147-19. |
| **HERO ID:** | 3099464 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Chemical concentration: | ceiling insulation: 25% chrysotile asbestos and 75% mineral wool/cellulose fiber (pg 6)ceiling insulation was between 25-40% chrysotile in combination with mineral wool and cellulose (pg 9) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | Report uses high quality data/techniques/methods from frequently-used sources. (NIOSH HHE) |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for construction materials, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: | Sample Size | Medium | Sample distribution characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Sawyer, R. N. (1977). Asbestos exposure in a Yale building: Analysis and resolution. Environmental Research 13(1):146-169. |
| **HERO ID:** | 180 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Throughput: | In the building studied, 35,000 ft2 of ceiling were sprayed with asbestos fireproofing. (3/24) |
| Chemical concentration: | Chrysotile asbestos constituted approximately 15% by weight of sprayed gypsum board ceiling material. (3/24) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | Report uses high quality data from frequently-used sources. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for commercial use of building construction materials, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: | Sample Size | Medium | Sample distribution characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Scansetti, G., Pira, E., Botta, G. C., Turbiglio, M., Piolatto, G. (1993). Asbestos exposure in a steam-electric generating plant. Annals of Occupational Hygiene 37(6):645-653. |
| **HERO ID:** | 3093853 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Chemical concentration: | Lagging at a power plant was 9-96% chrysotile, 11-15% amosite, and 15-33% both. (3/9) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | Report uses high quality methods and data from frequently-used sources. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Medium | Data are from Italy, an OECD country. |
| | Metric 3: | Applicability | High | Data are for industrial use in construction materials, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: | Sample Size | Medium | Sample distribution characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | Uncertainty is addressed in bulk sampling methods. Variability isn't addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Scarlett, H. P., Postlethwait, E., Delzell, E., Sathiakumar, N., Oestenstad, R. K. (2012). Asbestos in public hospitals: Are employees at risk?. Journal of Environmental Health 74(6):22-26. |
| **HERO ID:** | 2566558 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Production, import, or use volume: | Chrysotile was the type that 90% of ACBM found in buildings in the U.S. and elsewhere |
| Number of sites: | 16 hospitals had asbestos containing building materials |
| Chemical concentration: | Distribution of Hospitals by type and Percentage of Fiberin Samples With CBM (Table 2, pg. 4 ) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | Report is a published journal article, a frequently used source, and associated information does not indicate flaws or quality issues. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Low | Data is for Jamaica, an non-OECD country. |
| | Metric 3: | Applicability | High | Report is for an occupational scenario (construction materials) within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | High | The report is generally no more than 10 years old (2012). |
| | Metric 5: | Sample Size | N/A | N/A- qualitative information |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | Assessment or report clearly documents its data sources, assessment methods, results, andassumptions. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | High | Variability addressed by measuring various hospitals and uncertainty can be determined from analytical method. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Scarselli, A., Corfiati, M., Di Marzio, D. (2016). Occupational exposure in the removal and disposal of asbestos-containing materials in Italy. International Archives of Occupational and Environmental Health 89(5):857-865. |
| **HERO ID:** | 3531414 |
| **Conditions of Use:** | Other: |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Production, import, or use volume: | No information was available for US. In Italy, since post-war period up to the ban introduced in 1992, 3,748,550 tons of raw asbestos were produced, with a peak of 160,000 tons per annum between 1976 and 1980. (pg 857) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Methodology | High | The assessment or report uses high quality data and/or techniques or sound methods that are from frequently used sources. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | Medium | The data are from an OECD country other than the U.S. |
| | Metric 3: Applicability | Uninformative | Manufacture is not in scope for the legacy risk evaluation. |
| | Metric 4: Temporal Representativeness | Low | Data is from more than 20 years ago. |
| | Metric 5: Sample Size | Low | Distribution of samples is characterized by no statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | Low | Underlying data sources are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Low | The report does not address variability or uncertainty. |

## Overall Quality Determination Uninformative

| | |
|---|---|
| **Study Citation:** | Scarselli, A., Marinaccio, A., Corfiati, M., Di Marzio, D., Iavicoli, S. (2020). Occupational asbestos exposure after the ban: a job exposure matrix developed in Italy. European Journal of Public Health 30(5):936-941. |
| **HERO ID:** | 6874951 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Number of sites: | 272 sites were included in this study. (2/6) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | Report uses high quality data from frequently-used sources. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Medium | Data are from Italy, an OECD country. |
| | Metric 3: | Applicability | High | Data are for commercial use of building construction materials, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | High | Report is based on current industry conditions and data no more than 10 years old. |
| | Metric 5: | Sample Size | Medium | Sample distribution characterized by limited statistics (number of sites) but discrete samples not provided and distribution not fully characterized. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | High | Uncertainty is addressed in the study's methods. Variability is addressed by separating out the number of firms in each occupation. |

## Overall Quality Determination — High

| | |
|---|---|
| **Study Citation:** | Schanamann, S. R. (1986). Air monitoring is not enough to estimate future asbestos hazards. Occupational Health and Safety 55(8):31-5, 55. |
| **HERO ID:** | 3083246 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Process description: | Switching on the ventilation system in a commercial building can re-entrain fibers that settle out in still air. In addition, heavy occupant traffic in a building can re-entrain asbestos fibers that have settled to the floor when the building was unoccupied. Roof leaks or plumbing leaks can weaken the water-soluble adhesive used with most spray applied ceiling insulation, causing it to become friable, loosen and in severe cases drop off the ceiling in large clumps. High humidity can also loosen asbestos insulation or make it friable. (3/6) |
| Number of sites: | More than 700,000 public and commercials buildings in the U.S. contain asbestos material in friable form. (1/6) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Methodology | High | Report uses high quality data from frequently-used sources. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | High | Data are from the U.S. |
| | Metric 3: Applicability | Low | Data are for commercial use of building construction materials, an in-scope occupational scenario. However, there is limited information applicable to legacy uses. |
| | Metric 4: Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: Sample Size | Medium | Sample distribution characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | Medium | Methods, results, and assumptions are clearly documented, but underlying data sources are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Schepers, G. W. (1991). The Veterans Administration's Asbestos Abatement Program. Annals of the New York Academy of Sciences 643:597-608. |
| **HERO ID:** | 3082251 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Chemical concentration: | Recently it has been revealed that shipments of "amosite" to the United States and Canada never stopped and that "amosite" started containing ever larger quantities of silica and crocidolite, suggesting that crocidolite was blended with amosite, thelethal mixture being sold as "amosite. " The industrial practice of mixing crocidolite into amosite became the more heinous after Wagner, Sleggs, and Marchand published their data on the facility with which crocidolite inhalation leads to malignant mesothelioma. Later it was revealed that in the United States amosite (and, in view of the foregoing considerations, potentially crocidolite as well) was being incorporated into building products such as wallboard, spackling, ceiling tiles, and pipe insulation. (p. 6)A cubic millimeter of chrysotile asbestos potentially can release into the ambient air between 25 and 250 billion asbestos fibers of effective size range (10 by 0.02 micrometers) for pathogenic action including cancer causation (p. 7) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Methodology | Low | Sampling/analytical methodology is not specified. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | High | Data are from the U.S. |
| | Metric 3: Applicability | High | Data are for construction materials, an in-scope occupational scenario. |
| | Metric 4: Temporal Representativeness | Low | Data are significantly greater than 20 years old. |
| | Metric 5: Sample Size | Low | Sample distribution is characterized by no statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | Low | Assessment or report provides results, but the underlying methods, data sources, and assumptions are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Low | The report does not address variability or uncertainty |

## Overall Quality Determination Low

| | |
|---|---|
| **Study Citation:** | Schroeder, P. W., Pekron, P. (1990). Asbestos abatement during major coke plant steelwork repairs. Ironmaking Conference Proceedings, vol. 49 :169-171. |
| **HERO ID:** | 6879303 |
| **Conditions of Use:** | Disposal |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Process description: | Oven doors were rebuilt, door jambs were replaced, buckstay backplates were replaced, coke side buckstays were replaced, pusher side buckstays were replaced, buckstay backplate springs were installed, and asbestos contaminated material were removed. (3/5) |
| Throughput: | The quantity of removed asbestos was 1000 ft2. (3/5) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | Medium | Report uses high quality data that are not from frequently-used sources and there are no known quality issues. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for asbestos abatement, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: | Sample Size | Medium | Sample distribution characterized by limited statistics (throughput) but discrete samples not provided and distribution not fully characterized. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Methods, results, and assumptions are clearly documented, but underlying data sources are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination — Medium

| | |
|---|---|
| **Study Citation:** | Scott, W. C., Estes, E. H., Jr, Coble, Y. D., Jr, Eisenbrey, A. B., Karlan, M. S., Kennedy, W. R., Moulton, M. P., Numann, P. J., Skelton, W. D., Steinhilber, R. M., Strong, J. P., Wagner, H. N., Jr, Wheater, R. H., Doege, T. C. (1991). Asbestos removal, health hazards, and the EPA. JAMA: Journal of the American Medical Association 266(5):696-697. |
| **HERO ID:** | 3613449 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Number of sites: | 733,000 sites (ie, 20% of all government, residential, and private nonresidential buildings) contain some form of friable asbestos (pg 1) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | Report uses high quality data/techniques/methods from frequently-used sources. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for construction materials, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: | Sample Size | Low | Distribution of samples is qualitative or characterized by no statistics. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Methods, results, and assumptions are clearly documented, but underlying data sources are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Sebastien, P., Billon, M. A., Dufour, G., Gaudichet, A., Bonnaud, G., Bignon, J. (1979). Levels of asbestos air pollution in some environmental situations. Annals of the New York Academy of Sciences 330:401-415. |
| **HERO ID:** | 6867234 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Production, import, or use volume: | Prior to France banning the use of >1% asbestos in sprayed-on materials, 4,500,000 m2 of asbestos had been sprayed inside buildings. (3/15) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | Report uses high quality methods and data from frequently-used sources. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Medium | Data are from France, an OECD country. |
| | Metric 3: | Applicability | High | Data are for commercial use in construction materials, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: | Sample Size | Medium | Sample distribution characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Selikoff, I. J., Churg, J., Hammond, E. C. (1965). Relation between exposure to asbestos and mesothelioma. New England Journal of Medicine 272:560-565. |
| **HERO ID:** | 3085120 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Chemical concentration: | Insulation blocks and cements may contain 10-15% asbestos. (2/6) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | Report uses high quality methods and data from frequently-used sources. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for commercial use in construction materials, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: | Sample Size | Medium | Sample distribution characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Senate Committee on Public Works, (1986). Hazardous asbestos abatement. Hearing before the Subcommittee on Toxic Substances and Environmental Oversight of the Committee on Environment and Public Works, United States Senate, Ninety-ninth Congress, second session, on S. 2083 and S. 2300 bills providing for the abatement of hazardous asbestos, May 15, 1986. |
| **HERO ID:** | 6865629 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Number of sites: | APPROXIMATELY 31,000 SCHOOLS AND 733,000 PUBLIC BUILDINGS CONTAIN ASBESTOS THAT COULD BE HAZARDOUS TO PUBLIC HEALTH .Asbestos containing materials were found in 75 percent of 336 Vermont schools constructed of renovated between 1946 and 1974 (p. 36) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | The report uses high quality data from frequently used sources (U.S. Senate report) and are generally accepted by the scientific community, and associated information does not indicate flaws or quality issues. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | The data are from the United States and are representative of the industry being evaluated. |
| | Metric 3: | Applicability | Medium | The report is for an occupational scenario that is similar to an occupational scenario within the scope of the risk evaluation, in terms of the type of operations and work activities. |
| | Metric 4: | Temporal Representativeness | Low | The report is more than 20 years old. The report captures operations, equipment, and worker activities that are expected to be outdated. |
| | Metric 5: | Sample Size | N/A | n/a - no sampling data in the report |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | Assessment or report clearly documents its data sources, assessment methods, results, and assumptions. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | The report does not address variability or uncertainty. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Senior Labour Inspectors Committee, (2006). A practical guide on best practices to prevent or minimise asbestos risks in work that involves (or may involve) asbestos: for the employer, the workers, and the labour inspector.. |
| **HERO ID:** | 3982341 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Furnishing, Cleaning, Treatment Care Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Production, import, or use volume: | Between 300,000-400,000 tonnes consumed in Europe in 2000 (Figure 2.1) |
| Chemical concentration: | Table 4.1Sprayed coatings (85%), loose-fill (may be 100%), lagging and packing (1-100% asbestos), asbestos insulating boards (16-40%), ropes/yarns (may be 100%), cloth (may be 100%), millboard, paper, and paper products (90-100%), asbestos cement (10-15%), asbestos bitumen products (may be up to 5%), flooring material (may be up to 25%), textured coatings and paints (may contain 1-5% asbestos); mastics, sealants, adhesives (5-10%) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | The assessment or report uses high quality data and/or techniques or sound methods that are from frequently used sources (European Union) and are generally accepted by the scientific community, and associated information does not indicate flaws or quality issues. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Medium | The data are from an OECD country other than the U.S., and locality-specific factors (e.g., potential differences in regulatory occupational exposure or emission limits, industry/ processtechnologies) may impact exposures or releases relative to the U.S. |
| | Metric 3: | Applicability | High | The report is for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Medium | The report captures operations, equipment, and worker activities that are expected to be reasonably representative of current conditions. The report is generally more than 10 years but no more than 20 years old. |
| | Metric 5: | Sample Size | N/A | N/A - no sampling data |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | Assessment or report clearly documents its data sources, assessment methods, results, and assumptions. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | The report provides only limited discussion of the variability and uncertainty in the results. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Senior Labour Inspectors Committee, (2006). A practical guide on best practices to prevent or minimise asbestos risks in work that involves (or may involve) asbestos: for the employer, the workers, and the labour inspector.. |
| **HERO ID:** | 3982341 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Production, import, or use volume: | Between 300,000-400,000 tonnes consumed in Europe in 2000 (Figure 2.1) |
| Chemical concentration: | Table 4.1Sprayed coatings (85%), loose-fill (may be 100%), lagging and packing (1-100% asbestos), asbestos insulating boards (16-40%), ropes/yarns (may be 100%), cloth (may be 100%), millboard, paper, and paper products (90-100%), asbestos cement (10-15%), asbestos bitumen products (may be up to 5%), flooring material (may be up to 25%), textured coatings and paints (may contain 1-5% asbestos); mastics, sealants, adhesives (5-10%) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | The assessment or report uses high quality data and/or techniques or sound methods that are from frequently used sources (European Union) and are generally accepted by the scientific community, and associated information does not indicate flaws or quality issues. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Medium | The data are from an OECD country other than the U.S., and locality-specific factors (e.g., potential differences in regulatory occupational exposure or emission limits, industry/ processtechnologies) may impact exposures or releases relative to the U.S. |
| | Metric 3: | Applicability | High | The report is for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Medium | The report captures operations, equipment, and worker activities that are expected to be reasonably representative of current conditions. The report is generally more than 10 years but no more than 20 years old. |
| | Metric 5: | Sample Size | N/A | N/A - no sampling data |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | Assessment or report clearly documents its data sources, assessment methods, results, and assumptions. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | The report provides only limited discussion of the variability and uncertainty in the results. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Senitkova, I., Stevulova, N. (1999). Indoor pollution by asbestos and man-made mineral fibers. :613-618. |
| **HERO ID:** | 6863279 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Chemical concentration: | floor tile and sheet: 20-30% asbestoscement pipe: 20-30% paper pipe wrap: 70-80%sprayed, trowelled insulation: 50-70% (Table 2 pg 5) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | Medium | Report uses high quality data/techniques/methods that are not from frequently-used sources and there are no known quality issues. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Medium | Data are from Slovakia, an OECD country. |
| | Metric 3: | Applicability | High | Data are for construction materials, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: | Sample Size | Medium | Sample distribution characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Methods, results, and assumptions are clearly documented, but underlying data sources are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Sepulveda, M.,-J, Piacitelli, L. (1981). Health hazard evaluation report no. HHE 81-028-1059, Consolidated Railorad Corporation, Reading, Pennsylvania. |
| **HERO ID:** | 3970499 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Chemical concentration: | Lagging was 15% asbestos. (2/9) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Methodology | High | Report uses high quality methods and data from frequently-used sources. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | High | Data are from the U.S. |
| | Metric 3: Applicability | High | Data are for commercial use in building construction materials, an in-scope occupational scenario. |
| | Metric 4: Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: Sample Size | Medium | Sample distribution characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Sheehan, P., Mowat, F., Weidling, R., Floyd, M. (2010). Simulation tests to assess occupational exposure to airborne asbestos from artificially weathered asphalt-based roofing products. Annals of Occupational Hygiene 54(8):880-892. |
| **HERO ID:** | 2581178 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Chemical concentration: | Asbestos concentration ranged from 3.04% to 15.5% in the products. |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | The assessment or report uses high quality data and/or techniques or sound methods that are from frequently used sources. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | The data are from the United States. |
| | Metric 3: | Applicability | High | The report is for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Medium | The report is generally more than 10 years but no more than 20 years old. |
| | Metric 5: | Sample Size | N/A | No sample data. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | Assessment or report clearly documents its data sources, assessment methods, results, and assumptions. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | N/A | No scope to address variability and uncertainty. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Sheers, G., Coles, R. M. (1980). Mesothelioma risks in a naval dockyard. Archives of Environmental Health 35(5):276-282. |
| **HERO ID:** | 3084124 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Chemical concentration: | I n the case of a sprayer, the total fiber count was485,900/mg lung tissue, 93% being crocidolite, 4% amosite,and 2% chrysotile. In two shipwrights the total countswere 22,300 and 11,100 with 87% and 69% crocidolite,10% and 18% amosite, and 2% and 9% chrysotile, respectively.For an electrical fitter the total count was 83,900 with 76% crocidolite, 16% amosite, and 7% chrysotile. |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Methodology | Medium | Sampling or analytical methodology is not specified but it is assumed to be PCM. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | The data are from the United States |
| Metric 3: | Applicability | High | The report is for an occupational scenario |
| Metric 4: | Temporal Representativeness | Low | The report is more than 20 years old. |
| Metric 5: | Sample Size | Medium | Distribution of samples is characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | High | Assessment or report clearly documents its data sources, assessment methods, results, and assumptions. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Medium | The report provides only limited discussion of the variability and uncertainty in the results. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Shell Oil, (1985). Interoffice memorandum regarding asbestos monitoring results for Transite Clad Biotreater Buildings with attachments and cover sheet. |
| **HERO ID:** | 4158388 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Chemical concentration: | Transite siding was 30% chrysotile. (3/6) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | Medium | Report uses high quality data that are not from frequently-used sources and there are no known quality issues. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for commercial use in building construction materials, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: | Sample Size | Medium | Sample distribution characterized by limited statistics (percentages) but discrete samples not provided and distribution not fully characterized. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Methods, results, and assumptions are clearly documented, but underlying data sources are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination — Medium

