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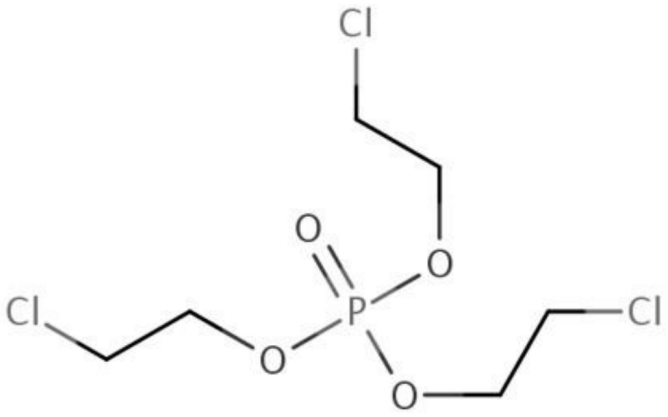
Office of Chemical Safety and
Pollution Prevention

Draft Risk Evaluation for Tris(2-chloroethyl) phosphate (TCEP)

Systematic Review Supplemental File:

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

CASRN: 115-96-8



December 2023

This supplemental file contains information regarding the data extraction and quality evaluation results for data sources that were considered for the Supplement to the Risk Evaluation for Tris(2-chloroethyl) phosphate (TCEP) and underwent systematic review. The systematic review steps are further described in Appendix C of the Supplement to the Risk Evaluation for Tris(2-chloroethyl) phosphate (TCEP). 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

7349020	ERG, (1998). Air emissions inventories, volume 2: Point sources: Chapter 11: Preferred and alternative methods for estimating air emissions from plastic products manufacturing.	**179**
1676728	Fang, M., Webster, T. F., Gooden, D., Cooper, E. M., McClean, M. D., Carignan, C., Makey, C., Stapleton, H. M. (2013). Investigating a novel flame retardant known as V6: measurements in baby products, house dust, and car dust. Environmental Science & Technology 47(9):4449-4454.	**180**
10604134	FCC, (2016). Safety Data Sheet: Flame control No. 40-40A - White and pastel tints.	**181**
10604137	FCC, (2011). Technical Data Sheet: Flame control No. 40-40A.	**183**
10604143	FCC, (2016). Safety Data Sheet: Flame control No. 5050 white and pastel tints.	**185**
10604144	FCC, (2010). Technical Data Sheet: Flame control No. 50-50 foam kote.	**187**
6766298	Fent, K. W., Horn, G. P., DeCrane, S. (2015). Firefighters" Perspective on Flame Retardants.	**189**
9493525	Fink, J. K. (2010). Acrylonitrile-Butadiene-Styrene Polymers. 211-267.	**190**
6558307	Grimes, G., Beaucham, C., Grant, M., Ramsey, J. (2019). Health hazard evaluation report: HHE-2016-0257-3333, May 2019, evaluation of exposure to metals and flame retardants at an electronics recycling company.	**191**
4168432	Hahladakis, J. N., Velis, C. A., Weber, R., Iacovidou, E., Purnell, P. (2018). An overview of chemical additives present in plastics: Migration, release, fate and environmental impact during their use, disposal and recycling. Journal of Hazardous Materials 344179-199.	**192**
6766299	Horn, G. P., Kerber, S., Fent, K. W., Fernhall, B., Smith, D. L. (2016). Interim Report: Cardiovascular & Chemical Exposure Risks in Modern Firefighting.	**193**
79051	IPCS, (1998). Flame retardants: Tris(chloropropyl) phosphate and tris(2-chloroethyl) phosphate.	**194**
10604581	J6 Polymers, (2018). Safety Data Sheet: JFOAM G-306-M-T.	**196**
10604582	J6 Polymers, (2018). Safety Data Sheet: JFOAM G-308-M-T.	**198**
10604583	J6 Polymers, (2018). Product bulletin: JFoam G-306.	**200**
10604584	J6 Polymers, (2018). Product bulletin: JFoam G-308.	**201**
11204812	J6 Polymers, (2021). Comment from J6 Polymers LLC regarding end usage characterization of tris(2"chloroethyl) phosphate (TCEP) in rigid polyurethane foam.	**202**
3012534	La Guardia, M. J., Hale, R. C. (2015). Halogenated flame-retardant concentrations in settled dust, respirable and inhalable particulates and polyurethane foam at gymnastic training facilities and residences. Environment International 79106-114.	**203**
2942545	Matsukami H., Nguyen Minh Tue, Suzuki G., Someya M., Le Huu Tuyen, Pham Hung Viet, Takahashi S., Tanabe S., Takigami H. (2015). Flame retardant emission from e-waste recycling operation in northern Vietnam: Environmental occurrence of emerging organophosphorus esters used as alternatives for PBDEs. Science of the Total Environment 514492-499.	**204**
6766303	Minnesota Department of Health (2016). Flame Retardants and Firefighter Exposure and Health.	**205**
10170891	NCBI, (2020). PubChem Compound Summary for CID 2577 Tris (2-chloroethyl) phosphate.	**206**
10604191	Normet, (2015). Safety Data Sheet: Tampur RBG Part B.	**208**
5466433	Nunez C., Mcminn B., Vitas J. (1996). Barriers to the use of radiation-curable adhesives in the coated and laminated substrate manufacturing industry. Journal of Hazardous Materials 45(1):59-78.	**210**
5469249	Parsons, N. S., Lam, M. H. W., Hamilton, S. E. (2013). Chemical characterization of automotive polyurethane foam using solid-phase microextraction and gas chromatography-mass spectrometry. Journal of Forensic Sciences 58(S1):S186-S191.	**211**
9493527	Pelzl, B., Wolf, R., Kaul, B. L. (2018). Plastics, additives. Jan-57.	**212**

Study Citation:	Beaucham, C. C., Ceballos, D., Page, E. H., Mueller, C., Calafat, A. M., Sjodin, A., Ospina, M., La Guardia, M., Glassford, E. (2018). Health Hazard Evaluation Report: HHE-2015-0050-3308, May 2018. Evaluation of Exposure to Metals, Flame Retardants, and Nanomaterials at an Electronics Recycling Company.
HERO ID:	5098163
Conditions of Use:	Recycling

EXTRACTION

Parameter	**Data**
Worker activity description:	Duties involved disassembly (five participants), shredding (three), batteries (four), sorting (six), shipping/receiving (one), and office work (two)
Exposure route:	dermal, inhalation
Personal sampling data:	ND (ng/m^ 3) (Pg. 22 of 80), 29 samples
Dermal exposure data:	Dermal exposure data
Number of workers:	15
Comments:	post-shift dermal - ND - 310 (ng/sample), 20 samplesNote: This appears to be a more recent report and could help determine how much recycling of TCEP still occurs

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 recycling, an in-scope occupational scenario.
	Metric 4: Temporal Representativeness	High	Monitoring 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	Sample type and exposure type provided but missing number of sites, exposure duration, exposure frequency, engineering control, PPE .
Domain 4: Variability and Uncertainty			
	Metric 7: Metadata Completeness	Medium	Variability addressed by taking both dermal and personal breathing zone samples, but uncertainty is not addressed.

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:	Firefighters (includes as PESS)

EXTRACTION

Parameter	**Data**
Worker activity description:	"overhaul activities" - the stage of firefighting where suppression of the fire is complete and firefighters are searching the structure for hidden fire and/or hot embers
Exposure route:	inhalation
Physical form:	dust
Personal sampling data:	8.01 mg/m3 average respirable dust (Table VI)
Area sampling data:	1.82 mg/m3 average total dust
Exposure duration:	overhaul phase lasts an average of 30 mins
Personal protective equipment:	Firefighters typically wear SCBA type respirators while actively fighting the fire but the assumption in this article is that, presumably, the firefighters remove the PPE once the active stage is over and are then exposed
Comments:	This article does not specifically mention TCEP

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	Firefighters will be included as a PESS, therefore the report is for an occupational scenario within the scope of the risk evaluation.
	Metric 4:	Temporal Representativeness	Medium	Even though the data is over 20 years old; operations, equipment, and worker activities are expected to be reasonably representative of current conditions.
	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:	Broadwater, K., Ceballos, D., Page, E., Croteau, G., Mueller, C. (2017). Health hazard evaluation report: HHE-2014-0131-3298, evaluation of occupational exposure to flame retardants at four gymnastics studios.
HERO ID:	6558292
Conditions of Use:	Flexible polyurethane foam

EXTRACTION

Parameter	**Data**
Worker activity description:	Foam replacement and gymnastic studio cleaning
Exposure route:	dermal; inhalation
Dermal exposure data:	Dermal exposure data
Exposure duration:	4 hours on average (range 1 - 8.5 hrs)
Number of workers:	18-20
Personal protective equipment:	Filtering facepiece respirators, gloves (the N95's were provided to the employees on a voluntarily basis, however the employees were not given Appendix D from OSHA which is a violation of the respiratory protection standard, it is also unclear if the employees were properly fitted with the N95s)
Comments:	Dermal exposure data: pg 18 (Table 6). 38 preshift and 38 postshift samples (handwipe sampling). Exposure duration: 4 hours (average). There is a lot of context in this article regarding handwashing and time spent on activity and exposure level.

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 flexible polyurethane foam, an in-scope occupational scenario.
	Metric 4:	Temporal Representativeness	High	Monitoring data are no more than 10 years old.
	Metric 5:	Sample Size	Medium	Sample distribution characterized by limited statistics (range, 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 some metadata (i.e., exposure frequency).
Domain 4: Variability and Uncertainty				
	Metric 7:	Metadata Completeness	Medium	Variability addressed by sampling before and after foam replacement, but uncertainty is not addressed.

Overall Quality Determination — High

Study Citation:	Craig, J. A., Ceballos, D. M., Fruh, V., Petropoulos, Z. E., Allen, J. G., Calafat, A. M., Ospina, M., Stapleton, H. M., Hammel, S., Gray, R., Webster, T. F. (2019). Exposure of nail salon workers to phthalates, di(2-ethylhexyl) terephthalate, and organophosphate esters: A pilot study. Environmental Science and Technology 53(24):14630-14637.
HERO ID:	6318028
Conditions of Use:	Commercial use

EXTRACTION

Parameter	**Data**
Worker activity description:	nail technicians/nail salon owners working in salons with primarily general nail salon services; procedures included regular, acrylic, or gel manicure, refill, and pedicure
Personal sampling data:	Personal air samples: only 11.1% of lapel samples above the LOD (30.6 ng/g), median <30.6 ng/g, and range from <30.6 ng/g to 56.2 ng/g (9 samples taken); all wrist samples were below LOD
Exposure duration:	work between 6-11 hours per day; nail salon workers employed 20-50 hours per week; worked in industry in range from less than one year to 33 years
Comments:	The air monitoring data does not constitute personal breathing zone data. The reported concentration is concentration of analyte on a matrix and not concentration of analyte in air.

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 personal care products containing organophosphate esters, 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 results 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 lapel and wrist sampling and various nail salons, but uncertainty is not addressed.

Overall Quality Determination High

Study Citation:	Heitbrink, W. (1993). In-depth survey report: Control technology for autobody repair and painting shops at Team Chevrolet, Colorado Springs, Colorado.
HERO ID:	6558535
Conditions of Use:	Paints and coatings

EXTRACTION

Parameter	**Data**
Worker activity description:	Spray painting (auto refinish shops)
Exposure route:	inhalation
Physical form:	mist and dust
Personal sampling data:	Table 3 summarizes total dust results (with ranges and statistical data - geometric mean and std. deviation); appendix provides raw data
Area sampling data:	Table 3 summarizes total dust results (with ranges and statistical data - geometric mean and std. deviation); appendix provides raw data
Exposure duration:	Varies with test
Number of workers:	13
Personal protective equipment:	half face-piece, air-purifying respirators with organic vapor cartridges and spray painting prefilters
Engineering control:	General discussion regarding use of spray booth (cross ventilation)
Comments:	PDs provided for cross draft spray painting booths in auto refinish shops. May be directly applicable if determined TCEP in auto painting or as an analogous use if spray application to other substrates.Number of samples: Several samples at various locations (table 3). Method: Total Dust: NIOSH 0500. Location: Two booths and 3 locations per booth: PBZ and 2 area sampling (spray booth and near exhaust filters)

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 spray application for autorefinishing, which is similar to the in-scope occupational scenario [spray application of coatings and paints]
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 in multiple spray booths at 3 similar sample locations

Overall Quality Determination High

Study Citation:	Heitbrink, W., Cooper, T., Edmonds, M., Bryant, C., Ruch, W. (1993). In-depth survey report: control technology for autobody repair and painting shops at Valley Paint and Body Shop, Amelia, Ohio.
HERO ID:	6558536
Conditions of Use:	Paints and Coatings

EXTRACTION

Parameter	**Data**
Exposure route:	inhalation
Physical form:	mist
Personal sampling data:	Table 4 summarizes paint mist results (with ranges and statistical data - geometric mean and std. deviation); appendix provides raw data
Area sampling data:	Table 4 summarizes paint mist results (with ranges and statistical data - geometric mean and std. deviation); appendix provides raw dataNumber of samples: Seven samples at three locations (personal, under car, near wall). Method: Total Dust: NIOSH 0500. Location: 3 locations per booth: PBZ and 2 area sampling (under car and near wall)
Exposure duration:	Varies with test
Number of workers:	7
Personal protective equipment:	half face-piece, air-purifying respirators during some sanding and welding; positive pressure air-supplied half-facepiece when silica sand is present. Also, rubber gloves and disposable clothing.
Engineering control:	General discussion regarding use of spray booth (down draft ventilation)

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 spray application for autorefinishing, which is similar to the in-scope occupational scenario [spray application of coatings and paints]
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 in multiple spray booths at 3 similar sample locations

Overall Quality Determination High

Study Citation:	La Guardia M. J., Schreder E. D., Uding N., Hale R. C. (2017). Human Indoor Exposure to Airborne Halogenated Flame Retardants: Influence of Airborne Particle Size.
HERO ID:	3863211
Conditions of Use:	Use of foam products (lab use as a standard)

EXTRACTION

Parameter	**Data**
Worker activity description:	vary by site
Exposure route:	inhalation, ingestion
Physical form:	dust
Personal sampling data:	Inhalable (>4 um) - nd"77.8 (89%) 19.1 (mean): Respirable (<4 um) - nd (0%) 0.75 (mean)
Area sampling data:	A total of 18 indoor environments were sampled. These included 14 common indoor spaces (i.e., residence/office (n = 10) [23], four coach residences, and four gymnasiums
Exposure duration:	12.9 - 24.6 hours
Exposure frequency:	1 day per person
Comments:	Number of samples: 10 individuals. Type of method/sampling PBZ; 24-hr sampling. See pg 11 for possibly useful digestion data

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 composite 24-hr samples that include general office and gym settings (applicable) and all other (non-occupational) settings in the day (home, transit, socializing, etc.), which may be applicable for in-scope occupational scenarios.
	Metric 4:	Temporal Representativeness	High	Monitoring data are no more than 10 years old.
	Metric 5:	Sample Size	Medium	Sample distribution characterized by limited statistics (range, 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 at multiple sites.

Overall Quality Determination High

Study Citation:	La Guardia, M. J., Hale, R. C. (2015). Halogenated flame-retardant concentrations in settled dust, respirable and inhalable particulates and polyurethane foam at gymnastic training facilities and residences. Environment International 79106-114.
HERO ID:	3012534
Conditions of Use:	Commercial Use - Furnishing, Cleaning, Treatment/Care Products

EXTRACTION

Parameter	**Data**
Exposure route:	Inhalation (dust)
Physical form:	Dust
Area sampling data:	Dust samples from houses ranged from 0.3 - 5.1 (micrograms TCEP/grams dust) with a mean of 2.5 (micrograms TCEP/grams dust). Dust samples from gyms ranged from 0.6 - 1.8 (micrograms TCEP/grams dust) with a mean of 1.18 (micrograms TCEP/grams dust). (Table 2 on pg. 5/9)
Particle size characterization:	Respirable size particles were not detected (Table 3 on pg. 6/9 and text on pg. 7/9)

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	High	Article is less 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 theuncertainty in the exposure estimates.

Overall Quality Determination High

Study Citation:	Muenhor D., Moon H. B., Lee S., Goosey E. (2018). Organophosphorus flame retardants (PFRs) and phthalates in floor and road dust from a manual e-waste dismantling facility and adjacent communities in Thailand. Journal of Environmental Science and Health, Part A: Toxic/Hazardous Substances & Environmental Engineering 53(1):79-90.
HERO ID:	4164912
Conditions of Use:	Recycling (a manual e-waste dismantling facility)

EXTRACTION

Parameter	**Data**
Worker activity description:	floor dust from facility, road dust in facility viscinity
Exposure route:	Inhalation, ingestion
Physical form:	solid (dust)
Comments:	No actual sampling - concentrations in dust that likely help inform exposure assessment: floor dust - 3.8 (ng/g); road dust - 5.6 (ng/g). Also contains estimates for ingestion, see Table-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	Low	Data are from Thailand, a non-OECD country.
	Metric 3:	Applicability	High	Data are for recycling, an in-scope occupational scenario.
	Metric 4:	Temporal Representativeness	High	Monitoring 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	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 Medium

Study Citation:	Mäkinen M. S. E., Mäkinen M. R. A., Koistinen J. T. B., Pasanen A. L., Pasanen P. O., Kalliokoski P. J., Korpi A. M. (2009). Respiratory and dermal exposure to organophosphorus flame retardants and tetrabromobisphenol A at five work environments. Environmental Science and Technology 43(3):941-947.
HERO ID:	2560628
Conditions of Use:	Incorporation into article (Furniture Workshop) and Recycling (2 different Electronics Dismantling Facilities)

EXTRACTION

Parameter	**Data**
Exposure route:	Inhalation, dermal
Personal sampling data:	See reference
Area sampling data:	See reference
Dermal exposure data:	Dermal exposure data
Comments:	The relevant data points are associated with the Furniture shop and the Electronic Dismantling Facilities.

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 Finland, an OECD country.
	Metric 3:	Applicability	High	Data are for recycling and furniture, in-scope occupational scenarios.
	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 a range with uncertain statistics.
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 taking personal breathing zone, area, and dermal samples, but uncertainty is not addressed.

Overall Quality Determination — High

Study Citation:	NCBI, (2020). PubChem Compound Summary for CID 2577 Tris (2-chloroethyl) phosphate.
HERO ID:	10170891
Conditions of Use:	May apply to more than 1 COU

EXTRACTION

Parameter	**Data**
Exposure route:	Occupational exposure may occur through inhalation and dermal contact with this compound at workplaces where it is produced or used (p. 19)
Physical form:	Section 6.1 provides environmental fate/exposure summary. E.g., "If released to air, a vapor pressure of 6.13X10-2 mm Hg at 25 °C indicates tris(2-chloroethyl) phosphate will exist solely as a vapor in the atmosphere (p. 19)."
Area sampling data:	Note: See 6.2 for data summaries from other published studies.TCEP detected in the air of a recycling electronic products plant at 15-36 ng/cu m in the dismantling hall, 28-34 ng/cu m in shredder during processing of plastics without brominated additives, and 33-38 ng/cu m in the shredder during processing of plastics containing brominated additives (p. 19). See: Sjoedin A et al; Environ Sci Technol 35: 448-54 (2001)See table on p. 20 for concentrations in different occupational media - inhalable air, particles, absorbent patches, hand wash samples - for circuit board factory and electronics dismantling (plus furniture shop, computer classroom, and offices) (p. 20).See: Makinen MSE et al; Environ Sci Technol 43: 941-7 (2009)"Tris(2-chloroethyl) phosphate was detected in a theater sample collected in Zurich, Switzerland at 36 ng/cu m... Tris(2-chloroethyl) phosphate was detected in a kindergarten and lecture room at 3 and 9 ng/cu m, respectively(5). Tris(2-chloroethyl) phosphate was detected at <0.2-23 ng/cu m in unspecified indoor air samples taken in Norway" (pg 25)
Dermal exposure data:	nan
Number of workers:	See section 6.2 probable routes of human exposure. Notes 2006 TSCA inventory reporting data estimate of 100-999 persons likely exposed in industrial manufacturing, processing, and use; states that this number may be "greatly underestimated" (p. 19).Notes that "NIOSH (NOES Survey 1981-1983) has statistically estimated that 5073 workers (578 of these are female) were potentially exposed" (p. 19)

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 various in-scope occupational scenarios.
	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 a range with uncertain statistics.
Domain 3: Accessibility/ Clarity				
	Metric 6:	Metadata Completeness	Medium	Sample type and exposure type provided but missing most other metadata.
Domain 4: Variability and Uncertainty				
	Metric 7:	Metadata Completeness	Medium	Variability addressed by sampling at multiple sites. Uncertainty is not addressed.

Overall Quality Determination Medium

Study Citation:	Okeme, J. O., Nguyen, L. V., Lorenzo, M., Dhal, S., Pico, Y., Arrandale, V. H., Diamond, M. L. (2018). Polydimethylsiloxane (silicone rubber) brooch as a personal passive air sampler for semi-volatile organic compounds. Chemosphere 2081002-1007.
HERO ID:	5017615
Conditions of Use:	Consumer use of various products

EXTRACTION

Parameter	**Data**
Worker activity description:	using computer workstations in offices
Physical form:	airborne vapors or particles
Personal sampling data:	Three participants: 27, 36, and 34 ng/m3 measured personal air concentration; median as 34 ng/m3
Exposure duration:	8hr working day
Comments:	Data is for air quality in areas that have products suspected of containing TCEP

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 consumer and general office exposures, which is similar to the the in-scope occupational scenario for commercial uses.
	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	Low	Variability and uncertainty are not addressed.

Overall Quality Determination Medium

Study Citation:	Sha, B., Dahlberg, A. K., Wiberg, K., Ahrens, L. (2018). Fluorotelomer alcohols (FTOHs), brominated flame retardants (BFRs), organophosphorus flame retardants (OPFRs) and cyclic volatile methylsiloxanes (cVMSs) in indoor air from occupational and home environments. Environmental Pollution 241319-330.
HERO ID:	5083520
Conditions of Use:	Commercial use, Consumer use

EXTRACTION

Parameter	**Data**
Exposure route:	inhalation
Physical form:	vapor and dust particles in indoor air
Area sampling data:	Area sampling data for TCEP in various occupational environments (lab, office, dining area, lecture room, computer room) provided graphically in pg/m3; exact values may be provided in supplementary data (separate document); TCEP had highest detection frequency of organophosphate flame retardants at a detection frequency of 73% ; sample results ranged from <9.4 pg/m3 to 240 pg/m3
Engineering control:	Forced ventilation in laboratories likely reduced the air concentrations

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 Sweden, an OECD country.
	Metric 3:	Applicability	High	Data pertain to occupational exposure in buildings (e.g., offices and laboratories.) Such exposure may be the result of commercial uses of TCEP that are in scope (e.g., use in coatings.)
	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, but in separate supplemental data).
Domain 3: Accessibility/ Clarity				
	Metric 6:	Metadata Completeness	High	All metadata provided.
Domain 4: Variability and Uncertainty				
	Metric 7:	Metadata Completeness	High	Variability is stated as ranges of concentrations of analytes, and uncertainty is discussed by the discussion of mean recovery +/- standard deviation of internal standards.

Overall Quality Determination High

Study Citation:	Shen, B., Whitehead TP, Gill, R., Dhaliwal, J., Brown, F. R., Petreas, M., Patton, S., Hammond SK (2018). Organophosphate flame retardants in dust collected from United States fire Stations. Environment International 11241-48.
HERO ID:	4167135
Conditions of Use:	Commercial Uses - Fabric, textile, and leather products not covered elsewhere

EXTRACTION

Parameter	**Data**
Worker activity description:	Fire station dust collected via vacuum; TCEP may be from textiles or use in polyurethane foams
Physical form:	dust at fire stations
Area sampling data:	Data located in Table 1: minimum 178 ng/g, median 1040 ng/g, mean 1320 ng/g, maximum 4660 ng/g
Comments:	Dust exposures more relevant to ambient environmental monitoring

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 end product uses with unknown sources (ambient exposures), which may be similar to the the in-scope occupational scenarios for commercial uses of consumer products such as furniture or textiles.
	Metric 4:	Temporal Representativeness	High	Monitoring data are no more than 10 years old.
	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	Low	Sample identified as dust samples collected via vacuum, but no other metadata related to exposures or TCEP sources provided.
Domain 4: Variability and Uncertainty				
	Metric 7:	Metadata Completeness	Medium	Variability addressed by comparing dust concentrations in various settings, including houses and dorms, as well as across states. Uncertainty is not addressed.

Overall Quality Determination Medium

Study Citation:	Shen, B., Whitehead TP, Gill, R., Dhaliwal, J., Brown, F. R., Petreas, M., Patton, S., Hammond SK (2018). Organophosphate flame retardants in dust collected from United States fire Stations. Environment International 11241-48.
HERO ID:	4167135
Conditions of Use:	Consumer products - Foam Seating and Bedding Products

EXTRACTION

Parameter	**Data**
Worker activity description:	Fire station dust collected via vacuum; TCEP may be from textiles or use in polyurethane foams
Physical form:	dust at fire stations
Area sampling data:	Data located in Table 1: minimum 178 ng/g, median 1040 ng/g, mean 1320 ng/g, maximum 4660 ng/g
Comments:	Dust exposures more relevant to ambient environmental monitoring

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 end product uses with unknown sources (ambient exposures), which may be similar to the the in-scope occupational scenarios for commercial uses of consumer products such as furniture or textiles.
	Metric 4:	Temporal Representativeness	High	Monitoring data are no more than 10 years old.
	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	Low	Sample identified as dust samples collected via vacuum, but no other metadata related to exposures or TCEP sources provided.
Domain 4: Variability and Uncertainty				
	Metric 7:	Metadata Completeness	Medium	Variability addressed by comparing dust concentrations in various settings, including houses and dorms, as well as across states. Uncertainty is not addressed.

Overall Quality Determination Medium

Study Citation:	Sjödin A., Carlsson H., Thuresson K., Sjölin S., Bergman Å., Östman C. (2001). Flame retardants in indoor air at an electronics recycling plant and at other work environments. Environmental Science and Technology 35(3):448-454.
HERO ID:	947816
Conditions of Use:	Recycling

EXTRACTION

Parameter	**Data**
Worker activity description:	"At this plant discarded electronic equipment, such as computers, printers, TV sets, microwave ovens, and numerous other electronic goods, are dismantled in order to recover valuable metals and dispose adequately of hazardous components" The dismantling process is performed manually using pneumatic tools. The electronic goods are separated into several types of materials, i.e., plastics, printed circuit boards, cables, metals, and hazardous waste. Plastic housings and other plastic components are shredded to reduce their volume." (pg 2-3)
Exposure route:	inhalation
Physical form:	dust
Area sampling data:	Dismantling hall: 25 (15-36) ng/m3; Shredder (non-BFR): 28, 34 ng/m3; Shredder (BFR): 33, 38 ng/m3 (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 Sweden, an OECD country.
	Metric 3: Applicability	High	Data are for recycling, an in-scope occupational scenario.
	Metric 4: Temporal Representativeness	Medium	Worker activity (dismantling products for disposal) could be expected to be reasonable representative of current operations, however, Monitoring data is 20 years old (article published in 2001).
	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, exposure frequency, engineering control, PPE.
Domain 4: Variability and Uncertainty			
	Metric 7: Metadata Completeness	Low	Variability and uncertainty are not addressed.

Overall Quality Determination Medium

Study Citation:	Stubbings, W. A., Nguyen, L. V., Romanak, K., Jantunen, L., Melymuk, L., Arrandale, V., Diamond, M. L., Venier, M. (2019). Flame retardants and plasticizers in a Canadian waste electrical and electronic equipment (WEEE) dismantling facility. Science of the Total Environment 675594-603.
HERO ID:	7537920
Conditions of Use:	Recycling/Disposal

EXTRACTION

Parameter	**Data**
Worker activity description:	samples collected from waste electrical and electronic equipment dismantling facility
Exposure route:	dust and air inhalation
Physical form:	TCEP used as additive plasticizer and viscosity regulator with flame retarding properties for the production of unsaturated polyester resins, acrylic resins, adhesives, and coatings; potentially present in electronic products being recycled
Area sampling data:	median dust concentration: 8500 ng/g; median air concentration: 19 ng/m3
Engineering control:	lack of ventilation systems

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 recycling/disposal, an in-scope occupational scenario.
	Metric 4:	Temporal Representativeness	High	Monitoring data are no more than 10 years old.
	Metric 5:	Sample Size	Medium	Sample distribution characterized by limited statistics (detection frequency, median, and range) 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	Uncertainty is addressed in sampling/analytical methodology but variability is not addressed.

Overall Quality Determination — High

Study Citation:	Yu, L., Ru, S., Zheng, X., Chen, S., Guo, H., Gao, G., Zeng, Y., Tang, Y., Mai, B. (2021). Brominated and phosphate flame retardants from interior and surface dust of personal computers: insights into sources for human dermal exposure. Environmental Science and Pollution Research International 28(10):12566-12575.
HERO ID:	7538009
Conditions of Use:	Consumer Exposure(s)

EXTRACTION

Parameter	**Data**
Exposure route:	dermal contact to dust
Physical form:	dust on external and internal surfaces of computers
Dermal exposure data:	Dermal exposure data

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, which is a non-OECD country.
	Metric 3:	Applicability	Low	Data are for consumer use of computers, which may be applied to in-scope occupational scenarios for dust exposures to TCEP-containing products during commercial use.
	Metric 4:	Temporal Representativeness	High	Monitoring data are no more than 10 years old.
	Metric 5:	Sample Size	Medium	Sample distribution characterized by limited statistics (median and range) 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 multiple computers tested in different areas.

Overall Quality Determination Medium

Study Citation:	Ng, M. G., van Tongeren, M., Semple, S. (2014). Simulated Transfer of Liquids and Powders from Hands and Clothing to the Mouth. Journal of Occupational and Environmental Hygiene 11(10):633-644.
HERO ID:	3222353
Conditions of Use:	Multiple

EXTRACTION

Parameter	**Data**
Exposure route:	oral
Physical form:	Liquids, solids
Dermal exposure data:	Dermal exposure data
Comments:	Task 1: Direct and Indirect TEs From Hand-to-mouth ContactTask 2: Direct and Indirect TEs From Glove-to-mouth ContactTask 3: Transfer While Putting a Respirator on and Taking it offTask 4: Transfer When Wiping the Mouth with the ArmTask 5: Object-to-mouth Transfer

EVALUATION

Domain	Metric		Rating	Comments
Domain 1: Reliability				
	Metric 1:	Methodology	Medium	The model is based on scientifically sound approaches, however, the model does not take into account evaporation or absorption. The experimentally determined TEs may be useful and the model may be adapted to account for those factors.
Domain 2: Representativeness				
	Metric 2:	Geographic Scope	Medium	The data are from the U.K., an OECD country.
	Metric 3:	Applicability	High	Model can be applied to occupational scenarios where inadvertent oral exposure is likely.
	Metric 4:	Temporal Representativeness	High	Data was published in 2014, so generally no more than 10 years old.
Domain 3: Accessibility/ Clarity				
	Metric 5:	Metadata Completeness	High	Model approach, equations, and choice of parameter values are transparent and clear and can be evaluated. Rationale for selection of approach, equations, and parameter values is provided.
Domain 4: Variability and Uncertainty				
	Metric 6:	Metadata Completeness	High	The model characterizes variability (e.g., study tests several different factors in varying transfer efficiencies) and uncertainty in the results (contains a limitation section).

