

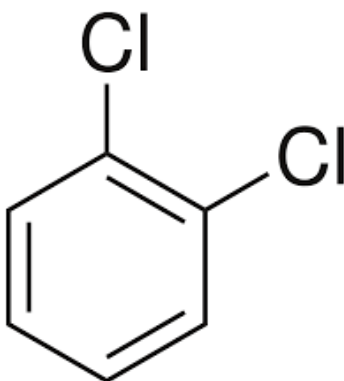


United States
Environmental Protection Agency

Draft Chemistry, Fate, Release, and Exposure Assessment for *o*-Dichlorobenzene

Technical Support Document for the Draft Risk Evaluation

CASRN 95-50-1



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791 **KEY ABBREVIATIONS AND ACRONYMS**

792	AC	Acute concentrations
793	ACC	American Chemistry Council
794	ADC	Average daily concentrations
795	ADME	Absorption, distribution, metabolism, and elimination
796	APDR	Acute potential dermal dose rates
797	APF	Assigned protection factor
798	APR	Air-purifying respirator
799	AMTIC	Ambient Monitoring Technology Information Center
800	AQS	Air Quality System
801	BAF	Bioaccumulation factor
802	BCF	Bioconcentration factor
803	BLS	Bureau of Labor Statistics (U.S.)
804	CAA	Clean Air Act
805	CASRN	Chemical Abstract Service registry number
806	CBI	Confidential business information
807	CDF	Cumulative distribution function
808	CDR	Chemical Data Reporting
809	CEHD	OSHA Chemical Exposure Health Database
810	CEM	Consumer Exposure Model
811	COU	Condition of use
812	CTD	Characteristic travel distance
813	CWA	Clean Water Act
814	EPA	Environmental Protection Agency (U.S.)
815	DMR	Discharge Monitoring Report
816	DRE	Destruction removal efficiency
817	ECHO	Enforcement and Compliance History Online
818	EIS	Emissions Inventory System
819	EPA	Environmental Protection Agency (U.S.)
820	ESD	Emission scenario document
821	FR SID	Facility Registry Services identification number
822	GS	Generic scenarios
823	HAP	Hazardous air pollutant
824	HEC	Human equivalent concentration
825	HED	Human equivalent dose
826	HEM	Human Exposure Model
827	HLC	Henry's Law constant
828	ICR	Information Collection Request
829	IECCU	Indoor Environmental Concentrations in Buildings with Conditioned and Unconditioned
830		Zones
831	IIOAC	Integrated Indoor Outdoor Air Calculation
832	IUR	Inhalation unit risk
833	K _{OA}	Octanol-air partition coefficient

834	Koc	Organic carbon-water partition coefficient
835	Kow	Octanol-water partition coefficient
836	LADC	Lifetime average daily concentrations
837	LCD	Life cycle diagram
838	LOD	Limit of detection
839	MOE	Margin of exposure
840	MDL	Method detection limit
841	MLE	Maximum likelihood estimation
842	NAAQS	National Ambient Air Quality Standard
843	NAICS	North American Industry Classification System
844	ND	Non-detect
845	NEI	National Emissions Inventory
846	NESHAP	National Emission Standard for Hazardous Air Pollutants
847	NIOSH	National Institute for Occupational Safety and Health
848	NIST	National Institute of Standards and Technology
849	NPDES	National Pollutant Discharge Elimination System
850	OCSPP	Office of Chemical Safety and Pollution Prevention (EPA)
851	OECD	Organisation for Economic Co-operation and Development
852	OEL	Occupational exposure limits
853	OES	Occupational exposure scenario
854	ONU	Occupational non-user
855	OPPT	Office of Pollution Prevention and Toxics (EPA)
856	OSHA	Occupational Safety and Health Administration (U.S.)
857	PESS	Potentially exposed or susceptible subpopulations
858	POD	Point of departure
859	PBZ	Personal breathing zone
860	PEL	Permissible exposure limits
861	POD	Point of departure
862	POTW	Publicly owned treatment works
863	PPE	Personal protective equipment
864	PPS	Polyphenylene sulfide
865	PV	Production volume
866	RCRA	Resource Conservation and Recovery Act
867	RfC	Reference concentration
868	SCC	Source Classification Code
869	SDS	Safety data sheet
870	SEG	Similar exposure group
871	SIC	Standard Industrial Classification
872	SOC	Standard Occupational Classification
873	SUSB	U.S. Census' Statistics of US Businesses
874	TLV	Threshold limit value
875	TRI	Toxics Release Inventory
876	TSCA	Toxic Substance Control Act
877	TWA	Time-weighted average
878	U.S.	United States
879	VOC	Volatile organic compound
880	WQP	Water Quality Portal
881	WWT/P	Wastewater treatment (plant)
882	WQX	Water Quality Exchange

SUMMARY

This draft technical summary document (TSD) is part of the Toxic Substances Control Act (TSCA) *Draft Risk Evaluation for o-Dichlorobenzene* ([U.S. EPA, 2026aa](#)) (see Appendix C the draft risk evaluation for a complete list of all TSDs and supplemental files).

The U.S. Environmental Protection Agency (EPA or the Agency) considered all reasonably available information identified through the TSCA systematic review process ([U.S. EPA, 2026ab](#)) to characterize the physical and chemical properties of *o*-dichlorobenzene as well as the environmental fate and transport of *o*-dichlorobenzene. The following points summarize the chemical properties and expected fate, releases, and exposures of *o*-dichlorobenzene in the environment.

Chemical Properties and Environmental Fate

- *o*-Dichlorobenzene is a clear-to-pale, yellow liquid with a pleasant, aromatic odor; it exists in a liquid phase at ambient temperatures.
- It has low-to-moderate solubility in aqueous systems (solubility = 141 mg/L). Partitioning values for *o*-dichlorobenzene indicate low-to-moderate sorption to soil, sediment, or organic matter (log K_{OC} = 2.45 and log K_{OW} = 3.38).
- *o*-Dichlorobenzene is a moderately volatile organic compound with a boiling point of 180.2 °C and a vapor pressure of 1.35 mm Hg. When released to water or soil, volatilization to the surrounding atmosphere is the primary removal mechanism.
- It has moderate persistence in air ($t_{1/2}$ = 38 days), aerobic soils or sediment ($t_{1/2}$ $\approx$ 30 days), and water ($t_{1/2}$ $\approx$ 12.8 days) with limited partitioning among media once in the environment. Although it may persist in anaerobic environments due to limited biodegradation, it is unlikely to be found in such media.
- There is low potential for *o*-dichlorobenzene to bioaccumulate (log BCF = 1.9), with BCF (bioconcentration factor) estimates ranging from 0.22 to 19,700. Depuration (*i.e.*, elimination) is expected to be rapid ([Oliver and Niimi, 1983](#); [Barrows et al., 1980](#); [Veith et al., 1980](#)), limiting any sustained concentrations in organisms within the environment.
 - Because concentrations of *o*-dichlorobenzene in soil, sediment, and water are negligible, limited environmental exposure is expected; thus, no trophic transfer is expected.

Environmental Releases

- In 2024, approximately 38% of *o*-dichlorobenzene was released to air (18.5% stack release, 19.5% fugitive release) and 17.8% was released to land via Class I underground injection with another 44.2% transferred to other locations including Resource Conservation and Recovery Act (RCRA) Subtitle C landfills.
 - Given this release pattern, coupled with environmental fate dynamics, air is expected to be the primary pathway of concern for *o*-dichlorobenzene in the environment.
- Accounting for less than 1% total *o*-dichlorobenzene environmental releases, water releases were assessed using reported Toxics Release Inventory (TRI) and Discharge Monitoring Report (DMR) releases from 2019 to 2023. The maximum annual discharge reported across sites and years was 107 kg/yr.

General Population Exposure

For general populations, the routes of exposure considered were ambient air inhalation and oral exposure via drinking water ingestion.

- Ambient air concentrations were modeled using the Indoor-Outdoor Air Calculator (IIOAC) based on facility releases reported to TRI between 2019 to 2023.
- The 95th percentile ambient air modeled concentrations across all facilities, reporting years, and modeled distances (100, 100–1,000, and 1,000 m) ranged from 0.0 to 26.2 $\mu\text{g}/\text{m}^3$, with the highest concentrations at 100 m from facility releases.
- Acute margin of exposures (MOEs) were calculated using the 50th and 95th percentile modeled concentrations and the acute human equivalent concentration (HEC) compared to a benchmark of 30.
- All non-cancer, screening-level risk estimates were above the non-cancer benchmark for acute exposures. Therefore, there is no expectation of non-cancer risks to the general population from TRI facility releases based on this screening-level assessment.
- Drinking water concentrations were extracted from systematic review with the highest concentrations reported of 13.3 and 95 $\mu\text{g}/\text{L}$ in surface water and groundwater, respectively. Drinking water doses were calculated for adults and infants (birth to <1 month) using the EPA *Exposure Factors Handbook* ([U.S. EPA, 2011b](#)) for drinking water intake and body weight.
- Acute margins of exposure (MOEs) were calculated using the acute human equivalent dose (HED) and compared to a benchmark of 30. Both adult and infant acute MOEs were above the benchmark. Therefore, there is no expectation of non-cancer risks to the general population from treated drinking water or to subpopulations that use untreated surface water or groundwater as a primary source of drinking water.

Consumer Exposure

- For consumer uses, *o*-dichlorobenzene is primarily used for its solvent properties in paint thinners and sheep branding fluid (0.30 weight fraction), glazes, lubricants, and septic tank cleaners (0.99 weight fraction).
 - Sheep branding fluid is a washable paint used to temporarily identify sheep on a farm. Septic tank cleaner is a liquid flushed down the toilet to cleanse residential septic tanks. There are also small amounts reported in toilet bowl deodorizers (0.01 weight fraction).
 - This preliminary assessment evaluates human exposure to *o*-dichlorobenzene in consumer products resulting from five conditions of use (COUs) as defined under TSCA.
 - One product (Marvel Mystery Oil) falls under both the lubricants and greases as well as the fuels and related products COU; however, Marvel Mystery Oil was only evaluated under the lubricants and greases COU.
 - The major routes of exposure considered are inhalation and dermal exposure. The exposure durations used are acute (1 day), intermediate (30 days), and chronic (1 year).
- EPA used the Consumer Exposure Model (CEM) and the Indoor Environmental Concentrations in Buildings with Conditioned and Unconditioned Zones (IECCU) Model to assess acute and chronic inhalation exposures to individuals using consumer products containing *o*-dichlorobenzene.
- Dermal modeling used fractional absorption and flux-based permeability methods. Bystanders

were not evaluated because they are expected to receive less inhalation exposure than the users. Dermal exposure was not evaluated for bystanders as they are not direct users of the product.

- EPA evaluated the highest reported weight fractions and representative exposure scenarios for each COU. If results from these scenarios indicated an associated risk of concern, the Agency may conduct an additional sensitivity analysis to determine at what level, if any, risk of concern may occur.
 - The acute air concentrations ranged from 7.3×10^{-4} to 29×10^{-2} mg/m³ and 6.5×10^{-6} to 8.0×10^{-2} mg/m³ for chronic, with septic tank cleaners being the highest for both acute and chronic. Dermal doses were also highest for both acute and chronic exposures for septic tank cleaners.
- Overall, confidence in the inhalation exposure modeled results ranged from moderate-to-robust, depending on the specific product and exposure scenario evaluated.

Occupational Exposure

EPA evaluated acute, intermediate, and chronic non-cancer exposures to workers. The Agency mapped 24 applicable COUs to 20 occupational exposure scenarios (OESs) based on data and information gathered during systematic review, industry outreach, and public comments. Each OES is developed based on a set of occupational activities and operational conditions such that similar occupational exposures are expected from the use(s) covered under the OES.

- To assess occupational exposure, EPA used monitoring data applicable to the chemical and the OES. If no monitoring data was available, the Agency used analogous and surrogate data to estimate exposure or conducted exposure modeling. Analogous data is from the same chemical but from a different OES expected to result in similar exposure. Surrogate data is from a different chemical for read across, based on similarity in structure, physical-chemical fate properties, and toxicity.
 - In this draft assessment, EPA used inhalation monitoring data from test orders and literature sources, as well as analogous data, surrogate data, and modeling.
- EPA evaluated inhalation and dermal exposures to worker populations for each OES and used inhalation monitoring data for 14 of the 20 OESs. Directly applicable monitoring data were used for six OESs, analogous data from other OESs were used for two OESs. Surrogate data from other chemicals were used for six OESs.
 - For three OESs (Sheep Branding Fluid and Septic Tank Cleaners), EPA's CEM was adjusted for occupational use because no monitoring data were available. One OES (air care products) used IECCU.
 - Probabilistic modeling was performed for one OES (Use of Lubricants and Greases), and GS/ESDs were used to assess exposures for two OESs (Use of Paints and Coatings and Use of Fuels and Related products).
 - Dermal exposure was modeled for all OESs that received a quantitative assessment using fraction absorbed values from test order data on *p*-dichlorobenzene, an isomer of *o*-dichlorobenzene, and therefore an appropriate chemical surrogate based on structural similarity ([Charles River Laboratories, 2025](#)).
- Both inhalation and dermal exposures to *o*-dichlorobenzene are highest during Repackaging and Processing OESs (Processing as a Reactant; Incorporation into Soap, Cleaning Compound, and Toilet Preparation Manufacturing; and Incorporation into Formulation, Mixture, or Reaction Product) and some commercial use OESs such as Use of Paints and Coatings, Use of Cleaning

and Furnishing Care Products, and Use of Other Cleaning Products.

- Uncertainties exist with the monitoring and modeling approaches used to assess *o*-dichlorobenzene occupational exposures. For example, EPA used generic models and default input parameter values when site-specific data were not available, or surrogate monitoring data when directly applicable data were not available.
 - Furthermore, site-specific differences in use practices and engineering controls exist, but are largely unknown, which represent another source of variability that EPA could not quantify in the assessment.
 - Finally, EPA used surrogate inhalation monitoring data from the risk evaluation for *p*-dichlorobenzene for certain OESs where there are no available monitoring data that are specific to *o*-dichlorobenzene. Uncertainties specific to the use of surrogate data are discussed in Sections 8.1.3.2.1 and 8.3.

1 INTRODUCTION

This draft TSD presents the chemistry, fate, release, and exposure assessment (also referred to as the “draft exposure TSD”) in support of the TSCA *Draft Risk Evaluation for o-Dichlorobenzene* (also referred to as the “[o-dichlorobenzene] draft risk evaluation”) ([U.S. EPA, 2026aa](#)). The draft risk evaluation was conducted under the Frank R. Lautenberg Chemical Safety for the 21st Century Act, which amended TSCA on June 22, 2016, and includes statutory requirements and deadlines for actions related to conducting risk evaluations of existing chemicals.

Under TSCA section 6(b), EPA must designate chemical substances as high-priority substances for risk evaluation or low-priority substances for which risk evaluations are not warranted at the time. Upon designating a chemical as a high priority, the Agency must initiate a risk evaluation on the substance. TSCA section 6(b)(4) directs EPA to conduct risk evaluations for existing chemicals to “determine whether a chemical substance presents an unreasonable risk of injury to health or the environment, without consideration of costs or other nonrisk factors, including an unreasonable risk to a potentially exposed or susceptible subpopulation identified as relevant to the risk evaluation by the Administrator under the conditions of use [COUs].”

TSCA section 6(b)(4)(D) and implementing regulations require that EPA publish the scope of the risk evaluation to be conducted—including the hazards, exposures, conditions of use and potentially exposed or susceptible subpopulations (PESS) that the Administrator expects to consider—within 6 months after the initiation of a risk evaluation. In addition, a draft scope is to be published pursuant to 40 CFR 702.43. In December 2019, EPA published a list of 20 chemical substances that have been designated high priority substances for risk evaluations (Docket ID: [EPA-HQ-OPPT-2018-0444](#)) (84 FR 71924, December 30, 2019), as required by TSCA section 6(b)(2)(B), which initiated the risk evaluation process for those chemical substances. *o*-Dichlorobenzene is one of the chemicals designated as a high priority substance for risk evaluation.

This draft TSD discusses the physical and chemical properties, environmental fate and transport, and exposure (environmental, occupational, consumer) of *o*-dichlorobenzene. The draft risk evaluation will summarize the results of this assessment/TSD and integrate the results with the hazard estimates to produce quantitative and qualitative risk estimates for all COUS under TSCA.

2 PHYSICAL AND CHEMICAL PROPERTY ASSESSMENT

2.1 Approach and Methodology for Physical and Chemical Property Assessment

EPA gathered and evaluated physical and chemical property data and information according to the process described in the *Draft Systematic Review Protocol Supporting TSCA Risk Evaluations for Chemical Substances, Version 1.0: A Generic TSCA Systematic Review Protocol with Chemical-Specific Methodologies* (also called the “[2021] Draft Systematic Review Protocol”) ([U.S. EPA, 2021a](#)). During the evaluation of *o*-dichlorobenzene, EPA considered both measured and estimated physical and chemical property data.

2.2 Final Selected Physical and Chemical Property Values for *o*-Dichlorobenzene

The systematic review process identified multiple data with high-quality ratings for the physical and chemical properties of *o*-dichlorobenzene ([U.S. EPA, 2026ab](#)). Most of the data were collected under standard environmental conditions (*i.e.*, 20–25 °C and 760 mm Hg). These data are presented in Table 2-1.

Table 2-1. Summary of Physical and Chemical Property Values for *o*-Dichlorobenzene

Property	Selected Value(s)	Reference(s)	Data Quality Rating
Molecular formula	C ₆ H ₄ Cl ₂	–	–
Molecular weight	147.00 g/mol	–	–
Physical form	Pale yellow liquid with pleasant, aromatic odor	Rumble (2018c) , RSC (2019)	High
Melting point	–17.2 °C	U.S. EPA (2019b)	High
Boiling point	180.2 °C	Rumble (2018c)	High
Density	1.301 g/cm ³ at 25 °C	Baragi et al. (2005)	High
Vapor pressure	1.35 mm Hg at 25°C	Rumble (2018a)	High
Vapor density	5.05 (air = 1) (unitless)	NLM (2014)	High
Water solubility	141 mg/L at 23 °C	Eurofins EAG Agrosience LLC (2022)	High
Octanol/water partition coefficient (log K _{ow})	3.38 (unitless)	Rumble et al. (2018)	High
Henry’s Law constant	1.9E–03 atm·m ³ /mol	OECD (2001b)	High
Flash point	68 °C	OECD (2001b)	High
Autoflammability	648 °C	Rumble (2018a)	High
Viscosity	1.324 centipoise (cP) at 25 °C	Rumble (2018b)	High
Refractive index	1.5515 at 20 °C	Rumble (2018c)	High
Dielectric constant	9.82 at 20 °C	Elsevier (2019)	High

To determine specific values for each parameter in Table 2-1, priority was given to data from expert-curated, peer-reviewed databases that have been identified as “trusted sources” as detailed in the 2021 Draft Systematic Review Protocol ([U.S. EPA, 2021a](#)). Where no data were available from trusted

databases, second preference was given to measured data from studies that implement experimental measurements according to established test guidelines or which are conducted according to accepted standard analytical methods, including but not limited to OECD guidelines or other developed standards with sufficient documentation.

2.2.1 Molecular Formula and Weight

The molecular formula of *o*-dichlorobenzene is $C_6H_4Cl_2$; the molecular weight is 147 g/mol. This value was not obtained by systematic review but rather was calculated from the known molecular formula. The uncertainty in this value is inherent to molecular weight determination from atomic masses and is negligible.

2.2.2 Physical Form

o-Dichlorobenzene is a liquid under ambient conditions (*i.e.*, at $\approx 20^\circ\text{C}$ and 760 mm Hg), which is consistent with the recorded melting and boiling point values listed in Table 2-1. Qualitative reports are consistent in describing it as clear-to-pale yellow in color and having a pleasant, aromatic odor ([RSC, 2019](#); [Rumble, 2018c](#)).

2.2.3 Melting and Boiling Point

Systematic review identified 13 high-quality melting point data (12 individual values and 1 data range), covering -18.0 to -14°C . The melting point geometric mean of the 12 values is $-17.16 \pm 0.32^\circ\text{C}$. The data range spans -17.6 to -14°C . A final value of -17.2°C ([U.S. EPA, 2019b](#)) was selected as the boiling point of *o*-dichlorobenzene because it aligns with the geometric mean. There is little uncertainty in the value selection for this property.

Systematic review identified 14 total high-quality boiling point data (14 individual data points and 1 data range), covering 178.1 to 181°C . The boiling point geometric mean of the 14 values is $180.0 \pm 0.85^\circ\text{C}$. The data range spans 179.2 to 181°C . The value identified in the *Final Scope of the Risk Evaluation for o-Dichlorobenzene; CASRN 95-50-1* ([U.S. EPA, 2020d](#)), 180.2°C ([Rumble, 2018c](#)) was selected because it aligns with the geometric mean. There is little uncertainty in the value selection for this property.

2.2.4 Density

Systematic review identified 14 high quality density data (12 individual values and 2 data ranges), covering 1.29 to 1.34 g/cm^3 . The density geometric mean of the twelve values is $1.3031 \pm 0.0030\text{ g/cm}^3$. The data ranges span 1.2934 to 1.3425 g/cm^3 . The value identified in the *Final Scope of the Risk Evaluation for o-Dichlorobenzene* ([U.S. EPA, 2020d](#)), 1.3009 g/cm^3 ([Baragi et al., 2005](#)), was selected because it aligns well with the geometric mean. There is little uncertainty in the value selection for this property.

2.2.5 Vapor Density

Systematic review identified four high-quality vapor density data covering 5.05 to 5.1 (relative to air = 1). Of those data, three specify the vapor density as 5.05 . The geometric mean of the four data points is 5.06 ± 0.025 . The value identified in the *Final Scope of the Risk Evaluation for o-Dichlorobenzene; (U.S. EPA, 2020d)*, 5.05 ([NLM, 2014](#)), was selected because it aligns with the geometric mean and is consistent with majority of the data. There is little uncertainty in the value selection for this property.

2.2.6 Vapor Pressure

Vapor pressure systematic review identified eight high-quality vapor pressure data ranging from 1.0 to 1.56 mm Hg , measured at room temperature (20 – 25°C). The geometric mean of the eight data points is

1.33 ± 0.17. A final value of 1.35 mm Hg at 25°C ([Rumble, 2018a](#)) was selected because it aligns with the geometric mean. There is little uncertainty in the value selection for this property.

2.2.7 Water Solubility

Systematic review identified 11 high-quality water solubility data (10 individual values and 1 data range) at room temperature (20–25°C), ranging from 92.3 to 170.0 mg/L. The geometric mean of the 10 values is 130.98 ± 27.19 mg/l. The single range spans 92.3 to 170.0 mg/L. A final value of 141.0 mg/L at 23 °C ([Eurofins EAG Agrosience LLC, 2022](#)) was selected as the water solubility for *o*-dichlorobenzene because it closely aligns with the geometric mean. There is little uncertainty in the value selection for this property.

2.2.8 Octanol/Water Partition Coefficient (Log Kow)

Systematic review identified 10 high quality octanol:water partition coefficient data (9 individual values and 1 data range) ranging from 3.00 to 3.56. The geometric mean of the nine values is 3.38 ± 0.16. The single range spans 3.28 to 3.42. A final value of 3.38 ([Rumble et al., 2018](#)) was selected because it aligns with the geometric mean. There is little uncertainty in the value selection for this property.

2.2.9 Henry's Law Constant

Systematic review identified six high-quality Henry's Law coefficient data covering 1.5×10⁻³ to 2.9×10⁻³ atm-m³/mol. The geometric mean of the six values is 1.9×10⁻³ atm-m³/mol. A final value of 1.9×10⁻³ atm-m³/mol ([OECD, 2001b](#)) was selected because it most closely aligns with the geometric mean. There is little uncertainty in the value selection for this property.

2.2.10 Flash Point

Systematic review identified 11 high-quality flash point data ranging from 66 to 74 °C. The geometric mean of the eleven values is 67.7 ± 2.6 °C. A final value of 68 °C ([OECD, 2001b](#)) was selected because it most closely aligns with the geometric mean. There is little uncertainty in the value selection for this property.

2.2.11 Autoflammability

Systematic review identified four total autoflammability data covering 640 to 648 °C. The geometric mean of the four values is 646 ± 4 °C. As the *CRC Handbook of Chemistry & Physics* is a trusted source, 648 °C ([Rumble, 2018a](#)) was selected because it is rated high-quality and aligns most closely with the mean of the data. There is little uncertainty in the value selection for this property.

2.2.12 Viscosity

Systematic review identified four high quality viscosity data (3 individual data points and 1 data range) covering 1.272 to 2.8 centipoise (Cp) at 25 °C. The three values were 1.324 cP, therefore a final value of 1.324 cP at 25 °C ([Rumble, 2018b](#)) was selected. There is little uncertainty in the value selection for this property.

2.2.13 Refractive Index

Systematic review identified five high-quality refractive index data (4 individual values and 1 data range) covering 1.54 to 1.57. The geometric mean of the four values is 1.5500 ± 0.0010. The data range spans 1.54 to 1.57 at room temperature (20–25°C). A final value of 1.5515 at 20 °C ([Rumble, 2018c](#)) was selected because it aligns with the geometric mean. There is little uncertainty in the value selection for this property.

2.2.14 Dielectric Constant

Systematic review identified seven high-quality viscosity data at room temperature (20–25 °C), ranging from 7.5 to 12.12. The geometric mean of the seven values is 9.81 ± 1.36 . A final value of 9.82 at 20 °C ([Elsevier, 2019](#)) was selected as the dielectric constant for *o*-dichlorobenzene because it closely aligns with the mean. There is little uncertainty in the value selection for this property.

2.3 Strengths, Limitations, Assumptions, and Key Sources of Uncertainty for the Physical and Chemical Property Assessment

The general confidence in the physical and chemical properties for *o*-dichlorobenzene is high. Measured data were identified from high-quality studies for all physical and chemical properties. The physical and chemical property data discussed in this draft assessment/TSD were the product of a systematic review of reasonably available information ([U.S. EPA, 2026ab](#)). Overall, there is little uncertainty in the physical and chemical data and analyses presented and there is high confidence in the data. The analysis presents the average and standard deviation of all data collected through the systematic review process for each parameter. The standard deviation is reported as uncertainty in the form of tolerance limits ($\pm$ range) on the average value. Data extracted as a range of values were excluded from the calculations unless expert judgment could identify precise data points within the range. These statistical analyses may be indicative of the amount of uncertainty related to different instrumental techniques or other experimental differences between the studies used to generate the data. Additional sources of uncertainty in these reported values may be inherent to the measurement of the data point itself (*e.g.*, sources of uncertainty or measurement error related to the instrumental method, precision with which a data point is measured and reported in the data source). Finally, all data was assumed to be collected under standard environmental conditions (*i.e.*, 20–25 °C and 760 mmHg) unless otherwise specified.

3 FATE AND TRANSPORT ASSESSMENT

3.1 Approach And Methodology for Fate and Transport Assessment

Reasonably available environmental fate data, including biotic and abiotic biodegradation rates, removal during wastewater treatment, volatilization from lakes and rivers, and organic carbon:water partition coefficient (log K_{OC}), were used to evaluate environmental fate and transport (Table 3-1). In assessing the environmental fate and transport of *o*-dichlorobenzene, EPA considered the full range of results from sources that were rated high- and medium-quality. Details on the rating criteria are contained in the 2021 Draft Systematic Review Protocol ([U.S. EPA, 2021a](#)). Information on the full extracted data sets are available in the supplemental file: *Data Quality Evaluation and Data Extraction Information for Environmental Fate and Transport Studies for o-Dichlorobenzene* ([U.S. EPA, 2026l](#)) and *Data Quality Evaluation and Data Extraction Information for Physical and Chemical Properties for o-Dichlorobenzene* ([U.S. EPA, 2026m](#)). Environmental fate estimates were also based on modeling results from EPI Suite™ ([U.S. EPA, 2012](#))—a predictive tool for physical, chemical, and environmental fate properties. EPI Suite™ was reviewed by the EPA Science Advisory Board ([SAB, 2007](#)) and the individual models that comprise EPI Suite™ have been peer reviewed through publication in technical journals. Citations for the supporting manuscripts are available in the EPI Suite™ help files.

3.1.1 EPI Suite™ Model Inputs and Settings

To parameterize EPI [Estimation Programs Interface] Suite™ for estimating environmental fate properties of *o*-dichlorobenzene, the physical and chemical properties were input based on the values listed in Table 2-1. EPI Suite™ was then run using default settings. Appendix C provides the EPI Suite™ input and output used in this draft assessment/TSD.

3.1.2 Evidence Integration for Fate and Transport Properties of *o*-Dichlorobenzene

EPA gathered and evaluated physical and chemical property data and environmental fate information according to the process described in the 2021 Draft Systematic Review Protocol ([U.S. EPA, 2021a](#)). During the evaluation of *o*-dichlorobenzene, EPA considered both measured and estimated data and information as applicable. Information and full extracted data sets are available in the supplemental file *Data Quality Evaluation and Data Extraction Information for Environmental Fate and Transport Studies for o-dichlorobenzene* ([U.S. EPA, 2026l](#)) and data evaluation information is available in the supplemental file *Data Quality Evaluation and Data Extraction Information for Physical and Chemical Properties for o-Dichlorobenzene* ([U.S. EPA, 2026m](#)). The values selected are based on an overall judgement of the strength of the scientific evidence and conclusions regarding the properties and fate of *o*-dichlorobenzene (Table 3-1). All judgments about the strength of the evidence are based upon consideration of consistency, study design, study conditions, and uncertainty.

Table 3-1. Final Environmental Fate and Transport Characteristics of *o*-Dichlorobenzene

Property or Endpoint	Selected Value(s)	Reference(s)	Data Quality Rating
Direct photodegradation	Stable; not expected to undergo direct photolysis in the environment due to the lack of chromophores that absorb at wavelengths >290 nm	Kochany and Bolton (1992)	High

Property or Endpoint	Selected Value(s)	Reference(s)	Data Quality Rating
Indirect photodegradation (Air)	12.1–13.4 days from $\cdot\text{OH}$ rate constant, $k = 4.2 \pm 0.2\text{E-}13 \text{ cm}^3/\text{molecule-second}$ at $20.85 \pm 1 \text{ }^\circ\text{C}$ (assuming 12-hour day, $1.5\text{E}06 \text{ } \cdot\text{OH}/\text{cm}^3$)	Wahner and Zetzsch (1981)	High
Hydrolysis	Stable; not expected to undergo hydrolysis in the environment due to the lack of hydrolysable functional groups	U.S. EPA (2009)	Medium
Photolysis in water	Not significant	Rathbun (1998)	Medium
Biodegradation in water	54 days (aerobic, groundwater, experimental)	Dermietzel and Vieth (2002)	High
	25 days (aerobic, aquifer)	Wilson et al. (1987)	High
	7 days (aerobic); 29–66% at 5 mg/L, 18–59% (at 10 mg/L)	(Tabak et al., 1981)	High
	23.1 days (aerobic, sandy aquifer)	Nielsen et al. (1996)	High
Biodegradation in sediment/soils	11.6–34.7 days (aerobic, sandy aquifer, experimental)	Nielsen et al. (1996)	High
	39.5 days (aerobic, sandy aquifer)	Nielsen and Christensen (1994)	High
	No significant aerobic biodegradation (aerobic soil)	Brunsbach and Reineke (1994)	High
	36.9 days (anaerobic, river sediment)	Masunaga et al. (1996a)	High
	36.9 days (anaerobic, river sediment)	Susarla et al. (1998)	High
	No anaerobic biodegradation (WWTP sludge)	Kirk et al. (1989)	High
	Transformation <25% under aerobic and anaerobic conditions (experimental)	Kuhn et al. (1985)	High
Wastewater treatment	3.72 days (aerobic)	Davis et al. (1981)	Medium
	>99.9% removal; 22% stripping, 0% sorption, 78% biodegradation (complete mix activated sludge)	Kincannon et al. (1983)	High
	Mean % removal in 6 municipal WWTP = 87% (67–97% range)	Van Luin and Van Starkenburg (1985)	Medium
	No anerobic degradation	Kirk et al. (1989)	High
	35% removal (poor removal), biodegradation rate coeffect (K_b) = 0.018 min^{-1} volatilization rate coefficient (K_v) =	Weber et al. (1987)	High

Property or Endpoint	Selected Value(s)	Reference(s)	Data Quality Rating
	0.025 min ⁻¹		
	65% BOD removal; 60% suspended solid removal	Union Carbide (1974)	Medium
BOD = biological oxygen demand; WWT = wastewater treatment plant			

3.2 Partitioning

Partitioning values indicate low to moderate sorption to soil, sediment ($\log K_{OC} = 2.45$), or organic matter ($\log K_{OW} = 3.38$) (Table 3-2). A Henry's Law constant of 0.0019 atm·m³/mol at 25 °C indicates rapid volatilization from surface water and soil surfaces. Because *o*-dichlorobenzene absorbs to sediment and soils, it has minimal partitioning to water. *o*-Dichlorobenzene minimally partitions from the media in which it is released. Thus, air is expected to be the major pathway of concern for *o*-dichlorobenzene in the environment.

Table 3-2. Partitioning Coefficients for *o*-Dichlorobenzene

Parameter	Value	Log Value	Reference	Predominant Phase
Octanol:Water (K_{OW})	2,692	3.433	Sabljić et al. (1993)	Organic carbon
	2,818	3.45	Paschke et al. (1998)	
	1,906–2,630	3.28–3.42	Elsevier (2019)	
	2,399	3.38	Rumble et al. (2018)	
	2,630	3.42	Verbruggen et al. (1999)	
	2,399	3.38	Wasik et al. (1983)	
	1,950	3.29	Bahadur et al. (1997)	
Organic Carbon:Water (K_{OC})	1,000–7,943	3.0–3.9	Masunaga et al. (1991)	Organic carbon
	280–3,200	2.45–3.51	Stauffer et al. (1989)	
	282	2.45	OECD (2001b)	
	385	2.585	Stauffer and Macintyre (1986)	
	4,898	3.69	Masunaga et al. (1996b)	
	1,000	3.0	Watts and Moore (1988)	
	977	2.99	Walton et al. (1992)	
Octanol:Air (K_{OA})	34,674	4.54	U.S. EPA (2010)	Organic carbon
Air:Water (K_{AW})	0.0785	–1.105	U.S. EPA (2019b)	Water
	0.0624	–1.205	NLM (2014)	
	0.0642	–1.192	Ashworth et al. (1988)	

Partitioning coefficients were measured across variable temperatures. The K_{OC} had the widest range of reported measurements (385–7,943), which suggests there is likely some partitioning from surface water to sediment. Migration from surface water to groundwater is also possible though likely negligible given competing volatilization. The K_{OW} and K_{OC} suggest that *o*-dichlorobenzene will partition to organic matter in the environment but could still be mobile in aquatic environments. The octanol:air partition coefficient, K_{OA} , suggests that some *o*-dichlorobenzene will minimally partition to air. The K_{AW}

indicates that there is not a strong tendency of *o*-dichlorobenzene to partition out of air to water or vice versa.

3.2.1 Fugacity Modeling

EPA ran the Level III Fugacity Model in EPI Suite™ (U.S. EPA, 2012) to predict how environmental releases of *o*-dichlorobenzene partition between environmental media compartments (air, water, soil, sediment). It is a steady-state, non-equilibrium model that includes the processes of degradation, advection (flow out of the evaluative environment) and intermedia transfer. Physical and chemical properties used as input to the model are described in Section 2 and summarized in Table 2-1. Additionally, environmental fate properties from Table 3-1 were also used as input to the model. The model was run holding the environmental release steady at a default rate of 1,000 kg/hour but varying the receiving medium (*i.e.*, air, water, soil). Releases were modeled for 1,000 kg/hour simultaneously to air, soil, and water (33% of release each) and 1,000 kg/hour released only to air, soil, or water (100% of release each). Additionally, TRI releases for 2018 (45% of release to air; 55% release to soil) were modeled (U.S. EPA, 2026b, u, 2026ad); TRI data indicated that there were no releases to water from 2021 to 2023. Rather, 19.5% of releases were to air via fugitive emissions; 18.5% to air via stack emissions; 18% release to land via underground injection, and 44.2% release to other off-site locations (*i.e.*, transfer to landfills).

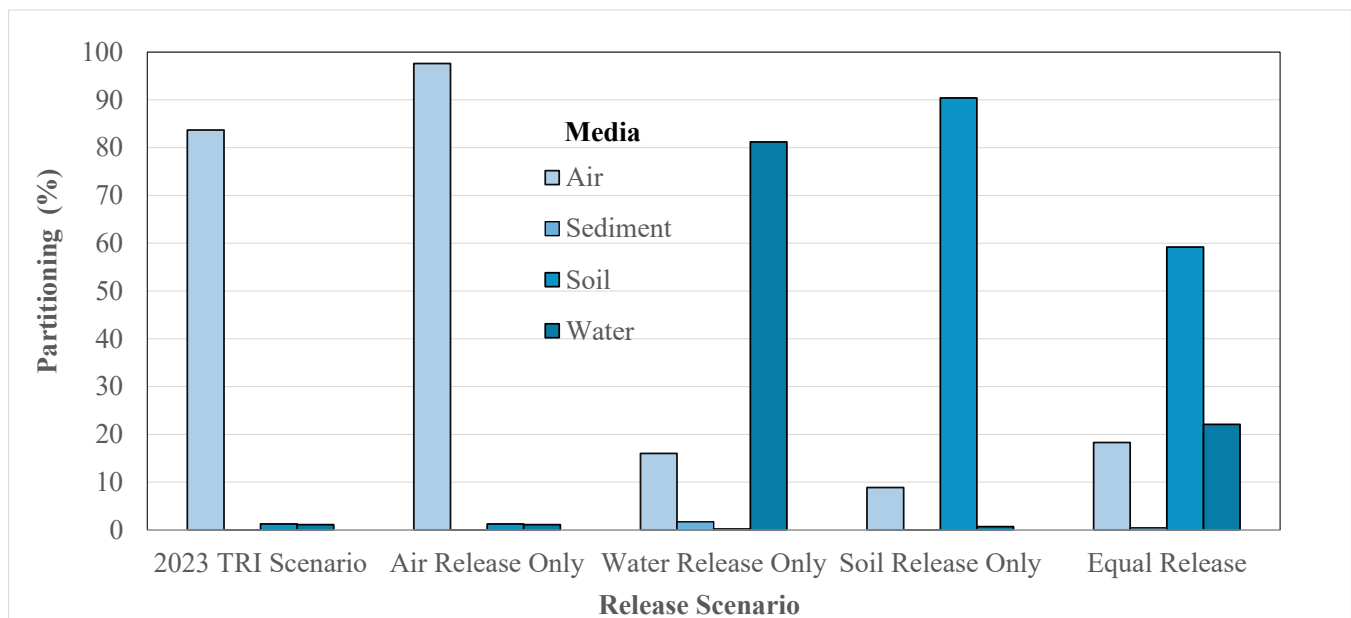


Figure 3-1. EPI Suite™ Level III Fugacity Modeling for *o*-Dichlorobenzene Showing Partitioning from Different Media Release Scenarios Assuming Constant Release

Modeling used half-life values of 30 days in air, 22 days in water, and 44 days in soil.

The fugacity modeling supports that *o*-dichlorobenzene will minimally partition out of release media. If released as air emissions, *o*-dichlorobenzene will predominantly stay in air; if released to water or soil, *o*-dichlorobenzene will predominantly stay in water or soil, respectively (assuming constant release). Thus, minimal partitioning among media is expected. Based on the expected emissions identified in the *Final Scope of the Risk Evaluation for o-Dichlorobenzene* (U.S. EPA, 2020d), approximately 56% of *o*-dichlorobenzene is released to land and about 44% is released to air with only small releases to water ($\approx 0.01\%$). Therefore, *o*-dichlorobenzene is expected to primarily be in soil and air. However, release to soil (*i.e.*, land) is through underground injection and landfills which are assumed to be impermeable. There are no direct releases to land. Class I Injection Wells are required to be designed and constructed

to prevent movement of injected waste streams into any additional pathways, including drinking water systems or other water pathways. The fugacity modeling from EPI Suite™ supports the classification of air as the major compartment for *o*-dichlorobenzene given the disposal pattern documented by TRI. Although air deposition to soil and water may occur, it is not expected to be significant given that *o*-dichlorobenzene is not a solid at ambient temperatures.

Once in the environment, *o*-dichlorobenzene is not expected to undergo rapid (*i.e.*, within hours) degradation in air, water, soil, or sediment. Based on results from EPI Suite™ BIOWIN, little biodegradation in aerobic or anaerobic sediments and soils is expected (not readily biodegradable; half-life greater than one month). Furthermore, there is relatively slow reaction with hydroxyl radicals ($t_{1/2} = 13.33$ days, AOPWIN) and no hydrolysable functional groups. These metrics further indicate *o*-dichlorobenzene may be persistent in the environment. Due to the physical and chemical properties of *o*-dichlorobenzene (Table 2-1), it is expected to volatilize from soil and other surfaces. Furthermore, there is low to moderate potential for sorption to organic matter ($K_{OC} = 2.45$). There is some potential for long-range transport in air given the limited degradation pathways and persistence in air. The characteristic travel distance (CTD) informs the potential for long-term transport. The CTD was calculated at 12,478 km using the Level III Fugacity Model in EPI Suite™. *o*-Dichlorobenzene is expected to remain largely in the vapor phase.

3.3 Transformation Processes

o-Dichlorobenzene can undergo various transformation processes in environmental media that affect persistence and retention within the environment. Transformation processes include biodegradation, photolysis, and hydrolysis. Potential anaerobic transformation products include chlorobenzene and benzene; potential aerobic transformation products include dichlorocatechols, chloroacids, and simple acids.

3.3.1 Biodegradation

In general, *o*-dichlorobenzene is minimally biodegradable in water, sediment, and soils. With abundant nutrients, some *o*-dichlorobenzene may biodegrade in water under aerobic conditions. Two high-quality studies measuring biodegradation in water under aerobic conditions yielded degradation half-lives of 54 days ([Dermietzel and Vieth, 2002](#)) and 25 days ([Wilson et al., 1987](#)) (mean = 40 ± 21 days). Both studies were further supported by aerobic degradation in water measured by Tabak ([1981](#)) and Nielsen ([1996](#)). In sediments, some biodegradation might also occur in aerobic environments, but results are inconsistent and likely based on the microbial community. For example, *o*-dichlorobenzene half-life (39.5 days) was measured in aerobic sediments from a sandy aquifer ([Nielsen and Christensen, 1994](#)). However, another high-quality study in aerobic soils yielded no significant biodegradation ([Brunsbach and Reineke, 1994](#)). When sediments or soils are anaerobic, minimal measurable biodegradation occurs (*i.e.*, half-life >1 month, see ([U.S. EPA, 2008](#))) ([Kirk et al., 1989](#); [Kuhn et al., 1985](#); [Tabak et al., 1964](#)). Importantly, several studies suggested that microbial acclimation to *o*-dichlorobenzene is likely with some microbial organisms having a higher affinity for *o*-dichlorobenzene ([Susarla et al., 1998](#); [Kuhn et al., 1985](#); [Union Carbide, 1974](#)).

3.3.2 Photolysis and Hydrolysis

o-Dichlorobenzene is not expected to undergo extensive transformation processes in the environment. Direct photolysis and hydrolysis are not expected due to a lack of chromophores that absorb at wavelengths greater than 290 nm or hydrolysable functional groups respectively. Limited data suggest that indirect photolysis in air and water is possible ([Kochany and Bolton, 1992](#); [Wahner and Zetzsch, 1981](#)), with a half-life of approximately 1 month for both processes.

3.4 Media Assessments

3.4.1 Air and Atmosphere

Numerous sources indicate that *o*-dichlorobenzene does not directly photolyze in sunlight because it does not contain chromophores that absorb at wavelengths greater than 290 nm (NLM, 2014; OECD, 2001a; Kochany and Bolton, 1992; Lyman et al., 1990). However, *o*-dichlorobenzene is expected to undergo indirect photolysis in the atmosphere due to reactions with the hydroxyl radical ($\cdot\text{OH}$). The half-life of these reactions is approximately 1 month (Wahner and Zetzsch, 1981) with a high-quality measured rate constant of $4.2 \pm 0.2 \times 10^{-13} \text{ cm}^3/\text{molecule} \cdot \text{sec}$ at $20.85 \pm 1^\circ\text{C}$. Assuming a 12-hour day and a concentration of $5 \times 10^5 \cdot\text{OH}/\text{cm}^3$ in the atmosphere, this rate constant equates to a half-life of 38 ± 2 days, which was used in analyses. Overall, the indirect photolysis half-life was 38 ± 2 days in measured data and ranged from 27 to 53 days in modeled estimates (AOPWIN).

Details on monitoring concentrations of *o*-dichlorobenzene in air across the United States can be found in Section 5.2.1.

3.4.2 Aquatic Environments

o-Dichlorobenzene does not undergo hydrolysis because it does not contain hydrolysable functional groups (NLM, 2014; Lyman et al., 1990).

Photolysis of nitrate and nitrite in surface water can lead to the formation of hydroxyl radicals ($\cdot\text{OH}$), which can, in turn, react with *o*-dichlorobenzene. However, there is some uncertainty as to the likelihood of these reactions due to the volatility of *o*-dichlorobenzene. No indirect photodegradation with irradiation of *o*-dichlorobenzene in water has been documented (Klán et al., 2001). However, when H_2O_2 was used as a photosensitizer to generate hydroxyl radicals in an *o*-dichlorobenzene aqueous solution (wavelengths $>300 \text{ nm}$), some photodegradation did occur ($k = 3.9 \pm 0.3$, 4.0 ± 0.3 , and $3.3 \pm 0.3 \times 10^9 \text{ M}^{-1} \text{ s}^{-1}$ for pH = 3.5, 7.0, and 11.0, respectively) (Kochany and Bolton, 1992). The half-life of *o*-dichlorobenzene in water via photolysis has been estimated at 12.8 days ((OECD, 2001b) citing Russi, 1982).

o-Dichlorobenzene in surface water is expected to volatilize given its physical and chemical properties (Table 2-1). EPI Suite™ estimated volatilization half-life ($t_{1/2}$) from water ranged from 1.61 hours in a model river to 4.97 days in a model lake. These volatilization half-lives are based on a depth of 1 m, wind velocity of 5 m/s and current velocity of 1 m/s for the model river and a depth of 1 m, wind velocity of 0.5 m/s, and current velocity of 0.05 m/s for the model lake. Other inputs to EPI Suite™ are listed in (Table 2-1).

Under ideal conditions with abundant nutrients, and to a lesser extent under anaerobic conditions, some *o*-dichlorobenzene may biodegrade in water. Three high-quality studies measuring biodegradation in water under aerobic conditions yielded degradation half-lives of 23.1 days (Nielsen et al., 1996), 54 days (Dermietzel and Vieth, 2002), and 25 days (Wilson et al., 1987) (mean = 34 ± 17 days) (also see (Tabak et al., 1981)).