| | |
|---|---|
| **Study Citation:** | Silver, K. Z. (1979). Asbestos in school buildings: Results of a nation-wide survey. Annals of the New York Academy of Sciences, vol. 330 :777-786. |
| **HERO ID:** | 3655624 |
| **Conditions of Use:** | Consumer Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Number of sites: | 25 schools with sprayed-on asbestos ceiling material in SD, 250 in NJ, 26 in CT, 86 in MA (3-5/10) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | Medium | Report uses high quality data that are not from frequently-used sources and there are no known quality issues. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | Low | Data are for consumer use in construction materials, which is similar to the in-scope occupational scenario commercial use of construction materials. |
| | Metric 4: | Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: | Sample Size | Medium | Sample distribution characterized by limited statistics (number of sites) but discrete samples not provided and distribution not fully characterized. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | Uncertainty isn't addressed. Variability is addressed by comparing ACM-containing buildings in different states. |

## Overall Quality Determination — Medium

| | |
|---|---|
| **Study Citation:** | Smith, R. J. (1979). State officials alerted to school asbestos hazard. Science 204(4390):285. |
| **HERO ID:** | 3615915 |
| **Conditions of Use:** | Consumer Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Number of sites: | Study in NJ: 10 percent of the schools were found to contain sprayed asbestos |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | Medium | The assessment or report uses high quality data and/or techniques or sound methods that are not from a frequently used source and associated information does not indicate flaws or quality issues. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | The data are from the United States. |
| | Metric 3: | Applicability | Low | The report is for a non-occupational scenario that is similar to an occupational scenario within the scope of the risk evaluation, such as a consumer DIY scenario that is similar to a worker scenario. |
| | Metric 4: | Temporal Representativeness | Low | The report is more than 20 years old. The report captures operations, equipment, and worker activities that are expected to be outdated. |
| | Metric 5: | Sample Size | N/A | N/A - no sampling data |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Low | Assessment or report provides results, but the underlying methods, data sources, and assumptions are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | The report does not address variability or uncertainty. |

## Overall Quality Determination — Low

| | |
|---|---|
| **Study Citation:** | Smither, W. J. (1979). Surveillance of high-risk groups–a survey of asbestos workers: The present position in the United Kingdom. Annals of the New York Academy of Sciences 330(1):525-532. |
| **HERO ID:** | 3084370 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Products not Described by Other Codes |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Chemical concentration: | (pg 528; Table 3)Approximate asbestos content in different products (%) are as follows (only limited examples are provided): Asbestos Cement: corrugated sheets - 10-12; flat sheets - 10-12; moulded and extruded products - 12-15; pipes - 12-15; low density panels - 25-40; Asbestos Insulation Board: building applications - 25-40; marina applications - 25-40; sprayed asbestos insulation - 50; |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | Low | The data and data sources used in the report are not specified. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Medium | The data are from an OECD country other than the U.S. |
| | Metric 3: | Applicability | High | The report is for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Low | The report is more than 20 years old. |
| | Metric 5: | Sample Size | Low | Distribution of samples is characterized by no statistics. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Low | Report provides results, but the data sources are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | The report does not address variability or uncertainty. |

## Overall Quality Determination Low

| | |
|---|---|
| **Study Citation:** | Smolianskiene, G., Adamoniene, D., Seskauskas, V. (2005). Studies on occupational asbestos in Lithuania: Achievements and problems. Indoor and Built Environment 14(3-4):331-335. |
| **HERO ID:** | 3581050 |
| **Conditions of Use:** | Other: |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Production, import, or use volume: | At the present time, the amount of asbestos produced worldwide is about 2 million tons per year which is almost entirely chrysotile. (1/5) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Methodology | Medium | Report uses high quality data that are not from frequently-used sources and there are no known quality issues. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | Medium | Data are from Lithuania, an OECD country. |
| | Metric 3: Applicability | Uninformative | Data are for manufacture of asbestos, which is not in scope. |
| | Metric 4: Temporal Representativeness | Medium | Report is based on data greater than 10 years old but no more than 20 years old and industry conditions that are expected to be representative of current industry conditions. |
| | Metric 5: Sample Size | Medium | Sample distribution characterized by limited statistics (production value) but discrete samples not provided and distribution not fully characterized. |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Uninformative

| | |
|---|---|
| **Study Citation:** | Spasiano, D., Pirozzi, F. (2017). Treatments of asbestos containing wastes. Journal of Environmental Management 204(Pt 1):82-91. |
| **HERO ID:** | 6865998 |
| **Conditions of Use:** | Disposal |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Production, import, or use volume: | The authority for waste management in Flanders reported that the amount of ACM is 3.7E6 tons, with 1.9E6 tons in buildings and 1/8E6 in utility pipelines. (2/10) |
| Chemical concentration: | Settled dust after 9/11 was 0.8-3.0% asbestos. (2/10) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | Report uses high quality methods and data from frequently-used sources. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Medium | Data are from Italy, an OECD country. |
| | Metric 3: | Applicability | High | Data are for disposal of asbestos products, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | High | Report is based on current industry conditions and data no more than 10 years old. |
| | Metric 5: | Sample Size | Medium | Sample distribution characterized by limited statistics (production volumes, ranges) but discrete samples not provided and distribution not fully characterized. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination — High

| | |
|---|---|
| **Study Citation:** | Spencer, J. W., Plisko, M. J., Balzer, J. L. (1999). Asbestos fiber release from the brake pads of overhead industrial cranes. Applied Occupational and Environmental Hygiene 14(6):397-402. |
| **HERO ID:** | 3615974 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Process description: | The first shift duty cycle included eight steps, with a totalcycle time of approximately six minutes per cycle. This resultedin a frequency of 10 duty cycles per hour. The first shift dutycycle included the following steps:1. main hoist lowering 15 feet unloaded2. main hoist raising 15 feet under load with 2 'jogs' (i.e.,engage brakes)3. trolley motion 12 span (20 feet)4. bridge motion of 80 feet5. trolley motion 12 span (20 feet)6. main hoist lowering 15 feet under load with 2±3 jogs7. reverse above 5 steps unloaded8. crane remained stationary for 3 minutes |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Methodology | High | The assessment or report uses high quality data. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | The data are from the United States. |
| Metric 3: | Applicability | High | The report is for an occupational scenario within the scope of the risk evaluation. |
| Metric 4: | Temporal Representativeness | High | The report is more than 20 years old. |
| Metric 5: | Sample Size | N/A | Process description. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Medium | Assessment or report clearly documents results, methods, and assumptions |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Low | The report does not address variability or uncertainty. |

## Overall Quality Determination — High

| | |
|---|---|
| **Study Citation:** | Spurny, K. R. (1989). Asbestos Fibre Release by Corroded and Weathered Asbestos-Cement Products. IARC Scientific Publications occupational Exposure to Mineral Fibres(90):367-371. |
| **HERO ID:** | 3098454 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Production, import, or use volume: | world consumption of asbestos >6 million tons/year (PDF pg 1) |
| Chemical concentration: | 11-12% (PDF pg 1) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | Low | Report does not specify the data/techniques/methods used. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Medium | Data are from Germany, an OECD country. |
| | Metric 3: | Applicability | High | Data are for construction materials, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: | Sample Size | Medium | Distribution of samples is characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Low | Assessment results are provided but underlying methods, assumptions, and data sources are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | The report does not address variability or uncertainty. |

## Overall Quality Determination — Low

| | |
|---|---|
| **Study Citation:** | Spurny, K. R. (1989). On the release of asbestos fibers from weathered and corroded asbestos cement products. Environmental Research 48(1):100-116. |
| **HERO ID:** | 380 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Production, import, or use volume: | World consumption of asbestos amounts to more than 6 megatons per year (Page 1). Source is published in 1989 so can assume this is the year PV they are referring to.Estimated in Germany there are 10^9 m^2 asbestos cement products and 10^10 m^2 asbestos cement products in West Europe. (Page 2). |
| Chemical concentration: | Asbestos cement prodcuts (i.e., roof tiles) contain up to 11-12% asbestos.The sizes for approximately 3E4 asbestos fibers were measured and evaluated from roofing tiles during this investigation. The measured and analyzed mineral fibers consist of 30% chrysotile and 25% amphiboles. |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Methodology | Medium | The assessment or report uses high quality data and/or techniques or sound methods that are not from a frequently used source and associated information does not indicate flaws or quality issues. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | Medium | The data are from an OECD country other than the U.S. |
| | Metric 3: Applicability | High | The report is for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: Temporal Representativeness | Low | The report is more than 20 years old. |
| | Metric 5: Sample Size | Medium | Distribution of samples is characterized by a range with uncertain statistics. It is unclear if analysis is representative. |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | Medium | Assessment or report clearly documents results, methods, and assumptions. Data sources are generally described but not fully transparent. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Medium | The report provides only limited discussion of the variability and uncertainty in the results. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Spurny, K. R. (1988). On the emission of fibrous particles from corroded asbestos-cement products. :205-208. |
| **HERO ID:** | 44608 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Chemical concentration: | Asbestos cement products, e.g. roof tiles, contain as much as 11 to15 % of chrysotile or amphibole asbestos (p. 1) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | Medium | The assessment or report uses high quality data and/or techniques or sound methods that are not from a frequently used source and associated information does not indicate flaws or quality issues. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Medium | The data are from an OECD country other than the U.S., and locality-specific factors (e.g., potential differences in regulatory occupational exposure or emission limits, industry/ processtechnologies) may impact exposures or releases relative to the U.S. |
| | Metric 3: | Applicability | High | The report is for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Low | The report is more than 20 years old. The report captures operations, equipment, and worker activities that are expected to be outdated. |
| | Metric 5: | Sample Size | Low | Distribution of samples is qualitative or characterized by no statistics. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Assessment or report clearly documents results, methods, and assumptions. Data sources are generally described but not fully transparent. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | The report does not address variability or uncertainty. |