Overall Quality Determination High

Study Citation:	ATSDR, (2012). Toxicological profile for phosphate ester flame retardants.
HERO ID:	3035885
Conditions of Use:	Various

EXTRACTION

Parameter	**Data**
Exposure route:	inhalation, dermal
Physical form:	present in rigid and flexible polyurethane foam and some textiles; liquids in pure form, may be aerosolized; used as plasticizer, flame retardant, lacquer/paint/glue, industrial processing chemical
Number of workers:	5073 total number of workers exposed based on NIOSH 1981-1983

EVALUATION

Domain	Metric		Rating	Comments
Domain 1: Reliability				
	Metric 1:	Methodology	High	Assessment 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	Medium	Data are applicable to general processing and use COUs, which may be in-scope.
	Metric 4:	Temporal Representativeness	Medium	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	N/A	N/A - information not dependent on samples
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:	ECB, (2009). European Union risk assessment report: Tris(2-chloroethyl) phosphate, TCEP. 213.
HERO ID:	3809216
Conditions of Use:	Manufacturing, Processing - Incorporation into a formulation, Processing - Incorporation into an article, Industrial and Commercial Uses, Disposal

EXTRACTION

Parameter	**Data**
Worker activity description:	Production of TCEP: exposure may occur during coupling and uncoupling of transfer lines, drumming, cleaning, maintenance, repair works and the taking of process samples...Processing into polymers and formulations: transporting and filling, mixing on site with additives and the base polymers or resins, adjusting and filling the products into drums or other containers; TCEP is brought to the customer sites mainly in tanks, to a less extent in drums. The substance is filled into storage tanks equipped with fixed pipelines to the location of further processing. The further processing is performed in closed systems and filling of the final product....Use of formulations and products: "Lacquers and paints are applied by brushing, rolling, spraying, dipping or covering by pouring. Spraying may be performed manually or automatically"
Exposure route:	inhalation, dermal
Physical form:	release of TCEP from plastic products; aerosolized forms of products
Personal sampling data:	Summary in Table 4.1.1.6 starting on pg 70 of PDF...Production of TCEP: 0-1.2 mg/m3 (inhalation), 0.1-1 mg/cm2/day (dermal)...Processing into polymers and formulations: 0-1.2 mg/m3 (inhalation), 0.1-1 mg/cm2/day (dermal)...Use of formulations and products: 8.3 mg/m3 (inhalation) with ratio used of 1/3 of TCEP concentration in paint for spray applications, use 0-1.2 mg/m3 (inhalation) in other cases where no spray application, 1-5 mg/cm2/day (dermal) for spray applications with aerosol droplets, use 0.1-1 mg/cm2/day (dermal) for applications without droplet formation
Dermal exposure data:	Dermal exposure data
Exposure duration:	full shift, although transfer and drumming expected during only part of the day
Exposure frequency:	daily for work days
Engineering control:	local exhaust ventilation
Comments:	Used EASE model and ratio of exposure in relation to isocyanates present in paints

EVALUATION

Domain	Metric		Rating	Comments
Domain 1: Reliability				
	Metric 1:	Methodology	High	Assessment uses high quality models from frequently-used sources.
Domain 2: Representativeness				
	Metric 2:	Geographic Scope	Medium	Data are from the EU, which includes OECD countries.
	Metric 3:	Applicability	High	Data are for various in-scope occupational scenarios.
	Metric 4:	Temporal Representativeness	Medium	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	N/A	N/A - information not dependent on samples
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 model documentation. Variability addressed by different aerosolized or non-aerosolized uses and various exposure scenarios.

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Study Citation: ECB, (2009). European Union risk assessment report: Tris(2-chloroethyl) phosphate, TCEP. 213.
HERO ID: 3809216
Conditions of Use: Manufacturing, Processing - Incorporation into a formulation, Processing - Incorporation into an article, Industrial and Commercial Uses, Disposal

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

Study Citation:	Grimes, G., Beaucham, C., Grant, M., Ramsey, J. (2019). Health hazard evaluation report: HHE-2016-0257-3333, May 2019, evaluation of exposure to metals and flame retardants at an electronics recycling company.
HERO ID:	6558307
Conditions of Use:	Recycling

EXTRACTION

Parameter	**Data**
Worker activity description:	Electronic recycling, disassembly, refurbishing and resale
Exposure route:	Inhalation, dermal
Personal sampling data:	PBZ: ND - 5.7 (ng/m^ 3)
Area sampling data:	Table 4 has hand wipe data, Table 5 has surface wipe data, Table 6 and Table 7 have PBZ data
Personal protective equipment:	The company completed a job hazard analysis for all departments or tasks. Each job hazard analysis included the recommended PPE; specifically, safety glasses, steel-toed boots, cutresistant gloves, chemical-resistant gloves, ear plugs, and voluntary use of N95 filtering facepiece respirators. We observed employees wearing ear plugs and respirators incorrectly. For example, employees did not fully insert ear plugs into the ear canal. Employees had been trained on using and storing respirators. However, we observed that some respirators were stored incorrectly in open boxes. Employees had received a copy of Appendix D of the OSHA respiratory protection standard (29 Code of Federal Regulation [CFR] 1910.134).

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 recycling, an in-scope occupational scenario.
Metric 4:	Temporal Representativeness	High	Assessment 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	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 pre- and post-shift but uncertainty is not addressed.

Overall Quality Determination — High

Study Citation:	(2015). Environmental concentrations and consumer exposure data for tris(2-chloroethyl) phosphate (TCEP).
HERO ID:	5155913
Conditions of Use:	Unspecified office settings

EXTRACTION

Parameter	**Data**
Exposure route:	inhalation
Physical form:	dust
Personal sampling data:	Table 2-3 summarizes data from four sources in Japan and Sweden. Ranges, and sometimes median values provided for concentrations in the "workplace" or "office" (note, summary data and table are very similar to similar data in HERO 5155526 from same authors)
Area sampling data:	Table 2-3 summarizes data from four sources in Japan and Sweden. Ranges, and sometimes median values provided for concentrations in the "workplace" or "office" (note, summary data and table are very similar to similar data in HERO 5155526 from same authors)
Comments:	The exposures provided in this source are related to consumer/general population. This particular form my not be relevant for the engineering portion of the RE.

EVALUATION

Domain	Metric		Rating	Comments
Domain 1: Reliability				
	Metric 1:	Methodology	Low	Assessment does not specifiy the techniques/methods used (original data sources briefly discussed).
Domain 2: Representativeness				
	Metric 2:	Geographic Scope	Medium	Data are from Japan/Sweden/China, OECD countries.
	Metric 3:	Applicability	Low	The assessment is for a non-occupational scenario
	Metric 4:	Temporal Representativeness	Medium	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	Medium	Sample distribution characterized by limited statistics (ranges, median) 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 addressed by presenting sampling data for multiple sites and presenting ranges, but uncertainty is not addressed.

Overall Quality Determination Low

Study Citation:	NICNAS, (2010). Ethanol, 2-chloro-, phosphate (3:1): Human health tier III assessment.
HERO ID:	5185320
Conditions of Use:	Industrial/Commercial Uses

EXTRACTION

Parameter	**Data**
Exposure route:	exposure may occur via inhalation, dermal or oral (hand-to-mouth, ingestion of settled dust or mouthing activities) routes
Comments:	exposure estimates provided for consumer exposures

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 Australia, which is an OECD country.
	Metric 3:	Applicability	Medium	Data are generic and likely include consumer exposures, which is similar to in-scope occupational scenarios
	Metric 4:	Temporal Representativeness	High	Assessment 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	Low	Variability and uncertainty are not addressed.

Overall Quality Determination Medium

Study Citation:	NICNAS, (2016). Ethanol, 2-chloro-, phosphate (3:1): Human health tier II assessment.
HERO ID:	5232796
Conditions of Use:	Incorporation into a formulation, Commercial/Industrial Uses

EXTRACTION

Parameter	**Data**
Worker activity description:	During product formulation, oral, dermal and inhalation exposure may occur, particularly where manual or open processes are used. These could include transfer and blending activities, quality control analysis, and cleaning and maintaining equipment. Worker exposure to the chemical at lower concentrations could also occur while using formulated products containing the chemical.
Exposure route:	inhalation, oral
Comments:	This only provides some very general statements about uses previously reported in Australia

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 Australia, which is an OECD country.
	Metric 3:	Applicability	High	Data are for incorporation into a formulation or use o TCEP-containing products, which are in-scope occupational scenarios.
	Metric 4:	Temporal Representativeness	High	Assessment is based on current industry conditions and data no more than 10 years old.
	Metric 5:	Sample Size	N/A	N/A - information not dependent on samples
Domain 3: Accessibility/ Clarity				
	Metric 6:	Metadata Completeness	Low	Assessment results relevant to occupational exposures are provided but underlying methods, assumptions, and information 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, (2001). Trisphosphates. Priority existing chemical assessment report Vol(20):49.
HERO ID:	659040
Conditions of Use:	Incorporation into formulation, Incorporation into article, Industrial/Commercial Uses

EXTRACTION

Parameter	**Data**
Worker activity description:	many of the specialist paints are applied in automatic spray booths; additional general worker activities included in process descriptions
Dermal exposure data:	Dermal exposure data
Number of workers:	estimated 2,000 employees in Australia employed in foam formulation/production
Personal protective equipment:	half-face respirators may be worn in fiberglass fabrication workplaces during spraying of resins containing flame retardant; operators wear leather gloves and respiratory protection during cutting of foam cutting
Engineering control:	ventilation systems

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 Australia, which is an OECD country.
Metric 3:	Applicability	High	Data are for various in-scope occupational scenarios, including incorporation into a formulation/article and industrial/commercial use
Metric 4:	Temporal Representativeness	Medium	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	N/A	N/A - information not dependent on samples
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:	OECD, (2011). Emission scenario document on coating application via spray-painting in the automotive refinishing industry.
HERO ID:	3808976
Conditions of Use:	Automotive Coating Application

EXTRACTION

Parameter	**Data**
Worker activity description:	transferring and mixing liquid products, container cleaning, transferring mixed coating to application equipment, overspray
Exposure route:	dermal and inhalation
Physical form:	liquid
Personal sampling data:	"dermal: Provides methods for modeling exposures to non-volatile liquids Inhalation: Provides methods for modeling exposures to mists"
Exposure frequency:	250 days/yr
Number of workers:	8 workers/site
Personal protective equipment:	air-purifying respirators or air-supplied respirators, Gloves (typically latex or nitrile), paint suits, and face masks/eye protection
Comments:	Type of Measurement or Method: "dermal: surrogate measured skin loading conditionsinhalation: 8-hr TWA surrogate data"

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 ESD was developed by EPA based on U.S. data
Metric 3:	Applicability	Medium	Data is for multiple in-scope occupational scenarios; however, data is general and not specific to a chemical.
Metric 4:	Temporal Representativeness	Low	Assessment is based on data 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 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 coating types.

Overall Quality Determination Medium

Study Citation: OECD, (2009). Emission scenario document on adhesive formulation.
HERO ID: 3827299
Conditions of Use: Processing-Polymers/resins (2-part formulations)

EXTRACTION

Parameter	Data
Worker activity description:	Sealed Process (Organic Solvent-Based, Reactive Adhesives)A. Inhalation and dermal exposure from unloading solid or liquid adhesive components.B. Inhalation and dermal exposure to solid or liquid adhesive components during container cleaning.D. Inhalation and dermal exposure to liquid adhesive product during sampling activities.E. Inhalation and dermal exposure to liquid during equipment cleaning of mixing and other process equipment.F. Inhalation and dermal exposure to liquids during the packaging of adhesive formulations into containers.pg.26/168Unsealed Process (Water-Based Adhesives, PSAs). details in the ref. (P. 28/168) Unsealed Heated Process (Hot-Melt Adhesives). details in the ref. (P. 30/168)
Exposure route:	inhalation, dermal (table 5.1)
Physical form:	volatile and nonvolatile chemical components contained in an adhesive formulation. This ESD describes the following general categories and types of adhesives:
Dermal exposure data:	nan
Number of workers:	It is therefore assumed that 62 percent of the 35 workers per site, or up to 22 workers per site, are potentially exposed to the chemical of interest while performing adhesive formulation process activities. No information was found that would provide bases for estimating the specific numbers of these 22 production workers that perform each of the exposure activities discussed in this section. Therefore, it can be conservatively estimated that all 22 workers per site are exposed during each activity. (P. 80/168)

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, 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	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 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 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	High	Assessment or report clearly documents its data sources, assessment methods, results, and assumptions
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: Processing-Polymers/resins (2-part formulations)

		EVALUATION	
Domain	Metric	Rating	Comments
	Metric 7: Metadata Completeness	High	The assessment addresses variability and uncertainty in the results. Uncertainty is well characterized

Overall Quality Determination High

Study Citation:	OECD, (2013). Emission scenario document on the industrial use of adhesives for substrate bonding.
HERO ID:	3827300
Conditions of Use:	Adhesive Application

EXTRACTION

Parameter	**Data**
Worker activity description:	unloading, container cleaning, adhesive application, equipment cleaning, curing/drying
Exposure route:	dermal and inhalation
Personal sampling data:	"dermal: Provides methods for modeling exposures to solids and non-volatile liquids Inhalation: Provides methods for modeling exposures to mists and volatile liquids"
Exposure frequency:	50-250 days/yr
Number of workers:	26-106 workers/site
Personal protective equipment:	chemical-resistant gloves and safety glasses. Heat-resistant gloves are used when applying hot-melt adhesives
Engineering control:	Spray booths

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 ESD was developed by EPA based on U.S. data
	Metric 3:	Applicability	Medium	Data is for an in-scope occupational scenario; however, data is general and not specific to a chemical.
	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 various chemical functions, types of adhesives, and end use markets.

Overall Quality Determination High

Study Citation:	OECD, (2017). Emission Scenario Document (ESD) on the use of textile dyes.
HERO ID:	3828838
Conditions of Use:	Textile Dyes

EXTRACTION

Parameter	**Data**
Worker activity description:	unloading, container cleaning, dyeing machine operation
Exposure route:	dermal and inhalation; "dermal: Provides methods for modeling exposures to non-volatile liquids and solids Inhalation: Provides methods for modeling exposures to volatile liquids and solids"
Exposure frequency:	31-250 days/yr
Number of workers:	1-6 workers/site
Personal protective equipment:	safety glasses, goggles, aprons, respirators, and/or masks

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 ESD was developed by EPA based on U.S. data
	Metric 3: Applicability	Medium	Data is for an in-scope occupational scenario; however, data is general and not specific to a chemical.
	Metric 4: Temporal Representativeness	Low	Assessment from 2015 but is based on data greater than 20 years old.
	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 chemical functions

Overall Quality Determination Medium

Study Citation: OECD, (2015). Emission scenario document on use of adhesives.
HERO ID: 3833136
Conditions of Use: Processing - use of polymers/resins (incorporation into article)

EXTRACTION

Parameter	Data
Worker activity description:	Industrial applications typically occur at the same site throughout the year, while in commercial applications workers will apply the adhesive at many different sites throughout the year (e.g. carpet layers moving between job sites). (P. 12/189)Section 2, pgs. 32-40/189, provide expected exposure points that may occur during a typical process. Section provides descriptions for multiple types of application
Exposure route:	Inhalation and dermal
Physical form:	Liquid, solid
Number of workers:	Table 5-2. Number of Production Workers Potentially Exposed During Application ProcessesTable 5-3. Number of Production Workers Potentially Exposed to Adhesives during Computer/Electronic Product ManufacturingTable 5-4. Number of Production Workers Potentially Exposed to Adhesives during Motor and Non-Motor Vehicle, Vehicle Parts, and Tire Manufacturing (Except Retreading)A NIOSH Health Hazard Evaluation Report (NIOSH, 2006) included a study of a single automobile manufacturing facility. The study notes, at the investigated site, that approximately 120 workers per shift work in the body shop, approximately 120 workers per shift work in the paint shop, approximately 700 workers per shift work in the assembly area, and approximately 130 workers per shift work in skilled trades, such as maintenance workers and electricians. An additional 85 skilled-trade workers work during the midnight shift. It is not clear how many of these workers would be exposed to adhesives during manufacturing.
Personal protective equipment:	Data from the FPA questionnaire indicates that the flexible packaging manufacturing industry utilizes the following PPE: chemical-resistant gloves and safety glasses. Heat-resistant gloves are used when applying hot-melt adhesives. Of the four sites that replied to the questionnaire, only one reported the use of respirators. This site applied solventless adhesives to substrates. In lieu of industry-wide survey data, this ESD assumes that the PPE reported by the questionnaires sites is representative of industry practices (FPA, 2009).
Engineering control:	potential for incineration, automated processes, and enclosed processes (see Control Technologies, pgs 61-62/189.

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, 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	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 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	The assessment captures operations, equipment, and worker activities expected to be representative of current conditions. EPA has no reason to believe exposures have changed. The completed exposure or risk assessment 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.

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Study Citation: OECD, (2015). Emission scenario document on use of adhesives.
HERO ID: 3833136
Conditions of Use: Processing - use of polymers/resins (incorporation into article)

			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	High	The assessment addresses variability and uncertainty in the results. Uncertainty is well characterized.

Overall Quality Determination High

Study Citation:	OECD, (2010). Emission scenario document on formulation of radiation curable coatings, inks and adhesives.
HERO ID:	3840003
Conditions of Use:	Formulation of Coatings, inks, and adhesives

EXTRACTION

Parameter	**Data**
Worker activity description:	Unloading, container cleaning, sampling, equipment cleaning, filter media changeout, packaging
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:	18-39 workers/site
Personal protective equipment:	"fabric or non-woven long sleeved shirts and pants, coveralls, and neoprene or rubber gloves. Barrier creams may be used to facilitate hand washing when materials or products penetrate gloves or other PPE. A rubber apron or rubber suit and rubber boots may also be worn in cases where there is potential for splashing on or penetration through clothing"

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 ESD was developed by EPA based on U.S. data
	Metric 3: Applicability	Medium	Data is for an in-scope occupational scenario; however, data is general and not specific to a chemical.
	Metric 4: Temporal Representativeness	Low	Assessment is based on data greater than 20 years old.
	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 various chemical functions and types of UV curable products.

Overall Quality Determination Medium

Study Citation:	Science Applications International Corporation, (1996). Generic scenario for automobile spray coating: Draft report.
HERO ID:	6311222
Conditions of Use:	Industrial/commercial use

EXTRACTION

Parameter	**Data**
Worker activity description:	"Auto OEM: robotics operations, paint mixing, paint booth cleaning, inspection, and manual ""touch-up"" paintingAutorefinish: wat sanding, car washing, stripping (paint removal), machine sanding, blowing, buffing, polishing, paint spraying, paint and primer mixing, and inspection"
Exposure route:	dermal and inhalation
Personal sampling data:	Inhalation: Provides methods for modeling exposures to mists
Dermal exposure data:	Dermal exposure data
Exposure frequency:	"Auto OEM: 250 days/yrAutorefinish: 170 days/yr"
Number of workers:	"Auto OEM: 17 workers/siteAutorefinish: 4-10 workers/site"
Engineering control:	Spray booths

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	Low	Data is for an occupational scenario similar to in-scope scenarios, and data is general and not specific to a chemical.
	Metric 4: Temporal Representativeness	Low	Assessment 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 OEM and refinish applications.

Overall Quality Determination Medium

Study Citation:	Toxicology Excellence for Risk Assessment (TERA) (2013). Toxicity review of tris(2-chloroethyl) phosphate (TCEP).
HERO ID:	5155526
Conditions of Use:	Unspecified office settings

EXTRACTION

Parameter	**Data**
Exposure route:	inhalation
Physical form:	dust
Area sampling data:	Table 6-1 summarizes data from four sources in Japan and Sweden. Ranges, and sometimes median values provided for concentrations in the "workplace" or "office" (note, summary data and table are very similar to similar data in HERO 5155913 from same authors)

EVALUATION

Domain	Metric		Rating	Comments
Domain 1: Reliability				
	Metric 1:	Methodology	Low	Assessment does not specify the techniques/methods used (original data sources briefly discussed).
Domain 2: Representativeness				
	Metric 2:	Geographic Scope	High	Data are from US (California), Japan/Sweden, OECD countries.
	Metric 3:	Applicability	Medium	Data are for unspecified workplaces and offices, which is likely applicable for in-scope scenarios.
	Metric 4:	Temporal Representativeness	Medium	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	Medium	Sample distribution characterized by limited statistics (ranges, median) 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 addressed by presenting sampling data for multiple sites and presenting ranges, but uncertainty is not addressed.

Overall Quality Determination Medium

Study Citation:	Toxicology Excellence for Risk Assessment (TERA) (2013). Toxicity review of tris(2-chloroethyl) phosphate (TCEP).
HERO ID:	5155526
Conditions of Use:	Unspecified work settings

EXTRACTION

Parameter	**Data**
Exposure route:	inhalation
Physical form:	dust/vapor (not specified)
Personal sampling data:	Detection frequency of TCEP in personal air monitors depended on the type of work place and ranged from 50% to 100% . TCEP was detected in personal air monitors at four of the five work places. The geometric means from the personal air monitors ranged from 5 to 450 ng/m3.
Comments:	Sampling location: "work places"

EVALUATION

Domain	Metric	Rating	Comments
Domain 1: Reliability			
	Metric 1: Methodology	Low	Assessment does not specifiy the techniques/methods used (original data sources briefly discussed).
Domain 2: Representativeness			
	Metric 2: Geographic Scope	High	Data are from the U.S.
	Metric 3: Applicability	Low	Data are for unspecified workplaces and offices, which is likely air quality for areas that have products suspected of containing TCEP.
	Metric 4: Temporal Representativeness	Medium	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	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 presenting sampling data for multiple sites and presenting ranges, but uncertainty is not addressed.

Overall Quality Determination Low

Study Citation: Toxicology Excellence for Risk Assessment (TERA) (2013). Toxicity review of tris(2-chloroethyl) phosphate (TCEP).
HERO ID: 5155526
Conditions of Use: Unspecified work settings

EXTRACTION

Parameter	Data
Exposure route:	dermal
Physical form:	dust
Dermal exposure data:	Dermal exposure data
Comments:	Sampling location: "work places". Dermal exposure potential was measured using patch samples attached to the workers" outer clothes (i.e., chest, arms and thigh). The detection frequency of TCEP in the patch samples was 67% at three of the work places and 100% at the fourth work place. The geometric means of the patch samples ranged from 0.1 to 0.4 ng/cm2 (M"kinen et al. 2009).

EVALUATION

Domain	Metric		Rating	Comments
Domain 1: Reliability				
	Metric 1:	Methodology	Low	Assessment does not specifiy the techniques/methods used (original data sources briefly discussed).
Domain 2: Representativeness				
	Metric 2:	Geographic Scope	High	Data are from the U.S.
	Metric 3:	Applicability	Low	Data are for unspecified workplaces and offices, which is likely air quality for areas that have products suspected of containing TCEP.
	Metric 4:	Temporal Representativeness	Medium	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	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 presenting sampling data for multiple sites and presenting ranges, but uncertainty is not addressed.

Overall Quality Determination Low

Study Citation:	U.S. EPA, (2023). Use of laboratory chemicals - Generic scenario for estimating occupational exposures and environmental releases (Revised draft generic scenario).
HERO ID:	10480466
Conditions of Use:	Use - Laboratory Chemicals

EXTRACTION

Parameter	**Data**
Worker activity description:	Container unloading (liquids and solids), container cleaning, equipment cleaning, laboratory analyses, disposal of laboratory chemicals
Exposure route:	Dermal, inhalation; dermal: Provides methods for modeling exposures to non-volatile and volatile liquids and solidsInhalation: Provides methods for modeling exposures to non-volatile and volatile liquids and solids
Physical form:	Liquid or solid
Exposure duration:	8-12 hr/day
Exposure frequency:	250 days/yr
Number of workers:	3 workers/facility and 3 ONUs/facility
Personal protective equipment:	Basic PPE includes wearing long sleeves (lab coats), long pants, closed-toe shoes, safety glasses or goggles, and gloves during the use of laboratory chemicals. Additional PPE may be worn depending on the level of hazard or specifics of the process.
Engineering control:	Fume hood

EVALUATION

Domain	Metric	Rating	Comments
Domain 1: Reliability			
	Metric 1: Methodology	High	Assessment uses high quality information/data from frequently-used sources.
Domain 2: Representativeness			
	Metric 2: Geographic Scope	High	This GS is based on U.S. data
	Metric 3: Applicability	Medium	Data is for an in-scope occupational scenario; however, data is general and not specific to a chemical.
	Metric 4: Temporal Representativeness	High	Assessment 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:	U.S. EPA, (2022). Chemical repackaging - Generic scenario for estimating occupational exposures and environmental releases (revised draft).
HERO ID:	11182966
Conditions of Use:	Repackaging

EXTRACTION

Parameter	**Data**
Worker activity description:	Unloading transport containers, container cleaning, equipment cleaning, loading of transport containers.
Exposure route:	Dermal, inhalation
Physical form:	Liquid or solid
Exposure duration:	8-12 hr/day
Exposure frequency:	The number of operating days is given in a range of 174-260 days/yr with an EPA default of 260 days/yr.
Number of workers:	3 workers/facility and 1 ONUs/facility (total number of employees and facilities given in Table 5-3)
Personal protective equipment:	Commonly used PPE includes safety glasses, face shields, aprons, and gloves.
Engineering control:	Local exhaust ventilation

EVALUATION

Domain	Metric		Rating	Comments
Domain 1: Reliability				
	Metric 1:	Methodology	High	Assessment uses high quality information/data from frequently-used sources.
Domain 2: Representativeness				
	Metric 2:	Geographic Scope	High	This GS is based on U.S. data
	Metric 3:	Applicability	Medium	Data are for an in-scope occupational scenario; however, data is general and not specific to a chemical.
	Metric 4:	Temporal Representativeness	Medium	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	High	Statistical distribution of samples is fully characterized (discrete use amounts 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 not addressed. Variability addressed by considering multiple worker activities.

Overall Quality Determination High

Study Citation:	U.S. EPA, (2014). Formulation of waterborne coatings - Generic scenario for estimating occupational exposures and environmental releases -Draft.
HERO ID:	3827197
Conditions of Use:	Processing - Incorporation into a formulation

EXTRACTION

Parameter	**Data**
Worker activity description:	Unloading, container cleaning, sampling, equipment cleaning, filter media changeout, packaging
Exposure route:	Dermal, Inhalation
Personal sampling data:	Inhalation: Provides methods for modeling exposures to volatile liquids and solids
Dermal exposure data:	nan
Exposure frequency:	235-350 days/yr
Number of workers:	25-40 workers/site
Personal protective equipment:	PPE depends on the type of potential exposure. Typically, PPE used in the workplace include safety glasses and gloves. Face shields and a particulate respirator may also be required in cases where there is a potential for dust exposure

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	Medium	Data is for an in-scope occupational scenario; however, data is general and not specific to a chemical.
	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 coating applications, and multiple chemical functions

Overall Quality Determination High

Study Citation:	U.S. EPA, (2004). Use of additives in foamed plastics - Generic scenario for estimating occupational exposures and environmental releases - Draft.
HERO ID:	6304171
Conditions of Use:	Processing - Additives in foamed plastics

EXTRACTION

Parameter	**Data**
Worker activity description:	Transfer from shipping containers, operation/supervision of the foam mix head/dispenser, foam production, transfer/handling of foamed articles
Exposure route:	dermal and inhalation
Exposure duration:	8 hr/day
Exposure frequency:	250 days/yr
Number of workers:	<50 workers/site

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	Medium	Data is for an in-scope occupational scenario; however, data is general and not specific to a chemical.
	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	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	Medium	Uncertainty not addressed. Variability addressed by considering multiple foam types.

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:	Plastics Compounding

EXTRACTION

Parameter	**Data**
Worker activity description:	Unloading and charging additives to process, Equipment Cleaning, Filling Containers with Compounded Resin
Exposure route:	Dermal and inhalation. Inhalation: Provides methods for modeling exposures to solids.
Dermal exposure data:	Dermal exposure data
Exposure frequency:	250 days/yr
Number of workers:	24 workers/site

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	Medium	Data is for an in-scope occupational scenario; however, data is general and not specific to a chemical.
	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	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	Medium	Uncertainty not addressed. Variability addressed by considering multiple plastic types, additive types, and worker activities.

Overall Quality Determination High

Study Citation:	U.S. EPA, (2014). Use of additives in the thermoplastic converting industry - generic scenario for estimating occupational exposures and environmental releases.
HERO ID:	6385711
Conditions of Use:	Plastics Converting

EXTRACTION

Parameter	**Data**
Worker activity description:	Unloading and charging compounded resins to process, converting processes, converting equipment cleaning, trimming processes
Exposure route:	Dermal and inhalation. Inhalation: Provides methods for modeling exposures to solids.
Dermal exposure data:	Dermal exposure data
Exposure frequency:	137-254 days/yr
Number of workers:	30-69 workers/site

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	Medium	Data is for an in-scope occupational scenario; however, data is general and not specific to a chemical.
	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	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	Medium	Uncertainty not addressed. Variability addressed by considering multiple plastic types, additive types, and worker activities.

Overall Quality Determination High

Study Citation:	U.S. EPA, (2004). Industry profile for the flexible polyurethane foam industry - generic scenario for estimating occupational exposures and environmental releases: Draft.
HERO ID:	6385715
Conditions of Use:	Processing - Incorporation into an article

EXTRACTION

Parameter	**Data**
Worker activity description:	Foam head operator, foam line operato, cut-off saw operator, and bun handler
Exposure route:	dermal and inhalation
Personal sampling data:	Inhalation: Provides TDI exposure concentrations
Dermal exposure data:	nan
Exposure frequency:	250 days/yr
Number of workers:	47 workers/site
Personal protective equipment:	"Foam head operator: No respiratorFoam line operator: half-face or full-face air-purifying respirators (APRs) with organic vapor (OV) cartridgesSaw operators: loose, hooded supplied-air respirators (SARs)Bun handlers: APRs"
Engineering control:	combination of containment (i.e., enclosure) and local exhaust ventilation (LEV)

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	Medium	Data is for an in-scope occupational scenario; however, data is general and not specific to a chemical.
Metric 4:	Temporal Representativeness	Medium	Sampling data is 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 mean with no other 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 foam and additive types.

Overall Quality Determination High

Study Citation:	U.S. EPA, (2004). Additives in plastics processing (converting) - Generic scenario for estimating occupational exposures and environmental releases - Draft.
HERO ID:	6549571
Conditions of Use:	Additives in Plastics Processing (Converting into Finished Products)

EXTRACTION

Parameter	**Data**
Worker activity description:	Receipt of compounded resin, Forming (Heating), Molding/Shaping, Trimming, Finishing (including coating)
Exposure route:	Inhalation and Dermal
Physical form:	Exposure to solids during unloading of compounded resin from transport containers and charging to forming operation; Exposure to dusts generated from converting processes; Exposure to liquids during equipment cleaning of equipment; Exposure to solids during trimming activities.
Personal sampling data:	Exposure from Unloading and Charging Compounded Resin; Exposure from Converting Processes; Exposure from Trimming Processes: Inhalation exposure = OSHA PEL x breathing rate x hours x fraction of additive in resin x fraction of chemical in additive (if applicable)Exposure from Converting Equipment Cleaning: Not expected, particles are expected to be contained in water.
Dermal exposure data:	Dermal exposure data
Exposure duration:	8 hours/day assumed for inhalation calculations
Exposure frequency:	CEB standard assumption, 250 days per year based on 5 day work week and two weeks per year of operation shut down.
Number of workers:	Overall, there were 736,698 workers employed in the Plastic Product Manufacturing industry in 2001. Table 1 provides Number of Workers for subcategories of NAICS 3261 Plastic Product Manufacturing.
Engineering control:	Water: According to the Development Document for Effluent Limitation Guidelines for the Plastics Molding and Forming Point Source Category (1984), approximately 31% of surveyed sites that use process water directly discharged their process water; 44% indirectly discharged (POTW); and 25% had a zero discharge. Zero discharge methods include recycling, evaporation pond, septic tank with leach field, evaporation from equipment, land application, and contract haul. Types of on-site treatment include settling, pH adjustment, activated sludge, activated carbon adsorption, filtration, and vacuum filtration.Air: The Emissions Scenario Document on Plastic Additives suggests that bag filters used to collect particulate emissions are 99% efficient. However, the prevalence of bag filter use was not available.