In sediments, some biodegradation may also occur under aerobic conditions, but results are variable and likely based on the local microbial community. For example, a 42-day *o*-dichlorobenzene half-life was measured in aerobic sediments from a sandy aquifer (Nielsen and Christensen, 1994). However, biodegradation half-lives ranged from 11.6 to 34.7 days under experimental conditions with sandy aquifer substrates. Biodegradation of *o*-dichlorobenzene is minimal in anaerobic sediments (Kirk et al., 1989; Kuhn et al., 1985; Tabak et al., 1964). However, one high-quality study measured biodegradation

of *o*-dichlorobenzene under anaerobic conditions in river sediment ($t_{1/2} = 36.9$ days ([Masunaga et al., 1996a](#))).

There are few direct water releases of *o*-dichlorobenzene to the environment from COUs under TSCA. TRI chemicals released into streams or other water bodies are referred to as “water releases” or “surface water discharges.” Wastewater containing *o*-dichlorobenzene may first be treated, which may include physical, chemical, and biological treatment, prior to discharge to either a receiving surface water body or a publicly owned treatment works (POTW) or industrial wastewater treatment (WWT) plant for further treatment prior to discharge to a receiving surface water body. From 2019 to 2023, one TRI facility has released 8.6 lb.

DMR water data reveal that there are low ambient concentrations of *o*-dichlorobenzene in water from 17 facilities in 2024. The ambient concentrations range from 7.98×10^{-3} to 1.10×10^{-4} mg/L. The Water Quality Portal ([WQP](#); accessed June 24, 2026) Data has 144,439 *o*-dichlorobenzene samples dating from 1980 to 2025, with more than 99.99% listed as non-detects (NDs). The EPA water quality data originates from the [Water Quality Exchange](#) (WQX; accessed June 24, 2026), the EPA’s repository of water quality monitoring data collected by water resource management groups across the country. Organizations, including states, tribes, watershed groups, other federal agencies, volunteer groups, and universities, submit data to the WQX to make their data publicly accessible. WQX collects water samples from a variety of sources. (e.g., sediment, surface water, groundwater, landfill effluent, bottom material, drinking water, wastewater, and stormwater). More details on monitoring data can be found in Section 5.3.

3.4.3 Terrestrial Environments

o-Dichlorobenzene is expected to have low-to-medium mobility in soils ($\log K_{OC} = 2.45$) with volatilization being the primary transport mechanisms for *o*-dichlorobenzene in soils ([OECD, 2001b](#)). *o*-Dichlorobenzene is not expected to undergo indirect photodegradation in soil. Furthermore, minimal biodegradation is expected, particularly under anaerobic conditions ([Brunsbach and Reineke, 1994](#); [Kirk et al., 1989](#); [Kuhn et al., 1985](#); [Tabak et al., 1964](#)).

According to the TSCA conditions of use for *o*-dichlorobenzene, releases to land ($\approx 62\%$ of releases) are limited to Class I underground injection and RCRA subtitle C landfills. Class I Injection Wells require that they are designed and constructed to prevent movement of injected waste streams into any additional pathways, including drinking water systems or other water pathways. Although air deposition to soil may occur, it is not expected to be significant. Due to the physical and chemical properties of *o*-dichlorobenzene (Table 2-1), it is expected to volatilize from soil and other surfaces. Furthermore, there is low-to-moderate potential for sorption to organic matter ($K_{OC} = 2.45$).

o-Dichlorobenzene in landfills is not expected to be a source of soil or groundwater contamination. Some biodegradation of *o*-dichlorobenzene in groundwater might be expected under aerobic conditions ([Nielsen et al., 1996](#); [Nielsen and Christensen, 1994](#)).

TRI reported 18 lb/yr releases of *o*-dichlorobenzene to wastewater treatment systems. As a result, EPA anticipates *o*-dichlorobenzene to be negligible in biosolids because of low releases of *o*-dichlorobenzene to wastewater treatment systems, low potential for sorption to organic matter, and volatility.

3.5 Persistence Potential of *o*-Dichlorobenzene

o-Dichlorobenzene may persist in environmental media although rapid volatilization from soil, sediment and water is expected. Based on results from BIOWIN™, which is an EPI Suite™ Program that

estimates the probability of environmental biodegradation of an organic compound in the presence of mixed populations of environmental microorganisms, *o*-dichlorobenzene is not readily biodegradable (*i.e.*, half-life greater than one month; see ([U.S. EPA, 2008](#))). Volatilization half-life from water is relatively rapid and estimated to range from 1.61 hours in rivers to 4.96 days in lakes (EPI Suite™). Atmospheric half-life associated with hydroxyl reactions ranged from $t_{1/2}$ = 13.33 days (AOPWIN Program) to 38 days ([Wahner and Zetzsch, 1981](#)).

3.5.1 Destruction and Removal Efficiency

The Clean Air Act 40CFR Part 63, Subpart EEE—National Emission Standards for Hazardous Air Pollutants from Hazardous Waste Combustors—requires all hazardous waste combustors, hazardous waste incinerators, hazardous waste cement kilns, hazardous waste lightweight aggregate kilns, hazardous waste solid fuel boilers, hazardous waste liquid fuel boilers, and hazardous waste hydrochloric acid production furnaces to achieve a destruction and removal efficiency (DRE) of 99.99% for each principle organic hazardous constituent (POHC)—including *o*-dichlorobenzene. No DRE values for *o*-dichlorobenzene were identified though it is expected to be $\geq 99.99\%$.

3.5.2 Removal in Wastewater Treatment

Due to the volatility of *o*-dichlorobenzene, only small amounts are expected to enter wastewater treatment plants (WWTPs). The small amounts that enter a WWTP are expected to be removed by volatilization and biodegradation. One high-quality study measured greater than 99.9% removal of *o*-dichlorobenzene during wastewater treatment with 22% of that removal through stripping, 0% through sorption, and 78% of *o*-dichlorobenzene biodegraded ([Kincannon et al., 1983](#)). Similarly, across six municipal WWTPs, 67 to 97% of *o*-dichlorobenzene was removed ([Van Luin and Van Starkenburg, 1985](#)). In a medium-quality study, 65% of BOD removal and 60% of suspended solid removal was measured ([Union Carbide, 1974](#)). In contrast, another high-quality study found poor removal (35%) of *o*-dichlorobenzene during wastewater treatment with removal primarily via volatilization and minimal biodegradation ([Weber et al., 1987](#)), which is consistent with no anaerobic degradation in Kirk ([1989](#)). A medium-quality study found a *o*-dichlorobenzene half-life of 3.72 days under aerobic conditions during WWT ([Davis et al., 1981](#)).

The EPI Suite™ ([U.S. EPA, 2012](#)) STP model was run using default settings (set biodegradation half-life [$t_{1/2}$] to 10,000 hours) to evaluate the potential for *o*-dichlorobenzene to volatilize to air or adsorb to sludge during wastewater treatment. In order to improve the accuracy of the EPI Suite™ estimations, physical and chemical properties (log K_{ow} , boiling point, melting point, vapor pressure, water solubility, Henry's Law constant) from Table 2-1 were entered into EPI Suite™ along with *o*-dichlorobenzene SMILES, c1ccc(c(c1)Cl)Cl notation entry before running the module.

EPI Suite™ STP modeling suggested moderate biodegradation in WWTP ($\approx 49\%$ removal) with 39.5% removal via volatilization, 9.1% removal via sludge adsorption, and less than 1% removal via biodegradation.

3.5.3 Bioaccumulation Potential of *o*-Dichlorobenzene

Measured BCFs ranged across several orders of magnitude from 0.22 in invertebrates (*Chironomid* sp.) to 19,700 in algae (*Selenestrum* sp.) (Table 3-3). Measured BCF were dependent on organism as well as surrounding environment (sediment, overlying water) and exposure conditions (equilibrium or non-equilibrium exposure conditions). The highest measured values were associated with algal species (*Selenestrum*, BCF = 19,700; fraction of adsorbing cells was not determined) ([Casserly et al., 1983](#)) and invertebrates under nonequilibrium conditions in low organic content sediment (*Chironomid*, BCF = 1,070) ([Knezovich and Harrison, 1988](#)).

o-Dichlorobenzene has low potential to bioaccumulate in organisms based on these measured BCF values. However, elimination of *o*-dichlorobenzene from organisms is known to be rapid and limits any sustained bioaccumulation within an organism, or biomagnification across organisms ([Barrows et al., 1980](#); [Veith et al., 1980](#)). Thus, any bioaccumulation of *o*-dichlorobenzene upon exposure is not retained within the organism (elimination <5 days, ([Oliver and Niimi, 1983](#); [Veith et al., 1980](#)).

The EPI Suite™ ([U.S. EPA, 2012](#)) BCFBAF Program also indicated low potential for *o*-dichlorobenzene bioaccumulation in the environment with an estimated log BCF of 1.9 (BCF = 78.9 L/kg wet-wt). The bioconcentration factor regression-based estimate was 78.91 L/kg wet-wt and the biotransformation half-life normalized to 10 g fish was 0.50 days.

Table 3-3. Bioconcentration (BCF) Values for *o*-Dichlorobenzene

Endpoint	Organism	Value(s)	Reference(s)	Data Quality Ranking
Bioconcentration factor (BCF, whole organism)	Algae, <i>Selenestrum capricornutum</i>	10,030–19,700	Casserty et al. (1983)	High
	Algae, various species	39–249	Wang et al. (2002)	High
	Aquatic plant, various species	13–76	Wolf et al. (1991)	High
	Invertebrate, <i>Chironomid</i>	0.22–1,070	Knezovich and Harrison (1988)	High
	Fish, bluegill	89	Barrows et al. (1980)	High
	Fish, rainbow trout	270–560	Oliver and Niimi (1983)	High

3.6 Overall Fate and Transport of *o*-Dichlorobenzene

Air is expected to be the primary major environmental compartment for *o*-dichlorobenzene due to release patterns (Section 0) and physical and chemical properties (Section 2) (Figure 3-2). It is minimally degraded via abiotic or biotic processes once in the environment. Half-life in the environment is approximately one month. Estimated and measured partitioning values indicate low to moderate sorption to soil, sediment, or organic matter (log K_{OC} = 2.45; log K_{OW} = 3.38). Thus, *o*-dichlorobenzene is not expected to associate strongly with airborne particulates; hence, it is not expected to undergo significant deposition to water or land. It is expected to remain largely in the vapor phase where it will undergo degradation.

There is some potential for long-range transport in air given the limited degradation pathways and persistence in air. Specifically, the characteristic travel distance (CTD) informs the potential for long range transport. The CTD was calculated using the Level III Fugacity model in EPI Suite™ at 12,478 km. Overall, *o*-dichlorobenzene is primarily released to air and will generally remain in air with limited partitioning or transformation though some volatilization from water and soil will occur (Figure 3-2).

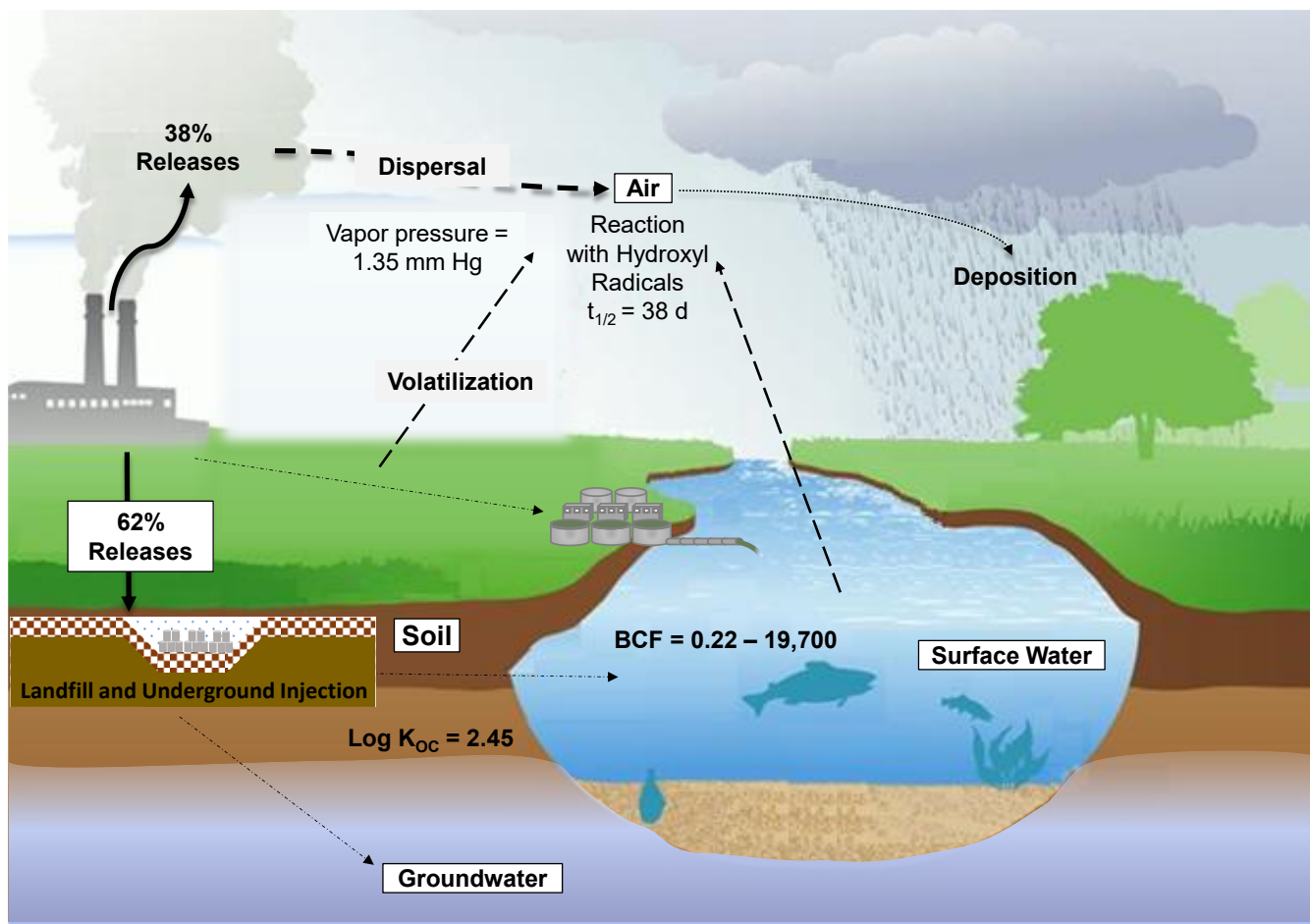


Figure 3-2. Transport, Partitioning, and Degradation of *o*-Dichlorobenzene in the Environment
The diagram depicts the 2024 release (TRI), distribution, transport and partitioning of *o*-dichlorobenzene in the environment. The width of the arrow is a qualitative indication of relative amounts of movement (*i.e.*, wider arrows indicate more likely partitioning).

Based on the release amounts of *o*-dichlorobenzene to the atmosphere, air is expected to be the primary pathway of exposure. Low release amounts to water as well as high volatility means the water pathway is not expected to be a significant pathway of exposure. Sediments and soil are also not expected to be major pathways for *o*-dichlorobenzene based on low partition coefficients to organic matter and no direct releases to land. There is low potential for bioaccumulation of *o*-dichlorobenzene in biota and elimination is rapid; thus, no trophic transfer is expected.

3.7 Weight of Scientific Evidence Conclusions for Fate and Transport

Evaluation of the weight of the scientific evidence for the fate and transport of *o*-dichlorobenzene is shown below and is based on categorization described in the 2021 Draft Systematic Review Protocol ([U.S. EPA, 2021a](#)).

There is robust evidence showing that *o*-dichlorobenzene will

- volatilize rapidly from soil and water surfaces;
- not hydrolyze significantly in water; and
- minimally partition to soil, sediment or organic matter.

There is moderate evidence showing that *o*-dichlorobenzene will

- undergo indirect photodegradation in air;
- biodegrade in aerobic conditions;
- minimally biodegrades in anaerobic conditions; and
- have low bioaccumulation potential.

3.7.1 Strengths, Limitations, Assumptions, and Key Sources of Uncertainty for the Fate and Transport Assessment

There is generally limited evidence on the fate of *o*-dichlorobenzene in the environment. This lack of data creates some uncertainty. Nevertheless, EPA has high confidence in our assumptions about the fate of *o*-dichlorobenzene in the environment based on its physical and chemical properties, environmental release data, and monitoring data.

Half-lives of *o*-dichlorobenzene in air can vary significantly under different environmental conditions, which result in spatial and temporal variation in degradation rates that contribute to uncertainty. For instance, greater residence times of *o*-dichlorobenzene are expected in colder, cloudy conditions.

The fate assessment of *o*-dichlorobenzene in aquatic environments was based mainly on physical and chemical data and estimated properties and release data. Volatilization and biodegradation are key processes in the fate of *o*-dichlorobenzene in water; however, no available data was found measuring the direct volatilization of *o*-dichlorobenzene from water and sediments. Estimations of volatilization using EPI SuiteTM are based on a shallow model river and lake and may be much lower for deeper water bodies.

Estimated and measured data of potential bioaccumulation of *o*-dichlorobenzene varied several orders of magnitude due to the physical and chemical conditions as well as the differences among organisms. No studies were available for potential bioaccumulation of *o*-dichlorobenzene by terrestrial organisms. As exposure is not expected to be significant in aquatic ecosystems, but there is potential exposure to terrestrial organisms via ambient air, there is some uncertainty. Furthermore, there is limited data on elimination of *o*-dichlorobenzene though EPA has high confidence in the assumption that bioaccumulation potential is minimal.

4 RELEASE ASSESSMENT

4.1 Occupational Exposure Scenarios

EPA assessed environmental releases and occupational exposures for the conditions of use (COUs) as described in Table 1-1 of the *Draft Risk Evaluation for o-Dichlorobenzene* (U.S. EPA, 2026z). The 24 COUs for *o*-dichlorobenzene are also listed in Table 4-1. TSCA section 3(4) defines COUs as “the circumstances, as determined by the Administrator, under which a chemical substance is intended, known, or reasonably foreseen to be manufactured, processed, distributed in commerce, used, or disposed of.” Initially, EPA identifies COUs for chemicals during the scoping phase and presents them in the *Final Scope of the Risk Evaluation for o-Dichlorobenzene* (U.S. EPA, 2020d)—though the COUs presented may change between the scope document and the risk evaluation as the assessment is conducted and more information about the chemical is gathered. Each COU is a unique combination of lifecycle stage, category(ies), and subcategory(ies) that describes the chemical’s use.

Each COU for *o*-dichlorobenzene was assigned an occupational exposure scenario (OES) that characterizes its release and exposure potential. Although named for their utility when assessing occupational exposure, these scenarios are also used when assessing environmental releases from industrial and commercial facilities. OES is a term that describes the grouping or segmenting of COUs for assessment of releases and exposures. For example, EPA may assess a group of multiple COUs together as one OES due to similarities in release and exposure sources, worker activities, and use patterns. Alternatively, the Agency may assess multiple OESs for one COU because there are different release and exposure potentials within a given COU. OES determinations are largely driven by the availability of data and available modeling approaches to assess occupational releases and exposures. Therefore, even if there are similarities between multiple COUs, if there is sufficient data to separately assess releases and exposures for each COU, EPA would not group them into the same OES. For each OES, environmental releases and occupational exposure results are provided and are expected to be representative of the sites and population of workers for the given OES in the United States. Figure 4-1 depicts how COUs may be mapped to OESs.

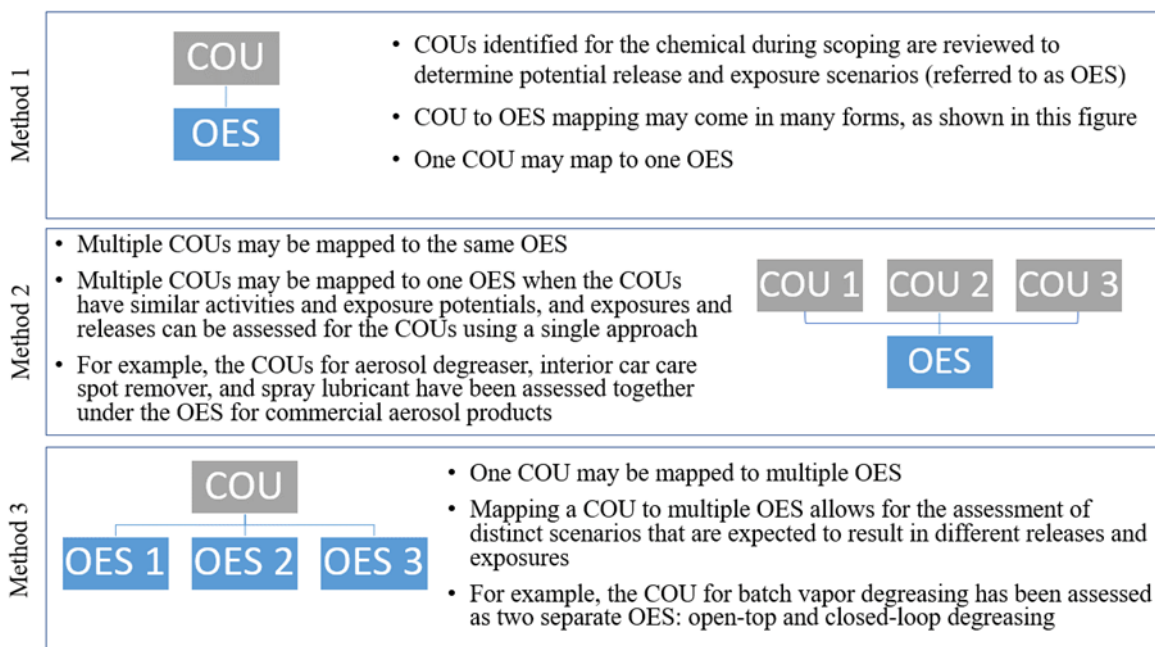


Figure 4-1. Conditions of Use to Occupational Exposure Scenario Mapping

EPA mapped OESs to COUs based on information gathered during systematic review, test orders collected under TSCA section 4, industry outreach, and public comments. Several of the COU categories and subcategories were grouped and assessed together in a single OES due to similarities in the processes or lack of data to differentiate between them. For example, the COUs with subcategories of “Importing” and “Repackaging” are both assessed under the Repackaging OES. This grouping minimized repetitive assessments. In three cases, the COU subcategories were further delineated into multiple OESs based on expected differences in process equipment and associated releases or exposure potentials between the different uses. These cases were the COUs with the subcategory of “Solvents (which become part of product formulation or mixture)”;

“Coatings and paints, thinners, paint removers”;

and “Laboratory chemicals; Cleaning and furnishing care products.” At least two unique activities were identified within these COUs, and sufficient data were available to separately assess these activities, therefore they each have two or three OESs assigned to them. A total of 20 unique OESs were identified. Table 4-1 lists each COU and its corresponding OES(s).

Table 4-1. Crosswalk of Conditions of Use (COUs) to Occupational Exposure Scenarios (OESs) Assessed

Life Cycle Stage ^a	COU Category ^b	Subcategory ^c	OES
Manufacturing	Manufacture	Domestic manufacture	Manufacturing
	Import	Import	Repackaging
Processing	Processing as a reactant	Processing as a reactant	Processing as a Reactant
	Processing – incorporation into formulation, mixture or reaction product	Intermediates in all other basic organic chemical manufacturing	Processing as a Reactant
		Solvents (which become part of product formulation or mixture)	Incorporation into Formulation, Mixture, or Reaction Product
			Plastic Compounding
			Plastic Converting
		Soap, cleaning compound, and toilet preparation manufacturing	Incorporation into Soap, Cleaning Compound, and Toilet Preparation Manufacturing
	Recycling	Recycling	Industrial Use of Solvents
	Repackaging	Repackaging	Repackaging
Distribution in commerce	Distribution in commerce	Distribution in commerce	Distribution in Commerce ^d
Industrial use	Solvents (which become part of product formulation or mixture)	Printing ink manufacturing; paint and coating manufacturing; synthetic dye and pigment manufacturing	Industrial Use of Solvents

Life Cycle Stage ^a	COU Category ^b	Subcategory ^c	OES
	Functional fluids (closed system)	All other basic organic chemical manufacturing	Functional Fluids (Closed System)
	Non-incorporative activities	Processing aids, not otherwise listed	Industrial Use of Solvents
Commercial use	Ink, toner, and colorant products	Ink and toners	Use of Ink, Toner, and Colorant Products
	Paints and coatings	Coatings and paints, thinners, paint removers	Use of Paints and Coatings
			Use of Paint Thinners and Removers
			Sheep Branding Fluid
	Lubricants and greases	Lubricants and greases	Use of Lubricants and Greases
	Fuels and related products	Fuel additive	Use of Fuels and Related Products
	Air care products	Continuous action air fresheners	Use in Solid Air Care Products
	Other use	Laboratory chemicals; cleaning and furnishing care products	Use of Laboratory Chemicals
			Use of Cleaning and Furnishing Care Products
			Use of Other Cleaning Products
Consumer use	Paints and coatings	Thinners, sheep-branding fluid	N/A ^f
	Lubricants and greases	Lubricants and greases	
	Fuels and related products	Fuel additive	
	Air care products	Continuous action air fresheners	
	Other use	Other use including ceramics glaze, and cleaning and furnishing care products	
Disposal	Disposal	Disposal	Disposal
^a Life Cycle Stage Use Definitions (40 CFR 711.3) - “Industrial Use” means use at a site at which 1 or more chemicals or mixtures are manufactured (including imported) or processed.			

Life Cycle Stage ^a	COU Category ^b	Subcategory ^c	OES
- “Commercial Use” means the use of a chemical or a mixture containing a chemical (including as part of an article) in a commercial enterprise providing saleable goods or services. - “Consumer Use” means the use of a chemical or a mixture containing a chemical (including as part of an article, such as furniture or clothing) when sold to or made available to consumers for their use. - Although EPA has identified both industrial and commercial uses here for purposes of distinguishing scenarios in this document, the Agency interprets the authority over “any manner or method of commercial use” under TSCA section 6(a)(5) to reach both. ^b These categories of COU appear in the life cycle diagram, reflect Chemical Data Reporting (CDR) codes, and broadly represent conditions of use of <i>o</i>-dichlorobenzene in industrial and/or commercial settings. ^c These subcategories reflect more specific COUs of <i>o</i>-dichlorobenzene. ^d EPA considers the activities of loading and unloading chemical products part of Distribution in Commerce; however, these activities were assessed as part of each COU’s OES. ^f Consumer uses are not assigned to an OES as they are not part of the occupational assessment. See Section 7 for information on the consumer exposure assessment.			

After identifying those OESs that will be assessed, the next step was to describe the function of *o*-dichlorobenzene within each OES. This information is utilized in mapping release and exposure data to an OES as well as applying modeling approaches. Table 4-2 is a summary; for more information on each OES see the corresponding process descriptions in Section 4.3.

Table 4-2. Description of the Function of *o*-Dichlorobenzene for Each OES

OES	Role/Function of <i>o</i> -Dichlorobenzene
Manufacturing	This OES captures the Manufacturing COU category. <i>o</i>-Dichlorobenzene is manufactured as a byproduct during the production of vinyl chloride monomer (VCM) {Exponent Inc, 2024, 13170985}. In this process, <i>o</i>-dichlorobenzene is separated from the intended product and managed as waste via incineration. <i>o</i>-Dichlorobenzene may also form as a byproduct in other manufacturing (e.g., certain herbicides, 3,4-dichloroaniline, and polyurethane-related isocyanates) {EPA-HQ-OPPT-2018-0444-0013}. Preliminary review of 2024 CDR data indicates that <i>o</i>-dichlorobenzene has also been domestically manufactured as a primary product in recent years. While the Manufacturing OES in this draft risk evaluation focuses on manufacture as a byproduct, EPA intends to incorporate 2024 CDR data and other reasonably available information regarding domestic manufacture of <i>o</i>-dichlorobenzene into the final risk evaluation.
Repackaging	This OES captures the Import and Repackaging COU categories. Import and repackaging sites are expected to distribute <i>o</i>-dichlorobenzene to various downstream uses. <i>o</i>-Dichlorobenzene is shipped as a bulk liquid at ambient temperature and pressure by highway and rails, and as packaged hazardous material for smaller-volume distribution.
Processing as a Reactant	This OES captures the Processing as a reactant COU category. <i>o</i>-Dichlorobenzene functions as a feedstock and key intermediate in the synthesis of downstream products from the basic organic chemical manufacturing sector. Regulatory sources identified its reactant use for manufacturing herbicide intermediates (e.g., precursors to 3,4-dichloroaniline compounds), producing dyes, and as a chemical intermediate in chlorinated aromatic chemistry
Incorporation into Formulation,	This OES captures part of the Solvents (which become part of product formulation of mixture) COU subcategory within the processing life cycle stage.

OES	Role/Function of <i>o</i> -Dichlorobenzene
Mixture, or Reaction Product	Incorporation into a formulation, mixture or reaction product refers to the process of mixing or blending of several raw materials to obtain a single product or preparation. EPA identified Incorporation into formulation, mixture, or reaction product as a use of <i>o</i> -dichlorobenzene due to <i>o</i> -dichlorobenzene's presence in products such as lubricating oils, fuel additives, paints, coatings, paint thinners, inks, cleaning products, functional fluids, laboratory standards, and solvents
Plastic Compounding	This OES captures part of the Solvents (which become part of product formulation of mixture) COU subcategory within the processing life cycle stage. <i>o</i> -Dichlorobenzene may be present at residual amounts when <i>p</i> -dichlorobenzene is used to make polyphenylene sulfide (PPS) resin. PPS resin contains less than 100 ppm of residual <i>p</i> -dichlorobenzene and thus would contain even less <i>o</i> -dichlorobenzene {American Chemistry Council, 2023, 13006361}. Residual <i>o</i> -dichlorobenzene is then incorporated into the downstream product during plastic compounding.
Plastic Converting	This OES captures part of the Solvents (which become part of product formulation of mixture) COU subcategory within the processing life cycle stage. <i>p</i> -Dichlorobenzene is used to make PPS resin, which contains less than 100 ppm of residual <i>p</i> -dichlorobenzene {American Chemistry Council, 2023, 13006361}, and even less residual <i>o</i> -dichlorobenzene. This residual <i>o</i> -dichlorobenzene is then incorporated into the downstream product during plastic compounding and then converted into finished products during plastic converting.
Incorporation into Soap, Cleaning Compound, and Toilet Preparation Manufacturing	This OES captures the Soap, cleaning compound, and toilet preparation manufacturing COU subcategory. EPA identified this as a use due to <i>o</i> -dichlorobenzene's presence in soap, cleaning compounds, and air care products.
Industrial Use of Solvents	This OES captures the Industrial use categories of Solvents (which become part of product formulation or mixture), and Non-incorporative activities, as well as the Processing category of Recycling. <i>o</i> -Dichlorobenzene is considered as a high-boiling organic solvent in industrial operations due to its strong solvency for hydrophobic chemicals and functional property stability. <i>o</i> -Dichlorobenzene dissolves, extracts, cleans, or facilitates processing of other chemicals in enclosed systems such as mixing vessels, separation units, cleaning equipment, and formulation tanks.
Distribution in Commerce	This OES captures the Distribution in commerce COU category. <i>o</i> -Dichlorobenzene is expected to be distributed in commerce for the purposes of each processing, industrial, and commercial use of the chemical. EPA expects <i>o</i> -dichlorobenzene to be transported from import sites to downstream processing and repackaging sites.
Functional Fluids (Closed System)	This OES captures the Functional fluids (closed system) COU category. <i>o</i> -Dichlorobenzene is used in a mixture with <i>p</i> -dichlorobenzene as a coolant in a closed system in the manufacture of some organic chemicals.
Use of Ink, Toner, and Colorant Products	This OES captures the Ink, toner, and colorant products COU category within the Commercial use life cycle stage. <i>o</i> -Dichlorobenzene is used as a solvent in the pigment manufacturing process, though is

OES	Role/Function of <i>o</i> -Dichlorobenzene
	stripped away before the final industry pigment product is produced. While not present intentionally, <i>o</i> -dichlorobenzene may appear in pigments due to this solvent use. At most, <i>o</i> -dichlorobenzene may be present in pigments at parts per million levels (EPA-HQ-OPPT-2018-0444-0024).
Use of Paints and Coatings	This OES captures part of the Coatings and paints, thinners, paint removers COU subcategory within the commercial use life cycle stage. <i>o</i>-Dichlorobenzene has been reported as a constituent within products or formulations for the manufacture, operation, and maintenance of aerospace products. More specifically it was reported as a component of precious metal inks that can be brushed onto a substrate. <i>o</i>-Dichlorobenzene is also used as an ingredient in some specialized metallic coatings for ceramics, functioning within the coating as a solvent at concentrations between 5 and 10% {Duncan, 2005, 13288780}. It also may be present at low levels within pigments due to its use as a solvent during the manufacturing process of some pigments (more specifically, Pigment Violet 23).
Use of Paint Thinners and Removers	This OES captures part of the Coatings and paints, thinners, paint removers COU subcategory within the commercial use life cycle stage. <i>o</i>-Dichlorobenzene has been reported as a constituent within products or formulations for the manufacture, operation, and maintenance of aerospace products. More specifically it was reported as a component of a formulation of paint stripper.
Sheep Branding Fluid	This OES captures part of the Coatings and paints, thinners, paint removers COU subcategory within the commercial use life cycle stage. <i>o</i>-Dichlorobenzene has been reported as a constituent within sheep branding fluid, which is a washable paint used by farmers to identify sheep on a farm. <i>o</i>-Dichlorobenzene may be present in this product at concentrations of up to 10 to 30% {Heiniger, 2016, 6328960}.
Use of Lubricants and Greases	This OES captures the Lubricants and greases COU category within the commercial use life cycle stage. <i>o</i>-Dichlorobenzene has been reported as a component of automotive engine oils, and oils used to maintain tools. A single relevant product was identified, and <i>o</i>-dichlorobenzene is indicated to be present at 0.12% (EPA-HQ-OPPT-2018-0446-0028).
Use of Fuels and Related Products	This OES captures the Fuels and related products COU category within the commercial use life cycle stage. <i>o</i>-Dichlorobenzene was indicated to be present in some fuel additive products that are marketed to the aerospace community but not widely used. A single relevant product was identified in which <i>o</i>-dichlorobenzene is present in the products at 0.12% (EPA-HQ-OPPT-2018-0446-0028).
Use in Solid Air Care Products	This OES captures the Air care products COU category within the commercial use life cycle stage. <i>o</i>-Dichlorobenzene may be present in air care products such as antimicrobial products, bathroom cleaners, urinal and toilet deodorants, and deodorizing wall blocks at concentrations of up to 1% {Willert Home Products, 2019, 6280693}.
Use of Laboratory Chemicals	This OES captures part of the Laboratory chemicals; cleaning and furnishing care products COU subcategory within the Commercial use life cycle stage.

OES	Role/Function of <i>o</i> -Dichlorobenzene
	EPA has identified several cases of <i>o</i> -dichlorobenzene in use as a laboratory chemical as a reference sample for analysis of material samples and in laboratory applications for analytical standards, research, equipment calibration, and sample preparation. Several products intended for laboratory use were also found, indicating <i>o</i> -dichlorobenzene may be present in neat form.
Use of Cleaning and Furnishing Care Products	This OES captures part of the Laboratory chemicals; cleaning and furnishing care products COU subcategory within the commercial use life-cycle stage. <i>o</i> -Dichlorobenzene was identified in some cleaning and washing agents as recently as 2012 {Substances in Preparations In the Nordic countries, 2020, 6984595}, and in products within dry-cleaning facilities at concentrations of up to 95% {OECD, 2001, 5185286}.
Use of Other Cleaning Products	This OES captures part of the Laboratory chemicals; cleaning and furnishing care products COU subcategory within the commercial use life-cycle stages. <i>o</i> -Dichlorobenzene was identified in some cleaning products including one septic tank cleaner that indicates the presence of <i>o</i> -dichlorobenzene at concentrations greater than 99% (Utility Wonder Products, 2014).
Disposal	This OES captures the Disposal COU category. Each of the OESs may generate waste streams of <i>o</i> -dichlorobenzene that are collected and transported to third-party sites for disposal or treatment, and these cases are assessed under this OES.

EPA reviewed release data from TRI from 2019 to 2023 ([U.S. EPA, 2026b, u, 2026ad](#)), and DMR from 2019 to 2023 ([U.S. EPA, 2026ad](#)) to identify relevant releases of *o*-dichlorobenzene to the environment. The National Emissions Inventory (NEI) is also commonly reviewed for assessment of environmental releases; however, *o*-dichlorobenzene does not report to NEI and so it was not reviewed. One more recent year of TRI data has become available, 2024, since the completion of this analysis. EPA reviewed the total TRI air releases from this year and found that the stack air releases from 2024 fell within the range of releases that occurred from 2019 to 2023, and fugitive air releases from 2024 were lower than the previous 5 years (3,587 kg in 2024; the next lowest amount was 4,145 kg in 2020). Although these databases sufficiently informed industrial and processing COUs, the databases are limited in data on environmental releases for commercial COUs. These databases may not identify all *o*-dichlorobenzene releases as some facilities may not be required to report due to reporting thresholds.

EPA's assessment of releases includes quantifying annual and daily releases of *o*-dichlorobenzene to air, water, and land. Releases to air include both fugitive and stack air emissions and emissions resulting from on-site waste treatment equipment, such as incinerators. Releases to water include both direct discharges from industrial facilities to surface water and indirect discharges to publicly owned treatment works (POTW) or non-POTW wastewater treatment (WWT). Note that indirect discharges are not released directly into the environment but instead transported to WWTPs. Releases to land include any disposal of liquid or solids wastes containing *o*-dichlorobenzene into landfills, land treatment, surface impoundments, or other land applications. The purpose of this section is to quantify releases. Environmental fate and transport of *o*-dichlorobenzene is discussed in Section 0; exposure estimates to the general population and ecological species are discussed in Section 0.

Note that in this assessment EPA used a tiered approach, where first releases from TRI, as well as the highest release from DMR, were assessed. If the MOEs calculated from these releases were above the benchmark MOE for the environment and general population, EPA did not seek to estimate releases

further. Because all MOEs were above the benchmark MOE as a result of this assessment, *o*-dichlorobenzene concentrations in air, water, and soil due to lower releases of the chemical were not calculated because no MOEs below the benchmark would be expected from these lower releases.

4.2 Approach and Methodology

An environmental release assessment was conducted for each OES specified in Table 4-1 and are presented in Section 4.3. Each section contains the following components:

- **Process Description:** A description of the OES, including (as available) the function of the chemical in the OES; physical forms and weight fractions of the chemical throughout the process; total PV associated with the OES; per site throughputs/use rates of the chemical; operating schedules; and process vessels, equipment, and tools used during the COU.
- **Estimates of Number of Facilities and Release Days:** An estimate of the number of sites that use *o*-dichlorobenzene for the given OES, as well as an estimate of the number of days per year a release of the chemical may occur.
- **Environmental Release Sources:** A description of each of the potential sources of environmental releases to air in the process for the given OES.
- **Environmental Release Assessment Results:** Estimates of chemical released into each environmental media (surface water, POTW, non-POTW WWT, fugitive air, stack air, and land disposal).

For the remainder of this section, the approach and methodology for completing each of the above listed components is described in more detail.

4.2.1 Process Descriptions

EPA performed a literature search to find descriptions of processes involved in each OES. When data were available to do so, the Agency included the following information in each process description:

- total PV associated with the OES;
- facility operating schedules (e.g., year-round, 5 days/week, batch process, continuous process, multiple shifts);
- key process steps;
- physical form and weight fraction of the chemical throughout the process steps;
- information on receiving and shipping containers; and
- ultimate destination of chemical leaving the facility.

Where *o*-dichlorobenzene-specific process descriptions were unclear or not available, EPA referenced generic process descriptions from literature, including relevant emission scenario documents (ESD) or generic scenarios (GS). Process descriptions for each OES can be found in Section 4.3.

4.2.2 Number of Facilities

To estimate the number of facilities within each OES, EPA used a combination of bottom-up analyses of EPA reporting programs and top-down analyses of U.S. economic data and industry-specific data. Generally, EPA used the following steps to develop facility estimates:

1. Identify or “map” each facility reporting for *o*-dichlorobenzene in the 2016 and 2020 CDR ([U.S. EPA, 2020a, b, 2019a](#)), 2019 to 2023 TRI ([U.S. EPA, 2024c](#)), and 2019 to 2023 DMR ([U.S. EPA, 2026ad](#)) to an OES. The full details of the methodology for mapping facilities from EPA reporting programs is described in Appendix D. In brief, mapping consists of using facility reported industry sectors (typically reported as either North American Industry Classification System [NAICS] or Standard Industrial Classification [SIC] codes) as we, and chemical activity,

processing, and use information to assign the most likely OES to each facility.

Note that facilities may report to multiple databases under different names, and in these cases, EPA used reported addresses and company information to match facilities with their equivalents across databases but there may be uncertainty to the facility estimates as a result. Another source of uncertainty is that facilities that produce or handle *o*-dichlorobenzene may have several uses for the chemical on-site; however, for the purposes of this draft assessment/TSD, each site can only be assigned one OES.

2. Based on the reporting thresholds and requirements of each dataset, evaluate whether the data in the reporting programs are expected to cover most or all the facilities within the OES. If so, no further action was required, and EPA assessed the total number of facilities in the OES as equal to the count of facilities mapped to the OES from each dataset. If not, EPA proceeded to Step 3. OESs with quantified releases and exposures obtained the number of facilities solely from reporting programs. Because for 13 of the 20 OESs, there were no reporting sites in the databases, EPA proceeded to Steps 3 and 4.
3. Supplement the available reporting data with U.S. economic and market data using the following method:
 - a. Identify the NAICS codes for the industry sectors associated with the OES.
 - b. Estimate total number of facilities using the U.S. Census' Statistics of US Businesses (SUSB) data on total establishments by 6-digit NAICS.
 - c. Use market penetration data to estimate the percentage of establishments likely to be using *o*-dichlorobenzene instead of other chemicals.
 - d. Combine the data generated in Steps 3.a through 3.c to produce an estimate of the number of facilities using *o*-dichlorobenzene in each 6-digit NAICS code and sum across all applicable NAICS codes for the OES to arrive at a total estimate of the number of facilities within the OES. Typically, EPA assumed this estimate encompasses the facilities identified in Step 1; therefore, EPA assessed the total number of facilities for the OES as the total generated from this analysis.
4. If market penetration data required for Step 3.c. are not available, use generic industry data from GSs, ESDs, and other literature sources on typical throughputs/use rates, operating schedules, and the *o*-dichlorobenzene PV used within the OES to estimate the number of facilities. In cases where EPA identified a range of operating data in the literature for an OES, EPA used stochastic modeling to provide a range of estimates for the number of facilities within an OES. EPA provided the details of the approaches, equations, and input parameters used in stochastic modeling in the relevant OES sections throughout this draft TSD.

4.2.3 Annual Release Estimates

Releases to the environment are a component of potential exposure and may be derived from reported data that are obtained through direct measurement via monitoring, calculations based on empirical data, and/or assumptions and models. For each OES, EPA, where applicable, provided annual releases, daily releases, and the number of release days per year for each media of release (air, water, and land). Annual and daily releases are provided as central tendency and high-end estimates, which are typically estimated, for data sets with six or more points, by taking the 50th and 95th percentiles respectively of release data from all facilities within the OES. For data sets with three to five data points, EPA estimated central tendency exposure using the 50th percentile (median) and the maximum as the observed high-end release point. For data sets with two data points, the Agency estimated the central tendency using

the midpoint value and the higher of the two values as the high-end. Finally, for data sets with only one data point, EPA presented the single release value (notes in the relevant tables each case when these release data sets contain <6 points).

EPA used the following hierarchy in selecting data and approaches for assessing environmental releases:

1. Monitoring and measured data:
 - a. Releases calculated from site-specific concentration in medium and flow rate data
 - b. Releases calculated from mass balances or emission factor methods using site-specific measured data
2. Modeling approaches
3. Release limits (company specific limits, regulatory limits, etc.).

As indicated in the list above, EPA's preference was to rely on facility-specific release data reported in TRI ([U.S. EPA, 2021b](#)) and DMR ([U.S. EPA, 2022b](#)) where available, and in the case of this draft risk evaluation, EPA used only data reported to TRI and DMR in the assessment of facility releases.

For the *o*-dichlorobenzene release assessment, EPA used a tiered approach for assessing environmental releases. The first tier of this approach included an assessment of the risk to the general population and the environment from all releases reported to TRI. The highest releasing facility from the DMR database (TotalEnergies Petrochemicals & Refining Inc - Port Arthur Refinery that uses *o*-dichlorobenzene as a solvent) was also considered. This DMR release, along with releases reported to TRI, are expected to be the largest sources of *o*-dichlorobenzene in the environment.

If the releases from TRI and DMR (2019–2023) resulted in MOEs below the benchmark MOE for the environment and general population, EPA would have continued to the next tier in the assessment. This would have included the use of modeling to obtain release estimates for each OES not represented in the release databases.

In the case of *o*-dichlorobenzene, MOEs were not below benchmarks for the environment or the general population due to the releases reported to TRI, or the highest release reported to DMR. Because EPA does not expect any facilities to have higher releases of *o*-dichlorobenzene than those represented within TRI and DMR, further investigation of other possible releasing facilities was not conducted. Release data collected from TRI can be found summarized for each OES in Section 4.3. Releases from DMR can be found summarized in water release and air release supplemental files ([U.S. EPA, 2026b](#), [2026ad](#)).

4.2.3.1 Introduction to the Data Reported to EPA

Generally, EPA used the facility-specific release data reported in TRI and DMR as annual releases in each dataset for each site and estimated the daily release by averaging the annual release over the expected release days per year. The Agency's approach to estimating release days per year is described in Section 4.2.5. The relevant supplemental files contain the calculations of the central tendency and high-end annual and daily releases for each OES that used EPA databases to estimate releases. For further information on release calculations, see *Land Releases for o-Dichlorobenzene* ([U.S. EPA, 2026u](#)), *Water Releases for o-Dichlorobenzene* ([U.S. EPA, 2026ad](#)), and *Air Releases for o-Dichlorobenzene* ([U.S. EPA, 2026b](#)).

Toxics Release Inventory

Section 313 of the Emergency Planning and Community Right-to-Know Act (EPCRA) established the TRI. TRI tracks the waste management of designated toxic chemicals from facilities within certain industry sectors. Facilities are required to report to TRI if the facility has 10 or more full-time

employees; is included in an applicable NAICS code; and manufactures, processes, or uses the chemical in quantities greater than a certain threshold (25,000 lb for manufacturers and processors and 10,000 lb for users of *o*-dichlorobenzene). Facilities provide on-site release information using readily available data (including monitoring data) collected pursuant to other provisions of law, or where such data are not readily available, “reasonable estimates” of the amounts released. EPA makes the reported information publicly available through TRI.

Each facility subject to the rule must report either using a Form R or a Form A. Facilities reporting using a Form R must report annually the volume of chemical released to the environment (*i.e.*, surface water, air, or land) and/or managed through recycling, energy recovery, and treatment (*e.g.*, incineration) from the facility. Facilities may submit a Form A if the volume of chemical manufactured, processed, or otherwise used does not exceed 1,000,000 lb per year (lb/year) and the total annual reportable releases do not exceed 500 lb/year. Facilities reporting using a Form A are not required to submit annual release and waste management volumes or use/sub-use information for the chemical. Due to reporting limitations, some sites that manufacture, process, or use *o*-dichlorobenzene may not report to TRI and are therefore not included in EPA’s assessment.