## Overall Quality Determination — Low

| | |
|---|---|
| **Study Citation:** | Standard Oil Company of California, (1979). Measurements of airborne asbestos in building one with cover letter and attachment. |
| **HERO ID:** | 3649379 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Chemical concentration: | Bulk samples of insulation on a cargo ship were ND-10%. (13/189) Bulk samples of pipe lagging at a refinery were 3-20%. (109/189) Bulk samples of insulation on a ship were 60-70% chrysotile asbestos and samples of pipe lagging were 10-15% amosite. (121/189) A bulk sample of insulation in a building were 3-5% chrysotile. (173/189) Bulk loose insulation at a refinery was 10-40% chrysotile and 5-20% amosite. (181/189) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Methodology | High | Report uses high quality methods and data from frequently-used sources. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | High | Data are from the U.S. |
| | Metric 3: Applicability | High | Data are for industrial use in construction materials, an in-scope occupational scenario. |
| | Metric 4: Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | Medium | Methods, results, and assumptions are clearly documented, but underlying data sources are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | High | Uncertainty is addressed in bulk sampling methods. Variability is addressed by sampling many locations. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Standard Oil, (1972). ASB dust survey of several insulation operations Richmond Refinery. |
| **HERO ID:** | 4158130 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Chemical concentration: | [PDF Pg. 4] The insulation was typically Johns-Manville "Thermobestos" or equivalent, containing about 15% asbestos in precast pipe forms or blocks. |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | Report uses high quality data/techniques/methods from frequently-used sources. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for Chemical Substances in Construction, Paint, Electrical, and Metal Products, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: | Sample Size | Low | Sample distribution is characterized by no statistics. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Methods, results, and assumptions are clearly documented, but underlying data sources are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Standard Oil, (1981). Occupational health survey El Segundo Refinery. |
| **HERO ID:** | 4158146 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Chemical concentration: | 2 bulk samples of asbestos insulation used in petroleum processing equipment (p. 6)1.) 30-40% chrysotile, 10-20% amosite; total: 40-60% asbestos2.) 10-20% chrysotile, 5-10% amosite; total: 15-30% asbestos |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Methodology | Medium | The assessment or report uses high quality data and/or techniques or sound methods that are not from a frequently used source and associated information does not indicate flaws or quality issues. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | High | The data are from the United States and are representative of the industry being evaluated. |
| | Metric 3: Applicability | High | The report is for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: Temporal Representativeness | Low | The report is more than 20 years old. The report captures operations, equipment, and worker activities that are expected to be outdated. |
| | Metric 5: Sample Size | Low | Distribution of samples is qualitative or characterized by no statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | Low | Assessment or report provides results, but the underlying methods, data sources, and assumptions are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Medium | The report provides only limited discussion of the variability and uncertainty in the results. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Standard Oil, (1981). Report correction to indus hygiene report dated 101581. |
| **HERO ID:** | 4158156 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Chemical concentration: | Bulk samples from cracker insulation were 5-20% amosite and 3-20% chrysotile. (4/9) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | Medium | The assessment or report uses high quality data and/or techniques or sound methods that are not from a frequently used source and associated information does not indicate flaws or quality issues. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for asbestos concentrations in refinery insulation. |
| | Metric 4: | Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: | Sample Size | Medium | Sample distribution characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Methods, results, and assumptions are clearly documented, but underlying data sources are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | Variability is addressed by sampling different insulation around the plant. Uncertainty is not characterized. |

## Overall Quality Determination — Medium

| | |
|---|---|
| **Study Citation:** | Standard Oil, (1981). Sampling results airborne asbestos survey with attachments. |
| **HERO ID:** | 4158159 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Chemical concentration: | pg 5: 60-70% chrysotile; 30-40% calcite (nonasbestos)pg 6: engine room pipe insulation: 10-15% amosite, 1-3% chrysotile, 82-89% calcite (nonasbestos)deck pump steam valve: 10-15% chrysotile, 85-90% calcite (nonasbestos) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | Medium | Report uses high quality data/techniques/methods that are not from frequently-used sources and there are no known quality issues. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for construction materials, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: | Sample Size | Medium | Sample distribution characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Methods, results, and assumptions are clearly documented, but underlying data sources are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | Variability addressed by sampling different types of asbestos insulation but uncertainty is not addressed. |

## Overall Quality Determination — Medium

| | |
|---|---|
| **Study Citation:** | Standard Oil, (1982). Industrial hygiene survey to identify potential health hazards of airborne contaminants. |
| **HERO ID:** | 4158161 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Chemical concentration: | duct insulation: 60-70% asbestos (chrysotile) (pg 43-44) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | Medium | Report uses high quality data/techniques/methods that are not from frequently-used sources and there are no known quality issues. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for construction materials, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: | Sample Size | Medium | Sample distribution characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Low | Assessment results are provided but underlying methods, assumptions, and data sources are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | State of North Carolina Office of State Personnel, (2000). OSHA training for workers and their supervisors who remove intact resilient asbestos-containing flooring. |
| **HERO ID:** | 3981065 |
| **Conditions of Use:** | Disposal |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Process description: | Inform workers who will remove the flooring, employer of employees working in the area and the building owner that Asbestos containing flooring has been identified.Demarcate the identified regulated area with signage.Vacuum the entire flooring using a HEPA vacuumSeparate carpet from tile underlayment (if needed) If possible removal the whole flooring: wood underlayment and flooring. This can be accomplished by cleaning the whole area with a HEPA vacuum and wet the surface with a mixture of water and detergent. Remove a 4-8 inch strip by one wall to identify the underlayment joints. Next, make a series of 4-8 inch wide strips cented over the underlayment joints. Continue for the entire floor. Pry up a corner of the strip farthest from the entrance – separating the backing from the wear surface. Remove and store each strip for disposal. Pry up individually tilesHeat can be used to loosen the adhesive followed by hand scraping under damp conditions. Start on the less trafficked area by carefully wedging the scraper in the seam of two adjoining tiles and gradually forcing the edge of one tile up and away. Continue with the next tile. Removed tiles are placed in a heavy-duty impermeable trash bad of leak tight container. It the tile will not come up apply heat to loosen the adhesive. It is possible to heat larger areas of flooring time using a hot air gun or infrared heat machine.Water with detergent can be applied to remove asphaltic cut back adhesives. Moisten an area 3ft by 10 ft. wet scrape with a stiff bladed wall or floor scraper. Place loosen adhesives in a leak proof container. To completely remove any remaining cutback adhesive, create a slurry of sand, water and detergent. Apply the slurry in 6 ft by 6 ft sections. Use a terrazzo floor machine to the section that the slurry was applied. Clean edge of room using a rubbing stone. Collect the wet used sand and adhesive and store in leak proof container for disposal. Alternatively, a floor buffing machined with floor stripping solution can be used to remove remaining adhesive. Apply a ethanolamine stripper to a 6 ft by 6 ft area. Allow 5 minutes to soak. Remove using a floor cleaning machine equipped with a 3M black floor pad. Areas around the edges can be addressed by using a hand held piece of the black flooring pad. Collect the waste adhesive and store in leak proof container for disposal.Sheet flooring removal is accomplished by slicing the vinyl flooring in 4-8 inch strips, peeling and rolling the wear layer while wetting the nip point with liquid detergent solution and scraping the residual backing. Dispose of strip in a leak proof container an repeat process. This will leave the flooring felt which can be removed by wet scrapping using a stiff-bladed scraper. Put the wet sections of felt in the leak proof container.The processes is similar for loose lay and peripherally adhered sheet flooring except that the strips can be 18 inches wide.Once all the flooring and adhesives have been removed, the site is vacuumed with a HEPA vacuum.The underlayment boards can now be removed by loosening the boards using a hammer and chisel. To pry up the underlayment. Moisten the surface through out the process. Each removed section should be quickly wrapped in 6 mil plastic sheeting and disposed. Vacuum remaining subflooring. Label waste for disposal ”Danger. Contains asbestos fibers. Avoid creating dust. Cancer and lung disease hazard.” And send to an approved land fill. |
| Chemical concentration: | Roofing felts 10-15% (early products) up to 45%Concrete from 10% upSiding shingles and panels 50% Ceiling tiles about 10%Spray on asbestos - 10-50%flooring tiles 10-20% |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Methodology | High | OSHA training |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | US |
| Metric 3: | Applicability | High | The report is for an occupational scenario (asbestos conatinaing flooring removal) within the scope of the risk evaluation. |
| Metric 4: | Temporal Representativeness | Medium | 2000- after PEL but more than 20 years old |
| Metric 5: | Sample Size | Medium | Concentrations are provided as ranges |
| Domain 3: Accessibility/ Clarity | | | |

**Continued on next page . . .**

. . . continued from previous page

**Study Citation:** State of North Carolina Office of State Personnel, (2000). OSHA training for workers and their supervisors who remove intact resilient asbestos-containing flooring.
**HERO ID:** 3981065
**Conditions of Use:** Disposal

| | | EVALUATION | | |
|---|---|---|---|---|
| Domain | | Metric | Rating | Comments |
| | Metric 6: | Metadata Completeness | Low | not sure where the concentration data are coming from |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | Variability is represented in the range values provided, lots of unreferenced comments on uncertainty but nothing about the uncertainty of the concentration data. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Stevens, W. H. (1997). Thermal removal of asbestos pipeline coating. Pipeline and Gas Journal 224(3):41-43. |
| **HERO ID:** | 3582345 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Process description: | The asbestos workers slice the length of the pipe's coating longitudinally at the 12:00 position with a razor knife. The coating is sprayed with water, then the heater is turned on. After heating for 30-60 seconds, there is visual indication (shriveling, drooping or even falling to the ground) that the coating is detached from the pipe's primed surface. The crew begins manually peeling the coating off. A rubber-tired front end loader with a clamping fork lifts the asbestos-free pipe and stacks it in the clean pipe area.The asbestos crew gathers the "sheets" of coal tar coating and asbestos wrap from the concrete floor and places them in a bladder bag-lined rolloff box. Once or more each working day the concrete surface is wetted, cleaned and the water is drawn up, filtered and discharged.Asbestos crews periodically inspect the ground around all stackedpipe, machinery pathways, pipe staging and cleaning areas for loose coating fragments. When found, fragments are picked up, bagged and disposed. [PDF Pg. 3] |
| Throughput: | The heat method, as described. removed the asbestos-containing coating from 17 miles of pipe in 68 calendar days without regulatory compliance (asbestos & opacity inspections) problems, damage or injury incidents or public complaints at a cost of approximately $4.30 per foot. [PDF Pg. 3] |
| Chemical concentration: | Outer pipeline wrap contains 35-65% chrysotile asbestos. [PDF Pg. 1] |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Methodology | High | Report uses high quality data/techniques/methods from frequently-used sources. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | High | Data are from the U.S. |
| | Metric 3: Applicability | High | Data are for Chemical Substances in Construction, Paint, Electrical, and Metal Products, an in-scope occupational scenario. |
| | Metric 4: Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: Sample Size | N/A | N/A - Process Description. |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | Medium | Methods, results, and assumptions are clearly documented, but underlying data sources are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Low | The report does not address variability or uncertainty. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Stewart Industrial Hygiene & Safety, (1982). Johns-Manville airborne asbestos evaluation Sibley Missouri. |
| **HERO ID:** | 4158255 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Process description: | The material , being removed was covered with tar paper reinforced with ”chicken wire.” This first had to be cut and pulled away before the asbestos-containing material was exposed. Everything was pulled off by hand and put in labelled bags. A lot of dust was generated in this process. Some pieces of the insulation.would also fall to the ground. [PDF Pg. 7] |
| Chemical concentration: | Bulk sample showed a concentration of ~40% amosite asbestos and <1% chrysotile. [PDF Pg. 8] |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Methodology | High | Report uses high quality data/techniques/methods from frequently-used sources. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | High | Data are from the U.S. |
| | Metric 3: Applicability | High | Data are for Chemical Substances in Construction, Paint, Electrical, and Metal Products, an in-scope occupational scenario. |
| | Metric 4: Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: Sample Size | Low | Sample distribution is characterized by no statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Stone, T. (1986). The hazards of asbestos. American City & County 101(2):68-75. |
| **HERO ID:** | 3659753 |
| **Conditions of Use:** | Consumer Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Production, import, or use volume: | 1.2 billion square feet of asbestos was present in public and private buildings as of 1986. (1/5) |
| Number of sites: | The article estimates that asbestos is still present in 770,000 public and private buildings in the U.S. (1/5) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Methodology | High | Report uses high quality methods and data from frequently-used sources. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | Data are from the U.S. |
| Metric 3: | Applicability | Low | Data are for consumer use of construction materials, which is similar to commercial use of construction materials, an in-scope occupational scenario. |
| Metric 4: | Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| Metric 5: | Sample Size | Medium | Sample distribution characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Medium | Methods, results, and assumptions are clearly documented, but underlying data sources are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Straub, W. E. (1976). Health hazard evaluation report no. HETA 76-4-310, ACF Industries, Amcar Division, Milton, PA. |
| **HERO ID:** | 3970493 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Furnishing, Cleaning, Treatment Care Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Process description: | Welding of the rail car under-carriage to the tank body, during which time a five-by-eight foot protective blanket is placed over the wheel and axle of the under-carriage. The blanket is used to protect the wheel and axle from any stray or accidental arc during welding that might occur, damaging the point of contact. In all cases, the working space is limited and the worker must come in close contact with the blanket to perform weld. With time, the blankets become worn resulting in some sloughing-off. (2/6) |
| Chemical concentration: | The blanket was 80-85% chrysotile. (2/6) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Methodology | High | Report uses high quality methods and data from frequently-used sources. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | High | Data are from the U.S. |
| | Metric 3: Applicability | High | Data are for industrial use in textiles, an in-scope occupational scenario. |
| | Metric 4: Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: Sample Size | Medium | Sample distribution characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Straub, W. E. (1976). Health hazard evaluation report no. HETA 76-4-310, ACF Industries, Amcar Division, Milton, PA. |
| **HERO ID:** | 3970493 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Packaging, Paper, Plastic, Toys, Hobby Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Process description: | The first area involved cutting three to four inch wide strips of asbestos paper board on a band saw. The strips were cut to length by hand and placed over a layer of fibrous glass insulation in place on the inner shell of a double wall tank. The asbestos strip protects the fibrous glass when the outer shell of the tank car is welded in place. (2/6) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | Report uses high quality methods and data from frequently-used sources. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for industrial use in paper products, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: | Sample Size | N/A | Process description. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Sullivan, R. J. (1969). Air pollution aspects of asbestos. |
| **HERO ID:** | 6865572 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Chemical concentration: | Table 13 (p. 87)Asbestos textiles: 80-100%Asbestos cement: 15-90%Friction materials and gaskets: 30-80%Asbestos paper and products: 80-90%Floor tile: 10-30% |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Methodology | Medium | The assessment or report uses high quality data and/or techniques or sound methods that are not from a frequently used source and associated information does not indicate flaws or quality issues. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | The data are from the United States and are representative of the industry being evaluated. |
| Metric 3: | Applicability | High | The report is for an occupational scenario within the scope of the risk evaluation. |
| Metric 4: | Temporal Representativeness | Low | The report is more than 20 years old. The report captures operations, equipment, and worker activities that are expected to be outdated. |
| Metric 5: | Sample Size | Medium | Distribution of samples is characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | High | Assessment or report clearly documents its data sources, assessment methods, results, and assumptions. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Medium | The report provides only limited discussion of the variability and uncertainty in the results. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Sussell, A., Shults, R. (1993). Health hazard evaluation report no. HETA 91-053-2320, Union Tank Car, Cleveland, Texas. |
| **HERO ID:** | 3970487 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Chemical concentration: | Valve gaskets were 90% chrysotile asbestos (p. 15) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | The assessment or report uses high quality data and/or techniques or sound methods that are from frequently used sources (NIOSH HHEs) and are generally accepted by the scientific community, and associated information does not indicate flaws or quality issues. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | The data are from the United States and are representative of the industry being evaluated. |
| | Metric 3: | Applicability | High | The report is for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Low | The report is more than 20 years old. The report captures operations, equipment, and worker activities that are expected to be outdated. |
| | Metric 5: | Sample Size | N/A | N/A - no sampling data |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | Assessment or report clearly documents its data sources, assessment methods, results, and assumptions. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | The report provides only limited discussion of the variability and uncertainty in the results. |