EVALUATION

Domain	Metric	Rating	Comments
Domain 1: Reliability			
Metric 1:	Methodology	High	The assessment uses high quality data 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	Medium	The assessment is for an occupational scenario within the scope of the risk evaluation. However, data are not chemical specific.
Metric 4:	Temporal Representativeness	Low	Data are greater than 20 years old.
Metric 5:	Sample Size	N/A	Sample size criteria are not applicable to data extracted.
Domain 3: Accessibility/ Clarity			
Metric 6:	Metadata Completeness	High	Assessment or report clearly documents its data sources, assessment methods, results, and assumptions.

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Study Citation: U.S. EPA, (2004). Additives in plastics processing (converting) - Generic scenario for estimating occupational exposures and environmental releases - Draft.

HERO ID: 6549571

Conditions of Use: Additives in Plastics Processing (Converting into Finished Products)

		EVALUATION	
Domain	Metric	Rating	Comments
Domain 4: Variability and Uncertainty			
	Metric 7: Metadata Completeness	Medium	Variability in worker activities is captured through identification of various NAICS codes associated with plastic additive use, but uncertainty associated with number of workers is not characterized.

Overall Quality Determination — Medium

Study Citation:	U.S. EPA, (2021). Application of spray polyurethane foam insulation - Generic scenario for estimating occupational exposures and environmental releases - Final.
HERO ID:	8674805
Conditions of Use:	Commercial Use

EXTRACTION

Parameter	**Data**
Worker activity description:	foam application, trimming, cleanup, chemical transfers, maintenance, disturbing foam during renovation and end-of-life activities
Exposure route:	dermal and inhalation
Personal sampling data:	Inhalation: Provides MDI, amine catalyst, blowing agent, and inhalable/respirable particulate exposure data
Number of workers:	253,700 total workers in industry see section 5-3

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	Low	Data may be relevant for a potential historic in-scope scenario; however, data is general and not specific to TCEP.
Metric 4:	Temporal Representativeness	High	Assessment is based on current industry conditions and data no more than 10 years old.
Metric 5:	Sample Size	Medium	Sample distribution characterized by a mean with no other 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 different chemical components and particle sizes

Overall Quality Determination High

Study Citation:	Burgess, W. A. (1991). Potential exposures in the manufacturing industry - Their recognition and control. 595-674.
HERO ID:	1267867
Conditions of Use:	Processing, Commercial use

EXTRACTION

Parameter	**Data**
Worker activity description:	information on paint application equipment used and occupational exposures during paint processes; various spray guns and powder coating application method
Physical form:	additive in chemical formulation and mixtures, paint mist and solvent vapors
Exposure duration:	general duration estimate for various worker exposures in chemicals industry; most specific work tasks take less than ten minutes, filtration tasks may take 1hr to half-shift
Engineering control:	Painting: ventilation, workplace design, respirator protection, and selection of paint system and application technique... Chemicals: exhaust ventilation and containment

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 generic paint application and chemical processing, which is similar to the in-scope occupational scenarios of TCEP use in paint and coatings and incorporation of TCEP into formulations, mixtures, and articles.
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:	EPA Office of Air and Water programs (1974). Air pollution control engineering and cost study of the paint and varnish industry.
HERO ID:	6580284
Conditions of Use:	Incorporation into a formulation

EXTRACTION

Parameter	**Data**
Number of workers:	Number of paint production employees estimated for given output of a plant: 58 hourly paid people and 12 salaried paid people per 1.9 million gallons of output annually
Engineering control:	Ventilation system in manufacturing area of model plant is designed for six air changes per hour with exhaust system

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 generic paint and coatings manufacturing and emissions of VOCs, which is similar to the in-scope occupational scenarios of TCEP use in paint and coatings.
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 due to confidential business information.
Domain 4: Variability and Uncertainty			
Metric 7:	Metadata Completeness	Medium	Variability addressed by addressing manufacturing plants throughout the United States, but uncertainty is not addressed.

Overall Quality Determination Medium

Study Citation:	U.S. Census Bureau, (2022). County Business Patterns: 2020.
HERO ID:	11224652
Conditions of Use:	All

EXTRACTION

Parameter	**Data**
Life cycle description:	All
Number of sites:	Used to develop a method to estimate number of sites and workers.
Number of workers:	Used to develop a method to estimate number of sites and workers.

EVALUATION

Domain	Metric		Rating	Comments
Domain 1: Reliability				
	Metric 1:	Methodology	High	U.S. Census Bureau is expected to use reliable survey and census methods.
Domain 2: Representativeness				
	Metric 2:	Geographic Scope	High	U.S. based economic data
	Metric 3:	Applicability	High	These economic data cover all industry and occupation types in scope for all chemicals.
	Metric 4:	Temporal Representativeness	High	The Census Bureau SUSB data are from 2015
	Metric 5:	Sample Size	High	The SUSB is a compilation of data extracted from the Business Register, U.S. Census Bureau's "most complete, current, and consistent data for U.S. business establishments." Incorporates data from economic censuses and current business surveys, quarterly and annual Federal tax records, and other departmental and federal statistics. Expected to be sufficiently representative. (https://www.census.gov/programs-surveys/susb/about.html)
Domain 3: Accessibility/ Clarity				
	Metric 6:	Metadata Completeness	Medium	U.S. Census Bureau documents results and methods, but underlying survey results not accessible.
Domain 4: Variability and Uncertainty				
	Metric 7:	Metadata Completeness	Medium	Limited discussion of variability and uncertainty in results.

Overall Quality Determination — High

Study Citation:	U.S. EPA, (2013). Updating CEB"s method for screening-level estimates of dermal exposure.
HERO ID:	11224653
Conditions of Use:	Industrial Use - Aircraft interiors and aerospace products

EXTRACTION

Parameter	**Data**
Dermal exposure data:	Dermal exposure data

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 based on study from Netherlands, an OECD country.
	Metric 3:	Applicability	Medium	Data are for generic for solids handling, which is similar to the in-scope occupational scenario for handling solid articles containing TCEP.
	Metric 4:	Temporal Representativeness	Low	Report is based on data greater than 20 years old, but industry conditions that are expected to be relevant.
	Metric 5:	Sample Size	N/A	This metric is not applicable to the data being extracted
Domain 3: Accessibility/ Clarity				
	Metric 6:	Metadata Completeness	Medium	Underlying data sources for obtaining dermal loading rates are provided, but methods are not fully transparent.
Domain 4: Variability and Uncertainty				
	Metric 7:	Metadata Completeness	Medium	Variability addressed by different scenarios or physical forms (liquid/solid) but uncertainty is not addressed.

Overall Quality Determination Medium

Study Citation:	U.S. EPA, (2013). Updating CEB"s method for screening-level estimates of dermal exposure.
HERO ID:	11224653
Conditions of Use:	Processing - Recycling

EXTRACTION

Parameter	**Data**
Dermal exposure data:	Dermal exposure data
Comments:	Relevant for recycling of electronics

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 based on study from Netherlands, an OECD country.
	Metric 3:	Applicability	Medium	Data are for generic for solids handling, which is similar to the in-scope occupational scenario for handling solid articles containing TCEP.
	Metric 4:	Temporal Representativeness	Low	Report is based on data greater than 20 years old, but industry conditions that are expected to be relevant.
	Metric 5:	Sample Size	N/A	This metric is not applicable to the data being extracted
Domain 3: Accessibility/ Clarity				
	Metric 6:	Metadata Completeness	Medium	Underlying data sources for obtaining dermal loading rates are provided, but methods are not fully transparent.
Domain 4: Variability and Uncertainty				
	Metric 7:	Metadata Completeness	Medium	Variability addressed by different scenarios or physical forms (liquid/solid) but uncertainty is not addressed.

Overall Quality Determination Medium

Study Citation:	U.S. EPA, (2013). Updating CEB"s method for screening-level estimates of dermal exposure.
HERO ID:	11224653
Conditions of Use:	Disposal

EXTRACTION

Parameter	**Data**
Dermal exposure data:	Dermal exposure data
Comments:	Relevant for disposal of solid products containing TCEP

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 based on study from Netherlands, an OECD country.
	Metric 3:	Applicability	Medium	Data are for generic for solids handling, which is similar to the in-scope occupational scenario for handling solid articles containing TCEP.
	Metric 4:	Temporal Representativeness	Low	Report is based on data greater than 20 years old, but industry conditions that are expected to be relevant.
	Metric 5:	Sample Size	N/A	This metric is not applicable to the data being extracted
Domain 3: Accessibility/ Clarity				
	Metric 6:	Metadata Completeness	Medium	Underlying data sources for obtaining dermal loading rates are provided, but methods are not fully transparent.
Domain 4: Variability and Uncertainty				
	Metric 7:	Metadata Completeness	Medium	Variability addressed by different scenarios or physical forms (liquid/solid) but uncertainty is not addressed.

Overall Quality Determination Medium

Study Citation:	U.S. EPA, (2015). TSCA work plan chemical, problem formulation and initial assessment, chlorinated phosphate ester cluster flame retardants.
HERO ID:	4565574
Conditions of Use:	Various

EXTRACTION

Parameter	**Data**
Exposure route:	vapor inhalation and dermal exposure considered most important
Physical form:	only CDR reported use is in paints and coatings industry, though TCEP also used as additive in polyurethane foam and other matrices
Engineering control:	reported use of dust extractors to limit dust exposure in Europe

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 various generic occupational scenarios, which would include 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 - 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:	U.S. EPA, (2005). Furniture flame retardancy partnership: Environmental profiles of chemical flame-retardant alternatives for low-density polyurethane foam: Volume 1.
HERO ID:	956579
Conditions of Use:	Commercial use of Furnishing, Cleaning, Treatment/Care Products

EXTRACTION

Parameter	**Data**
Worker activity description:	Discusses general exposure points for chemical manufacturing, foam manufacturing, and furniture manufacturing; not chemical-specificDiscusses releases during consumer use such as in foam seating or mattress products
Exposure route:	Suggests inhalation of dusts, vapors, and mists; dermal; and ingestion routes (not chemical-specific), though ingestion considered less applicable in occupational scenarios

EVALUATION

Domain	Metric		Rating	Comments
Domain 1: Reliability				
	Metric 1:	Methodology	High	The assessment is developed by EPA.
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	Data are for multiple in-scope occupational scenarios; however, data is general and not specific to a chemical.
	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	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 accounting for different chemicals and physical forms, but uncertainty is not addressed.

Overall Quality Determination Medium

Study Citation:	Velázquez-Gómez, M., Hurtado-Fernández, E., Lacorte, S. (2019). Differential occurrence, profiles and uptake of dust contaminants in the Barcelona urban area. Science of the Total Environment 6481354-1370.
HERO ID:	5043338
Conditions of Use:	Commercial use, Consumer use

EXTRACTION

Parameter	**Data**
Exposure route:	dust ingestion
Physical form:	TCEP released from TCEP-containing products and adsorbed to dust

EVALUATION

Domain	Metric		Rating	Comments
Domain 1: Reliability				
	Metric 1:	Methodology	High	Report uses high quality information that is from frequently-used sources and there are no known quality issues.
Domain 2: Representativeness				
	Metric 2:	Geographic Scope	Medium	Data are from Spain, an OECD country.
	Metric 3:	Applicability	High	The data are relevant to the assessment of occupational exposure which would result from use of TCEP in various commercial uses (e.g., paints and coatings, ...etc.) that are associated with buildings.
	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 and uncertainty are not addressed.

Overall Quality Determination — High

Study Citation:	Whitmyre, G. K., Driver, J. H., Ginevan, M. E., Tardiff, R. G., Baker, S. R. (1992). Human exposure assessment I: understanding the uncertainties. Toxicology and Industrial Health 8(5):297-320.
HERO ID:	4635
Conditions of Use:	Processing and Use (not chemical specific)

EXTRACTION

Parameter	**Data**
Exposure route:	inhalation, dermal
Exposure duration:	model parameters for dermal and inhalation exposure (e.g., skin surface area, inhalation rate)
Exposure frequency:	model parameters for dermal and inhalation exposure (e.g., skin surface area, inhalation rate)
Comments:	This is not chemical specific but might still be useful

EVALUATION

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Methodology	Medium	Report uses high quality information and is not from frequently-used sources. 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 more targeted towards consumer or ambient exposures with non-specific chemicals, but they can be used for generic exposures.
	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	Source discusses uncertainty of exposure modeling. Variability is not addressed with specific respect to chemicals or certain occupational scenarios.

Overall Quality Determination Medium

Study Citation:	CEPE, (2020). SpERC Fact Sheet: Industrial application of coatings by spraying.
HERO ID:	10442901
Conditions of Use:	Industrial Use of Paints and Coatings

EXTRACTION

Parameter	**Data**
Release or emission factors:	Release or emission factors
Release frequency:	225 days/year
Waste treatment methods and pollution control:	Waste treatment methods and pollution control
Comments:	The industrial uses that the data in the data source pertain to are specified in the data source by codes. These codes are defined in EU guidance documents, but are not defined in the data source. Whether these industrial uses are relevant to the assessment of TECP cannot be determined based on the data source.

EVALUATION

Domain	Metric	Rating	Comments
Domain 1: Reliability			
Metric 1:	Methodology	Medium	EU data expected to be accurate
Domain 2: Representativeness			
Metric 2:	Geographic Scope	Medium	EU data
Metric 3:	Applicability	Medium	There is some uncertainty about whether the data are associated with a COU
Metric 4:	Temporal Representativeness	High	Data is less than 20 years
Metric 5:	Sample Size	Low	No statistics
Domain 3: Accessibility/ Clarity			
Metric 6:	Metadata Completeness	Low	Only media is provided
Domain 4: Variability and Uncertainty			
Metric 7:	Metadata Completeness	Low	Variability and uncertainty not addressed

Overall Quality Determination Low

Study Citation:	CEPE, (2020). SpERC Fact Sheet: Professional application of coatings and inks by spraying.
HERO ID:	10442902
Conditions of Use:	Commercial Use of Paints and Coatings

EXTRACTION

Parameter	**Data**
Release or emission factors:	Release or emission factors
Release frequency:	Indoor: 365 days/yearOutdoor: 225 days/year

EVALUATION

Domain	Metric	Rating	Comments
Domain 1: Reliability			
	Metric 1: Methodology	High	EU data expected to be accurate
Domain 2: Representativeness			
	Metric 2: Geographic Scope	Medium	EU data
	Metric 3: Applicability	High	Data pertain to a COU
	Metric 4: Temporal Representativeness	High	Data is less than 20 years
	Metric 5: Sample Size	Low	No statistics
Domain 3: Accessibility/ Clarity			
	Metric 6: Metadata Completeness	High	Meta data included
Domain 4: Variability and Uncertainty			
	Metric 7: Metadata Completeness	Low	Variability and uncertainty not addressed

Overall Quality Determination Medium

Study Citation:	J6 Polymers, (2021). Comment from J6 Polymers LLC regarding end usage characterization of tris(2"chloroethyl) phosphate (TCEP) in rigid polyurethane foam.
HERO ID:	11204812
Conditions of Use:	Processing - incorporation into article (aircraft interior)

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	This source comes directly from the manufacturer.
Domain 2: Representativeness				
	Metric 2:	Geographic Scope	High	This company is based directly from the U.S.
	Metric 3:	Applicability	High	This source applies directly to a COU and is specific to the chemical.
	Metric 4:	Temporal Representativeness	High	Company provided this source in 2021.
	Metric 5:	Sample Size	Low	Not characterized by statistics.
Domain 3: Accessibility/ Clarity				
	Metric 6:	Metadata Completeness	High	Source is directly from the manufacturer.
Domain 4: Variability and Uncertainty				
	Metric 7:	Metadata Completeness	Low	Does not provide variability or uncertainty.

Overall Quality Determination High

Study Citation:	NCBI, (2020). PubChem Compound Summary for CID 2577 Tris (2-chloroethyl) phosphate.
HERO ID:	10170891
Conditions of Use:	Disposal

EXTRACTION

Parameter	**Data**
Description of release source:	Municipal treatment plants, industrial sewage treatment plants. Section 6.11 contains information on effluent concentrations, primarily municipal treatment plants.
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	Medium	Data are from Germany, an OECD country.
	Metric 3:	Applicability	High	Data are for disposal, 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	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:	Schripp, T., Wensing, M. (2009). Emission of VOCs and SVOCs from electronic devices and office equipment. 405-430.
HERO ID:	9493521
Conditions of Use:	Incorporation into Article (Flame Retardant in Electronics)

EXTRACTION

Parameter	**Data**
Description of release source:	VOC/SVOCs "can be released from electronic equipment into indoor air due to the heating - up of the device interior" (p. 405).Flame retardants and plasticizer (i.e., TBP, TCEP, and TCPP) emissions "increase with increasing operating time even if the device is operated longer than one week" (Figure 17.5) (p. 422).
Release or emission factors:	Release or emission factors

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 Germany, an OECD country.
	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, such as a consumer scenario that is similar to a worker 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 frequency (continuous but not steady-state) provided but missing other metadata.
Domain 4: Variability and Uncertainty				
	Metric 7:	Metadata Completeness	Medium	Variability is addressed by sampling after different lengths of operating time. Uncertainty is not addressed.

Overall Quality Determination Medium

Study Citation:	U.S. EPA, (2022). DMR Data for TCEP, formaldehyde, trans-1,2-dichloroethylene, 1,1-dichloroethane, and 1,2-dichloroethane.
HERO ID:	11181053
Conditions of Use:	All

EXTRACTION

Parameter	**Data**
Life cycle description:	All
Description of release source:	Provides media of release.
Release or emission factors:	nan
Comments:	Source is tagged for TCEP but they are all non detects from 2010 to 2021.

EVALUATION

Domain	Metric		Rating	Comments
Domain 1: Reliability				
	Metric 1:	Methodology	Low	Methodology used by submitters to estimate release data is not known.
Domain 2: Representativeness				
	Metric 2:	Geographic Scope	High	DMR is U.S. based data
	Metric 3:	Applicability	High	DMR includes industries included in the scopes of multiple chemicals
	Metric 4:	Temporal Representativeness	High	DMR data are from 2010-2021.
	Metric 5:	Sample Size	Medium	Universe is limited to NPDES permit holders; statistical representativeness is unclear.
Domain 3: Accessibility/ Clarity				
	Metric 6:	Metadata Completeness	Low	DMR only includes release media but no other metadata.
Domain 4: Variability and Uncertainty				
	Metric 7:	Metadata Completeness	Low	DMR does not address variability or uncertainty in submitter provided data.

Overall Quality Determination — Medium

Study Citation:	U.S. EPA, (1995). AP-42: Compilation of air pollutant emission factors. Volume I: Stationary point and area sources, fifth edition.
HERO ID:	46492
Conditions of Use:	Incorporation into article, Industrial/Commercial Uses, Disposal

EXTRACTION

Parameter	**Data**
Description of release source:	Predominantly VOC or gaseous emissions (as opposed to SVOC... Section 2 specifies emissions associated with solid waste disposal operations, including potentially applicable incineration and landfilling for TCEP-containing products; Section 4.2.2.1 (general industrial coating), 4.2.2.5 (wood panel coating), 4.2.2.7 (polymeric coating of supporting substrates), and potentially other coating sections applicable with emission points in process; Section 4.3 (waste water treatment); Section 4.6 (polyester resin plastic product formulation); Section 4.11 (textile fabric printing)
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 information and data from frequently-used or direct sources.
Domain 2: Representativeness			
Metric 2:	Geographic Scope	High	Data are from the U.S.
Metric 3:	Applicability	Medium	Data are for air releases/emissions, primarily for VOCs and not directed at TCEP, as applicable to in-scope 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 - information not dependent on samples
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 different processes used in industry, but uncertainty is not addressed.

Overall Quality Determination Medium

Study Citation:	U.S. EPA, (1995). Chapter 6: Organic chemical process industry. Compilation of air pollutant emission factors. Volume I: Stationary point and area sources, fifth edition, AP-42.
HERO ID:	7310513
Conditions of Use:	Processing - Incorporation into a formulation

EXTRACTION

Parameter	**Data**
Release or emission factors:	Release or emission factors
Waste treatment methods and pollution control:	Waste treatment methods and pollution control
Comments:	Data is general and not chemical-specific for TCEP and potentially not for applicable physical forms of TCEP.

EVALUATION

Domain	Metric	Rating	Comments
Domain 1: Reliability			
Metric 1:	Methodology	High	Report uses high quality information and data from frequently-used or direct sources.
Domain 2: Representativeness			
Metric 2:	Geographic Scope	High	Data are from the U.S.
Metric 3:	Applicability	Medium	Data are for general paint/varnish manufacturing occupational scenarios, but are not chemical-specific for TCEP and potentially not for applicable physical forms of TCEP.
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 is given as estimates with no description of state 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 different products manufactured in the paint industry, but uncertainty is not addressed.

Overall Quality Determination Medium

Study Citation:	U.S. EPA, (1995). Chapter 4.2: Introduction to surface coating. Compilation of air pollutant emission factors. Volume I: Stationary point and area sources, fifth edition, AP-42.
HERO ID:	7315820
Conditions of Use:	Industrial/Commercial Uses, Disposal

EXTRACTION

Parameter	**Data**
Description of release source:	Predominantly VOC or gaseous emissions (as opposed to SVOC); Section 2 specifies emissions associated with solid waste disposal operations, including potentially applicable incineration and landfilling for TCEP-containing products; Section 4.2.2.1 (general industrial coating), 4.2.2.5 (wood panel coating), 4.2.2.7 (polymeric coating of supporting substrates), and potentially other coating sections applicable with emission points in process; Section 4.3 (waste water treatment); Section 4.6 (polyester resin plastic product formulation); Section 4.11 (textile fabric printing)
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 information and data from frequently-used or direct sources.
Domain 2: Representativeness			
Metric 2:	Geographic Scope	High	Data are from the U.S.
Metric 3:	Applicability	Medium	Data are for air releases/emissions, primarily for VOCs and not directed at TCEP, as applicable to in-scope 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 - information not dependent on samples
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 different processes used in industry, but uncertainty is not addressed.

Overall Quality Determination Medium

Study Citation:	ATSDR, (2012). Toxicological profile for phosphate ester flame retardants.
HERO ID:	3035885
Conditions of Use:	Processing and Disposal

EXTRACTION

Parameter	**Data**
Description of release source:	Phosphate ester flame retardants are released to environmental surface water and groundwater primarily from leaching of hydraulic fluid spills and discarded or landfilled PVC, polyurethane foam, electronic wall coverings, and other flame retardant materials; released to soil; released to air from aerosolized fluids during manufacturing, production, and transportation with purer forms

EVALUATION

Domain	Metric		Rating	Comments
Domain 1: Reliability				
	Metric 1:	Methodology	Medium	Assessment 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 applicable to general processing and use COUs, which may be in-scope.
	Metric 4:	Temporal Representativeness	Medium	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	N/A	N/A - information not dependent on samples
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:	ECB, (2009). European Union risk assessment report: Tris(2-chloroethyl) phosphate, TCEP. 213.
HERO ID:	3809216
Conditions of Use:	Processing - Incorporation into a formulation, Processing - Incorporation into an article, Industrial and Commercial Uses, Disposal

EXTRACTION

Parameter	**Data**
Description of release source:	"The flame retardant TCEP is physically combined with the polymer matrix. Therefore, TCEP could migrate to the surface. Releases might be expected during service life and disposal of products containing TCEP."; release during processing and formulation in the polymers and paints/varnishes industries..."TCEP is present as an impurity in the substance V6. Production and use of V6 could therefore lead to environmental releases of TCEP"
Release quantity:	"total tonnage ending up landfilled can be estimated to < 700 t/a"... Total releases are estimated and summarized in Table 3.10 of source on pg 43 of the PDF
Release or emission factors:	nan
Release frequency:	284 days for polymers processing; 300 days for paint/varnish formulation; 200 days for paint/varnish processing
Waste treatment methods and pollution control:	Waste treatment methods and pollution control
Comments:	Use 2003 ESD for coatings industry and 2004 ESD on plastic additives for generic estimates of releases

EVALUATION

Domain	Metric	Rating	Comments
Domain 1: Reliability			
Metric 1:	Methodology	High	Assessment uses high quality models from frequently-used sources.
Domain 2: Representativeness			
Metric 2:	Geographic Scope	Medium	Data are from the EU, which includes OECD countries.
Metric 3:	Applicability	High	Data are for various in-scope occupational scenarios.
Metric 4:	Temporal Representativeness	Medium	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	N/A	N/A - information not dependent on samples
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 model documentation. Variability addressed by different release routes and sources including TCEP as impurity in V6.

Overall Quality Determination High

Study Citation:	NICNAS, (2010). Ethanol, 2-chloro-, phosphate (3:1): Human health tier III assessment.
HERO ID:	5185320
Conditions of Use:	Industrial/Commercial Use

EXTRACTION

Parameter	**Data**
Description of release source:	The chemical may be released from various products due to its migration to the surface or via matrix decomposition, aging or mechanical action
Comments:	exposure estimates provided for consumer exposures

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 Australia, which is an OECD country.
	Metric 3:	Applicability	Medium	Data are generic and likely include consumer exposures, which is similar to in-scope occupational scenarios
	Metric 4:	Temporal Representativeness	High	Assessment is based on current industry conditions and data no more than 10 years old.
	Metric 5:	Sample Size	N/A	N/A - information not dependent on samples
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:	NICNAS, (2001). Trisphosphates. Priority existing chemical assessment report Vol(20):49.
HERO ID:	659040
Conditions of Use:	Incorporation into formulation, Incorporation into article, Industrial/Commercial Uses

EXTRACTION

Parameter	**Data**
Description of release source:	Release can occur during manufacture of products containing chlorinated triphosphates, during use of products, or during disposal of products; likely to be slowly released to atmosphere from surfaces of solid articles containing chemical during normal product use; may be released to wastewater during washing of fabrics containing chemical
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	Assessment uses high quality data from frequently-used sources.
Domain 2: Representativeness			
Metric 2:	Geographic Scope	Medium	Data are from Australia, which is an OECD country.
Metric 3:	Applicability	High	Data are for various in-scope occupational scenarios, including import, incorporation into a formulation, and industrial/commercial use, and disposal
Metric 4:	Temporal Representativeness	Medium	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	N/A	N/A - information not dependent on samples
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:	OECD, (2011). Emission scenario document on coating application via spray-painting in the automotive refinishing industry.
HERO ID:	3808976
Conditions of Use:	Automotive Coating Application

EXTRACTION

Parameter	**Data**
Description of release source:	Container cleaning, equipment cleaning, coating application (overspray)
Release or emission factors:	nan
Release frequency:	250 days/yr
Waste treatment methods and pollution control:	nan
Comments:	media: air, land

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 ESD was developed by EPA based on U.S. data
Metric 3:	Applicability	Medium	Data is for multiple in-scope occupational scenarios; however, data is general and not specific to a chemical.
Metric 4:	Temporal Representativeness	Low	Assessment 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 multiple coating types.

Overall Quality Determination Medium

Study Citation:	OECD, (2009). Emission scenario documents on coating industry (paints, lacquers and varnishes).
HERO ID:	3827298
Conditions of Use:	Formulation of Coatings and Use of Coatings

EXTRACTION

Parameter	**Data**
Description of release source:	"PROC: material loading, heat-up, surface evaporation, filling, micellaneous operations, material storage, leaks, spills USE: Application losses, equipment residues, drum residues"
Release or emission factors:	Release or emission factors
Waste treatment methods and pollution control:	Waste treatment methods and pollution control
Comments:	media: water, air, land

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 is for an in-scope occupational scenario; however, data is general and not specific to a chemical.
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 chemical functions and coating types

Overall Quality Determination Medium

Study Citation:	OECD, (2009). Emission scenario document on adhesive formulation.
HERO ID:	3827299
Conditions of Use:	Processing-Polymers/resins (2-part formulations)

EXTRACTION

Parameter	**Data**
Description of release source:	Sealed Process (Organic Solvent-Based, Reactive Adhesives)1. Container residue from adhesive component transport container released to water, incineration, or landfill.2. Open surface losses of volatile chemicals to air during container cleaning.3. Transfer operation losses to air of volatile chemicals from unloading the adhesive component.4. Dust losses vented to outside air from the transfer of a solid/powdered adhesive component into the process.Alternatively, these dusts are captured on vent filters or settle within the workspace, and are subsequentlycollected and released to water, incineration, or landfill.5. Vented losses of volatile chemicals to air during mixing operations.6. Product sampling wastes disposed to water, incineration or landfill (not quantified in this ESD).7. Open surface losses of volatile chemicals during product sampling.8 Equipment cleaning releases to water, incineration, or landfill.9. Open surface losses of volatile chemicals to air during equipment cleaning.10. Transfer operation losses of volatile chemicals to air from loading adhesive product into transport containers.11. Off-spec adhesive product released to water, incineration, or landfill. (P. 26/168)Unsealed Process (Water-Based Adhesives, PSAs) (P. 28/168)Unsealed Heated Process (Hot-Melt Adhesives) . (P. 30/168)
Release or emission factors:	Release or emission factors

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, 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	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 similar to an occupational scenario within the scope of the risk evaluation, in terms of the type of industry, operations, and workactivities.
	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	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: OECD, (2009). Emission scenario document on adhesive formulation.
HERO ID: 3827299
Conditions of Use: Processing-Polymers/resins (2-part formulations)

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

Study Citation:	OECD, (2013). Emission scenario document on the industrial use of adhesives for substrate bonding.
HERO ID:	3827300
Conditions of Use:	Adhesive Application

EXTRACTION

Parameter	**Data**
Description of release source:	container cleaning, unloading, equipment cleaning, application losses, curing/drying, trimming
Release or emission factors:	nan
Release frequency:	50-365 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 ESD was developed by EPA based on U.S. data
Metric 3:	Applicability	Medium	Data is for an in-scope occupational scenario; however, data is general and not specific to a chemical.
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 various chemical functions, types of adhesives, and end use markets.

Overall Quality Determination High

Study Citation: OECD, (2017). Emission Scenario Document (ESD) on the use of textile dyes.
HERO ID: 3828838
Conditions of Use: Textile Dyes

EXTRACTION

Parameter	Data
Description of release source:	unloading, container cleaning, disposal of spent dye bath, equipment cleaning
Release or emission factors:	nan
Release frequency:	31-295 days/yr
Waste treatment methods and pollution control:	nan

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 ESD was developed by EPA based on U.S. data
Metric 3:	Applicability	Medium	Data is for an in-scope occupational scenario; however, data is general and not specific to a chemical.
Metric 4:	Temporal Representativeness	Low	Assessment from 2015 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 multiple chemical functions

Overall Quality Determination Medium

Study Citation: OECD, (2015). Emission scenario document on use of adhesives.
HERO ID: 3833136
Conditions of Use: Processing - use of polymers/resins (incorporation into article)

EXTRACTION

Parameter	Data
Description of release source:	Section 2, pgs. 32-40/189, provide expected release points that may occur during a typical process. Section provides descriptions for multiple types of application
Release quantity:	various model estimates for release are given in sec. 7.
Release frequency:	EPA default = 1 event/worker-day
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 a frequently used source (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	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 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	The assessment captures operations, equipment, and worker activities expected to be representative of current conditions. EPA has no reason to believe exposures have changed. The completed exposure or risk assessment 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	High	The assessment addresses variability and uncertainty in the results. Uncertainty is well characterized.