For each release quantity reported, TRI filers select a “basis of estimate” code to indicate the principal method used to determine the release quantity. TRI provides six basis of estimate codes, which in no particular order are continuous monitoring, periodic monitoring, mass balance calculations, published emission factors, site-specific emission factors, and engineering calculations/best engineering judgment. For facilities that use a TRI chemical in multiple operations, the filer may use a combination of methods to calculate the overall release quantity. In such cases, TRI instructs the facility to enter the basis of estimate code for the method that corresponds to the largest portion of the reported release quantity.¹ Additional details on the basis for the reported release estimate (*e.g.*, calculations, underlying assumptions) are not reported in TRI.

EPA included only TRI Form R submissions in the analysis of environmental releases. For Form Rs, the Agency assessed releases using the reported annual release volumes from each media. Three facilities reported *o*-dichlorobenzene releases to TRI submitted as Form A, and their releases were not quantified in this risk evaluation. EPA used TRI data from reporting years 2019 to 2023 to provide a basis for estimating releases ([U.S. EPA, 2021b](#)). Further details on EPA’s approach to using TRI data for estimating releases are described in Appendix D and Appendix F.

The Agency obtained 2019 to 2023 TRI data for *o*-dichlorobenzene from EPA’s Basic Plus Data Files. The Agency followed a similar approach to estimate air, water, and land releases; that is, EPA used the reported annual releases directly as reported in TRI and then divided the annual releases over the number of estimated operating days to obtain daily average release estimates. The release data are presented as high-end and central tendency estimates calculated from the 50th and 95th percentiles of the releases from all facilities mapped to a given OES. Release estimates are separated where relevant by stack and fugitive air emissions, surface water discharges, POTWs, non-POTW WWT, and land releases.

- Air emissions in TRI are reported separately for stack air and fugitive air and occur on-site at the facility. From 2019 to 2023, 25 facilities reported air emissions of *o*-dichlorobenzene, and there were 79 total reports.

¹ See [TRI Program Guidance](#) (accessed June 18, 2026) on EPA’s GuideME website under Reporting Forms and Instructions, Section 5. Quantity of the Toxic Chemical Entering Each Environmental Medium On-Site (Form R).

- Water releases in TRI include both reports of annual direct discharges to surface water and annual indirect discharges to off-site POTWs and WWT facilities. A total of 6 facilities reported non-zero water releases of *o*-dichlorobenzene.
- Land releases in TRI provide the type of release media for a particular facility, as well as how the chemical is managed through recycling, energy recovery, or treatment. A total of 9 facilities reported non-zero land releases of *o*-dichlorobenzene with a total of 19 reports.

NEI

The NEI was established to track emissions of Criteria Air Pollutants (CAPs) and CAP precursors and assist with National Ambient Air Quality Standard (NAAQS) compliance under the Clean Air Act (CAA). EPA uses NEI data to quantify air emissions of chemicals undergoing risk evaluation under TSCA. However, because *o*-dichlorobenzene is not listed as a CAA-HAP and facilities do not report *o*-dichlorobenzene air releases to NEI, the NEI database is not used to estimate any industrial or commercial *o*-dichlorobenzene release estimation.

DMR

Under the Clean Water Act (CWA), EPA regulates the discharge of pollutants into receiving waters through National Pollutant Discharge Elimination System (NPDES) permits, which authorize discharging facilities to discharge pollutants to specified effluent limits. There are two types of effluent limits: (1) technology-based, and (2) water quality-based. Although the technology-based effluent limits are uniform across the nation, the water quality-based effluent limits vary and are more stringent in certain areas. NPDES permits may also contain requirements for sewage sludge management.

NPDES permits apply pollutant discharge limits to each outfall at a facility. For TSCA risk evaluation purposes, EPA was interested only in the outfalls to surface water bodies. NPDES permits also include internal outfalls but they are not included in this analysis. This is because these outfalls are internal monitoring points within the facility wastewater collection or treatment system and do not represent discharges from the facility. NPDES permits require facilities to monitor their discharges and report the results to EPA and the state regulatory agency as results in DMRs. The Agency makes these reported data publicly available via EPA's Enforcement and Compliance History Online (ECHO) system and Water Pollutant Loading Tool (also referred to as "Loading Tool"). The latter is a web-based tool that obtains DMR data through ECHO, presents data summaries, and calculates pollutant loading (mass of pollutant discharged).

For this draft risk evaluation, EPA queried DMRs for all *o*-dichlorobenzene point source water discharges available for 2019 to 2023. Only the highest reported discharge was used in this draft assessment. A summary of all release data considered from DMR can be found in the water release supplemental information document ([U.S. EPA, 2026ad](#)). Additional details on EPA's approach to using DMR data for estimating releases are described in Section 4.2.3.2.

4.2.3.2 Approach for Estimating Water Releases from TRI and DMR

Where available, EPA used TRI and DMR to estimate annual wastewater discharges, average daily wastewater discharges, and high-end daily wastewater discharges. Water releases in TRI include both reports of annual direct discharges to surface water and annual indirect discharges to off-site POTWs and WWT facilities. Water releases in DMR considered in this assessment only include direct discharge to surface water. Direct surface water discharges are released to the environment, discharges to POTWs and WWT facilities are not directly released into the environment, but to treatment facilities.

Due to the volatility of *o*-dichlorobenzene, only small amounts are expected to enter wastewater treatment plants (WWTPs). Therefore, the *o*-dichlorobenzene discharged to a WWTP is expected to be

removed by volatilization and biodegradation, with volatilization being the predominant mechanism. See Section 3.5.2 for more information.

Annual Wastewater Discharges

For TRI, annual discharges are reported directly by facilities. For DMR, annual discharges are automatically calculated by the Loading Tool based on the sum of the discharges associated with each monitoring period in DMR. Monitoring periods in DMR are set by each facility's NPDES permit and can vary between facilities. Typical monitoring periods in DMR include monthly, bimonthly, quarterly, biannual, and annual reporting. In instances where a facility reports a period's monitoring results as below the LOD (or ND) for a pollutant, the Loading Tool applies a hybrid method to estimate the wastewater discharge for the period. The hybrid method sets the values to half of the LOD, if there was at least one detected value in the facility's DMRs in a calendar year. If all values were less than the LOD in a calendar year, the annual load is set to zero.

Average Daily Wastewater Discharges

To estimate average daily discharges, EPA used the following steps:

1. Obtained total annual loads calculated from the DMR Loading Tool and reported annual direct surface water discharges and indirect discharges to POTW and non-POTW WWT in TRI.
2. Any TRI reporters using Form A were removed as they were not included in the assessment
3. Determined if any of the facilities receiving indirect discharges reported in TRI have reported DMRs for the corresponding TRI reporting year. This indicates that the indirect discharge from TRI enter the facility that reported to DMR, and so the release to surface water reported from the DMR report captures the actual amount that is released to the environment, and the TRI indirect release can be excluded.
4. Divided the annual discharges over the number of estimated operating days (estimated as described in Section 4.2.5).
5. Estimated a release duration using facility-specific data available in models and/or literature sources. If no data was available, listed as "unknown."

The results of these calculations for DMR and TRI releases can be found in the water release supplemental information document ([U.S. EPA, 2026ad](#)).

4.2.3.3 Approach for Estimating Air Releases from TRI

Where available, EPA used TRI to estimate annual and average daily fugitive and stack air emissions. For air emissions, the Agency estimated both release patterns (*i.e.*, days per year of release) and release durations (*i.e.*, hours per day the release occurs). Air releases considered are available for review in the air release supplemental information document ([U.S. EPA, 2026b](#)).

Annual Emissions

Facility-level annual emissions are available for TRI reporters. EPA considered the reported annual emissions directly as reported in TRI for major sources. Emissions from TRI are summarized in this section.

Average Daily Emissions

To estimate average daily emissions for TRI reporters, EPA used the following steps:

1. Obtain total annual fugitive and stack emissions for each TRI reporter.
2. Any TRI reporters using Form A were removed, as they were not included in the assessment.
3. Divide the annual stack and fugitive emissions over the number of estimated operating days.

Estimate a release duration using facility-specific data available in models, and/or literature sources. If no data is available, list as “unknown.”

4.2.3.4 Approach for Estimating Land Releases from TRI

Where available, EPA used TRI data to estimate annual and average daily land disposal volumes. TRI includes reporting of disposal volumes for a variety of land disposal methods, including underground injection, RCRA Subtitle C landfills, land treatment, RCRA Subtitle C surface impoundments, other surface impoundments, and other land disposal. TRI also provides the type of release media for a particular facility, as well as how the chemical is managed through recycling, energy recovery, or treatment. EPA provided estimates for the total aggregated land disposal volume.

Annual Land Disposal

Facility-level annual disposal volumes are available directly for TRI reporters. EPA used the reported annual land disposal volumes directly as reported in TRI for each land disposal method. The Agency combined totals from all land disposal methods from each facility to estimate a total annual aggregate disposal volume to land.

Average Daily Land Disposal

To estimate average daily disposal volumes, EPA used the following steps:

1. Obtain total annual disposal volumes for each land disposal method for each TRI reporter.
2. Any TRI reporters using Form A were removed, as they were not included in the assessment.
3. Divide the annual disposal volumes for each land disposal method over the number of estimated operating days.

4.2.4 Approach for Identifying Release Sources

EPA performed a literature search to identify process operations that could potentially result in releases of *o*-dichlorobenzene to air, water, or land from each OES. For each OES, the Agency identified the release sources and the associated media of release. Where *o*-dichlorobenzene release sources were unclear or not available, EPA referenced relevant ESDs or GSs. Descriptions of release sources for each OES can be found in Section 4.3.

4.2.5 Approach for Estimating Number of Release Days

EPA typically assumed the number of release days per year from any release source will be equal to the number of operating days at the facility unless information is available to indicate otherwise. To estimate the number of operating days, EPA used the following hierarchy:

1. **Facility-Specific Data:** EPA used facility-specific operating days per year data if available. If facility-specific data was not available for one facility of interest but was available for other facilities within the same OES, EPA estimated the operating days per year using one of the following approaches:
 - a. If other facilities have known or estimated average daily use rates, EPA calculated the days per year as: $\text{Days/year} = \text{estimated annual use rate for the facility (kg/year)} / \text{average daily use rate from facilities with available data (kg/day)}$.
 - b. If facilities with days per year data do not have known or estimate average daily use rates, EPA used the average number of days per year from the facilities with such data available.
2. **Industry-Specific Data:** EPA used industry-specific data available from GSs, ESDs, trade publications, or other relevant literature.

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- 1926 3. ***Manufacture of Large-PV Commodity Chemicals:*** Commodity chemicals are basic and
1927 relatively inexpensive compounds that are often produced in large quantities at plants built
1928 specifically to make one chemical. These plants are often run continuously, typically only
1929 shutting down for a few weeks a year for maintenance. Because of this, for the manufacture of
1930 the large-PV commodity chemicals, EPA used a value of 350 days per year. This assumes the
1931 plant runs 7 days per week and 50 weeks per year (with 2 weeks down for turnaround) and
1932 assumes that the plant is always producing the chemical.
- 1933 4. ***Manufacture of Lower-PV Specialty Chemicals:*** Specialty chemicals are often more expensive
1934 and are produced less frequently, at smaller quantities, and on an “as needed” basis. Because of
1935 this, for the manufacture of lower-PV specialty chemicals, it is unlikely the chemical is being
1936 manufactured continuously throughout the year. Therefore, EPA used a value of 250 days per
1937 year. This assumes the plant manufactures the chemical five days per week and 50 weeks per
1938 year (with 2 weeks down for turnaround).
- 1939 5. ***Processing as Reactant (Intermediate Use) in the Manufacture of Commodity Chemicals:***
1940 Similar to #3, EPA assumed the manufacture of commodity chemicals occurs 350 days per year
1941 such that the use of a chemical as a reactant to manufacture a commodity chemical would also
1942 occur 350 days per year.
- 1943 6. ***Processing as Reactant (Intermediate Use) in the Manufacture of Specialty Chemicals:***
1944 Similar to #4, the manufacture of specialty chemicals is not likely to occur continuously
1945 throughout the year. Therefore, EPA used a value of 250 days per year.
- 1946 7. ***Other Chemical Plant OESs (e.g., Processing into Formulation and Use of Industrial***
1947 ***Processing Aids):*** For these OESs, EPA assumed that the chemical of interest is not always in
1948 use at the facility, even if the facility operates 24/7. Therefore, in general, EPA used a value of
1949 300 days/year based on the “[Specific Environmental Release Categories] SpERC fact sheet –
1950 Formulation & (re)packing of substances and mixtures – Industrial (Solvent-borne),” which uses
1951 a default of 300 days/year for the chemical industry ([ESIG, 2012](#)). However, in instances where
1952 the OES uses a low volume of the chemical of interest, EPA used 250 days per year as a lower
1953 estimate.
- 1954 8. ***POTWs:*** Although EPA expects POTWs to operate continuously over 365 days per year, the
1955 discharge frequency of the chemical of interest from a POTW will be dependent on the discharge
1956 patterns of the chemical from the upstream facilities discharging to the POTW. However, there
1957 can be multiple upstream facilities (possibly with different OESs) discharging to the same
1958 POTW and information to determine when the discharges from each facility occur on the same
1959 day or separate days is typically not available. Therefore, EPA could not determine an exact
1960 number of days per year the chemical of interest is discharged from the POTW and used a value
1961 of 365 days per year.
- 1962 9. ***All Other OESs:*** Regardless of what the facility operating schedule is, other OESs are unlikely
1963 to use the chemical of interest every day. Therefore, EPA used a value of 250 days per year for
1964 these OESs.

1965 **4.2.6 Evidence Integration for Environmental Releases**

1966 Evidence integration for the environmental release assessment includes analysis, synthesis, and
1967 integration of information and data to produce estimates of environmental releases and occupational
1968 inhalation exposures. During evidence integration, EPA considered the likely location, duration,
1969 intensity, frequency, and quantity of releases and exposures while also considering factors that increase

or decrease the strength of evidence when analyzing and integrating the data. Key factors the Agency considered when integrating evidence include the following:

1. **Data Quality:** EPA only integrated data or information rated as *high*, *medium*, or *low* obtained during the data evaluation phase. Data and information rated as *uninformative* are not used in exposure evidence integration. In general, higher rankings are given preference over lower ratings; however, lower ranked data may be used over higher ranked data when specific aspects of the data are carefully examined and compared. For example, a lower ranked dataset that precisely matches the OES of interest may be used over a higher ranked study that does not as closely match the OES of interest.
2. **Data Hierarchy:** EPA used both measured and modeled data to obtain accurate and representative estimates (e.g., central tendency, high-end) of the environmental releases and occupational exposures resulting directly from a specific source, medium, or product. If available, measured release and exposure data are given preference over modeled data, with the highest preference given to data that are both chemical-specific and directly representative of the OES/exposure source.

EPA considered both data quality and data hierarchy when determining evidence integration strategies. For example, the Agency may have given preference to high quality modeled data directly applicable to the OES being assessed over low quality measured data that is not specific to the OES. The final integration of the environmental release and occupational exposure evidence combined decisions regarding the strength of the available information, including information on plausibility and coherence across each evidence stream.

4.3 Industrial and Commercial Release Assessment

The following sections contain process descriptions and specific details (release sources, media of release, and release assessment approach and results) for the assessment of each OES. Only TRI releases are summarized in this section because they were the primary data used in the assessment. Releases from DMR are referenced if applicable in each OES section.

Refer to Table 4-1 to see how each OES described below pairs with the COUs stated in the *Draft Risk Evaluation for o-Dichlorobenzene* ([U.S. EPA, 2026z](#)).

A summary of the release data collected from the databases and considered in this assessment can be found at in the following locations:

- For surface water, POTW, and WWT releases (where applicable) from TRI and DMR, see *Water Releases for o-Dichlorobenzene* ([U.S. EPA, 2026ad](#));
- For stack and fugitive air releases from TRI, see *Air Releases for o-Dichlorobenzene* ([U.S. EPA, 2026b](#)); and
- For land releases, see *Land Releases for o-Dichlorobenzene* ([U.S. EPA, 2026u](#)).

4.3.1 Manufacturing

EPA identified that domestically, *o*-dichlorobenzene is unintentionally manufactured as a byproduct during the production of vinyl chloride monomer (VCM) ([Exponent Inc., 2024](#)). *o*-Dichlorobenzene may also be generated unintentionally during the process of manufacturing herbicides, 3,4-dichloroaniline, and isocyanates used to make polyurethane {[EPA-HQ-OPPT-2018-0444-0013](#)}. Preliminary review of 2024 CDR data indicates that *o*-dichlorobenzene has also been domestically manufactured as a primary product in recent years. While the Manufacturing OES in this draft risk evaluation focuses on manufacture as a byproduct, EPA intends to incorporate 2024 CDR data and other

reasonably available information regarding domestic manufacture of *o*-dichlorobenzene into the final risk evaluation.
As listed in Table 4-1, this OES addresses the Manufacturing COU category.

4.3.1.1 Process Description

Westlake reported that *o*-dichlorobenzene, along with its isomer *p*-dichlorobenzene, is manufactured as a byproduct during the production of VCM ([Exponent Inc., 2024](#)). Westlake indicated that in VCM production, chlorinated aromatics, including chlorobenzene and the *o*- and *p*-dichlorobenzene isomers, can form non-selectively during cyclization, aromatization, and chlorination steps. In the VCM unit, ethylene dichloride (EDC) is thermally cracked in vinyl furnaces to produce VCM in a continuous, semi-automatic process. Side reactions can form benzene, which may chlorinate to form chlorobenzenes, including *o*-dichlorobenzene. These byproducts are mixed with an intermediate feedstock (IFS) stream that comes into the facility from other plants and then routed to the waste treatment unit (WTU) for separation into two streams. After separation, one stream containing *o*-dichlorobenzene is routed to the Per-Tri Unit for processing, and here any residual level of *o*-dichlorobenzene in the IFS is expected to be consumed. The second stream is a non-recoverable organic mixture stream that is sent to waste storage and then it is incinerated in a halogen acid furnace (HAF) unit.

The concentration of *o*-dichlorobenzene in these streams is unknown, but the concentration of *p*-dichlorobenzene in the non-recoverable organic mixture stream was reported as 2%. Using this composition value, *p*-dichlorobenzene production was estimated to average 374,258 lb per year over 2017 to 2024. Westlake has confirmed that the amount of *o*-dichlorobenzene produced is less than the percentage of *p*-dichlorobenzene and so while it cannot be estimated, it is assumed to be less than the production volume of *p*-dichlorobenzene.

Regarding laboratory technicians, the laboratory analyzes the samples collected from the VCM and WTU units; samples are analyzed for water, pH level, product purity, and color, among other parameters. The laboratory does not analyze any samples for *o*-dichlorobenzene as this chemical is present in very low concentrations. Sample analysis is performed daily.

Also, as occurring during the manufacturing of VCM, *o*-dichlorobenzene may be produced as a byproduct for other manufacturing processes such as when manufacturing herbicides, 3,4-dichloroaniline, and isocyanates used to make polyurethane. However, EPA did not find descriptions of these chemical processes.

4.3.1.2 Number of Facilities and Release Days

EPA used TRI, DMR, and CDR data between 2019 and 2023 to identify four facilities that potentially manufacture *o*-dichlorobenzene as a byproduct in their chemical manufacturing process. Facilities that indicated the release of *o*-dichlorobenzene and were seen to produce VCM, or indicated in TRI that the chemical's presence is due to its manufacture as a byproduct, were categorized into this OES.

Note that facilities may report to multiple databases under different names and in these cases, EPA used reported addresses and company information to match facilities with their equivalents across databases; therefore, there is some uncertainty to the facility estimate.

Due to the uncertainty associated with reporting limits in the release databases, which may result in an underestimate of releasing facilities, EPA also considered the estimation approach of using the number of manufacturing sites for *o*-dichlorobenzene's isomer, *p*-dichlorobenzene, as a surrogate estimate for

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the number of sites for *o*-dichlorobenzene ([U.S. EPA, 2020e](#)). Using *p*-dichlorobenzene as a surrogate for *o*-dichlorobenzene is reasonable because Westlake reports *o*-dichlorobenzene forms in the same reactions as *p*-dichlorobenzene, and *p*-dichlorobenzene is produced domestically only as a VCM byproduct where *o*-dichlorobenzene is also present ([Exponent Inc., 2024](#)). Therefore, EPA estimates there may be as many as 14 *o*-dichlorobenzene manufacturing sites, which is equal to the number of VCM manufacturers that reported to CDR in 2020 ([U.S. EPA, 2020e](#)).

For facility operating schedules, *o*-dichlorobenzene is a byproduct in the manufacture of VCM, which is a large-PV commodity chemical most commonly used to manufacture other chemicals, so as described in Section 4.2.5, the Agency assumes that the facility operates 7 days per week, 50 weeks per year (2 weeks down for turnaround) and that the facility is producing and releasing the chemical daily during operation. This results in an estimated 350 days/year of operation. Without additional information, EPA assumes that number of release days per year is equivalent to the number of operating days per year.

4.3.1.3 Release Points

In general, potential sources of water releases in the chemical industry may include equipment cleaning operations, transport container cleaning, aqueous wastes from scrubbers/decanter, reaction water, process water from washing intermediate products, and trace water settled in storage tanks. Sources specific to *o*-dichlorobenzene may include cleaning of the waste storage tanks or transport containers holding the *o*-dichlorobenzene-containing IFS stream.

Sources of stack air releases are expected from vented losses to air during process operations and incineration of waste, as well as fugitive air releases from leakage of pipes (including equipment such as valves, pumps, and connectors), flanges, loading racks, and during container filling from equipment leaks and displaced vapor as containers are filled. Releases may also occur during sampling of the process.

4.3.1.4 Release Assessment

EPA used 2019 to 2023 TRI and 2019 to 2023 DMR to estimate environmental releases during the manufacture of *o*-dichlorobenzene. A summary of all releases can be found in the supplemental files referenced at the beginning of this section (Section 4.3). A summary of releases reported to TRI and DMR is presented in Table 4-5. According to reported data, *o*-dichlorobenzene is released through the following environmental media: surface water, fugitive air, and stack air. Also, for this OES, no on-site or off-site land releases and no POTW transfers are reported. Therefore, EPA does not expect direct or indirect land disposal.

Table 4-3. Summary of Environmental Releases During the Manufacture of *o*-Dichlorobenzene^a

Media	Estimated Annual Release Range Across Sites (kg/yr)		Number of Release Days	Estimated Daily Release Range Across Sites (kg/day)		Number of Facilities (and Data Points)	Source
	Central Tendency	High-End		Central Tendency	High-End		
Air (fugitive)	4.1	6.0	350	1.2E-02	1.7E-02	1 (3)	TRI
Air (stack)	136	146	350	0.39	0.42	1 (5)	TRI
Water (surface)	0.45	2.3	350	1.3E-03	6.5E-03	1 (5)	TRI
Water (surface)	0.45	21	350	1.3E-03	6.1E-02	1 (5)	DMR

4.3.2 Repackaging

o-Dichlorobenzene is considered “repackaged” when it is prepared for distribution in a different form (concentration change), state (solid, liquid, gas), or quantity than originally received, including imported material. EPA identified an Import and Repackaging OES based on 2020 CDR data ([U.S. EPA, 2020b](#)) that indicate two importers of record: one ships *o*-dichlorobenzene directly to other sites (*i.e.*, the importing sites of record do not handle or store the material) whereas the other classified the information of whether the chemical is on their site as confidential business information (CBI). This OES covers any facility that primarily repackages and distributes *o*-dichlorobenzene to its various downstream uses.

EPA assesses releases from transport operations (*e.g.*, loading/unloading) across relevant life cycle stages and COUs, not solely under a single distribution scenario. This section focuses on releases at facilities that primarily import or repackage *o*-dichlorobenzene; releases during transportation (*e.g.*, accidental spills) are addressed in Section 4.3.9 (Distribution in Commerce).

As listed in Table 4-1, this OES corresponds to the Import and Repackaging COU categories.

4.3.2.1 Process Description

In general, chemicals may be imported into the United States in bulk via water, air, land, and intermodal shipments ([Tomer and Kane, 2015](#)). These shipments take the form of oceangoing chemical tankers, railcars, tank trucks, and intermodal tank containers. *o*-Dichlorobenzene is shipped as a bulk liquid at ambient temperature and pressure by highway and rails, and as packaged hazardous material for smaller-volume distribution. By highway, it is commonly transported in DOT specification cargo tank motor vehicles (*e.g.*, DOT 407) under the U.S. DOT hazardous Materials Regulations for packaging specifications and tank requirements. By Rail, *o*-dichlorobenzene is transported in general-service tank cars in the 29,000-gallon class used for DOT-regulated liquid commodities. For packaged and intermediate bulk shipments, *o*-dichlorobenzene is often distributed in intermediate bulk containers (IBCs) (totes) (275–330 gallon capacity) and in 55-gallon drums for smaller customer deliveries. Because of its volatility and combustibility properties, facilities typically use tight connections, vapor controls, and proper site-permit-specific ventilation (per 49 CFR 179).

During loading and unloading of the material, hoses and transfer lines will be connected and disconnected between storage tanks and trucks, tanker cars, tanker trailers, and ISO (International Organization for Standardization) containers.

o-Dichlorobenzene may be imported or repackaged neat or as a component in formulation. Figure 4-2 provides both typical release and occupational exposure points during the repackaging of *o*-dichlorobenzene.

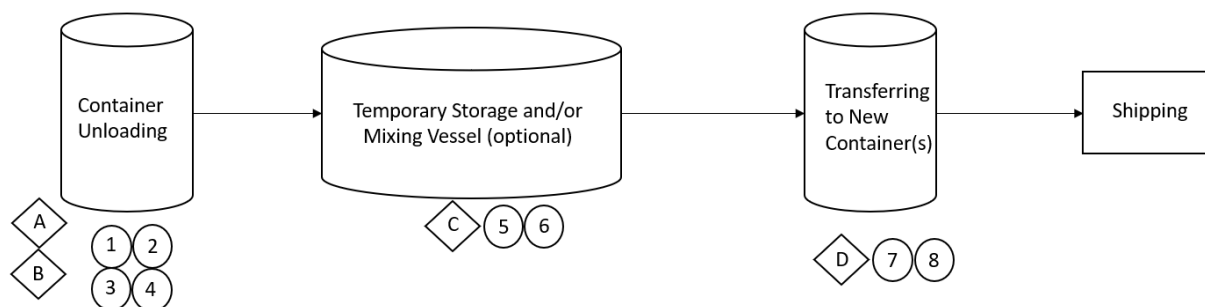


Figure 4-2. Typical Release and Exposure Points During the Repackaging of *o*-Dichlorobenzene

Source: ([U.S. EPA, 2022a](#))

Environmental Releases:

1. Releases to air from unloading volatile chemicals from transport containers.
2. Releases to air, water, incineration, or landfill from unloading solids from transport containers.
3. Releases to water, incineration or land from transport container residue (via container cleaning or direct disposal of empty containers).
4. Releases to air from cleaning transport containers containing volatile chemicals
5. Releases to water, incineration or land from cleaning of storage/mixing vessels and other equipment.
6. Releases to air from cleaning equipment used to process volatile chemicals.
7. Releases to air from loading volatile chemicals into transport containers.
8. Releases to air, water, incineration, or landfill from loading solids into transport containers.

Occupational Exposures:

- A. Inhalation exposures to volatile liquids and dust from unloading transport containers.
- B. Inhalation exposures to volatile liquids from transport container cleaning.
- C. Inhalation exposures to volatile liquids from equipment cleaning.
- D. Inhalation exposures to volatile liquids from loading transport containers.

4.3.2.2 Number of Facilities and Release Days

EPA used TRI, DMR, and CDR data between 2019 and 2023 to identify five facilities that potentially import or repackage *o*-dichlorobenzene. Facilities that indicated releases of *o*-dichlorobenzene and were reported to store, repackage, or import *o*-dichlorobenzene were categorized into this OES.

Note that facilities may report to multiple databases under different names and in these cases, EPA used reported addresses and company information to match facilities with their equivalents across databases, but there is some uncertainty to the facility estimate as a result.

Due to the uncertainty associated with reporting limits in the release databases, which may result in an underestimate of releasing facilities, EPA also considered the estimation approach of estimating number of facilities using relevant NAICS codes for the OES. EPA assessed a bounding estimate of 21,140 sites for this OES based on the number of sites listed under the identified NAICS codes. Using a bounding estimate will overestimate the true number of sites that use *o*-dichlorobenzene for this OES. EPA assigned the following NAICS codes for this OES:

- 325211 – Plastics Material and Resin Manufacturing
- 325991 – Custom Compounding of Purchased Resins
- 325199 – All Other Basic Organic Chemical Manufacturing
- 424610 – Plastics Materials and Basic Forms and Shapes Merchant Wholesalers
- 424690 – Other Chemical and Allied Products Merchant Wholesalers
- 424710 – Petroleum Bulk Stations and Terminals
- 424720 – Petroleum and Petroleum Products Merchant Wholesalers (except Bulk Stations and Terminals).

EPA did not identify data on facility operating schedules; therefore, the Agency assumes repackaging occurs 7 days/week and 50 weeks/year (with 2 weeks down for turnaround), which results in an estimate of 350 days/year of operation. Without additional information, EPA assumes that number of release days per year is equivalent to the number of operating days per year.

4.3.2.3 Release Points

Potential releases to air, water, or land may occur from loading and unloading of *o*-dichlorobenzene from transport containers, cleaning transport containers, cleaning of storage or mixing vessels and other equipment, cleaning equipment used to process the chemical, and loading into transport containers.

4.3.2.4 Release Assessment

EPA used 2019 to 2023 TRI and 2019 to 2023 DMR to estimate environmental releases during the repackaging of *o*-dichlorobenzene. A summary of releases can be found in the supplemental files referenced at the beginning of this section. According to reported data, *o*-dichlorobenzene is released through the following environmental media: fugitive air, stack air, and surface water. EPA does not expect significant releases to land from this OES.

Table 4-4. Summary of Environmental Releases During the Repackaging of *o*-Dichlorobenzene^a

Media	Estimated Annual Release Range Across Sites (kg/yr)		Number of Release Days	Estimated Daily Release Range Across Sites (kg/day)		Number of Facilities (and Data Points)	Source
	Central Tendency	High-End		Central Tendency	High-End		
Air (fugitive)	0		350	0		3	TRI
Air (stack)	0		350	0		3	TRI
Land	0		350	0		3	TRI
Water (surface)	0.5	0.83	350	2.4E-03	4.8E-04	2 (2)	DMR

4.3.3 Processing as a Reactant

o-Dichlorobenzene functions as a feedstock and key intermediate in the synthesis of downstream products from the basic organic chemical manufacturing sector. Regulatory sources identified its reactant use for manufacturing herbicide intermediates (e.g., precursors to 3,4-dichloroaniline compounds), producing dyes, and as a chemical intermediate in chlorinated aromatic chemistry (e.g., to produce 3,4,4'-trichlorocarbanilide [TCC]). TCC is a bacteriostat used in deodorant soaps ([Krishnamurti, 2001](#)). These chemical reaction operations run in enclosed batch and continuous reactor units, followed by separation and purification steps (distillation equipment). During this OES, *o*-dichlorobenzene is chemically transformed rather than a physical change for blending and mixture formulation.

As listed in Table 4-1, this OES addresses the Processing as a Reactant COU category.

4.3.3.1 Process Description

The 2024 CDR data identified two companies reporting processing of *o*-dichlorobenzene as a reactant. Company 1 (plastics/resin manufacturing sector and mostly CBI information) reported a maximum *o*-dichlorobenzene content greater than 90% and tagged “reactant” and industrial function as solvent. Thus, it is more likely used as a solvent than consumed as a reactant. Company 2 (other basic organic chemicals) reported import/manufacture with maximum *o*-dichlorobenzene content of less than 1%. Such concentration is impractical as a reactant, but more reasonably an incidental byproduct that is then processed. Thus, exact operations for the use of *o*-dichlorobenzene as a reactant to produce other chemicals were not found. For using a chemical as a reactant, operations would typically involve unloading the chemical from transport containers and feeding the chemical into a reaction vessel(s), where the chemical would react either fully or to a lesser extent. Following completion of the reaction, the produced substance may be purified further, thus removing unreacted *o*-dichlorobenzene (if any exists).

o-Dichlorobenzene is handled as a bulk liquid reagent or intermediate in basic organic chemical manufacturing systems. According to CDR, it has an overall PV range of 100,000 to 500,000 lb per year associated with industrial manufacture or processing uses. Typical facilities operate continuously

(utilities and tank-farm logistics), batch and consecutive batch reaction (no continuous operations), and running across multiple shifts and most days of the year. Received liquid *o*-dichlorobenzene goes to quality check and may then be stored in designated tanks. Then, *o*-dichlorobenzene is metered, fed to reactor units, and reacted in chlorinated-aromatic chemistry to synthesize intermediate chemicals (*e.g.*, feedstocks in herbicide and dye manufacturing). Crucial process steps include storage, transfer/charging, reaction, separation, purification, recycling, and waste-management. In a typical process, the chemical being processed as a reactant starts as a liquid at 95 to 100% in incoming material and later 5 to 30% of a total reactor charge depending on stoichiometry needs. The concentration decreases during the reaction as it is consumed and it then appears either as high-purity recycle cuts (>90%) or as lower fraction residues in waste streams. It is expected that this generic process is applicable to *o*-dichlorobenzene when it is processed as a reactant.

4.3.3.2 Number of Facilities and Release Days

EPA used TRI, DMR, and CDR data between 2019 and 2023 to identify three facilities that potentially process *o*-dichlorobenzene as a reactant. Facilities that indicated releases of *o*-dichlorobenzene and were reported to use *o*-dichlorobenzene as a reactant, or that are indicated to produce intermediate chemicals where *o*-dichlorobenzene is a known reactant, were categorized into this OES.

Note that facilities may report to multiple databases under different names, and in these cases, EPA used reported addresses and company information to match facilities with their equivalents across databases, but there is some uncertainty to the facility estimate as a result.

Due to the uncertainty associated with reporting limits in the release databases, which may result in an underestimate of releasing facilities, EPA also considered the estimation approach of estimating number of facilities using relevant NAICS codes for the OES. The potential number of sites for this OES was then estimated based on CDR. In 2020, one CDR reporter (Lanxess Corporation) listed an industrial function category of “intermediate.” The reporter estimated a maximum of 10 industry sites with this function. EPA assigned the following NAICS codes for this OES:

- 325199 – All Other Basic Organic Chemical Manufacturing
- 325211 – Plastics Material and Resin Manufacturing
- 325110 – Petrochemical Manufacturing
- 325180 – Other Basic Inorganic Chemical Manufacturing.

Information on operating days is typically reported by facilities to NEI. However, *o*-dichlorobenzene is not listed as a CAA-HAP and facilities do not report *o*-dichlorobenzene air releases to NEI. Therefore, based on *o*-dichlorobenzene being a commodity chemical, EPA assumes processing plants run 7 days per week, 50 weeks per year, which is 350 days per year. EPA assumed the number of release days per year will be equal to the number of operating days at the facility.

4.3.3.3 Release Points

In the chemical industry, water releases commonly arise from equipment and container cleaning, aqueous wastes from scrubbers/decanter, reaction and wash waters, and trace water in storage tanks. For *o*-dichlorobenzene, cleaning waste storage tanks or transport containers that hold *o*-dichlorobenzene-containing streams can generate water discharges. Air emission sources include stack/vented losses during process operations and waste incineration, and from fugitive leaks in piping/equipment (valves, pumps, connectors), flanges, loading racks, container filling (including displaced vapor), and process sampling.

4.3.3.4 Release Assessment

EPA used 2019 to 2023 TRI and 2019 to 2023 DMR to estimate environmental releases during the processing of *o*-dichlorobenzene as a reactant. A summary of all releases can be found in the supplemental files referenced at the beginning of this section (Section 4.3). A summary of releases reported to TRI and DMR is presented in Table 4-5. According to reported data, *o*-dichlorobenzene is released through the following environmental media: surface water, fugitive air, and stack air. Note that reported releases of “0” do not necessarily mean no releases, small releases below estimation methods or reporting thresholds may still have occurred and so are included in the table below. EPA does not expect significant releases to land from this OES.

Table 4-5. Summary of Environmental Releases During the Processing of *o*-Dichlorobenzene as a Reactant

Media	Estimated Annual Release Range Across Sites (kg/yr)		Number of Release Days	Estimated Daily Release Range Across Sites (kg/day)		Number of Facilities (and Data Points)	Source
	Central Tendency	High-End		Central Tendency	High-End		
Air (fugitive)	0	0	350	0	0	1	TRI
Air (stack)	0	0	350	0	0	1	TRI
Water (surface)	3.3	12	350	9.5E-03	3.3E-02	2 (5)	DMR

4.3.4 Incorporation into Formulation, Mixture, or Reaction Product

Incorporation into a formulation, mixture or reaction product refers to the process of mixing or blending of several raw materials to obtain a single product or preparation. EPA identified Incorporation into formulation, mixture, or reaction product as a use of *o*-dichlorobenzene due to *o*-dichlorobenzene’s presence in products such as lubricating oils, fuel additives, paints, coatings, paint thinners, inks, cleaning products, functional fluids, laboratory standards, and solvents (EPA-HQ-OPPT-2018-0446-0042; EPA-HQ-OPPT-2018-0444-0004; EPA-HQ-OPPT-2018-0444-0024). *o*-Dichlorobenzene is also used as a solvent in the pigment manufacturing process, though is stripped away before the final industry pigment product is produced. While not present intentionally, *o*-dichlorobenzene may appear in pigments due to this solvent use (EPA-HQ-OPPT-2018-0446-0039).

As listed in Table 4-1, this OES addresses part of the Solvents (which become part of product formulation or mixture) COU subcategory within the Processing life cycle stage.

4.3.4.1 Process Description

Incorporation into a formulation, mixture or reaction product refers to the process of mixing or blending of several raw materials to obtain a single product or preparation. *o*-Dichlorobenzene is incorporated into formulations for products such as lubricating oils, fuel additives, paints, coatings, paint thinners, cleaning products, functional fluids, laboratory standards, and solvents. EPA did not find process descriptions specifically relevant to *o*-dichlorobenzene, but below some descriptions of lubricant manufacturing and paint manufacturing are provided. These are expected to be relevant to *o*-dichlorobenzene.

Finished lubricants processing consists of blending base stock lubricants with additive chemicals to create a finished product. The three most common blending methods include batch, partial in-line, and continuous in-line blending. In each method, the base stock and additive chemical are unloaded into mixing equipment, blended, and transferred to storage (then transport

2302 containers), or directly to transport containers ([OECD, 2020](#)). *o*-Dichlorobenzene may be present in
2303 lubricants at up to 0.12%.
2304

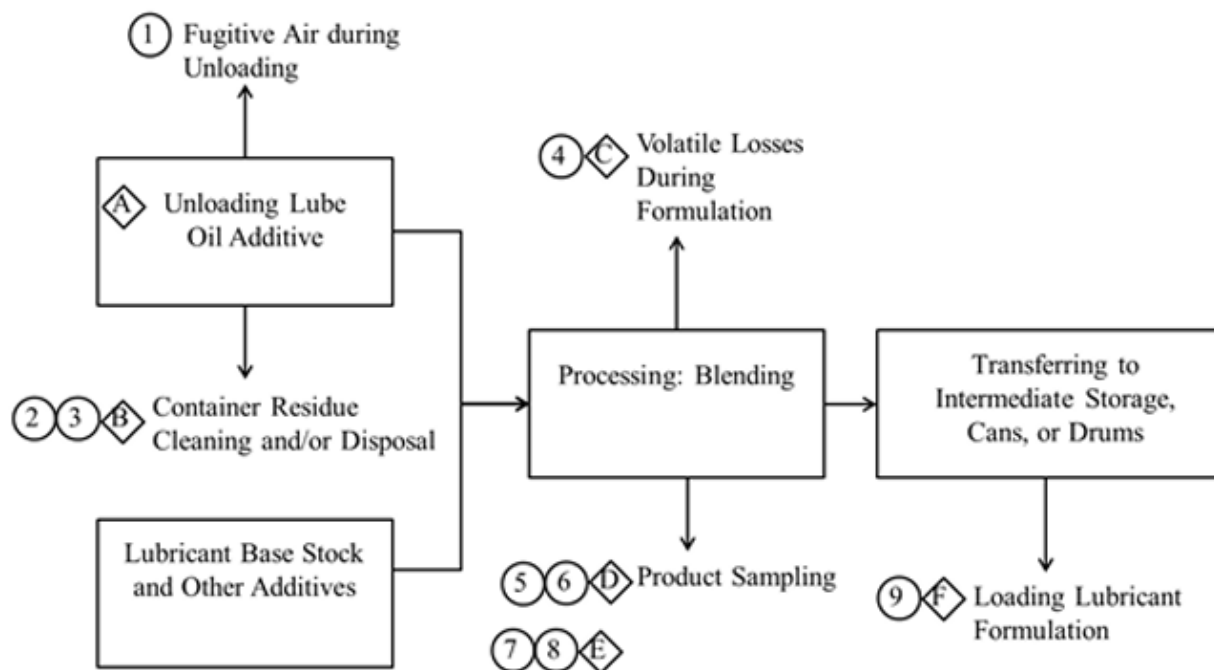


Figure 4-3. Typical Release and Exposure Points During Finished Lubricants Processing

Source: (OECD, 2020).

Environmental Releases:

1. Transfer operation losses of volatile chemicals to air
2. Container residue losses to water, incineration, or landfill
3. Open surface losses of volatile chemicals during container cleaning to air
4. Vented losses of volatile chemicals to air during blending
5. Open surface losses of volatile chemicals to air during product sampling
6. Product sampling wastes to water, incineration or landfill
7. Equipment cleaning losses to incineration or landfill
8. Open surface losses of volatile chemicals during equipment cleaning to air
9. Transfer operation losses of volatile chemicals to air

Occupational Exposure:

- A. Inhalation (volatiles only) and dermal exposures during container unloading
- B. Inhalation (volatiles only) and dermal exposures during container cleaning
- C. Inhalation (volatiles only) exposure during formulation
- D. Inhalation (volatiles only) and dermal exposures during product sampling
- E. Inhalation (volatiles only) and dermal exposures during equipment cleaning
- F. Inhalation (volatiles only) and dermal exposures during container loading

The formulation of paints and coatings typically involves dispersion, milling, finishing and filling into final packages (OECD, 2010). The highest concentration of *o*-dichlorobenzene in these products is for a sheep branding fluid, used similarly to a paint, that contained *o*-dichlorobenzene as concentrations up to 30% (Heiniger Australia Pty Ltd, 2016).

4.3.4.2 Number of Facilities and Release Days

EPA did not find information from TRI, DMR, or CDR data between 2019 and 2023 to identify number of facilities associated with this OES. Therefore, the potential number of sites for this OES was estimated based on the number of reporting sites from SUSB for the identified NAICS codes. EPA assessed a bounding estimate of 2,915 sites for this OES based on the number of sites listed under the identified NAICS codes. Using a bounding estimate will overestimate the true number of sites that use

o-dichlorobenzene for this OES. EPA assigned the following NAICS codes for this OES:

- 325510 – Paint and Coating Manufacturing
- 325130 – Synthetic Dye and Pigment Manufacturing
- 325910 – Printing Ink Manufacturing
- 325998 – All Other Miscellaneous Chemical Product and Preparation Manufacturing.

EPA did not identify data on facility operating schedules; therefore, EPA assumes that the chemical of interest is not always in use at the facility, even if the facility operates 24/7. EPA also assumes 300 days/year based on the “SpERC fact sheet – Formulation & (re)packing of substances and mixtures – Industrial (Solvent-borne),” which uses a default of 300 days/year for the chemical industry ([ESIG, 2012](#)). See Section 4.2.5 for more information. Without additional information, EPA assumes that number of release days per year is equivalent to the number of operating days per year.

4.3.4.3 Release Points

EPA expects releases to occur to water, incineration, or landfill due to container residue in transport containers, product sample wastes, and equipment cleaning. Due to the chemical’s volatility EPA also expects losses to air during container and equipment cleaning, transfer operations such as loading and unloading, product sampling, and mixing operations. EPA also expects stack air releases from vented losses during process operations and packaging into transport containers.

4.3.4.4 Release Assessment

EPA used 2019 to 2023 TRI and 2019 to 2023 DMR to estimate environmental releases during the use of *o*-dichlorobenzene in Incorporation into formulation, mixture, or reaction product. A summary of releases can be found in the supplemental files referenced at the beginning of this section (Section 4.3). Because there are no reported releases of *o*-dichlorobenzene found associated with this OES, EPA does not expect significant releases to air, water, or land from this OES.

4.3.5 Plastic Compounding

EPA identified Incorporation into formulation, mixture, or reaction product as a use of *o*-dichlorobenzene. *o*-Dichlorobenzene may be present at residual amounts when *p*-dichlorobenzene is used to make polyphenylene sulfide (PPS) resin. PPS resin contains less than 100 ppm of residual *p*-dichlorobenzene ([ACC, 2023](#)), and thus would contain even less *o*-dichlorobenzene. Residual *o*-dichlorobenzene may then be incorporated into the downstream product during plastic compounding.

As listed in Table 4-1, this OES includes part of the Solvents (which become part of product formulation of mixture) COU subcategory within the processing life cycle stage.

4.3.5.1 Process Description

After the manufacture of PPS resin, the resin may be transported to another facility for compounding. Compounding consists of blending polymers with plastics chemical additives to form a masterbatch, which is a mixture of polymers and additives, for further converting into finished articles. Also, chemical additives can be added during the converting process described in Section 4.3.6 In the compounding facilities, PPS polymer is blended with other additives and extruded into pellets. Extruders have individual exhaust ventilation over the die heads that are used to shape the plastic material into the desired pellets ([ACC, 2023](#)). One facility that compounds PPS reports having three compounding machines that are run 24 hours a day, 7 days a week.

Figure 4-4 below illustrates the general compounding processes and their associated environmental release sources and occupational exposure activities.