## Overall Quality Determination — High

| | |
|---|---|
| **Study Citation:** | Szeszenia-Dąbrowska, N., Swiątkowska, B., Szubert, Z., Wilczyńska, U. (2011). Asbestos in Poland: occupational health problems. International Journal of Occupational Medicine and Environmental Health 24(2):142-152. |
| **HERO ID:** | 2575095 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Production, import, or use volume: | The total quantity of asbestos products in Poland is estimated to be approximately 15.5 million tonnes, the 14.9 million tonnes of which are asbestos-cement boards (1351.5 million m2 . The remaining 600,000 tonnes are piping and other asbestos-cement products. . In Poland, about 85% of asbestos is located in construction materials and products. Since 1945, a total of 2 million tonnes raw material had been imported to Poland.In the manufacture of asbestos-cement products, the total consumption of asbestos since 1960s to 1998 is estimated to be about 1.5 million tonnes; including about 86 000 tonnes of crocidolite and about 8500 tonnes of amosite |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Methodology | Medium | Report uses high quality data that are not from frequently-used sources and there are no known quality issues. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | Medium | Data are from Poland, an OECD country. |
| Metric 3: | Applicability | High | Data are for "Industrial Commercial USe : Chemical Substances in Construction, Paint, Electrical, and Metal Products" an in-scope occupational scenario. |
| Metric 4: | Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| Metric 5: | Sample Size | Low | Sample distribution is characterized by no statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Low | Variability addressed by discussing the range of types of asbestos in building materials and presenting a spread of years of data but uncertainty is not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Terazono, A. (2010). Experiences of asbestos emission control and waste management in Japan. :539-541. |
| **HERO ID:** | 6877326 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Production, import, or use volume: | Sprayed-on asbestos was commonly used on concrete walls, ceilings, and steel structures before 1975. The Japan Asbestos Association estimated from limited data that 62 000 t in total was sprayed, but estimate 170 000 t from mineral use statistics. [PDF Pg. 3] |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Methodology | High | The assessment or report uses high quality data and/or techniques or sound methods that are from frequently used sources. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | Medium | Data are from Japan, an OECD country. |
| | Metric 3: Applicability | Medium | The report is for an occupational scenario within the scope of the risk evaluation but use data from Japan might not be similar to the U.S. |
| | Metric 4: Temporal Representativeness | Low | Data from more than 20 years ago. |
| | Metric 5: Sample Size | Low | Sample distribution is described qualitatively. |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Terazono, A., Moriguchi, Y., Sakai, S.,i, Takatsuki, H. (2000). Environmental impact assessment of sprayed-on asbestos in buildings. Journal of Material Cycles and Waste Management 2(2):80-88. |
| **HERO ID:** | 6915910 |
| **Conditions of Use:** | Disposal |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Life cycle description: | A difficulty with introducing health-risk concepts into life cycle assessment (LCA) is the pulse–flux problem, which is discussed in the article. Figure 1 (pg 81) presents the inventory analysis and impact assessment in LCA. In this study, the authors focussed on asbestos, which is a hazardous substance, particularly in its disposal stage, and estimated health risks as well as energy consumption. They conducted an estimation of asbestos emission and energy consumption as an inventory analysis, and converted asbestos emissions into health risks as an impact assessment. At the same time, the authors discuss a way to resolve the pulse–flux problem, which is a difficulty when taking hazardous substances into account in LCA. In this paper, the authors do not weight health risk and energy consumption (pg 81). The results for life-cycle energy consumption are shown in Table 3 (pg 87). Regarding the difference between scenarios in the disposal stage, the melting requires 17.1Gcal of energy, while the packaging/landfilling requires only 0.254 Gcal. However, when the authors considered the life-cycle energy consumption of sprayed-on asbestos, it was estimated that the use of asbestos conserved several hundred gigacalories of energy, based on the assumptions given, owing to its huge insulating effect in the use stage. Such energy conservation greatly exceeded the energy consumption required for melting, and the life-cycle energy consumption was found to be hardly affected by the selection of scenarios (pg 86). |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Methodology | High | Report uses high quality data and/or techniques |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | Medium | The data are from an OECD country other than the U.S. |
| Metric 3: | Applicability | High | The report is for an occupational scenario within the scope of the risk evaluation. |
| Metric 4: | Temporal Representativeness | Low | The report is more than 20 years old. |
| Metric 5: | Sample Size | Low | Distribution of samples is characterized by no statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | High | Report clearly documents its data sources, assessment methods, results, and assumptions. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Low | The report does not address variability or uncertainty. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Terazono, A., Sakai, S., Takatsuki, H. (2000). The great Hanshin-Awaji Earthquake of Japan 1995 and asbestos emission. Advances in Air Pollution Series (Vol. 8) :583-592. |
| **HERO ID:** | 6880182 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Production, import, or use volume: | The only statistic we have on the amount of sprayed-on asbestos consumed in Japanese buildings is the 61,931 t from 1971 to 197... we estimate that about 170,000 t of sprayed-on asbestos was used [from 1957-1980] (pg 6)total calculated sprayed-on asbestos stock in earthquake zone: 3,740 t (pg 8) |
| Throughput: | We therefore calculated the amount of sprayed-on asbestos used per unit floor space as 170,000 t/1.97 billion m2 = 0.086 kg/m2 (pg 6) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Methodology | Medium | Report uses high quality data/techniques/methods that are not from frequently-used sources and there are no known quality issues. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | Medium | Data are from Japan, an OECD country |
| | Metric 3: Applicability | High | Data are for construction materials, an in-scope occupational scenario. |
| | Metric 4: Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: Sample Size | Low | Sample distribution is characterized by no statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | Medium | Methods, results, and assumptions are clearly documented, but underlying data sources are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination — Low

| | |
|---|---|
| **Study Citation:** | Tiseo, I. (2022). U.S. C&D debris generation by source 2018: Weight of waste generated during construction and demolition in the United States in 2018, by source (in million metric tons). |
| **HERO ID:** | 11138826 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Throughput: | 2018 C&D data used to estimate number of demolitions per year188.8 million metric tons from building waste |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | Medium | The assessment or report uses high quality data and/or techniques or sound methods that are not from a frequently used source and associated information does not indicate flaws or quality issues. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | The data are from the United States |
| | Metric 3: | Applicability | High | This data is relevant to the Maintenance, Renovation, and Demolition OES and is used to estimate the number of demolitions per year, which informs release estimates and exposure frequency |
| | Metric 4: | Temporal Representativeness | High | The report is generally no more than 10 years old. |
| | Metric 5: | Sample Size | N/A | N/A - This metric is not applicable to the data being extracted |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Assessment or report clearly documents results, methods, and assumptions. Data sources are generally described but not fully transparent. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | The report does not address variability or uncertainty. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | TOMA, (1979). Cross-sectional health study of workers at the Follansbee, West Virginia plant of Koppers Company, Inc. |
| **HERO ID:** | 3230139 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Process description: | Asbestos added to coal tar distillate products; "The bagged asbestos is received by the plant. the bags opened and by varying techniques added to a mixture of distillate products to enhance enduse properties of the materials" (pg 177) |
| Chemical concentration: | No asbestos present in talc material - Nytal 400 (pg 597) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | Report uses high quality data from frequently-used sources. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | Medium | Data are for manufacturing of tar, which is similar to the in-scope occupational scenario for industrial uses. |
| | Metric 4: | Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Methods, results, and assumptions are clearly documented, but underlying data sources are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | U.S. Census Bureau, (2022). 2021 American Community Survey, 1-year estimates: What type of structure do renters live in?. |
| **HERO ID:** | 11138831 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Number of sites: | Data on the percentage of Americans living in apartments (54%) vs homes (46%) is used to calculate the average waste for a residential building demolition |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | Medium | The assessment or report uses high quality data and/or techniques or sound methods that are not from a frequently used source and associated information does not indicate flaws or quality issues. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | The data are from the United States. |
| | Metric 3: | Applicability | High | Data are relevant to the OES for demolition, maintenance, and renovation. |
| | Metric 4: | Temporal Representativeness | High | The data is no more than 10 years old. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized. Sample size is sufficiently representative. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | Assessment or report clearly documents its data sources, assessment methods, results, and assumptions. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | The report provides only limited discussion of the variability and uncertainty in the results. |

## Overall Quality Determination — High

| | |
|---|---|
| **Study Citation:** | U.S. EPA, (2022). 2016-2020 TRI Data: Asbestos. |
| **HERO ID:** | 11138810 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Number of sites: | TRI data is used to estimate the number of sites that use asbestos |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | Medium | The number of sites that report releases to TRI is dictated and explained by TRI submission guidelines. However, assumptions on the number of reporting sites are not fully transparent. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | The data are from the United States and are representative of the industry being evaluated. |
| | Metric 3: | Applicability | Medium | The report is for an occupational scenario within the scope of the risk evaluation. However, not all releasing entities are captured in TRI due to reporting guidelines. |
| | Metric 4: | Temporal Representativeness | High | Report is based on current industry conditions and data no more than 10 years old. |
| | Metric 5: | Sample Size | Medium | Distribution of samples is characterized by a range with uncertain statistics. It is unclear if analysis is representative. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Low | Assessment or report provides results, but the underlying methods, data sources, and assumptions are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | The report does not address variability or uncertainty. |

## Overall Quality Determination **Medium**

| | |
|---|---|
| **Study Citation:** | U.S. EPA, (1983). Guidance for controlling friable asbestos-containing materials in buildings. |
| **HERO ID:** | 3647616 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Chemical concentration: | Various Types of Friable and Nonfriable Materials and Products (as of 1977)Subdivision Asbestos (%) Dates of use Friable insulation material 1-95 1935-1970 Preformed thermal insulating products 15 1926-1949 calcium silicate 6-8 1949-1971Textiles blankets (fire)100 1910-presentfelts: 90-95 1920-presentblue stripe 80 1920-presentred stripe 90 1920-presentgreen stripe 95 1920-presentsheets 50-95 1920-presentcord/rope/yarn80-1001920-presenttubing 80-85 1920-presenttape/strip 90 1920-presentcurtains (theatre, welding) 60-651945-presentCementitious extrusion panels: 8 1965-1977 corrugated 20-45 1930-presentflat 40-501930-presentflexible 30-50 1930-presentflexible perforated 30-50 1930-presentlaminated 35-501930-present roof tiles 20-30 1930-present clapboard and shingles:clapboard 12-151944-1945siding shingles 12-14unknown-present roofing shingles 20-32 unknown-presentpipe 20-15 1935-presentPaper products corrugated:high temperature 90 1935-present moderate temperature 35-701910-present indented 98 1935-presentmillboard80-851925-presentRoofing felts smooth surface 10-15 1910-present mineral surface 10-151910-presentshingles 1 1971-1974pipeline 10 1920-presentAsbestos containing compoundscaulking putties 30 1930-presentadhesive (cold applied)5-251945-presentroofing asphalt 5 unknown-presentmastics 5-251920-presentasphalt tile cement13-251959-presentroof putty10-25unknown-presentplaster/ stucco 2-10 unknown-present spackles 3-5 1930-1975sealants fire/water50-551935-presentcement, insulation 20-1001900-1973cement, finishing55 1920-1973cement, magnesia15 1926-1950Asbestos Ebony Products 50 1930-presentFlooring tile and sheetsvinyl/asbestos tile 21 1950-presentasphalt/asbestos tile 26-331920-presentsheet goods/resilient 30 1950-presentWall Covering vinyl wallpaper 6-8 unknown-presentPaints and Coatingsroof coating 4-7 1900-present air tight 15 1940-present |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Methodology | High | EPA Report |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | USA |
| Metric 3: | Applicability | High | The report is for an occupational scenario (building asbestos cleanup) within the scope of the risk evaluation. |
| Metric 4: | Temporal Representativeness | Low | 1983 prior to the most recent PEL ( 1994) and more than 20 years old |
| Metric 5: | Sample Size | Medium | Range data provided but no other statistical summaries |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Medium | EPA report - but not certain where the asbestos concentration data came from. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Medium | range data were provided that could be useful in assessing variability. Uncertainty not discussed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | U.S. EPA, (1992). Observations on asbestos release during demolition activities. |
| **HERO ID:** | 3970144 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Chemical concentration: | U.S. Arroy – Fort Bliss. El Paso. TexasDemolition of several wooden barracks- Contained as much as 20 percent chrysotile asbestos, over mastic that contained 15 percent asbestos. (P. 9/14) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | The U.S. Environmental Protection Agency's. Risk Reduction Engineering Laboratory (RREL) data. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | The data are from the United States. |
| | Metric 3: | Applicability | High | The report is for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Low | More than 20 years old. |
| | Metric 5: | Sample Size | Medium | Distribution of samples is characterized by a range. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Assessment or report clearly documents results, methods, and assumptions. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | The report does not address variability or uncertainty. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | U.S. EPA, (1993). Airborne asbestos concentrations during buffing of resilient floor tile. |
| **HERO ID:** | 3970145 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Number of sites: | The study was conducted at 17 schools distributed among 8 school districts. [PDF Pg. 2]. |
| Chemical concentration: | The resilient flooring in the 28 study sites (representing 17 schools) included mostly 9- in. by 9-in. tiles and some 12-in. by 12-in. tiles. Although the asbestos content of the tiles ranged from 1 % to 38%, the content of most of the tiles exceeded 10%. [PDF Pg. 3] |
| Comments: | Throughput not described. |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Methodology | High | Report uses high quality data/techniques/methods from frequently-used sources. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | High | Data are from the U.S. |
| | Metric 3: Applicability | High | Data are for Chemical Substances in Construction, Paint, Electrical, and Metal Products, an in-scope occupational scenario. |
| | Metric 4: Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: Sample Size | Medium | Sample distribution characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Medium

**Study Citation:** U.S. EPA, (2008). Comparison of the alternative asbestos control method and the NESHAP method for demolition of asbestos-containing buildings.
**HERO ID:** 3970151
**Conditions of Use:** Disposal