Overall Quality Determination High

Study Citation:	OECD, (2010). Emission scenario document on formulation of radiation curable coatings, inks and adhesives.
HERO ID:	3840003
Conditions of Use:	Formulation of Coatings, inks, and adhesives

EXTRACTION

Parameter	**Data**
Description of release source:	Container cleaning, dusts and volatiles from unloading containers, vented losses during mixing, sampling, equipment cleaning, volatiles from loading containers, filter wastes
Release quantity:	Provides models for estimating various fugitive air releases
Release or emission factors:	Release or emission factors
Release frequency:	250 days/year
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 ESD was developed by EPA based on U.S. data
Metric 3:	Applicability	Medium	Data is for an in-scope occupational scenario; however, data is general and not specific to a chemical.
Metric 4:	Temporal Representativeness	Low	Assessment 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 various chemical functions and types of UV curable products.

Overall Quality Determination Medium

Study Citation:	OECD, (2009). Emission scenario document on plastic additives.
HERO ID:	5079084
Conditions of Use:	Plastics Compounding and Converting

EXTRACTION

Parameter	**Data**
Description of release source:	Raw material handling, compounding, converting, service life, disposal
Release or emission factors:	nan
Comments:	media: air, water

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, (2009). Emission scenario document on transport and storage of chemicals.
HERO ID:	6393282
Conditions of Use:	Processing

EXTRACTION

Parameter	**Data**
Description of release source:	filling and emptying of containers, storage, pipelines, washing and cleaning, recycling and disposal of packaging
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	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 is for an in-scope occupational scenario; however, data is general and not specific to a chemical.
Metric 4:	Temporal Representativeness	Low	Assessment 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 multiple chemical forms, containers and storage system types.

Overall Quality Determination Medium

Study Citation: Science Applications International Corporation, (1996). Generic scenario for automobile spray coating: Draft report.
HERO ID: 6311222
Conditions of Use: Industrial/commercial use

EXTRACTION

Parameter	Data
Description of release source:	Auto OEM: blowdown, sludge processing, generated sludge, stack air releasesAutorefinish: air filter waste from overspray, stack air
Release or emission factors:	Release or emission factors
Release frequency:	Auto OEM: sludge pit cleaning: 1 day/yr All other releases: 250 days/yrAutorefinish: 170 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	Medium	Data is for an in-scope occupational scenario; however, data is general and not specific to a chemical.
Metric 4:	Temporal Representativeness	Low	Assessment 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 OEM and refinish applications.

Overall Quality Determination Medium

Study Citation:	U.S. EPA, (2023). Use of laboratory chemicals - Generic scenario for estimating occupational exposures and environmental releases (Revised draft generic scenario).
HERO ID:	10480466
Conditions of Use:	Use - Laboratory Chemicals

EXTRACTION

Parameter	**Data**
Description of release source:	Container unloading, container cleaning, labware equipment cleaning, during laboratory analyses, waste disposal; Release media: Water, air, landfill
Release or emission factors:	Release or emission factors
Release frequency:	260 day/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 information/data from frequently-used sources.
Domain 2: Representativeness			
Metric 2:	Geographic Scope	High	This GS is based on U.S. data
Metric 3:	Applicability	Medium	Data is for an in-scope occupational scenario; however, data is general and not specific to a chemical.
Metric 4:	Temporal Representativeness	High	Assessment 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: U.S. EPA, (2022). Chemical repackaging - Generic scenario for estimating occupational exposures and environmental releases (revised draft).
HERO ID: 11182966
Conditions of Use: Repackaging

EXTRACTION

Parameter	Data
Description of release source:	Transfer losses, container cleaning, equipment cleaning, transfer losses during loading.Air, water, incineration, landfill
Release quantity:	Provides methodology to estimate total emissions for rapackaging sites and process steps.Provides methodology to estimate releases based on various parameters including: opening area of cleaning equipment, physical-chemical properties, air velocity, etc.
Release or emission factors:	Release or emission factors
Release frequency:	The number of operating days is given in a range of 174-260 days/yr with an EPA default of 260 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	Medium	Data is for an in-scope occupational scenario; however, data is general and not specific to a chemical.
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 emissions from multiple activities.

Overall Quality Determination High

Study Citation:	U.S. EPA, (2014). Formulation of waterborne coatings - Generic scenario for estimating occupational exposures and environmental releases -Draft.
HERO ID:	3827197
Conditions of Use:	Processing - Incorporation into a formulation

EXTRACTION

Parameter	**Data**
Description of release source:	Unloading containers, container cleaning, dispersion and blending operations, sampling, equipment cleaning, filter wastes, loading, off-spec coating
Release quantity:	Provides models for estimating various fugitive air releases
Release or emission factors:	nan
Release frequency:	235-350 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	Medium	Data is for an in-scope occupational scenario; however, data is general and not specific to a chemical.
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 coating applications, and multiple chemical functions

Overall Quality Determination High

Study Citation:	U.S. EPA, (2004). Use of additives in foamed plastics - Generic scenario for estimating occupational exposures and environmental releases - Draft.
HERO ID:	6304171
Conditions of Use:	Processing - Additives in foamed plastics

EXTRACTION

Parameter	**Data**
Description of release source:	Container residues, equipment residues, release of auxiliary blowing agents (ABAs), scrap or off-spec product disposal
Release or emission factors:	Release or emission factors

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	Medium	Data is for an in-scope occupational scenario; however, data is general and not specific to a chemical.
	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 foam types.

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:	Plastics Compounding

EXTRACTION

Parameter	**Data**
Description of release source:	Container Residue from Original Additive Transport Container, Dust from Compounding, Fugitive Air from Compounding, Residual from Compounding Equipment Cleaning
Release quantity:	Provides models for estimating various releases to air, water, and landfill.
Release or emission factors:	Release or emission factors
Waste treatment methods and pollution control:	Waste treatment methods and pollution control
Comments:	media: water, air, land

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	Medium	Data is for an in-scope occupational scenario; however, data is general and not specific to a chemical.
	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 High

Study Citation:	U.S. EPA, (2008). Releases from roll coating and curtain coating operations - generic scenario for estimating occupational exposure and environmental releases.
HERO ID:	6385699
Conditions of Use:	Industrial/commercial use

EXTRACTION

Parameter	**Data**
Description of release source:	Releases in curtain coating operations may come from residual coating formulation. Releases in roll coating operations may come from splatter and mist generation or residual coating in the reservoir.
Release or emission factors:	Release or emission factors
Comments:	Data is general and not specific to TCEP

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	Low	Data is for an occupational scenario similar to in-scope scenarios, but data is general and not specific to a chemical.
Metric 4:	Temporal Representativeness	Low	Assessment 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	Uncertainty is addressed by discussion of data source and limitations of the transfer efficiency metric. Variability is not addressed.

Overall Quality Determination Medium

Study Citation: U.S. EPA, (2014). Use of additives in the thermoplastic converting industry - generic scenario for estimating occupational exposures and environmental releases.
HERO ID: 6385711
Conditions of Use: Plastics Converting

EXTRACTION

Parameter	Data
Description of release source:	Container cleaning, spillage, unloading, dusts and fugitive emissions from converting, equipment cleaning, trimming wastes
Release quantity:	Provides models for estimating various releases to air, water, and landfill.
Release or emission factors:	Release or emission factors
Release frequency:	137-254
Waste treatment methods and pollution control:	Waste treatment methods and pollution control
Comments:	media: water, air, land

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	Medium	Data is for an in-scope occupational scenario; however, data is general and not specific to a chemical.
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 High

Study Citation:	U.S. EPA, (2004). Industry profile for the flexible polyurethane foam industry - generic scenario for estimating occupational exposures and environmental releases: Draft.
HERO ID:	6385715
Conditions of Use:	Processing - Incorporation into an article

EXTRACTION

Parameter	**Data**
Description of release source:	Container cleaning, curing emissions, equipment cleaning, scraps and off-spec foam disposal
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	The data are from the United States
Metric 3:	Applicability	Medium	Data is for an in-scope occupational scenario; however, data is general and not specific to a chemical.
Metric 4:	Temporal Representativeness	Low	Assessment 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	High	Uncertainty not addressed. Variability addressed by considering multiple foam and additive types.

Overall Quality Determination High

Study Citation:	U.S. EPA, (2004). Additives in plastics processing (converting) - Generic scenario for estimating occupational exposures and environmental releases - Draft.
HERO ID:	6549571
Conditions of Use:	Additives in Plastics Processing (Converting into Finished Products)

EXTRACTION

Parameter	**Data**
Description of release source:	1. Container residue from plastic resin transport container released to water, incineration, or landfill.2. Dust generation from forming processes released to water or landfill.3. Fugitive air emissions from forming and molding processes released to water or air.4. Equipment cleaning and cooling water from forming and molding processes released to water, incineration, or landfill.5. Solid waste from trimming operations released to water or landfill.
Release quantity:	Container Residue from Compounding Transport Container: Daily Release from Container Residue (kg/site-day) = Daily Use Rate (kg/site-day) x Loss FractionDust Generation from Converting Activities Released to Water or Landfill: Daily release of dust = daily use rate x loss fractionFugitive Air from Converting Activities Released to Water or Air: Daily release to water (or air) from volatilization = daily use rate x loss fractionResidual from Converting Equipment Cleaning: Daily release from equipment cleaning = daily use rate x loss fractionTrimming Waste: Daily release from trimmings = daily use rate x loss fraction
Release or emission factors:	Release or emission factors
Release frequency:	CEB standard assumption, 250 days per year based on 5 day work week and two weeks per year of operation shut down.
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 uses high quality data and 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	Medium	The assessment is for an occupational scenario within the scope of the risk evaluation. However, data are not chemical specific.
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	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 evaluation of various sources of release, but uncertainty in release estimation is not addressed.

Overall Quality Determination Medium

Study Citation:	U.S. EPA, (2021). Application of spray polyurethane foam insulation - Generic scenario for estimating occupational exposures and environmental releases - Final.
HERO ID:	8674805
Conditions of Use:	Commercial Use

EXTRACTION

Parameter	**Data**
Description of release source:	Container residues, air emissions during application, equipment cleaning, cutting/grinding wastes, spills/leaks, PPE disposal
Release or emission factors:	nan
Waste treatment methods and pollution control:	nan
Comments:	Data is general and not specific to TCEP.

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	Low	Data may be relevant for a potential historic in-scope scenario; however, data is general and not specific to TCEP.
Metric 4:	Temporal Representativeness	High	Assessment 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	Uncertainty not addressed. Variability addressed by considering one- and two-component foams.

Overall Quality Determination High

Study Citation:	Verbruggen, E. M. J., Rila, J. P., Traas, T. P., Posthuma-Doodeman, C. J. A.,M, Posthumus, R. (2005). Environmental risk limits for several phosphate esters, with possible application as flame retardant.
HERO ID:	5349334
Conditions of Use:	Processing

EXTRACTION

Parameter	**Data**
Description of release source:	enters water via manufacturing wastewater

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 Europe, which includes multiple OECD countries.
	Metric 3:	Applicability	High	Data are for releases of TCEP from manufacturing processes, which is pertinent to processing scenarios.
	Metric 4:	Temporal Representativeness	Low	Report is mostly 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:	Verbruggen, E. M. J., Rila, J. P., Traas, T. P., Posthuma-Doodeman, C. J. A.,M, Posthumus, R. (2005). Environmental risk limits for several phosphate esters, with possible application as flame retardant.
HERO ID:	5349334
Conditions of Use:	Industrial Use - Other

EXTRACTION

Parameter	**Data**
Description of release source:	It must be assumed that partial release from polyurethane and other foams to the atmosphere occurs, although volatilisation can be prevented if foams arecovered

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 Europe, which includes multiple OECD countries.
	Metric 3: Applicability	High	Data are for releases of TCEP from polyurethane and other foams, which is an in-scope use/scenario for TCEP
	Metric 4: Temporal Representativeness	Low	Report is mostly 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:	CEC, (2015). Enhancing Trilateral Understanding of Flame Retardants and Their Use in Manufactured Items: Supply Chain Analysis of Select Flame Retardants Contained in Manufactured Items that are Used in Indoor Environments.
HERO ID:	4565753
Conditions of Use:	Disposal

EXTRACTION

Parameter	**Data**
Description of release source:	"A majority of disposed furniture continues to end up in landfills. Based on conversations with industry, although furniture may also be recycled under state or local programs, industrial recycling and recovery processes for upholstered furniture are atypical" (foam recycling activities in Canada, Mexico, and the US tend to occur during furniture manufacturing rather than at the end-of-life stage)
Comments:	General release information

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	Low	Data are for disposal of articles containing flame retardants, an in-scope occupational scenario, but TCEP specifically is not characterized
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	Release source information
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:	CECBP, (2008). Brominated and chlorinated organic chemical compounds used as flame retardants: Materials for the December 4-5, 2008 meeting of the California Environmental Contaminant Biomonitoring Program (CECBP): Scientific Guidance Panel (SGP): Agenda item: Consideration of potential designated chemicals.
HERO ID:	4296230
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/information 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 drinking water treatment methods and chemical-specific, but are not addressed towards 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	Medium	Results, motivation, and sources are clearly documented, but underlying data 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:	ECCC/HC, (2020). Science assessment of plastic pollution.
HERO ID:	7330238
Conditions of Use:	Industrial/Commercial use, Consumer use, Disposal

EXTRACTION

Parameter	**Data**
Description of release source:	additives including flame retardants leached from plastic materials and microplastics during use and disposal; migration pathways in food, water, and indoor dust Page 75
Release or emission factors:	Release or emission factors

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	Information is from Canada, which is an OECD country.
	Metric 3:	Applicability	Medium	Information is for generic plastic pollution and additives including the general class of flame retardants, which is similar to the in-scope occupational scenarios of TCEP use as an additive and in disposal.
	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	Low	Variability and uncertainty are not addressed.

Overall Quality Determination Medium

Study Citation:	EPA Office of Air and Water programs (1974). Air pollution control engineering and cost study of the paint and varnish industry.
HERO ID:	6580284
Conditions of Use:	Incorporation into formulation

EXTRACTION

Parameter	**Data**
Description of release source:	Sources include varnish cooking, resin cooking, thinning, handling & storage, milling operation, blending & finishing, and filling; exhaust from ventilation system
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 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 generic paint and coatings manufacturing and emissions of VOCs, which is similar to the in-scope occupational scenarios of TCEP use in paint and coatings.
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 due to confidential business information.
Domain 4: Variability and Uncertainty			
Metric 7:	Metadata Completeness	Medium	Variability addressed by addressing manufacturing plants throughout the United States, but uncertainty is not addressed.

Overall Quality Determination Medium

Study Citation:	ERG, (1998). Air emissions inventories, volume 2: Point sources: Chapter 11: Preferred and alternative methods for estimating air emissions from plastic products manufacturing.
HERO ID:	7349020
Conditions of Use:	Processing - incorporation into an article

EXTRACTION

Parameter	**Data**
Description of release source:	Release sources generally for plastic manufacturing includes volatilization of free monomer and solvent, VOC emissions from secondary materials such as additives, VOC and particulate emissions from byproducts during heating of resins or reactions, and particulate emissions during material handling and finishing 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 information/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 general plastic manufacturing occupational scenarios, but are not chemical-specific for TCEP.
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	Release source information
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:	Kim, H., Tanabe, S. I., Koganei, M. (2019). The emission rate of newly regulated chemical substances from building materials. IOP Conference Series: Materials Science and Engineering 60942046.
HERO ID:	7978640
Conditions of Use:	Commercial use of Furnishing, Cleaning, Treatment/Care Products; Construction, Paint, Electrical, and Metal Products; and Paints and Coatings

EXTRACTION

Parameter	**Data**
Description of release source:	TCEP emissions measured from building materials including adhesive, indoor paint, polystyrene foam, PVC sheet, carpet
Release or emission factors:	Release or emission factors

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 Japan, which is an OECD country.
	Metric 3:	Applicability	Low	Data are for emissions from consumer building products during service life, which can inform in-scope occupational scenarios for manufacture and incorporation into building 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	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 are not fully transparent.
Domain 4: Variability and Uncertainty				
	Metric 7:	Metadata Completeness	Medium	Variability addressed by accounting for different building materials, but uncertainty is not addressed.

Overall Quality Determination Medium

Study Citation:	Matsukami H., Nguyen Minh Tue, Suzuki G., Someya M., Le Huu Tuyen, Pham Hung Viet, Takahashi S., Tanabe S., Takigami H. (2015). Flame retardant emission from e-waste recycling operation in northern Vietnam: Environmental occurrence of emerging organophosphorus esters used as alternatives for PBDEs. Science of the Total Environment 514492-499.
HERO ID:	2942545
Conditions of Use:	Incorporation into an article

EXTRACTION

Parameter	**Data**
Description of release source:	Recycling or disposal of e-waste; open storage of e-waste including cathode ray tubes, electronic housings, and printed circuit boards; 40 million tons of e-waste generated globally per year; TCEP typically used in polyurethane forms as FR

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	Study was conducted by Japan, an OECD country. However the data is from Vietnam
	Metric 3:	Applicability	Low	The recycling of articles occurred in make shift areas; "Recycling operations were family based and took place on a small scale in the backyards of homes, often within 20 m distance from living area."
	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	All data sources, methods, results, and assumptions are clearly documented.
Domain 4: Variability and Uncertainty				
	Metric 7:	Metadata Completeness	Low	Variability addressed by different temperatures and gaseous environments, but uncertainty is not addressed.

Overall Quality Determination Medium

Study Citation:	Salthammer, T., Fuhrmann, F., Uhde, E. (2003). Flame retardants in the indoor environment – Part II: release of VOCs (triethylphosphate and halogenated degradation products) from polyurethane. Indoor Air 13(1):49-52.
HERO ID:	4663142
Conditions of Use:	Industrial Use

EXTRACTION

Parameter	**Data**
Description of release source:	offgassing from polyurethane products, though TCEP has been substituted by TCPP once classified as hazardous; hard foams stated to be "very low emission" and no data for TCEP emissions

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 Germany, which is an OECD country.
	Metric 3:	Applicability	Medium	Data are for offgassing PUR products, though not explicitly for TCEP. May be applied to qualitative discussion of release from end uses.
	Metric 4:	Temporal Representativeness	Medium	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	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	Uncertainty is addressed by discussion of emission sources and measurement methods. Variability is not addressed.

Overall Quality Determination Medium

Study Citation:	Salthammer, T., Fuhrmann, F., Uhde, E. (2003). Flame retardants in the indoor environment – Part II: release of VOCs (triethylphosphate and halogenated degradation products) from polyurethane. Indoor Air 13(1):49-52.
HERO ID:	4663142
Conditions of Use:	Commercial Use

EXTRACTION

Parameter	**Data**
Description of release source:	offgassing from polyurethane products, though TCEP has been substituted by TCPP once classified as hazardous; hard foams stated to be "very low emission" and no data for TCEP emissions

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 Germany, which is an OECD country.
	Metric 3:	Applicability	Medium	Data are for offgassing PUR products, though not explicitly for TCEP. May be applied to qualitative discussion of release from end uses.
	Metric 4:	Temporal Representativeness	Medium	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	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	Uncertainty is addressed by discussion of emission sources and measurement methods. Variability is not addressed.

Overall Quality Determination Medium

Study Citation:	U.S. EPA, (2015). TSCA work plan chemical, problem formulation and initial assessment, chlorinated phosphate ester cluster flame retardants.
HERO ID:	4565574
Conditions of Use:	Various

EXTRACTION

Parameter	**Data**
Description of release source:	Emission from products, adsorption deposition to particulates or matrix decomposition, aging, or release

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 various generic occupational scenarios, which would include 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 - 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:	U.S. EPA, (2005). Furniture flame retardancy partnership: Environmental profiles of chemical flame-retardant alternatives for low-density polyurethane foam: Volume 1.
HERO ID:	956579
Conditions of Use:	Commercial use of Furnishing, Cleaning, Treatment/Care Products

EXTRACTION

Parameter	**Data**
Description of release source:	Discusses general release points for chemical manufacturing, foam manufacturing, and furniture manufacturing; not chemical-specificDiscusses releases during consumer use such as in foam seating or mattress products

EVALUATION

Domain	Metric		Rating	Comments
Domain 1: Reliability				
	Metric 1:	Methodology	High	The assessment or report is developed by EPA.
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	Data are for multiple in-scope occupational scenarios; however, data is general and not specific to a chemical.
	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	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 accounting for different chemicals and physical forms, but uncertainty is not addressed.

Overall Quality Determination Medium

Study Citation:	ATSDR, (2012). Toxicological profile for phosphate ester flame retardants.
HERO ID:	3035885
Conditions of Use:	Manufacturing

EXTRACTION

Parameter	**Data**
Production, import, or use volume:	TCEP production in 1975 estimated at >908kg; estimated in 2006 IUR to be produced in range of 500,000-1million pounds; TCEP imports in 1972 considered negligible
Process description:	"produced by chemical synthesis via condensation of phosphorus oxychloride and an alkyl or aryl alcohol at low temperatures and pressures to avoid formation of alkyl chlorides"; TCEP used to produce TCPP using ethylene oxide

EVALUATION

Domain	Metric	Rating	Comments
Domain 1: Reliability			
	Metric 1: Methodology	High	Assessment 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	Uninformative	Manufacture is not in scope
	Metric 4: Temporal Representativeness	Medium	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	N/A	N/A - information not dependent on samples
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:	EC, (2008). 2,2-bis(chloromethyl) trimethylene bis[bis(2-chloroethyl) phosphate] (v6); CAS No: 38051-10-4, EINECS No: 253-760-2, Risk assessment.
HERO ID:	10284991
Conditions of Use:	Furnishing, Cleaning, Treatment/Care Products (Foam Seating and Bedding Products)

EXTRACTION

Parameter	Data
Production, import, or use volume:	"The level of automotive imports and exports into the EU were examined to indicate whether additional V6 could be entering via this route. European Commission data (EC 2002) indicate that in 1999, EU imports of cars, light commercial vehicles and components were worth EUR 46.58 billion. During the same period, the EU exported the equivalent of EUR 61.35 billion. Thus there was a net trade surplus for the EU with the rest of the world amounting to EUR 14.8 billion in 1999. On this basis it could be argued that there is likely to be a net export from the EU of V6 in automotive goods. To be conservative, no attempt has been made to account for this trade in the assessment." (pg. 35/262)Imports of furniture into the EU were examined to identify whether additional V6 may be entering the EU via this route. Imports of upholstered furniture from outside the EU-15 amounted to 848 million Euros in 1997. Most of these were sourced from Poland (more than 50%). Imports have been increasing continuously since 1993 to satisfy a growing internal demand. Extra-European exports of upholstered furniture stood at 1.17 billion Euro in 1997, an increase of 25% on the previous year. Two countries accounted for more than half of these exports: the United States (39%) and Switzerland (15%) (UEA, 2002). Thus there was a net trade surplus for the EU with the rest of the world amounting to 322 million Euro in 1997. On this basis it could be argued that there is likely to be a net export from the EU of V6 in furniture products, especially as the main export market is the US and V6 is used to meet the US standard (California 117). To be conservative, no attempt has been made to account for this trade in the assessment." (pg. 36/263)
Life cycle description:	"Moulded foam is mainly used in the automotive industry (seat cushions, headrests), with some use for office furniture. Slabstock foam is cut in accordance with the specifications demanded by customers, the main application being for furniture (EC, 1997). Slabstock foams are also used for rear car seats and fabric lining for seat covers and roofing in cars. The market for slabstock foams is around seven times larger than the market for moulded foams for car seats (Mark and Kamprath 2000)...V6 is used in flexible slabstock polyether and moulded foams (Rhodia 2000)." pg. 31/262"Following manufacture, most (over 95%) of the V6 produced is used as a flame retardant in the production of flexible polyurethane (PUR) foam, mainly for use in the automotive industry. V6 is not used in rigid foams owing to cost considerations. Flexible foams are produced by pouring the blend of two raw materials (polyol and isocyanate) onto a rolling conveyer belt (slabstock foam) or into a mould (moulded foam). Moulded foam is mainly used in the automotive industry (seat cushions headrests), with some use for office furniture. The main application of slabstock foam is for furniture." (pg. 89/262)"Data provided by a foam producer indicates that V6 is used in the production of foams for use with textiles in the manufacture ofcar seat, door panels, soundproofing, head-liners and cushions. The bulk of the seats are made using foam that doesn"t contain flame retardant. It is only the outer covering of foam associated with the covering fabric that contains V6. The assembly processes will vary depending on the product being made, but will usually involve the use of adhesives to laminate foam and the material being used for the interior of the car, cutting, trimming and stitching of components. Different operatives would carry out different tasks, so that, for example, one operator would laminate the foam and fabric, another would stitch and trim the seat covering and another would assemble the seat. Some of these activities may be carried out by employees in different companies." (pg. 107/262)
Process description:	"Flexible foams are produced by pouring the blend of the two raw materials (polyol containing additives including flame retardants such as V6, and di-isocyanate) onto a rolling conveyor belt (slabstock foam) or into a mould (moulded foam)...Blocks of PUR foam generally have to be cut into the required size/shape of the final product. This operation usually occurs after the blocks have cured and cooled. For some applications (e.g. seats for office furniture), PUR foam can be produced in a mould of the desired shape and so cutting is not required...Scrap foam may be sold as second quality foam, or will be granulated (to form "crumb") and made into rebonded foam." pg. 31-32/262
Number of sites:	"ISOPA data (undated) indicates that 400 foamers/moulders are involved in the production of furniture and bedding from PUR foam in Europe each year, consuming 530,000 tonnes of polyurethane. Given the price and specialist nature of V6, only a small number of foamers will use this flame retardant. Data have been provided by the producer of V6. The number of sites using V6 is known." (pg. 35/262)
Chemical concentration:	V6 contains between 4.5 and 7.5 % TCEP (w/w) (pg. 18/262), however, "It has been indicated (EUROPUR, 2005a) that V6 is now available with no TCEP impurity" (pg. 19/262)
Comments:	Per V6 assessment, EU is expected to have exported these types of products to the US, however they also acknowledge that the EU has tended away from exporting scrap foam to the US (pg. 36/262) "The use of the flame retardant V6 in automotive and furniture applications is driven by firesafety standards. The key standards, applicable globally, are:" the Federal Motor Vehicles Safety Standard No. 302 for automotive applications (seeSection 2.2.2.1.5)" the California Bulletin of Home Furnishings 117 for furniture applications (see section2.2.2.1.6)." (pg. 37/262)

EVALUATION

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Study Citation: EC, (2008). 2,2-bis(chloromethyl) trimethylene bis[bis(2-chloroethyl) phosphate] (v6); CAS No: 38051-10-4, EINECS No: 253-760-2, Risk assessment.
HERO ID: 10284991
Conditions of Use: Furnishing, Cleaning, Treatment/Care Products (Foam Seating and Bedding 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 a frequently used source (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	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	Medium	The assessment is for an occupational scenario within the scope of the risk evaluation, however, the scenario(s) may or my not be currently ongoing.
	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	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:	EC, (2008). 2,2-bis(chloromethyl) trimethylene bis[bis(2-chloroethyl) phosphate] (v6); CAS No: 38051-10-4, EINECS No: 253-760-2, Risk assessment.
HERO ID:	10284991
Conditions of Use:	Construction, Paint, Electrical, and Metal Products (Building/construction materials not covered elsewhere (e.g., roofing insulation))

EXTRACTION

Parameter	**Data**
Life cycle description:	"V6 can be combined with either TDCP or TCPP in order to reduce formulation cost (Rhodia, 2002)." (pg. 35/262). (Note: TDCP and/or TCPP can be used in rigid foams
Chemical concentration:	V6 contains between 4.5 and 7.5 % TCEP (w/w) (pg. 18/262), however, "It has been indicated (EUROPUR, 2005a) that V6 is now available with no TCEP impurity" (pg. 19/262)
Comments:	Per V6 assessment, EU is expected to have exported these types of products to the US, however they also acknowledge that the EU has tended away from exporting scrap foam to the US (pg. 36/262) "The use of the flame retardant V6 in automotive and furniture applications is driven by firesafety standards. The key standards, applicable globally, are:" the Federal Motor Vehicles Safety Standard No. 302 for automotive applications (seeSection 2.2.2.1.5)" the California Bulletin of Home Furnishings 117 for furniture applications (see section2.2.2.1.6)." (pg. 37/262)

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, 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	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	Medium	The assessment is for an occupational scenario within the scope of the risk evaluation, however, the scenario(s) may or my not be currently ongoing.
	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	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:	EC, (2008). 2,2-bis(chloromethyl) trimethylene bis[bis(2-chloroethyl) phosphate] (v6); CAS No: 38051-10-4, EINECS No: 253-760-2, Risk assessment.
HERO ID:	10284991
Conditions of Use:	Construction, Paint, Electrical, and Metal Products (Building/construction materials - wood and engineered wood products (e.g., composites))

EXTRACTION

Parameter	**Data**
Life cycle description:	(note: this is considered a recycling option for PUR foam) Adhesive pressing - PUR is granulated and blended with 5% to 10% polymeric MDI and formed into boards/mouldings at temperatures up to 200oC and under pressure (20 to 200 bar). Products are finished by sawing and sanding or by applying additional facings. Mainly for production trim from rigid block foam and panel production where composition is known. Also for production trim or used PUR from some automotive parts (e.g. thermoformable foam from headliners, flexible integral skin foam from steering wheels, flexible foam backed car carpets). Main applications are furniture in kitchens and sailing boats because virtually unaffected by water, also for flooring e.g. in gymnasiums which needs to have a certain elasticity (see ISOPA 2001b)." (pg. 185/262)
Chemical concentration:	V6 contains between 4.5 and 7.5 % TCEP (w/w) (pg. 18/262), however, "It has been indicated (EUROPUR, 2005a) that V6 is now available with no TCEP impurity" (pg. 19/262)
Comments:	Per V6 assessment, EU is expected to have exported these types of products to the US, however they also acknowledge that the EU has tended away from exporting scrap foam to the US (pg. 36/262) "The use of the flame retardant V6 in automotive and furniture applications is driven by firesafety standards. The key standards, applicable globally, are:" the Federal Motor Vehicles Safety Standard No. 302 for automotive applications (seeSection 2.2.2.1.5)" the California Bulletin of Home Furnishings 117 for furniture applications (see section2.2.2.1.6)." (pg. 37/262)

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, 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	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	Medium	The assessment is for an occupational scenario within the scope of the risk evaluation, however, the scenario(s) may or my not be currently ongoing.
	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	High	Assessment or report clearly documents its data sources, assessment methods, results, and assumptions
Domain 4: Variability and Uncertainty				

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Study Citation:	EC, (2008). 2,2-bis(chloromethyl) trimethylene bis[bis(2-chloroethyl) phosphate] (v6); CAS No: 38051-10-4, EINECS No: 253-760-2, Risk assessment.
HERO ID:	10284991
Conditions of Use:	Construction, Paint, Electrical, and Metal Products (Building/construction materials - wood and engineered wood products (e.g., composites))

		EVALUATION	
Domain	Metric	Rating	Comments
	Metric 7: Metadata Completeness	High	The assessment addresses variability and uncertainty in the results. Uncertainty is well characterized

Overall Quality Determination High

Study Citation: EC, (2008). 2,2-bis(chloromethyl) trimethylene bis[bis(2-chloroethyl) phosphate] (v6); CAS No: 38051-10-4, EINECS No: 253-760-2, Risk assessment.
HERO ID: 10284991
Conditions of Use: Foam Recycling