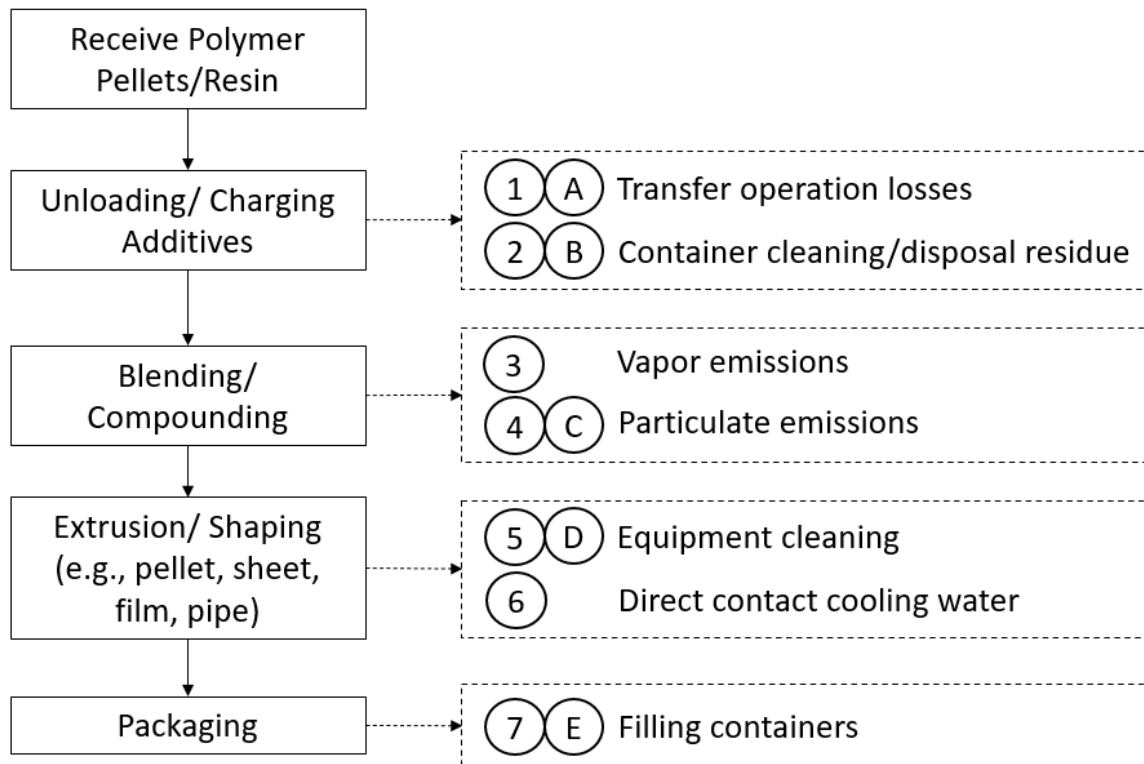


Figure 4-4. Typical Release and Exposure Points During Plastic Compounding

Source: (U.S. EPA, 2021c).

Environmental Releases:

- Transfer operations losses to air, water, incineration, or landfill from container transfers of additives
- Container residue cleaning/disposal losses to water, landfill, or incineration
- Vapor emissions from blending/compounding to fugitive or stack air (liquid additives only)
- Particulate emissions from blending/compounding to air, water, incineration, or landfill (solid additives only)
- Equipment cleaning residue losses to water, landfill, or incineration
- Direct contact cooling water releases to water
- Transfer operations losses to air, water, incineration, or landfill from loading compounded plastics into final containers (only applicable to pellets, granules, flakes, and other similar shapes)

Occupational Exposure:

- Inhalation exposure to solids and dermal exposure to liquids and solids during unloading of additive chemicals
- Inhalation exposure to solids and dermal exposure to liquids and solids during container cleaning
- Inhalation exposure to dusts generated during blending/compounding process operations
- Dermal exposure to liquids during equipment cleaning
- Inhalation exposures to solids during packaging of compounded plastics containing additive chemical (only applicable to pellets, granules, flakes, and other similar shapes)

4.3.5.2 Number of Facilities and Release Days

EPA did not find information from TRI, DMR, or CDR data between 2019 and 2023 to identify number of facilities associated with this OES. Therefore, the potential number of sites for this OES was then estimated based on the number of reporting sites from SUSB for the identified NAICS codes. EPA assessed a bounding estimate of 1,527 sites for this OES based on the number of sites listed under the identified NAICS codes. Using a bounding estimate will overestimate the true number of sites that use *o*-dichlorobenzene for this OES. EPA assigned the following NAICS codes for this OES:

- 325211 – Plastics Material and Resin Manufacturing

- 325991 – Custom Compounding of Purchased Resins

EPA did not identify data on facility operating schedules. The ESD on Plastic Additives references European technical guidance, which estimates up to 300 operating days/year for the polymers industry ([OECD, 2009](#)). EPA assumes 300 days/year of operation. Without additional information, EPA also assumes that number of release days per year is equivalent to the number of operating days per year.

4.3.5.3 Release Points

EPA expects releases to occur to air, water, landfill, or incineration from container transfers of compounded resin, container residue cleaning/disposal, vapor emissions from compounding and converting, and equipment cleaning. EPA also expects releases to wastewater from direct contact cooling and incineration, and landfill releases from solid waste trimming.

4.3.5.4 Release Assessment

EPA used 2019 to 2023 TRI and 2019 to 2023 DMR to estimate environmental releases during the use of *o*-dichlorobenzene in plastic compounding. A summary of releases can be found in the supplemental files referenced at the beginning of this section (Section 4.3). Because there are no reported releases of *o*-dichlorobenzene found associated with this OES, the Agency does not expect significant releases to air, water, or land from this OES.

4.3.6 Plastic Converting

EPA identified Incorporation into formulation as a use of *o*-dichlorobenzene, which encompasses plastic converting. *p*-Dichlorobenzene is used to make PPS resin, which contains less than 100 ppm of residual *p*-dichlorobenzene ([ACC, 2023](#)), and even less residual *o*-dichlorobenzene. This residual *o*-dichlorobenzene is then incorporated into the downstream product during plastic compounding, presented in Section 4.3.5, and then converted, described within this section.

As listed in Table 4-1, this OES includes part of the Solvents (which become part of Product formulation of mixture) COU subcategory within the processing life cycle stage.

4.3.6.1 Process Description

After the compounding process described in Section 4.3.5, compounded plastic and rubber resins are converted into solid articles. EPA did not find a process description specific to *o*-dichlorobenzene-containing plastic resin that would be converted but presents here a general process description of plastic converting, which is expected to be applicable.

Common converting processes include injection molding, extrusion, calendaring, blow molding, and thermoforming ([Sun and Wristers, 2002](#)). In injection molding, heated resin is injected into a cold mold where the plastic takes the shape of the mold as it solidifies. In extrusion, heated resin is forced through a die and then quenched to form products such as pipe, profiles, sheets, and wire coating and in calendaring, heated resin is fed onto rolls that compress the material into a thin layer to form sheets and films ([OECD, 2009](#)).

There are two types of blow molding that plastic and rubber producers use: extrusion and injection blow molding. In extrusion blow molding, an extruder delivers a tubular extrudate (parison) between two halves of a mold which are brought together around the hot extrudate, closing its top and bottom. Air is blown into the parison, forcing the polymer melt against the sides of the mold. In injection blow molding, the parison, usually in a preform shape, is formed by injection molding. The parison is normally transferred directly to a blow molding unit or it may be cooled and stored as a preform. In thermoforming, a plastic sheet is locked in a frame and is heated to the forming temperature when it is

brought into contact with a mold whose shape it assumes. In some cases, the process is assisted by drawing the sheet on to the form using vacuum, in others, pressure is applied. For all methods, in some cases the plastic product may undergo subsequent trimming to remove excess material. Other finishing operations, such as paint, coating, and bonding may occur (these are covered under other conditions of use) (OECD, 2009). Figure 4-5 highlights typical release and exposure points during plastics converting.

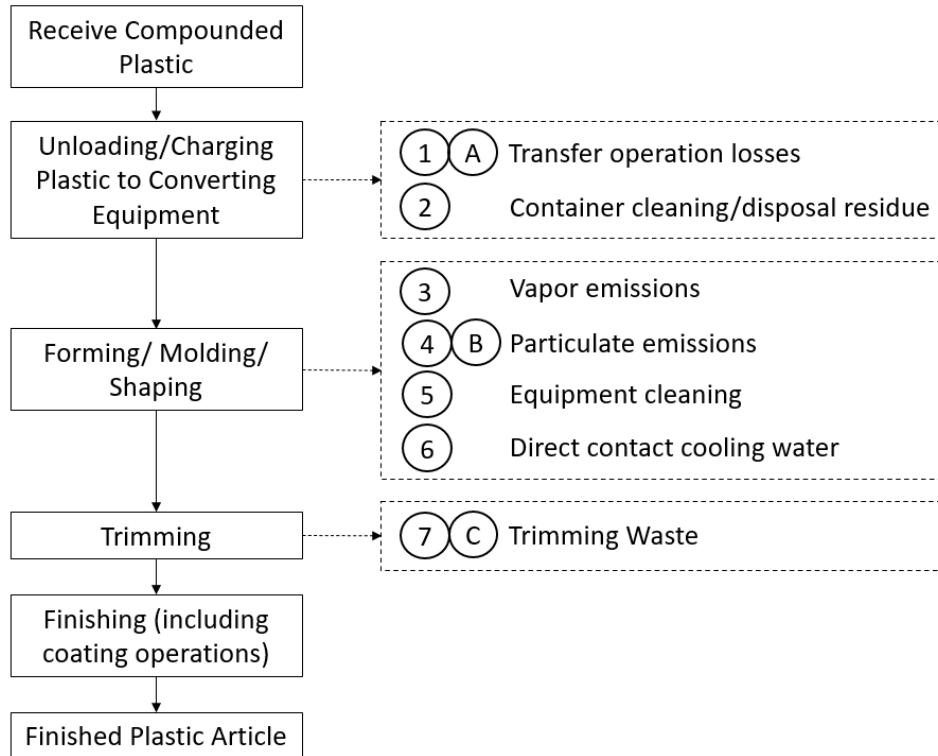


Figure 4-5. Typical Release and Exposure Points During Plastics Converting

Source: (U.S. EPA, 2004a)

Environmental Releases:

- Transfer operation losses to air, water, landfill or incineration from container transfers of compounded resin
- Container residue cleaning/disposal losses to water, landfill, or incineration
- Vapor emissions from converting to stack or fugitive air (liquid additives only)
- Particulate emissions from converting to air, water, incineration, or landfill (all additive types)
- Equipment cleaning losses to water, landfill, or incineration
- Direct contact cooling water release to water
- Solid waste from trimming operations to landfill or incineration

Occupational Exposure:

- Inhalation exposures to solids during unloading of compounded resins
- Inhalation exposure to dusts generated during converting processes
- Inhalation exposure to solids during trimming activities

4.3.6.2 Number of Facilities and Release Days

EPA did not find information from TRI, DMR, or CDR data between 2019 and 2023 to identify number of facilities associated with this OES. Therefore, the potential number of sites for this OES was then estimated based on the number of reporting sites from SUSB for the identified NAICS codes. EPA assessed a bounding estimate of 7,380 sites for this OES based on the number of sites listed under the identified NAICS codes. Using a bounding estimate will overestimate the true number of sites that use *o*-dichlorobenzene for this OES. EPA assigned the following NAICS codes for this OES. EPA assigned the following NAICS codes for this OES:

- 325199 – All Other Basic Organic Chemical Manufacturing
- 326100 – Plastics Product Manufacturing.

EPA did not identify data on facility operating schedules. The ESD on Plastic Additives references European technical guidance, which estimates up to 300 operating days/year for the polymers industry (OECD, 2009). EPA assumes 300 days/year of operation. Without additional information, EPA assumes that number of release days per year is equivalent to the number of operating days per year.

4.3.6.3 Release Points

EPA expects releases to occur to air, water, landfill, or incineration from container transfers of compounded resin, container residue cleaning/disposal, vapor emissions from compounding and converting, and equipment cleaning. EPA also expects releases to wastewater from direct contact cooling and incineration, and landfill releases from solid waste trimming.

4.3.6.4 Release Assessment

EPA used 2019 to 2023 TRI and 2019 to 2023 DMR to estimate environmental releases during the use of *o*-dichlorobenzene in Plastic converting. A summary of releases can be found in the supplemental files referenced at the beginning of this section (Section 4.3). Because there are no reported releases of *o*-dichlorobenzene found associated with this OES, EPA does not expect significant releases to air, water, or land from this OES.

4.3.7 Incorporation into Soap, Cleaning Compounds, and Toilet Preparation Manufacturing

Incorporation into a formulation, mixture or reaction product refers to the process of mixing or blending of several raw materials to obtain a single product or preparation. EPA identified Incorporation into formulation, mixture, or reaction product as a use of *o*-dichlorobenzene, due to *o*-dichlorobenzene's presence in soap, cleaning compounds, and air care products (EPA-HQ-OPPT-2018-0444-0004). This OES encompasses the releases and exposures that may occur during the formulation of these products.

As listed in Table 4-1, this OES captures the Soap, cleaning compound, and toilet preparation manufacturing COU subcategory.

4.3.7.1 Process Description

Incorporation into a formulation, mixture or reaction product refers to the process of mixing or blending of several raw materials to obtain a single product or preparation. *o*-Dichlorobenzene is incorporated into formulations for products such as precision parts cleaners (vapour degreasing chemicals), soaps, cleaning compounds, and air care products. EPA did not find process descriptions specifically relevant to *o*-dichlorobenzene, but below some descriptions of cleaning product formulations are provided. More specifically, formulation relevant to vapor degreasing is described as this is expected to be relevant to *o*-dichlorobenzene.

Vapour degreasing chemicals, such as *o*-dichlorobenzene, are manufactured as liquids. After manufacture, they could be used neat or could be further formulated. A typical vapour degreasing formulation contains more than 90% of the primary solvent and small amounts of secondary solvents and stabilizers. The composition of cleaners that have *o*-dichlorobenzene is unknown. Formulators (*i.e.* solvent producers) may add organic stabilizers to chlorinated solvents to inhibit decomposition of the solvent from reaction with water, oxygen, or ultraviolet light.

4.3.7.2 Number of Facilities and Release Days

EPA did not find information from TRI, DMR, or CDR data between 2019 and 2023 to identify number

of facilities associated with this OES. Therefore, the potential number of sites for this OES was then estimated based on the number of reporting sites from SUSB for the identified NAICS codes. EPA assessed a bounding estimate of 12,398 sites for this OES based on the number of sites listed under the identified NAICS codes. Using a bounding estimate will overestimate the true number of sites that use *o*-dichlorobenzene for this OES. EPA assigned the following NAICS codes for this OES:

- 325611 – Soap and Other Detergent Manufacturing
- 325612 – Polish and Other Sanitation Good Manufacturing
- 325620 – Toilet Preparation Manufacturing
- 424210 – Drugs and Druggists' Sundries Merchant Wholesalers.

EPA did not identify data on facility operating schedules; therefore, the Agency assumes that the chemical of interest is not always in use at the facility, even if the facility operates 24/7. Therefore, EPA assumes 300 days/year based on the “SpERC fact sheet – Formulation & (re)packing of substances and mixtures – Industrial (Solvent-borne)” which uses a default of 300 days/year for the chemical industry ([ESIG, 2012](#)). See Section 4.2.5 for more information. Without additional information, EPA assumes that number of release days per year is equivalent to the number of operating days per year.

4.3.7.3 Release Points

EPA expects releases to occur to water, incineration, or landfill due to container residue in transport containers, product sample wastes, and equipment cleaning. Due to the chemical’s volatility EPA also expects losses to air during container and equipment cleaning, transfer operations such as loading and unloading, product sampling, and mixing operations. EPA also expects stack air releases from vented losses during process operations and packaging into transport containers.

4.3.7.4 Release Assessment

EPA used 2019 to 2023 TRI and 2019 to 2023 DMR to estimate environmental releases during the use of *o*-dichlorobenzene in incorporation into soap, cleaning compounds, and toilet manufacturing products. A summary of releases can be found in the supplemental files referenced at the beginning of this section (Section 4.3). Because there are no reported releases of *o*-dichlorobenzene found associated with this OES, EPA does not expect significant releases to air, water, or land from this OES.

4.3.8 Industrial Use of Solvents

o-Dichlorobenzene is considered as a high-boiling organic solvent in industrial operations due to its strong solvency for hydrophobic chemicals and functional property stability. *o*-Dichlorobenzene dissolves, extracts, cleans, or facilitates processing of other chemicals in enclosed systems such as mixing vessels, separation units, cleaning equipment, and formulation tanks ([U.S. EPA, 2020d](#)).

As listed in Table 4-1, this OES addresses the Industrial Use categories of Solvents (which become part of product formulation or mixture), and non-incorporative activities, as well as the Processing category of Recycling.

4.3.8.1 Process Description

In the generic process flow diagram shown in Figure 4-6, *o*-dichlorobenzene is received in bulk-packaged shipments (*e.g.*, cargo tank trucks, intermediate bulk containers, rail tank cars), transferred to bulk storage, and pumped to solvent-use units for cleaning, extraction, blending, and formulation. The resulting multicomponent mixture undergoes product/solvent phase separation: the product-rich stream moves to purification and finishing, while the solvent-rich stream goes to a recovery unit (distillation/stripping). The recovery unit returns a high-purity *o*-dichlorobenzene recycle to storage. Still bottoms and spent solvent are shipped off-site to permitted treatment, storage, and disposal facilities

Typical environmental release points include unloading connections, storage tank vents, process and recovery-system vents, non-condensable streams, and spent-solvent handling units. Vents may be routed to air pollution controls such as condensers, carbon adsorption beds, thermal oxidizers, and flares.



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2580 *o*-Dichlorobenzene is also used as a reaction medium in the color pigment industry in the manufacture of
2581 Pigment Violet 23 as it is a relatively inert aromatic solvent with a high boiling point. In the
2582 manufacturing process, pigment ingredients were introduced into a reactor vessel containing *o*-
2583 dichlorobenzene. The ingredients dissolved into the chemical, which enhanced the completeness of their
2584 mixing and minimized the amount of unreacted ingredients. At the completion of the reaction, the *o*-
2585 dichlorobenzene was stripped off from the product, either by the introduction of steam into the reactor
2586 vessel or by washing with a miscible solvent. The remaining pigment product was then removed from
2587 the vessel and sold either as a dry powder or as a wet filter press cake (wet with water, not solvent). No
2588 solvent remained in the pigment at higher than parts per million levels. After being stripped off, the *o*-
2589 dichlorobenzene was recycled, typically by being reclaimed and then reused for additional iterations of
2590 the same manufacturing process. This process is reported to occur at only one company in the United
2591 States (EPA-HQ-OPPT-2018-0444-0024).

2592

EPA used TRI, DMR, and CDR data between 2019 and 2023 to identify 30 facilities that potentially use *o*-dichlorobenzene as an industrial solvent. Facilities that indicated the release of *o*-dichlorobenzene and were reported to use *o*-dichlorobenzene as a solvent were categorized into this OES.

Note that facilities may report to multiple databases under different names, and in these cases, EPA used reported addresses and company information to match facilities with their equivalents across databases but there is some uncertainty to the facility estimate as a result.

Operating schedule data were available from one reporting facility ([WeylChem, 2025](#)), which operates 24/7 year-round. Given that *o*-dichlorobenzene is a commodity solvent, EPA assumes typical industrial operations of 7 days/week for 50 weeks/year (350 days/year). Release days are assumed to be equal operating days.

4.3.8.3 Release Points

In the chemical industry, water releases commonly arise from equipment and container cleaning, aqueous wastes from scrubbers/decanter, reaction and wash waters, and trace water in storage tanks. For *o*-dichlorobenzene, cleaning waste storage tanks or transport containers that hold *o*-dichlorobenzene-containing streams can generate water discharges. Air emissions stem from stack/vented losses during process operations and waste incineration, and from fugitive leaks in piping/equipment (valves, pumps, connectors), flanges, loading racks, container filling (including displaced vapor), and process sampling.

Typical release points may include storage tank vents, loading and unloading operations, blending or mixing vessel vents, distillation and solvent recovery loops, equipment cleaning activities, and fugitive emission from pumps, valves, and transfer lines.

4.3.8.4 Release Assessment

EPA used 2019 to 2023 TRI and 2019 to 2023 DMR to estimate environmental releases during the industrial use of solvents of *o*-dichlorobenzene. A summary of all releases can be found in the supplemental files referenced at the beginning of this section (Section 4.3). A summary of releases reported to TRI and DMR is presented in Table 4-6. According to reported data, *o*-dichlorobenzene is released through the following environmental media: surface water, POTW transfer, fugitive air, and stack air. However, EPA does not expect significant releases to land from this OES.

Table 4-6. Summary of Environmental Releases During the Industrial Use of *o*-Dichlorobenzene as a Solvent

Media	Estimated Annual Release Range Across Sites (kg/yr)		Number of Release Days	Estimated Daily Release Range Across Sites (kg/day)		Number of Facilities (and Data Points)	Source
	Central Tendency	High-End		Central Tendency	High-End		
Air (fugitive)	581	5,148	350	1.7	15	3 (14)	TRI
Air (stack)	5.9	3,510	350	1.7E-02	10	4 (17)	TRI
Water (surface)	2.7		350	7.8E-03		1 (1)	TRI
Water (discharges to POTW)	5.4E-02	0.45E-01	350	1.6E-04	1.3E-03	2 (3)	TRI
Water (surface)	0.45	9.5	350	1.3E-03	2.7E-02	26 (51)	DMR
Land	0		350	0		4	TRI

4.3.9 Distribution in Commerce

For purposes of assessment in this risk evaluation, distribution in commerce consists of the

transportation associated with the moving of *o*-dichlorobenzene or *o*-dichlorobenzene-containing products and/or articles between sites manufacturing, processing, and use COUs, or the transportation of *o*-dichlorobenzene-containing wastes to recycling sites or for final disposal. EPA expects all the *o*-dichlorobenzene or *o*-dichlorobenzene-containing products and/or articles to be transported in closed system or otherwise to be transported in a form (e.g., articles containing *o*-dichlorobenzene) such that there is negligible potential for releases except during an incident. Therefore, no occupational exposures are reasonably expected to occur, and no separate assessment was performed for estimating releases and exposures from distribution in commerce.

4.3.10 Functional Fluids (Closed System)

It was reported to EPA that *o*-dichlorobenzene is used in a mixture with *p*-dichlorobenzene as a coolant in a closed system in the manufacture of organic chemicals.

As listed in Table 4-1, this OES includes the Function fluids (closed system) COU category.

4.3.10.1 Process Description

The *o*-dichlorobenzene in this process is used as a non-contact cooling medium. It is contained in a closed heat transfer system that recirculates within an organic chemical manufacturing process unit. The heat transfer fluid is a mixture of 75% *o*-dichlorobenzene and 25% *p*-dichlorobenzene. The *o*-dichlorobenzene is removed from the system only during maintenance, which occurs every 3 to 5 years (see EPA-HQ-OPPT-2018-0446-0037).

4.3.10.2 Number of Facilities and Release Days

EPA did not find information from TRI, DMR, or CDR data between 2019 and 2023 to identify number of facilities associated with this OES. Therefore, EPA assessed a bounding estimate of 841 sites for this OES based on the number of sites listed under the identified NAICS code. Using a bounding estimate will overestimate the true number of sites that use *o*-dichlorobenzene for this OES. EPA assigned the following NAICS codes for this OES:

- 333415 – Air-Conditioning and Warm Air Heating Equipment and Commercial and Industrial Refrigeration Equipment Manufacturing.

Because EPA did not identify data on facility operating schedules, the Agency assumed that the chemical of interest is not always in use at the facility, even if the facility operates 24/7. For these cases in general EPA may use a value of 300 days/year based on the “SpERC fact sheet – Formulation & (re)packing of substances and mixtures – Industrial (Solvent-borne)” which uses a default of 300 days/year for the chemical industry ([ESIG, 2012](#)). However, in instances such as Use in Functional Fluids, where the OES uses a low volume of the chemical of interest, EPA assumes 250 days per year as a lower estimate (see Section 4.2.5). Without additional information, the Agency assumes that number of release days per year is equivalent to the number of operating days per year.

4.3.10.3 Release Points

EPA expects releases to water, incineration, or landfill due to container residue in transport containers, product sample wastes, and equipment cleaning. Due to the chemical’s volatility EPA also expects losses to air during container and equipment cleaning, transfer operations such as loading and unloading, and product sampling. The Agency further also expects stack air releases from vented losses during packaging into transport containers. Most release points would occur during the transport of the material to and from the process, as the process is a closed system in which the chemical is rarely removed, and so releases to the environment due to the process itself are expected to be minimal.

4.3.10.4 Release Assessment

EPA used 2019 to 2023 TRI and 2019 to 2023 DMR to estimate environmental releases during the use of *o*-dichlorobenzene in functional fluids. A summary of releases can be found in the supplemental files referenced at the beginning of this section (Section 4.3). Because there are no reported releases of *o*-dichlorobenzene found associated with this OES, EPA does not expect significant releases to air, water, or land from this OES.

4.3.11 Use of Ink, Toner, and Colorant Products

o-Dichlorobenzene is used as a solvent in the pigment manufacturing process, though is stripped away before the final industry pigment product is produced. Although not present intentionally, *o*-dichlorobenzene may appear in pigments due to this solvent use ([EPA-HQ-OPPT-2018-0446-0039](#)). At most, *o*-dichlorobenzene may be present in pigments C.I. Pigment Violet 23 at parts per million levels ([EPA-HQ-OPPT-2018-0444-0024](#)).

As listed in Table 4-1, this OES captures the Ink, toner, and colorant products COU category within the commercial use life cycle stage.

4.3.11.1 Process Description

EPA did not find information on a process description for this use.

4.3.11.2 Number of Facilities and Release Days

EPA did not find information from TRI, DMR, or CDR data between 2019 and 2023 to identify number of facilities associated with this OES. Therefore, EPA assessed a bounding estimate of 23,585 sites for this OES based on the number of sites listed under the identified NAICS code. Using a bounding estimate will overestimate the true number of sites that use *o*-dichlorobenzene for this OES. EPA assigned the following NAICS codes for this OES:

- 325992 – Photographic Film, Paper, Plate, and Chemical Manufacturing
- 323111 – Commercial Printing (except Screen and Books)
- 323113 – Commercial Screen Printing.

EPA did not identify data on operating schedules; therefore, the Agency assumes the relevant products may not be used every day of the year, and so an estimate of 250 days/year of release is used in the assessment (Section 4.2.5).

4.3.11.3 Release Points

EPA expects releases to air, water, and land during the transport and use of this product. Releases to air during initial application, and to a lesser degree through the product's life even following application, are expected due to the chemical's volatility. Releases due to incineration and landfill as expected during the disposal of the product.

4.3.11.4 Release Assessment

EPA used 2019 to 2023 TRI and 2019 to 2023 DMR to estimate environmental releases during the use of *o*-dichlorobenzene in use of ink, toner, and colorant products. A summary of releases can be found in the supplemental files referenced at the beginning of this section (Section 4.3). Because there are no reported releases of *o*-dichlorobenzene found associated with this OES, EPA does not expect significant releases to air, water, or land from this OES.

4.3.12 Use of Paints and Coatings

o-Dichlorobenzene has been reported as a constituent within products or formulations for the

manufacture, operation, and maintenance of aerospace products. More specifically it was reported as a component of precious metal inks that can be brushed onto a substrate (EPA-HQ-OPPT-2018-0444-0016; EPA-HQ-OPPT-2018-0444-0004). *o*-Dichlorobenzene is also used as an ingredient in some specialized metallic coatings for ceramics, functioning within the coating as a solvent at concentrations between 5 and 10% (EPA-HQ-OPPT-2018-0444-0024)

It also may be present at low levels within pigments due to its use as a solvent during the manufacturing process of some pigments (more specifically, Pigment Violet 23) (EPA-HQ-OPPT-2018-0444-0024).

As listed in Table 4-1, this OES captures part of the Coatings and paints, thinners, paint removers COU subcategory within the commercial use life cycle stage.

4.3.12.1 Process Description

Paints and coatings containing *o*-dichlorobenzene may be applied via brushing the product onto a substrate, or it may be dipped or sprayed when applied as a coating on ceramics.

4.3.12.2 Number of Facilities and Release Days

EPA did not find information from TRI, DMR, or CDR data between 2019 and 2023 to identify number of facilities associated with this OES. Therefore, EPA assessed a bounding estimate of 54,075 sites for this OES based on the number of sites listed under the identified NAICS codes. Using a bounding estimate will overestimate the true number of sites that use *o*-dichlorobenzene for this OES. EPA assigned the following NAICS codes for this OES:

- 337126 – Household Furniture (except Wood and Upholstered) Manufacturing
- 337214 – Office Furniture (except Wood) Manufacturing
- 337127 – Institutional Furniture Manufacturing
- 337215 – Showcase, Partition, Shelving, and Locker Manufacturing
- 337122 – Nonupholstered Wood Household Furniture Manufacturing
- 337211 – Wood Office Furniture Manufacturing
- 337212 – Custom Architectural Woodwork and Millwork Manufacturing
- 337110 – Wood Kitchen Cabinet and Countertop Manufacturing
- 811120 – Automotive Body, Paint, Interior, and Glass Repair.

EPA did not identify data on operating schedules; therefore, the Agency assumes the relevant products may not be used every day of the year, and so an estimate of 250 days/year of release is used in the assessment (Section 4.2.5).

4.3.12.3 Release Points

EPA expects releases to air, water, and land during the transport and use of this product. Releases to air during initial application, and to a lesser degree through the product's life even following application, are expected due to the chemical's volatility. Releases due to incineration and landfill as expected during the disposal of the product.

4.3.12.4 Release Assessment

EPA used 2019 to 2023 TRI and 2019 to 2023 DMR to estimate environmental releases during the use of *o*-dichlorobenzene in use of paints and coatings. A summary of releases can be found in the supplemental files referenced at the beginning of this section (Section 4.3). Because there are no reported releases of *o*-dichlorobenzene found associated with this OES, EPA does not expect significant releases to air, water, or land from this OES.

4.3.13 Use of Paint Thinners and Removers

o-Dichlorobenzene has been reported as a constituent within products or formulations for the manufacture, operation, and maintenance of aerospace products. More specifically it was reported as a component of a formulation of paint stripper (EPA-HQ-OPPT-2018-0444-0004).

As listed in Table 4-1, this OES captures part of the Coatings and paints, thinners, paint removers COU subcategory within the commercial use life cycle stage.

4.3.13.1 Process Description

EPA did not find information on a process description for this use; however, the Agency assumes that this product may be used by pouring it into paint cans to thin the paint or brushing the product onto a painted surface and allowing time for the product to interact with the painted surface and allow for easier removal.

4.3.13.2 Number of Facilities and Release Days

EPA did not find information from TRI, DMR, or CDR data between 2019 and 2023 to identify number of facilities associated with this OES. Therefore, EPA assessed a bounding estimate of 1,760 sites for this OES based on the number of sites listed under the identified NAICS code. Using a bounding estimate will overestimate the true number of sites that use *o*-dichlorobenzene for this OES. Based on a public comment from the AIA (EPA-HQ-OPPT-2018-0444-0004), EPA assigned the following NAICS codes for this OES:

- 336410 – Aerospace Product and Parts Manufacturing.

EPA did not identify data on operating schedules; therefore, the Agency assumes the relevant products may not be used every day of the year, and so an estimate of 250 days/year of release is used in the assessment (Section 4.2.5).

4.3.13.3 Release Points

EPA expects releases to air, water, and land during the transport and use of this product. Releases to air during initial application, and to a lesser degree through the product's life even following application, are expected due to the chemical's volatility. Releases due to incineration and landfill as expected during the disposal of the product.

4.3.13.4 Release Assessment

EPA used 2019 to 2023 TRI and 2019 to 2023 DMR to estimate environmental releases during the use of *o*-dichlorobenzene in use of paint thinners and removers. A summary of releases can be found in the supplemental files referenced at the beginning of this section (Section 4.3). Because there are no reported releases of *o*-dichlorobenzene found associated with this OES, EPA does not expect significant releases to air, water, or land from this OES.

4.3.14 Sheep Branding Fluid

o-Dichlorobenzene has been reported as a constituent within sheep branding fluid at concentrations of up to 10 to 30% ([Heiniger Australia Pty Ltd, 2016](#)). The product comes in several colors in containers of 1.06 gallons.

As listed in Table 4-1, this OES captures part of the Coatings and paints, thinners, paint removers COU subcategory within the commercial use life cycle stage.

4.3.14.1 Process Description

The manufacturer website describes the use of this product. The container is shaken and stirred well with a broad flat paddle before use. The face of the branding iron is then dipped into the fluid. The paint is allowed to drip off the iron (into the can) to remove excess paint. The iron is then pressed firmly against the sheep ([Heiniger Australia Pty Ltd, 2016](#)).

The marking will last up to 2 to 4 months depending on variables such as weather and wool of the sheep.

4.3.14.2 Number of Facilities and Release Days

EPA did not find information from TRI, DMR, or CDR data between 2019 and 2023 to identify number of facilities associated with this OES. Therefore, the Agency assessed a bounding estimate of 4,758 sites for this OES based on the number of sites listed under the identified NAICS codes. Using a bounding estimate will overestimate the true number of sites that use *o*-dichlorobenzene for this OES. EPA assigned the following NAICS codes for this OES:

- 112410 – Sheep Farming; and
- 115210 – Support Activities for Animal Production.

EPA did not identify data on operating schedules; therefore, the Agency assumes the relevant products may not be used every day of the year and an estimate of 250 days/year of release was used in the draft assessment (Section 4.2.5).

4.3.14.3 Release Points

EPA expects releases to air, water, and land during the transport and use of this product. Releases to air during initial application, and to a lesser degree through the product's life even following application, are expected due to the chemical's volatility. Releases due to incineration and landfill as expected during the disposal of the product.

4.3.14.4 Release Assessment

EPA used 2019 to 2023 TRI and 2019 to 2023 DMR to estimate environmental releases during the use of *o*-dichlorobenzene in Sheep branding fluid. A summary of releases can be found in the supplemental files referenced at the beginning of this section (Section 4.3). Because there are no reported releases of *o*-dichlorobenzene found associated with this OES, EPA does not expect significant releases to air, water, or land from this OES.

4.3.15 Use of Lubricants and Greases

o-Dichlorobenzene has been reported as a constituent within products or formulations for the manufacture, operation, and maintenance of automotive and aerospace products. More specifically it was reported as a component of automotive engine oils, and oils used to maintain tools (EPA-HQ-OPPT-2018-0444-0016; EPA-HQ-OPPT-2018-0444-0004). *o*-Dichlorobenzene was identified as a component within a multipurpose lubricant for use in a variety of engine types, and a lubricant used specifically for pneumatic tools, both containing *o*-dichlorobenzene at concentrations of up to 0.12% (EPA-HQ-OPPT-2018-0446-0042).

As listed in Table 4-1, this OES captures the Lubricants and greases COU category within the commercial use life cycle stage.

4.3.15.1 Process Description

EPA has identified one product that acts exclusively as a lubricant, and which contains *o*-dichlorobenzene. This product is an oil for air tools that is designed to lubricate air-driven motors in

tools such as impact wrenches and other tools with high-speed motors that are air-driven. The product is reported to be used throughout commercial manufacturing and maintenance operations nationwide. It is sold in 4- and 32-ounce sizes, and the product accounts for less than 5% of the volume of products produced by the manufacturer. Recommended use of the product includes the application of 3 droplets to the tool from its dispensing container once per day for a daily-use tool. Use of the product is reported to extend tool life when used as recommended, thus reducing reduce waste disposal (EPA-HQ-OPPT-2018-0444-0026).

4.3.15.2 Number of Facilities and Release Days

EPA did not find information from TRI, DMR, or CDR data between 2019 and 2023 to identify number of facilities associated with this OES. Therefore, the Agency assessed a bounding estimate of 112,387 sites for this OES based on the number of sites listed under the identified NAICS codes. Using a bounding estimate will overestimate the true number of sites that use *o*-dichlorobenzene for this OES. EPA assigned the following NAICS codes for this OES:

- 811111 – General Automotive Repair
- 811114 – Specialized Automotive Repair
- 811191 – Automotive Oil Change and Lubrication Shops
- 336100 – Motor Vehicle Manufacturing
- 336200 – Motor Vehicle Body and Trailer Manufacturing
- 336300 – Motor Vehicle Parts Manufacturing
- 336400 – Aerospace Product and Parts Manufacturing
- 336411 – Aircraft Manufacturing
- 336600 – Ship and Boat Building
- 336900 – Other Transportation Equipment Manufacturing.

EPA did not identify data on operating schedules; therefore, the Agency assumes the relevant products may not be used every day of the year, and so an estimate of 250 days/year of release is used in the assessment (Section 4.2.5).

4.3.15.3 Release Points

EPA expects releases to air, water, and land during the transport and use of this product. Releases to air during initial application, and to a lesser degree through the product's life even following application, are expected due to the chemical's volatility. Releases due to incineration and landfill as expected during the disposal of the product.

4.3.15.4 Release Assessment

EPA used 2019 to 2023 TRI and 2019 to 2023 DMR to estimate environmental releases during the use of *o*-dichlorobenzene in lubricants and greases. A summary of releases can be found in the supplemental files referenced at the beginning of this section (Section 4.3). Because there are no reported releases of *o*-dichlorobenzene found associated with this OES, EPA does not expect significant releases to air, water, or land from this OES.

4.3.16 Use of Fuels and Related Products

o-Dichlorobenzene has been reported as a constituent within products or formulations for the manufacture, operation, and maintenance of automotive and aerospace products. More specifically it was reported as a component of automotive engine oils (EPA-HQ-OPPT-2018-0444-0016; EPA-HQ-OPPT-2018-0444-0004). *o*-Dichlorobenzene was identified at concentrations up to 0.12% as a component of a multipurpose lubricant product that also acts as a registered fuel additive for use in unleaded gasoline and diesel under EPA Office of Transportation and Air Quality (EPA-HQ-OPPT-

2018-0446-0042). *o*-Dichlorobenzene was also indicated to be present in some fuel additive products that are marketed to the aerospace community but not widely used (EPA-HQ-OPPT-2018-0444-0016).

As listed in Table 4-1, this OES captures the Fuels and related products COU category within the Commercial use life cycle stage.

4.3.16.1 Process Description

EPA has identified one product that acts as an additive to fuels and oils and that contains *o*-dichlorobenzene. This product is designed to be used in automobiles as an engine oil additive and as a fuel additive. It may also be used in snow blowers, lawn mowers, and other lawn implements. The product demonstrates the ability to improve the flow of engine oil and lubrication and it lubricates the top end systems of an engine and reduce sludge and varnish buildup that impede engine performance. The product is sold in 16-, 32-, and 128-ounce containers.

The product has been recommended as a 25% replacement for normal two-cylinder oil in tools and machines that use oil in gasoline for combustion. When used as a fuel additive, the product is directed to be added to either gasoline or diesel fuel at a rate of 4 fluid oz per 10 gallons of fuel. Once in the system, the manufacturer reports that the *o*-dichlorobenzene in the product will be combusted before exiting the engine exhaust, and a tail pipe's pollution control device may be designed to recycle any un-combusted vapors back into the fuel system (EPA-HQ-OPPT-2018-0444-0026).

4.3.16.2 Number of Facilities and Release Days

EPA did not find information from TRI, DMR, or CDR data between 2019 and 2023 to identify number of facilities associated with this OES. Therefore, EPA assessed a bounding estimate of 126,879 sites for this OES based on the number of sites listed under the identified NAICS codes. Using a bounding estimate will overestimate the true number of sites that use *o*-dichlorobenzene for this OES. EPA assigned the following NAICS codes for this OES:

- 221112 – Fossil Fuel Electric Power Generation
- 324199 – All Other Petroleum and Coal Products Manufacturing
- 457110 – Gasoline Stations with Convenience Stores
- 457120 – Other Gasoline Stations
- 457210 – Fuel Dealers
- 488190 – Other Support Activities for Air Transportation.

EPA did not identify data on operating schedules; therefore, the Agency assumes the relevant products may not be used every day of the year, and so an estimate of 250 days/year of release is used in the assessment (Section 4.2.5).

4.3.16.3 Release Points

EPA expects releases to air, water, and land during the transport and use of this product. Releases to air during initial application, and to a lesser degree through the product's life even following application, are expected due to the chemical's volatility. Releases due to incineration and landfill as expected during the disposal of the product.

4.3.16.4 Release Assessment

EPA used 2019 to 2023 TRI and 2019 to 2023 DMR to estimate environmental releases during the use of *o*-dichlorobenzene in fuels and related products. A summary of releases can be found in the supplemental files referenced at the beginning of this section (Section 4.3). Because there are no reported releases of *o*-dichlorobenzene found associated with this OES, EPA does not expect significant

releases to air, water, or land from this OES.

4.3.17 Use in Solid Air Care Products

o-Dichlorobenzene may be present in air care products such as antimicrobial products, bathroom cleaners, urinal and toilet deodorants, and deodorizing wall blocks at concentrations of up to 1% ([Home Depot, 2019](#)).

As listed in Table 4-1, this OES captures the Air care products COU category within the Commercial use life cycle stage.

4.3.17.1 Process Description

o-Dichlorobenzene may be present in multiple air care products. In the case of toilet deodorizers, these products are manufactured in tablet form, and each tablet is attached to a hanging device and hung on a toilet bowl or garbage can. The product is expected to slowly evaporate when exposed to air (EPA-HQ-OPPT-2018-0446-0011).

4.3.17.2 Number of Facilities and Release Days

EPA did not find information from TRI, DMR, or CDR data between 2019 and 2023 to identify number of facilities associated with this OES. Therefore, the Agency assessed a bounding estimate of 69,698 sites for this OES based on the number of sites listed under the identified NAICS codes. This value represents the number of contracting firms that provide janitorial services, as opposed to the number of facilities cleaned by the firms. As one firm can clean multiple sites, this may underestimate the true number of sites that use *o*-dichlorobenzene for this OES. Conversely, using a bounding estimate may overestimate the true number of sites that use *o*-dichlorobenzene for this OES. EPA assigned the following NAICS code for this OES:

- 561720 – Janitorial Services.

EPA did not identify data on operating schedules; therefore, the Agency assumes the relevant products may not be used every day of the year, and so an estimate of 250 days/year of release is used in the assessment (Section 4.2.5).

4.3.17.3 Release Points

EPA expects releases to water during the transport, installation, and use of this product. Releases to air are expected through the product's lifecycle due to the chemical's volatility and releases due to incineration and landfill as expected during the disposal of the product.

4.3.17.4 Release Assessment

EPA used 2019 to 2023 TRI and 2019 to 2023 DMR to estimate environmental releases during the use of *o*-dichlorobenzene in air care products. A summary of releases can be found in the supplemental files referenced at the beginning of this section (Section 4.3). Because there are no reported releases of *o*-dichlorobenzene found associated with this OES, EPA does not expect significant releases to air, water, or land from this OES.

4.3.18 Use of Laboratory Chemicals

EPA has identified several cases of *o*-dichlorobenzene in use as a laboratory chemical. A comment (EPA-HQ-OPPT-2018-0446-0036) from the National Aeronautics and Space Administration (NASA) provided descriptions of their use of *o*-dichlorobenzene as a critical use as a reference sample for analysis of terrestrial and extraterrestrial material samples and in laboratory applications for analytical standards, research, equipment calibration and sample preparation. Several products intended for

laboratory use were also found, indicating *o*-dichlorobenzene may be present in neat form ([Harrell Industries, 2015](#)).

As listed in Table 4-1, this OES captures part of the Laboratory chemicals; Cleaning and furnishing care products COU subcategory within the Commercial use life cycle stage.

4.3.18.1 Process Description

o-Dichlorobenzene may be involved in various processes as a laboratory chemical. *o*-Dichlorobenzene is expected to be used in these laboratory procedures and then disposed of with other laboratory wastes. Figure 4-7 highlights the typical release and exposure points during the use of *o*-dichlorobenzene as a laboratory chemical.

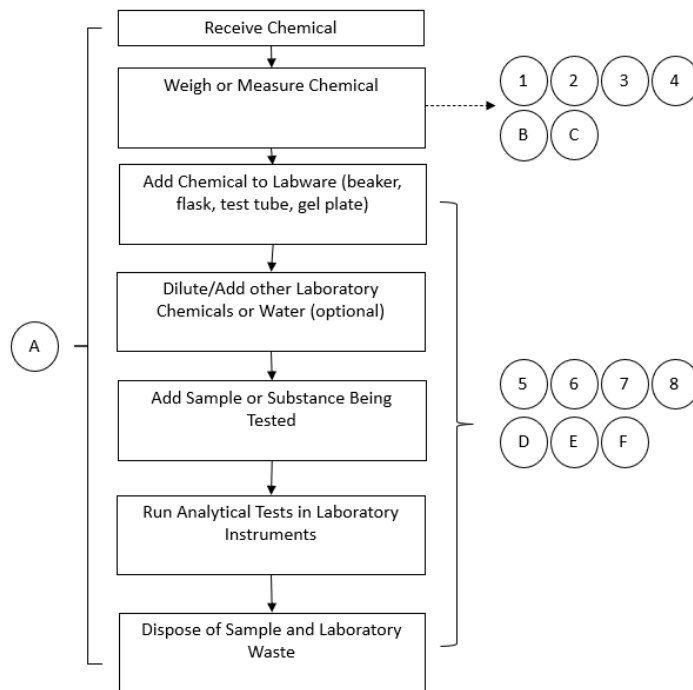


Figure 4-7. Typical Release and Exposure Points During the Laboratory Use of *o*-Dichlorobenzene

Source: ([U.S. EPA, 2023b](#))

Environmental Releases:

1. Release to air from transferring volatile chemicals from transport containers.
2. Release to air, water, incineration, or landfill from transferring solid powders.
3. Release to water, incineration, or land from cleaning or disposal of transport containers.
4. Release to air from cleaning containers used for volatile chemicals.
5. Labware equipment cleaning residuals released to water, incineration, or landfill.
6. Release to air during labware equipment cleaning for volatile chemicals.
7. Release to air from laboratory analyses for volatile chemicals.
8. Release to water, incineration, or landfill from laboratory waste disposal.

Occupational Exposures:

- A. Full-shift inhalation exposure from all activities.
- B. Inhalation exposure from unloading chemicals from transport containers (if full-shift estimates are not used).
- C. Inhalation exposure during container cleaning throughout sample preparation and testing activities (if full-shift estimates are not used).
- D. Inhalation exposure during equipment cleaning (if full-shift estimates are not used).
- E. Inhalation exposure during laboratory analyses (if full-shift estimates are not used).
- F. Inhalation exposure during disposal of laboratory chemicals (non-quantifiable)

4.3.18.2 Number of Facilities and Release Days

EPA did not find information from TRI, DMR, or CDR data between 2019 and 2023 to identify number of facilities associated with this OES. Therefore, EPA assessed a bounding estimate of 10,490 sites for this OES based on the number of sites listed under the identified NAICS codes. Using a bounding estimate will overestimate the true number of sites that use *o*-dichlorobenzene for this OES. EPA assigned the following NAICS codes for this OES:

- 541380 – Testing Laboratories
- 541714 – Research and Development in Biotechnology (except Nanobiotechnology).

EPA did not identify data on operating schedules; therefore, the Agency assumes the relevant products may not be used every day of the year, and so an estimate of 250 days/year of release is used in the assessment (Section 4.2.5).

4.3.18.3 Release Points

EPA expects releases to air, water, incineration, or landfill from transferring volatile chemicals from transport containers, cleaning or disposal of transport containers, cleaning containers used for volatile chemicals, labware equipment cleaning residuals, labware equipment cleaning, laboratory analyses, and laboratory waste disposal.

4.3.18.4 Release Assessment

EPA used 2019 to 2023 TRI and 2019 to 2023 DMR to estimate environmental releases during the use of *o*-dichlorobenzene in laboratory chemicals. A summary of releases can be found in the supplemental files referenced at the beginning of this section (Section 4.3). Because there are no reported releases of *o*-dichlorobenzene found associated with this OES, EPA does not expect significant releases to air, water, or land from this OES.

4.3.19 Use of Cleaning and Furnishing Care Products

o-Dichlorobenzene was identified in some cleaning and washing agents as recently as 2012 {Substances in Preparations in the Nordic countries, 2020, 6984595}, and in products within dry-cleaning facilities at concentrations of up to 95% {OECD, 2001, 5185286}.

As listed in Table 4-1, This OES captures part of the Laboratory chemicals; Cleaning and furnishing care products COU subcategory within the Commercial use life cycle stage.