**EXTRACTION**

| Parameter | Data |
|---|---|
| Process description: | NESHAP approach all asbestos-containing material (content > 1%) are removed from the site prior to demolitionAACM approach - thermal insulation and fireproofing are removed prior to demolition. wallboard joint compound, resilient flooring/mastic, and glazing compounds can remain. Amended-water wetting agents (surfactants) are used to suppress dust before, during, and after demolition. Amended-water will be applied using 2 hoses delivered as a mist. During demolition. Breakage of asbestos-containing materials shall be minimized. All debris generated shall be removed from the site for disposal on the day of demotion, including disposal PPE. Reusable PPE shall be decontaminated daily. All waste must be disposed of at an appropriate disposal facility using leak proof double lined haulers.Contaminated waters shall be contained within a bermed or trench. this includes water from vehicle decontamination. |
| Number of sites: | 2 |
| Chemical concentration: | Soil PLM NESHAP approach 0.03% (range 0-0.34%) AACM approach 0% (range 0-0%)Soil TEM NESHAP approach 1.81 x 10^8 s/g (range 0-1.6x10^9 s/g) AACM approach 1.67x10^7 s/g (range 0-1.5x10^8 s/g)NESHAP Method Building (#3602)Wallboard Joint Compound PLM 1-5% asbestos GR/TEM 10-19 % AsbestosJoint Interval Composite GR/TEM 4-7 % AsbestosNon-Joint Skim Coat PLM ND Flooring9-by 9-inch Tile PLM 10-20% Asbestos GR/TEM 14-24% AsbestosSheet PLM 15-25% AsbestosMastic PLM NDRoofingShingle PLM NDFelt PLM NDGlazing Compound PLM Trace GR/TEM 8-9% AsbestosAttic Insulation PLM NDAACM Method Building (#3607)Wallboard Joint Compound PLM 1-5% asbestos GR/TEM 4-10 % AsbestosJoint Interval Composite GR/TEM 1- 4 % AsbestosNon-Joint Skim Coat PLM ND GR/TEM < 0.3-2Flooring9-by 9-inch Tile PLM 10-20% Asbestos GR/TEM 17-20% AsbestosSheet PLM 15-25% AsbestosMastic PLM NDRoofingShingle PLM NDFelt PLM NDGlazing Compound PLM Trace GR/TEM<0.1% AsbestosAttic Insulation PLM ND |
| Comments: | In 2006 and 2007 the Environmental Protection Agency (EPA) conducted three tests to examine the cost and environmental effectiveness of Alternative Asbestos Control Method (AACM). Two tests were conducted in Fort Chafee, Arkansas and one was conducted in Forth Worth, Texas. The EPA discontinued testing the AACM due to technical deficiencies. The AACM remains unapproved and should not be used. |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | EPA study |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | US |
| | Metric 3: | Applicability | High | The report is for an occupational scenario ( asbestos contaminated building demolition)within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Medium | 2006-2007 more than 10 but less tha 20 years |
| | Metric 5: | Sample Size | Medium | Range of concentration data were provided. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | Assessment or report clearly documents its data sources, assessment methods, results, and assumptions. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | High | Range data provided can be used to assess variability and it is assumed that uncertainty was addressed in the methods used. |

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| | |
|---|---|
| **Study Citation:** | U.S. EPA, (2008). Comparison of the alternative asbestos control method and the NESHAP method for demolition of asbestos-containing buildings. |
| **HERO ID:** | 3970151 |
| **Conditions of Use:** | Disposal |

| | | **EVALUATION** | |
|---|---|---|---|
| Domain | Metric | Rating | Comments |
| **Overall Quality Determination** | | **High** | |

| | |
|---|---|
| **Study Citation:** | U.S. EPA, (1993). Evaluation of asbestos fiber release during maintenance of asbestos-containing floor tile. |
| **HERO ID:** | 3970155 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Process description: | To refinish asbestos containing tiles, first dry sweep the stripped floor to remove any settled debris. Apply polish from a mop bucket and wring the mop out until slowly dripping. Using a cotton string mop, apply the wax as evenly as possible, covering about 100 square feet per 24 ounce mop head. Let each coat dry thoroughly before the next application, typically 20-30 minutes. Apply two uniform coats of polish. (50/71) To strip the tiles, sweep the floors, mix stripping solution in a bucket of water, apply generously and allow to stand for 5 minutes. Double scrub the floor with a black pad. Use a second bucket and mop to pickup the spent stripper solution. Rinse the floor and remove all residue twice. Repeat as necessary. (51/71) |
| Chemical concentration: | Tiles contained 14-26% chrysotile asbestos. (18/71) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Methodology | High | Report uses high quality data from frequently-used sources. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | Data are from the U.S. |
| Metric 3: | Applicability | High | Data are for commercial use of building construction materials, an in-scope occupational scenario. |
| Metric 4: | Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| Metric 5: | Sample Size | Medium | Sample distribution characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | High | Uncertainty is addressed in the study's methods. Variability is addressed by comparing reported concentrations to actual concentrations. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | U.S. EPA, (1998). From roofs to roads... Recycling asphalt roofing shingles into paving materials. |
| **HERO ID:** | 3981081 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Life cycle description: | "Regional distribution of ACRM cannot be determined. As some shingles last up to 20 years and some roofs are covered by a double layer, reroofing projects may encounter ACRM throughapproximately 2016. Although only a small percentage of shingle production over a limited number of years involved asbestos, ACRM is a potential hazard that recyclers and regulators both must face. " |
| Chemical concentration: | 0.02% for asphalt shingles manufactured in 1963 and 0.00016% in 1973 |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Methodology | Medium | The assessment or report uses high quality data and/or techniques that are not from a frequently used source and associated information does not indicate flaws or quality issues. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | High | The data are from the United States. |
| | Metric 3: Applicability | High | The report is for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: Temporal Representativeness | Low | The report is more than 20 years old. |
| | Metric 5: Sample Size | Low | Distribution of samples is characterized by no statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | High | Assessment or report clearly documents its data sources, assessment methods, results, and assumptions. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Low | The report does not address variability or uncertainty. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | U.S. EPA, (1986). Assessment of assay methods for evaluating asbestos abatement technology at the Corvallis Environmental Research Laboratory. |
| **HERO ID:** | 6892380 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Chemical concentration: | 80% chrysotile asbestos in bulk sampling of insulation (pg 18) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | Report uses high quality data/techniques/methods from frequently-used sources. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for construction materials, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized (discrete sampling data provided). |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | U.S. EPA, (1986). Assessment of assay methods for evaluating asbestos abatement technology. |
| **HERO ID:** | 6892385 |
| **Conditions of Use:** | Consumer Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Chemical concentration: | The range of asbestos concentration for the fireproofing insulation was 30 to 60 percent chrysotile asbestos. (20/86) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Methodology | High | Report uses high quality methods and data from frequently-used sources. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | High | Data are from the U.S. |
| | Metric 3: Applicability | Low | Data are for school and office workers exposures, which is similar to commercial use of construction products. |
| | Metric 4: Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: Sample Size | Medium | Sample distribution characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Medium | Uncertainty is addressed by the bulk sampling methodology. Variability isn't addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | U.S. EPA, (1985). Guidance for controlling asbestos-containing materials in buildings: 1985 edition. |
| **HERO ID:** | 6893665 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Process description: | Figure 6 outlines how to inspect pipe and boiler insulation. Start in the boiler room and follow air and water distribution systems throughout the building. Building plans should indicate the location of pipes and ducts. Sample the insulation materials from the damaged or exposed ends or other parts. Procedures for sampling and analyzing insulation materials are similar to those for surfacing materials:• Identify homogeneous areas (i.e., sections of insulation that appear uniform in color and texture).• Take samples for each homogeneous area where the insulation is damaged or exposed.Remember, all persons taking samples should wear a respirator.• Submit samples to a qualified laboratory for analysis (see Appendix G). [PDF Pg.32] |
| Chemical concentration: | [PDF Pg. 73-74]Performed Thermal and Insulating ProductsSprayed or troweled on surfacing material: 1-95%Perforated thermal insulating products (85% magnesia): 15%Perforated thermal insulating products (calcium silicate): 6-8%TextilesCloth blankets (fire): 100%Blue stripe felt: 80%Red stripe felt: 90%Green stripe felt: 95%Sheets: 50-95%Cord/rope/yarn: 80-100%Tubing: 80-85%Tape/strip: 90%Curtains (theater): 60-65%Cementous Concrete-Like ProductsExtrusion panels: 8%Corrugated: 20-45% Flat: 40-50%Flexible: 30-50%Flexible perforated: 30-50%Laminated: 35-50%Roof Tiles: 20-30%Clapboard and ShinglesClapboard: 12-15%Siding shingles: 12-14%Roofing shingles: 20-32%Pipe: 15-20%Paper ProductsCorrugatedHigh-temperature: 90%Moderate-temperature: 35-70%Indented: 98%Millboard: 80-85%Roofing FeltsSmooth surface: 10-15%Mineral Surface: 10-15%shingles: 1%Pipeline: 10%Asbestos-Containing CompoundsCaulking putties: 30%Adhesive (cold applied) joint compound: 5-25%Roofing asphalt: 5%Mastics: 5-25%Asphalt tile cement: 13-25%Roof putty: 10-25%Plaster/stucco: 2-10%Spackles: 3-5%Sealants fire/water: 50-55%Cement, insulation: 20-100%Cement, finishing: 55%Cement, magnesia: 15%Asbestos ebony products: 50%Floor Tile and Sheet GoodsVinyl/asbestos tile: 21%Asphalt/asbestos tile: 26-33%Sheet goods/resilient: 30%Vinyl wallpaper: 6-8%Paints and CoatingsRoof coating: 4-7%Air tight: 15% |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Methodology | High | Report uses high quality data/techniques/methods from frequently-used sources. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | Data are from the U.S. |
| Metric 3: | Applicability | High | Data are for Chemical Substances in Construction, Paint, Electrical, and Metal Products, an in-scope occupational scenario. |
| Metric 4: | Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| Metric 5: | Sample Size | Medium | Sample distribution characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Medium | Variability addressed by giving concentrations for multiple products but uncertainty is not addressed. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | U.S. EPA, (1991). Evaluation of two cleaning methods for removal of asbestos fibers from carpet. |
| **HERO ID:** | 6900998 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Furnishing, Cleaning, Treatment Care Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Process description: | [PDF Pg. 2]Two experiments were conducted each day of the study. Each combination of cleaning method and contamination level was tested twice in each test room. A single experiment consisted of contaminating a new piece of carpet (approximately 500 ft2} with asbestos fibers, collecting work-area air samples, collecting microvacuum and bulk carpet samples, dry-vacuuming or wet cleaning the carpet while collecting a second set of work-area air samples, collecting a second set of microvacuum ,and bulkcarpet samples, removing the carpet, and decontaminating the test room. Each test room was decontaminated by encapsulating the carpet and the polyethylene sheeting on the ceiling and walls before their removal. These materials were removed and replaced after each experiment.Experimental procedures for this second set of experiments were identical to those in the first 16 except that the carpet was dry vacuumed, wet-cleaned, and then dry vacuumed again when dry. The same test area was also used; however, the two 500- ft2 test rooms were converted to four 160-ft2 test rooms, each with dimensions of approximately 8 x 20 ft. |
| Chemical concentration: | Asbestos contamination in carpets 8,000 s/ft2-2 billion s/ft2 (microvac technique) and 30 million to 4 billion s/ft2 (sonication technique) |
| Comments: | Experimental details meant to mimic real-world custodian work. |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Methodology | High | Report uses high quality data/techniques/methods from frequently-used sources. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | High | Data are from the U.S. |
| | Metric 3: Applicability | High | Data are for cleaning of carpets contaminated with asbestos, which could be from Chemical subtances in Construction or Chemical Substances in Furnishing, Cleaning, Treatment Care Products, in-scope occupational scenarios. |
| | Metric 4: Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: Sample Size | N/A | N/A - Process Description. |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | Low | For concentration data, its unclear if the field data was done by the authors and report lacks additional details on which sites were sampled, how many sites, and other metadata. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | High | The report addresses variability and uncertainty in the different processes of cleaning carpets. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | U.S. EPA, (1988). Asbestos problem resolution. |
| **HERO ID:** | 6904069 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Process description: | Operations and Maintenance: "identifying all ACM in the building, notifying occupants of the locations and warning all that there is to be no disturbance of the ACM except by trained personnel using the proper equipmentand practices. All custodial and maintenance workers are instructed in the proper cleaning and maintenance procedures and provided with proper equipment. Visible ACM debris is wetted and cleaned up as soon as possible. Periodic inspections are required to maintain up-to-date records of the condition of all ACM. Repairs are done as soon as possible after damage is found, and are done only by trained personnel using proper techniques andequipment." (p. 10)"Only ACM strong enough to be wetted and stay in place,previously unpainted, and not water damaged should be considered for encapsulation. If the ACM is in a location subject to frequent disturbance or maintenance or in a building nearing the end of its useful life, it should not be encapsulated." (p. 11) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Methodology | High | The assessment or report uses high quality data and/or techniques or sound methods that are from frequently used sources (U.S. EPA) and are generally accepted by the scientific community, and associated information does not indicate flaws or quality issues. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | The data are from the United States. |
| Metric 3: | Applicability | High | The report is for an occupational scenario within the scope of the risk evaluation. |
| Metric 4: | Temporal Representativeness | Low | The report is more than 20 years old. |
| Metric 5: | Sample Size | N/A | n/a - no sampling data |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | High | Assessment or report clearly documents its data sources, assessment methods, results, and assumptions. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Medium | The report provides only limited discussion of the variability and uncertainty in the results. |

## Overall Quality Determination — High

| | |
|---|---|
| **Study Citation:** | U.S. EPA, (2019). National emission standards for hazardous air pollutants for asbestos: Notice of final approval for an alternative work practice standard for asbestos cement pipe replacement. 84:26852-26866. |
| **HERO ID:** | 6906129 |
| **Conditions of Use:** | Disposal |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Process description: | ”Asbestos Cement pipes are conventionally remediated in one of three ways: Cured-in place pipe (CIPP) lining, abandoned in place, and open trenching. The CIPP lining is used only on pipes that are still in good condition, and strong enough to withstand the daily pressures of their intended use. The CIPP lining is sprayed on the interior of unbroken, inline pipes, and is used to extend the useful life of the pipe. Asbestos cement pipes may also be abandoned in place, with the new pipeline laid in a separate area. Open trenching is the practice under which the entire A/C pipe is excavatedand open to the ambient air. After excavation, the A/C pipe is wet-cut into 6- and 8-foot sections using a snap cutter or similar tool, wrapped for containment, and removed for disposal. (3/15)” |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Methodology | High | Report uses high quality data from frequently-used sources. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | Data are from the U.S. |
| Metric 3: | Applicability | High | Data are for asbestos disposal, an in-scope occupation al scenario. |
| Metric 4: | Temporal Representativeness | High | Report is based on current industry conditions and data no more than 10 years old. |
| Metric 5: | Sample Size | N/A | Process description |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Medium | Methods, results, and assumptions are clearly documented, but underlying data sources are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Low | The report provides only limited discussion of the variability and uncertainty in the results. |