EXTRACTION

Parameter	Data
Production, import, or use volume:	"A survey carried out by EUROPUR (pers. comm. 7th December 2005) accounted for approximately 45 kilotonnes of rebonded foam produced in the EU, and it was estimated that approximately 60 kilotonnes are rebonded in total. A high proportion of this is produced in the UK (approximately 22 kilotonnes). Across the EU, only a low proportion of this willcontain flame retardants. Cheaper non-FR foam trim can be obtained exclusively but it is likely that a site rebonding FR-PUR will also be handling non-FR foam. It has been estimated that a typical site might rebond 3-5 kilotonnes of foam per year in total (pers. comm. 29th April 2004)." (pg. 33/262)
Life cycle description:	"Use of Rebonded Foam - The relative high density and resilience of rebond make it suitable for applications including vibration sound dampening, sport mats, cushioning, packaging and carpet underlay and new applications are constantly being developed (ISOPA 2001a). In cars, rebond can be used for sound insulation, for example under the carpet in the boot. In cushioning, a strip of re-bonded foam is used along the front of some cushions on the basis that it is more hard wearing. There is also some use in office furniture (ISOPA 2003)." Pg. 33/262
Process description:	"Rebonding - In a typical process, foam scrap is fed through a shredding machine and then into a granulator. The granules are screw conveyed into a vessel where the material is sprayed with pre-polymer and mixed to ensure a thorough coating. The coating granules are then screw conveyed into a rectangular or circular moulding press where the mix is compressed and consolidated as the pre-polymer cures. Curing is facilitated by steam injection (HMIP 1995). The condensate is ultimately removed under vacuum and vented to the air (pers. comm. 29th April 2004). The rebonded blocks are removed and allowed to stand in order to cool (HMIP, 1995). The foam product is then either cut (converted) in the usual way (EUROPUR, 2005a), or can be"peeled" from the block at the desired thickness and a suitable backing is then applied (EC, 2000). It has been reported that V6 is used as flame retardant for virgin and bonded flexible urethane foam (Ash 1997). While V6 will be present in off-cuts of slabstock foam which undergo rebonding, owing to cost considerations it is believed that V6 would not be added directly to the re-bonding process." (pg. 33/262)"Loose crumb - Shredded scrap foam is used directly for some applications. This is referred to as "loose crumb" and is used in deep-buttoned soft-cushions for garden furniture and in some low-grade furniture applications. In Europe, the major use of loose crumb is reported to be in garden furniture. The foam industry has indicated that the market for reuse of scrap foam in this way is small and is deteriorating (B"rgi, 2002). To give a realistic worst case, and in the absence of firm information, it is assumed in this assessment that 70% of the scrap foam remaining in the EU will be rebonded and 30% will be recycled as loose crumb. While all such furniture previously was returned to the UK to meet the demand generated by UK regulations, 50% now stays in mainland Europe. For the purposes of this risk assessment it is assumed that 75% of scrap foam generated in the EU remains here, with the remaining 25% being exported to the US. Thus it is assumed that 75% of the V6 in scrap foam remains in the EU." (pg. 34/262)For a full summary of recycling options for PUR foams, including further details on the rebonding process and use of rebonded foam, refer to section 2 of the Life Cycle Annex.
Chemical concentration:	V6 contains between 4.5 and 7.5 % TCEP (w/w) (pg. 18/262), however, "It has been indicated (EUROPUR, 2005a) that V6 is now available with no TCEP impurity" (pg. 19/262)
Comments:	Per V6 assessment, EU is expected to have exported these types of products to the US, however they also acknowledge that the EU has tended away from exporting scrap foam to the US (pg. 36/262) "The use of the flame retardant V6 in automotive and furniture applications is driven by firesafety standards. The key standards, applicable globally, are:" the Federal Motor Vehicles Safety Standard No. 302 for automotive applications (seeSection 2.2.2.1.5)" the California Bulletin of Home Furnishings 117 for furniture applications (see section2.2.2.1.6)." (pg. 37/262)

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, 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			

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Study Citation: EC, (2008). 2,2-bis(chloromethyl) trimethylene bis[bis(2-chloroethyl) phosphate] (v6); CAS No: 38051-10-4, EINECS No: 253-760-2, Risk assessment.
HERO ID: 10284991
Conditions of Use: Foam Recycling

Domain	Metric		EVALUATION 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/process technologies) may impact exposures or releases relative to the U.S.
	Metric 3:	Applicability	Medium	The assessment is for an occupational scenario within the scope of the risk evaluation, however, the scenario(s) may or my not be currently ongoing.
	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	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:	EC, (2008). 2,2-bis(chloromethyl) trimethylene bis[bis(2-chloroethyl) phosphate] (v6); CAS No: 38051-10-4, EINECS No: 253-760-2, Risk assessment.
HERO ID:	10284991
Conditions of Use:	Disposal

EXTRACTION

Parameter	**Data**
Process description:	"The [plastic] ESD gives lifetimes for furniture of five to ten years. ISOPA (1997) gives PUR-specific lifetimes for furnishing/mattresses of greater than ten years. This is supported by reports that 50% of households change their upholstered furniture every eight to sixteen years (DTI undated). In the risk assessment, a lifetime of ten years is used. All in-service losses are evaluated on a regional basis (over 365 days per year) because no specific local source can be identified for these releases. All service is taken to be indoors." (pg. 44/262)"Disposal to landfill is considered likely to be the most significant route of disposal of flexible foam and other articles containing V6. Monitoring data for landfill leachate in England and Wales suggests that this is a significant exposure route for TCPP but not for TDCP. There are no monitoring data available on concentrations of V6 in landfill leachate. However, V6 has a lower volatility than both TDCP and TCPP and its water solubility and adsorption potential is intermediate between the two. It is therefore likely to be less mobile in landfills than TCPP. In addition, the tonnage of V6 in articles in service (and hence tonnages passing to landfill) per year, at the regional scale, is less than 5% of the equivalent tonnage of TCPP. Therefore the contribution of releases via landfill leachate to the PEC regional values is considered to be negligible for the present risk assessment." (pg. 45/262)
Chemical concentration:	V6 contains between 4.5 and 7.5 % TCEP (w/w) (pg. 18/262), however, "It has been indicated (EUROPUR, 2005a) that V6 is now available with no TCEP impurity" (pg. 19/262)
Comments:	Per V6 assessment, EU is expected to have exported these types of products to the US, however they also acknowledge that the EU has tended away from exporting scrap foam to the US (pg. 36/262) "The use of the flame retardant V6 in automotive and furniture applications is driven by firesafety standards. The key standards, applicable globally, are:" the Federal Motor Vehicles Safety Standard No. 302 for automotive applications (seeSection 2.2.2.1.5)" the California Bulletin of Home Furnishings 117 for furniture applications (see section2.2.2.1.6)." (pg. 37/262)

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, 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	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	Medium	The assessment is for an occupational scenario within the scope of the risk evaluation, however, the scenario(s) may or my not be currently ongoing.
	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	High	Assessment or report clearly documents its data sources, assessment methods, results, and assumptions
Domain 4: Variability and Uncertainty				

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Study Citation: EC, (2008). 2,2-bis(chloromethyl) trimethylene bis[bis(2-chloroethyl) phosphate] (v6); CAS No: 38051-10-4, EINECS No: 253-760-2, Risk assessment.
HERO ID: 10284991
Conditions of Use: Disposal

		EVALUATION	
Domain	Metric	Rating	Comments
Metric 7:	Metadata Completeness	High	The assessment addresses variability and uncertainty in the results. Uncertainty is well characterized

Overall Quality Determination High

Study Citation:	EC, (2008). 2,2-bis(chloromethyl) trimethylene bis[bis(2-chloroethyl) phosphate] (v6); CAS No: 38051-10-4, EINECS No: 253-760-2, Risk assessment.
HERO ID:	10284991
Conditions of Use:	Furnishing, Cleaning, Treatment/Care Products (Fabric, textile, and leather products not covered elsewhere)

EXTRACTION

Parameter	**Data**
Process description:	"Flame bonding is a method for laminating polyurethane foam sheet to materials such as textiles. The foam sheet is passed across a propane/air flame and the foam is then brought together with the textile material between pressure rolls. The flame treatment generates a chemically active surface which facilitates bonding to the textile substrate (HMIP, 1995). The high temperature used in flame bonding leads to emission of volatile organic compounds (VOCs), including benzene, together with hydrogen cyanide and particulate matter as a result of pyrolysis. Free di-isocyanates including toluene di-isocyanate (TDI), are also present in the fumes which are given off in the process, as a result of oxidation and chain scission (HMIP, 1995). Flame lamination companies within the EU have to comply with national emission regulations and most facilities achieve these requirements by the use of appropriate attenuation techniques. Activated carbon scrubbing techniques are often used to meet the more stringent national emission legislation (pers. comm. 22nd January 2007)." (pg. 32/262)
Chemical concentration:	V6 contains between 4.5 and 7.5 % TCEP (w/w) (pg. 18/262), however, "It has been indicated (EUROPUR, 2005a) that V6 is now available with no TCEP impurity" (pg. 19/262)
Comments:	Per V6 assessment, EU is expected to have exported these types of products to the US, however they also acknowledge that the EU has tended away from exporting scrap foam to the US (pg. 36/262) "The use of the flame retardant V6 in automotive and furniture applications is driven by firesafety standards. The key standards, applicable globally, are:" the Federal Motor Vehicles Safety Standard No. 302 for automotive applications (seeSection 2.2.2.1.5)" the California Bulletin of Home Furnishings 117 for furniture applications (see section2.2.2.1.6)." (pg. 37/262)

EVALUATION

Domain	Metric		Rating	Comments
Domain 1: Reliability				
	Metric 1:	Methodology	High	The assessment or report uses high quality data and sound methods that are from a frequently used source (e.g., European Union reports) 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	Medium	The assessment is for an occupational scenario within the scope of the risk evaluation, however, the scenario(s) may or my not be currently ongoing.
	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	High	Assessment or report clearly documents its data sources, assessment methods, results, and assumptions
Domain 4: Variability and Uncertainty				

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Study Citation:	EC, (2008). 2,2-bis(chloromethyl) trimethylene bis[bis(2-chloroethyl) phosphate] (v6); CAS No: 38051-10-4, EINECS No: 253-760-2, Risk assessment.
HERO ID:	10284991
Conditions of Use:	Furnishing, Cleaning, Treatment/Care Products (Fabric, textile, and leather products not covered elsewhere)

EVALUATION

Domain	Metric	Rating	Comments
	Metric 7: Metadata Completeness	High	The assessment addresses variability and uncertainty in the results. Uncertainty is well characterized

Overall Quality Determination — High

Study Citation:	ECB, (2009). European Union risk assessment report: Tris(2-chloroethyl) phosphate, TCEP. 213.
HERO ID:	3809216
Conditions of Use:	Import, Processing - incorporation into an article

EXTRACTION

Parameter	**Data**
Production, import, or use volume:	1998 production in the EU was about 2,000 tonnes/yr, no production reported in EU in 2002; global consumption of TCEP peaked in 1989 at 9,000 tonnes/yr; in 2002, three companies imported a total of 1,150 tonnes of TCEP into the EU, with some exported and a total inflow of 1,007 tonnes/yr in 2002; Table 2.1 on pg 18 of PDF breaks down use rates for various applications
Process description:	Risk assessment references various ESD's for plastics and paints and only provided a process description for manufacturing which is out of scope
Chemical concentration:	"addition of 10 % TCEP relative to the finished foam is sufficient to achieve a clear flame retardant effect" for polyurethane foams; "the concentration of TCEP in products amounts to 5 - 12 % (w/w). In addition in one product (cellulose acetate) a concentration of up to 70 % TCEP is possible. According to literature data concentrations up to 40 % are used"
Comments:	See Section 3.1.5 for use of ESD for paint and coating industry

EVALUATION

Domain	Metric	Rating	Comments
Domain 1: Reliability			
Metric 1:	Methodology	High	Assessment uses high quality information and data from frequently-used sources.
Domain 2: Representativeness			
Metric 2:	Geographic Scope	Medium	Data are from the EU, which includes OECD countries.
Metric 3:	Applicability	High	Data are for manufacturing/import and processing, in-scope occupational scenarios.
Metric 4:	Temporal Representativeness	Medium	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	N/A	N/A - information not dependent on samples
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 change over time and surveying multiple companies, but uncertainty is not addressed.

Overall Quality Determination High

Study Citation: (2015). Environmental concentrations and consumer exposure data for tris(2-chloroethyl) phosphate (TCEP).
HERO ID: 5155913
Conditions of Use: Processing (various end products in several industries)

EXTRACTION

Parameter	Data
Chemical concentration:	Table 2-8 gives TCEP concentration in several products. data from many studies by multiple authors are summarized. TCEP detected in polyurethane foam samples for several end products (e.g., couches, mattresses, baby products), paints, computers, LCDs, and sealants. Studies from U.S., Canada, Belgium, Japan, Denmark, and Germany. Table 2-7 provides similar data for concentrations in dust

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	Medium	Data are from the U.S. and 3 OECD countries (Canada, Belgium, Germany)
	Metric 3:	Applicability	High	Data are for various processing and/or use operations, which are in-scope occupational scenarios.
	Metric 4:	Temporal Representativeness	Medium	Assessment is based on data from several sources ranging from 1985 to 2012, most in early 2000s, that are expected to be representative of current industry conditions
	Metric 5:	Sample Size	Medium	Sample distribution characterized by limited statistics (mean/median, ranges) 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 addressed by presenting data ranges but uncertainty is not addressed.

Overall Quality Determination Medium

Study Citation: NICNAS, (2010). Ethanol, 2-chloro-, phosphate (3:1): Human health tier III assessment.
HERO ID: 5185320
Conditions of Use: Industrial/Commercial Use

EXTRACTION

Parameter	Data
Chemical concentration:	"In general, to achieve appropriate flame retardant effects, the loading rates of the chemical in flexible foams are between 2.5 and 14 % "; known impurity in V6 mixtures at concentration of 4.5-7% ; "TCEP was measured in children"s car seats, baby slings and prams (Danish EPA, 2016). The TCEP levels ranged between 41-840 mg/kg. In the USA market, TCEP was detected in concentrations over 1000 mg/kg foam in car seats, changing pads, sleep positioners, portable mattresses, nursing pillows, baby carriers, rocking chairs, high chairs, infant bath mats, and baby walkers "

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 Australia, which is an OECD country.
Metric 3:	Applicability	High	Data are for various industrial and commercial uses, including in-scope occupational scenarios.
Metric 4:	Temporal Representativeness	High	Assessment is based on current industry conditions and data no more than 10 years old.
Metric 5:	Sample Size	N/A	N/A - information not dependent on samples
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:	NICNAS, (2001). Trisphosphates. Priority existing chemical assessment report Vol(20):49.
HERO ID:	659040
Conditions of Use:	Import, Incorporation into formulation, Industrial/Commercial Uses

EXTRACTION

Parameter	**Data**
Production, import, or use volume:	Total chlorinated triphosphates (mostly TCEP and TCPP) imported in bulk around 410 tonnes per yr, with TCEP imported at 120 tonnes/yr; TCEP imports expected to decrease; 85% used for flexible or rigid PU foams; one reporter stated that <5% of paints manufactured contained TCEP, and another reported use between 5,000-10,000kg of TCEP per year
Process description:	formulation of TCEP-containing resins typically carried out in closed system; paint manufacturing with TCEP carried out standard closed industrial mixers
Throughput:	imported in 200 Liter steel drums into Australia; TCEP-containing resin formulation performed twice per month, with 150kg of TCEP used per batch
Chemical concentration:	chlorinated triphosphates used exclusively as flame retardants and/or plasticizers, typically in concentrations of 5-20% ; typically around 7% present in final flexible or rigid foams; polyester resins typically contain 4-20% TCEP

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 Australia, which is an OECD country.
	Metric 3: Applicability	High	Data are for various in-scope occupational scenarios, including import, incorporation into a formulation, and industrial/commercial use, and disposal
	Metric 4: Temporal Representativeness	Medium	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	N/A	N/A - information not dependent on samples
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 change over time and occasional information from different manufacturers, but uncertainty is not addressed.

Overall Quality Determination Medium

Study Citation:	OECD, (2011). Emission scenario document on coating application via spray-painting in the automotive refinishing industry.
HERO ID:	3808976
Conditions of Use:	Automotive Coating Application

EXTRACTION

Parameter	**Data**
Production, import, or use volume:	"54,633,000 total gallons automotive refinish coatings/yr 99,747 - 1,097,457 gallons coating/yr (depending on coating type)
Process description:	Repair/replace automotive surface, initial wash (water/detergent and/or solvent), sanding (dry or wet), mixing of primer coatings, spray paint (multiple layers of primer), curing/drying each layer, sanding (dry or wet), solvent wipe-down, mixing of each coating (basecoat and clearcoat), spray paint (multiple layes of basecoat and clearcoat), curing/drying each layer
Throughput:	"0.25-12 gal coating/site-day, depending on number of jobs Also provides method for adjsuting the use rate based on the type of coating product used"
Number of sites:	32,296
Chemical concentration:	15-25%
Comments:	operating days: 250 days/yr

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 ESD was developed by EPA based on U.S. data
Metric 3:	Applicability	Medium	Data is for multiple in-scope occupational scenarios; however, data is general and not specific to a chemical.
Metric 4:	Temporal Representativeness	Low	Assessment is based on data 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 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 coating types.

Overall Quality Determination Medium

Study Citation:	OECD, (2009). Emission scenario documents on coating industry (paints, lacquers and varnishes).
HERO ID:	3827298
Conditions of Use:	Formulation of Coatings and Use of Coatings

EXTRACTION

Parameter	**Data**
Production, import, or use volume:	3.2 million tonnes coating/yr
Process description:	"PROC: Dispersion, milling, finishing, filling USE: Application via roller/brush, air spray systems, airless and air-assissted airless spray systems, electrostatic spray, electrodeposition/electrocoating and autodeposition, dip coating, flow and curtain coating, roll coating, and supercritical carbon dioxide coating systems"
Throughput:	0.62-9.0 l/vehicle (auto refinishing); 1.1-5.1 g coating/can (metal can coating sites)
Number of sites:	60,330 automotive application sites; 33 metal coating application sites
Chemical concentration:	Provides conc. estimates based on the chemical function, 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	Medium	This ESD was not developed by EPA, but another OECD-member country.
Metric 3:	Applicability	Medium	Data is for an in-scope occupational scenario; however, data is general and not specific to a chemical.
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 chemical functions and coating types

Overall Quality Determination Medium

Study Citation:	OECD, (2009). Emission scenario document on adhesive formulation.
HERO ID:	3827299
Conditions of Use:	Processing-Polymers/resins (2-part formulations)

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 (Kirk-Othmer, 2002).Table 3.2, pg. 43/168, gives breakdown of PV's by adhesive type
Process description:	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 (ASC, 2005). The three general process types each have distinct sources of release and worker exposure activities. Figures 2-1, 2-2, and 2-3 illustrate these adhesive process types. The followingsections describe each type of process in more detail. (P. 24/168)
Number of sites:	Table 3.2, pg. 43/168, gives breakdown of number of sites by adhesive type
Chemical concentration:	Table 2.1, pg. 32/168,

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, 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	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 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 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	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: OECD, (2009). Emission scenario document on adhesive formulation.
HERO ID: 3827299
Conditions of Use: Processing-Polymers/resins (2-part formulations)

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

Study Citation:	OECD, (2013). Emission scenario document on the industrial use of adhesives for substrate bonding.
HERO ID:	3827300
Conditions of Use:	Adhesive Application

EXTRACTION

Parameter	**Data**
Production, import, or use volume:	1,500 - 9,100,000 kg adhesive/site-yr
Process description:	unloading, dilute and mix (optional), application (roll, spray, curtain, bead/syringe), drying/curing, product finishing
Throughput:	Provides methodology for estimating throughput based on the amount of adhesived used, and the concentration of the chemical in the formulation
Number of sites:	541-22,294
Chemical concentration:	Provides conc. estimates based on chemical function and adhesive type, not chemical specific.
Comments:	operating days: 50-365 days/yr

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 ESD was developed by EPA based on U.S. data
Metric 3:	Applicability	Medium	Data is for an in-scope occupational scenario; however, data is general and not specific to a chemical.
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 various chemical functions, types of adhesives, and end use markets.

Overall Quality Determination High

Study Citation:	OECD, (2017). Emission Scenario Document (ESD) on the use of textile dyes.
HERO ID:	3828838
Conditions of Use:	Textile Dyes

EXTRACTION

Parameter	**Data**
Process description:	Dye formulation received, unloaded, dyeing of fiber, yarn, or fabric
Throughput:	Provides methodology for estimating throughput based on the amount of textile dyed and concentration of chemical in the dye
Number of sites:	Provides methodology to estimate number of sites based on chemical production volume, use rate, and operating days
Chemical concentration:	Provides conc. estimates based on the chemical function, not chemical specific.
Comments:	operating days: 31-295 days/yr

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 ESD was developed by EPA based on U.S. data
	Metric 3: Applicability	Medium	Data is for an in-scope occupational scenario; however, data is general and not specific to a chemical.
	Metric 4: Temporal Representativeness	Low	Assessment from 2015 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 multiple chemical functions

Overall Quality Determination Medium

Study Citation:	OECD, (2015). Emission scenario document on use of adhesives.
HERO ID:	3833136
Conditions of Use:	Processing - use of polymers/resins (incorporation into article)

EXTRACTION

Parameter	**Data**
Production, import, or use volume:	Approximately 18 billion pounds (8.2 billion kilograms) of adhesives and sealants with an estimated value of $12.3 billion were used in the United States in 2003 (Impact Marketing, 2005).Tables 1-6 and 1-7 provide PVs by end use market and product type respectively. (pgs 27-28/189)
Life cycle description:	The end use market for adhesives is extremely broad and diverse. Adhesives are generally composed of a binder material formulated with other components. Binders are typically natural or synthetic high molecular weight polymers. Binders may alternatively contain reactive organic compounds (e.g. prepolymers, oligomers, monomers) that form polymers during the bonding process. Some materials commonly used as binders in adhesive formulations are esters, natural and synthetic rubber, polyvinyl compounds, polyurethanes, epoxy resins, and acrylate polymers. Adhesives may also contain components such as non-reactive resins, plasticizers, fillers, thickeners, solvents, hardeners, and setting retarders (Ullmann, 1985).
Process description:	Table 1, pg 11/189, provides end use markets and typical application methods.Section 2 provides process descriptions for several application methods (pgs 32-40/189)
Chemical concentration:	Tables 1-3, 1-4, and 1-5, pg. 25-26/189, provides concentration ranges by component type

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, 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	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 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	The assessment captures operations, equipment, and worker activities expected to be representative of current conditions. EPA has no reason to believe exposures have changed. The completed exposure or risk assessment 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				

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Study Citation: OECD, (2015). Emission scenario document on use of adhesives.
HERO ID: 3833136
Conditions of Use: Processing - use of polymers/resins (incorporation into article)

		EVALUATION	
Domain	Metric	Rating	Comments
	Metric 7: Metadata Completeness	High	The assessment addresses variability and uncertainty in the results. Uncertainty is well characterized.

Overall Quality Determination High

Study Citation:	OECD, (2010). Emission scenario document on formulation of radiation curable coatings, inks and adhesives.
HERO ID:	3840003
Conditions of Use:	Formulation of Coatings, inks, and adhesives

EXTRACTION

Parameter	**Data**
Production, import, or use volume:	0.7-69.84 million kg coating/ink/adhesive/yr
Process description:	Preheating (optional), Unloading raw materials from containers into mixing kettle, mixing, filtering, packaging
Throughput:	Provides methodology for estimating throughput based on the amount of product produced, and the concentration of the chemical in the formulation
Number of sites:	Provides methodology for estimating number of sites based on chemical PV, the use rate, and the concentration of the chemical in the formulation
Chemical concentration:	Provides conc. estimates based on chemical function, not chemical specific.
Comments:	operating days: 250 days/yr

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 ESD was developed by EPA based on U.S. data
Metric 3:	Applicability	Medium	Data is for an in-scope occupational scenario; however, data is general and not specific to a chemical.
Metric 4:	Temporal Representativeness	Low	Assessment 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 various chemical functions and types of UV curable products.

Overall Quality Determination Medium

Study Citation:	OECD, (2009). Emission scenario document on plastic additives.
HERO ID:	5079084
Conditions of Use:	Plastics Compounding and Converting

EXTRACTION

Parameter	**Data**
Production, import, or use volume:	Provides % of polymers used for various end-use applications
Process description:	"Provides descriptions for a variety of closed, partially open, and open compounding 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.

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:	OECD, (2009). Emission scenario document on transport and storage of chemicals.
HERO ID:	6393282
Conditions of Use:	Processing

EXTRACTION

Parameter	**Data**
Production, import, or use volume:	11 million tonnes shipped via rail tankers 30 million tonnes shipped via pipelines
Life cycle description:	Transport and storage of chemicals
Process description:	On-site storage of chemicals, filling of containers, transport to distributors/downstream users/consumers, containers with residual chemical transported to recylcing/cleaning or disporal site, empty/cleaned containers returned to distributor or production site
Throughput:	Road tankers: 18-25 tonnes Rail tankers: 130,000 L IBCs: 400-2,000 L or 225-2,270 kg Steel Drums: 49-416 L Steel Pails: </= 45 L Plastic drums: 9.5-208 L Fibre drums: 4-450 L or up to 400 kg Bags/sacks: 25-1000 kg Carboys: 10-50 L Glass bottles </=2.5 L
Number of sites:	Container cleaning sites in UK: 40 for road tankers; 8 for steel drums; 8 for plastics drums; 6 for fibre drums; 13 for IBCs; 7 for hazardous waste containers
Comments:	most of the values are for UK

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 is for an in-scope occupational scenario; however, data is general and not specific to a chemical.
	Metric 4: Temporal Representativeness	Low	Assessment 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 multiple chemical forms, containers and storage system types.

Overall Quality Determination Medium

Study Citation:	Science Applications International Corporation, (1996). Generic scenario for automobile spray coating: Draft report.
HERO ID:	6311222
Conditions of Use:	Industrial/commercial use

EXTRACTION

Parameter	**Data**
Production, import, or use volume:	"Number of cars painted per site: 166,000 (range: 81,563 to 262,000 for 14 plant Auto refinish: 70-2,000 L paints/yr"
Process description:	Pretreatment (wash) of car body, E-coat (dip), oven/cure, primer (spray), oven/cure, basecoat (spray), oven/cure, clearcoat (Spray), oven/cure
Throughput:	"Auto OEM: 250 days/yrAuto refinish: 170 days/yr"
Number of sites:	"Auto OEM: 61 sitesAuto refinish: 1000's of sites"

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	Low	Data is for an occupational scenario similar to in-scope scenarios, and data is general and not specific to a chemical.
Metric 4:	Temporal Representativeness	Low	Assessment 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 OEM and refinish applications.

Overall Quality Determination Medium

Study Citation:	Toxicology Excellence for Risk Assessment (TERA) (2013). Toxicity review of tris(2-chloroethyl) phosphate (TCEP).
HERO ID:	5155526
Conditions of Use:	Incorporation into article(s)

EXTRACTION

Parameter	**Data**
Chemical concentration:	Table 6-5 gives TCEP concentration in several products. data from seven studies by multiple authors are summarized. TCEP detected in polyurethane foam samples, paints, mattresses, and sealants. Studies from U.S., Canada, Belgium and Germany.

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	Medium	Data are from the U.S. and 3 OECD countries (Canada, Belgium, Germany)
	Metric 3:	Applicability	High	Data are for products containing TCEP, which is in-scope.
	Metric 4:	Temporal Representativeness	Medium	Assessment is based on data from several sources ranging from 1985 to 2012, most in early 2000s, that are expected to be representative of current industry conditions
	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	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 presenting data ranges but uncertainty is not addressed.

Overall Quality Determination — Medium

Study Citation:	U.S. EPA, (2023). Use of laboratory chemicals - Generic scenario for estimating occupational exposures and environmental releases (Revised draft generic scenario).
HERO ID:	10480466
Conditions of Use:	Use - Laboratory Chemicals

EXTRACTION

Parameter	**Data**
Production, import, or use volume:	Provides methodology to estimate annual use rate.
Life cycle description:	Laboratory Chemicals
Process description:	Receive chemicals, weigh or measure chemical, add chemical to labware, dilute/add other laboratory chemicals, add sample, run analytical testing, dispose of sample and laboratory chemical waste
Throughput:	260 days/yr; 255 grams reagent/site-day (average); 2,000 mL reagent/site-day (average); Table 3-2 gives daily throughput for laboratory stock solutions
Number of sites:	Provides methodology to estimate number of sites based on chemical production volume, annual throughput - 40,639 total establishments
Chemical concentration:	'Provides conc. estimates based on the chemical function, not chemical specific.

EVALUATION

Domain	Metric	Rating	Comments
Domain 1: Reliability			
Metric 1:	Methodology	High	Assessment uses high quality information/data from frequently-used sources.
Domain 2: Representativeness			
Metric 2:	Geographic Scope	High	This GS is based on U.S. data
Metric 3:	Applicability	Medium	Data is for an in-scope occupational scenario; however, data is general and not specific to a chemical.
Metric 4:	Temporal Representativeness	High	Assessment 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	Uncertainty not addressed. Variability addressed by considering different chemical functions

Overall Quality Determination High

Study Citation:	U.S. EPA, (2022). Chemical repackaging - Generic scenario for estimating occupational exposures and environmental releases (revised draft).
HERO ID:	11182966
Conditions of Use:	Repackaging

EXTRACTION

Parameter	**Data**
Production, import, or use volume:	Table B-1 presents PMN data on repackaging rate in kg chemical/site-yr.
Life cycle description:	Repackaging
Process description:	Pre-manufacture notices (PMN) submitted from 2010 to 2020 under EPA"s New Chemicals Program indicated imported and repackaged chemicals can be solids or liquids and may be neat or in solutions/mixtures and contained in various packaging types. After they arrive at the repackaging site, repackaging operations occur where the chemical is transferred from the transport container it was imported in to a new one of a different size in order to meet the customer"s needs (JACO, 2021). Chemicals may also be transferred from original containers to intermediate storage containers before packaging into smaller containers (Cooke, 2013; NIOSH, 2009). Chemicals are expected to be received at repackaging sites in drums or larger bulk containers (supersacks, totes, tank trucks, etc.) (Cooke, 2013; NIOSH, 2009). The chemical of interest may be received in its final formulation and transferred directly from these large containers into smaller containers, charged to a temporary storage tank, or it may be charged to a mixing tank and diluted or mixed with other chemicals before it is repackaged. Once the chemical has been formulated to desired specifications, it can be repackaged. Workers may be potentially exposed during the unloading of chemicals from the original transport containers into temporary storage or new transport containers. Releases of chemicals may also occur during this stage, from open container surfaces (e.g., if the chemical is volatile), transfer operations (e.g., if the chemical is volatile or a powder), and original transport container disposal.Repackaging operations for liquid chemicals typically involve pouring or pumping the product from the original containers or mixing /storage tanks into the new containers. A study conducted by the Health and Safety Laboratory in the U.K. investigated two chemical repackaging sites (Cooke, 2013). At both of these sites the chemical was delivered to the site by road tanker and pumped into dedicated storage tanks. One of the sites, a hydrazine supplier, pumped the hydrazine into a mixing vessel where it was diluted with water and packaged into smaller containers for sale to customers. At the other site, trichloroethylene was pumped from storage tanks into a closed loop system where workers using a hydraulic lance connected to a semi-automated filling system transferred the chemical into new containers (Cooke, 2013). The usual process for repackaging solid chemicals differs from the processes for liquids. A NIOSH Health Hazard Evaluation Report (HHE) from 2009 investigated a repackaging facility that was transferring bulk shipments of silane-coated glass beads ranging between 0.2 " 1.2mm in diameter. At this facility, 2,200 lb supersacks of the product are lifted with a forklift over a metal bin, then cutting the bottom of the container with a knife to empty the beads into the bin. The metal bin is then lifted by a forklift, and the glass beads are poured into hoppers. From the hoppers the beads are gravity fed into smaller cardboard boxes or paper sacks that are shipped to customers (NIOSH, 2009). Workers may be potentially exposed during the transfer of chemicals from temporary storage into new transport containers. Releases of chemicals may also occur during this stage from open container surfaces (e.g., if the chemical is volatile), transfer operations (e.g., if the chemical is volatile or a powder), and cleaning any equipment that was used in during the process.
Throughput:	The number of operating days is given in a range of 174-260 days/yr with an EPA default of 260 days/yr.
Number of sites:	Table 1-2 presents the number of repackaging sites based on 2019 U.S. Census data.
Chemical concentration:	A fraction of completed IRERs from 2010-2020 were reviewed, 21 submissions contained information on chemical repackaging. In these submissions, chemicals were repackaged at concentrations ranging from 1% to 100% , with a 50th percentile of 93% , a 95th percentile of 100% , and a mode of 100% .
Physical form:	Solid or liquid.