4.3.19.1 Process Description

A process description relevant to these products was not found.

4.3.19.2 Number of Facilities and Release Days

EPA did not find information from TRI, DMR, or CDR data between 2019 and 2023 to identify number of facilities associated with this OES. Therefore, the Agency assessed a bounding estimate of 28,144 sites for this OES based on the number of sites listed under the identified NAICS codes. Using a bounding estimate will overestimate the true number of sites that use *o*-dichlorobenzene for this OES. EPA assigned the following NAICS codes for this OES:

- 561740 – Carpet and Upholstery Cleaning Services
- 812320 – Drycleaning and Laundry Services (except Coin-Operated).

EPA did not identify data on operating schedules; therefore, the Agency assumes the relevant products may not be used every day of the year, and so an estimate of 250 days/year of release is used in the assessment (Section 4.2.5).

4.3.19.3 Release Points

EPA expects releases to air, water, and land during the transport and use of this product. Releases to air during initial application, and to a lesser degree through the product's life even following application, are expected due to the chemical's volatility. Releases due to incineration and landfill as expected during the disposal of the product.

4.3.19.4 Release Assessment

EPA used 2019 to 2023 TRI and 2019 to 2023 DMR to estimate environmental releases during the use of *o*-dichlorobenzene in cleaning and furnishing care products. A summary of releases can be found in the supplemental files referenced at the beginning of this section (Section 4.3). Because there are no reported releases of *o*-dichlorobenzene found associated with this OES, EPA does not expect significant releases to air, water, or land from this OES.

4.3.20 Use of Other Cleaning Products

o-Dichlorobenzene was identified in some cleaning products, including one septic tank cleaner, Pro/pel Cesspool and Septic Tank Cleaner², that its material safety data sheet (MSDS) indicates the presence of *o*-dichlorobenzene at concentrations of greater than 99% ([Utility Wonder Products, 2014](#)).

As listed in Table 4-1, This OES captures part of the Laboratory chemicals; Cleaning and furnishing care products COU subcategory within the Commercial use life cycle stage.

4.3.20.1 Process Description

A process description relevant to the specific septic tank cleaner was not found but may involve the product being poured into a toilet and flushed.

4.3.20.2 Number of Facilities and Release Days

EPA did not find information from TRI, DMR, or CDR data between 2019 and 2023 to identify number of facilities associated with this OES. Therefore, the Agency assessed a bounding estimate of 3,545 sites for this OES based on the number of sites listed under the identified NAICS codes. Using a bounding estimate will overestimate the true number of sites that use *o*-dichlorobenzene for this OES. EPA assigned the following NAICS codes for this OES:

- 562991 – Septic Tank and Related Services.

EPA did not identify data on operating schedules; therefore, the Agency assumes the relevant products may not be used every day of the year, and so an estimate of 250 days/year of release is used in the assessment (Section 4.2.5).

4.3.20.3 Release Points

EPA expects releases to air, water, and land during the transport and use of this product. Releases to air during initial application, and to a lesser degree through the product's life even following application, are expected due to the chemical's volatility. Releases due to incineration and landfill as expected during the disposal of the product.

² https://www.utilitychemicals.com/pdf_files/10-205_SDS.pdf (accessed June 18, 2026).

4.3.20.4 Release Assessment

EPA used 2019 to 2023 TRI and 2019 to 2023 DMR to estimate environmental releases during the use of *o*-dichlorobenzene in other cleaning products. A summary of releases can be found in the supplemental files referenced at the beginning of this section (Section 4.3). Because there are no reported releases of *o*-dichlorobenzene found associated with this OES, EPA does not expect significant releases to air, water, or land from this OES.

4.3.21 Disposal

o-Dichlorobenzene is managed as a component of industrial waste streams for on-site and off-site management. This COU mostly occurs when *o*-dichlorobenzene is present in spent solvents, off-specification materials, contaminated processes residues, wastewater streams, and lab packs generated during manufacturing, processing, and use life cycle stages. Industrial sites that generate, treat, and dispose of waste on-site assess these releases within their relevant COU evaluation. *o*-dichlorobenzene off-site management occurs at permitted treatment, storage, and disposal facilities (TSDFs) for thermal destruction, energy recovery (co-processing), wastewater treatment, recycling, or final disposal. Figure 4-8 describes a typical waste disposal process starting from the waste generation facility to the TSDF. This OES encloses end-of-life management scenarios instead of intentional industrial use.

As listed in Figure 4-1, this OES captures the Disposal COU category.

4.3.21.1 Process Description

Waste containing *o*-dichlorobenzene generated during a COU sent to a TSDF may include the following:

- Wastewater: *o*-dichlorobenzene may be contained in wastewater discharged to POTW or non-public treatment facilities for treatment. Off-site transfers may include aqueous streams collected and sent for treatments, such as particulate matter captured in air pollution control devices, wastewater and slurries from equipment cleaning, plastic pellet spills, and container residues ([OECD, 2004](#)). Industrial wastewater containing *o*-dichlorobenzene discharged to a POTW may be subject to EPA or authorized NPDES state pretreatment programs. Assessment of wastewater discharges to POTWs and non-public treatment works for *o*-dichlorobenzene is included for each COU listed in Figure 4-1.
- Solid Wastes: Under RCRA, “solid waste” means any discarded material—such as abandoned materials, inherently waste-like materials, certain recycled materials, or discarded military munitions. Some instances of generating and legitimately reclaiming secondary materials are excluded from the solid waste definition. A solid waste is a hazardous waste if it is listed (40 CFR 261.30 to 261.35) or if it exhibits a hazardous characteristic (ignitability, corrosivity, reactivity, or toxicity; 40 CFR 261.20 to 261.24). Hazardous wastes are regulated under Subtitle C; non-hazardous solid wastes are regulated under Subtitle D. Off-site waste transfers from COUs listed in Figure 4-1 may include solids collected and sent to TSDFs.
- *o*-Dichlorobenzene is a U-listed hazardous waste under code U071 under RCRA; therefore, discarded, unused pure and commercial grades of *o*-dichlorobenzene are regulated as a hazardous waste under RCRA (40 CFR 261.33(f)).
- Wastes Exempted as Solid Wastes under RCRA: Certain COU of *o*-dichlorobenzene may generate wastes of *o*-dichlorobenzene that are exempted as solid wastes under 40 CFR 261.4(a). For example, the generation and legitimate reclamation of hazardous secondary materials of *o*-dichlorobenzene may be exempt as a solid waste.

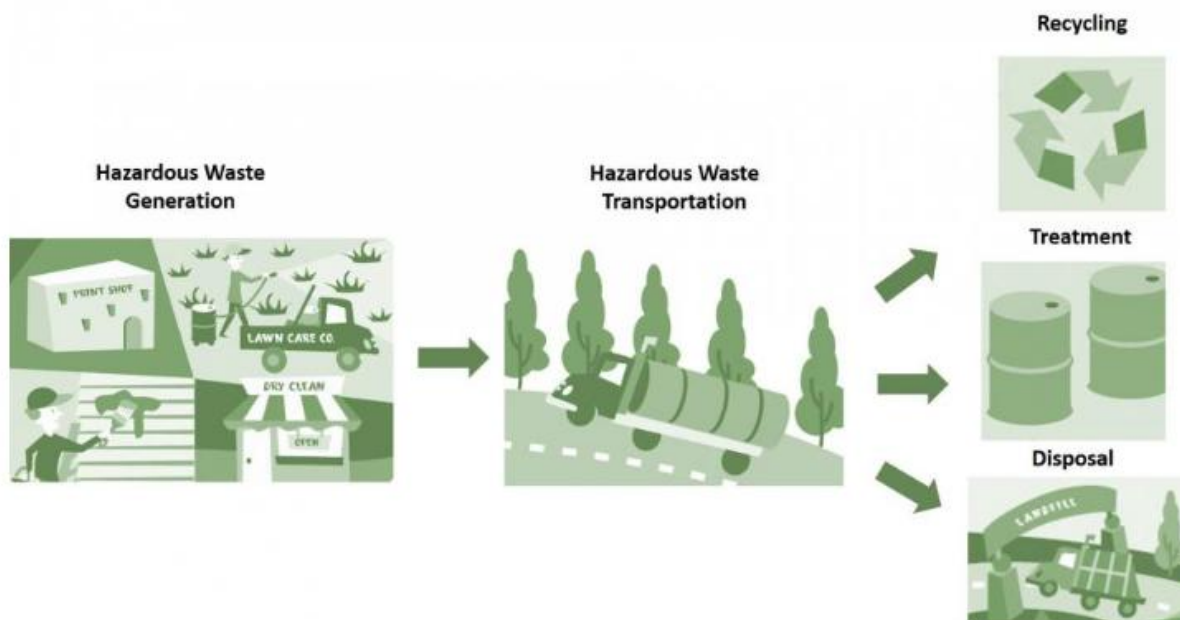


Figure 4-8. Typical Waste Disposal Process ([U.S. EPA, 2019f](#))

Municipal Waste Incineration

Energy-recovering municipal waste combustors (MWCs) typically operate at large facilities with an enclosed tipping floor and a deep waste pit. Capacities generally range from about 250 to over 1,000 tons per day. Waste is not handled directly by workers: trucks dump into the pit or onto the floor, where a front-end loader pushes it into the pit. An overhead crane with a grapple transfers waste to a hopper, and hydraulic rams feed it continuously into the combustion unit at a controlled rate. The crane operator mixes waste in the pit for consistent composition and heating value and removes hazardous or problematic items.

Facilities processing refuse-derived fuel (RDF) perform on-site sorting, shredding, and inspection to recover recyclables and remove hazardous or unwanted materials. Sorting is largely automated using mechanical separation (*e.g.*, trommel and disk screens, magnetic separators). After processing, the material is sent to a storage pit or conveyed directly to the combustion hopper.

Tipping-floor operations can generate dust, but air from the enclosed floor is continuously drawn into the furnace by forced-draft fans, serving as primary combustion air and reducing odors. Dust and lint are typically captured by filters or other air-cleaning devices to protect air-heating coils and help dry higher-moisture feed ([Kitto and Stultz, 1992](#)).

Hazardous Waste Incineration

Figure 4-9 illustrates a typical industrial incineration process. Commercial hazardous waste incinerators commonly use a two-stage design—a rotary kiln followed by an afterburner—to handle both solid and liquid wastes. Liquids are pumped and atomized through nozzles for efficient combustion, while solids are fed to the kiln as loose materials via a gravity hopper or in drums/containers on a conveyor ([ETC, 2018](#); [Heritage, 2018](#)). Hazardous waste is typically received by truck or rail and inspected upon arrival; liquid receiving areas include a dock, pumphouse, and storage, and solids are moved by conveyor systems ([ETC, 2018](#); [Kitto and Stultz, 1992](#)). Smaller units (*e.g.*, municipal or hospital infectious/hazardous waste incinerators) often require more direct handling; batch-loaded units involve placing waste on the grate before operation, sometimes by manually dumping or shoveling from containers.

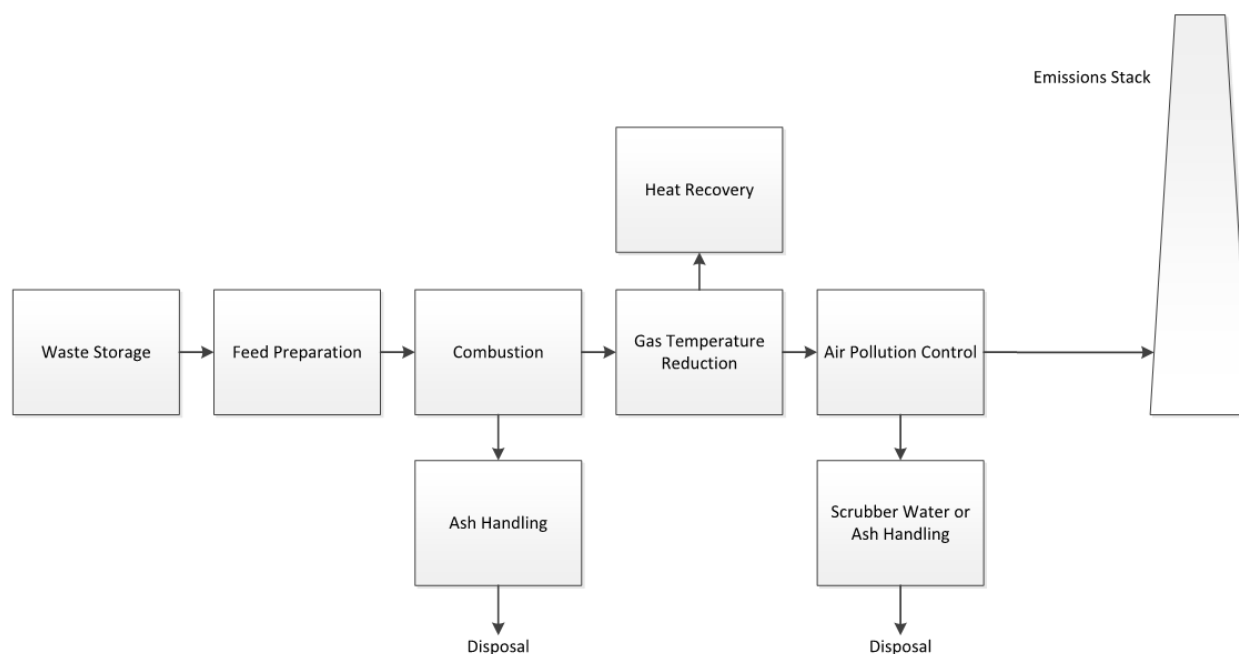


Figure 4-9. Typical Industrial Incineration Process

Municipal Waste Landfill

Municipal solid waste (MSW) landfills are engineered facilities that receive household waste and other non-hazardous solid wastes (e.g., industrial and commercial). They are regulated under RCRA Subtitle D, and states may adopt more stringent requirements. Core standards include location restrictions, composite liners with leachate collection and removal, operating practices, groundwater monitoring, closure and post-closure care, corrective action provisions, and financial assurance.

MSW may first be consolidated at transfer stations for temporary storage before transport to landfills or other treatment/disposal facilities. Certain wastes that would otherwise be hazardous can be disposed of at non-Subtitle C landfills if they are specifically exempt or conditionally excluded (e.g., household waste, certain special wastes) and meet applicable federal/state criteria.

Hazardous Waste Landfill

Hazardous waste landfills are engineered sites for the final disposal of non-liquid hazardous wastes. They must meet stringent design standards, including double liners, double leachate collection/removal systems, leak detection, run-on/runoff and wind-dispersal controls, and a construction quality assurance program (U.S. EPA, 2018b). Closure and post-closure requirements include installing a final cover and ongoing monitoring and maintenance to protect groundwater and nearby surface waters. These facilities are regulated under 40 CFR Parts 264/265, Subpart N.

4.3.21.2 Number of Facilities and Release Days

EPA used TRI, DMR, and CDR data from 2019 to 2023 to identify 35 facilities that potentially handle, treat, and dispose of *o*-dichlorobenzene containing waste. Facilities reporting *o*-dichlorobenzene releases and appear to conduct waste-handling activities were grouped into this OES.

Because facilities may report to multiple databases under different names, EPA matched records using reported addresses and company information. Some uncertainty in the facility count remains due to

potential duplicates or mismatches.

EPA did not identify data on facility operating schedules; therefore, the Agency assumes waste handling occurs 7 days/week and 50 weeks/year (with 2 weeks down for turnaround), which results in an estimate of 350 days/year of operation. Without additional information, EPA assumes that number of release days per year is equivalent to the number of operating days per year.

4.3.21.3 Release Points

Potential environmental releases may occur during unloading of solid or liquid waste containers, when connecting or disconnecting transfer lines and hoses, and during waste treatment operations. EPA expects air emissions of volatile *o*-dichlorobenzene during waste handling, treatment, and disposal, and anticipates releases of solid or liquid wastes to land.

4.3.21.4 Release Assessment

EPA estimated environmental releases associated with *o*-dichlorobenzene waste handling, treatment, and disposal using TRI (2019–2023) and DMR (2019–2023) data. Summary results are provided in the supplemental files cited at the start of Section 4.3, with TRI releases detailed in Table 4-7. TRI is the primary source for this assessment because it reports the largest quantities of environmental releases. Reported *o*-dichlorobenzene releases occur to surface water, fugitive air, stack air, and land.

Table 4-7. Summary of Environmental Releases During the Disposal of *o*-Dichlorobenzene

Media	Estimated Annual Release Range Across Sites (kg/yr)		Number of Release Days	Estimated Daily Release Range Across Sites (kg/day)		Number of Facilities	Source
	Central Tendency	High-End		Central Tendency	High-End		
Air (fugitive)	0.11	11	350	3.2E-04	3.2E-02	13 (41)	TRI
Air (stack)	0.45	31	350	1.3E-03	9.0E-02	10 (34)	TRI
Land (on-site)	3,270	1.1E04	350	9.4	31	1 (5)	TRI
Land (off-site)	1.9	4.8	350	5.4E-03	1.4E-02	4 (6)	TRI
Water (direct discharges)	0.17	40	350	4.7E-04	0.11	19 (36)	DMR

4.4 Weight of Scientific Evidence Conclusions for Release Assessment

EPA considered the assessment approach, the quality of the data, and the strengths, limitations, assumptions, and key sources of uncertainties in the assessment results to determine a weight of scientific evidence (WOSE) rating. EPA considered factors that increase or decrease the strength of the evidence supporting the release estimate—including quality of the data/information, applicability of the release or exposure data to the OES (including considerations of temporal relevance, locational relevance) and the representativeness of the estimate for the whole industry. The best professional judgment is summarized using the descriptors of robust, moderate, slight, or indeterminant, according to EPA’s Draft Systematic Review Protocol ([U.S. EPA, 2021a](#)). For example, a conclusion of moderate is appropriate where there is measured release data from a limited number of sources such that there is a limited number of data points that may not cover most or all the sites within the OES. A conclusion of slight is appropriate where there is limited information that does not sufficiently cover all sites within the OES, and the assumptions and uncertainties are not fully known or documented. See the Draft Protocol ([U.S. EPA, 2021a](#)) for additional information on weight of scientific evidence conclusions.

WOSE ratings for the environmental release and occupational exposure estimates for each OES, including details on the basis EPA used to determine the rating, are provided in the sections and tables that follow.

4.4.1 Overall Confidence in Release Estimates by OES

EPA considered release data from TRI and DMR to estimate releases for this chemical. In a screening level approach, the Agency investigated the MOEs below the benchmark MOE for the general population and the environment associated with all releases from TRI as well as the highest release from DMR. No MOEs were below the benchmark for the general population or the environment due to these releases. Because releases greater than those that report to TRI and DMR are not expected, EPA did not take further steps to model OESs that had limited release data.

Water releases are assessed using reported releases from 2019 to 2023 TRI and DMR. These databases received a medium and high data quality rating in systematic review respectively. The primary strength of TRI data is that it compiles the best readily available release data for all reporting facilities. Factors that decrease the overall confidence for this estimate include the uncertainty in the accuracy of reported releases, in mapping the releases to an OES, and in matching TRI sites with their entries in DMR (in cases when a facility may report to both). Most facilities only report NAICS codes to DMR; therefore, it can be uncertain what specific activity involving *o*-dichlorobenzene is occurring at the site. Additionally, there are a multitude of sites that report to TRI and not DMR—indicating that *o*-dichlorobenzene is present in more facilities than are reported in the water release data available to EPA. It is unclear whether these sites do not release to water, or if the site does not meet reporting thresholds for TRI.

Air releases are assessed using reported releases from 2019 to 2023 TRI. Factors that decrease the overall confidence in information from the TRI database include the uncertainty in the accuracy of reported releases and the limitations in representativeness to all sites because TRI may not capture all relevant sites. Additionally, EPA made assumptions on the number of operating days to estimate daily releases.

Land releases are assessed using reported releases from 2019 to 2023 TRI. The primary strength of TRI data is that TRI compiles the best readily available release data for all reporting facilities. Factors that decrease the overall confidence for this estimate include the uncertainty in the accuracy of reported releases and the limitations in representativeness to all sites because TRI may not capture all relevant sites.

In conclusion, though there is uncertainty of whether the databases capture all sites releasing to each medium, the release data are rated medium-to-high in systematic review and provide releases directly from a wide number of facilities. Based on this information, EPA has concluded that the weight of scientific evidence for this release assessment relevant to OESs that had release data available is moderate-to-robust. Some OESs did not have release data available; these cases were assessed qualitatively using the assumption that these cases would not have releases higher than those releases reported to the databases. These qualitative cases received a moderating rating in consideration of the strengths and limitations of reasonably available data. Table 4-8 presents which assessments were assessed quantitatively vs. qualitatively.

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Table 4-8. Summary of the Data Sources for Environmental Releases by OES

OES	Release Media	Reported Data ^a	Data Quality Rating ^b	Qualitative Assessment ^c	WOSE Conclusion
Manufacturing	Air	✓	M	✗	Moderate-to-Robust
	Water	✓	H	✗	
	Land	✗	N/A	✓	
Repackaging	Air, land	✗	N/A	✓	Moderate
	Water	✓	H	✗	Robust
Processing as a Reactant	Air	✓	M	✗	Moderate-to-Robust
	Water	✓	M/H	✗	
	Land	✓	M	✗	
Incorporation into Formulation, Mixture, or Reaction Product	Air, water, land	✗	N/A	✓	Moderate
Plastic Compounding	Air, water, land	✗	N/A	✓	Moderate
Plastic Converting	Air, water, land	✗	N/A	✓	Moderate
Incorporation into Soap, Cleaning Compound, and Toilet Preparation Manufacturing	Air, water, land	✗	N/A	✓	Moderate
Industrial Use of Solvents	Air	✓	M	✗	Moderate-to-Robust
	Water	✓	M/H		
	Land	✗	N/A		
Use in Functional Fluids	Air, water, land	✗	N/A	✓	Moderate
Use in Ink, Toner, and Colorant Products	Air, water, land	✗	N/A	✓	Moderate
Use of Paints and Coatings	Air, water, land	✗	N/A	✓	Moderate
Use of Paint Thinners and Removers	Air, water, land	✗	N/A	✓	Moderate
Sheep Branding Fluid	Air, water, land	✗	N/A	✓	Moderate
Use of Lubricants and Greases	Air, water, land	✗	N/A	✓	Moderate
Use in Solid Air Care Products	Air, water, land	✗	N/A	✓	Moderate
Use as Laboratory Chemical	Air, water, land	✗	N/A	✓	Moderate
Use of Cleaning and Furnishing Care Products	Air, water, land	✗	N/A	✓	Moderate
Use of Other Cleaning Products	Air, water, land	✗	N/A	✓	Moderate
Disposal	Air	✓	M	✗	Moderate-to-Robust
	Water	✓	M/H	✗	
	Land	✓	M	✗	

OES	Release Media	Reported Data ^a	Data Quality Rating ^b	Qualitative Assessment ^c	WOSE Conclusion
WOSE – weight of scientific evidence					
^a Reported data includes data obtained from EPA databases (<i>i.e.</i> , TRI and DMR).					
^b Data quality ratings for reported data are based on EPA systematic review and include ratings Low (L), Medium (M), and High (H)					
^c Where no data were available to estimate releases for an OES, releases were described qualitatively.					

3267
3268 Table 4-9 below provides further discussion on the rating of each OES.

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Table 4-9. Summary of Assumptions, Uncertainty, and Overall WOSE Conclusions in Environmental Release Estimates by OES

OES	Weight of Scientific Evidence Rating
Manufacturing	Environmental releases to air were assessed using reported releases from 2019–2023 TRI (U.S. EPA, 2026b), which received a medium rating in EPA’s systematic review. Releases to water from DMR data from 2019–2023 (U.S. EPA, 2026ad) were also considered but not expected to be significant due to the screening level assessments conducted (see Sections 6.3 and 6.5). DMR received a high rating from EPA’s systematic review process. No releases to land for this OES were reported. The assessment of release data from multiple EPA environmental release reporting databases increases confidence in release estimates. Furthermore, these data capture environmental releases from four manufacturing facilities that potentially manufacture <i>o</i>-dichlorobenzene as a byproduct in their chemical manufacturing process. Facilities that indicated the release of <i>o</i>-dichlorobenzene and were seen to produce VCM or indicated in TRI that the chemical’s presence is due to its manufacture as a byproduct, were categorized into this OES. Because the programmatic data provide a holistic assessment of releases from manufacturing <i>o</i>-dichlorobenzene as a byproduct, there is increased confidence that the release data cover all known manufacturing releases in the United States. As discussed above, the main strength of the analysis includes using industry reported release data to various EPA databases. However, the limitations of the analysis include the uncertainties discussed above, such as the temporal relevancy of the release data compared to the current year. Therefore, EPA concluded that the weight of scientific evidence for this assessment is moderate-to-robust, considering the strengths and limitations of reasonably available data.
Repackaging	*See table note
Processing as a Reactant	Environmental releases to air, water, and land were assessed using reported releases from 2019–2023 TRI (U.S. EPA, 2026b, 2026ad), which received a medium rating in EPA’s systematic review. DMR water release data from 2019–2023 received a high rating from the Agency’s systematic review process. The assessment of release data from multiple EPA environmental release reporting databases increases confidence in release estimates. Furthermore, these data capture environmental releases from 3 processing sites. Because the programmatic data provide a holistic assessment of releases from the processing of <i>o</i>-dichlorobenzene, there is increased confidence that the release data cover all known processing releases in the United States. The main strength of the analysis includes using industry reported release data to various EPA databases. However, the limitations of the analysis include the temporal relevancy of the release data compared to the current year. Therefore, the Agency concluded that the weight of scientific evidence for this assessment is moderate-to-robust, considering the strengths and limitations of reasonably available data.
Incorporation into Formulation, Mixture, or Reaction Product	*See table note

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OES	Weight of Scientific Evidence Rating
Plastic Compounding	
Plastic Converting	
Incorporation into Soap, Cleaning Compound, and Toilet Preparation Manufacturing	
Industrial use of Solvents	Environmental releases to air, water, and land were assessed using reported releases from 2019–2023 TRI (U.S. EPA, 2026b, 2026ad), which received a medium rating in EPA’s systematic review. DMR water release data from 2019–2023 received a high rating from EPA’s systematic review process. The assessment of release data from multiple EPA environmental release reporting databases increases confidence in release estimates. Furthermore, these data capture environmental releases from 30 sites that use <i>o</i>-dichlorobenzene as a solvent. Because the programmatic data provide a holistic assessment of releases from this use of <i>o</i>-dichlorobenzene, there is increased confidence that the release data cover all known releases in the United States. The main strength of the analysis includes using industry reported release data to various EPA databases. However, the limitations of the analysis include the temporal relevancy of the release data compared to the current year. Therefore, the Agency concluded that the weight of scientific evidence for this assessment is moderate-to-robust, considering the strengths and limitations of reasonably available data.
Functional Fluids	*See table note
Use of Ink, Toner, and Colorant Products	
Use of Paints and Coatings	
Use of Paint Thinners and Removers	
Sheep Branding Fluid	
Use of Lubricants and Greases	
Use of Fuels and Related Products	
Use in Solid Air Care	

OES	Weight of Scientific Evidence Rating
Products	
Use as Laboratory Chemical	
Use of Cleaning and Furnishing Care Products	
Use of Other Cleaning Products	
Disposal	Environmental releases to air and land were assessed using reported releases from 2019–2023 TRI (U.S. EPA, 2026b, 2026ad), which received a medium rating in EPA’s systematic review. DMR water release data from 2019–2023 received a high rating from the Agency’s systematic review process. The assessment of release data from multiple EPA environmental release reporting databases increases confidence in release estimates. Furthermore, these data capture environmental releases from 35 disposal sites. Because the programmatic data provide a holistic assessment of releases from the disposal of <i>o</i>-dichlorobenzene, there is increased confidence that the release data cover all known disposal releases in the United States. The main strength of the analysis includes using industry reported release data to various EPA databases. However, the limitations of the analysis include the temporal relevancy of the release data compared to the current year. Therefore, the Agency concluded that the weight of scientific evidence for this assessment is moderate-to-robust, considering the strengths and limitations of reasonably available data.
*There were no release data for air, water, or land in the release databases from facilities that use <i>o</i>-dichlorobenzene for this purpose. Consequently, EPA provided a qualitative assessment of releases. It is expected that releases to air, water, and land from this OES will be less than processing uses, otherwise they would have been reported to the release databases. For this reason, there is increased confidence in the qualitative assessment of releases from facilities that use <i>o</i>-dichlorobenzene for this OES. The strengths of the qualitative analysis include the comparison with processing data that is expected to be higher. However, the limitations of the analysis include the lack of directly applicable release data. Therefore, EPA concluded that the weight of scientific evidence for this assessment is moderate, considering the strengths and limitations of reasonably available data.	

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4.4.2 Strengths, Limitations, Assumptions, and Key Sources of Uncertainty for the Release Assessment

EPA estimated air, water, and land releases of *o*-dichlorobenzene using TRI and DMR data. TRI was determined to have an overall data quality rating of medium through EPA's systematic review process and DMR was determined to have a high-quality rating.

Strengths

TRI (which reports releases to air, land, and water) provides a comprehensive amount of release data for *o*-dichlorobenzene. A strength of using TRI is that it compiles the best readily available release data for all facilities that reported to EPA.

A strength of using DMR data and the Pollutant Loading Tool is that the tool calculates an annual pollutant load by integrating monitoring period release reports provided to the EPA and extrapolating over the course of the year. However, this approach assumes average quantities, concentrations, and hydrologic flows for a given period are representative of other times of the year.

Limitations

When using TRI data to analyze chemical releases, it is important to acknowledge that TRI reporting does not include all releases of the chemical and therefore, the number of sites for a given OES may be underestimated. For each OES that had TRI or DMR data, the analysis of releases for those OESs was limited to the facilities that reported releases to TRI and DMR. Therefore, it is uncertain the extent to which sites not captured in these databases have air, water, or land releases of *o*-dichlorobenzene.

Assumptions

To assess daily air and water discharges, EPA assumed that the number of facility operating days was equal to the number of release days. In some cases, EPA assumed the number of operating days based on industry information described in generic scenarios. In all other cases, the Agency has developed generic estimates for operating days described previously in Section 4.

There is uncertainty that all sites for a given OES operate for the assumed duration; therefore, the average daily releases may be higher if sites have fewer release days or lower if they have greater release days. Furthermore, *o*-dichlorobenzene concentrations in air emissions and wastewater release to receiving waterbodies at each facility may vary from day-to-day such that on any given day the actual daily releases may be higher or lower than the estimated average daily discharge. Thus, this approach minimizes variations in emissions and discharges from day-to-day. EPA did not estimate daily land releases due to the high level of uncertainty in the number of release days associated with land releases. The Agency expects that sites may not send waste to landfills every day and are more likely to accumulate waste for periodic shipments to landfills. However, sites that release to municipal landfills may have more frequent release days based on the frequency of shipments.

Uncertainties

Uncertainties with using TRI and DMR data include underestimation of the number of sites for a given OES due to reporting thresholds in TRI, the accuracy of EPA's mapping of sites reporting to TRI and DMR to a specific OES, and quality of the data reported to TRI and DMR.

Some uncertainties of using DMR data include the accuracy of EPA's mapping of sites reporting to DMR to a specific OES, and quality of the data reported to DMR. Also, an uncertainty of using the ECHO Pollutant Loading Tool Advanced Search option is that average measurements may be reported

as a quantity (kg/day) or a concentration (mg/L). Calculating annual loads from concentrations requires adding wastewater flow to the equation, which increases the uncertainty of the calculated annual load. In addition, for facilities that reported having zero pollutant loads to DMR, the EZ Search Load Module uses a combination of setting non-detects equal to zero and as one-half the detection limit to calculate the annual pollutant loadings. This method could cause overestimation or underestimation of annual and daily pollutant loads.

In some cases, the number of facilities for a given OES was estimated using data from the U.S. Census. In such cases, the average daily release calculated from sites reporting to TRI or NEI was applied to the total number of sites reported ([U.S. BLS, 2023b](#)). It is uncertain how accurate this average release is to actual releases at these sites; therefore, releases may be higher or lower than the calculated amount.

5 ENVIRONMENTAL MEDIA ASSESSMENT

5.1 Approach and Methodology

A literature search was conducted to identify peer-reviewed or gray sources of *o*-dichlorobenzene measured and reported modeled data. Environmental media concentration data from studies and databases identified through systematic review were evaluated according to the process described in the Draft Systematic Review Protocol ([U.S. EPA, 2021a](#)).

EPA searched peer-reviewed and gray literature³ published from 1990 through 2019 and databases through 2023, to obtain concentrations of *o*-dichlorobenzene in various media (air, water and land). The Agency considered the results of the initial literature search to have sufficient information on physical and chemical properties, as well as environmental fate and transport properties and did not proceed with an update to the peer-reviewed literature search for those disciplines. Although the systematic review included studies conducted outside of the United States, discussion herein is focused on U.S. and Canadian studies as these studies are most informative for this draft assessment. Supplemental information is provided for these studies and details on how to read and interpret the figures is provided in Appendix H. For more details on the systematic review for *o*-dichlorobenzene, see the *Draft Systematic Review Protocol for o-Dichlorobenzene* ([U.S. EPA, 2026ab](#)).

The approaches for estimating the concentrations of *o*-dichlorobenzene in environmental media rely on facility-specific releases associated with TSCA COUs as reported to TRI (air, water, and land), NEI (air), and NPDES and DMR (surface water). Where facility-specific releases were not identified for a given TSCA COU, releases were estimated, as described in detail in Section 4.

5.2 Air Pathway

5.2.1 Measured Concentrations in Ambient Air

5.2.1.1 Air Quality System (AQS)

Measured ambient air concentrations of *o*-dichlorobenzene were obtained from the EPA's Air Quality System (AQS), which contains ambient air pollution data collected by EPA, state, local, and tribal (SLT) air pollution control agencies from hundreds of monitors and serves as a repository of ambient air quality data that assists in air quality assessments, air quality designations (attainment/non-attainment), modeling for permit review and preparing reports for Congress as mandated by the CAA.

EPA evaluated monitoring data for samples collected from January 2019 through December 2023 in AQS to align monitoring data with the TRI 2019 to 2023 release data evaluated in this assessment. The *o*-dichlorobenzene monitoring data included over 31,000 24-hour sampling entries. Samples were collected using pressurized canisters over 24-hour durations and analyzed using gas chromatograph mass spectrometer (GC/MS). The resulting *o*-dichlorobenzene concentrations were reported in parts per billion-carbon (ppb-C) and converted into ppb by dividing by 6 (the number of carbon atoms in *o*-dichlorobenzene). The ppb values were then converted to $\mu\text{g}/\text{m}^3$ based on standard ambient temperature (25 °C) and pressure (1 atm). 77.4% of *o*-dichlorobenzene samples collected between 2019 through 2023

³ "Gray literature" is defined as the broad category of data or information sources not found in the standard, peer-reviewed literature databases such as PubMed and Web of Science. It is produced by organizations outside of traditional academic publishing channels. Gray literature includes data/information sources such as white papers, conference proceedings, technical reports, reference books, dissertations, information on various stakeholder websites, and various databases.

reported concentrations as zero.⁴ Detected air concentrations, *i.e.*, non-zero measurements, ranged from 0.006 to 23.1 $\mu\text{g}/\text{m}^3$; the highest concentration was reported in Pennsylvania in 2019.

Overall, across all detected 24-hour concentrations from all AQS monitoring stations between 2019 to 2023, the arithmetic mean was 0.13 $\mu\text{g}/\text{m}^3$, the geometric mean was 0.03 $\mu\text{g}/\text{m}^3$ and the median was 0.02 $\mu\text{g}/\text{m}^3$, indicating a positive skewness in the distribution of the monitoring data with 97.7% of the detected concentrations reported as less than 1 $\mu\text{g}/\text{m}^3$. Most of the samples reporting between 0.01 to 0.25 $\mu\text{g}/\text{m}^3$ as shown in Figure 5-1. The method detection limit (MDL) from AQS was not reported.

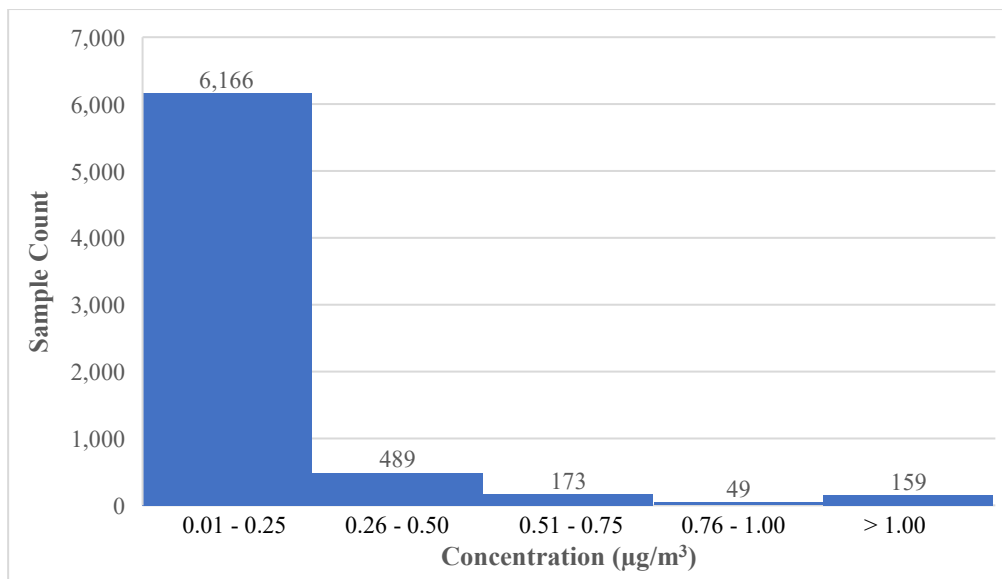


Figure 5-1. Histogram of AQS *o*-Dichlorobenzene 24-Hour Monitoring Concentrations (2019–2023)

When including zero measurements, 24-hour concentrations from all AQS monitoring stations between 2019 and 2023, the arithmetic mean ranged from 0.008 to 0.032 $\mu\text{g}/\text{m}^3$ across the years and the geometric mean and median were 0.0 $\mu\text{g}/\text{m}^3$. See Table_Apx G-1 for a summary of the AQS monitoring data for *o*-dichlorobenzene.

For more information on *o*-dichlorobenzene ambient air monitoring data, see the supplemental file *Draft Air Quality System (AQS) Monitoring Data 2019 to 2023 for o-Dichlorobenzene* ([U.S. EPA, 2026a](#)).

5.2.2 Measured Concentrations in Indoor Air

5.2.2.1 Peer-Reviewed Literature

Measured concentrations of *o*-dichlorobenzene in indoor air were extracted from three U.S. studies and one Canadian study published between the years 1995 and 2019 (Figure 5-2). Within the United States, Chin et al. (2014) collected samples in 126 residential homes in Detroit, Michigan, and reported concentrations ranging from non-detect (ND) to 0.51 $\mu\text{g}/\text{m}^3$ with an MDL of 0.01 $\mu\text{g}/\text{m}^3$ and a detection frequency of 2%. Lindstrom et al. (1995) measured *o*-dichlorobenzene in pre- and post-occupancy in conventional and experimental residential homes in Denver, Colorado; experimental homes were built with low-emitting building materials and appliances intended to improve indoor air quality. All homes reported NDs (MDL ranged from 0.24–2.4 $\mu\text{g}/\text{m}^3$) for *o*-dichlorobenzene in both pre- and post-occupancy phases, except for one experimental home, which reported a geometric mean of 3.24 $\mu\text{g}/\text{m}^3$.

⁴ The AQS does not report the MDL or samples as below MDL (<MDL) or NDs; these values are reported as zeros.

but only during the pre-occupancy phase. The New York Indoor Environmental Quality Center (NYIEQ) (2005) measured *o*-dichlorobenzene in over 130 residential homes between June 2001 to November 2004 in Syracuse, New York (n = 270) and reported minimum, median, mean and maximum concentrations of 4.6, 6.9, 14.4 and 73.05 µg/m³, respectively, with a detection frequency of 6%. Li et al. (2019), reported *o*-dichlorobenzene concentrations from measurements collected as part of the Canadian Health Measures Survey across 3,524 homes over a 24-month period throughout the country. Concentrations for *o*-dichlorobenzene ranged from ND to 5.4 µg/m³ with a detection limit of 0.01 µg/m³ and a detection frequency of 17.2%. None of the studies identified attributable sources for *o*-dichlorobenzene.

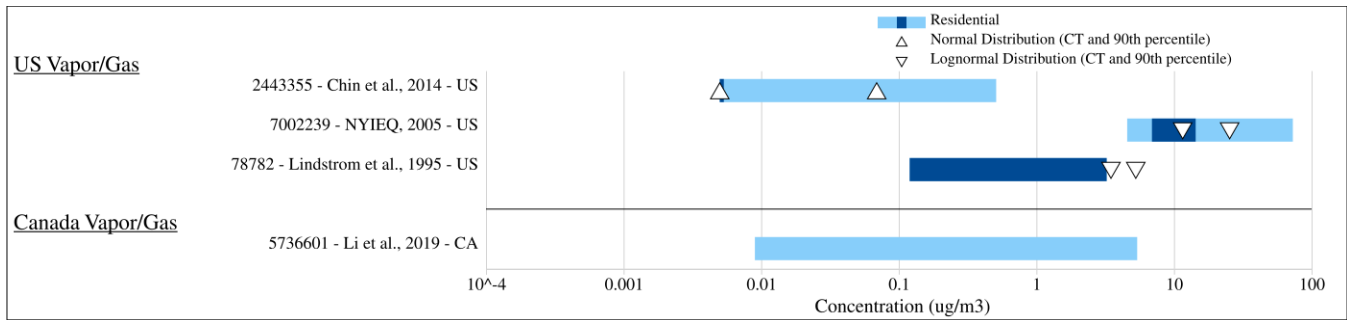


Figure 5-2. Concentrations of *o*-Dichlorobenzene (µg/m³) in the Vapor/Gas Fraction of Indoor Air in Residential Locations from 1992–2013

5.2.3 Evidence Integration for Air

Data from AQS and the literature show *o*-dichlorobenzene in ambient and indoor air, indicating environmental and general population exposure; therefore, EPA conducted a quantitative exposure assessment. EPA used the Integrated Indoor-Outdoor Air Calculator (IIOAC) to model ambient air concentrations based on facility releases from the TRI 2019 to 2023 database to assess environmental and general population exposure to air from facility releases of *o*-dichlorobenzene. See Section 3.4 for more details.

In addition, EPA used two models—the Consumer Exposure Model (CEM) and the Indoor Environmental Concentrations in Buildings with Conditioned and Unconditioned Zones (IECCU) Model—to assess consumer exposure for individuals using products containing *o*-dichlorobenzene within the indoor environment (see Section 7 for more details).

5.3 Water Pathway

5.3.1 Measured Concentrations in Surface Water and Sediment

5.3.1.1 Water Quality Portal

The Water Quality Portal (WQP) (NWQMC, 2022) is a publicly available resource that integrates water quality data from the U.S. Geological Survey (USGS) National Water Information System (NWIS) (USGS, 2013) and EPA’s Water Quality Exchange Data Warehouse (U.S. EPA, 2019h). The NWIS database contains current and historical data from more than 1.5 million sites across the nation. The WQX is the EPA’s repository of water quality monitoring data collected by U.S. water resource management groups. The complete set of *o*-dichlorobenzene monitoring results stored in WQP was retrieved in June 2025 with only the chemical name applied as a filter. The raw dataset included 16,276 samples from across the United States collected between 2019 and 2025. Although the *o*-dichlorobenzene WQP dataset exceeded 16,000 samples, most of the samples were groundwater with

only 3,029 samples from surface water collection ([U.S. EPA, 2026ac](#)).

Surface water monitoring data indicate that *o*-dichlorobenzene is usually below detection limits (<0.05 µg/L). Specifically, 99.6% of all *o*-dichlorobenzene surface water samples were either below detection limits (245 samples), below reporting limit (11 samples), not detected (2,561 samples), or present below quantification limit (212 samples). The highest detection limit across surface water monitoring data was 0.5 µg/L with one surface water sample having *o*-dichlorobenzene measured at the detection limit. No surface water samples had *o*-dichlorobenzene measured above detection limits.

Similarly, all sediment samples (100% of 525 samples) from the WQP database measured *o*-dichlorobenzene at or below detection limits with a maximum detection limit of 0.17 µg/L.

For more information and details, see the supplemental file *Water Quality Portal (WQP) Results for o-Dichlorobenzene and p-Dichlorobenzene* ([U.S. EPA, 2026ac](#)).

5.3.1.2 Peer-Reviewed Literature

EPA has identified studies through systematic review that measured *o*-dichlorobenzene in surface water and sediment. Measured concentrations of *o*-dichlorobenzene in surface water were extracted from two U.S. studies published between 1995 and 2010 (Figure 5-3). Coiner et al. (2010) collected 18 surface water samples from multiple creeks around Fort Riley, Kansas. All samples were below the minimum reporting level, which ranged from 10.2 to 13.3 µg/L. Chen et al. (1995) collected surface water samples near the Orange County municipal landfill in Orlando, Florida, between 1992 to 1993 and a reported a range of ND to 0.10 µg/L. The detection limit was not reported.

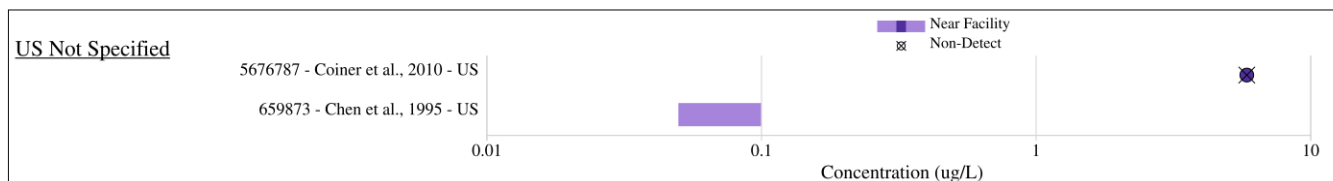


Figure 5-3. Concentrations of *o*-Dichlorobenzene (µg/L) in Surface Water from 1989–2008

Measured concentrations of *o*-dichlorobenzene in sediment were extracted from two U.S. studies published between 2010 and 2011 (Figure 5-4). Coiner et al. (2010) collected 18 sediment samples from multiple creeks around Fort Riley, Kansas. All samples were below the minimum reporting level (<RL) which ranged from 1,360 to 1,570 µg/kg. Yun and Kannan (2011) reported 75 surface sediment samples collected from the Pine River, Tittabawassee River, Shiawassee River, Saginaw River, and Saginaw Bay, Michigan between 2002 to 2004 with a concentration range from below limit of detection (<LOD) of 0.02 to 3.03 ng/g dry weight).