## Overall Quality Determination High

**Continued on next page . . .**

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| | |
|---|---|
| **Study Citation:** | U.S. EPA, (2018). National emission standards for hazardous air pollutants for asbestos: Request for approval of an alternative work practice for asbestos cement pipe replacement. Federal Register 83 (80):18042-18051. |
| **HERO ID:** | 6908876 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|

| | |
|---|---|
| **Study Citation:** | U.S. EPA, (2018). National emission standards for hazardous air pollutants for asbestos: Request for approval of an alternative work practice for asbestos cement pipe replacement. Federal Register 83 (80):18042-18051. |
| **HERO ID:** | 6908876 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Process description: | removal and replacement of asbestos-cement pipeRemoval of A/C pipe while replacing it with non-asbestos materials; converts friable ACM, and ACM that may become friable when disturbed into nonfriable ACM during the replacement process; and uses amended water to achieve adequate wetting of all ACM.When a facility component that contains, is covered with, or is coated with RACM is being removed from a facility as a unit or insections (e.g., a pipeline), the rule requires adequate wetting of all RACM exposed during cutting or disjoining operations; and each unit or section to be carefully lowered to the floor and/orground level, not dropping, throwing, sliding, or otherwise damaging or disturbing the RACM. After a facility component (e.g., pipeline section) containing, covered with, or coated with RACM has been taken out of the facility as a unit or in sections pursuant to paragraph (c)(2), it shall be stripped or contained in leak-tight wrapping.8 If stripped, the owner/operator may either adequately wet the RACM during stripping; or use a local exhaust ventilation and collection system designed and operated to capture the particulate asbestos material produced by the stripping, and this system must exhibit no VE to the outside air, or be designed and operated in accordance with 40 CFR 61.152 (air cleaning).The accepted technique to remove and replace A/C pipes is known as ‘‘open trench replacement.’’ In open trench replacement, the pipe is located, cleaned, and inspected. Because pipes run beneath and cross transportation corridors, traffic is rerouted to availabledetours. Temporary water and sewer service is installed to handle the water supply and/or wastewater handling affected by the disruption of service. Other utilities (electricity, cable, opticalfiber) that may obstruct or interfere with pipe replacement are also identified. Once the location of the pipe and all utilities are identified, the road surfacing, and other structures, such assidewalks, medians, etc., are removed and an open trench is dug to expose the length of pipe to be replaced. A pipe cutter is clamped around the A/C pipe being replaced, and it is scored along the outside of its circumference while water is applied to prevent emissions of asbestos to the atmosphere, which may occur along the line of cutting. The pipe is snapped along the cut and the process is repeated to produce transportable 6- to 8-foot sections of pipe. Asbestos cement pipe in poor condition may resemble wet cardboard in the way it responds to these removal activities. Itcan simply collapse and tear into smaller pieces, rather than snap, as A/C pipe in good condition is known to do. Each pipe section is removed, wrapped in plastic, and placed on a truck labelled according to regulations for asbestos waste disposal.The ‘‘Close Tolerance Pipe Slurrification’’ (CTPS) method uses an equipment train to deliver drilling fluids and clays in suspension through a pipe in the center of the train. The equipment train uses a cutting head which grinds the underground A/C pipe to a fine grain while the fluids maintain the adequately wet requirements of 40 CFR 61.145 and entrain the finely ground pipe fragments in a slurry. The proposed CTPS AWP is as follows:Prior to using the CTPS for an ACPRP, the owner/operator would conduct underground pipe inspections (e.g., by using remote technologies like robotic cameras) and shall identify, locate, andmark onto an underground utility map of the area all identified potential areas of malfunctions, such as changes in pipe type, drops in the line, broken and offcenter points, and changes in soil type.1. Vertical Access PointsVertical access points (e.g., manholes, trenches) are made at designated intervals along the length of pipe replacement. The distance between vertical access points is a function of the soil type, pipe size, pneumatic pressure on the CTPS head, and frictional drag on the line; and is determined for each project on a case-by-case basis by the owner/operator. Incorrect estimation ofthe vertical access point locations may result in a malfunction. The owner/operator must not disturb A/C pipe during the digging out of these access points. Water and suction should be used to uncover as much of the A/C pipe as is needed to begin the CTPSprocess.2. Removal of Pipe at Terminals and Vertical Access PointsAt the starting and terminal points, and at designated intervals along the length of pipe replacement, sections of pipe are cut and removed at the vertical access points (i.e., manholes, trenches).The owner/operator must handle all sections of A/C pipe in accordance with 40 CFR 61.145 and 40 CFR 61.150 of theAsbestos NESHAP.3. CTPS Equipment Train The CTPS technique should use a drilling head train with a slightly larger diameter than the pipe being replaced. This technology must use a heavy duty four-stage cutting and wetting train, made of hardened carbon steel, which is able to be fed directly around the pipe to be replaced. The cutting head must be drawn around the existing pipe and must be capable of grinding the old A/C pipe to a fine powder using a liquid delivery system as described in sectionThe process must return the A/C pipe to a cementitious slurry that is a homogenous mixture and stays adequately wet through disposal according to the requirements of 40 CFR 61.145. The owner/operator must ensure that the CTPS train pulls the replacement pipe behind it, and that no ACM contacts the inside of the new pipe.4. Liquid DeliveryThe horizontal drilling train must be equipped with ports to deliver liquid materials to the drilling head. Drilling fluids and bentonite clay should also be delivered through these ports to reduce frictional drag on the line, and to lubricate the interface along the soil to pipe line.5. Trackable PipelineThe owner/operator would be required to ensure that the new pipeline is trackable by steel cable (or other durable trackable material) laid with the new pipe.6. Slurry CharacteristicsThe owner/operator would be required to ensure that no visibleemissions are discharged to the air from the slurry, and that the slurry is a homogenous mixture comprised of finely ground A/C pipe, drilling fluids, bentonite clay, and other |

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| | |
|---|---|
| **Study Citation:** | U.S. EPA, (2018). National emission standards for hazardous air pollutants for asbestos: Request for approval of an alternative work practice for asbestos cement pipe replacement. Federal Register 83 (80):18042-18051. |
| **HERO ID:** | 6908876 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

| Domain | Metric | EVALUATION Rating | Comments |
|---|---|---|---|

| Domain | Metric | | EVALUATION Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | The process description of asbestos-containing pipe removal is from a frequently used source (EPA FR notice). |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | The data are from the United States. |
| | Metric 3: | Applicability | High | The report is for an occupational scenario (Asbestos-cement pipe replacement) within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | High | The report captures operations, equipment, and worker activities expected to be representative of current conditions. The report is generally no more than 10 years old. |
| | Metric 5: | Sample Size | N/A | Qualitative process/control information provided. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | Assessment or report clearly documents its data sources, assessment methods, results, and assumptions. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | N/A | Qualitative process/control information provided. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | U.S. EPA, (2000). Sampling and analysis of consumer garden products that contain vermiculite. |
| **HERO ID:** | 783704 |
| **Conditions of Use:** | Other: |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Life cycle description: | Vermiculite is produced from mined ore and is used in agricultural and horticultural products as well as in insulation and construction applications. |
| Chemical concentration: | The Agency purchased and began testing a limited number of vermiculite products available in garden stores in the Seattle area to determine if they were contaminated with asbestos. Sixteen products were tested using widely-recognized standard protocols and asbestos was detected in five of them. However, only three of these contained enough asbestos to allow EPA to quantify the percentage of asbestos reliably.PRODUCT ANALYSIS (see Table 1)Therm-O-Rock (~0.33%)Zonolite Chemical Packaging Vermiculite (~1.88%)Coles Cactus Mix (~0.45%) |
| Comments: | Therm-O-Rock and Coles Cactus Mix come from the W.R. Grace Mine in Enoree, SC where there are active vermiculite mines. However, Zonolite Chemical Packaging Vermiculite came from Libby, and it is expected that all product from Libby has been used at this point. Therefore, we will only consider Therm-O-Rock and Coles Cactus Mix for purposes of investigation of Lawn & Garden Care Products containing vermiculite. |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | The assessment uses high quality data and sound methods that are from frequently used sources and are generally accepted by the scientific community, and associated information does not indicate flaws or quality issues. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | The data are from the United States and are representative of the industry being evaluated. |
| | Metric 3: | Applicability | High | The report is for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Low | The report is more than 20 years old. The report captures operations, equipment, and worker activities that are expected to be outdated. |
| | Metric 5: | Sample Size | High | Statistical distribution of samples is fully characterized. Sample size is sufficiently representative. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | Assessment clearly documents its data sources, assessment methods, results, and assumptions. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | High | The report addresses variability and uncertainty in the results. Uncertainty is well characterized. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | U.S. EPA,, Environmental Quality Management,, Inc., (1995). Buffing, burnishing, and stripping of vinyl asbestos floor tile. |
| **HERO ID:** | 3981057 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Products not Described by Other Codes |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Chemical concentration: | Airborne total fiber concentrations were measured for comparison with the OSHA's Permissible Exposure Limit (PEL) of 0.1 f/cm3. |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Methodology | High | report uses high quality data |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | High | The data are from the United States |
| | Metric 3: Applicability | High | The report is for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: Temporal Representativeness | Low | The report is more than 20 years old. |
| | Metric 5: Sample Size | N/A | N/A - This metric is not applicable to the data being extracted |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | High | report clearly documents its data sources |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Low | The report does not address variability or uncertainty. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Union Carbide, (1987). Population-based mortality surveillance in carbon products manufacturing facilities with cover letter dated 013087. |
| **HERO ID:** | 3656836 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Number of sites: | 11 active locations (pg 7) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | Medium | Report uses high quality data/techniques/methods that are not from frequently-used sources and there are no known quality issues. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for construction materials, an in-scope |
| | Metric 4: | Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: | Sample Size | Low | Distribution of samples is qualitative or characterized by no statistics. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Methods, results, and assumptions are clearly documented, but underlying data sources are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | The report does not address variability or uncertainty. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | University of Iowa, (2001). Needs assessment- December 2001: Burlington atmoic energy comission plant-Former worker program. |
| **HERO ID:** | 3974978 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Life cycle description: | miles of asbestos-coated steam pipe coursing the complex as well as many miles of tremolite asbestos fiberboard lined tunnels (p. 12) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | Medium | The assessment or report uses high quality data and/or techniques or sound methods that are not from a frequently used source and associated information does not indicate flaws or quality issues. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | The data are from the United States and are representative of the industry being evaluated. |
| | Metric 3: | Applicability | High | The report is for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Low | The report is more than 20 years old. The report captures operations, equipment, and worker activities that are expected to be outdated. |
| | Metric 5: | Sample Size | Low | Distribution of samples is qualitative or characterized by no statistics. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | Assessment or report clearly documents its data sources, assessment methods, results, and assumptions. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | The report does not address variability or uncertainty. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | USGS, (2017). Mineral commodity summaries 2017. |
| **HERO ID:** | 3827270 |
| **Conditions of Use:** | Other: |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Production, import, or use volume: | ASBESTOS:In 2016, U.S. consumption of asbestos was estimated to be about 340 tons, essentially unchanged from that of 2015 (likely all chloralkali industry). An unknown quantity of asbestos was imported within manufactured products, possibly including brake linings and pads, building materials, gaskets, millboard, and yarn and thread, among others. (p. 32/206)TALC:Three companies operated five talc-producing mines in three States during 2016, and domestic production of crude talc was estimated to have decreased by 4% to 660,000 tons valued at $19.1 million. Montana was the leading producer State, followed by Texas and Vermont. One company in Virginia that mines soapstone for dimension stone purposes had previously been included in the domestic talc data but was removed beginning in 2014. Total sales (domestic and export) of talc by U.S. producers were estimated to be 545,000 tons valued at $97.5 million, a slight decline from those in 2015. Talc produced and sold in the United States was used in ceramics (including automotive catalytic converters) (26%), paper (18%), paint (17%), unclassified end uses (13%), plastics (12%), roofing (7%), rubber (4%), and cosmetics (3%). Of the estimated 385,000 tons of talc that was imported in 2016, it is likely that more than 75% was used in cosmetics, paint, and plastics applications. Including imported talc, the U.S. end-use rankings were thought to be, in decreasing order by tonnage, plastics, ceramics, paint, paper, roofing, rubber, cosmetics, and other. (p.168/206) |

**EVALUATION**

| Domain | | Metric | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | The assessment or report uses high quality data and/or techniques or sound methods that are from frequently used sources (USGS) and are generally accepted by the scientific community, and associated information does not indicate flaws or quality issues. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | The data are from the United States and are representative of the industry being evaluated. |
| | Metric 3: | Applicability | High | Report contains information about import and use of asbestos, as well as mining, import, and use of talc in the U.S. |
| | Metric 4: | Temporal Representativeness | High | The report captures operations, equipment, and worker activities expected to be representative of current conditions. The report is generally no more than 10 years old. |
| | Metric 5: | Sample Size | Medium | Distribution of samples is characterized by a range with uncertain statistics. It is unclear if analysis is representative. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | Assessment or report clearly documents its data sources, assessment methods, results, and assumptions. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | The report provides only limited discussion of the variability and uncertainty in the results. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Utah DEQ, (2017). Pollutants: Asbestos: Intro. |
| **HERO ID:** | 3982264 |
| **Conditions of Use:** | Consumer Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Production, import, or use volume: | In 1979, the United States' consumption of asbestos amounted to 560,000 metric tons. By 1983, the annual total consumption had dropped to 217,000 tons. (3/4) |
| Life cycle description: | Sprayed or trowelled-on materials used on ceilings or walls: This surfacing material is found as a white, popcorn textured decorative, acoustical, and fire proofing cover in homes, buildings, and schools. TSI: Here asbestos is often found as plaster cement wrap around boilers, on water and steampipe elbows, tees, fittings, and pipe runs. Asbestos is also found on duct systems, and as acardboard type of material (called aircell) found on steam pipe runs.Miscellaneous material: This includes all materials containing asbestos which were not included in the above groups. For example: floor tile, sheet rock, ceiling tiles, automotive friction products, rubber tile matting, rubber stair treading and risers, auditorium acoustical panels and sound proofing, gasket material, stage curtains, roofing materials, transite siding, caulking, cement pipe, kiln insulation, electrical panel insulation and wiring, fire brick, tar, and others. (3/4) |
| Number of sites: | In a survey of 3.6 million public and commercial buildings, friable asbestos was found in 733,000 buildings (20%). Sprayed or trowelled-on ACM was present in 192,000 buildings (5%). Thermal System Insulation (TSI) was found in 563,000 buildings (16%). 501,000 buildings (14%) contained damaged ACM. 184,000 buildings (5%) contained moderately damaged ACM. 317,000 buildings (9%) contained severely damaged ACM. Of the 733,000 public and commercial buildings containing friable asbestos, the following was found: 511,000 buildings (70%) were private, nonresidential structures. 208,000 buildings (28%) were apartments with ten or more units. 14,000 buildings (2%) were Federal Buildings. (4/4) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Methodology | Medium | The assessment or report uses high quality data and/or techniques or sound methods that are not from a frequently used source and associated information does not indicate flaws or quality issues. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | Data are from the U.S. |
| Metric 3: | Applicability | Low | Data are for consumer use in construction materials, which may be similar to the in-scope occupational scenario of commercial use in construction materials. |
| Metric 4: | Temporal Representativeness | High | The report is generally no more than 10 years old. |
| Metric 5: | Sample Size | Medium | Sample distribution characterized by limited statistics (number of sites, percentages, consumptions) but discrete samples not provided and distribution not fully characterized. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Medium | Methods, results, and assumptions are clearly documented, but underlying data sources are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | van Orden, D. R., Lee, R. J., Bishop, K. M., Kahane, D., Morse, R. (1995). Evaluation of ambient asbestos concentrations in buildings following the Loma Prieta earthquake. Regulatory Toxicology and Pharmacology 21(1):117-122. |
| **HERO ID:** | 3615956 |
| **Conditions of Use:** | Other: |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Number of sites: | 25 school buildings, 3 university buildings, 20 commercial buildings, 5 public buildings, and 2 residential buildings (2/6) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | Report uses high quality methods and data from frequently-used sources. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for disaster response activities, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: | Sample Size | Medium | Sample distribution characterized by limited statistics (number of sites) but discrete samples not provided and distribution not fully characterized. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Medium