EVALUATION

Domain	Metric	Rating	Comments
Domain 1: Reliability			
Metric 1:	Methodology	High	Assessment uses high quality information/data from frequently-used sources.
Domain 2: Representativeness			
Metric 2:	Geographic Scope	High	This GS is based on U.S. data.
Metric 3:	Applicability	Medium	Data are for an in-scope occupational scenario; however, data is general and not specific to a chemical.

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Study Citation: U.S. EPA, (2022). Chemical repackaging - Generic scenario for estimating occupational exposures and environmental releases (revised draft).
HERO ID: 11182966
Conditions of Use: Repackaging

			EVALUATION	
Domain		Metric	Rating	Comments
	Metric 4:	Temporal Representativeness	Medium	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	High	Statistical distribution of samples is fully characterized (discrete use amounts 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 not addressed. Variability addressed by considering multiple repackaging facilities.

Overall Quality Determination High

Study Citation:	U.S. EPA, (2014). Formulation of waterborne coatings - Generic scenario for estimating occupational exposures and environmental releases -Draft.
HERO ID:	3827197
Conditions of Use:	Processing - Incorporation into a formulation

EXTRACTION

Parameter	**Data**
Production, import, or use volume:	1.6-16 million kg coatings/site-yr
Process description:	Unloading solid/liquid components from tank cars, totes, drums, or sacks and from filter replacement –> pre-mixer (pigment dispersion), grinder (pigment dispersion), blending tank, filter, packaging
Throughput:	Provides methodology for estimating throughput based on the amount of coatings produced, and the concentration of the chemical in the coating235-350 operating days/yr
Chemical concentration:	Provides conc. estimates based on chemical function and coating type, 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	Medium	Data is for an in-scope occupational scenario; however, data is general and not specific to a chemical.
	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 coating applications, and multiple chemical functions

Overall Quality Determination High

Study Citation:	U.S. EPA, (2004). Use of additives in foamed plastics - Generic scenario for estimating occupational exposures and environmental releases - Draft.
HERO ID:	6304171
Conditions of Use:	Processing - Use of Additives in Foamed Plastics

EXTRACTION

Parameter	**Data**
Production, import, or use volume:	2,365 million lbs polyurethane foam/yr6,442 million lbs polystyrene/yr
Process description:	Converters mix plastic resins with additives, shaping/molding
Number of sites:	566 total polystyrene sites, 610 total polyurethane foam sites

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	Medium	Data is for an in-scope occupational scenario; however, data is general and not specific to a chemical.
	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 reasonably 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	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 foam types.

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:	Plastics Compounding

EXTRACTION

Parameter	**Data**
Process description:	Polymer pellets/resins received, blending/compounding into masterbatch, extrusion/shaping, packaging
Throughput:	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.
Comments:	operating days: 148-264 days/yr

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	Medium	Data is for an in-scope occupational scenario; however, data is general and not specific to a chemical.
	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 High

Study Citation:	U.S. EPA, (2014). Use of additives in the thermoplastic converting industry - generic scenario for estimating occupational exposures and environmental releases.
HERO ID:	6385711
Conditions of Use:	Plastics Converting

EXTRACTION

Parameter	**Data**
Process description:	Compounded resins received, unloaded, forming/molding/shaping, trimming, finishing (including coating operations)
Throughput:	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.
Comments:	operating days per year: 137-254

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	Medium	Data is for an in-scope occupational scenario; however, data is general and not specific to a chemical.
	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 High

Study Citation:	U.S. EPA, (2004). Industry profile for the flexible polyurethane foam industry - generic scenario for estimating occupational exposures and environmental releases: Draft.
HERO ID:	6385715
Conditions of Use:	Processing - Incorporation into an article

EXTRACTION

Parameter	**Data**
Production, import, or use volume:	42-578 million lbs flex foam/yr
Process description:	"Slabstock foam: Raw materials metered into a single mix head, dispensed to an enclosed conveyor system, foam-producing reactions, foam cutting/ fabricationMolded foam: Premix of raw materials (optional), raw materials pumped to a common mix head, dispensed into molds, heating/curing, molds opened and emptied, cell crushing, foam repair (optional)"
Throughput:	Provides methodology for estimating throughput based on the amount of foam produced, and the concentration of the chemical in the foam250 operating days/yr
Number of sites:	Provides methodology for estimating number of sites based on chemical PV, the use rate, and the concentration of the chemical in the foam
Chemical concentration:	Provides conc. estimates based on chemical function, not chemical specific.
Comments:	Data is general and not specific to a TCEP.

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	Medium	Data is for an in-scope occupational scenario; however, data is general and not specific to a chemical.
	Metric 4: Temporal Representativeness	Low	Assessment 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 multiple foam and additive types.

Overall Quality Determination Medium

Study Citation:	U.S. EPA, (2004). Additives in plastics processing (converting) - Generic scenario for estimating occupational exposures and environmental releases - Draft.
HERO ID:	6549571
Conditions of Use:	Additives in Plastics Processing (Converting into Finished Products)

EXTRACTION

Parameter	**Data**
Production, import, or use volume:	Table 2 presents the types of thermoplastic resins, common uses, and 2003 production volume.
Life cycle description:	The plastic manufacturing industry can be divided into four sections: polymer manufacturing, compounding, converting, and "in-house" manufacturing. This generic scenario will address converting operations. Polymer manufacturing will not be included in this scenario. Compounders produce masterbatches of plastic resins with specific properties by blending the polymer (resin), additives, fillers, and reinforcements. Converters receive the masterbatch of plastic resin from compounders and form finished plastic products. Compounding and converting may take place as the same facility ("in-house" manufacturing) or at separate facilities. This scenario assumes that compounding and converting take place at separate facilities; therefore, in-house manufacturing is not covered in this scenario.
Process description:	Various plastic processing operation descriptions are provided in Table 5, and a Process Diagram is provided on PDF pg. 10. More generally, polymer resin is received at the compounding sites from the resin manufacturer in the form of pellets. A compounding site blends the resin and additives to produce a masterbatch. The converting site then processes the masterbatch by shaping the plastic into the desired form for the final plastic product. The blending and forming may take place at the same facility ("in house" manufacturing) or separate facilities. As a conservative estimate, it is assumed that the compounding of the plastic resin and the converting of the resin into plastic products take place at separate facilities. Therefore, in-house manufacturing is not covered in this scenario. After shaping, finishing operations such as filing, grinding, sanding, polishing, painting, bonding, coating, engraving etc. are performed to complete the finished plastic product. This scenario covers the converting of plastic resins into finished products.
Throughput:	Daily use rate = amount of resin /# converting sites /days of operation x fraction of additive x fraction of chemical in additive
Number of sites:	Overall, there were 12,191 Plastic Product Manufacturing establishments in 2001. Table 1 provides Number of Establishments for subcategories of NAICS 3261 Plastic Product Manufacturing.
Chemical concentration:	Default values used to represent the weight fraction of various additives in plastic resin range from 0.001 - 0.5. These values are provided in Table 2 and Table 3.

EVALUATION

Domain	Metric		Rating	Comments
Domain 1: Reliability				
	Metric 1:	Methodology	High	The assessment uses high quality data that are from a frequently used source 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 assessment is for an occupational scenario within the scope of the risk evaluation. However, data is not chemical specific.
	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. It is unclear if analysis is representative.
Domain 3: Accessibility/ Clarity				

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Study Citation:	U.S. EPA, (2004). Additives in plastics processing (converting) - Generic scenario for estimating occupational exposures and environmental releases - Draft.
HERO ID:	6549571
Conditions of Use:	Additives in Plastics Processing (Converting into Finished Products)

			EVALUATION	
Domain		Metric	Rating	Comments
	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 evaluation of various plastic processing operations, as well as various additive fractions. However, uncertainty associated with data are not characterized.

Overall Quality Determination Medium

Study Citation:	U.S. EPA, (2021). Application of spray polyurethane foam insulation - Generic scenario for estimating occupational exposures and environmental releases - Final.
HERO ID:	8674805
Conditions of Use:	Commercial Use

EXTRACTION

Parameter	**Data**
Production, import, or use volume:	365 million lbs of 2-component spray foam/yr and 55 million lbs of 1-component spray foam/yr
Process description:	pre-spraying activites, SPF application, trimming, cleanup, chemical transfers, maintenance activites
Comments:	Data is general and not specific to TCEP.

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	Low	Data may be relevant for a potential historic in-scope scenario; however, data is general and not specific to TCEP.
	Metric 4: Temporal Representativeness	High	Assessment is based on current industry conditions and data no more than 10 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	Uncertainty not addressed. Variability addressed by considering one- and two-component foams.

Overall Quality Determination Medium

Study Citation:	Verbruggen, E. M. J., Rila, J. P., Traas, T. P., Posthuma-Doodeman, C. J. A.,M, Posthumus, R. (2005). Environmental risk limits for several phosphate esters, with possible application as flame retardant.
HERO ID:	5349334
Conditions of Use:	Import

EXTRACTION

Parameter	**Data**
Production, import, or use volume:	According to data from IUCLID for 1991/1992, the European market amounted up to 10,500 tonnes per year (European Commission, 2004c). IPCS (1998) states that global consumption of TCEP peaked at over 9000 tonnes in 1989 but had declined to below 4000 tonnes by 1997. This number is markedly lower today being less than 1000 tonnes

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 Europe, which includes multiple OECD countries.
Metric 3:	Applicability	High	Data are for manufacture/use volume of TCEP, which is related to import scenarios.
Metric 4:	Temporal Representativeness	Low	Report is mostly 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 change over time, but uncertainty is not addressed.

Overall Quality Determination Medium

Study Citation:	Verbruggen, E. M. J., Rila, J. P., Traas, T. P., Posthuma-Doodeman, C. J. A.,M, Posthumus, R. (2005). Environmental risk limits for several phosphate esters, with possible application as flame retardant.
HERO ID:	5349334
Conditions of Use:	Commercial Uses (all)

EXTRACTION

Parameter	**Data**
Life cycle description:	historic use in rigid and flexible polyurethane foams and systems; TCEP is used primarily as a flame retardant for unsaturated polyester resins and no longer much used in polyurethanes. The main industrial branches to use TCEP as a flame-retardant plasticiser are the textile and the building industry (roof insulation). Other utilisation in small volumes of TCEP is represented by flame resistant paints and varnishes, e.g. for polyvinyl acetate or acetyl cellulose.

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 Europe, which includes multiple OECD countries.
	Metric 3:	Applicability	High	Data are for use of TCEP in polyurethane foams, resins, and paints/varnishes, which are in-scope for TCEP
	Metric 4:	Temporal Representativeness	Low	Report is mostly 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 information is 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:	BJB Enterprises, (2017). Safety Data Sheet: TC-800 Part A.
HERO ID:	10604005
Conditions of Use:	Processing " incorporation into formulation, mixture or reaction product

EXTRACTION

Parameter	**Data**
Chemical concentration:	SDS lists TCEP as ingredient at weight percent of 1 to 5
Comments:	Product listed with specific gravity of 1.15

EVALUATION

Domain	Metric	Rating	Comments
Domain 1: Reliability			
	Metric 1: Methodology	High	Source uses data reported by product manufacturer/distributor
Domain 2: Representativeness			
	Metric 2: Geographic Scope	High	Data are from the U.S.
	Metric 3: Applicability	High	Data are for incorporation into polymer resins, 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	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:	BJB Enterprises, (2017). Safety Data Sheet: TC-800 Part A.
HERO ID:	10604005
Conditions of Use:	Processing " incorporation into article

EXTRACTION

Parameter	**Data**
Chemical concentration:	SDS lists TCEP as ingredient at weight percent of 1 to 5
Comments:	Product listed with specific gravity of 1.15

EVALUATION

Domain	Metric		Rating	Comments
Domain 1: Reliability				
	Metric 1:	Methodology	High	Source uses data reported by product manufacturer/distributor
Domain 2: Representativeness				
	Metric 2:	Geographic Scope	High	Data are from the U.S.
	Metric 3:	Applicability	High	Data are for incorporation of TCEP-containing resin into articles, 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	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:	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:	Firefighters (Included as PESS)

EXTRACTION

Parameter	**Data**
Number of sites:	25 sites analyzed (14 houses, 6 apartments, and 5 commercial buildings)
Comments:	Per the article it is during the overhaul stage, due to little or no smoke, that a firefighter may decide to remove their respirator. The article does not have any data for, nor does it mention, TCEP. There is exposure data for a variety of other chemicals typically encountered in a fire, this could still be useful in the event that byproducts or degradants are evaluated.

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	The data are from the United States and are representative of the industry being evaluated.
	Metric 3:	Applicability	High	Firefighters will be included as a PESS, therefore the report is for an occupational scenario within the scope of the risk evaluation.
	Metric 4:	Temporal Representativeness	Medium	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	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	High	The report addresses variability and uncertainty in the results. Uncertainty is well characterized.

Overall Quality Determination High

Study Citation:	Burgess, W. A. (1991). Potential exposures in the manufacturing industry - Their recognition and control. 595-674.
HERO ID:	1267867
Conditions of Use:	Processing, Commercial use

EXTRACTION

Parameter	**Data**
Process description:	General process description for use of reactors, liquid-solid separations, drying and packaging, and transport... Process description for various paint application method including low pressure-low volume, high volume-low pressure, electrostatic, and powder coating; transfer efficiencies and use rates provided as estimates
Chemical concentration:	additives included in powder paint particles at 1-2%

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 generic paint application and chemical processing, which is similar to the in-scope occupational scenarios of TCEP use in paint and coatings and incorporation of TCEP into formulations, mixtures, and articles.
	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:	CEC, (2015). Enhancing Trilateral Understanding of Flame Retardants and Their Use in Manufactured Items: Supply Chain Analysis of Select Flame Retardants Contained in Manufactured Items that are Used in Indoor Environments.
HERO ID:	4565753
Conditions of Use:	Processing - Incorporation into articles

EXTRACTION

Parameter	**Data**
Chemical concentration:	Flame retardant concentrations in flexible PUF generally range from zero to 15 percent.It was speculated that flame retardants may be found in lower density foams in concentrations up to five percent, while higher density foams may typically have lower flame retardant concentrations, if they use flame retardants at all
Comments:	Potentially Contains TCEP in flexible PUF. Signified as known to be or likely present in rigid plastic, flexible PUF, textiles, PVC, resin, rigid PUF, spray foam, furnishings/electrical/electronic products, construction materials, automotive, and textiles/coatings/adhesives. Lists some specific manufactured items.

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 incorporation of flame retardants into articles, an in-scope occupational scenario, but TCEP specifically is not characterized at specific concentrations
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	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:	CEC, (2015). Enhancing Trilateral Understanding of Flame Retardants and Their Use in Manufactured Items: Supply Chain Analysis of Select Flame Retardants Contained in Manufactured Items that are Used in Indoor Environments.
HERO ID:	4565753
Conditions of Use:	Manufacturing - Import

EXTRACTION

Parameter	**Data**
Production, import, or use volume:	presents CDR data for TCEP-CBI dataIndustry representatives estimated that approximately 30 percent of residential upholstered furniture is imported from overseas, predominantly from China... Both AHFA and major manufacturers of flame retardants speculated that more flame retardants are imported into North America already incorporated into manufactured items than are imported as raw materials.
Number of sites:	1 site-Import

EVALUATION

Domain	Metric	Rating	Comments
Domain 1: Reliability			
	Metric 1: Methodology	High	Report uses high quality data/information from frequently-used sources.
Domain 2: Representativeness			
	Metric 2: Geographic Scope	High	Data are from the U.S.
	Metric 3: Applicability	High	Covers chemical and product manufacturers and importers, which 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	Low	Sample distribution is described qualitatively and speculated.
Domain 3: Accessibility/ Clarity			
	Metric 6: Metadata Completeness	Medium	Sources, 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:	CECBP, (2008). Brominated and chlorinated organic chemical compounds used as flame retardants: Materials for the December 4-5, 2008 meeting of the California Environmental Contaminant Biomonitoring Program (CECBP): Scientific Guidance Panel (SGP): Agenda item: Consideration of potential designated chemicals.
HERO ID:	4296230
Conditions of Use:	Industrial/Commercial Use

EXTRACTION

Parameter	**Data**
Life cycle description:	TCEP is an additive flame retardant and plasticizer used in flexible and rigid polyurethane foams, plastics, carpet backing, and textile backcoating.

EVALUATION

Domain	Metric		Rating	Comments
Domain 1: Reliability				
	Metric 1:	Methodology	High	Report uses high quality data/information 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	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:	CECBP, (2008). Brominated and chlorinated organic chemical compounds used as flame retardants: Materials for the December 4-5, 2008 meeting of the California Environmental Contaminant Biomonitoring Program (CECBP): Scientific Guidance Panel (SGP): Agenda item: Consideration of potential designated chemicals.
HERO ID:	4296230
Conditions of Use:	Manufacturing/Import

EXTRACTION

Parameter	**Data**
Production, import, or use volume:	Annual U.S. production/import volume was 1-10 million pounds for the reporting years 1986, 1990, 1994, 1998 and 2002.

EVALUATION

Domain	Metric	Rating	Comments
Domain 1: Reliability			
	Metric 1: Methodology	High	Report uses high quality data/information 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	Medium	Sample distributions characterized by 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 accounting for different years, but uncertainty is not addressed.

Overall Quality Determination — High

Study Citation:	CEPE, (2020). SpERC Fact Sheet: Industrial application of coatings by spraying.
HERO ID:	10442901
Conditions of Use:	Industrial Use of Paints and Coatings

EXTRACTION

Parameter	**Data**
Production, import, or use volume:	Pg. 2/5: The typical maximum daily usage per site of the product is 1000 kg. This amount is subdivided as follows: pigment/extender/filler: 100 kg; Binder: 100 kg; Water 350 kg; Organic solvent/coalescent: 450 kg; and additive: 5 kg.
Comments:	The industrial uses that the data in the data source pertain to are specified in the data source by codes. These codes are defined in EU guidance documents, but are not defined in the data source. Whether these industrial uses are relevant to the assessment of TECP cannot be determined based on the data source.

EVALUATION

Domain	Metric	Rating	Comments
Domain 1: Reliability			
Metric 1:	Methodology	High	EU data
Domain 2: Representativeness			
Metric 2:	Geographic Scope	Medium	EU data
Metric 3:	Applicability	Medium	There is uncertainty about whether the data is applicable - see comment above.
Metric 4:	Temporal Representativeness	High	Data is less than 20 years old.
Metric 5:	Sample Size	Low	No statistics
Domain 3: Accessibility/ Clarity			
Metric 6:	Metadata Completeness	Low	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:	CEPE, (2020). SpERC Fact Sheet: Professional application of coatings and inks by spraying.
HERO ID:	10442902
Conditions of Use:	Commercial Use of Paints and Coatings

EXTRACTION

Parameter	**Data**
Production, import, or use volume:	Pg. 2/4: The typical maximum daily usage per site of the product is 100 kg. This amount is subdivided as follows: pigment/extender/filler: 10 kg; Binder: 10 kg; Water 35 kg; Organic solvent/coalescent: 45 kg; and additive: 0.5 kg.

EVALUATION

Domain	Metric	Rating	Comments
Domain 1: Reliability			
	Metric 1: Methodology	High	EU data
Domain 2: Representativeness			
	Metric 2: Geographic Scope	Medium	EU data
	Metric 3: Applicability	High	Data is for a COU
	Metric 4: Temporal Representativeness	High	Less than 20 years old
	Metric 5: Sample Size	Low	No statistics
Domain 3: Accessibility/ Clarity			
	Metric 6: Metadata Completeness	Low	Data sources and rationale not transparent.
Domain 4: Variability and Uncertainty			
	Metric 7: Metadata Completeness	Low	Uncertainty and variability not addressed.

Overall Quality Determination Medium

Study Citation:	CharCoat, (2017). Safety Data Sheet: 2017-2018, CharCoat CC.
HERO ID:	10604006
Conditions of Use:	Processing " incorporation into formulation, mixture or reaction product

EXTRACTION

Parameter	**Data**
Chemical concentration:	TCEP present at 0.9 to 1.5 percent in coating formulation (pg 2)
Comments:	Also contains product density of 1.43 g/mL

EVALUATION

Domain	Metric		Rating	Comments
Domain 1: Reliability				
	Metric 1:	Methodology	High	Source uses data reported by product manufacturer
Domain 2: Representativeness				
	Metric 2:	Geographic Scope	Medium	Data are from Canada, an OECD country.
	Metric 3:	Applicability	High	Data are for incorporation into paints and coatings, 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	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 range of possible concentrations for product listed on SDS, but uncertainty is not addressed.

Overall Quality Determination Medium

Study Citation: CharCoat, (2017). Safety Data Sheet: 2017-2018, CharCoat CC.
HERO ID: 10604006
Conditions of Use: Commercial Use - Paints and Coatings

EXTRACTION

Parameter	**Data**
Chemical concentration:	TCEP present at 0.9 to 1.5 percent in coating formulation (pg 2)
Comments:	Also contains product density of 1.43 g/mL

EVALUATION

Domain	Metric		Rating	Comments
Domain 1: Reliability				
	Metric 1:	Methodology	High	Source uses data reported by product manufacturer
Domain 2: Representativeness				
	Metric 2:	Geographic Scope	Medium	Data are from Canada, an OECD country.
	Metric 3:	Applicability	High	Data are for use in paints and coatings, 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	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 range of possible concentrations for product listed on SDS, but uncertainty is not addressed.

Overall Quality Determination Medium

Study Citation:	CharCoat, (2019). Technical Data Sheet: CharCoat CC cable coating.
HERO ID:	10604008
Conditions of Use:	Commercial Use - Paints and Coatings

EXTRACTION

Parameter	**Data**
Process description:	Flame retardant coating technical sheet provides end uses and directions for application ("Application by brush, roller or airless spraying"). Also provides container size of product (5 gal plastic pail)

EVALUATION

Domain	Metric	Rating	Comments
Domain 1: Reliability			
	Metric 1: Methodology	High	Source uses information reported by product manufacturer
Domain 2: Representativeness			
	Metric 2: Geographic Scope	Medium	Data are from Canada, an OECD country, based on country that SDS originated from for product.
	Metric 3: Applicability	High	Data are for use in paints and coatings, 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	Medium	Methods, results, and assumptions are clearly documented, but underlying data sources for deriving recommendations are not fully transparent.
Domain 4: Variability and Uncertainty			
	Metric 7: Metadata Completeness	Low	Variability and uncertainty are not addressed - single flame retardant product.

Overall Quality Determination Medium

Study Citation:	CharCoat, (2019). Technical Data Sheet: CharCoat CC cable coating.
HERO ID:	10604008
Conditions of Use:	Processing " incorporation into formulation, mixture or reaction product

EXTRACTION

Parameter	**Data**
Process description:	Flame retardant coating technical sheet provides end uses and directions for application ("Application by brush, roller or airless spraying"). Also provides container size of product (5 gal plastic pail)

EVALUATION

Domain	Metric		Rating	Comments
Domain 1: Reliability				
	Metric 1:	Methodology	High	Source uses information reported by product manufacturer
Domain 2: Representativeness				
	Metric 2:	Geographic Scope	Medium	Data are from Canada, an OECD country, based on country that SDS originated from for product.
	Metric 3:	Applicability	High	Data are for incorporation into coatings (packaging formulated coatings), 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	Medium	Methods, results, and assumptions are clearly documented, but underlying data sources for deriving recommendations are not fully transparent.
Domain 4: Variability and Uncertainty				
	Metric 7:	Metadata Completeness	Low	Variability and uncertainty are not addressed - single flame retardant product.

Overall Quality Determination Medium

Study Citation:	Chem Service, (2015). Safety Data Sheet: Tris(2-chloroethyl)phosphate.
HERO ID:	10604009
Conditions of Use:	Commercial Use - e.g., Laboratory chemicals

EXTRACTION

Parameter	**Data**
Chemical concentration:	Neat TCEP concentration listed as 100 percent; for lab use (pg 2)
Comments:	1.4249 g/cm3 estimated at 20 °C pg. 4/8

EVALUATION

Domain	Metric	Rating	Comments
Domain 1: Reliability			
	Metric 1: Methodology	High	Source uses data reported by product manufacturer/distributor
Domain 2: Representativeness			
	Metric 2: Geographic Scope	High	Data are from the U.S.
	Metric 3: Applicability	High	Data are for laboratory use of TCEP, 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:	Chupeau, Z., Bonvallot, N., Mercier, F., Le Bot, B., Chevrier, C., Glorennec, P. (2020). Organophosphorus Flame Retardants: A Global Review of Indoor Contamination and Human Exposure in Europe and Epidemiological Evidence. International Journal of Environmental Research and Public Health 17(18):6713.
HERO ID:	7537959
Conditions of Use:	Manufacturing/Import

EXTRACTION

Parameter	**Data**
Production, import, or use volume:	European consumption of phosphorous flame retardants in 2015 was 89,640 metric tons, which represented 18% of flame retardants
Comments:	primarily dust exposures from general population exposure

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 Europe, which includes OECD countries.
Metric 3:	Applicability	Uninformative	Data are for general use of OPFRs in Europe, which is not similar to the the in-scope occupational scenario of TCEP import.
Metric 4:	Temporal Representativeness	High	Assessment is based on current industry conditions and data no more than 10 years old.
Metric 5:	Sample Size	N/A	N/A - data not dependent on samples
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:	Duratec, (2018). Safety Data Sheet: Grey fire-resistant primer.
HERO ID:	10604010
Conditions of Use:	Processing " incorporation into formulation, mixture or reaction product

EXTRACTION

Parameter	**Data**
Chemical concentration:	TCEP concentration in flame retardant coating listed as less than or equal to 5 percent
Comments:	Density of product listed as specific gravity 1.3

EVALUATION

Domain	Metric		Rating	Comments
Domain 1: Reliability				
	Metric 1:	Methodology	High	Source uses data reported by product manufacturer/distributor
Domain 2: Representativeness				
	Metric 2:	Geographic Scope	High	Data are from the U.S.
	Metric 3:	Applicability	High	Data are for incorporation into coatings, 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	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: Duratec, (2018). Safety Data Sheet: Grey fire-resistant primer.
HERO ID: 10604010
Conditions of Use: Commercial Use - Paints and coatings

EXTRACTION

Parameter	Data
Chemical concentration:	TCEP concentration in flame retardant coating listed as less than or equal to 5 percent
Comments:	Density of product listed as specific gravity 1.3

EVALUATION

Domain	Metric		Rating	Comments
Domain 1: Reliability				
	Metric 1:	Methodology	High	Source uses data reported by product manufacturer/distributor
Domain 2: Representativeness				
	Metric 2:	Geographic Scope	High	Data are from the U.S.
	Metric 3:	Applicability	High	Data are for use in coatings, 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	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:	Ekpe, O. D., Choo, G., Barceló, D., Oh, J. E. (2020). Chapter One - Introduction of emerging halogenated flame retardants in the environment. 88Jan-39.
HERO ID:	8775306
Conditions of Use:	Furnishing, Cleaning, Treatment/Care Products (Foam Seating and Bedding Products and Fabric, textile, and leather products not covered elsewhere)

EXTRACTION

Parameter	**Data**
Production, import, or use volume:	Global flame retardant production of 2.49 million tons (2015) with market growth rate of 4.9% . North America accounts for 22% of consumption. pg 2; Fig 3 breaks the global market into flame retardant categories, chlorinated phosphates accounts for 10% global market. pg. 3; Fig. 4 has US production volumes of TCEP for 1986-2016. pg. 25
Life cycle description:	"TCEP exists in several commercial preparations, namelyDisflamoll TCA, Antiblaze 100, Fyrol CEF, or Celluflex CEF... Tetrakis(2-chloroethyl) dichloroisopentyl diphosphate (V6) is an additive flame retardant produced from pentaerythritol, phosphorus trichoride, chlorine and ethylene oxide, and finds application mainly in the production of flexible PUFs for use in the automotive and furniture industry. Its application as additive FR in these products makes it subject to volatization or leaching from the polymer matrix. It exists in the same market domain with TCPP and TDCPP and is often used in cases where specific standards need to be met by enhanced flame retardant properties. Commercial V6 mixture (Antiblaze V6) has 4.5"10% TCEP as its main impurity by weight" pgs. 24-25/39
Process description:	"Tris(1-chloro-2-propyl) phosphate (TCEP) is a non-volatile, colourless to pale yellow liquid, manufactured via the reaction of phosphorus oxychloride with ethylene oxide. On thermal decomposition, it forms carbon monoxide, hydrogen chloride, 2-chloroethane and dichloroethane." [Reviewer believes chemical name is a typo, see comment] pg. 24
Comments:	Report defines Tris(1-chloro-2-propyl) phosphate as both TCPP and TCEP, reviewer believes that this is a typo in which TCEP should be reported as Tris(2-chloroethyl) Phosphate (pg. 24). Report provides support for TCEP being found in these types of products as a result of TCEP being an impurity of V6

EVALUATION

Domain	Metric	Rating	Comments
Domain 1: Reliability			
Metric 1:	Methodology	Medium	The assessment or report uses high quality data that are not from frequently used sources
Domain 2: Representativeness			
Metric 2:	Geographic Scope	High	The authors are from an OECD country other than the U.S. (Korea and Spain), but extracted information is pertinent to 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 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	Uncertainty is not addressed. The report does address variability or uncertainty.

Overall Quality Determination **High**

Study Citation:	EPA Office of Air and Water programs (1974). Air pollution control engineering and cost study of the paint and varnish industry.
HERO ID:	6580284
Conditions of Use:	Incorporation into a formulation

EXTRACTION

Parameter	**Data**
Process description:	Paint manufacturing process described for mixing raw materials; includes solvent or dispersing medium, binders such as oil or resin, vehicle solid or film former, and additives such as preservatives or driers; some recipes given around page 99 of PDF file
Number of sites:	Around 1,700 plant sites in paint and varnish manufacturing; provides distribution of plants by number of employees

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 generic paint and coatings manufacturing and emissions of VOCs, which is similar to the in-scope occupational scenarios of TCEP use in paint and coatings.
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 due to confidential business information.
Domain 4: Variability and Uncertainty			
Metric 7:	Metadata Completeness	Medium	Variability addressed by addressing manufacturing plants throughout the United States, but uncertainty is not addressed.