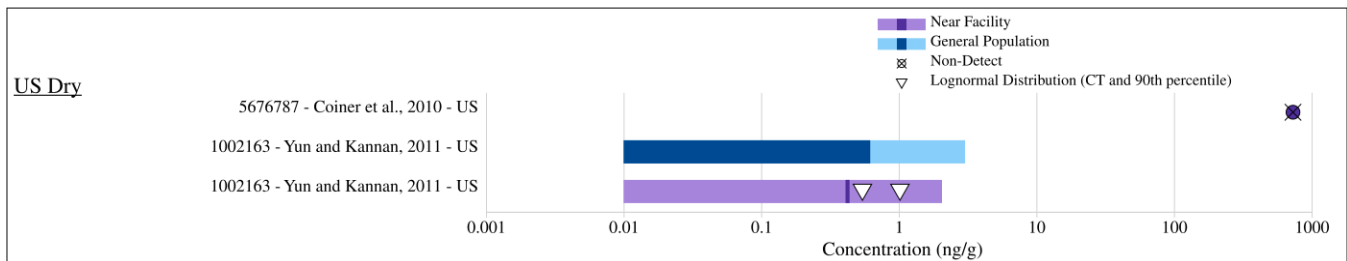


Figure 5-4. Concentrations of *o*-Dichlorobenzene (ng/g) in Sediment from 2002–2008

5.3.2 Measured Concentrations in Drinking Water

5.3.2.1 Peer-Reviewed Literature

Measured concentrations of *o*-dichlorobenzene in drinking water were extracted from two U.S. studies published between 2008 and 2009 (Figure 5-5). Kingsbury et al. (2008) and Hopple et al. (2009) are both studies published by USGS as part of the National Water Quality Assessment Program (NAWQA). Kingsbury et al. (2008) detailed concentrations of organic compounds, including *o*-dichlorobenzene, in surface water as the source for community drinking water treatment systems; Hopple et al. (2009) detailed concentrations of organic compounds in groundwater as the source for community drinking water treatment systems. Both studies measured concentrations at the source (surface and groundwater) and at the finished water (post-drinking water treatment). Both studies reported all samples as non-detects (NDs) for *o*-dichlorobenzene with a detection limit of 0.048 µg/L

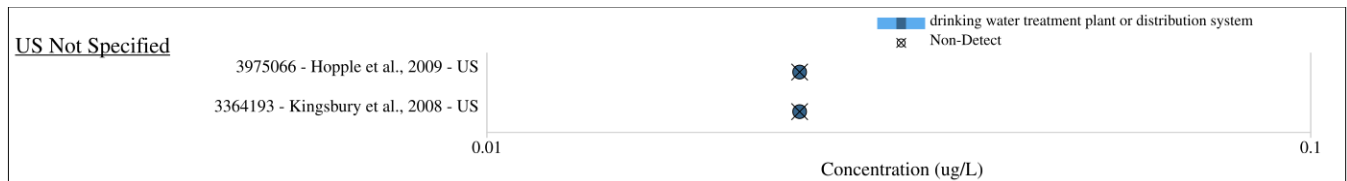


Figure 5-5. Concentrations of *o*-Dichlorobenzene (µg/L) in Drinking Water from 2002–2005

5.3.3 Measured Concentrations in Wastewater

5.3.3.1 Water Quality Portal

Effluent monitoring data from the WQP were below detection limits. Specifically, 100% of all *o*-dichlorobenzene effluent samples were below detection limits (8 samples) with a maximum detection limit of 0.15 µg/L. For more information and details, see the supplemental file *Draft Water Quality Portal (WQP) Results of o-Dichlorobenzene and p-Dichlorobenzenes* (U.S. EPA, 2026ac).

5.3.3.2 Peer-Reviewed Literature

Measured concentrations of *o*-dichlorobenzene in wastewater were extracted from two U.S. studies published between 1996 and 2006 (Figure 5-6). Sauer and Tyler (1996) collected 11 septic tank effluent samples from 4 publicly owned motor vehicle service stations in Wisconsin between 1991 and 1992. The study reported a concentration range of 9 to 48 µg/L, a mean concentration of 5 µg/L and detection frequency of 13%. Conn et al. (2006) collected 90 samples across 30 on-site wastewater treatment systems: 22 tank-based, 7 biofilter-based, and 1 sub-surface flow constructed wetland, residential, and non-residential areas in Summit and Jefferson Counties, Colorado, between 2003 to 2004. All samples were below the reporting limit (<RL) of 0.5 µg/L.



Figure 5-6. Concentrations of *o*-Dichlorobenzene (µg/L) in Wastewater from 1991–2004

5.3.4 Measured Concentrations in Groundwater

5.3.4.1 Water Quality Portal

From 2019 to 2025, 11,910 samples from monitoring sites across the country measured *o*-dichlorobenzene in groundwater samples (NWQMC, 2022). Of these samples, 99.6% were at or below detection limits (0.5 µg/L *o*-dichlorobenzene). Sixty-two samples (0.4%) measured *o*-dichlorobenzene above detection limits in groundwater (maximum concentration = 19.9 µg/L). For more information and details, see the supplemental file *Draft Water Quality Portal (WQP) Results of o-Dichlorobenzene and p-Dichlorobenzenes* (U.S. EPA, 2026ac).

5.3.4.2 Peer-Reviewed Literature

Measured concentrations of *o*-dichlorobenzene in groundwater were extracted from four U.S. studies published between 1992 and 2009 (Figure 5-7). Westinghouse Savannah River Company (1997) collected samples from 89 wells underneath the sanitary landfill at the Savannah River site, South Carolina, in 1996 and reported a range from below the limit of detection (<LOD) of 0.05 to 3.2 µg/L; most samples were less than 0.05 µg/L. Overall detection frequencies were not reported, but were as low as 1% for some samples. Chen et al. (1995) collected groundwater samples from monitoring wells at the Orange County municipal landfill in Orlando, Florida, between 1992 to 1993 and reported a range of ND to 1.56 µg/L, though the detection limit was not reported. Heck et al. (1992) performed a similar investigative study for the Reno County landfill, Kansas, between 1990 and 1991 and reported a range of below limit of detection (<LOD) of 0.20 to 95 µg/L. Most of the samples from these studies were reported as NDs/<LOD. Hopple et al. (2009) detailed concentrations of organic compounds in groundwater as source for community water systems nationwide and collected 221 groundwater samples; all samples were reported as NDs for *o*-dichlorobenzene (RL = 0.048 µg/L).

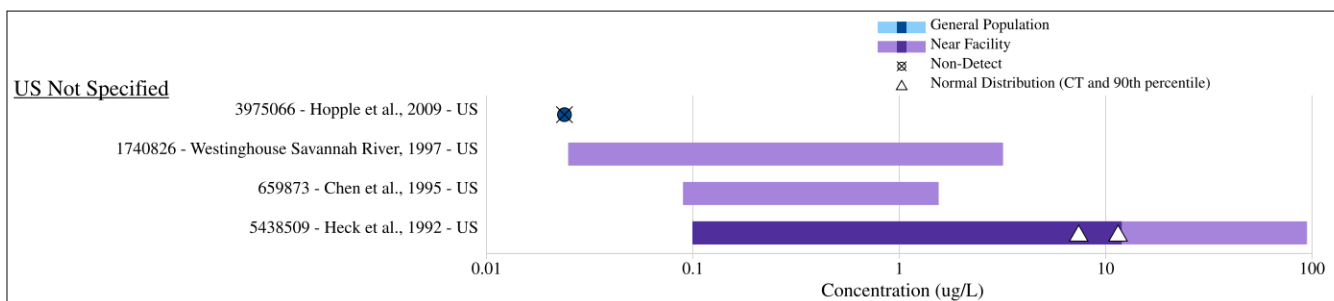


Figure 5-7. Concentrations of *o*-Dichlorobenzene (µg/L) in Groundwater from 1989–2005

5.3.5 Evidence Integration for Water

Across monitoring sources and available literature data, *o*-dichlorobenzene is often below detection limits in water sources (Table 5-1). Additionally, when *o*-dichlorobenzene is detected in water, it is measured at concentrations less than 1 µg/L.

Table 5-1. Summary of Measured Data for *o*-Dichlorobenzene in Water

Source	Maximum Concentration	Detection Frequency (%) ^a
Surface Water: WQP	0.5 µg/L	0.4
Surface Water: Literature	<13.3 µg/L	0.0
Sediment: WQP	<0.17 µg/L	0.0
Sediment: Literature	<1,570 µg/kg	0.0
Drinking Water: Literature	<0.048 µg/L	0.0
Wastewater Effluent: WQP	<0.15 µg/L	0.0
Wastewater Effluent: Literature	48 µg/L	13
Groundwater: WQP	19.9 µg/L	0.4
Groundwater: Literature	95 µg/L	<1
^a Detection limit range = 0.01–0.5 mg/L		

Although *o*-dichlorobenzene is expected to volatilize from water given its physical and chemical properties (Section 2), and deposition from air is expected to be negligible, *o*-dichlorobenzene can be present in water as evidenced by the available measured data (Table 5-1).

Based on the low reported releases to surface water (Section 4), physical and chemical properties of *o*-dichlorobenzene (Section 2), as well as monitoring data indicating minimal detections of *o*-dichlorobenzene in wastewater, EPA did not perform a quantitative analysis for the release of *o*-dichlorobenzene to wastewater because exposure to the general population is not expected to occur.

5.4 Land Pathway

5.4.1 Measured Concentrations in Soil

5.4.1.1 Peer-Reviewed Literature

Measured concentrations of *o*-dichlorobenzene in soil were extracted from two U.S. studies published in 2001 and 2011 (Figure 5-8). Yun and Kannan (2011) reported 38 soil samples collected from the Pine River, Tittabawassee River, Shiawassee River, Saginaw River, and Saginaw Bay, Michigan, between 2002 to 2004 with concentrations ranging from below the LOD (<0.02 ng/g) to 4.26 ng/g dry weight; the detection frequency was not reported. Jang and Townsend (2001) collected 12 recovered soil fines samples collected from 14 construction and demolition waste recycling facilities in Florida. One sample reported a measured concentration of 17 ng/g, all other samples were NDs with a LOD of 5 ng/g.

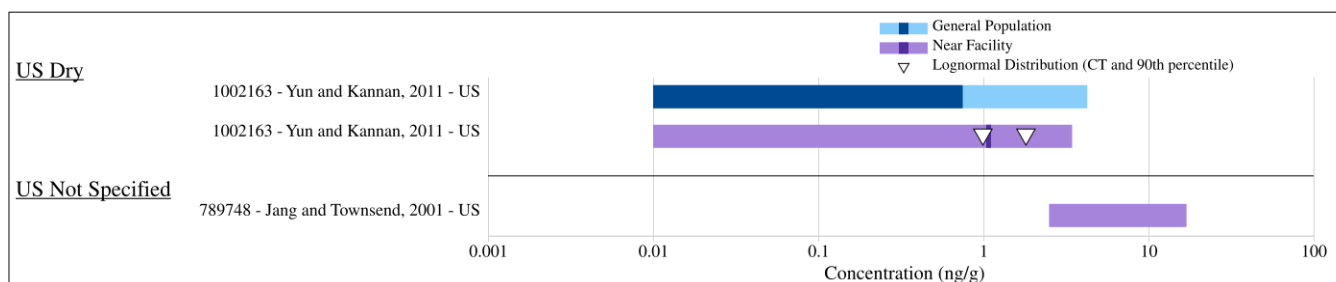


Figure 5-8. Concentrations of *o*-Dichlorobenzene (ng/g) in Soil from 2001–2004

5.4.2 Evidence Integration for Soil

Release of *o*-dichlorobenzene to land is through underground injection and landfills (Section 4), which are assumed to be impermeable. There are no direct releases of *o*-dichlorobenzene to land. Class I Injection Wells are required to be well designed and constructed to prevent movement of injected waste streams into any additional pathways including drinking water systems or other water pathways. Although some studies from systematic review have reported concentrations of *o*-dichlorobenzene in soil, most samples reported in the studies were either NDs, or low concentrations overall. Based on the low volume of releases to land, the low risk of failure of the predominant release scenario, the physical and chemical properties of *o*-dichlorobenzene, as well as monitoring data indicating minimal detections of *o*-dichlorobenzene in soil, EPA did not perform a quantitative analysis for the land pathway because exposure to the general population is not expected to occur.

5.5 Weight of Scientific Evidence Conclusions for Environmental Media Concentration Assessment

5.5.1 Strengths, Limitations, Assumptions, and Key Sources of Uncertainty for the Environmental Media Concentration Assessment

AQS data has been reviewed and verified by the Ambient Air Monitoring Group, which has taken quality assurance steps to ensure data quality and has been certified in accordance with 40 CFR 58.15. Due to strictly regulated monitoring requirements, EPA has high confidence in the AQS ambient air dataset ([U.S. EPA, 2017](#)), which also received a high-quality rating from EPA's systematic review process for *o*-dichlorobenzene ([U.S. EPA, 2026ab](#)). A primary limitation of the AQS data, and other monitoring data, is that because the data have not been annualized, they represent a diverse collection of sampling durations (none of which are annual averages) that are not directly comparable to modeled data. Additionally, because monitoring data represents a total aggregate concentration from all sources of *o*-dichlorobenzene contributing to ambient air concentrations, monitoring data cannot be used to characterize exposures exclusively from sources associated with COUs.

The WQP contains data from Water Quality Exchange (WQX). Many data fields in WQX are highly variable to accommodate the many original sources of data that WQX captures. The data also provides results based on different analytical methods and study goals. WQX data are often not nationally representative, and the data often overlap with nationally representative water data such as USGS' NAWQA, which provides current conditions and water quality with the information stored in National Water Information System (NWIS). Because NWIS data reflects that *o*-dichlorobenzene is typically not detected above the detection limit in surface water or groundwater, EPA has robust confidence that in areas lacking data, which are mainly areas associated with lower releases, *o*-dichlorobenzene will not be present in the water. In addition, based on the physical and chemical properties of *o*-dichlorobenzene and low release quantities to water and land, EPA has confidence that the WQP data are representative

3592 of the entire United States. Furthermore, WQP is not specific to COUs under TSCA.
3593 The *o*-dichlorobenzene media concentrations (air, water, sediment, and soil) from systematic review
3594 were extracted from multiple studies, primarily from the United States. All media types included studies
3595 and data collected in the United States with ratings of medium- or high-quality, which are representative
3596 of both environmental exposure and exposure for the U.S. general population. See Appendix H for study
3597 ratings for all peer-reviewed literature from systematic review. Notably, measured data from systematic
3598 review vary temporally—media concentrations are especially subject to season variation and vary
3599 geospatially. Methodology for sample collection and analysis are specific to each peer-reviewed
3600 literature and vary with instrumentation and analysis. Concentrations of *o*-dichlorobenzene across all
3601 media are attributed to many different sources, including but not limited to facility emissions and
3602 consumer activities.

6 GENERAL POPULATION AND ENVIRONMENTAL EXPOSURE ASSESSMENT

6.1 Approach and Methodology

6.1.1 General Population Exposure Scenarios

Figure 6-1 illustrates potential exposure pathways for the general population. For *o*-dichlorobenzene, EPA expects ambient air to be a potential exposure pathway. *o*-Dichlorobenzene is released from industrial facilities as uncontrolled fugitive releases such as process equipment leaks, process vents, building windows, building doors, and roof vents. It is also released from industrial facilities as stack releases, which may be either uncontrolled (e.g., direct releases out a stack) or controlled with a pollution control device (e.g., baghouse, scrubber, thermal oxidizer). Once released to ambient air, *o*-dichlorobenzene can move off-site into the surrounding areas where human populations may be exposed through inhalation. The ambient air exposure assessment focuses on exposures to a subset of the general population living near industrial facilities that are releasing *o*-dichlorobenzene to the ambient air in Section 6.2. EPA did not model deposition for *o*-dichlorobenzene because, as described in Section 3.6, *o*-dichlorobenzene is not expected to associate strongly with airborne particulates and therefore, not expected to undergo significant deposition to water or land.

In addition, based on concentrations reported in studies from systematic review, EPA considers drinking water to be a potential exposure pathway and details the drinking water exposure scenario for adults and infants in Section 6.3. General population exposure pathways through soil, swimming and fish ingestion are not expected because, *o*-dichlorobenzene in soil and surface water is expected to volatilize given its physical and chemical properties as described in Section 3.4.2 and that *o*-dichlorobenzene has low potential to bioaccumulate in organisms based on measured BCF values as described in Section 3.5.3.

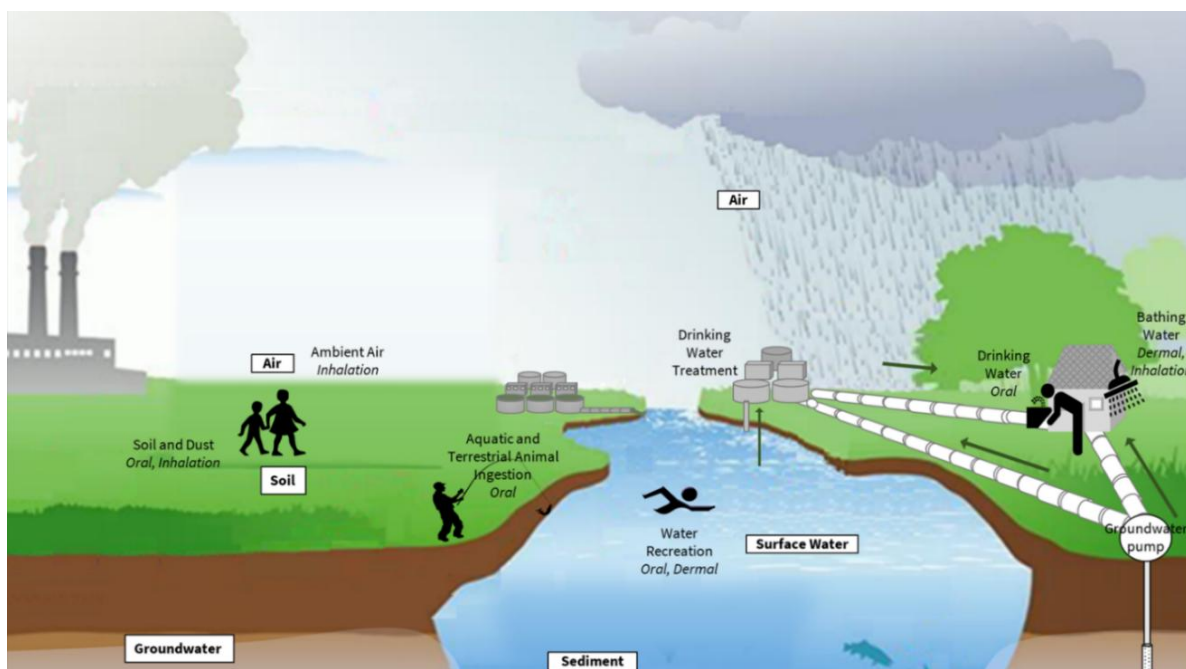


Figure 6-1. Potential Human Exposure Pathways to *o*-Dichlorobenzene for the General Population

6.1.2 Environmental Releases

Industry-reported air releases of *o*-dichlorobenzene from industrial sources were extracted from the TRI

for reporting years 2019 through 2023 as described in Section 4. The TRI dataset for *o*-dichlorobenzene included 3 form A and 22 Form R reporting facilities across the 6 years of reporting data queried, equaling a total of 82 individual reported releases. Total annual fugitive releases for the Form R reporters ranged from 4,145 to 6,056 kg/yr, while total annual stack releases for the Form R reporters ranged from 2,603 to 4,675 kg/yr.

Once *o*-dichlorobenzene reported release data are extracted, each TRI-reporting facility is assigned to an OES. OESs are established based on similarities or differences in release and exposure sources, worker activities, and use patterns occurring at a facility. OESs are then mapped to COUs shown in Table 4-1. TRI facility releases were associated with the following four OESs and associated COUs below in Table 6-1 (see also Table 4-1 for the full list of OESs and associated COUs). Since there are no quantifiable facility releases tied to the other OESs and associated COUs, general population ambient air exposures to those OESs from facility releases are not expected to occur.

Table 6-1. Occupational Exposure Scenarios and Conditions of Use for General Population Exposures

Life Cycle Stage	Category	Subcategory	Occupational Exposure Scenario (OES)
Processing	Recycling	Recycling	Industrial Use of Solvents
Manufacturing	Manufacture	Domestic manufacture	Manufacturing
Manufacturing	Import	Import	Repackaging
Processing	Repackaging	Repackaging	
Disposal	Disposal	Disposal	Waste Handling, Treatment, and Disposal

6.2 Air Exposure Assessment

6.2.1 Integrated Indoor/Outdoor Air Calculator Model (IIOAC)

IIOAC estimates indoor and outdoor ambient air concentrations at three distances (100, 100–1,000, and 1,000 m) from sources that release chemical substances to the air. IIOAC uses pre-run results from a suite of dispersion scenarios modeled with EPA’s American Meteorological Society/Environmental Protection Agency Regulatory Model ([AERMOD](#); accessed June 18, 2026). While the pre-run scenarios include a variety of meteorological and land-use settings, IIOAC is limited by the parameterizations utilized for those pre-run scenarios (meteorologic data, stack heights, distances, exposed population, etc.). Additional information on IIOAC can be found in the user guide ([U.S. EPA, 2019i](#)).

EPA used the IIOAC Model and 2019 to 2023 TRI *o*-dichlorobenzene release data to estimate daily and annual average ambient and indoor air concentrations at 100, 100 to 1,000, and 1,000 m from reporting facilities. These results informed a screening-level assessment of general population exposures near industrial sources, identifying facilities and COUs that may warrant higher-tier analysis or refined modeling.

6.2.1.1 Model Input Parameters and Settings

IIOAC can model a variety of user defined input parameters and exposure scenarios, including varying release scenarios/patterns, release types, release durations, urban/rural settings (topography), and meteorological conditions. Releases from individual facilities reported in TRI 2019 to 2023 were reported as stack and/or fugitive releases; with facilities reporting both types of releases. Stack and fugitive releases were used as direct inputs to IIOAC and were modeled separately (stack releases as

point sources, fugitive releases as area sources). Modeled concentration outputs from IIOAC for each release type are then summed together by facility and year to give a “total” exposure from both release types at each distance evaluated for each facility. EPA modeled stack and fugitive releases using the default parameters integrated within the IIOAC, along with a user-defined length and width for fugitive releases shown in Table 6-2.

Table 6-2. IIOAC Default Input Parameters for Stack and Fugitive Air Releases

Stack Release Parameters	Value	Fugitive Release Parameters	Value
Stack height (m)	10	Length (m)	10
Stack diameter (m)	2	Width (m)	10
Exit velocity (m/sec)	5	Angle (°)	0
Exit temperature (K)	300	Release height (m)	3.05

For this draft assessment/TSD, modeled air concentrations from IIOAC are based on the following:

1. The annual release values reported by Form R individual facilities (assigned to OESs and mapped to respective COUs for the TRI 2019–2023 data sets), assuming the total annual reported releases are continuous and equally distributed across all days of operation.
2. An operating scenario representing industrial facilities releasing *o*-dichlorobenzene to the ambient air operating 24 hours/day, 7 days/week, 365 days/year. This is a conservative assumption for this screening-level estimate, in which, facilities are constantly releasing *o*-dichlorobenzene every day and every hour throughout the year.
3. Application of the meteorology patterns from the Lake Charles, Louisiana (south coastal), meteorological station to every facility (regardless of the facility’s geographic location), and assumption of a “rural” land designation for fugitive releases and “urban” land designation for stack releases for every facility. These designations of meteorology and land settings are recommended in the IIOAC user guide ([U.S. EPA, 2019i](#)) for when conservative estimates are desired. These assumptions result in conservative air concentrations that are appropriate for a screening-level assessment.

6.2.1.2 Model Output

IIOAC provides output values for daily-average and annual-average high-end (95th percentile) and mean (50th percentile) ambient air concentrations in circular rings at two finite distances (100 and 1,000 m) and one area distance (100–1,000 m) from releasing facilities. These distances are also referred to as “fenceline,” “outer-boundary,” and “community average,” respectively, in IIOAC. The daily-average values are obtained by adding all modeled hourly concentrations for each day evaluated. The annual average is a 365-day rolling average of each daily average value across the 5 years of meteorological data modeled in IIOAC. Since releases were modeled in IIOAC based on the assumption that facilities are releasing *o*-dichlorobenzene to the ambient air with a steady, continuous release over time, operating 24 hours/day, 7 days/week, 365 days/year, the daily-average and annual-average concentrations are equal.

For the two finite distances (100 and 1,000 m), IIOAC considers a polar grid of 16 modeled exposure receptors evenly spaced around each distance ring. Since EPA considered 5 years of environmental release data (TRI 2019–2023) for this assessment, and the exposure scenario assumes 365 days of operation each year (366 for a leap year), this results in a total of 1,826 separate daily-averaged

concentrations for each receptor around each finite distance ring. For the area distance (100–1,000 m from the releasing facility), IIOAC uses a cartesian grid of 228 and 234 receptors, for stack and fugitive releases, respectively, placed at 100-meter intervals across the entire area. The daily and annual averages for the area distance are calculated across all receptors within the area distance and therefore represents an average concentration within the area distance rather than at each receptor within the area distance.

The 95th percentile concentration at each distance ring (100, 100–1,000, and 1,000 m) is the 95th percentile modeled concentration across the entire distribution of modeled concentrations at each distance per facility per TRI reporting year. Generally, for the finite distances, the 95th percentile represents a downwind concentration at a modeled exposure point where a resident lives downwind of the industrial release, considering a non, site-specific estimate for dispersion and dilution. Additional information on IIOAC model outputs can be found in the user guide ([U.S. EPA, 2019i](#)).

The mean (50th percentile) modeled concentrations ranged from 0.0 to 23.9 $\mu\text{g}/\text{m}^3$. The 95th percentile ambient air modeled concentrations across all facilities, reporting years and modeled distances (100, 100–1,000 and 1,000 m) ranged from 0.0 to 26.2 $\mu\text{g}/\text{m}^3$ (Table 6-3), with the highest modeled concentration at 100 m. Highest modeled concentrations were associated with the OES: Industrial use of solvents. For full IIOAC modeling results, see the supplemental file: *Draft Integrated Indoor Outdoor Air Calculator (IIOAC) TRI 2019-2023 Exposure and Risk Analysis for o-Dichlorobenzene* ([U.S. EPA, 2024a](#)).

3725 **Table 6-3. HIOAC-Modeled Concentrations from TRI Facility Releases**

Life Cycle Stage	Category	Subcategory	Occupational Exposure Scenario (OES)	Facility Count	Maximum 50th Percentile Modeled Concentration (µg/m ³)			Maximum 95th Percentile Modeled Concentration (µg/m ³)		
					Distance			Distance		
					100 m	100–1,000 m	1,000 m	100 m	100–1,000 m	1,000 m
Processing	Recycling	Recycling	Industrial Use of Solvents	4	23.91	2.81	1.09	26.20	3.15	1.29
Manufacturing	Manufacture	Domestic manufacture	Manufacturing	2	0.05	0.01	0.01	0.06	0.01	0.01
Manufacturing	Import	Import	Repackaging ⁵	1	0.00	0.00	0.00	0.00	0.00	0.00
Processing	Repackaging	Repackaging								
Disposal	Disposal	Disposal	Waste handling, treatment, and disposal	15	4.38	0.50	0.19	4.78	0.56	0.23
Total				22						

3726

⁵ Facility assigned to OES – Repackaging, reported 0 lb of *o*-dichlorobenzene release to TRI; therefore, exposure concentrations were modeled as 0.00 µg/m³.

For the general population, EPA assumed that populations residing near facilities (within 100–1,000 m) are exposed to modeled concentrations 24 hours a day, 365 days a year for a lifetime. For environmental exposures, ambient air concentrations at 100 m from the facility were evaluated.

6.2.1.3 Ambient Air Screening-Level Risk Estimates

Because of assumptions made for general population regarding exposure duration, exposure frequency, breathing rates, and other factors that are used to calculate exposure concentrations from modeled air concentrations, for this risk evaluation an individual's exposure concentration is equivalent to the modeled ambient, outdoor concentration from the IIOAC outputs. Therefore, the daily and annual-average modeled ambient air concentration results from IIOAC are equal to acute and chronic exposure concentrations used to calculate acute and chronic non-cancer screening-level risk estimates.

Since EPA used the IIOAC-modeled results as a screening-level analysis to see if one or more facilities/COUs may raise exposure (and associated risk) concerns, EPA used the IIOAC-modeled concentration results to derive screening-level acute non-cancer estimates. The screening-level risk estimates are used to inform whether a higher-tier/more refined exposure analysis is warranted to confirm any screening-level exposure (and associated risk) concerns identified.

EPA chose a non-cancer endpoint for general population acute exposure with a human equivalent concentration (HEC) value of 0.45 ppm (2,700 $\mu\text{g}/\text{m}^3$). A benchmark of 30 was used for acute screening-level risk estimates. Hazard values used to calculate screening-level risk estimates are described in the *Draft Human Health and Environmental Hazard Assessment for o-Dichlorobenzene* (U.S. EPA, 2026r). Margin of exposures (MOEs) were calculated at each distance (100, 100–1,000, and 1,000 m) using the 50th and 95th percentile IIOAC-modeled ambient air concentrations as conservative exposure estimates for each individual facility and for every reporting year. See Appendix I for more details.

All non-cancer screening-level risk estimates were above the non-cancer benchmark for acute exposures (Table 6-4). Therefore, it is not necessary to refine the conservative assumptions of the screening level assessment. Exposure concentrations and acute non-cancer screening-level risk estimates based on IIOAC-modeled results are presented the supplemental file: *Draft Integrated Indoor Outdoor Air Calculator (IIOAC) TRI 2019-2023 Exposure and Risk Analysis for o-Dichlorobenzene* (U.S. EPA, 2026t).

6.2.1.4 Indoor Air Screening-Level Risk Estimates

IIOAC also calculates a mean and high-end indoor air concentration based on the outdoor/ambient air concentration and mean and high-end indoor-outdoor ratios. In many screening models, the indoor-outdoor ratio is set to a value of 1, which represents the upper bound of this ratio if there are no indoor sources. In IIOAC, indoor-outdoor ratios of 0.65 and 1 are used for the mean and high-end ratios, respectively. Because all non-cancer, screening-level risk estimates were above the non-cancer benchmark for acute exposures for 50th and 95th percentile modeled outdoor (ambient) air concentrations, there is no expectation of non-cancer risks to the general population exposures to indoor air from TRI facility releases based on this screening-level assessment. However, Section 7 provides details on indoor air assessments for consumer exposures.

3770 **Table 6-4. Acute Margin of Exposures Based on Highest HIOAC Modeled Concentrations**

Life Cycle Stage	Category	Subcategory	Occupational Exposure Scenario (OES)	Facility Count	Acute MOE based on Highest 50th Percentile Modeled Concentration			Acute MOE based on Highest 95th Percentile Modeled Concentration		
					Benchmark = 30			Benchmark = 30		
					Distance			Distance		
					100 m	100 to 1,000 m	1,000 m	100 m	100 to 1,000 m	1,000 m
Processing	Recycling	Recycling	Industrial Use of Solvents	4	1.1E02	9.6E02	6.7E07	1.0E02	8.6E02	2.1E03
Manufacturing	Manufacture	Domestic Manufacture	Manufacturing	2	5.6E04	2.6E05	3.4E06	4.7E04	2.4E05	4.8E05
Manufacturing	Import	Import	Repackaging ⁶	1	—	—	—	—	—	—
Processing	Repackaging	Repackaging								
Disposal	Disposal	Disposal	Waste handling, treatment, and disposal	15	6.2E02	5.4E03	6.3E10	5.6E02	4.8E03	1.2E04
Total				22						

3771

⁶ Facility assigned to OES – Repackaging, reported 0 lb of *o*-dichlorobenzene release to the TRI. Margin of exposure (MOE) calculated is undefined due to modeled exposure concentrations of 0.00 µg/m³.

6.3 Drinking Water Exposure Assessment

Based on the concentrations of *o*-dichlorobenzene extracted from literature. EPA conducted a screening-level approach—specifically for subpopulations exposures that use untreated surface water or groundwater as the primary source of drinking water—using the highest concentrations in surface water and groundwater reported from Coiner et al. (2010) and Heck et al. (1992) of 13.3 and 95 µg/L for surface water and groundwater, respectively. The Agency also used highly conservative exposure parameters for daily water intake rate and body weight to calculate dose using the following equation:

Equation 6-1.

$$D = \frac{C \times IR \times ED}{BW \times AT \times CF}$$

Where:

<i>D</i>	=	Dose (mg/kg-day)
<i>C</i>	=	Concentration in media (ug/L)
<i>IR</i>	=	Intake rate (L/day): 2.972 L/day (95th percentile All Ages) EPA <i>Exposure Factors Handbook</i> (U.S. EPA, 2019c)
<i>ED</i>	=	Exposure duration: 365 days
<i>BW</i>	=	Body weight (kg): 80 kg (adult) 4.8 kg (birth to <1 month) EPA <i>Exposure Factors Handbook</i> (U.S. EPA, 2011b)
<i>AT</i>	=	Averaging time: 365 days
<i>CF</i>	=	Conversion factor (µg to mg): 1,000

6.3.1 Screening-Level Risk Estimates

Acute margin of exposures (MOEs) were calculated using an acute human equivalent dose (HED) of 11.0 mg/kg-day using Equation_Apx I-1. The benchmark of 30 was used for acute screening-level risk estimates. Hazard values and benchmarks are described in the *Draft Human Health and Environmental Hazard Assessment for o-Dichlorobenzene* (U.S. EPA, 2026r). Both adult and infant acute MOEs were above the benchmark (Table 6-5). Therefore, it is not necessary to refine the conservative assumptions of the screening level assessment.

Table 6-5. Calculated Drinking Water Doses for Adults and Infants

Age Group	Concentration (µg/L)	Dose (mg/kg-day)	Acute MOE (Benchmark = 30)
Adults	13.3	4.94E-04	2.23E04
	95	3.53E-03	3.12E03
Infant (birth to <1 month)	13.3	8.23E-03	1.34E03
	95	5.88E-02	1.87E02
MOE = margin of exposure			

6.4 Consumer (Down-the-Drain)

EPA acknowledges there may be environmental releases of *o*-dichlorobenzene from consumer products containing *o*-dichlorobenzene through end-of-life disposal as well as down-the-drain release. These products can be disposed of down-the-drain while users wash their hands, brushes, sponges, and other product-applying tools in a sink or with a hose. In addition, they can also be disposed when users no longer have use for them or as products become expired and are thrown into garbage or taken directly to landfills. Other down the drain releases of *o*-dichlorobenzene can occur with products like toilet bowl

deodorizers which may slowly release *o*-dichlorobenzene down the drain into sewers every time a toilet is flushed as water moves across the product. Although EPA acknowledges that there may be *o*-dichlorobenzene releases to the environment, the Agency does not consider the disposal or down the drain COUs as pathways of concern for consumers because of the high volatility of *o*-dichlorobenzene and limited presence in water. The physical-chemical property information supports a low concern for the down-the-drain pathway due to volatility and high predicted wastewater treatment removal. Studies have reported up to 99% removal of *o*-dichlorobenzene during wastewater treatment (Kincannon et al., 1983). *o*-Dichlorobenzene concentrations are below the level of detection in over 99% of surface water and groundwater samples in the WQP (U.S. EPA, 2026ac). In the 2021 to 2023 TRI, all industrial land releases were to underground injection and none to landfills (U.S. EPA, 2018c). The consumer products are expected to be disposed in waste handling locations that properly manage their disposal. These all suggest that *o*-dichlorobenzene consumer products will not be associated with down-the-drain exposures. Therefore, EPA did not quantitatively assess these scenarios in this draft assessment/TSD.

6.5 Human Biomonitoring

EPA only identified two biomonitoring studies from the United States and Canada (1991–2025) that contained *o*-dichlorobenzene. The two studies below only identified low concentration found in blood. There were no studies that identified *o*-dichlorobenzene in urine. This suggests that *o*-dichlorobenzene in blood or urine is not a media of concern. The studies are described below.

6.5.1 Human Biomonitoring – Blood (ng/g) – Wet Fraction

Measured concentrations of *o*-dichlorobenzene in Human Biomonitoring – Blood with unit of ng/g, extracted from 1 source, are summarized in Figure 6-1 and supplemental information is provided in Table 6-1. The study measured blood samples from 25 samples collected in 1992 in British Columbia, Canada. Details of the subjects were not reported, therefore location types were categorized as General Population. The limits of detection for blood is 3.12 ng/g. The concentrations ranged from not detected to 14.3 ng/g. Reported detection frequency was not reported.



Figure 6-2. Concentrations of *o*-Dichlorobenzene (ng/g) in the Wet Fraction of Human Biomonitoring – Blood in General Population Locations in 1992

Table 6-6. Summary of Peer-Reviewed Literature That Measured *o*-Dichlorobenzene (ng/g) Levels in the Wet Fraction of Human Biomonitoring – Blood

Citation	Country	Location Type	Sampling Year	Sample Size (Frequency of Detection)	Detection Limit (ng/g)	Overall Quality Level
Mes (1992)	Canada	General Population	1992	25 (N/R)	3.12	Medium

6.5.2 Human Biomonitoring – Blood (ng/L)

Measured concentrations of *o*-dichlorobenzene in Human Biomonitoring – Blood with unit of ng/L, extracted from one source, are summarized in Figure 6-2 and supplemental information is provided in Table 6-2. The study analyzed the Third National Health and Nutrition Examination Survey (NHANES

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III) in the United States in 2006. The detection limit was 0.044 ug/L. Concentrations ranged from not detected to 22 ng/L from 727 samples collected. Location types were categorized as general population. Reported detection frequency was not reported.



Figure 6-3. Concentrations of *o*-Dichlorobenzene (ng/L) in Human Biomonitoring – Blood in General Population Locations in 2006

Table 6-7. Summary of Peer-Reviewed Literature That Measured *o*-Dichlorobenzene (ng/L) Levels in Human Biomonitoring – Blood

Citation	Country	Location Type	Sampling Year	Sample Size (Frequency of Detection)	Detection Limit (ng/L)	Overall Quality Level
Wu et al. (2006)	US	General Population	2006	727 (N/R)	44	Medium

6.6 Surface Water Exposure Assessment

6.6.1 Modeling Approach for Estimating Concentrations in Surface Water

Surface water concentrations were estimated for environmental risk assessment. Although there are few direct releases of *o*-dichlorobenzene to surface water, physical-chemical properties indicate that *o*-dichlorobenzene can be present in water though will partition to air via volatilization. Thus, a screening assessment was conducted using the highest maximum annual release of *o*-dichlorobenzene to surface water from 2019 to 2023 DMR and TRI data (maximum release = 226 kg/yr) using a simple mass balance model:

$$Q_s C_s = Q_d C_d + Q_r C_r$$

Where:

Q = Discharge

C = Concentration of the surface water body (subscript *s*), discharge point (subscript *d*) and subsequent receiving water body (subscript *r*) after mixing

The model employs the conservative assumption of no volatilization though *o*-dichlorobenzene is moderately volatile. Additionally, the model assumes no *o*-dichlorobenzene present in the water body before discharge and an annual release of *o*-dichlorobenzene over 250 days of the year. Solving for receiving water concentrations (C_r), surface water concentrations do not exceed acute aquatic hazard concentrations of concern (COC = 0.38 mg/L)—even under low flow conditions (<1 ft³/s). Specifically, receiving water concentrations range from 1.6×10^{-5} mg/L with 1 ft³/s flow in the receiving water and 1 kg of annual *o*-dichlorobenzene release to 1.6×10^{-2} mg/L with 1 ft³/s flow in the receiving water and 10,000 kg of annual *o*-dichlorobenzene release (Table 6-8). The lowest flow reported in a receiving water body was 31 ft³/s in Upper Otter Creek, Kentucky, which had a maximum *o*-dichlorobenzene annual discharge of 107 kg/yr. The highest reported release of *o*-dichlorobenzene is 107 kg per year as reported to DMR. However, several Form A facilities reported to TRI. These facilities are not required to report releases up to 226 kg per year.

Table 6-8. Mass Balance Model Results for Receiving Water Concentrations with *o*-Dichlorobenzene Release^a

Receiving Water Flow, Q_s (ft ³ /s)	Receiving Water Concentrations, C_r (mg/L)				
	Annual Release (kg)				
	1	100	250	500	1,000
1	1.62E-05	1.62E-03	4.05E-03	8.09E-03	1.62E-02
10	1.49E-05	1.49E-03	3.72E-03	7.43E-03	1.49E-02
50	1.09E-05	1.09E-03	2.72E-03	5.45E-03	1.09E-02
100	8.17E-06	8.17E-04	2.04E-03	4.09E-03	8.17E-03
500	2.72E-06	2.72E-04	6.81E-04	1.36E-03	2.72E-03
1,000	1.49E-06	1.49E-04	3.72E-04	7.43E-04	1.49E-03
5,000	3.21E-07	3.21E-05	8.01E-05	1.60E-04	3.21E-04
10,000	1.62E-07	1.62E-05	4.05E-05	8.09E-05	1.62E-04
50,000	3.26E-08	3.26E-06	8.16E-06	1.63E-05	3.26E-05
100,000	1.63E-08	1.63E-06	4.08E-06	8.17E-06	1.63E-05
500,000	3.27E-09	3.27E-07	8.17E-07	1.63E-06	3.27E-06
1,000,000	1.63E-09	1.63E-07	4.09E-07	8.17E-07	1.63E-06
5,000,000	3.27E-10	3.27E-08	8.17E-08	1.63E-07	3.27E-07
10,000,000	1.63E-10	1.63E-08	4.09E-08	8.17E-08	1.63E-07

^a Table displays calculated receiving water concentrations (C_r) with varying amounts of annual release and receiving water flow.

6.7 Weight of Scientific Evidence Conclusions for General Population and Environmental Exposure Assessment

6.7.1 Strengths, Limitations, Assumptions, and Key Sources of Uncertainty for the General Population and Environmental Exposure Assessment

6.7.1.1 IIOAC

The approach and methodology presented in this assessment replicates previously peer-reviewed approaches and methods that underwent public comment and incorporates recommendations by peer reviewers and public comments to provide a more comprehensive exposure assessment. As such, EPA has robust confidence in the IIOAC modeling used in this assessment to evaluate high-end, conservative, health-protective exposure scenarios to inform whether there are exposures (and associated risk estimates) of concern that warrant more refined analyses.

Strengths of this ambient air exposure assessment include use of actual environmental release data from multiple years that are reported by industry, as required by statute, and undergoes repeatable quality assurance quality control reviews. These release data are used as direct inputs to two separate EPA peer-reviewed models (IIOAC and AERMOD) to estimate concentrations at several distances from releasing facilities where individuals may reside for many years.

Although IIOAC was used as a screening tool, a general limitation of IIOAC is that the modeling is based on pre-run scenarios within AERMOD. As such, default input parameters for IIOAC are confined to those input parameters utilized for those pre-run AERMOD scenarios and cannot be changed, including default stack parameters, 2011 to 2015 meteorological data, and the lack of site-specific information like building dimensions, stack heights, elevation, and land use.

6.7.1.2 TRI Release Data

There are several assumptions, strengths, limitations, and uncertainties associated with the TRI dataset. One strength of the TRI-reported releases is they are industry reported releases which are required by statute and submitted annually. Additionally, the TRI-reported releases generally capture the highest releasing facilities across the nation due to certain reporting requirements within the statute and applicable regulations. Since TRI releases are reported annually, the 6 years of TRI release data evaluated for *o*-dichlorobenzene provide greater confidence that higher years of release are not missed and maintains a higher level of health protection. This adds confidence that the TRI dataset captures the facilities with the greatest impact on ambient concentrations, exposures, and risks.

When considering aggregate exposures with the TRI dataset, the total facility-reported releases are tied to a specific facility (with a latitude and longitude). This provides strength to the assessment because both the fugitive- and stack-reported releases for an aggregate assessment are spatially aligned. Finally, another uncertainty when considering aggregate using the TRI dataset is the accuracy and precision of the latitude and longitude reported by a facility. The TRI-reported latitude and longitude is generally a single, possibly centralized location that may not represent the actual release point.

6.7.2 Conclusions

EPA has robust confidence in the overall characterization of exposure in this general population and environmental exposure assessment and that the exposure scenarios represent a conservative upper bound on exposure. This confidence is based on EPA's use of methodologies and models that previously underwent peer review and public comment.

EPA additionally has robust confidence in the use of facility-reported release data from TRI as model inputs. Modeled results using the TRI dataset were used to derive exposure concentrations at distances from releasing facilities where individuals and ecological organisms reside for many years. The use of release data across multiple years of data provides a comprehensive ambient air exposure assessment and helps ensure higher release years are not missed. This practice provides added confidence to EPA's use of modeled concentrations to characterize exposures. Furthermore, use of actual reported TRI releases provides added confidence that modeled concentrations and exposures are representative of exposures from facility reported releases and not hypothetical.

Taken together, the various modeling and monitoring lines of evidence considered by EPA in this general population exposure assessment for *o*-dichlorobenzene give the Agency robust confidence in its characterization of general population and environmental exposures. Additionally, the various lines of evidence support EPA's use of the modeled concentrations in this assessment to derive risk estimates and inform risk determination and rulemaking for *o*-dichlorobenzene.

EPA has robust confidence in the drinking water screening-level exposure assessment for the general population. The exposure parameters used in this assessment from EPA's *Exposure Factors Handbook* ([U.S. EPA, 2011b](#)) were selected to evaluate high-end, conservative, health-protective exposure scenarios to inform whether there are exposures (and associated risk estimates) of concern for age groups ranging from infants (birth to <1 month) to adults. In addition, the highest concentrations

3947 reported in surface water and groundwater were taken into consideration for subpopulations that use
3948 untreated surface water or groundwater as a primary source of drinking water.

7 CONSUMER EXPOSURE ASSESSMENT

7.1 Introduction

o-Dichlorobenzene is a pale, yellow liquid at ambient temperatures with a pleasant, aromatic odor. The primary consumer uses of *o*-dichlorobenzene are for five COUs, which include Lubricants and greases, Fuels and related products, Air care products, Paintings and coatings, and Other use. Although *o*-dichlorobenzene was identified in air care product SDSs 0.01 weight fraction, EPA did not find evidence of *o*-dichlorobenzene as an active ingredient from the manufacturing process in air care products. Therefore, EPA concludes that the small amount of *o*-dichlorobenzene found in air care products come from residual or impurities from *para*-dichlorobenzene (*p*-dichlorobenzene), which is the active ingredient in these products during the manufacturing process. For the purpose of this assessment, EPA still evaluated air care products as a COU for *o*-dichlorobenzene. In addition, Marvel Mystery Oil is the only product identified under the fuels and related products COU as well as under lubricant/greases. For the purposes of this risk assessment, Marvel Mystery Oil was evaluated under the lubricant and grease COU. Because *o*-dichlorobenzene exists in liquid phase and is used as a solvent for lubricants, paint thinners, and glazes, there is the potential for inhalation of vapors and dermal exposure through contact or accidental splashing.

EPA searched 2016 and 2020 data reported in the Chemical Data Reporting (CDR) database and collected information from a variety of other sources including SDSs, company websites and published literature. EPA also received and used information from the American Chemical Council (ACC) for emission rate test order. In evaluation of the test order, EPA determined if certain products are currently in production or discontinued and to identify COUs under TSCA for *o*-dichlorobenzene relevant to consumer exposures (see below for more information). There were four SDSs identified for ceramic glazes and one for the other COUs. For description on which SDS was used for ceramic glazes, see Section 7.2.2.