**Study Citation:** Verein Deutscher Ingenieure, (1982). Emission control: Extraction and processing of asbestos treatment of products containing asbestos.
**HERO ID:** 6906351
**Conditions of Use:** Other:

**EXTRACTION**

| Parameter | Data |
|---|---|
| Production, import, or use volume: | In 1980, the world production of asbestos amounted to approx. 7 million tons. 45 % of the total quantity of asbestos is exploited in the USSR, 35 % in Canada, 10 % in Southern Africa. Further deposits are mined in the United States, Italy, Brazil, Australia, and the People's Republic of China (pg 3) |
| Process description: | Pg 3-19 have info for mining, milling, asbestos cement production, asbestos textile production, friction products production, gasket production, paper and millboard production, compound materials and insulation foams |
| Chemical concentration: | The asbestos ore contains only approx. 3 to 10 % by weight of asbestos fibres in the known asbestos ore mines. (pg 3)The secondary milling plant is fed with asbestos fibre concentrate which, depending on the technical equipment of the milling plant, contains 15 to 40 % asbestos fibres (pg 7)The content of asbestos in asbestos cement is usually 10 to 15 % by weight (pg 8)Friction products: The raw materials used are up to 50% asbestos (in exceptional cases up to 70%) (pg 14)Gaskets and packings: Primarily chrysotile is applied in contents of between 5 and 100 % by weight. (pg 15)compound materials and insulation foams: have been mixed with a filler containing asbestos ratios of approx. 20 to 90% by weight (pg 18) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | Medium | Report uses high quality data that are not from frequently-used sources and there are no known quality issues. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Medium | Data are from Germany, an OECD country |
| | Metric 3: | Applicability | High | Data are mostly applicable for upstream, out-of-scope COUs, but concentration data provided is applicable for multiple in-scope COUs |
| | Metric 4: | Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: | Sample Size | Medium | Sample distribution characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Methods, results, and assumptions are clearly documented, but underlying data sources are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Verma, D. K., Middleton, C. G. (1980). Occupational exposure to asbestos in the drywall taping process. American Industrial Hygiene Association Journal 41(4):264-269. |
| **HERO ID:** | 3084138 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Process description: | In the construction of a commercial building, wallboards are fixed to metal studs with screws, while in residential houses the gypsum wallboards are nailed onto the wooden studs. The joints are finished by taping. The dry powder is mixed with water and stirred to form putty. Then, the compound is placed on the bottom side of a paper tape and is applied to cover the joint between the gypsum board and allowed to dry. The joints are sanded after this, and 3-4 coats of the putty are applied. The debris and dust are swept up with a broom. (3/7) |
| Chemical concentration: | The joint compounds contains 3-6% chrysotile asbestos. (3/7) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Methodology | High | Report uses high quality data from frequently-used sources. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | Medium | Data are from Canada, an OECD country. |
| Metric 3: | Applicability | High | Data are for commercial use of building construction materials, an in-scope occupational scenario. |
| Metric 4: | Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| Metric 5: | Sample Size | Medium | Sample distribution characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Medium | Variability is addressed by mentioning that in the past, the joint compound may have had higher concentrations. Uncertainty isn't addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Vernez, D., Duperrex, O., Herrera, H., Perret, V., Rossi, I., Regamey, L., Guillemin, B. (2019). Exposure to amosite-containing ceiling boards in a public school in Switzerland: A case study. International Journal of Environmental Research and Public Health 16(24):5069. |
| **HERO ID:** | 6874591 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Number of sites: | 1 school |
| Chemical concentration: | asbestos in ceiling tile = 1% (mass) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | Low | The data collection and analysis methodology used in the report are not specified. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Medium | The data are from an OECD country other than the U.S. |
| | Metric 3: | Applicability | High | The report provides asbestos content in ceiling tiles, which is within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | High | The report is generally no more than 10 years old. |
| | Metric 5: | Sample Size | Low | Distribution of samples is qualitative or characterized by no statistics. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Assessment or report clearly documents results, methods, and assumptions. Data sources are generally described but not fully transparent. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | The report does not address variability or uncertainty. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Virta, R. L. (2011). Asbestos. :1-40. |
| **HERO ID:** | 3827175 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Production, import, or use volume: | in 2000 US production was 5,260 metric tons2010 total US imports 820 metric tons2010 imports from Canada 74 metric tons2010 exports 180 metric tons2010 Consumption 820 metric tons. Table 8 (P. 27/40) |
| Life cycle description: | 1974 80% of world usage was for construction products which increased to 95% in 2010. US: 1990s the dominant markets were in roofing and other uses. In 2009, the major use for asbestos in the United States was in roofing compounds, estimated to account for 72% of U.S. consumption, followed by anode coatings used in the chlorine industry with 18% and unknown or unspecified uses with 10%. (P. 32/40) |
| Process description: | open pit mining - using bench drilling techniquesDry milling crushed and driedFiber extraction - crushing, vacuum aspiration on a vibrating screencyclone separatorfiltering |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | The assessment or report uses high quality data and/or techniques or sound methods. Kirk-Othmer |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | From US |
| | Metric 3: | Applicability | High | The report is for an occupational scenario (production and consumption of asbestos) within the scope of the risk evaluation |
| | Metric 4: | Temporal Representativeness | Medium | 2011 - more than 10 but less than 20 years old. |
| | Metric 5: | Sample Size | Medium | Distribution of samples is characterized by a range with uncertain statistics. It is unclear if analysis is representative. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | asessment or report clearly documents its data sources, |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Medium | The report provides only limited discussion of the variability and uncertainty in the results. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Wagner, G., Hearl, F. J. (2005). Mineral dusts: Asbestos, silica, coal, manufactured fibers. :1073-1086. |
| **HERO ID:** | 6889039 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Production, import, or use volume: | By 1950, the annual US demand for asbestos grew to over 660,000metric tons, and increased to over 801,000 metric tons by 1970. Recent total US production of asbestos fell from 9550 metric tons in 1996, to an estimated production of 5260 metric tons in 2000. |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | The assessment or report uses high quality data that are from frequently used sources and are generally accepted by the scientific community. Associated information does not indicate flaws or quality issues. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | The data are from the United States. |
| | Metric 3: | Applicability | Medium | The report is for an occupational scenario that is similar to an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Medium | The manufacture and import data is greater than 20 years old. |
| | Metric 5: | Sample Size | N/A | n/a - no sampling data |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | Assessment or report clearly documents its data sources, assessment methods, results, and assumptions. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | The report does not address variability or uncertainty. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Walker, B. L. (2015). Environments of terror: 9/11, World Trade Center dust, and the global nature of New York's toxic bodies. Environmental History 20(4):779-795. |
| **HERO ID:** | 3699619 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Production, import, or use volume: | By 1968 an estimated 40,000 tons of spray-on asbestos insulation was being used in the United States. [PDF Pg. 10] |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | Medium | Report uses high quality data/techniques/methods that are not from frequently-used sources and there are no known quality issues. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are for the U.S. |
| | Metric 3: | Applicability | High | Data are for construction, paint, electrical and metal products, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: | Sample Size | Low | Sample distribution is characterized by no statistics. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Methods, results, and assumptions are clearly documented, but underlying data sources are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Welsh, D. E. (2007). Asbestos exposure during an abatement project. Journal of Occupational and Environmental Hygiene 4(2):D7-D9. |
| **HERO ID:** | 3079700 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Chemical concentration: | Composed of approximately 80% asbestos, 40% chrysotile and 40% amosite. (P. 2/4) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | The assessment or report uses high quality data and/or techniques or sound methods. Performed the removal following all applicable OSHA standards and, specifically, the OSHA asbestos standard (29 CFR 1926.1101), including air monitoring. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | The data are from the United States. |
| | Metric 3: | Applicability | High | The report is for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Medium | More than 10 years but no more than 20 years old. |
| | Metric 5: | Sample Size | Medium | Distribution of samples is characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Assessment or report clearly documents results, methods, and assumptions. Data sources are generally described but not fully transparent. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | The report does not address variability or uncertainty. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | WHO, (1998). Chrysotile asbestos. |
| **HERO ID:** | 4140385 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Production, import, or use volume: | Annual world production of asbestos peaked at over 5 million tonnes in the mid-1970s but has since declined to a current level of about 3 million tonnes... The asbestos-cement industry is by far the largest user of chrysotile fibres, accounting for about 85% of all use. (pg 24)More production data (general, not COU specific; basically mining) on pg 46-48; product-specific data for 1977, '84, and'91 in Table 2 (pg 49)Asbestos-cement production facilities exist in more than 100countries and produce 27 to 30 million tonnes annually (pg 49)Although declining in the North American and Western European markets, asbestos-cement product manufacturing continues to grow in South America, South-East Asia, the eastern Mediterranean region and eastern Europe (Pigg, 1994). Japan, Thailand, Malaysia, Korea and Taiwan imported 430 000 tonnes, well over 30%o of world-wide imports in 1989 (pg 50) |
| Life cycle description: | There are five major asbestos-cement products: (a) corrugated sheets; (b) flat sheets and building boards; (c) slates; (d) moulded goods, including low-pressure pipes; and (e) high-pressure water pipes (pg 49) |
| Chemical concentration: | Asbestos-cement products contain 10-15% of asbestos, mostly chrysotile, although limited amounts of crocidolite have been used in large diameter, high-pressure pipes. (pg 49) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Methodology | High | Report uses high quality [data/techniques/methods] from frequently-used sources. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | Medium | Data are for various countries, mostly OECD. |
| Metric 3: | Applicability | High | Data are mostly general asbestos production, but also contains data for construction materials, an in-scope occupational scenario. |
| Metric 4: | Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| Metric 5: | Sample Size | Medium | Sample distribution characterized by limited statistics (ranges, assumed means/averages) but discrete samples not provided and distribution not fully characterized. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Medium | Methods, results, and assumptions are clearly documented, but underlying data sources are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Medium | Variability addressed by providing data over different time periods but uncertainty is not addressed |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Whysner, J., Covello, V. T., Kuschner, M., Rifkind, A. B., Rozman, K. K., Trichopoulos, D., Williams, G. M. (1994). ASBESTOS IN THE AIR OF PUBLIC BUILDINGS - A PUBLIC-HEALTH RISK. Preventive Medicine 23(1):119-125. |
| **HERO ID:** | 3087131 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Number of sites: | 511,110 commercial, nonresidential buildings contain friable ACM. (1/7) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | Report uses high quality methods and data from frequently-used sources. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for commercial use in construction materials, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: | Sample Size | Medium | Sample distribution characterized by limited statistics (number of sites) but discrete samples not provided and distribution not fully characterized. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Williams, M. G., Crossman, R. N. (2003). Asbestos release during removal of resilient floor covering materials by recommended work practices of the resilient floor covering institute. Applied Occupational and Environmental Hygiene 18(6):466-478. |
| **HERO ID:** | 3080352 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Chemical concentration: | Sheet vinyl floor covering does not contain asbestos in thewalk surface but the backing frequently is asbestos felt (paper)and contains in our experience 40 percent to 75 percent asbestos.The asbestos content of square tiles is usually in the range of8–50 percent. (P. 3/14)Asbestos: bulk analysisSheet vinyl, light green: Backing: 60-65% (PLM), 70-80% (ATEM) (P. 8/14)12" X 12" tan tile: ND (PLM), 4-8% (ATEM)Black mastic: 5-8% (PLM)(P. 9/14)9"x9" beige tile: 1-3% (PLM), 12-19% (TEM)Black mastic: 7-10% (PLM)(P. 10/14) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Methodology | High | The assessment or report uses high quality data and/or techniques or sound methods. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | The data are from the United States |
| Metric 3: | Applicability | High | The report is for an occupational scenario within the scope of the risk evaluation. |
| Metric 4: | Temporal Representativeness | Medium | More than 10 years but no more than 20 years old. |
| Metric 5: | Sample Size | Medium | Distribution of samples is characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | Medium | Assessment or report clearly documents results, methods, and assumptions. |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Medium | The report provides only limited discussion of the variability and uncertainty in the results. |