Overall Quality Determination Medium

Study Citation:	ERG, (1998). Air emissions inventories, volume 2: Point sources: Chapter 11: Preferred and alternative methods for estimating air emissions from plastic products manufacturing.
HERO ID:	7349020
Conditions of Use:	Processing - incorporation into an article

EXTRACTION

Parameter	**Data**
Process description:	Foam processing basic process description starting on page 15 of PDF, including blowing operations

EVALUATION

Domain	Metric		Rating	Comments
Domain 1: Reliability				
	Metric 1:	Methodology	High	Report uses high quality information/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 general plastic manufacturing occupational scenarios, but are not chemical-specific for TCEP.
	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:	Fang, M., Webster, T. F., Gooden, D., Cooper, E. M., McClean, M. D., Carignan, C., Makey, C., Stapleton, H. M. (2013). Investigating a novel flame retardant known as V6: measurements in baby products, house dust, and car dust. Environmental Science & Technology 47(9):4449-4454.
HERO ID:	1676728
Conditions of Use:	Commercial Use-Furnishing, Cleaning, Treatment/Care Products

EXTRACTION

Parameter	**Data**
Chemical concentration:	Study provides multiple values for TCEP concentrations in V6 mixtures; TCEP is found in V6 mixtures up to 14% w/w (pg 1/15) and TCEP is found in V6 mixtures of 4.5 - 7.5% w/w (pg 2/15)
Comments:	States that TCEP was phased out of these products starting in the 1980s (pg 2/15). V6 is mostly used in automobiles (pg 6/15)

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
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	High	Provides multiple sources for concentration of TCEP in V6 mixtures
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:	FCC, (2016). Safety Data Sheet: Flame control No. 40-40A - White and pastel tints.
HERO ID:	10604134
Conditions of Use:	Processing " incorporation into formulation, mixture or reaction product

EXTRACTION

Parameter	**Data**
Chemical concentration:	TCEP concentration in product listed as 0.1 to 1 percent
Comments:	Specific gravity listed as 1 to 1.1

EVALUATION

Domain	Metric		Rating	Comments
Domain 1: Reliability				
	Metric 1:	Methodology	High	Source uses data reported by product manufacturer/distributor
Domain 2: Representativeness				
	Metric 2:	Geographic Scope	High	Data are from the U.S.
	Metric 3:	Applicability	High	Data are for incorporation into coatings, 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	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: FCC, (2016). Safety Data Sheet: Flame control No. 40-40A - White and pastel tints.
HERO ID: 10604134
Conditions of Use: Commercial Use - paints and coatings

EXTRACTION

Parameter	**Data**
Chemical concentration:	TCEP concentration in product listed as 0.1 to 1 percent
Comments:	Specific gravity listed as 1 to 1.1

EVALUATION

Domain	Metric		Rating	Comments
Domain 1: Reliability				
	Metric 1:	Methodology	High	Source uses data reported by product manufacturer/distributor
Domain 2: Representativeness				
	Metric 2:	Geographic Scope	High	Data are from the U.S.
	Metric 3:	Applicability	High	Data are for use in coatings, 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	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:	FCC, (2011). Technical Data Sheet: Flame control No. 40-40A.
HERO ID:	10604137
Conditions of Use:	Processing " incorporation into formulation, mixture or reaction product

EXTRACTION

Parameter	**Data**
Process description:	Technical data sheet lists end uses, application parameters and methods (brush, roller, or airless spray) and packaging container size (1 and 5 gallon containers)

EVALUATION

Domain	Metric		Rating	Comments
Domain 1: Reliability				
	Metric 1:	Methodology	High	Source uses data reported by product manufacturer/distributor
Domain 2: Representativeness				
	Metric 2:	Geographic Scope	High	Data are from the U.S.
	Metric 3:	Applicability	High	Data are for incorporation into coatings (packaging formulated coating), 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	Medium	Uncertainty is addressed by listing several different application methods and ranges of parameters . Variability is not addressed.

Overall Quality Determination High

Study Citation: FCC, (2011). Technical Data Sheet: Flame control No. 40-40A.
HERO ID: 10604137
Conditions of Use: Commercial Use - paints and coatings

EXTRACTION

Parameter	Data
Process description:	Technical data sheet lists end uses, application parameters and methods (brush, roller, or airless spray) and packaging container size (1 and 5 gallon containers)

EVALUATION

Domain	Metric		Rating	Comments
Domain 1: Reliability				
	Metric 1:	Methodology	High	Source uses data reported by product manufacturer/distributor
Domain 2: Representativeness				
	Metric 2:	Geographic Scope	High	Data are from the U.S.
	Metric 3:	Applicability	High	Data are for use in coatings, 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	Medium	Uncertainty is addressed by listing several different application methods and ranges of parameters . Variability is not addressed.

Overall Quality Determination High

Study Citation:	FCC, (2016). Safety Data Sheet: Flame control No. 5050 white and pastel tints.
HERO ID:	10604143
Conditions of Use:	Processing " incorporation into formulation, mixture or reaction product

EXTRACTION

Parameter	**Data**
Chemical concentration:	TCEP concentration in product listed as 1 to 5 percent
Comments:	Specific gravity listed as 1.2 to 1.3

EVALUATION

Domain	Metric		Rating	Comments
Domain 1: Reliability				
	Metric 1:	Methodology	High	Source uses data reported by product manufacturer/distributor
Domain 2: Representativeness				
	Metric 2:	Geographic Scope	High	Data are from the U.S.
	Metric 3:	Applicability	High	Data are for incorporation into coatings, 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	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:	FCC, (2016). Safety Data Sheet: Flame control No. 5050 white and pastel tints.
HERO ID:	10604143
Conditions of Use:	Commercial Use - paints and coatings

EXTRACTION

Parameter	**Data**
Chemical concentration:	TCEP concentration in product listed as 1 to 5 percent
Comments:	Specific gravity listed as 1.2 to 1.3

EVALUATION

Domain	Metric		Rating	Comments
Domain 1: Reliability				
	Metric 1:	Methodology	High	Source uses data reported by product manufacturer/distributor
Domain 2: Representativeness				
	Metric 2:	Geographic Scope	High	Data are from the U.S.
	Metric 3:	Applicability	High	Data are for use in coatings, 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	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:	FCC, (2010). Technical Data Sheet: Flame control No. 50-50 foam kote.
HERO ID:	10604144
Conditions of Use:	Commercial use - paints and coatings

EXTRACTION

Parameter	**Data**
Process description:	Flame retardant coating end uses, application parameters and methods (Brush, roller, conventional and airless spray), and product container size (1 and 5 gallon containers)

EVALUATION

Domain	Metric	Rating	Comments
Domain 1: Reliability			
	Metric 1: Methodology	High	Source uses data reported by product manufacturer/distributor
Domain 2: Representativeness			
	Metric 2: Geographic Scope	High	Data are from the U.S.
	Metric 3: Applicability	High	Data are for use in coatings, 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	Medium	Methods, results, and assumptions are documented for application methods, but underlying data sources are not fully transparent.
Domain 4: Variability and Uncertainty			
	Metric 7: Metadata Completeness	Medium	Variability addressed by different application methods, but uncertainty is not addressed.

Overall Quality Determination — High

Study Citation:	FCC, (2010). Technical Data Sheet: Flame control No. 50-50 foam kote.
HERO ID:	10604144
Conditions of Use:	Processing " incorporation into formulation, mixture or reaction product

EXTRACTION

Parameter	**Data**
Process description:	Flame retardant coating end uses, application parameters and methods (Brush, roller, conventional and airless spray), and product container size (1 and 5 gallon containers)

EVALUATION

Domain	Metric		Rating	Comments
Domain 1: Reliability				
	Metric 1:	Methodology	High	Source uses data reported by product manufacturer/distributor
Domain 2: Representativeness				
	Metric 2:	Geographic Scope	High	Data are from the U.S.
	Metric 3:	Applicability	High	Data are for incorporation into coatings (packaging formulation into product containers), 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	Medium	Methods, results, and assumptions are documented for application methods, but underlying data sources are not fully transparent.
Domain 4: Variability and Uncertainty				
	Metric 7:	Metadata Completeness	Medium	Variability addressed by different application methods, but uncertainty is not addressed.

Overall Quality Determination — High

Study Citation:	Fent, K. W., Horn, G. P., DeCrane, S. (2015). Firefighters" Perspective on Flame Retardants.
HERO ID:	6766298
Conditions of Use:	Commercial use of furnishing, cleaning, treatment/care products

EXTRACTION

Parameter	**Data**
Chemical concentration:	On and after July 1, 2018, no manufacturer or wholesaler may manufacture, sell, offer for sale, distribute for sale, or distribute for use in this state a children's product or upholstered residential furniture containing, in amounts greater than 1,000 parts per million in any product component, the following flame-retardants..." includes TCEP (for Minnesota); Vermont prohibits the sale of residential upholstered furniture, children"s products, and certain electronic devices containing TDCPP or related chemical TCEP; Maryland and New York prohibit the sale of children"s products containing TDCPP and TCEP; EU"s toy safety directive restricts the use of TCEP, TDCCP, and tris(1-chloro-2-propyl)phosphate (TCPP) in children"s toys above the amount of 5 mg/kg
Comments:	Same source as HERO ID 6766303Information is just regulatory limits

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	Data are primarily for consumer uses, though concentrations may also be applicable to the the in-scope occupational scenarios for commercial uses of Furnishing, Cleaning, Treatment/Care Products.
	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	Medium	Variability addressed by addressing regulations in different states, but uncertainty is not addressed.

Overall Quality Determination Medium

Study Citation:	Fink, J. K. (2010). Acrylonitrile-Butadiene-Styrene Polymers. 211-267.
HERO ID:	9493525
Conditions of Use:	Flame Retardant in Plastic (ABS)

EXTRACTION

Parameter	**Data**
Life cycle description:	General information on ABS production, uses, recycling and disposal.
Process description:	Table 8.9 Indicates that TCEP use as a flame retardant in ABS blends (p. 22). General information on ABS polymerization and blending.
Comments:	TCEP is only mentioned 1 time in the article where TCEP has been identified as a flame retardant for ABS Blends.

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 flame retardant use in plastic, 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 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	N/A	process description/life cycle info

Overall Quality Determination High

Study Citation:	Grimes, G., Beaucham, C., Grant, M., Ramsey, J. (2019). Health hazard evaluation report: HHE-2016-0257-3333, May 2019, evaluation of exposure to metals and flame retardants at an electronics recycling company.
HERO ID:	6558307
Conditions of Use:	Recycling

EXTRACTION

Parameter	**Data**
Process description:	9,000 square foot facility with 50 workers (5 - 10 work in the office and may be considered ONU's) that sort and take inventory of electronics. The sorted components then go to the refurbishing section, where dust is vacuumed away and functionality is tested. Any hard drives are then "wiped" and then the components either go to resale or disassembly.
Comments:	"At the time of our evaluation, approximately 50 employees worked at the company. Their primary activities included sorting and taking inventory of incoming electronics, refurbishing and resale of functional electronics, manual and mechanical disassembly of electronics, and office work." Note: 5-10 are office workers and 6 work in resale; they may be considered ONU's

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 recycling, 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	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	process description

Overall Quality Determination High

Study Citation:	Hahladakis, J. N., Velis, C. A., Weber, R., Iacovidou, E., Purnell, P. (2018). An overview of chemical additives present in plastics: Migration, release, fate and environmental impact during their use, disposal and recycling. Journal of Hazardous Materials 344179-199.
HERO ID:	4168432
Conditions of Use:	Incorporation into articles, Disposal

EXTRACTION

Parameter	**Data**
Life cycle description:	The life cycle of plastics in general (Fig. 1, pg 5/21 of PDF);

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/United Kingdom, which are OECD countries.
	Metric 3:	Applicability	High	Data are for incorporation into articles and disposal, 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 - This metric is not applicable to the data being extracted
Domain 3: Accessibility/ Clarity				
	Metric 6:	Metadata Completeness	High	References to original data sources are given.
Domain 4: Variability and Uncertainty				
	Metric 7:	Metadata Completeness	N/A	Variability and uncertainty are not relevant to a description of the life cycle.

Overall Quality Determination High

Study Citation:	Horn, G. P., Kerber, S., Fent, K. W., Fernhall, B., Smith, D. L. (2016). Interim Report: Cardiovascular & Chemical Exposure Risks in Modern Firefighting.
HERO ID:	6766299
Conditions of Use:	Commercial use of furnishing, Cleaning, Treatment/Care Products

EXTRACTION

Parameter	**Data**
Chemical concentration:	flame retardants as contaminants on firefighting gear; TCEP detected on curtain liner (at 1.4 microgram/gram)and non-detect for other furnishings
Comments:	Primarily firefighter exposure assessment, but firefighting exposures not in-scope

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	Low	Data are for firefighter exposures and TCEP in consumer products, which may be applicable to TCEP for in-scope occupational exposures.
	Metric 4:	Temporal Representativeness	High	The report is 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	Medium	Variability addressed by comparing different furnishings but uncertainty is not addressed.

Overall Quality Determination Medium

Study Citation:	IPCS, (1998). Flame retardants: Tris(chloropropyl) phosphate and tris(2-chloroethyl) phosphate.
HERO ID:	79051
Conditions of Use:	Import

EXTRACTION

Parameter	**Data**
Production, import, or use volume:	Production and use of TCEP has been in decline since the 1980s. Global TCEP consumption peaked at over 9000 tonnes in 1989, but had declined to below 4000 tonnes by 1997

EVALUATION

Domain	Metric	Rating	Comments
Domain 1: Reliability			
	Metric 1: Methodology	High	Report uses high quality information/techniques/methods from frequently-used sources.
Domain 2: Representativeness			
	Metric 2: Geographic Scope	Medium	Data are compiled by World Health Organization and United Nations, which includes the United States and many OECD countries.
	Metric 3: Applicability	High	Data are in-scope for the manufacturing/import occupational scenario, and they also address potential end uses within 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	Data is characterized by ranges/estimations with uncertain statistics or distributions.
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 mentioning temporal trends, but uncertainty is not addressed.

Overall Quality Determination Medium

Study Citation: IPCS, (1998). Flame retardants: Tris(chloropropyl) phosphate and tris(2-chloroethyl) phosphate.
HERO ID: 79051
Conditions of Use: Incorporation into articles

EXTRACTION

Parameter	Data
Life cycle description:	"Historically TCEP was used in polyurethane foams and systems, mainly for rigid foam but with minor use in flexible polyurethane. TCEP is currently mainly used in the production of liquid unsaturated polyester resins. It is also used in textile back-coating formulations, PVC compounds, cellulose ester compounds and coatings.TCEP is not recommended by producers for use as a flame retardant additive for use in textiles nor for use in block polyurethane foams because of the probability of its decomposition"

EVALUATION

Domain	Metric		Rating	Comments
Domain 1: Reliability				
	Metric 1:	Methodology	High	Report uses high quality information/techniques/methods from frequently-used sources.
Domain 2: Representativeness				
	Metric 2:	Geographic Scope	Medium	Data are compiled by World Health Organization and United Nations, which includes the United States and many OECD countries.
	Metric 3:	Applicability	High	Data are in-scope for the manufacturing/import occupational scenario, and they also address potential end uses within 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	usage information
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 mentioning temporal changes, but uncertainty is not addressed.

Overall Quality Determination Medium

Study Citation:	J6 Polymers, (2018). Safety Data Sheet: JFOAM G-306-M-T.
HERO ID:	10604581
Conditions of Use:	Processing " incorporation into formulation, mixture or reaction product

EXTRACTION

Parameter	**Data**
Chemical concentration:	Concentration ranges of components listed for product known to contain flame retardant; specific gravity listed as 1.22

EVALUATION

Domain	Metric		Rating	Comments
Domain 1: Reliability				
	Metric 1:	Methodology	High	Source uses data reported by product manufacturer/distributor
Domain 2: Representativeness				
	Metric 2:	Geographic Scope	High	Data are from the U.S.
	Metric 3:	Applicability	High	Data are for incorporation into resin formulations, 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	Concentration 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: J6 Polymers, (2018). Safety Data Sheet: JFOAM G-306-M-T.
HERO ID: 10604581
Conditions of Use: Processing " incorporation into article

EXTRACTION

Parameter	Data
Chemical concentration:	Concentration ranges of components listed for product known to contain flame retardant; specific gravity listed as 1.22

EVALUATION

Domain	Metric		Rating	Comments
Domain 1: Reliability				
	Metric 1:	Methodology	High	Source uses data reported by product manufacturer/distributor
Domain 2: Representativeness				
	Metric 2:	Geographic Scope	High	Data are from the U.S.
	Metric 3:	Applicability	High	Data are for incorporation of resin into articles, 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	Concentration 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:	J6 Polymers, (2018). Safety Data Sheet: JFOAM G-308-M-T.
HERO ID:	10604582
Conditions of Use:	Processing " incorporation into formulation, mixture or reaction product

EXTRACTION

Parameter	**Data**
Chemical concentration:	Concentration of components in product known to contain TCEP; specific gravity listed as 1.22

EVALUATION

Domain	Metric		Rating	Comments
Domain 1: Reliability				
	Metric 1:	Methodology	High	Source uses data reported by product manufacturer/distributor
Domain 2: Representativeness				
	Metric 2:	Geographic Scope	High	Data are from the U.S.
	Metric 3:	Applicability	High	Data are for incorporation into resin formulations, 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	Concentration 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: J6 Polymers, (2018). Safety Data Sheet: JFOAM G-308-M-T.
HERO ID: 10604582
Conditions of Use: Processing " incorporation into article

EXTRACTION

Parameter	Data
Chemical concentration:	Concentration of components in product known to contain TCEP; specific gravity listed as 1.22

EVALUATION

Domain	Metric		Rating	Comments
Domain 1: Reliability				
	Metric 1:	Methodology	High	Source uses data reported by product manufacturer/distributor
Domain 2: Representativeness				
	Metric 2:	Geographic Scope	High	Data are from the U.S.
	Metric 3:	Applicability	High	Data are for incorporation of resin into articles, 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	Concentration 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:	J6 Polymers, (2018). Product bulletin: JFoam G-306.
HERO ID:	10604583
Conditions of Use:	Processing " incorporation into article

EXTRACTION

Parameter	**Data**
Process description:	Product data sheet provides mixing ratio for 2-part resin and use instructions

EVALUATION

Domain	Metric		Rating	Comments
Domain 1: Reliability				
	Metric 1:	Methodology	High	Source uses data reported by product manufacturer/distributor
Domain 2: Representativeness				
	Metric 2:	Geographic Scope	High	Data are from the U.S.
	Metric 3:	Applicability	High	Data are for incorporation of resin into articles, 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	Medium	Methods, results, and assumptions are documented for application methods, but underlying data sources are not fully transparent.
Domain 4: Variability and Uncertainty				
	Metric 7:	Metadata Completeness	Medium	Variability addressed by different application methods, but uncertainty is not addressed.

Overall Quality Determination — High

Study Citation:	J6 Polymers, (2018). Product bulletin: JFoam G-308.
HERO ID:	10604584
Conditions of Use:	Processing " incorporation into article

EXTRACTION

Parameter	**Data**
Process description:	Product data sheet provides mixing ratio for 2-part resin and instructions for use

EVALUATION

Domain	Metric		Rating	Comments
Domain 1: Reliability				
	Metric 1:	Methodology	High	Source uses data reported by product manufacturer/distributor
Domain 2: Representativeness				
	Metric 2:	Geographic Scope	High	Data are from the U.S.
	Metric 3:	Applicability	High	Data are for incorporation of resins into articles, 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	Medium	Methods, results, and assumptions are documented for application methods, but underlying data sources are not fully transparent.
Domain 4: Variability and Uncertainty				
	Metric 7:	Metadata Completeness	Medium	Variability addressed by different application methods, but uncertainty is not addressed.

Overall Quality Determination High

Study Citation:	J6 Polymers, (2021). Comment from J6 Polymers LLC regarding end usage characterization of tris(2"chloroethyl) phosphate (TCEP) in rigid polyurethane foam.
HERO ID:	11204812
Conditions of Use:	Processing - incorporation into article (aircraft interior)

EXTRACTION

Parameter	**Data**
Production, import, or use volume:	10lbs of TCEP used over 3 years.
Life cycle description:	Processing - incorporation into article (aircraft interior)
Process description:	TCEP is present in the formulation of one TDI prepolymer (KA8860) modified with a flame retardant sold by J6 polymers. TCEP is added to the formulation for its flame retardant properties, as well as a plasticizer and viscosity regulator. Orders for KA8860 are packaged in UN certified packaging which range from 1/2 pint to 5 gallons in size.
Throughput:	nan
Chemical concentration:	TCEP comprises approximately 10% of the final foam sytems.

EVALUATION

Domain	Metric	Rating	Comments
Domain 1: Reliability			
	Metric 1: Methodology	High	This source comes directly from the manufacturer.
Domain 2: Representativeness			
	Metric 2: Geographic Scope	High	This company is based directly from the U.S.
	Metric 3: Applicability	High	This source applies directly to a COU and is specific to the chemical.
	Metric 4: Temporal Representativeness	High	Company provided this source in 2021.
	Metric 5: Sample Size	Low	Not characterized by statistics.
Domain 3: Accessibility/ Clarity			
	Metric 6: Metadata Completeness	High	Source is directly from the manufacturer.
Domain 4: Variability and Uncertainty			
	Metric 7: Metadata Completeness	Low	Does not provide variability or uncertainty.

Overall Quality Determination High

Study Citation:	La Guardia, M. J., Hale, R. C. (2015). Halogenated flame-retardant concentrations in settled dust, respirable and inhalable particulates and polyurethane foam at gymnastic training facilities and residences. Environment International 79106-114.
HERO ID:	3012534
Conditions of Use:	Commercial Use - Furnishing, Cleaning, Treatment/Care Products

EXTRACTION

Parameter	**Data**
Life cycle description:	Study tested for TCEP in polyurethane foams used in gymnasiums and houses
Chemical concentration:	TCEP was detected in foam used in gyms at concentrations in the foam of 1.6 - 1.9 micrograms/g dry weight

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	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	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:	Matsukami H., Nguyen Minh Tue, Suzuki G., Someya M., Le Huu Tuyen, Pham Hung Viet, Takahashi S., Tanabe S., Takigami H. (2015). Flame retardant emission from e-waste recycling operation in northern Vietnam: Environmental occurrence of emerging organophosphorus esters used as alternatives for PBDEs. Science of the Total Environment 514492-499.
HERO ID:	2942545
Conditions of Use:	Incorporation into an article

EXTRACTION

Parameter	**Data**
Production, import, or use volume:	total FR consumption in Japan in 2004 was approx. 190,000 tons with organophsphorous flame retardants accounting for 15% ... total FR consumption in Europe in 2006 was approx. 465,000 tons with organophsphorous flame retardants accounting for 20%

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	Study was conducted by Japan, an OECD country. However data is from Vietnam
	Metric 3: Applicability	Low	"Recycling operations were family based and took place on a small scale in the back-yards of homes, often within 20 m distance from living area."
	Metric 4: Temporal Representativeness	High	The report captures operations, equipment, and worker activities expected to be repre-sentative 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	High	All data sources, methods, results, and assumptions are clearly documented.
Domain 4: Variability and Uncertainty			
	Metric 7: Metadata Completeness	Low	Variability addressed by different temperatures and gaseous environments, but uncer-tainty is not addressed.

Overall Quality Determination Medium

Study Citation:	Minnesota Department of Health (2016). Flame Retardants and Firefighter Exposure and Health.
HERO ID:	6766303
Conditions of Use:	Commercial Uses - Furnishing, Cleaning, Treatment/Care Products

EXTRACTION

Parameter	**Data**
Chemical concentration:	State regulations for TCEP: On and after July 1, 2018, no manufacturer or wholesaler may manufacture, sell, offer for sale, distribute for sale, or distribute for use in this state a children's product or upholstered residential furniture containing, in amounts greater than 1,000 parts per million in any product component, the following flame-retardants..." includes TCEP (for Minnesota); Vermont prohibits the sale of residential upholstered furniture, children"s products, and certain electronic devices containing TDCPP or related chemical TCEP; Maryland and New York prohibit the sale of children"s products containing TDCPP and TCEP; EU"s toy safety directive restricts the use of TCEP, TDCCP, and tris(1-chloro-2-propyl)phosphate (TCPP) in children"s toys above the amount of 5 mg/kg
Comments:	Only regulatory information. Firefighter exposures generally are not in scope for engineering assessments.

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	Data are primarily for consumer uses, though concentrations may also be applicable to the the in-scope occupational scenarios for commercial uses of Furnishing, Cleaning, Treatment/Care Products.
	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	Medium	Variability addressed by including regulations in different states, but uncertainty is not addressed.

Overall Quality Determination Medium

Study Citation:	NCBI, (2020). PubChem Compound Summary for CID 2577 Tris (2-chloroethyl) phosphate.
HERO ID:	10170891
Conditions of Use:	Manufacturing

EXTRACTION

Parameter	**Data**
Production, import, or use volume:	See section 9.6 for US production volumes for 1972 - 2002 (p. 35). Important data only provided for 1972 and listed as negligible (p. 36). Aceto Corporation, 4 Tri Harbor Ct, Port Washington, NY 11050 listed as importer based on 2014 CDR search (p. 34).
Process description:	Made from a three-to-one mole ratio of ethylene oxide ... and phosphorus oxychloride.

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 various OECD countries.
	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	PV and process description 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: NCBI, (2020). PubChem Compound Summary for CID 2577 Tris (2-chloroethyl) phosphate.
HERO ID: 10170891
Conditions of Use: Uses

EXTRACTION

Parameter	Data
Life cycle description:	Used in rigid polyurethane and polyisocyanurate foams, carpet backing, flame-laminated and rebounded flexible foam, flame-retardant coatings, adhesives, and cast acrylic sheet and wood-resin composites (e.g., particle board) (p. 2). Used in most classes of thermosets (p. 20). See Section 9.1 for citations for use information (p. 34)."Tris(2-chloroethyl) phosphate was detected in the sediment at a landfill and near a car demolition site at 27-380 and 2300-5500 ug/kg, respectively (p. 25)."van der Been I, de Boer J; Chemosphere 88: 1119-53 (2012)

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 various OECD countries.
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	PV and process description 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:	Normet, (2015). Safety Data Sheet: Tampur RBG Part B.
HERO ID:	10604191
Conditions of Use:	Processing " incorporation into formulation, mixture or reaction product

EXTRACTION

Parameter	**Data**
Chemical concentration:	TCEP concentration listed as 1 to 5 percent in product
Comments:	Relative density listed as 1.205

EVALUATION

Domain	Metric	Rating	Comments
Domain 1: Reliability			
	Metric 1: Methodology	High	Source uses data reported by product manufacturer/distributor
Domain 2: Representativeness			
	Metric 2: Geographic Scope	Low	Data are from Taiwan, a non-OECD country.
	Metric 3: Applicability	High	Data are for incorporation into coatings, 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	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:	Normet, (2015). Safety Data Sheet: Tampur RBG Part B.
HERO ID:	10604191
Conditions of Use:	Processing " incorporation into article

EXTRACTION

Parameter	**Data**
Chemical concentration:	TCEP concentration listed as 1 to 5 percent in product
Comments:	Relative density listed as 1.205

EVALUATION

Domain	Metric		Rating	Comments
Domain 1: Reliability				
	Metric 1:	Methodology	High	Source uses data reported by product manufacturer/distributor
Domain 2: Representativeness				
	Metric 2:	Geographic Scope	Low	Data are from Taiwan, a non-OECD country.
	Metric 3:	Applicability	High	Data are for incorporation into articles, 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	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:	Nunez C., Mcminn B., Vitas J. (1996). Barriers to the use of radiation-curable adhesives in the coated and laminated substrate manufacturing industry. Journal of Hazardous Materials 45(1):59-78.
HERO ID:	5466433
Conditions of Use:	Paints and coatings

EXTRACTION

Parameter	**Data**
Process description:	Several pages of PDs provided for various coating operations (general for all chemicals)

EVALUATION

Domain	Metric		Rating	Comments
Domain 1: Reliability				
	Metric 1:	Methodology	High	Report uses high quality from frequently-used sources (EPA source).
Domain 2: Representativeness				
	Metric 2:	Geographic Scope	High	Data are from the U.S.
	Metric 3:	Applicability	High	Data are for paints and coatings, 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	N/A	N/A - process description
Domain 4: Variability and Uncertainty				
	Metric 7:	Metadata Completeness	N/A	N/A - process description

Overall Quality Determination High

Study Citation:	Parsons, N. S., Lam, M. H. W., Hamilton, S. E. (2013). Chemical characterization of automotive polyurethane foam using solid-phase microextraction and gas chromatography-mass spectrometry. Journal of Forensic Sciences 58(S1):S186-S191.
HERO ID:	5469249
Conditions of Use:	Consumer use of foam seating

EXTRACTION

Parameter	**Data**
Chemical concentration:	Only relative abundance from GC-MS analysis given for various car makes and models

EVALUATION

Domain	Metric		Rating	Comments
Domain 1: Reliability				
	Metric 1:	Methodology	Medium	The data is not from a frequently used source but the information does not indicate flaws.
Domain 2: Representativeness				
	Metric 2:	Geographic Scope	High	The authors reside in Hong Kong, which is associated with the OECD.
	Metric 3:	Applicability	Low	Data are concentration of TCEP in polyurethane foam obtained from a car. This use may be similar to the in-scope use of TCEP involving foam seating.
	Metric 4:	Temporal Representativeness	High	data is no more than 10 years old.
	Metric 5:	Sample Size	Low	Sample distribution is not 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 different car makes and models, but uncertainty is not addressed.