The volatilization of *o*-dichlorobenzene from consumer products has been identified as a potential mechanism of exposure. Consumers using *o*-dichlorobenzene based products may be exposed to *o*-dichlorobenzene through inhalation during volatilization. Direct solid and liquid contact may lead to dermal exposure. Inhalation and dermal exposures through mists are not expected as spray products were not identified.

Table 7-1. Consumer Conditions of Use Table

Life Cycle Stage ^a	Category ^b	Subcategory ^c	Reference(s)
Consumer use	Lubricants and greases	Lubricants and greases	(Marvel Oil Company, 2024b); (Marvel Oil Company, 2024a)
	Fuels and related products ^d	Fuel additive	(Marvel Oil Company, 2024b)
	Air care products	Continuous action air fresheners	(Willert Home Products, 2019)
	Paints and coatings	Thinners, Sheep-branding fluid	(Mayco, 2022); (Heiniger Australia Pty Ltd, 2016)
	Other use	Other use including ceramics glaze, and cleaning and furnishing care products	(Mayco, 2023a); (Mayco, 2023b); (Mayco, 2023c); (Mayco, 2023d); (Utility Wonder Products, 2014)

Life Cycle Stage ^a	Category ^b	Subcategory ^c	Reference(s)
Disposal	Disposal	N/A	
^a Life Cycle Stage Use Definition (40 CFR 711.3) – “Consumer use” means the use of a chemical or a mixture containing a chemical (including as part of an article such as furniture or clothing) when sold to or made available to consumers for their use. ^b These categories of COUs in the life cycle diagram (LCD), reflect CDR codes, and broadly represent COUs of <i>o</i> -dichlorobenzene in industrial and/or commercial settings. ^c These subcategories reflect more specific COUs of <i>o</i> -dichlorobenzene. ^d Marvel Mystery Oil falls under both the lubricants and greases as well as the fuels and related products COU.			

EPA also determined whether *o*-dichlorobenzene is present in mattresses, carpet products, and other articles. In one study, concentrations and emissions of *o*-dichlorobenzene in glued wallpaper and carpet were not detected ([Wallace et al., 1987](#)). Other studies found carpet and other interior building materials are not sources of *o*-dichlorobenzene ([Eikilani et al., 2003](#)); ([Won et al., 2000](#)). Based on these data, minimal evidence of *o*-dichlorobenzene in mattress or carpet products was found and therefore was not accessed in this draft consumer exposure assessment.

A test order was issued to the ACC in 2022 for consumer product emission rate testing from ceramic glazes, paint thinner, aerosol/foam greases, and drain openers. Upon further review of the products, it was determined that the identified aerosol/foam greases no longer report *o*-dichlorobenzene as an ingredient. Additionally, it was discovered that the drain opener product is not available in the United States and there are no alternative products available to test. Therefore, greases and drain products test orders were extinguished and only the paint thinner and ceramic glazes were tested. No evaluation was conducted for aerosol/foam greases or drain openers. Section 7.2.3 describes the test order in more detail.

7.2 Consumer Exposure Approach and Methodology

The main steps in performing a consumer exposure assessment are summarized below:

1. Identification and mapping of product examples following the consumer COU (Table 7-1), product identification.
2. Selection of exposure routes and exposed populations according to product use descriptions.
3. Compilation of products manufacturing use instructions to determine patterns of use.
4. Identification of data gaps and further literature searching to fill gaps with studies, test orders, or professional judgement.⁷
5. Selection of appropriate modeling tools based on available information and chemical properties.
6. Gathering of input parameters that are needed per exposure scenario.
7. Parameterization of selected modeling tools.
8. Conducting model simulations and review and extraction of results.

Consumer products containing *o*-dichlorobenzene were matched with COUs under TSCA appropriate for the anticipated use of the item. For *o*-dichlorobenzene consumer exposure assessment, quantitative analysis was conducted on inhalation and dermal routes.

⁷ *Professional judgement* as referenced throughout this draft TSD refers to the utilization of the best available data or information to assess a population, route, or pathway for consumer or indoor dust exposures—especially where substantial data gaps and/or uncertainties are present. This involves conducting supplemental research to address the identified data gaps or uncertainties including a consideration of concurrent or previous experience with similar assessments, product or article manufacturer use descriptions, and realistic product and article use patterns according to the most recently available literature.

Exposure via inhalation was evaluated using EPA's CEM Version 3.2 ([U.S. EPA, 2023a](#)) for all but one COU (toilet bowl deodorizer). The toilet bowl deodorizer COU was evaluated with EPA's IECCU Model rather than CEM as explained further in Section 7.3.3. Dermal exposure to *o*-dichlorobenzene containing consumer products was estimated using a computational framework and the models within the framework has previously been peer reviewed by EPA's Science Advisory Committee on Chemicals (SACC) ([U.S. EPA, 2026j](#)). Section 7.4 provides a detailed description of dermal modeling, consumer specific dermal modeling parameters, and assumptions for exposure estimates. In general, EPA used the 95th and 50th percentile values for input parameters characterized by a high level of variability (e.g., duration and frequency of use) for acute and chronic exposure estimates, respectively. The highest reported weight fraction was used for each product type. All CEM and dermal inputs, sources of information, assumptions, and exposure scenario descriptions are available in the *Draft Consumer Exposure Analysis and Risk Calculator for o-dichlorobenzene* ([U.S. EPA, 2026j](#)). Furthermore, as *o*-dichlorobenzene is volatile, potential take-home exposures (e.g., residues from work clothing and shoes to home) are likely small in comparison to the residential use scenarios considered in this assessment, thus take-home exposures were not further explored.

EPA assessed acute and chronic exposures to *o*-dichlorobenzene from all consumer COUs and intermediate exposures only for paint thinners and ceramic glazes. For acute 24-hour average concentrations, an averaging time of 1-day was used. In CEM, the 24-hour average was calculated from air concentrations of the user's predicted room for every 30 seconds over 24 hours. The 24-hour average concentrations were used as the health effects are derived for 24-hour health outcomes. See *Draft o-Dichlorobenzene Human Health and Environmental Hazard Assessment* ([U.S. EPA, 2026r](#)) for more information. The chronic average daily concentration (CADC) is calculated iteratively at 30-second intervals during the first 24 hours and hourly thereafter for 60 days and averaged over 1 year. "Intermediate" products were identified as items that are likely used for short-term projects and as a result may lead to exposures that may take an extended period of time to complete (i.e., 1–2 months) but are not expected to be used chronically (i.e., for 1 year or longer). The paint thinner and glaze products were candidates for intermediate exposure scenarios. Intermediate exposure scenarios assumed the products were used for 8 days in a month. Based on manufacturer use description and professional judgment, these products may be used repeatedly within a 30-day period depending on the nature of the projects.

7.2.1 Scope of Exposure Routes

As described in the *Final Scope of the Risk Evaluation for o-Dichlorobenzene; CASRN 95-50-1* ([U.S. EPA, 2020d](#)), consumer exposures to *o*-dichlorobenzene are primarily expected to occur via the inhalation route through vapor from use of consumer products. The magnitude of inhalation exposure depends upon the concentration of *o*-dichlorobenzene in products, use patterns (including frequency, duration, amount of product used, and room of use), and product application methods ([U.S. EPA, 2011a](#)).

Dermal exposure to *o*-dichlorobenzene may occur via solid or direct liquid contact with the skin. The magnitude of dermal exposure depends on factors like skin surface area, product weight fraction, chemical loading, and exposure duration ([U.S. EPA, 2011a](#)). Although *o*-dichlorobenzene that deposits on the skin is primarily expected to evaporate based on physical-chemical properties (e.g., vapor pressure of 1.35 mmHg and boiling point of 180 °C) limiting exposure, some may remain on the skin long enough to be absorbed dermally.

Consumer exposure to *o*-dichlorobenzene from TSCA COUs via the oral (ingestion) route is not expected. There are no intended consumer oral uses for *o*-dichlorobenzene and incidental contact would

not yield appreciable oral exposures. Systematic review of *o*-dichlorobenzene exposure literature found no studies to support the potential for *o*-dichlorobenzene oral exposures through dust, and based on its volatility, *o*-dichlorobenzene is not expected to absorb to dust or other particles within a residence that could be subsequently ingested.

7.2.2 Products with Dichlorobenzene Content

Products are defined as consumable liquids or solids that are used a given number of times before they are exhausted. The preferred data sources for *o*-dichlorobenzene content in U.S. consumer goods were SDSs for specific products available in the United States with reported *o*-dichlorobenzene content. EPA evaluated these products to ensure that data were representative of items which may expose U.S. consumers to *o*-dichlorobenzene. Where possible, SDSs were validated with company websites to ensure that each product could reasonably be purchased by consumers. When weight fractions in SDSs were reported as a range, the maximum was chosen to determine the possibility of risk with the exception of ceramic glazes (see Section 7.2.2.4 for more information). For a list of SDSs used in this assessment, refer to the *Draft Consumer Exposure Analysis and Risk Calculator for o-dichlorobenzene* ([U.S. EPA, 2026j](#)).

7.2.2.1 Lubricants and Greases

Two lubricant/grease products were identified with *o*-dichlorobenzene content. The first product is Marvel Mystery Oil, which reports maximum *o*-dichlorobenzene content of 0.5% (0.005 weight fraction) ([Marvel Oil Company, 2024b](#)). The second is Marvel Air Tool, which reports maximum *o*-dichlorobenzene content of 1% (0.01 weight fraction) ([Marvel Oil Company, 2024a](#)).

7.2.2.2 Air Care Products

One air care product was identified with *o*-dichlorobenzene content: a solid toilet bowl deodorizer that reported an *o*-dichlorobenzene maximum content of 1% (0.01 weight fraction) ([Willert Home Products, 2019](#)).

7.2.2.3 Paints and Coatings

Two paints and coatings products were identified with *o*-dichlorobenzene content. The first product is a paint thinner, which reports maximum *o*-dichlorobenzene content of 30% (0.30 weight fraction) ([Mayco, 2022](#)). The second is a sheep branding fluid, which also reports maximum *o*-dichlorobenzene content of 30% (0.30 weight fraction) ([Heiniger Australia Pty Ltd, 2016](#)).

7.2.2.4 Other Use (Ceramic Glazes)

Four ceramic glaze products were identified with *o*-dichlorobenzene content. The reported concentrations were 0.5% (0.005 weight fraction), 2.5% (0.0025 weight fraction), 6% (0.06 weight fraction), and 10% (0.1 weight fraction). The 10% is reported for the Hobby Brushing Bright Platinum Luster glaze ([Mayco, 2023b](#)). Although the platinum luster contains the highest concentration for glazes, the Mother of Pearl (0.06 weight fraction) was used in CEM modeling as it showed the highest emission rate in the test order (1.19 mg/h vs. 0.90 mg/h). This could be due to other ingredients in the product that affect the emission rates.

One septic tank cleaner product was identified with *o*-dichlorobenzene content with 99% concentration (0.99 weight fraction) ([Utility Wonder Products, 2014](#)).

7.2.3 Consumer Test Order for Paint Thinners and Ceramic Glazes

A test order was issued to the ACC in 2022 for consumer product emission rate testing from one paint thinner and ceramic glazes. ACC submitted the final study report to EPA in September 2024 ([Integral](#)

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[Consulting, 2024](#)). EPA reviewed the initial pilot testing report and determined that the proposed methods and materials, including products identified for testing and chamber specifications, were appropriate. Each product tested underwent three trials, each with two samples at eight sampling time intervals, ranging from 0.25 to 12 hours (see Table 7-2 for more information), for a total of 48 samples. Sampling was conducted for 24 hours.

For the paint thinner, to simulate a reasonably anticipated common use scenario during which a ceramicist would periodically dip their brush into an open cup or apply the brush cleaner onto a palette, the product was poured into a 100 mm diameter by 15 mm tall petri dish during the testing process. The glazes were brush-applied to the surface of one 3-inch diameter stainless steel sphere. Approximately 1.5 g of the glaze was applied to the sphere. The sphere was weighed before glaze application, after glaze application, and after the trial to determine the amount of glaze applied and the mass evaporated over the course of the trial. For both products, pouring of the product occurred outside of the test chamber so as not to influence emission testing results.

The calculated 24-hour average emission rate was 18.92 mg/h (0.315 mg/min) for the paint thinner and 1.19 mg/h (0.0198 mg/min) for the mother of pearl. EPA used these emission rates as inputs into CEM to calculate consumer exposure. For acute exposure, the Agency used the 24-hour average emission rates to derive the 8-hour average emission rates for both products. The emission rate over a shorter duration, such as 8 hours, more accurately captures what the user is exposed to compared to 24-hour emission rate. Briefly, the trapezoidal method was used to calculate the area under the curve in 2-hour intervals from 0-8 hours. Additional information can be found in the *Draft Consumer Exposure Analysis and Risk Calculator for o-dichlorobenzene* ([U.S. EPA, 2026j](#)). For the paint thinner the 8-hour average emission rate is 27.2 mg/h (0.45 mg/min) and 2.8 mg/h (0.05 mg/min) for the mother of pearl. For chronic concentrations, EPA still used the 24-hour average emission rates, as it is representative of a longer-term exposure. For more information about study procedures and results, see the full report ([Integral Consulting, 2024](#)).

Table 7-2. Total Sample Numbers for Each Product

Sample Interval (Sample Start Time to Sample End Time) (hours)	No. of Sample per Trial	Total No. of Samples Across 3 Trials
t = 0–0.25	2	6
t = 0.25–0.5	2	6
t = 0.5–1	2	6
t = 1–1.5	2	6
t = 1.5–2.0	2	6
t = 2–5	2	6
t = 5–12	2	6
t = 12–24	2	6
Totals	16	48

7.2.3.1 Consumer Test Order Uncertainties

Upon review of the final test order report, there is uncertainty about the emission rates of the paint thinner and two of the glazes (mother of pearl and white gold). Reported concentrations were above the linear range of the calibration curve. This introduces uncertainty in the test order experimental results as they may be underestimating or overestimating the actual concentration being emitted. According to

Test Protocol 3: Chamber emission testing ([U.S. EPA, 2015b](#)), sample analysis should be conducted following EPA Method TO-17 ([Woolfenden and McClenny, 1999](#)), where instrument calibration is done to determine instrument sensitivity and the calibration range of the analyte. The report mentions that the upper calibration range was 0.5 mg per sample. TO-17, the analytical method used in test order, mentions that if the compound exceeds the calibration range, then the original solution must be diluted and reanalyzed. However, there is no evidence in the report suggesting that the samples outside the calibration curve were diluted or other corrections made to improve the quality of the data. Due to the uncertainty of the test order data, EPA has presented both the air concentrations using the test order and CEM default emission rates for comparison.

7.2.4 Qualitative Assessment

EPA did not perform quantitative assessments of the COU summarized in Table 7-3. Instead, the Agency provided a qualitative discussion below about the conclusions for toilet bowl products and down the drain and disposal practices for releases to the environment.

Table 7-3. COUs and Products or Articles Without a Quantitative Assessment

Consumer Use Category	Consumer Use Subcategory	Product/Article	Comment
Air care products	Continuous action air fresheners	Bowl Fresh Toilet Bowl Deodorizer	Qualitative assessment for <i>oral route</i>
Disposal	N/A	Down-the-drain products	Qualitative assessment – due to limited information on source attribution of the consumer COUs

For air care products, *o*-dichlorobenzene will sublime and has little potential to bind to dust particles. Therefore, due to its high vapor pressure, dust ingestion is considered a minor route. There have been several reports of pica (*i.e.*, ingestion of inedible substances) of toilet bowl cleaners that indicate a range of neurological symptoms including fatigue, dizziness, tremors, altered mental status, reduced motor and executive functioning, brain damage, and even coma or death ([Weidman et al., 2015](#); [Buckman, 2013](#); [Friedman et al., 2012](#); [Murray et al., 2010](#); [Avila et al., 2006](#); [Campbell and Davidson, 1970](#); [Frank and Cohen, 1961](#)). However, these case reports do not suggest regular behavior and the amounts ingested are unquantifiable. Thus, EPA does not further evaluate the oral route for *o*-dichlorobenzene in air care products beyond the qualitative assessment presented herein.

7.3 Inhalation Modeling Approach

CEM Version 3.2 ([U.S. EPA, 2023a](#)) was selected for inhalation consumer exposure modeling as the most appropriate model to use based on the type of input data available for *o*-dichlorobenzene containing consumer products. The advantages of using CEM to assess exposures to consumers are as follows:

- CEM has been peer-reviewed ([ERG, 2016](#)); and
- CEM accommodates the distinct inputs available for the products containing *o*-dichlorobenzene, such as weight fractions, product density, room of use, frequency, and duration of use.

CEM 3.2 generates exposure estimates based on user-provided input parameters and various assumptions (or defaults). The model contains a variety of pre-populated scenarios for specific product categories and allows the user to define generic categories for any product where the prepopulated scenarios are not adequate. Where generic categories/scenarios are necessary for this consumer exposure assessment, EPA uses physical and chemical properties identified in Section 2 to calculate emission profiles of volatile and SVOCs. There are six emission calculation profiles within CEM (labeled E1–E6)

that represent specific use conditions and properties of various products. A description of these models is summarized in the CEM user guide and associated appendices.⁸

7.3.1 Inhalation Modeling for Products

The calculated emission rates are used in a deterministic, mass balance calculation of indoor air concentrations. However, CEM employs different models for different types of products. CEM 3.2 uses a two-zone representation of the building of use when predicting indoor air concentrations. Zone 1 represents the room where the consumer product is used. Zone 2 represents the remainder of the building. Each zone is considered well-mixed.

The modeled concentrations in the two zones are a function of the time-varying emission rate in Zone 1, the volumes of Zones 1 and 2, the air flows between each zone and outdoor air, and the air flows between the two zones. Following product use, the user may follow one of three pre-defined activity patterns which determine the length of time they are present in the home and exposed to products in the home environment. The predefined activity patterns represent full-time employment outside the home, part-time employment outside of the home, and stay-at-home. The activity use pattern determines which zone is relevant for the user and the duration of the exposures. The user inhales airborne concentrations within these zones, which can vary over time, resulting in the overall estimated exposure for each individual. The stay-at-home activity pattern, in which the user is assumed to be in the home the majority of the day (20 hours) was chosen as to represent a higher number of exposure hours in the home.

The air exchange rate (AER) and interzonal air flow rates (IAR) determine the movement of air from outside and within a building. The AER is a measure of the number of times per hour that the air in the room where the product is being used (Zone 1) is replaced by air from the portion of the building where the product is not in use (Zone 2). The IAR is the rate of air movement between Zones 1 and 2 within a building. The CEM default for AER is 0.45 air changes/hour for residential buildings ([U.S. EPA, 2011a](#)). The IAR is a function of the overall air exchange and volume of the building as well as the openness of the room, which is characterized in a regression approach for closed rooms and open rooms. For example, the bathroom and utility room are considered more closed, while garages are considered more open. The following equations calculate IAR using the AER (0.45 air exchanges/hour) and house volume (492 m³) ([U.S. EPA, 2023a](#)):

Equation 7-1. IAR for Closed Rooms (Bathroom, Utility Room)

$$IAR = (0.078 + 0.31 * AER) * V$$

Equation 7-2. IAR for Open Rooms (Garage)

$$IAR = (0.046 + 0.39 * AER) * V$$

Where:

<i>IAR</i>	=	Interzonal air flow rate
<i>AER</i>	=	Air exchange rate (air changes/hour)
<i>V</i>	=	Volume of house (m ³)

The bathroom and utility have an IAR of 107.01 m³/hour, while garage has a value of 108.98 m³/hour. In the instance where outside is the use environment, the outside is considered Zone 1, and the IAR is

⁸ <https://www.epa.gov/tsca-screening-tools> (accessed June 18, 2026)

therefore equal to the negligible value of $1.0 \times 10^{-30} \text{ m}^3/\text{hour}$.

The embedded model designated as E1 (Emission from Product Applied to a Surface Indoors Incremental Source Model) within CEM 3.2 was used for lubricants and greases. This model assumes a constant use rate over a duration of use. Each application has an emission rate that declines exponentially over time, at a rate that depends on the chemical's molecular weight and vapor pressure. This model is generally applicable to liquid products that evaporate from surfaces. For paint thinners, sheep-branding fluid, and glazes, the model of E2 (Emission from Product Applied to a Surface Indoors Double Exponential Model) was used. This model accounts for an initial fast release by evaporation, followed by a slow release dominated by diffusion. As dermal exposure was modeled separately, only inhalation routes were evaluated in CEM.

From ACC's final test order study report, the 24-hour average emission rates were calculated for the paint thinner and glazes ([Integral Consulting, 2024](#)). The calculation was done using the Area Under the Curve method, which represents the average amount of *o*-dichlorobenzene emitted over 24 hours. As discussed in Section 8, the 24-hour average estimated maximum emission rate was 18.92 mg/hour (0.315 mg/min) for the essence and 1.19 mg/hour (0.0198 mg/min) for the white gold glaze. Therefore, for the paint thinner and glaze scenario, the "User-Defined Emission Rate" option of CEM was used with these values rather than the "Let CEM Estimate Emission Rate" option.

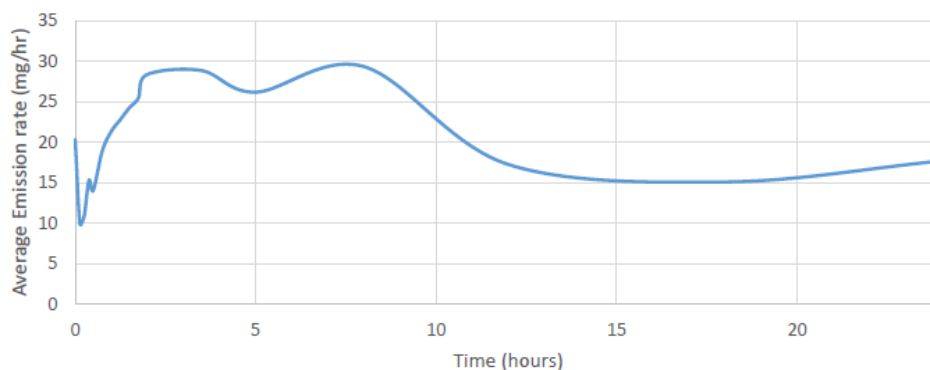


Figure 7-1. Hobby Essence 24-Hour Emission Rate

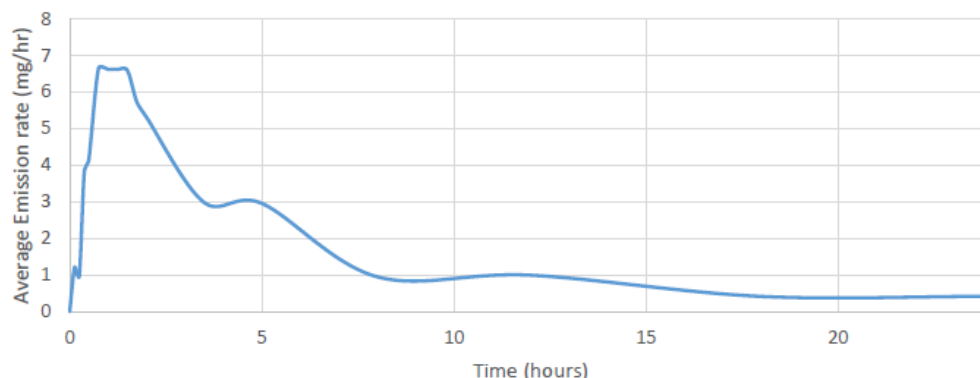


Figure 7-2. Mother of Pearl 24-Hour Emission Rate

7.3.2 CEM Modeling Inputs and Parameterization

The embedded models within CEM 3.2 that were used for *o*-dichlorobenzene are listed in Table 7-4 below. As dermal exposure was modeled separately, only inhalation routes were evaluated in CEM.

Table 7-4. CEM 3.2 Inhalation Model Codes and Descriptions

Model Code	Description
E1	Emission from Product Applied to a Surface Indoors Incremental Source Model
E2	Emission from Product Applied to a Surface Indoors Double Exponential Model
E4	Emission from Product Added to Water

Table 7-5 presents a crosswalk between the COU subcategories with either a predefined or generic scenario. Models were generated to reflect specific use conditions as well as physical and chemical properties of identified products. For the paints and coatings, the COU mapped to more than one product/scenario (paint thinner and sheep-branding fluid). The table also provides data on emissions model and exposure pathways modeled for each exposure scenario. Emissions models were selected based upon physical and chemical properties of the product and application use method for products. Exposure pathways were selected to reflect the anticipated use of each product. For the sheep-branding fluid, no specific scenario was identified in CEM, so the “Generic P2 E2” scenario was selected. The “Generic P2 E2” scenario also uses the E2 and P_INH1 and model. The P-INH1 Model predicts indoor air concentrations from product use by implementing a deterministic, mass-balance calculation utilizing an emission profile determined by implementing E1 through E5. The model uses a two-zone representation of the building of use (e.g., residence, school, office) with Zone 1 representing the room where the consumer product is used (e.g., a kitchen) and Zone 2 being the remainder of the building. The product user is placed within Zone 1 for the duration of use.

Table 7-5. Crosswalk of COU Subcategories, CEM 3.2 Scenarios, and Relevant CEM 3.2 Models Used for Consumer Modeling

Consumer COU Category	Product	Emission Model	Exposure Pathway Model and CEM Saved Analysis
Lubricants and greases	Automotive lubricant/greases	E1	Lubricants (non-spray)
	Tool lubricant/greases		
Paints and coatings	Paint thinners	E2	Paint thinners
	Sheep-branding fluid	E2	Generic P2 E2
Other use	Ceramics glaze	E2	Lacquers and stains
	Septic tank cleaner	E4	Drain and toilet cleaners

7.3.2.1 Key Parameters for Products Modeled in CEM

All products were assessed using the highest reported weight fraction. For acute exposure, high-end values were used for frequency of contact and duration of product applied, representing the highest exposure within 24 hours. For chronic exposure, the median frequency of use and duration of product use values were selected because they represent the average exposure within 1 year. High-end and median values for frequency of use and duration of product use were taken from EPA’s *Exposure Factors Handbook*. For parameters that were not specified, professional judgement or CEM defaults were used for the product. CEM default product densities were used as product specific densities were not identified elsewhere. Emission rates were calculated by CEM from physical chemical properties, except for the paint thinner and glaze scenario, which used the values from the test order.

7.3.2.1.1 Mass of Product Used

For all of the products which are liquid, the volume of product per use was based on the product directions or professional judgement. This was multiplied by the assumed density to determine mass of product per use. Table 7-6 lists the liquid product volume per use.

Table 7-6. Mass of Product Used

Product	Volume Per Use (cm ³)	Density (g/cm ³) ^a	Mass Per Use (g)	Product Directions
Marvel Mystery Oil	118	0.90	106.2	At every fill-up add 4 oz to every 10 gallons of gas or diesel ^c
Marvel Air Tool Oil	0.3	0.90	0.27	Add 2–5 drops per use ^d
Paint thinner	N/A		17.9 ^b	EPA used the mass that was applied in the consumer test order report.
Sheep branding fluid	100	1.09	109	Professional judgement; assumes use on multiple sheep
Ceramic glaze	N/A		1.5 ^b	Assumes thin layer of application per use and expected amount based on test order data
Septic tank cleaner	450	1.30	585	Volume of recommended dose in {Robertson, WD, 1994, 5256137}
^a CEM defaults, volume and density are N/A for thinner and glaze as mass used is already provided by test order and not needed to be calculated for CEM. ^b Mass taken from test order data. ^c https://marvelmysteryoil.com/blogs/how-to-use/automobile (accessed June 18, 2026) ^d https://marvelmysteryoil.com/blogs/how-to-use/tool-oil (accessed June 18, 2026)				

7.3.2.1.2 Duration of Use

The duration of use may differ depending on the product. EPA's *Exposure Factors Handbook* or professional judgement was used to obtain duration of uses for acute and chronic scenarios for each of the scenarios. Table 7-7 lists the durations of use for each product and the source and reasoning for each value used.

Table 7-7. Duration of Use for Consumer Products

Product	Duration of Use (min/event)		Table in EFH	Reasoning
	Acute	Chronic		
Marvel Mystery Oil	10	5	Professional judgement	EPA assumes that the product takes 5–10 minutes to use (pouring oil into gas tank before filling; applying air tool to product before use)
Marvel Air Tool Oil				
Paint thinner	180	10	17-5 (paint thinners)	95th percentile for acute use and 50th percentile for chronic use; EPA assumes that sheep branding fluid and ceramic glaze would be used in same duration as paint thinner
Sheep branding fluid				
Ceramic glaze				
Septic tank cleaner	5	5	Professional judgement	EPA assumes that a user will pour the product into a toilet, flush, and the task does not take a significant amount of time.
EFH = EPA's <i>Exposure Factors Handbook</i> (U.S. EPA, 2011b)				

7.3.2.1.3 Frequency of Use

Similar to the duration of use, EPA's *Exposure Factors Handbook* ([U.S. EPA, 2011b](#)) was used to was used to obtain frequencies of use for acute and chronic scenarios. Table 7-8 lists the frequencies of use for each product and the source and reasoning for each value used. For paint thinners and ceramic glaze, EPA decided to use 95th percentile for chronic use as it is reasonable that a consumer could use those products that many times in a year.

Table 7-8. Frequency of Use for *o*-Dichlorobenzene Consumer Products

Product	Frequency of Use		Source	Notes
	Acute (Events/Day)	Chronic (Events/Year)		
Marvel Mystery Oil	1	52	Professional judgement	EPA assumes user could use the product every time they fill gas tank
Marvel Air Tool Oil		12		EPA assumes user could use the product once a month
Paint thinner	4	23	<i>Exposure Factors Handbook</i> (U.S. EPA, 2011b) 17-4 (paint thinners)	95th percentile for chronic use. EPA is assuming the ceramic glazes is used the same amount as paint thinners
Ceramic glaze				
Sheep branding fluid	1	6	https://www.premier1supplies.com/p/si-ro-mark-marking-fluid (accessed June 18, 2026)	Chronic use based on product directions saying marking will last 2–4 months
Septic tank cleaner	1	1	Professional judgement	Based on purpose of product, EPA assumed once a year use

7.3.2.1.4 Environmental Parameters

The use environment was based on the expected room of the products. The room parameters, such as volume and interzone ventilation rates, were based on CEM defaults. Table 7-9 summarizes the environmental parameters of CEM defaults. Based on Marvel Mystery Oil product directions, the product is used “at every fill up” with gas, therefore EPA modeled the product being used at a gas station in an outdoor environment.

Table 7-9. Environmental Parameters

Product	Use Environment	Use Environ. Volume (m ³)	Interzone Ventilation Rate (m ³ /h)
Marvel Mystery Oil	Outside	492	1E-30
Sheep branding fluid			
Marvel Air Tool	Garage	90	108.98
Paint thinner	Utility room	20	107.01
Ceramics glaze			
Septic tank cleaner	Bathroom	15	72.47

7.3.3 Limitations of CEM for Toilet Bowl Deodorizer

A limitation of CEM is that there is no scenario or emission model that represents a hanging toilet bowl deodorizer. *o*-dichlorobenzene from a toilet bowl deodorizer has a high initial emission rate but decays

rapidly over a 15-day period due to the reduction in product surface area as *o*-dichlorobenzene sublimates from the product. Although the other emission models within CEM account for decay, they are only applicable for other types of products (e.g., E3 for products sprayed). The E5 model is applicable for a product placed in the environment, however, it assumes a constant rate of emission of the product with no decay. For example, this is applicable for a liquid wall plug in air freshener, but not the solid toilet bowl deodorizer. Therefore, EPA identified the Indoor Environmental Concentrations in Buildings with Conditioned and Unconditioned Zones model IECCU as more appropriate for modeling exposure resulting from use of this product.

7.3.4 IECCU Model Development and Parameterization

As a more refined model, IECCU Version 1.1 ([U.S. EPA, 2019e](#)) was selected to model consumer inhalation exposures to *o*-dichlorobenzene for the use of the toilet bowl deodorizer products using the single exponential decay model within IECCU. In this decay model, the emissions are modeled at an initial rate specified by the user followed by a decay in emission rate as the chemical concentration in the product declines. The calculated emission rates are then used in a deterministic, mass balance calculation to determine indoor air concentrations. IECCU can be configured with one, two, or up to three zones within a building. EPA has determined that most US residences have at least two bathrooms. To match the conditions used in CEM for products, the toilet bowl deodorizer was modeled in IECCU using a three-zone configuration, where Zones 1 and 3 are the bathrooms and Zone 2 represents the rest of the house.

Advantages of IECCU over CEM include that it considers both sources and sinks and allows generation of exposure estimates over longer periods of time. It also provides customizable time points within the chosen period of time, allowing for flexibility in the granularity of the data. There is also the ability for the user to define the decay rate. IECCU is an indoor air pollutant transport model designed to estimate concentrations within various zones (conditioned and unconditioned). Unlike CEM, IECCU does not distinguish between exposures to users, does not include a near field option, and does not contain any default input parameters (i.e., all inputs are user defined). To align the IECCU exposure scenario with the CEM exposure scenarios, EPA used CEM default environmental input values including building volumes, ventilation rates, and interzonal air flows, values and conditions which matched to conditions used in CEM for specific room or whole house scenarios. As with CEM, EPA evaluated exposure scenarios using high-end model inputs for exposure scenarios to support a health protective exposure assessment for the evaluated products.

7.3.4.1 Air Zones and Ventilation

When choosing inputs for air exchange flow rates in the IECCU modeling, the values were calculated based on the house and room volumes and interzonal flows from either the *Exposure Factors Handbook* ([U.S. EPA, 2011b](#)) or CEM default values. The average volume of a whole house from EPA's *Exposure Factors Handbook* ([U.S. EPA, 2011b](#)) is 492 m³. The volume of 15 m³ for the bathrooms was taken from CEM; thus, the Zone 2 (or "rest of house") volume is 462 m³ (492-[15×2] = 462 m³).

The average residential air exchange rate from the *Exposure Factors Handbook* ([U.S. EPA, 2011b](#)) is 0.45 exchanges per hour. The interzone ventilation rate of 107 m³/hour was also taken from CEM. As a conservative estimate, EPA is assuming there is no HVAC in the bathroom, although most bathrooms have a fan for ventilation. When calculating air flow to different zones, the air exchange rate (0.45 air changes per hour) is multiplied by the room volume. For example, from Zone 0 (representing the ambient environment) to Zone 1 (bathroom), the value is (0.45×15 = 6.75 m³/hour; see Table 3.1 in the IECCU user guide for example calculation) ([U.S. EPA, 2019e](#)). For Zone 0 to Zone 2, the rest of house volume of 462 m³ multiplied by 0.45 to get 207.9 m³/hour.

Table 7-10. Air Exchange Flow Rates (m³/h) to and from Different Zones

	To Zone 1	To Zone 2	To Zone 3
From Zone 0	6.75	207.9	6.75
From Zone 1	N/A	107	0
From Zone 2	107	N/A	107
From Zone 3	0	107	N/A

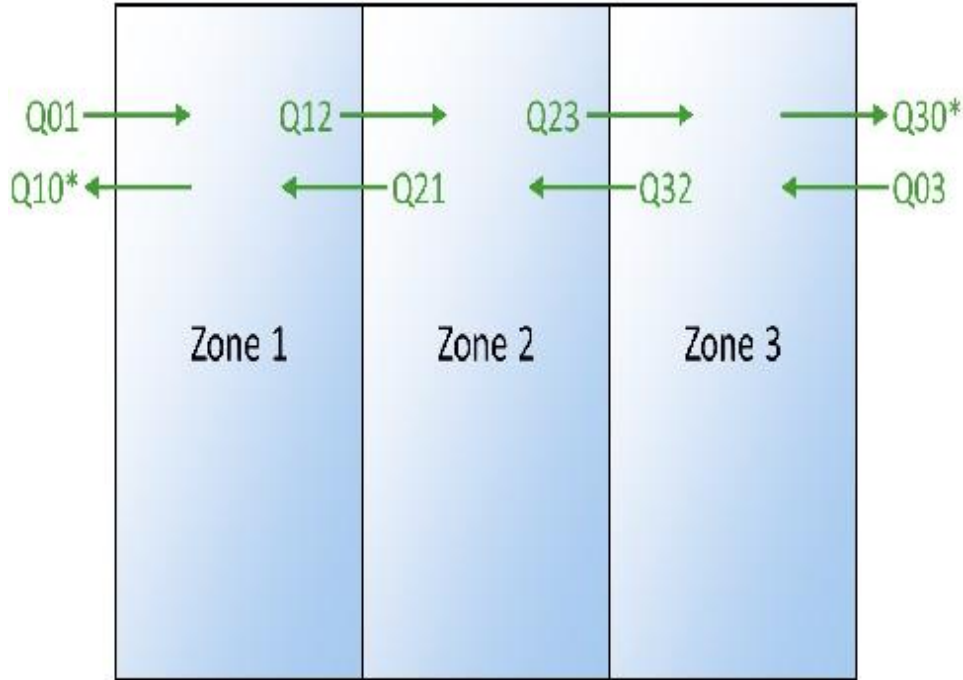


Figure 7-3. Diagram of Flow Rates from Different Zones

7.3.4.2 Source Model and Inputs

The “First-order decay” model within IECCU was selected as the appropriate model to determine the decay of the *o*-dichlorobenzene emission rate from toilet bowl deodorizers. The equation is as follows:

Equation 7-3. First-Order Decay Model

$$R = A \times E_0 \times e^{-kt}$$

Where:

R	=	Emission rate (μg/hour)
A	=	Source area (m ²)
E_0	=	Initial emission factor (μg/m ² /hour)
k	=	First-order decay constant (1/hour)
t	=	Elapsed time (hour)

EPA used the emission rate versus time data reported by ([Guerrero and Corsi, 2012](#)) to derive the initial emission factor and first-order decay constant most appropriate for this COU. Ultimately, E_0 was set

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to $5.00 \times 10^3 \mu\text{g}/\text{m}^2/\text{hour}$ and k was set equal to $4.471 \times 10^{-3} \text{ h}^{-1}$. Although the experimental study was conducted using *p*-dichlorobenzene, the data were considered an appropriate surrogate for *o*-dichlorobenzene in the same product type because *p*-dichlorobenzene and *o*-dichlorobenzene are structural isomers with the same molecular weight and similar volatility characteristics. Because the experimental product contained greater than 99% *p*-dichlorobenzene, the derived initial emission rate was adjusted to 1% to reflect the concentration of *o*-dichlorobenzene in the modeled product.

Activity Patterns

To simulate a person moving through Zones 1, 2, 3, and outside the house, EPA used the time in different areas of the house from Table 16-16 of EPA's *Exposure Factors Handbook* ([U.S. EPA, 2011b](#)).

For the acute exposure calculations, the 95th percentile activity pattern was used, where the person spends 1.5 hours/day in the bathroom (Zones 1 or 3) and 24 hours per day in the house. That gives 22.5 hours per day in the "rest of the house," or Zone 2. For acute exposure concentrations, the zonal air concentrations were weighted-averaged in Excel using this activity pattern, and the 24-hour average concentration was used as representative for the acute exposures.

For the chronic exposure calculations, the 50th percentile activity pattern was used, where the person spends 25 minutes per day in the bathroom (Zones 1 or 3), and 16.4 hours per day in the house. That gives 16.0 hours per day in the "rest of the house," or Zone 2 and 7.6 hours outside the house. For chronic exposure concentrations, the zonal air concentrations were weighted-averaged in a spreadsheet using this activity pattern (assuming no exposure for the 7.6 hours outside the home), and the 30-day average was used as representative for the chronic exposures.

Table 7-11. Activity Patterns Implemented as a Post-Processing Step

	Exposure Zone	95th Percentile Hours Per Day (Acute)	95th percentile Percent of Time (Acute)	50th Percentile Hours Per Day (Chronic)	50th Percentile Percent of Time (Chronic)
In the Residence		24	100	16.4	68.4
In the Bathroom	1 or 3	1.5	6.3	0.4	1.7
In the "Rest of House"	2	22.5	93.8	16	66.7
Outside the House	No Exposure	0	0	7.6	31.6

7.3.4.3 Model Output Time Period

IECCU was used to generate 30-day average concentrations of *o*-dichlorobenzene due to product use. To evaluate air concentrations relevant to acute and chronic exposure, the simulation duration selected was 720 hours (30 days), and the number of data points selected was 5,000, where each of the points represents a time stamp. A toilet bowl deodorizer is expected to typically last 30 days, and 5,000 data points is the maximum number of data points during the 30 days. After the simulation duration of 720 hours, air concentrations in all models were not zero, but were small enough to be considered negligible ($1.72 \mu\text{g}/\text{m}^3$) in Zone 2. Concentrations peaked at $80.4 \mu\text{g}/\text{m}^3$ at around 8 to 9 hours after the simulation start time in Zones 1 and 3 and logarithmically decayed to $40 \mu\text{g}/\text{m}^3$ after one week in Zone 1 and 3.

7.4 Dermal Modeling Approach

This section summarizes the available dermal absorption data related to *o*-dichlorobenzene, the

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interpretation of the dermal absorption data, dermal absorption modeling efforts, and uncertainties associated with dermal absorption estimation. While inhalation was modeled using CEM, dermal modeling was conducted outside of CEM. The use of the CEM model for dermal absorption, which relies on total concentration rather than aqueous saturation concentration, would greatly overestimate exposure to *o*-dichlorobenzene in liquid products. Therefore, the dermal modeling was done using the approach described below. Dermal data were sufficient to characterize consumer dermal exposures to liquids or formulations containing *o*-dichlorobenzene. Both the Fraction Absorbed and permeability model equations were derived from *Dermal Exposure Assessment: A Summary of EPA Approaches* (U.S. EPA, 2007).

For dermal exposure, the acute daily dose and chronic average daily doses were calculated for age groups that are expected to be users of the product. Although dermal exposures were not calculated using CEM, EPA used the lifestages in CEM as a guide for life stage categorization and “inside both hands” surface area to body weight ratios for the toilet bowl deodorizer and 10% of hand for rest of the products as they are only expected to splash on the skin. The lifestages and expected users for products are defined in Table 7-12 and Table 7-13.

Table 7-12. Dermal Lifestages and Ages

Life Stage	Age (years)	Inside Both Hands Surface Area/Body Weight Ratio
Adult	≥21 years	5.2
Teenager and young adult	16–20 years	4.9
Young teen	11–15 years	5.2

For air fresheners and lubricants/greases, EPA expects adults, teenagers, and young adults to have contact with the product during installation or use. For paint thinners and glazes, adults, young adults, teenagers, and young teens are expected to be users.

Table 7-13. Expected Dermal Users for Each Product

Product	Life Stage
Toilet bowl deodorizers	Adult
Lubricants/greases	Teenager and young adult
Sheep branding fluid	
Septic tank cleaner	
Paint thinners	Adult
Ceramic glazes	Teenager and young adult
	Young teen

7.4.1 Fractional Absorption Dermal Modeling

EPA used the fractional absorption dermal model for liquid products. The fractional absorption method was identified as the most appropriate for liquids as it is a finite splash-type exposure, where there is instantaneous deposition onto the skin. The following equation in the fractional absorption dermal model for finite doses was used to calculate both acute and chronic doses for each applicable life stage:

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Equation 7-4. Fractional Absorption Dermal Model for Finite Doses

$$DD = \frac{Q_u \times WF \times SA \times f_{abs} \times FQ \times ED}{BW \times AT}$$

Where:

DD	=	Daily dose (mg/kg-day)
Q_u	=	Dermal loading (mg/cm ² -event)
WF	=	Weight fraction
f_{abs}	=	Fraction absorbed
FQ	=	Frequency of contact
		• Acute: (events/day) • Chronic: (events/year)
ED	=	Exposure duration
		• Acute (1 day) • Chronic (1 year)
SA	=	Surface area of contact (cm ²)
BW	=	Body weight (kg)
AT	=	Averaging time
		• Acute: (1 day) • Chronic: (365 days)

To calculate Q_u ([U.S. EPA, 2023a](#)):**Equation 7-5. Amount Retained on Skin Equation**

$$Q_u = FT \times \rho \times (1 - \text{FracRemove}) \times CF_1$$

Where:

Q_u	=	Dermal loading (mg/cm ² -event)
FT	=	Film thickness (cm)
ρ	=	Density of formulation (g/cm ³)
FracRemove	=	Fraction of product removed by washing or wearing (unitless)
CF_1	=	Conversion factor (1,000 mg/g)

The Q_u is the amount of chemical retained on the skin. For consumer products, the Q_u is an estimate assuming that the consumer not wiping or removing any of the product when it comes in contact with the skin. Therefore, the fraction removed is 0. The amount of product that is retained on the skin is the product of the film thickness of the liquid on the skin's surface and the density of the formulation.

The film thickness refers to the thickness of the layer of product remaining on the skin after use. Table B-3 of the *CEM User Guide Appendices* ([U.S. EPA, 2023a](#)) gives film thickness for various products. Similar to inhalation modeling, dermal modeling uses the highest weight fraction for each product. The frequency of skin contact is dependent on the product and uses and is the same for the liquid products for inhalation. The mean of “inside both hands” value for surface area of skin contact with product was determined to be the most representative surface area to body weight ratio for all liquid products use for each life stage modeled.

Fractional absorption is the appropriate metric for estimating absorption from a thin film or splash-type

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exposure scenario, where there is a finite or depletable amount of chemical on the skin. Systematic review did not identify any reliable dermal absorption studies for *o*-dichlorobenzene; however, based on physical chemical properties it is expected that *o*-dichlorobenzene absorption will be very similar to *p*-dichlorobenzene. EPA estimated 2% absorption based on test order data for neat *p*-dichlorobenzene from ([Charles River Laboratories, 2025](#)). This study reported 0.93 to 2.24% absorption for *p*-dichlorobenzene concentrations of 50% or less in organic solvents. Other than the septic tank cleaner, liquid consumer products contain less than 50% of *p*-dichlorobenzene, and therefore the 2% absorption from the neat chemical is applied to these exposures. For the septic tank cleaner 4% absorption was used. See Section 3.1 of the *Draft Human Health and Environmental Hazard Assessment for o-Dichlorobenzene* for more details ([U.S. EPA, 2026r](#)). Table 7-14 presents the list of dermal inputs for the fractional absorption model.