## Overall Quality Determination — High

| | |
|---|---|
| **Study Citation:** | Williams, P. R. D., Phelka, A. D., Paustenbach, D. J. (2007). A review of historical exposures to asbestos among skilled craftsmen (1940-2006). Journal of Toxicology and Environmental Health, Part B: Critical Reviews 10(5):319-377. |
| **HERO ID:** | 1971635 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Chemical concentration: | Insulation and Filler Pipe covering/insulation 6–43% Chrysotile Pipe covering/insulation 57–94% Amosite Pipe insulation (Unibestos) 60% Amosite Pipe covering/insulation 15–90% Amosite Corrugated pipe insulation ~100% All Types Rock wool filler and binder 15% Chrysotile Filler and binder 95% Amosite Filler and binder 100% Chrysotile Calcium silicate insulation 11–12% Amosite Calcium silicate insulation 7% Chrysotile Magnesium carbonate insulation 15% Insulating boards (Asbestolux, Marinite) 16–40% Amosite and/or chrysotile Fireproofing spray insulation 10–40% Chrysotile 60–70% Amosite Thermal and acoustic spray insulation Pre-1974 ≤85% Mixture; Pre-1970 (thermal) Crocidolite; Pre-1970 (Fire protection) AmositeBlock Block and pipe section 10–15% Amosite Block and pipe section 10–15% Chrysotile and/or amosite Magnesia block 15% Amosite Pre-1950 Block ~100% Amosite ~1950–1960 Calcium silicate block 12–15% Amosite Post-1960 Magnesia block 15% Calcium silicate slabs 6–8% Pre-1975 Insulating blocks 85% Amosite Cement Cement (mud) 50–100% Chrysotile Cement 10–25% Cement 15% Cement 100% Chrysotile Pre-1970 Cement ≤15% Chrysotile Post-1970 Cement 10–15% Crocidolite 1950–1969 Insulating cement 100% Chrysotile Blankets and Cloth Blankets 100% Amosite Blankets 100% Amosite Blankets and felt ~100% Pre-1975 Cloth 80–95% Chrysotile Cloth 80–95% Chrysotile or amosite Cloth 80–85% Cloth ~100% All types, mostlychrysotileGaskets and packing Gaskets ≥70% Chrysotile Gaskets 50–60% Chrysotile Gaskets >70% Chrysotile Gaskets 50–60% Chrysotile Gaskets 45–93% Chrysotile Gaskets and seals ~100% All types Gaskets 80% Chrysotile Gaskets 40–80% Chrysotile Gaskets 70–85% Chrysotile Packing material 30–50% Chrysotile Stem and valve packing 85% Chrysotile Packing material 60–90% Chrysotile Packing material 65% Chrysotile Stem packing 40–80% Chrysotile Ropes and yarns ~100% All types Pre-1970 / Chrysotile Post-1970 Taping compounds Spackling, patching, taping compounds 5–10% (consumer); 5–12% (industrial) Chrysotile Spackling, patching, taping compounds 10–12% (consumer) Anthophylite Spackling, patching, taping compounds 4–6% (consumer) Tremolite; 1975 5–7% (industrial) Taping compounds 5–15% Chrysotile Taping compounds 2–12% Tremolite Joint compounds 3–6% Chrysotile Textured coatings/paints 3–5% Chrysotile Pre-1988 Mastics, sealants, adhesives Mastics, sealants, adhesives 0.5–2% Brickwork caulking ~100% All types Pre-1970 / Chrysotile Post-1970 Floor tiles Floor tiles <25% Chrysotile Floor tiles <25% Electrical Insulation Electrical wire/cable 25–40% Chrysotile Electrical wire/cable (shipboard) 15–25% Chrysotile Electrical wire/cable 20–50% Chrysotile Heat insulation of electrical equipment and cable ~100% All types Pre-1965 / Chrysotile Post-1965Roofing Materials Roofing felt ~100% All types Pre-1965 / Chrysotile Post-1965 Roofing tile 10–15% Crocidolite 1950–1969 / Amosite 1945–1976 Chrysotile Primary type |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | Low | The data, data sources, and/or techniques or methods used in the assessment or report are not specified |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Medium | Mix of countries including the US and other OECD countries |
| | Metric 3: | Applicability | High | The data are for an occupational scenario (variety of craftsmen who could be exposed to asbestos) within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Low | Studies are from 1937-2006 |
| | Metric 5: | Sample Size | Medium | Varies by study - distribution of samples is characterized by mean and/or standard deviation and range values. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Assessment or report clearly documents results, methods, and assumptions. Data sources are generally described but not fully transparent. |

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| | |
|---|---|
| **Study Citation:** | Williams, P. R. D., Phelka, A. D., Paustenbach, D. J. (2007). A review of historical exposures to asbestos among skilled craftsmen (1940-2006). Journal of Toxicology and Environmental Health, Part B: Critical Reviews 10(5):319-377. |
| **HERO ID:** | 1971635 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

| | | EVALUATION | |
|---|---|---|---|
| Domain | Metric | Rating | Comments |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Medium | The report provides only limited discussion of the variability and uncertainty in the results. |

## Overall Quality Determination — Medium

| | |
|---|---|
| **Study Citation:** | Williams, P., Paustenbach, D., Balzer, J. L., Mangold, C. (2007). Retrospective exposure assessment of airborne asbestos related to skilled craftsmen at a petroleum refinery in Beaumont, Texas (1940-2006). Journal of Toxicology and Environmental Health, Part A: Current Issues 70(13-14):1076-1107. |
| **HERO ID:** | 1971634 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Throughput: | The refinery historically operated 24 h/d and processed about 36,000 barrels/d of crude oil in 1920, 112,000 barrels/d in 1940, 220,000 barrels/d in 1960, and 365,000 barrels/d since the 1970s. |
| Chemical concentration: | Based on a review of company records and discussions with professionals at the refinery, approximately 60% of the piping systems and vessels at the facility were insulated over time (seeTable 1). Of that 60%, approximately 15% were in "cold" service, 25% in "hot" service (at least 280º F), and 20% in "very hot" service (at least 800ºF). Prior to 1975, the predominant forms ofinsulation in use at the refinery included ceramic fiber, fiberglass, mineral and rock wool, rubber and foam, and asbestos containing insulation (calcium silicate and magnesium carbonate).The asbestos-containing insulation was predominantly used for "very hot" service, and to a lesser extent for "hot" service. A relatively small amount of asbestos-containing insulation was also likely used for "cold" service prior to 1960. The calcium silicate and magnesium carbonate insulation used in these applications typically contained about 5–20% chrysotile, amosite or a blend of the two asbestos, with some brands containing as much as 30% or more chrysotile or amosite. For example, amosite was used extensively in 85% Mag (magnesium carbonate) and several brands of calcium silicate insulation) that were historically widely used in various industries including petroleum refineries.Beginning in 1972, asbestos-free insulation products had become available for "hot" and "very hot" insulation applications at the refinery. By 1974, these substitute products were used forall new construction projects and for insulation replaced during maintenance and turnaround activities. |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| Metric 1: | Methodology | Medium | Data is based on a variety of sources. |
| Domain 2: Representativeness | | | |
| Metric 2: | Geographic Scope | High | US |
| Metric 3: | Applicability | High | The report is for an occupational scenario (refinery workers exposed to asbestos) within the scope of the risk evaluation. |
| Metric 4: | Temporal Representativeness | Medium | 1940-2006 - more than 10 years old and less than 20 |
| Metric 5: | Sample Size | Medium | Distribution of samples is not characterized by statistics, but the basis for the data includes a full array of statistical parameters. |
| Domain 3: Accessibility/ Clarity | | | |
| Metric 6: | Metadata Completeness | High | very well documented |
| Domain 4: Variability and Uncertainty | | | |
| Metric 7: | Metadata Completeness | Medium | For the general engineering elements, uncertainty and variance is not discussed |

## Overall Quality Determination — High

| | |
|---|---|
| **Study Citation:** | Woitowitz, H. J., Kraus, T. (2000). Screening of asbestos-exposed workers in Germany. People and work research reports, 36 :42-52. |
| **HERO ID:** | 3086899 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Production, import, or use volume: | In Germany "after the Second World War some 5.8 million tons of asbestos were used in both parts of our country, at least 70% in the construction industry |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | Medium | Report uses high quality information that are not from frequently-used sources and there are no known quality issues. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Medium | Data are from Germany, an OECD country. |
| | Metric 3: | Applicability | High | Data are for construction sector, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: | Sample Size | N/A | No sampling data provided. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Methods, results, and assumptions are clearly documented, but underlying data sources are not fully transparent. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Woodson, R. D. (2012). Quick tips for contractors working with asbestos. :43-51. |
| **HERO ID:** | 6876973 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Process description: | Devise a means of handling and removing nonfriable asbestosmaterial to control the release of fibers and keep breakage toa minimum.Mist the materials being removed with a water spray toprevent fibers from becoming airborne. To enhance the effectiveness of the spray, the water should be treated with a chemical wetting agent. Figure 5.2 shows an example of this.Use plastic or polyethylene (some type of synthetic membrane)to collect errant pieces of material dislodged duringremoval; for example, use plastic sheeting around the perimeterof a house during siding removal.Package the asbestos waste material as soon as possible anddo not leave it unattended or open to the public.Wear a disposable Tyvek suit, gloves, and a half-mask respiratorwith high-efficiency particulate air (HEPA) filters while removing, packaging, and disposing of the asbestos waste material. It should be noted that it is required to seek a medical opinion before wearing a respirator, which places an additional strain on the heart and lungs.Generate a Waste Shipment Record (WSR). This information/form is required prior to disposal at a facility permitted for that purpose. |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | Report uses high quality data/techniques/methods from frequently-used sources. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | Data are from the U.S. |
| | Metric 3: | Applicability | High | Data are for Chemical Substances in Construction, Paint, Electrical, and Metal Products, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | High | Report is based on current industry conditions and data no more than 10 years old. |
| | Metric 5: | Sample Size | N/A | N/A - Process description. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | N/A | N/A - Process description. |

## Overall Quality Determination High

| | |
|---|---|
| **Study Citation:** | Wright, G. W. (1969). Asbestos and health in 1969. American Review of Respiratory Disease 100(4):467-479. |
| **HERO ID:** | 1270703 |
| **Conditions of Use:** | Other: |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Production, import, or use volume: | The estimated consumption of asbestos fiber in the U.S. has increased from 125,000 short tons in 1918 to 720,000 in 1965. (8/13) Total talc used in the U.S. in 1967 was 826,000 tons. (10/13) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Methodology | Medium | Report uses high quality data that are not from frequently-used sources and there are no known quality issues. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | High | Data are from the U.S. |
| | Metric 3: Applicability | High | Data are for consumption of asbestos for all commercial uses, which is in-scope. |
| | Metric 4: Temporal Representativeness | Low | Report is based on data greater than 20 years old and industry conditions that are expected to be outdated. |
| | Metric 5: Sample Size | Medium | Sample distribution characterized by limited statistics (production values) but discrete samples not provided and distribution not fully characterized. |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination Medium

| | |
|---|---|
| **Study Citation:** | Zanoni, C., Singh, K. (2003). Asbestos abatement. Professional Safety 48(1):33-36. |
| **HERO ID:** | 6886745 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Process description: | Abatement plan called for use of a plywood and steel clamped envelope to isolate the canopy asbestos-containing portion of the platform from the rest of the structure. A waste area was designated. |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | Medium | The assessment or report uses high quality data and/or techniques or sound methods that are not from a frequently used source and associated information does not indicate flaws or quality issues. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | High | The data are from the United States and are representative of the industry being evaluated. |
| | Metric 3: | Applicability | High | The report is for an occupational scenario within the scope of the risk evaluation. |
| | Metric 4: | Temporal Representativeness | Medium | The report captures operations, equipment, and worker activities that are expected to be reasonably representative of current conditions. The report is generally more than 10 years but no more than 20 years old. |
| | Metric 5: | Sample Size | N/A | n/a - no sampling |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | Medium | Assessment or report clearly documents results, methods, and assumptions. Data sources are generally described but not fully transparent. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | N/A | No scope to address variability and uncertainty. |

## Overall Quality Determination **High**

| | |
|---|---|
| **Study Citation:** | Zhang, Y. L., Byeon, H. S., Hong, W. H., Cha, G. W., Lee, Y. H., Kim, Y. C. (2021). Risk assessment of asbestos containing materials in a deteriorated dwelling area using four different methods. Journal of Hazardous Materials 410(Elsevier):124645. |
| **HERO ID:** | 7462926 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Throughput: | A total of 9595 m2 of slates, 2135 m2 of gypsum cement boards, 156 m2 of cement/wood boards, and 8/58 m2 of gaskets contained asbestos. (8/12) |
| Number of sites: | In the U.S., asbestos was found to only remain in about 840,000 commercial and public buildings, including schools. (1/12) |
| Chemical concentration: | Slate had asbestos contents of 6-16% (mean of 12.3%). Gypsum cement boards contained 2-10% asbestos (5.0% mean). Cement/wood boards contained 6-14% asbestos (10.0% mean). Gaskets contained 10-15% asbestos (14.95 mean). (7/12) |

**EVALUATION**

| Domain | Metric | | Rating | Comments |
|---|---|---|---|---|
| Domain 1: Reliability | | | | |
| | Metric 1: | Methodology | High | Report uses high quality data from frequently-used sources. |
| Domain 2: Representativeness | | | | |
| | Metric 2: | Geographic Scope | Medium | Data are from South Korea, an OECD country. |
| | Metric 3: | Applicability | Medium | Data are for consumer use of construction materials, which is similar to commercial use of construction materials, an in-scope occupational scenario. |
| | Metric 4: | Temporal Representativeness | High | Report is based on current industry conditions and data no more than 10 years old. |
| | Metric 5: | Sample Size | Medium | Sample distribution characterized by limited statistics (ranges, means) but discrete samples not provided and distribution not fully characterized. |
| Domain 3: Accessibility/ Clarity | | | | |
| | Metric 6: | Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | | |
| | Metric 7: | Metadata Completeness | High | Uncertainty is addressed in the study's methods. Variability is addressed by sampling different materials in different buildings. |

## Overall Quality Determination — High

| | |
|---|---|
| **Study Citation:** | Zichella, L., Baudana, F., Zanetti, G., Marini, P. (2021). Vinyl-asbestos floor risk exposure in three different simulations. International Journal of Environmental Research and Public Health 18(4):2073. |
| **HERO ID:** | 7459759 |
| **Conditions of Use:** | Industrial/Commercial Uses-Chemical Substances in Construction, Paint, Electrical, and Metal Products |

**EXTRACTION**

| **Parameter** | **Data** |
|---|---|
| Chemical concentration: | Sprayed coatings, lagging, and insulation can be up to 85% asbestos. Pipe and boiler lagging are 6-10% asbestos. Cardboard, paper, and similar materials are 10% chrysotile. Asbestos cement products are 10-15% asbestos. Mastics, sealants, and adhesives are 0.5-2% asbestos. Floors and vinyl tiles are 10-25% asbestos. (4/18) |

**EVALUATION**

| Domain | Metric | Rating | Comments |
|---|---|---|---|
| Domain 1: Reliability | | | |
| | Metric 1: Methodology | Medium | Report uses high quality data that are not from frequently-used sources and there are no known quality issues. |
| Domain 2: Representativeness | | | |
| | Metric 2: Geographic Scope | Medium | Data are from Italy, an OECD country. |
| | Metric 3: Applicability | High | Data are for construction materials that are in-scope for the occupational assessment of legacy asbestos. |
| | Metric 4: Temporal Representativeness | High | Report is based on current industry conditions and data no more than 10 years old. |
| | Metric 5: Sample Size | Medium | Sample distribution characterized by a range with uncertain statistics. |
| Domain 3: Accessibility/ Clarity | | | |
| | Metric 6: Metadata Completeness | High | All data sources, methods, results, and assumptions are clearly documented. |
| Domain 4: Variability and Uncertainty | | | |
| | Metric 7: Metadata Completeness | Low | Variability and uncertainty are not addressed. |

## Overall Quality Determination — Medium