Overall Quality Determination Medium

Study Citation:	Pelzl, B., Wolf, R., Kaul, B. L. (2018). Plastics, additives. Jan-57.
HERO ID:	9493527
Conditions of Use:	Incorporation into formulation, mixture, or reaction product

EXTRACTION

Parameter	**Data**
Life cycle description:	See p. 38, Table 10 for producers/trade names of organophosphorus flame retardants.See p. 40 for general uses - 10% of all plastics (chiefly PVC, ABS, polystyrene, unsaturated polyesters, polypropylene, polyethylene, and polyurethanes) contain flame retardants.
Process description:	"Although additives can be added to the monomer prior to polymerization, they are usually introduced immediately after polymerization, blended, and extruded to form granular(pelletized) products and compounds. Many additives are not introduced until the granules are processed into moldings, films, orfibers" (p. 2)."More than 90% of the flame retardants used in thermoplastics are of the additive type. They are added before, during, or after polymerization, but usually when the polymers are processedinto compounds or finished products. In the latter case, the retardant is often used as a highly concentrated masterbatch containing 50"80% of the agent" (p. 40).
Chemical concentration:	Some formulations of flexible polyurethane foams (e.g., for upholstery) contain tris(2-chloroethyl) phosphate. (pg 41)

EVALUATION

Domain	Metric	Rating	Comments
Domain 1: Reliability			
Metric 1:	Methodology	High	Report uses high quality data from frequently-used sources (Ullmann's).
Domain 2: Representativeness			
Metric 2:	Geographic Scope	Medium	Data are from France and Austria, OECD countries.
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	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:	PPG, (2010). Safety Data Sheet: PITT-CHAR XP EP 97-194 Component A.
HERO ID:	10604352
Conditions of Use:	Processing " incorporation into article

EXTRACTION

Parameter	**Data**
Chemical concentration:	TCEP concentration listed as 10 to 25 percent in product
Comments:	Density listed as 1.49 g/cm3

EVALUATION

Domain	Metric		Rating	Comments
Domain 1: Reliability				
	Metric 1:	Methodology	High	Source uses data reported by product manufacturer/distributor
Domain 2: Representativeness				
	Metric 2:	Geographic Scope	Medium	Data are from Belgium, an OECD country.
	Metric 3:	Applicability	High	Data are for incorporation of resin into articles, an in-scope occupational scenario.
	Metric 4:	Temporal Representativeness	Medium	Report is between 10 and 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 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: PPG, (2010). Safety Data Sheet: PITT-CHAR XP EP 97-194 Component A.
HERO ID: 10604352
Conditions of Use: Processing " incorporation into formulation, mixture or reaction product

EXTRACTION

Parameter	Data
Chemical concentration:	TCEP concentration listed as 10 to 25 percent in product
Comments:	Density listed as 1.49 g/cm3

EVALUATION

Domain	Metric		Rating	Comments
Domain 1: Reliability				
	Metric 1:	Methodology	High	Source uses data reported by product manufacturer/distributor
Domain 2: Representativeness				
	Metric 2:	Geographic Scope	Medium	Data are from Belgium, an OECD country.
	Metric 3:	Applicability	High	Data are for incorporation into coatings/resins, an in-scope occupational scenario.
	Metric 4:	Temporal Representativeness	Medium	Report is between 10 and 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 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: PPG, (2010). Safety Data Sheet: PITT-CHAR XP EP 97-194 Component A.
HERO ID: 10604352
Conditions of Use: Commercial Use - paints and coatings

EXTRACTION

Parameter	**Data**
Chemical concentration:	TCEP concentration listed as 10 to 25 percent in product
Comments:	Density listed as 1.49 g/cm3

EVALUATION

Domain	Metric		Rating	Comments
Domain 1: Reliability				
	Metric 1:	Methodology	High	Source uses data reported by product manufacturer/distributor
Domain 2: Representativeness				
	Metric 2:	Geographic Scope	Medium	Data are from Belgium, an OECD country.
	Metric 3:	Applicability	High	Data are for use in coatings, an in-scope occupational scenario.
	Metric 4:	Temporal Representativeness	Medium	Report is between 10 and 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 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:	PPG, (2016). Safety Data Sheet: PITT-CHAR XP PART A OFF WHITE.
HERO ID:	10604368
Conditions of Use:	Processing " incorporation into formulation, mixture or reaction product

EXTRACTION

Parameter	**Data**
Chemical concentration:	TCEP concentration listed as 10 to 20 percent in product
Comments:	Relative density listed as 1.49

EVALUATION

Domain	Metric		Rating	Comments
Domain 1: Reliability				
	Metric 1:	Methodology	High	Source uses data reported by product manufacturer/distributor
Domain 2: Representativeness				
	Metric 2:	Geographic Scope	High	Data are from the U.S.
	Metric 3:	Applicability	High	Data are for incorporation into resins/coatings, 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	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:	PPG, (2016). Safety Data Sheet: PITT-CHAR XP PART A OFF WHITE.
HERO ID:	10604368
Conditions of Use:	Processing " incorporation into article

EXTRACTION

Parameter	**Data**
Chemical concentration:	TCEP concentration listed as 10 to 20 percent in product
Comments:	Relative density listed as 1.49

EVALUATION

Domain	Metric		Rating	Comments
Domain 1: Reliability				
	Metric 1:	Methodology	High	Source uses data reported by product manufacturer/distributor
Domain 2: Representativeness				
	Metric 2:	Geographic Scope	High	Data are from the U.S.
	Metric 3:	Applicability	High	Data are for incorporation of resins into articles, 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	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: PPG, (2016). Safety Data Sheet: PITT-CHAR XP PART A OFF WHITE.
HERO ID: 10604368
Conditions of Use: Commercial Use - paints and coatings

EXTRACTION

Parameter	Data
Chemical concentration:	TCEP concentration listed as 10 to 20 percent in product
Comments:	Relative density listed as 1.49

EVALUATION

Domain	Metric		Rating	Comments
Domain 1: Reliability				
	Metric 1:	Methodology	High	Source uses data reported by product manufacturer/distributor
Domain 2: Representativeness				
	Metric 2:	Geographic Scope	High	Data are from the U.S.
	Metric 3:	Applicability	High	Data are for use in coatings, 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	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:	PPG, (2008). Product Data Sheet: Pitt-Char XP" Epoxy Intumescent Fire Protective Coating.
HERO ID:	10604369
Conditions of Use:	Processing " incorporation into formulation, mixture or reaction product

EXTRACTION

Parameter	**Data**
Process description:	Product application methods and parameters (including trowel and spray) and end uses provided

EVALUATION

Domain	Metric		Rating	Comments
Domain 1: Reliability				
	Metric 1:	Methodology	High	Source uses data reported by product manufacturer/distributor
Domain 2: Representativeness				
	Metric 2:	Geographic Scope	High	Data are from the U.S.
	Metric 3:	Applicability	High	Data are for incorporation into resins/coatings, 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 documented for application methods, but underlying data sources are not fully transparent.
Domain 4: Variability and Uncertainty				
	Metric 7:	Metadata Completeness	Medium	Variability addressed by different application methods, but uncertainty is not addressed.

Overall Quality Determination — High

Study Citation: PPG, (2008). Product Data Sheet: Pitt-Char XP" Epoxy Intumescent Fire Protective Coating.
HERO ID: 10604369
Conditions of Use: Processing " incorporation into article

EXTRACTION

Parameter	**Data**
Process description:	Product application methods and parameters (including trowel and spray) and end uses provided

EVALUATION

Domain	Metric		Rating	Comments
Domain 1: Reliability				
	Metric 1:	Methodology	High	Source uses data reported by product manufacturer/distributor
Domain 2: Representativeness				
	Metric 2:	Geographic Scope	High	Data are from the U.S.
	Metric 3:	Applicability	High	Data are for incorporation of resin into articles, 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 documented for application methods, but underlying data sources are not fully transparent.
Domain 4: Variability and Uncertainty				
	Metric 7:	Metadata Completeness	Medium	Variability addressed by different application methods, but uncertainty is not addressed.

Overall Quality Determination — High

Study Citation: PPG, (2008). Product Data Sheet: Pitt-Char XP" Epoxy Intumescent Fire Protective Coating.
HERO ID: 10604369
Conditions of Use: Commercial Use - paints and coatings

EXTRACTION

Parameter	Data
Process description:	Product application methods and parameters (including trowel and spray) and end uses provided

EVALUATION

Domain	Metric		Rating	Comments
Domain 1: Reliability				
	Metric 1:	Methodology	High	Source uses data reported by product manufacturer/distributor
Domain 2: Representativeness				
	Metric 2:	Geographic Scope	High	Data are from the U.S.
	Metric 3:	Applicability	High	Data are for use in paints and coatings, 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 documented for application methods, but underlying data sources are not fully transparent.
Domain 4: Variability and Uncertainty				
	Metric 7:	Metadata Completeness	Medium	Variability addressed by different application methods, but uncertainty is not addressed.

Overall Quality Determination High

Study Citation:	Rampf, (2017). Safety Data Sheet: RC 0555 Poly.
HERO ID:	10604370
Conditions of Use:	Processing " incorporation into formulation, mixture or reaction product

EXTRACTION

Parameter	**Data**
Chemical concentration:	TCEP concentration listed as 30 to 40 percent in product
Comments:	Specific gravity listed as 1.1

EVALUATION

Domain	Metric		Rating	Comments
Domain 1: Reliability				
	Metric 1:	Methodology	High	Source uses data reported by product manufacturer/distributor
Domain 2: Representativeness				
	Metric 2:	Geographic Scope	High	Data are from the U.S.
	Metric 3:	Applicability	High	Data are for incorporation into resins, 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	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:	Rampf, (2017). Safety Data Sheet: RC 0555 Poly.
HERO ID:	10604370
Conditions of Use:	Processing " incorporation into article

EXTRACTION

Parameter	**Data**
Chemical concentration:	TCEP concentration listed as 30 to 40 percent in product
Comments:	Specific gravity listed as 1.1

EVALUATION

Domain	Metric		Rating	Comments
Domain 1: Reliability				
	Metric 1:	Methodology	High	Source uses data reported by product manufacturer/distributor
Domain 2: Representativeness				
	Metric 2:	Geographic Scope	High	Data are from the U.S.
	Metric 3:	Applicability	High	Data are for incorporation of resin into articles, 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	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:	Santa Cruz Biotechnology, (2018). Safety Data Sheet: Tris(2-chloroethyl) phosphate, SC-229621.
HERO ID:	10604372
Conditions of Use:	Commercial Use - e.g., Laboratory chemicals

EXTRACTION

Parameter	**Data**
Chemical concentration:	Neat TCEP listed with concentration of greater than 98 percent

EVALUATION

Domain	Metric		Rating	Comments
Domain 1: Reliability				
	Metric 1:	Methodology	High	Source uses data reported by product manufacturer/distributor
Domain 2: Representativeness				
	Metric 2:	Geographic Scope	High	Data are from the U.S.
	Metric 3:	Applicability	High	Data are for laboratory uses, 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	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:	Sigma-Aldrich, (2019). Safety Data Sheet: Tris(2-chloroethyl) phosphate, 119660.
HERO ID:	10604373
Conditions of Use:	Commercial Use - e.g., Laboratory chemicals

EXTRACTION

Parameter	**Data**
Chemical concentration:	Neat TCEP concentration listed as less than or equal to 100 percent

EVALUATION

Domain	Metric		Rating	Comments
Domain 1: Reliability				
	Metric 1:	Methodology	High	Source uses data reported by product manufacturer/distributor
Domain 2: Representativeness				
	Metric 2:	Geographic Scope	High	Data are from the U.S.
	Metric 3:	Applicability	High	Data are for laboratory uses, 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	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:	Swedish Environmental Protection Agency, (2017). Replacement substances for the brominated flame retardants PBDE, HBCDD, and TBBPA.
HERO ID:	8775303
Conditions of Use:	Industrial/Commercial use

EXTRACTION

Parameter	**Data**
Life cycle description:	TCEP is an additive FR used in e.g. PVC, textile and polyurethane foam.

EVALUATION

Domain	Metric		Rating	Comments
Domain 1: Reliability				
	Metric 1:	Methodology	High	Report uses high quality data/information from frequently-used sources.
Domain 2: Representativeness				
	Metric 2:	Geographic Scope	Medium	Data are from Sweden, which is 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	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:	Swedish Environmental Protection Agency, (2017). Replacement substances for the brominated flame retardants PBDE, HBCDD, and TBBPA.
HERO ID:	8775303
Conditions of Use:	Manufacturing

EXTRACTION

Parameter	**Data**
Production, import, or use volume:	TCEP listed as quantity index of ""4"" in Swedish Product Register based on registered use patterns in year 2015.According to the Swedish Chemicals Agency, the use of TCEP in the Nordic countries has decreased since 2000. In 2010, Sweden and Denmark used less than 10 tonnes each, while Finland and Norway used 147 and 65 tonnes, respectively.

EVALUATION

Domain	Metric		Rating	Comments
Domain 1: Reliability				
	Metric 1:	Methodology	High	Report uses high quality data/information from frequently-used sources.
Domain 2: Representativeness				
	Metric 2:	Geographic Scope	Medium	Data are from Sweden, which is an OECD country.
	Metric 3:	Applicability	Medium	The report is for an occupational scenario within the scope of the risk evaluation, but usage information is not specific to U.S.
	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 distributions characterized by ranges/estimations 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 mentioning temporal trend, but uncertainty is not addressed.

Overall Quality Determination Medium

Study Citation:	Swedish Environmental Protection Agency, (2017). Replacement substances for the brominated flame retardants PBDE, HBCDD, and TBBPA.
HERO ID:	8775303
Conditions of Use:	Disposal

EXTRACTION

Parameter	**Data**
Chemical concentration:	TCEP found in effluent from point source WWTPs at ranges 90-450 ng/L and 130-2,500 ng/L. Also detected in sludges.

EVALUATION

Domain	Metric	Rating	Comments
Domain 1: Reliability			
	Metric 1: Methodology	High	Report uses high quality data/information from frequently-used sources.
Domain 2: Representativeness			
	Metric 2: Geographic Scope	Medium	Data are from Sweden, which is an OECD country.
	Metric 3: Applicability	Medium	Data are for disposal from point sources via wastewater, an in-scope occupational scenario, but specific point sources and treatment methods are not specified
	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 distributions characterized by ranges/estimations 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:	TCI America, (2018). Safety Data Sheet: Tris(2-chloroethyl) phosphate, P0268.
HERO ID:	10604374
Conditions of Use:	Commercial Use - e.g., Laboratory chemicals

EXTRACTION

Parameter	**Data**
Chemical concentration:	Neat TCEP concentration listed as at least 97 percent (safety data sheet)

EVALUATION

Domain	Metric		Rating	Comments
Domain 1: Reliability				
	Metric 1:	Methodology	High	Source uses data reported by product manufacturer/distributor
Domain 2: Representativeness				
	Metric 2:	Geographic Scope	High	Data are from the U.S.
	Metric 3:	Applicability	High	Data are for laboratory use, 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	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 are not addressed.

Overall Quality Determination — High

Study Citation:	Tokumura, M., Seo, M., Wang, Q., Miyake, Y., Amagai, T., Makino, M. (2019). Dermal exposure to plasticizers in nail polishes: An alternative major exposure pathway of phosphorus-based compounds. Chemosphere 226316-320.
HERO ID:	5163392
Conditions of Use:	Laboratory Use (TCEP Standard used for calibration purposes)

EXTRACTION

Parameter	**Data**
Chemical concentration:	Not identified in 45 nail polishes of various country origin
Comments:	While TCEP was considered by this study as a potential ingredient in nail polishes, that is not included as a COU in the RE nor was it detected in any of the nail polishes. This is a much better example of how TCEP is used in a laboratory as a standard. From the text: "Isotope-labeled internal standards of tributyl phosphate (TBP)-d27, tris(2-ethylhexyl) phosphate (TEHP)-d51, TPhP-d15, tricresylphosphate (TCsP)-d21, and tris(2-chloroethyl) phosphate (TCEP)-d12were purchased from Hayashi Pure Chemical Industries Ltd. (Osaka,Japan)....To prepare samples for analysis, 10 mg of nail polish was placedin a 10-mL test tube, dissolved in 5 mL acetone, sonicated for10 min, and centrifuged at 3000 rpm for 10 min. Then, 50 mL of thesupernatant was added to 930 mL of acetonitrile and 20 mL of theinternal standards...Calibration curves for the phosphorus compounds were linearover the standard solution concentration range of 3e1000 ng/mL(3, 10, 30, 100, 300, 1000 ng/mL; r^ 2 > 0.99)."

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	Study was conducted in Japan (some of the nail polishes analyzed came from the US but the study was intended to be representative of what is on the market in Japan)
	Metric 3:	Applicability	High	Laboratory Use is in the scope of the RE.
	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-TCEP was not detected in any nail polishes).
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 nail polishes from various countries but uncertainty is not addressed.

Overall Quality Determination High

Study Citation:	Tollback J., Isetun S., Colmsjo A., Nilsson U. (2010). Dynamic non-equilibrium SPME combined with GC, PICI, and ion trap MS for determination of organophosphate esters in air. Analytical and Bioanalytical Chemistry 396(2):839-844.
HERO ID:	386928
Conditions of Use:	Other Use (e.g., lab chemicals)

EXTRACTION

Parameter	**Data**
Process description:	TCEP is used for calibration purposes in a laboratory environment (it does not appear that the the lab in which the area samples were acquired was the same lab, or at the same time, as the experiment)
Comments:	This study describes a Laboratory Use of TCEP, the so called "working environments" that were area sampled during this study are not areas that TCEP is used. These areas were chosen because they contain articles (such as computers, flat screen monitors, and/or building materials) that are known, or suspected, to contain TCEP. As such I do not consider this article to have relevant worker exposure and only consider it relevant to the process description of using TCEP as a lab standard for calibration purposes.

EVALUATION

Domain	Metric		Rating	Comments
Domain 1: Reliability				
	Metric 1:	Methodology	High	The manner in which the experiment was conducted is very well described. Methods, models, and/or equipment used are well known and generally accepted by the scientific community.
Domain 2: Representativeness				
	Metric 2:	Geographic Scope	Medium	Data are from Sweden, an OECD country.
	Metric 3:	Applicability	High	Laboratory use is included in the scope
	Metric 4:	Temporal Representativeness	Medium	The report is generally more than 10 yearsbut no more than 20 years old.
	Metric 5:	Sample Size	N/A	There is no sample size, this is a process description for using TCEP as a laboratory standard for calibration purposes.
Domain 3: Accessibility/ Clarity				
	Metric 6:	Metadata Completeness	N/A	This is a process description for using TCEP as a laboratory standard for calibration purposes.
Domain 4: Variability and Uncertainty				
	Metric 7:	Metadata Completeness	N/A	This is a process description for using TCEP as a laboratory standard for calibration purposes.

Overall Quality Determination High

Study Citation:	U.S. EPA, (2015). Flame retardants used in flexible polyurethane foam: An alternatives assessment update (Sections 1-6).
HERO ID:	10180886
Conditions of Use:	Flame Retardant in Flexible PU Foam

EXTRACTION

Parameter	**Data**
Life cycle description:	"Although TCEP was previously not thought to be used in foam, it has been identified in upholstered FPUF products (Stapleton, Klosterhaus et al. 2011)." (p. 3-15)Exposure to reactive flame retardants could occur at all points in the life cycle, including manufacture, use, and disposal (p. 3-2)."
Process description:	"See 3.1 on p. 3-1 - 3-2""Flexible foam is made either in large slabs ("slabstock") that are cut to shape, or in molds that have the shape of the finished product. The basic ingredients include polyols, isocyanates, blowing agents, and other additives (including flame retardants). In manufacturing slabstock, the ingredients are blended in a mixing head and deposited on a conveyor belt, where the polymerization reactions occur, and the foam is expanded by blowing agents into a large (e.g., 60 foot) "bun." The buns are cured before being cut into shapes for a finished product. In molded foam, the polymerization reactions occur within the mold, and are heated to accelerate curing.Furniture and other foam product manufacturers typically receive cured foam and do not directly handle flame retardant chemicals. Because slabstock is made in very large buns, uses requiring smaller pieces of foam may consist of off-cuts from larger buns. This may be why smaller polyurethane foam products may contain flame retardants, even when they are not required to do so by regulation."""Flame retardants used in FPUF are typically classified as "additive." Additive flame retardants are blended evenly into the foam, but remain unbound.""
Chemical concentration:	MD passed a law prohibiting >0.1% TCEP by mass in products intended for use by children under age of 3 (pg 34)
Comments:	This is not an active use, actual source of flame retardant is unclear

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 flame retardant use in flexible PU foam, which is no longer an active 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 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 — Medium

Study Citation:	U.S. EPA, (2015). TSCA work plan chemical, problem formulation and initial assessment, chlorinated phosphate ester cluster flame retardants.
HERO ID:	4565574
Conditions of Use:	Manufacturing, Incorporation into an article

EXTRACTION

Parameter	**Data**
Process description:	Formed by adding and reacting ethylene oxide (epoxide) with phosphoryl chloride
Number of sites:	Aceto Corporation was the only company that reported manufacturing TCEP during the 2012 CDR reporting cycle
Chemical concentration:	Found in baby products at loading levels ranging from 1.08 to 5.95 mg/g

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 manufacturing and incorporation into an article, 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	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:	U.S. EPA, (1995). AP-42: Compilation of air pollutant emission factors. Volume I: Stationary point and area sources, fifth edition.
HERO ID:	46492
Conditions of Use:	Import, Distribution in Commerce, Incorporation into article, Industrial/Commercial Uses, Disposal

EXTRACTION

Parameter	**Data**
Process description:	Section 2 specifies processes associated with solid waste disposal operations, including potentially applicable incineration and landfilling for TCEP-contianing products; Section 4.2.2.1 (general industrial coating), 4.2.2.5 (wood panel coating), 4.2.2.7 (polymeric coating of supporting substrates), and potentially other coating sections applicable with process descriptions and some flow diagrams/figures showing processes; wastewater treatment processes in Section 4.3 may be applicable to exposure from disposal operations; Section 4.4 includes polyester resin plastic product fabrication processes such as hand layup, continuous lamination, marble casting, etc; Section 4.8 includes tank and drum cleaning operations, which may be related to import or distribution in commerce; Section 4.11 (textile fabric printing)

EVALUATION

Domain	Metric	Rating	Comments
Domain 1: Reliability			
Metric 1:	Methodology	High	Report uses high quality information and data from frequently-used or direct sources.
Domain 2: Representativeness			
Metric 2:	Geographic Scope	High	Data are from the U.S.
Metric 3:	Applicability	Medium	Data are for general occupational scenarios potentially applicable to in-scope scenarios for TCEP.
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 - information not dependent on samples
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 different processes used in industry, but uncertainty is not addressed.

Overall Quality Determination Medium

Study Citation:	U.S. EPA, (2015). Flame retardants used in flexible polyurethane foam: An alternatives assessment update.
HERO ID:	5113326
Conditions of Use:	Furnishing, Cleaning, Treatment/Care Products (Foam Seating and Bedding Products)

EXTRACTION

Parameter	**Data**
Process description:	PDs provided (Section 3.1 - flex foam, furniture mfg)

EVALUATION

Domain	Metric		Rating	Comments
Domain 1: Reliability				
	Metric 1:	Methodology	High	Report uses high quality data from frequently-used sources (EPA).
Domain 2: Representativeness				
	Metric 2:	Geographic Scope	High	Data are from the U.S.
	Metric 3:	Applicability	High	Data are for Furnishing, Cleaning, Treatment/Care Products (Foam Seating and Bedding 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	N/A	N/A - process description
Domain 4: Variability and Uncertainty				
	Metric 7:	Metadata Completeness	N/A	N/A - process description

Overall Quality Determination High

Study Citation:	U.S. EPA, (1995). Chapter 6: Organic chemical process industry. Compilation of air pollutant emission factors. Volume I: Stationary point and area sources, fifth edition, AP-42.
HERO ID:	7310513
Conditions of Use:	Processing - Incorporation into a formulation

EXTRACTION

Parameter	**Data**
Process description:	Chapter 6.4.1 discusses paint and varnish manufacturing processes
Comments:	AP-42 Chapter 6; subsection of HERO ID 46492Data is general and not chemical-specific for TCEP and potentially not for applicable physical forms of TCEP.

EVALUATION

Domain	Metric	Rating	Comments
Domain 1: Reliability			
	Metric 1: Methodology	High	Report uses high quality information and data from frequently-used or direct sources.
Domain 2: Representativeness			
	Metric 2: Geographic Scope	High	Data are from the U.S.
	Metric 3: Applicability	Low	Data are for general paint/varnish manufacturing occupational scenarios, but are not chemical-specific for TCEP.
	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:	U.S. EPA, (1995). Chapter 4.2: Introduction to surface coating. Compilation of air pollutant emission factors. Volume I: Stationary point and area sources, fifth edition, AP-42.
HERO ID:	7315820
Conditions of Use:	Industrial/Commercial Uses, Disposal

EXTRACTION

Parameter	**Data**
Process description:	Section 4.2.2.1 (general industrial coating), 4.2.2.5 (wood panel coating), 4.2.2.7 (polymeric coating of supporting substrates), and potentially other coating sections applicable with process descriptions and some flow diagrams/figures showing processes; wastewater treatment processes in Section 4.3 may be applicable to exposure from disposal operations; Section 4.4 includes polyester resin plastic product fabrication processes such as hand layup, continuous lamination, marble casting, etc; Section 4.8 includes tank and drum cleaning operations, which may be related to import or distribution in commerce; Section 4.11 (textile fabric printing)

EVALUATION

Domain	Metric		Rating	Comments
Domain 1: Reliability				
	Metric 1:	Methodology	High	Report uses high quality information and data from frequently-used or direct sources.
Domain 2: Representativeness				
	Metric 2:	Geographic Scope	High	Data are from the U.S.
	Metric 3:	Applicability	Medium	Data are for general occupational scenarios potentially applicable to in-scope scenarios for TCEP.
	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 - information not dependent on samples
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 different processes used in industry, but uncertainty is not addressed.

Overall Quality Determination Medium

Study Citation:	U.S. EPA, (2005). Furniture flame retardancy partnership: Environmental profiles of chemical flame-retardant alternatives for low-density polyurethane foam: Volume 1.
HERO ID:	956579
Conditions of Use:	Commercial use of Furnishing, Cleaning, Treatment/Care Products

EXTRACTION

Parameter	**Data**
Life cycle description:	Life cycle for flame retardant chemicals incorporated into foams - includes chemical manufacturing, incorporation into articles, recycling, consumer use, and disposal
Process description:	Discusses process of foam manufacturing and furniture manufacturing.

EVALUATION

Domain	Metric		Rating	Comments
Domain 1: Reliability				
	Metric 1:	Methodology	High	The assessment is developed by EPA.
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	Data are for multiple in-scope occupational scenarios; however, data is general and not specific to a chemical.
	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	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 accounting for different chemicals and physical forms, but uncertainty is not addressed.

Overall Quality Determination Medium

Study Citation:	Velázquez-Gómez, M., Hurtado-Fernández, E., Lacorte, S. (2019). Differential occurrence, profiles and uptake of dust contaminants in the Barcelona urban area. Science of the Total Environment 6481354-1370.
HERO ID:	5043338
Conditions of Use:	Commercial use, Consumer use

EXTRACTION

Parameter	**Data**
Chemical concentration:	Concentration of TCEP in dust samples from various areas including houses, high schools, museums, libraries, and cars; 100% detection frequency in each location with median concentrations ranging from 96 ng/g in houses to 412 ng/g in high schools; min and max dust concentrations also included

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 Spain, an OECD country.
	Metric 3:	Applicability	High	The data are relevant to the assessment of occupational exposure which would result from use of TCEP in various commercial uses (e.g., paints and coatings, ...etc.) that are associated with buildings.
	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) in available supplementary data. Medians, detection frequencies, and minimum/maximum provided within article.
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 various locations samples, but uncertainty is not addressed.

Overall Quality Determination — High

Study Citation:	Vimasco, (2016). Safety Data Sheet: Cable Coating 3i.
HERO ID:	10604375
Conditions of Use:	Processing " incorporation into formulation, mixture or reaction product

EXTRACTION

Parameter	**Data**
Chemical concentration:	TCEP concentration in product listed as 0.9 to 1.5 percent (safety data sheet)
Comments:	Specific gravity listed as 1.2

EVALUATION

Domain	Metric		Rating	Comments
Domain 1: Reliability				
	Metric 1:	Methodology	High	Source uses data reported by product manufacturer/distributor
Domain 2: Representativeness				
	Metric 2:	Geographic Scope	High	Data are from the U.S.
	Metric 3:	Applicability	High	Data are for incorporation into coating formulations, 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	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:	Vimasco, (2016). Safety Data Sheet: Cable Coating 3i.
HERO ID:	10604375
Conditions of Use:	Commercial Use - paints and coatings

EXTRACTION

Parameter	**Data**
Chemical concentration:	TCEP concentration in product listed as 0.9 to 1.5 percent (safety data sheet)
Comments:	Specific gravity listed as 1.2

EVALUATION

Domain	Metric		Rating	Comments
Domain 1: Reliability				
	Metric 1:	Methodology	High	Source uses data reported by product manufacturer/distributor
Domain 2: Representativeness				
	Metric 2:	Geographic Scope	High	Data are from the U.S.
	Metric 3:	Applicability	High	Data are for use in paints and coatings, 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	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:	Weil, E. D. (2000). Polyesters, thermoplastic.
HERO ID:	10186966
Conditions of Use:	Incorporation into formulation, mixture, or reaction product

EXTRACTION

Parameter	**Data**
Process description:	Tris(2-chloroethyl) phosphate [115-96-8], C H Cl O P (2-chloroethanol phosphate (3:1)), is a low viscosity liquid product that has found widespread usage because of low cost, low odor, high percent phosphorus, and compatibility with essentially all polymers containing polar groups. Akzo's Fyrol CEF contains 10.8% phosphorus and 36.7% chlorine, and is made from a three-to-one mole ratio of ethylene oxide (qv) and phosphorus oxychloride ((69)). This phosphate is used in rigid polyurethane and polyisocyanurate foams, carpet backing, flamelaminated and rebonded flexible foam, flame-retardant coatings, most classes of thermosets, adhesives (qv), cast acrylic sheet, and wood"resin composites such as particle board. It is used with melamine in flexible urethane foam cushions and institutional mattresses.

EVALUATION

Domain	Metric	Rating	Comments
Domain 1: Reliability			
Metric 1:	Methodology	High	Report uses high quality data from frequently-used sources. (Kirk-Othmer)
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, in terms of the type of industry, operations, and work activities.
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:	Weil, E. D., Levchik, S. V. (2017). Phosphorus flame retardants. Jan-34.
HERO ID:	9493523
Conditions of Use:	Incorporation into Formulation, mixture, or reaction product

EXTRACTION

Parameter	**Data**
Production, import, or use volume:	"TCEP "has now been discontinued, except perhaps in China (p. 9)."
Chemical concentration:	No specific concentration data. Notes that TCEP "has been used in polyurethane and polyisocyanurate foams, flame-retardant coatings, various thermosets, adhesives, cast acrylic sheet, and wood"resin composites (pp. 8-9)."

EVALUATION

Domain	Metric		Rating	Comments
Domain 1: Reliability				
	Metric 1:	Methodology	High	Report uses high quality data from frequently-used sources (Kirk-Othmer chapter).
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, in terms of the type of industry, operations, and work activities.
	Metric 4:	Temporal Representativeness	Low	based on data 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	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:	Xie, Q., Guan, Q., Li, L., Pan, X., Ho, C. L., Liu, X., Hou, S., Chen, D. (2021). Exposure of children and mothers to organophosphate esters: Prediction by house dust and silicone wristbands. Environmental Pollution 282117011.
HERO ID:	7538124
Conditions of Use:	Consumer exposure

EXTRACTION

Parameter	**Data**
Production, import, or use volume:	Annual OPE demands worldwide have been reported to increase from 102,000 tons in 1992 to 680,000 tons in 2015; In China, the total amount of OPEs produced was estimated to be 100000 tons in 2011, and the annual demand has grown by 15% per year
Comments:	general organophosphate esters (OPEs); primarily dust exposures for general population

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 China, a non-OECD country.
	Metric 3: Applicability	Low	Data are for general manufacturing of OPEs, which is similar to the the in-scope occupational scenario of TCEP import.
	Metric 4: Temporal Representativeness	High	Assessment is based on current industry conditions and data no more than 10 years old.
	Metric 5: Sample Size	N/A	N/A - information not dependent on samples
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 change over time, but uncertainty is not addressed.

Overall Quality Determination Medium

Study Citation:	Yang X., Sun L., Xiang J., Hu S., Su S. (2013). Pyrolysis and dehalogenation of plastics from waste electrical and electronic equipment (WEEE): A review. Waste Management 33462-473.
HERO ID:	5519320
Conditions of Use:	Recycling and disposal

EXTRACTION

Parameter	**Data**
Process description:	Brief PDs of four primary disposal and recycling methods of Waste Electronic and Electronic Equipment (WEEE) containing flame retarded plastics and detailed PD for pyrolsis

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 is from China
	Metric 3:	Applicability	High	Data are for recycling (electronic waste), 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	N/A	N/A - process description
Domain 4: Variability and Uncertainty				
	Metric 7:	Metadata Completeness	N/A	N/A - process description

Overall Quality Determination High

Study Citation:	Young, A. S., Allen, J. G., Kim, U. J., Seller, S., Webster, T. F., Kannan, K., Ceballos, D. M. (2018). Phthalate and Organophosphate Plasticizers in Nail Polish: Evaluation of Labels and Ingredients. Environmental Science and Technology 52(21):12841-12850.
HERO ID:	5164231
Conditions of Use:	Plasticizer in nail polish

EXTRACTION

Parameter	**Data**
Chemical concentration:	TCEP was not detected in any samples
Comments:	TCEP was not detected in any of the samples tested. TPP (called TPHP in the article) was detected in nail polishes.

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	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	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	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