Table 7-14. Dermal Inputs for Fractional Absorption Model

Product	Film Thickness (cm)	Density (ρ) (g/cm ³)	Amount Retained on Skin (Qu) (mg/cm ² - Event)	Weight Fraction	Fraction Absorbed (f _{abs})
Marvel Mystery Oil	8.21E-05	0.90	1.23E-01	0.005	0.02
Marvel Air Tool Oil		0.90		0.01	
Paint thinner	3.5E-05	0.78	3.82E-02	0.3	
Sheep branding fluid		1.09			
Ceramic glaze	1E-04	0.88	8.80E-02	0.1	
Septic tank cleaner	1E-04	1.30	1.31E-01	0.99	0.04

7.4.2 Permeability Dermal Modeling

EPA used the flux-based permeability dermal model for the solid air freshener product. The flux-based method was identified as the most appropriate for solids, which may be considered a nondepletable source over the duration of the exposure. This scenario applies to products comprised of a solid *o*-dichlorobenzene block, where absorption is driven by the duration of dermal contact. The method provides an estimate that assumes constant exposure and no depletion of the chemical from the skin surface over time, thus giving the maximum skin absorption. The following equation calculates the flux-based dermal model for infinite dose, which is derived from *Dermal Exposure Assessment: A Summary of EPA Approaches* ([U.S. EPA, 2007](#)):

Equation 7-6. Flux-Based Permeability Dermal Model for Infinite Dose

$$DD = \frac{K_p \times C \times SA \times t_{event} \times FQ \times ED}{BW \times AT}$$

Where:

- DD = Daily dose (mg/kg-day)
 K_p = Skin permeability coefficient (cm/h)
 C = Chemical concentration (mg/cm³)
 t_{event} = Event contact time (hours)
 FQ = Frequency of contact
 • Acute: (events/day)
 • Chronic: (events/year)
 ED = Exposure duration
 • Acute: (1 day)

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- Chronic: (1 year)
- SA = Surface area of contact (cm^2)
- BW = Body weight (kg)
- AT = Averaging time
- Acute: (1 day)
- Chronic: (365 days)

The chemical concentration in the product is calculated from multiplying the weight fraction by density of formulation ([U.S. EPA, 2023a](#)):

Equation 7-7. Concentration of Chemical based on Weight Fraction

$$C = WF \times \rho \times CF_1$$

Where:

- C = Chemical concentration (mg/cm^3)
- WF = Weight fraction
- ρ = Density of formulation (g/cm^3)
- CF_1 = Conversion factor (1,000 mg/g)

The skin permeability coefficient K_p , (with units of length per time such as cm/hour), is a concentration-dependent parameter that is derived from the steady-state flux of material through the skin. For short-term *o*-dichlorobenzene dermal exposure to these products, EPA used a K_p of 3.75×10^{-4} cm/h , derived from the measured flux rate of *p*-dichlorobenzene in solution over a 10-minute period ([CPA, 2005](#)). See Section 3.1 of the *Draft Human Health and Environmental Hazard Assessment for o-Dichlorobenzene* for more details ([U.S. EPA, 2026r](#)).

Similar to inhalation modeling, dermal modeling uses the highest weight fraction for each product, which is then used to calculate the concentration of chemical in the product using Equation 7-7. The frequency of contact is dependent on the product and uses. Similar to liquid products, the mean “inside both hands” surface area was chosen as the most appropriate contact area for each life stage modeled.

7.5 Exposure Modeling Results

This section summarizes the air concentrations from inhalation and dose estimates from dermal exposure to *o*-dichlorobenzene in consumer products. Exposure via the inhalation route occurs during inhalation of vapor emissions of *o*-dichlorobenzene. Exposure via the dermal route occurs from direct contact with the air freshener.

7.5.1 Acute Inhalation Concentrations and Dermal Dose Rate Results

Table 7-15. summarizes the acute 24-hour average air concentrations and Table 7-16 for dermal acute dose rate (ADR). The relevant lifestages from CEM modeling of inhalation exposures and computational modeling of all dermal exposures are displayed in the tables below.

Table 7-15. Acute 24-Hour Average Concentrations from *o*-Dichlorobenzene in Products

Product	Acute 24-Hour Average Concentration (mg/m^3)
Air care products in 2 bathrooms	$3.92\text{E}-02^a$
Automotive lubricant/degreaser	$1.50\text{E}-03$
Tool lubricant/degreaser	$7.33\text{E}-04$
Sheep branding fluid	$1.65\text{E}-03$
Paint thinner (test order emission rate)	$2.14\text{E}-02^b$

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Paint thinner (default emission rate)	3.54E-02 ^c
Ceramic glaze (test order emission rate)	2.38E-03 ^b
Ceramic glaze (default emission rate)	6.40E-04 ^c
Septic tank cleaner	35
^a Modeled using IECCU	
^b Emission rate provided in response to test order issued by EPA	
^c Default emission rates used from CEM	

Table 7-16. Acute Dermal Dose Rates in Products

Product	Age Group	Acute Dose Rate (mg/kg/d)
Air care products	Adult (≥21 years)	5.81E-03
	Youth (16–20 years)	5.44E-03
Automotive lubricant/greases	Adult (≥21 years)	8.87E-09
	Youth (16–20 years)	8.87E-09
Tool lubricant/greases	Adult (≥21 years)	1.77E-08
	Youth (16–20 years)	1.77E-08
Paint thinners	Adult (≥21 years)	7.86E-07
	Youth (16–20 years)	7.86E-07
	Youth (11–15 years)	8.52E-07
Sheep-branding fluid	Adult (≥21 years)	1.68E-05
	Youth (16–20 years)	1.68E-05
Ceramics glaze	Adult (≥21 years)	8.45E-07
	Youth (16–20 years)	8.45E-07
	Youth (11–15 years)	9.15E-07
Septic tank cleaner	Adult (≥21 years)	6.21E-03
	Youth (16–20 years)	6.21E-03

7.5.2 Intermediate Inhalation Concentration and Dermal Average Daily Dose Results

For both inhalation concentrations and dermal doses, EPA assumed that a user could use paint thinners and ceramic glazes twice a week (8 times total) during a 30-day period (Table 7-17 and Table 7-18). To calculate the intermediate time-scale inhalation concentrations and dermal average daily dose for these products, the acute concentrations and dose rates were multiple by 8 (for the number of events) and divided by the 30-day averaging period ([U.S. EPA, 2026j](#)).

Table 7-17. Intermediate Inhalation Concentration Rates

Product	Concentration (mg/m ³)
Paint thinner (test order emission rate)	5.71E-03
Paint thinner (default emission rate)	9.44E-03
Ceramic glaze (test order emission rate)	6.35E-04
Ceramic glaze (default emission rate)	1.71E-04

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Table 7-18. Intermediate Dermal Dose Rates

Product	Age Group	Dermal
Paint thinners	Adult (≥ 21 years)	2.10E-07
	Youth (16–20 years)	2.10E-07
	Youth (11–15 years)	2.27E-07
Ceramics glaze	Adult (≥ 21 years)	2.25E-07
	Youth (16–20 years)	2.25E-07
	Youth (11–15 years)	2.44E-07

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7.5.3 Non-Cancer Chronic Inhalation Concentrations and Dermal Dose Rate Results

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Table 7-19 summarizes the non-cancer chronic inhalation air concentrations and chronic average daily dose (CADD) results for expected lifestages from CEM modeling of inhalation exposures and computational modeling of all dermal exposures ([U.S. EPA, 2026j](#)). In the “non-cancer” context, “chronic” is considered 1 year rather than a lifetime.

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Table 7-19. Chronic Air Concentrations of *o*-Dichlorobenzene from Products

Product	Chronic ADC (mg/m ³)
Air care products in 2 bathrooms	8.91E-03 ^a
Automotive lubricant/degreaser	2.22E-04
Tool lubricant/degreaser	1.53E-05
Sheep branding fluid	1.06E-04
Paint thinner (user emission rate)	2.08E-04
Paint thinner (default emission rate)	9.68E-03
Ceramic glaze (user emission rate)	6.54E-06
Ceramic glaze (default emission rate)	1.86E-04
Septic tank cleaner	7.98E-02
^a Modeled using IECCU	

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Table 7-20. Non-Cancer Chronic Average Daily Dose Dermal Dose Rates

Product	Age Group	Dermal
Air care products	Adult (≥ 21 years)	1.91E-04
	Youth (16–20 years)	1.79E-04
Automotive lubricant/greases	Adult (≥ 21 years)	1.26E-09
	Youth (16–20 years)	1.26E-09
Tool lubricant/greases	Adult (≥ 21 years)	5.83E-10
	Youth (16–20 years)	5.83E-10
Paint thinners	Adult (≥ 21 years)	1.24E-08
	Youth (16–20 years)	1.24E-08
	Youth (11–15 years)	1.34E-08

Product	Age Group	Dermal
Sheep-branding fluid	Adult (≥ 21 years)	2.76E-07
	Youth (16–20 years)	2.76E-07
Ceramics glaze	Adult (≥ 21 years)	1.33E-08
	Youth (16–20 years)	1.33E-08
	Youth (11–15 years)	1.44E-08
Septic tank cleaner	Adult (≥ 21 years)	1.70E-05
	Youth (16–20 years)	1.70E-05

7.5.4 IECCU Results

To calculate 24-hour average acute concentrations, the average concentration at 166 points, between 0.144 hours to 24 hours, were determined for all three zones depending on the amount of time the user spends in each zone during the time of day. A stay-at-home user may be in the bathroom (Zone 1) for 1.5 hours of the day and how long they are expected to be in rest of the house (Zone 2) (from 95th percentile of EPA's *Exposure Factors Handbook* ([U.S. EPA, 2011b](#))) for the remainder of the day (22.5 hours). Based on this, the individual's average exposure concentration in Zone 1 was weighted by multiplying the modeled concentration by 0.0625 (1.5 hours $\div$ 24 hours) and Zone 2 by multiplying the modeled concentration by 0.9375 (22.5 hours $\div$ 24 hours) to determine the individuals average daily exposure concentration. These two values were then added together to determine an individual's total daily average exposure concentration of 6.15×10^{-2} mg/m³.

Similarly, to calculate the 30-day average chronic concentrations, the average concentration of 5,000 points between 0.144 hours to 720 hours were determined for both zones. For the 50th percentile chronic concentrations, it is estimated that a user may be in the bathroom (Zone 1) for an average of 12.5 hours in a month and 480 hours in the rest of the house. The rest of the time is assumed to be outside. The individual's average exposure concentration in Zone 1 is weighted by 0.017 (12.5 hours $\div$ 720 hours) and Zone 2 by 0.67 (480 hours $\div$ 720 hours) to determine the individual's average daily exposure concentration. These two values were then added together for a value to determine an individual's total daily average exposure concentration of 4.16×10^{-3} .

7.6 Weight of Scientific Evidence

The exposure assessment of *o*-dichlorobenzene from consumer products has challenges due to variability and uncertainty. Variability comes from product formulation and composition as SDS concentrations vary across products, including changes in ingredients by manufacturers, concentrations, and outdated SDSs. Variability can also come from product use patterns. Although EPA's *Exposure Factors Handbook* ([U.S. EPA, 2011b](#)) gives estimated values for frequency and duration of use, these numbers are not specific to a product, but rather a group of products. Uncertainty comes from application methods and time for certain products, as there is professional judgement involved when estimating these inputs. For example, the method and time of using a ceramic glaze varies between users even if they are using the same exact product. There is also uncertainty in the test order emissions rates. As mentioned in Section 7.2.3.1, test order emission rates may be underestimated or overestimated because of concentrations measured over the calibration range.

7.6.1 Inhalation and Dermal Confidence in Parameters

Generally, designation of robust confidence suggests thorough understanding of the scientific evidence and uncertainties. The supporting weight of the scientific evidence outweighs the uncertainties to the point where it is unlikely that the uncertainties could have a significant effect on the exposure estimate.

4630 The designation of moderate confidence suggests some understanding of the scientific evidence and
4631 uncertainties. More specifically, the supporting scientific evidence weighed against the uncertainties is
4632 reasonably adequate to characterize exposure estimates. The designation of slight confidence is assigned
4633 when the weight of the scientific evidence may not be adequate to characterize the scenario, and when
4634 the assessor is making the best scientific assessment possible in the absence of complete information and
4635 there are additional uncertainties that may need to be considered.

4636
4637 The lubricants/greases COU had an overall robust confidence for inhalation while other COUs had
4638 moderate overall confidence. The overall confidence is determined by a variety of factors, such as the
4639 source and representativeness of the inputs. Table 7-21 describes each factor in detail and where the
4640 information comes from, as well as the overall confidence for each COU.

4641 **Table 7-21. Inhalation Confidence in CEM Parameters**

Consumer COU Category	Weight of Scientific Evidence	Inhalation Overall Confidence
Lubricants and greases	Two products were assessed for this COU (Marvel Mystery Oil and Marvel Air Tool Oil). Maximum reported weight fraction and high-end product use pattern inputs were obtained from SDS, EPA's <i>Exposure Factors Handbook</i> (EFH) (U.S. EPA, 2011b) or CEM default values (U.S. EPA, 2023a). EFH and CEM default parameters generally represent actual products on the market, relevant use patterns and location of use. Therefore, the overall confidence for this COU inhalation exposure estimate is robust.	Robust
Thinners, Sheep-branding fluid	Two products were assessed for this COU (one paint thinner and one sheep-branding fluid). Maximum reported weight fraction and high-end product use pattern inputs were obtained from SDS, EFH or CEM default values. There is, however, uncertainty about the frequency and duration of use used for both products, requiring professional judgement. The mass of product used was also based on professional judgement. The sheep branding fluid scenario was not listed in EFH, so the paint thinners frequency and duration of use were used instead. Therefore, the overall confidence in this COU inhalation exposure estimate is moderate.	Moderate
Other use including ceramics glaze, and cleaning and furnishing care products	Two products were assessed for this COU. For glazes, the product with the highest emission rate was assessed for this COU. For septic tank cleaners, one product was assessed. The weight fraction and high-end product use pattern inputs were obtained from SDS, EFH or CEM default values. There is, however, uncertainty about the frequency of use, duration of use and amount used (for glaze) as they are not specified by the product. The ceramic glaze scenario was not listed in EFH, so the paint thinners frequency and duration of use were used instead. Therefore, the overall confidence in this COU inhalation exposure estimate is moderate.	Moderate
Air care products	One product with the highest weight fraction was assessed for this COU. The weight fraction and product use pattern inputs were obtained from SDS or EFH defaults. Therefore, the overall confidence in this COU inhalation exposure estimate is robust.	Robust

4642
4643 For all COUs, the overall confidence in dermal exposure estimates is moderate. The film thickness is a
4644 CEM default value with uncertain origin. The K_p and f_{abs} are measured information derived from *p*-
4645 dichlorobenzene test orders and are considered robust. The other inputs generally represent actual
4646 products on the market and relevant use patterns.

4647 **7.6.2 Product Formulation and Composition, Use Patterns, and Modeling Tools**

4648 Variability in the formulation of consumer products, including changes in ingredients, concentrations,
4649 and chemical forms, can introduce uncertainty in exposure assessments. EPA obtained *o*-
4650 dichlorobenzene weight fractions in various products from material safety sheets, data bases, and
4651 existing literature. For the air care product, EPA obtained multiple SDSs and values for weight fractions
4652 from different products, using the highest value in the high exposure scenario. Overall, weight fraction
4653 confidence is moderate as they only have one SDS as there is some uncertainty of changing
4654 formulations.

4655
4656 Consumer use patterns like frequency of use, duration of use, and methods of application are expected to
4657 differ. As detailed in Section 7.2, these inputs were either determined by professional judgement or

taken from EPA's *Exposure Factors Handbook* ([U.S. EPA, 2011b](#)). Exposure and risk estimates are considered representative of consumer use patterns and well characterized. Overall confidence in all product use patterns is rated robust confidence in mass of product per use and other values that were based on professional judgement in the absence of relevant or supporting data was rated low. For more information on the individual parameters used in the exposure scenario, see Sections 7.3.2.1 and 7.3.4.

CEM 3.2 and IECCU have been peer reviewed, are publicly available, and have been applied in a manner intended by estimating exposures associated with uses of household products. The models also explicitly state the sources of the default values for inputs, such as building and room volumes, interzonal ventilation rates, and air exchange rates. Overall confidence in the proper use of CEM and IECCU for consumer exposure modeling is robust.

7.7 Conclusions and Steps Toward Risk Characterization

All COU exposure-related air concentrations and dose results have a moderate-to-robust confidence and therefore can be used to determine risk to humans at various lifestages. This assessment is based on the information available to make the calculations, confidence in this information, and robustness of models available. The approaches used representative assumptions and inputs on the high-end of the distributions, for which EPA has robust or moderate confidence. This ensures results are health protective and gives the Agency a moderate-to-high confidence in the overall consumer exposure results depending on the specific products evaluated. Because these are health-protective estimates, they are appropriate to use to derive associated risk estimates, inform risk determination, rulemaking, and regulatory decision-making. The risk calculations will be used to inform risk management decisions on the use of *o*-dichlorobenzene in consumer products.

8 OCCUPATIONAL EXPOSURE ASSESSMENT

8.1 Approach and Methodology

A preliminary occupational exposure assessment was conducted for each OES specified in Table 4-1. For each OES, the following components are presented:

- **Worker Activities:** A description of the worker activities, including an assessment for potential points of worker and ONU exposure.
- **Number of Workers and ONUs:** An estimate of the number of workers and ONUs potentially exposed to the chemical for the given OES.
- **Occupational Inhalation Exposure Results:** Central tendency and high-end estimates of inhalation exposure to workers and ONUs; see Section 8.1.3 for a discussion of EPA's statistical analysis approach for assessing inhalation exposure.
- **Occupational Dermal Exposure Results:** Central tendency and high-end estimates of dermal exposure to workers; see Section 8.1.4 for a discussion of EPA's approach for assessing dermal exposure.
- **Exposure Controls and Personal Protective Equipment (PPE):** A description of any known exposure controls and PPE that may be present during this use.

For the remainder of this section, the approach and methodology for completing each of the above components is described in additional detail.

EPA used a variety of sources to estimate workplace exposures for each OES, resulting in different OESs having different levels of granularity in their exposure estimates. In some cases, EPA received inhalation exposure data from companies that manufacture, process, and use *o*-dichlorobenzene in response to a test order. In these test order study reports, the companies grouped employees into similar exposure groups (SEGs) based on their expected work activities and potentials for exposure to *o*-dichlorobenzene. In this assessment, EPA generally grouped exposure data provided by these reports into the designated SEGs that the company specified in their data, and so in some cases an OES may have multiple exposure estimates within it, each corresponding to these designated SEGs.

For some OESs—particularly those that assessed exposures using data that did not come from industry sources and thus had limited associated metadata—the more general SEGs of “workers” and “ONUs” were used. Workers are defined as employees who may directly handle *o*-dichlorobenzene, while ONUs are employees at the facility who do not directly handle *o*-dichlorobenzene but perform job activities in an area where the chemical is present. Typically, EPA assesses only inhalation exposures to ONUs and assesses dermal exposures as negligible. However, for chemicals in solid form or in spray or mist applications, the Agency may also assess dermal exposures from dusts/droplets that settle onto workplace surfaces.

The Agency's estimates of occupational exposure presented in this document do not assume the use of PPE; however, the effect of respiratory protection factors on EPA's occupational exposure estimates can be explored in the “Risk Reduction” tab in the *Draft Risk Calculator for o-Dichlorobenzene* ([U.S. EPA, 2026x](#)). For more discussion on respiratory protection and glove protection, refer to Section 8.1.5.

Figure 8-1 presents the conceptual model for exposure pathways, exposure routes, and hazards to human populations from industrial and commercial activities and uses of *o*-dichlorobenzene. There is potential for exposure to workers and/or ONUs via inhalation of vapor due to the activities and uses of *o*-dichlorobenzene. Exposure may occur due to fugitive emissions present during activities such as the

4726 manufacture and processing of *o*-dichlorobenzene. Fugitive air emissions are emissions that are not
4727 routed through a stack and include fugitive equipment leaks from valves, pump seals, flanges,
4728 compressors, sampling connections and open-ended lines; evaporative losses from surface impoundment
4729 and spills; and releases from building ventilation systems. Exposure may also occur due to uses of *o*-
4730 dichlorobenzene such as use as a laboratory chemical or the application of a paint or lubricant containing
4731 *o*-dichlorobenzene. Exposure may also occur through the dermal route for workers who handle *o*-
4732 dichlorobenzene. Dermal exposure to liquids is generally not expected for ONUs as they are not
4733 expected to directly handle *o*-dichlorobenzene, but ONU dermal exposure to solids may occur from
4734 dermal contact with settled dust on surfaces and dermal exposure to liquids may occur for exposure to
4735 mist that collects on surfaces after spray application, which was assessed for the Use of Paints and
4736 Coatings OES.

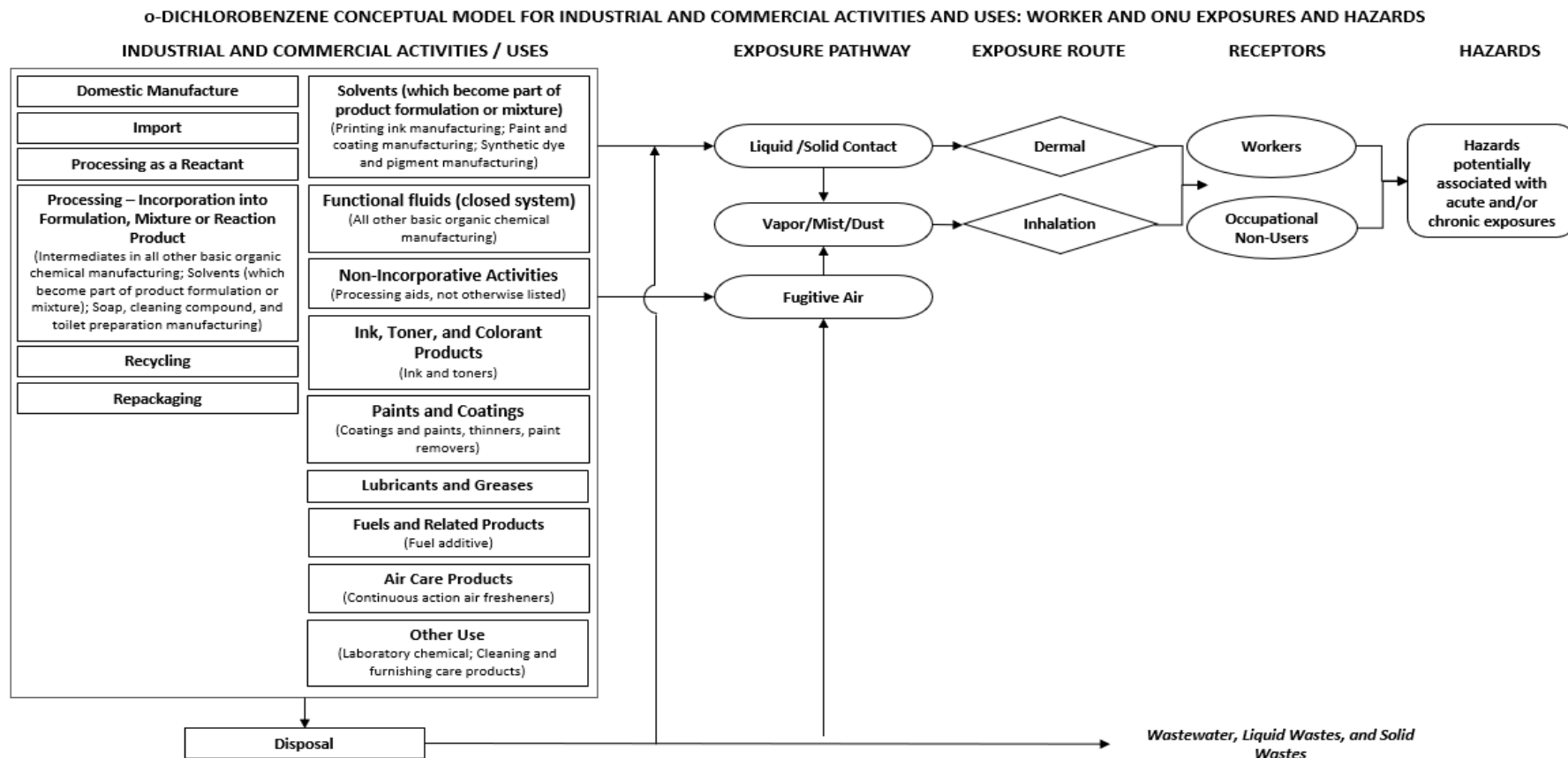


Figure 8-1. o-Dichlorobenzene Conceptual Model for Industrial and Commercial Activities and Uses: Potential Exposure and Hazards

Inhalation exposure to workers and ONUs may occur via fugitive emissions (equipment leaks, spills, ventilation) and uses such as laboratory work and adhesives/sealants; dermal exposure may occur for workers but is not expected for ONUs in cases aside from exposure to solids that may settle on surfaces.

EPA provided occupational inhalation and dermal exposure results representative of central tendency and high-end conditions. The central tendency is assumed to be representative of occupational exposures that are expected to be typical for a given COU. For the draft risk evaluation, EPA used the 50th percentile (median), mean (arithmetic or geometric), mode, or midpoint values of a distribution as representative of the central tendency scenario. The Agency's preference is to provide the 50th percentile of the distribution. However, if the full distribution is not known, EPA may assume that the mean, mode, or midpoint of the distribution represents the central tendency depending on the statistics available for the distribution.

The high-end is assumed to be representative of occupational exposures that occur at probabilities above the 90th percentile but below the exposure of the individual with the highest exposure ([U.S. EPA, 1992a](#)). For the draft risk evaluation, EPA provided high-end results at the 95th percentile. If the full distribution is not known and the preferred statistics are not available, the Agency estimated a maximum or bounding estimate in lieu of the high-end.

For each OES, EPA attempted to provide central tendency and high-end, full-shift time-weighted averages (TWAs) (typically as 8-hour TWAs) inhalation exposure concentrations and central tendency and high-end acute potential dermal dose rates (APDR). EPA uses the following hierarchy in selecting data and approaches for assessing occupational exposures:

1. Monitoring data:
 - a. Personal and directly applicable
 - b. Area and directly applicable
 - c. Personal and potentially applicable or similar
 - d. Area and potentially applicable or similar
2. Modeling approaches:
 - a. Surrogate or analogous monitoring data
 - b. Fundamental modeling approaches
 - c. Statistical regression modeling approaches
3. Occupational exposure limits (these limits would likely be used jointly in an assessment):
 - a. Company-specific occupational exposure limits (OELs) (for site-specific exposure assessments, for example, there is only one manufacturer who provides EPA their internal OEL but does not provide monitoring data)
 - b. Occupational Safety and Health Administration (OSHA) permissible exposure limits (PELs)
 - c. Voluntary limits (American Conference of Governmental Industrial Hygienists [ACGIH] Threshold Limit Values [TLV], National Institute for Occupational Safety and Health [NIOSH] Recommended Exposure Limits [REL], Occupational Alliance for Risk Science (OARS) workplace environmental exposure level (WEEL) [formerly by AIHA])

With exposure estimates identified for all OESs using monitoring data and modeling, occupational exposure limits were not used in this assessment. For *o*-dichlorobenzene, EPA used the estimated central tendency and high-end, full-shift TWA inhalation exposure concentrations and APDR to calculate exposure metrics required for risk evaluation. Exposure metrics for inhalation exposures include acute concentrations (AC), intermediate average daily concentrations (IADC), and average daily concentrations (ADC). Exposure metrics for dermal exposures include APDR, acute absorbed dose (AAD), intermediate absorbed dose (IAD), and chronic absorbed dose (CAD) non-cancer. Relevant equations and sample calculations can be found in Appendix K.

These exposure metrics are important because they allow for the assessment of different timeframes of exposure. Acute exposures occur over the course of a single working day. An 8-hour exposure duration is assumed each day to represent a typical worker's shift, unless otherwise specified (12-hour shifts, for example, are used in some cases when industry information indicates the presence of these shift lengths). Intermediate exposure occurs over 1 month, or 22 working days to account for a worker's usual schedule where they do not work on weekends. Chronic exposure (non-cancer) occurs over the worker's working years and is assumed to be 31 years at central tendency, and 40 years at high-end. It is assumed a worker will work no more than 250 days per year.

See the *Draft Risk Calculator for o-Dichlorobenzene* ([U.S. EPA, 2026j](#)), "Inhalation Exposure" tab, for a summary of the inhalation data used in this assessment. Click on the "Dermal Exposure" tab for details on how dermal exposure was estimated for this draft risk evaluation.

8.1.1 Identifying Worker Activities

EPA performed a literature search to identify worker activities that could potentially result in occupational exposures. Where worker activities were unclear or not available, the Agency referenced relevant ESDs or GSs. Worker activities for each OES are described in each OESs respective subsections within Section 8.

For number of working days, unless informed otherwise by industry, EPA assumes these to be the same as facility operating days, with a maximum number of routine working days per year being 250 days for workers on an 8-hour shift (5 days per week for 50 weeks, and 2 weeks of leave). For workers on a 10-hour shift, a maximum of 200 working days per year is assumed. For workers on a 12-hour shift, a maximum of 167 working days per year is assumed unless company information indicates otherwise.

8.1.2 Estimating Number of Workers and Occupational Non-Users

When able, EPA identified applicable NAICS codes for the industry sectors associated with each OES to estimate the number of workers and ONUs. The Agency performed this estimation using the following method:

1. Identify the North American Industry Classification System (NAICS) codes for the industry sectors associated with each condition of use.
 - a. Refine the identification of applicable NAICS codes by reviewing CDR data for the chemical.
 - b. Refine the identification of applicable NAICS codes by referencing EPA/OPPT GSs and Organisation for Economic Co-operation and Development (OECD) ESDs.
2. Estimate total employment by industry/occupation combination using the latest Bureau of Labor Statistics' (BLS) occupational employment statistics data.
3. Refine the occupational employment statistics estimates where they are not sufficiently granular by using the U.S. Census' Statistics of U.S. Businesses (SUSB) data on total employment by 6-digit NAICS.
4. Estimate the percentage of employees likely to be using the chemical of interest instead of other chemicals (*i.e.*, the market penetration of the chemical of interest in the condition of use).
 - a. Conduct market penetration research through a top-down approach.
 - b. Conduct market penetration research through a bottom-up approach.
5. Estimate the number of sites and number of potentially exposed employees per site.
6. Estimate the number of potentially exposed employees within the COU.

There are uncertainties surrounding the estimated number of workers potentially exposed to *o*-dichlorobenzene. First, BLS employment data for each industry/occupation combination are only available at the 3-, 4-, or 5-digit NAICS level—rather than at the full 6-digit NAICS level. This lack of specificity could result in an overestimate of the number of exposed workers if some 6-digit NAICS are included in the less granular BLS estimates but are not likely to use *o*-dichlorobenzene for the assessed applications. EPA addressed this issue by refining the Occupational Employment Statistics data using total employment data from the U.S. Census' SUSB. However, this approach assumes that the distribution of occupation types (Standard Occupational Classification, or SOC, codes) in each 6-digit NAICS is equal to the distribution of occupation types at the parent 5-digit NAICS level. If the distribution of workers in occupations with *o*-dichlorobenzene exposure differs from the overall distribution of workers in each NAICS, then this approach will result in inaccuracy. The effects of this uncertainty on the number of worker estimates are unknown, as the uncertainties may result in either over or underestimation of the estimates depending on the actual distribution.

Second, EPA's determinations of industries (represented by NAICS codes) and occupations (represented by SOC codes) that are associated with the OESs assessed in this report are based on EPA's understanding of how *o*-dichlorobenzene is used in each industry. The designations of which industries and occupations have potential exposures is a matter of professional judgment; therefore, the possibility exists for the erroneous inclusion or exclusion of some industries or occupations. This may result in inaccuracy but would be unlikely to systematically either overestimate or underestimate the count of exposed workers.

8.1.3 Estimating Inhalation Exposures

8.1.3.1 Inhalation Monitoring Data

To assess inhalation exposure, EPA reviewed workplace inhalation monitoring data collected by government agencies such as OSHA and NIOSH, monitoring data found in published literature (*i.e.*, personal exposure monitoring data and area monitoring data), and monitoring data submitted via Test Orders and public comments. Studies were evaluated using the evaluation strategies laid out in the *Application of Systematic Review in TSCA Risk Evaluations* ([U.S. EPA, 2018a](#)). Data and studies considered in this assessment can be found in the *Draft Systematic Review Protocol for o-Dichlorobenzene* ([U.S. EPA, 2026ab](#)) and in the "Inhalation Exposure" tab of the *Draft Occupational Risk Calculator for o-Dichlorobenzene* ([U.S. EPA, 2026x](#)).

EPA calculated exposures from the monitoring data sets provided in the sources discussed above, using different methodologies depending on the size of the dataset. For data sets with six or more data points, the Agency estimated central tendency and high-end exposures using the 50th percentile and 95th percentile. For data sets with three to five data points, EPA estimated central tendency exposure using the 50th percentile and the maximum as the high-end exposure estimate. For data sets with two data points, the Agency estimated the central tendency using the midpoint value and the higher of the two values as the high-end. Finally, for data sets with only one data point, EPA presented the single exposure value. For data sets including exposure data that were reported as below the limit of detection (LOD), the Agency estimated the exposure concentrations for these data following EPA's *Guidelines for Statistical Analysis of Occupational Exposure Data* ([U.S. EPA, 1994](#)), which recommends using the $\frac{LOD}{\sqrt{2}}$ if the geometric standard deviation of the data is less than 3.0 and $\frac{LOD}{2}$ if the geometric standard deviation is 3.0 or greater. When all datapoints in a dataset were non-detects, EPA used half the maximum LOD and the maximum LOD as the central tendency and high-end respectively.

When a dataset contains many non-detect samples (>40%), the substitution method described above may not be appropriate. In these cases, the use of Maximum Likelihood Estimation (MLE) was also considered as an option for accounting for exposure data below the limit of detection. MLE may be appropriate when a dataset has a sample size of 20 or more, with 5 or more detected samples. These criteria was not met in any case for *o*-dichlorobenzene, so the substitution method was used in all cases.

EPA combined the exposure data from all studies applicable to a given OES into a single dataset unless otherwise identified in the description of the assessments in Section 8.2.

EPA received inhalation exposure data from a company that uses *o*-dichlorobenzene in response to a test order. In the test order study report, the company grouped employees into SEGs based on their expected work activities and potentials for exposure to *o*-dichlorobenzene. In this assessment, EPA grouped exposure data provided by this report into the designated SEGs that the company specified in their data. For this reason, some OESs have multiple exposure estimates within it, each corresponding to these designated SEGs.

For some OESs, particularly those that assessed exposures using data that did not come from industry sources and thus had limited associate metadata, the more general SEGs of “workers” and “ONUs” were used. Here, workers are defined as employees who may directly handle *o*-dichlorobenzene, while ONUs are employees at the facility who work in the process area/room in the vicinity of chemical-related activities and may be indirectly exposed to the chemical as part of their employment.

OSHA Chemical Exposure Health Data

OSHA CEHD (Chemical Exposure Health Data) is collected through industrial hygiene samples taken by OSHA compliance officers during monitoring of worker exposures to chemical hazards. OSHA CEHD data is obtained typically from facilities when there is suspicion about high workplace exposure levels or potential violations. OSHA CEHD represents a reasonably available source of information to obtain monitoring data and has received a rating of high from EPA’s systematic review process. Air sampling data records from inspections are entered into the OSHA CEHD that can be accessed online. The database includes PBZ monitoring data, area monitoring data, bulk samples, wipe samples, and serum samples. The collected samples are used for comparing to OSHA’s Permissible Exposure Limits (PELs). OSHA’s CEHD website indicates that they do not: perform routine inspections at every business that uses toxic/hazardous chemicals, completely characterize all exposures for all employees every day, or always obtain a sample for an entire shift. Rather, OSHA performs targeted inspections of certain industries based on National and regional emphasis programs, often attempts to evaluate worst case chemical exposure scenarios, and develop “snapshots” of chemical exposures and assess their significance (*e.g.*, comparing measured concentrations to PELs).

EPA took the following approach to analyzing OSHA CEHD:

1. **Downloaded all data for *o*-dichlorobenzene from all available years in the CEHD** (generally 1984 to present).
2. **Organized data by site** (group data collected at the same site together).
3. **Removed data in which all measurements taken at the site were recorded as “0” or below the limit of detection (LOD)** as EPA could not be certain the chemical of interest was at the site at the time of the inspection (Note: sites where bulk samples were collected that indicate *o*-dichlorobenzene was present were not removed from the dataset).
4. **Removed serum samples, bulk samples, wipe samples, and blanks.** These data were not used

in EPA's assessment.

5. **Assigned each data point to an OES.** Reviewed NAICS codes, SIC codes, and as needed, company information available online, to map each sample to an OES. In some instances, EPA was not able to determine the OES from the information in the CEHD; in such cases, EPA did not use the data in the assessment. EPA also removed data determined to be for non-TSCA uses or otherwise out of scope.
6. **Combined samples from the same worker.** In some instances, OSHA inspectors will collect multiple samples from the same worker on the same day (these are indicated by sample ID numbers). In these cases, EPA treated these exposures as numerous portions of a single full shift, and combined results from each sample to construct an exposure concentration based on the totality of exposures from each sample. This involved calculating an average of the reported exposures, weighed for the length of time each exposure was measured over.
7. **Addressed less than LOD samples.** Occasionally, one or all the samples associated with a single sample number measured below the limit of detection, and so the substitution method described earlier in this section is used to include them in the assessment. Because the samples were often on different time scales (*e.g.*, one hour vs. four hours), EPA did not include these data in the statistical analysis to estimate values below the LOD. Sample results from different time scales may vary greatly as short activities may cause a large, short-term exposure that when averaged over a full-shift are comparable to other full-shift data. Therefore, including data of different time scales in the analysis may give the appearance of highly skewed data when in fact the full-shift data are not skewed. Therefore, EPA performed the statistical analysis (as needed) using all the non-OSHA CEHD data for each OES and applied the approach determined by the analysis to the non-detects in the OSHA CEHD data. Where all the exposure data for an OES came from CEHD, EPA used only the 8-hour TWAs that did not include samples that measured below the LOD to perform the statistical analysis.
8. **Calculated 8-hour TWA results from combined samples.** Where the total sample time was less than 8 hours, EPA calculated an 8-hour TWA by assuming exposures were zero for the remainder of the shift.

It should be noted that the OSHA CEHD does not provide job titles or worker activities associated with the samples; therefore, EPA assumed all data were collected on workers and not ONUs.

Specific details related to the use of monitoring data for each OES can be found in Section 4.3.

8.1.3.2 Inhalation Exposure Modeling

Where inhalation exposures are expected for an OES but monitoring data were not available or where EPA determined monitoring data did not sufficiently capture the exposures for an OES, EPA utilized surrogate data or models to estimate inhalation exposures of *o*-dichlorobenzene. Surrogate monitoring data are data of a different chemical but for similar activity. The usage of surrogate data was determined by comparing the physical properties of the potential surrogate chemical and *o*-dichlorobenzene and examining the activities occurring during the potential surrogate's sampling.

For exposure models, outputs from models may be the result of deterministic calculations, stochastic calculations, or a combination of both deterministic and stochastic calculations. For each OES with modeled inhalation exposures, EPA followed these steps to estimate exposures:

1. Identified worker activities/sources of exposures from process.
2. Identified or developed relevant models for estimating exposures from each source.
3. Identified model input parameter values from relevant literature sources, including activity

4975 durations associated with sources of exposures.

- 4976 4. If a range of input values was available for an input parameter, determined the associated
- 4977 distribution of input values.
- 4978 5. Calculated exposure concentrations associated with each activity.
- 4979 6. Calculated full-shift TWAs based on the exposure concentration and activity duration associated
- 4980 with each exposure source.
- 4981 7. Calculated exposure metrics (AC, IADC, ADC) from full-shift TWAs.

4982 For exposure models that utilized stochastic calculations, EPA performed a Monte Carlo simulation
4983 using the Palisade @Risk Industrial Edition, Version 8.12 software with 100,000 iterations and the Latin
4984 Hypercube sampling method. Detailed descriptions of the model approaches used for each OES, model
4985 equations, input parameter values and associated distributions are provided in Section 8 and Appendix
4986 N.

4987 **8.1.3.2.1 Use of Surrogate Inhalation Exposure Monitoring Data**

4988 As discussed in Section 8.1.3.2, in cases where there are no available monitoring data that are specific to
4989 *o*-dichlorobenzene and the OES being assessed, data from another similar chemical may be used to as
4990 surrogate to estimate worker exposures. Data from both *p*-dichlorobenzene and 1,1,2-trichloroethane
4991 were used as surrogate data in the estimation of inhalation exposures. Both *p*-dichlorobenzene and 1,1,2-
4992 trichloroethane received multiple sets of inhalation sampling data from industrial sites in response to test
4993 orders. EPA determined that some of this data covered worker activities that applied to processing and
4994 use operations for *o*-dichlorobenzene as well. *p*-Dichlorobenzene and *o*-dichlorobenzene are isomers
4995 with similar physical chemical properties. 1,1,2-trichloroethane is a solvent with similar vapor pressure
4996 and molecular weight to *o*-dichlorobenzene. Because of these similarities in physical chemical
4997 properties and expected use cases, EPA used surrogate exposure monitoring data from *p*-
4998 dichlorobenzene and 1,1,2-trichloroethane to generate exposure estimates for OESs where data specific
4999 to *o*-dichlorobenzene weren't available. The OESs assessed using *p*-dichlorobenzene data as surrogate
5000 were as follows:

- 5001 • Manufacturing,
- 5002 • Processing as a Reactant,
- 5003 • Plastics Compounding,
- 5004 • Plastics Converting,
- 5005 • Use of Laboratory Chemicals, and
- 5006 • Disposal.

5007 The OES assessed using 1,1,2-trichloroethane data as surrogate was:

- 5008 • Processing as a Reactant (Laboratory Technician SEG)
- 5009 • Use of Laboratory Chemicals.

5010 For the Use of Laboratory Chemicals OES and the Laboratory Technician SEG within Processing as a
5011 Reactant OES, EPA considered data obtained from both *p*-dichlorobenzene and 1,1,2-trichloroethane
5012 data in the assessment, and the results from both are presented.

5013 Note that in the case of Manufacturing, Plastic Compounding, and Plastic Converting, only a qualitative
5014 assessment was performed. These are discussed further in their corresponding sections; Section 8.2.1,
5015 Section 8.2.6, and Section 8.2.7, respectively.

5016 To account for differences in vapor pressure and chemical concentration in the substance, EPA corrected
5017 the surrogate monitoring data from *p*-dichlorobenzene and 1,1,2-TCA for use with *o*-dichlorobenzene

using Equation 4-4 of EPA's *Chemical Engineering Branch Manual for the Preparation of Engineering Assessments* (CEB, 1991). Equation 4-4 of the CEB Manual is reproduced below as Equation 8-1.:

Equation 8-1.

$$C_{v2} = C_{v1} \times \frac{VP_2 \times X_2}{VP_1 \times X_1}$$

Where:

- C_{v2} = Estimated volumetric concentration of the chemical of interest (ppm)
 C_{v1} = Measured volumetric concentration of surrogate chemical in air (ppm)
 VP_1 = Vapor pressure of surrogate chemical
 X_1 = Mole fraction of surrogate chemical in mixture
 VP_2 = Vapor pressure of chemical of interest
 X_2 = Mole fraction of chemical of interest in mixture

Where information on chemical mole fraction in products or mixtures was unavailable, EPA assumed that the mole fraction concentration was equivalent to the weight fraction of the chemical in the substance. The weight fractions of the two chemicals used to correct for OES-specific chemical concentrations are shown in Table 8-1 below.

Table 8-1. OES-Specific Weight Fractions Used for Vapor Correction Calculations

OES ^a	Surrogate Chemical Used	Concentration of <i>p</i> -Dichlorobenzene Assessed (X ₁)	Concentration of <i>o</i> -Dichlorobenzene Assessed (X ₂)	Rationale
Processing as a Reactant	<i>p</i> -dichlorobenzene	1	1	See Section 8.2.3.3
Use of Laboratory Chemicals	1,1,2-trichloroethane and <i>p</i> -dichlorobenzene	0.43	1	See Section 8.2.16.3
^a Disposal is not included in this table because it is assumed that the concentrations of <i>p</i> -dichlorobenzene and <i>o</i> -dichlorobenzene at a disposal site are comparable, therefore the <i>o</i> -dichlorobenzene results are not corrected for a difference in weight fraction.				

Uncertainties associated with the use of surrogate data are discussed in Section 8.3.

8.1.3.3 Acute, Intermediate, and Chronic (Non-Cancer) Inhalation Exposure

For each OES, EPA used the estimated TWA exposures to calculate acute exposure concentrations (AC), intermediate average daily concentrations (IADC), average daily concentrations (ADC) for chronic, and non-cancer risks. These calculations require additional parameter inputs, such as years of exposure, exposure duration, and exposure frequency. Lifetime average daily concentrations, used to estimate cancer risk, were not calculated in this assessment because *o*-dichlorobenzene is not likely to be carcinogenic to humans. See the *Draft Human Health and Environmental Hazard Assessment for p-Dichlorobenzene* for more information (U.S. EPA, 2026s).

For the final exposure result metrics, each of the input parameters (e.g., air concentrations, working years, exposure frequency) may be a point estimate (i.e., a single descriptor or statistic, such as central tendency or high-end) or a full distribution. EPA considered three general approaches for estimating the final exposure result metrics:

- Deterministic calculations: EPA used combinations of point estimates of each parameter to estimate a central tendency and high-end for each final exposure metric result. EPA documented

the method and rationale for selecting parametric combinations to be representative of central tendency and high-end.

- Probabilistic (stochastic) calculations: EPA used Monte Carlo simulations using the full distribution of each parameter to calculate a full distribution of the final exposure metric results and selecting the 50th and 95th percentiles of this resulting distribution as the central tendency and high-end, respectively.
- Combination of deterministic and probabilistic calculations: EPA had full distributions for some parameters but point estimates of the remaining parameters. For example, EPA used Monte Carlo modeling to estimate exposure concentrations but only had point estimates of exposure duration and frequency. In this case, EPA documented the approach and rationale for combining point estimates with distribution results for estimating central tendency and high-end results.

Equations, parameter inputs, and sample calculations for these exposures can be found in Appendix K and Appendix L, respectively.

8.1.4 Dermal Exposure Approach and Methodology

Dermal exposure data were not reasonably available for the conditions of use in the assessment. For the OESs where *o*-dichlorobenzene is assessed as a liquid, EPA estimated dermal exposures via a fractional absorption approach. The key parameters involved in this approach are the dermal loading value (mg product/cm²), *o*-dichlorobenzene concentration (mg *o*-dichlorobenzene/mg product), fractional absorption of *o*-dichlorobenzene into the skin (% absorbed), and surface area of dermal contact (cm²).

The dermal loading value is the quantity of chemical on the skin after the dermal contact event. This value represents the quantity remaining after the bulk chemical formulation has fallen from the hand that cannot be removed by wiping the skin (*e.g.*, the film that remains on the skin). To estimate the dermal load from liquids, EPA analyzed data from the technical report *A Laboratory Method to Determine the Retention of Liquids on the Surface of the Hands* ([U.S. EPA, 1992b](#)). For powders and solid articles, EPA used data from literature ([Marquart et al., 2006](#); [Lansink et al., 1996](#)).

EPA assessed concentrations of *o*-dichlorobenzene in the chemical products being handled using available test order data, CDR data, Generic Scenarios, Emission Scenario Documents, product safety data sheets, and the *o*-dichlorobenzene Use Report ([U.S. EPA, 2020f](#)). Fractional absorption data was obtained empirically via a test order. Per the data, 4% of the applied dose is absorbed through the skin, for products with *o*-dichlorobenzene concentrations greater than 50% weight fraction. Otherwise, the 2% of the applied dose is absorbed ([Charles River Laboratories, 2025](#)).

EPA used an exposed skin surface area for workers based a range between 0 to the mean two-hand surface area for adult males ages 21 or older from Chapter 7 of EPA's *Exposure Factors Handbook* ([U.S. EPA, 2011a](#)). For ONUs experiencing incidental contact to mist or dust deposited on surfaces, EPA assumed a representative exposure surface area equivalent to the mean value for one palm.

EPA varied all of the above parameters via a Monte Carlo simulation with 100,000 iterations and the Latin Hypercube sampling method in response to recommendations from SACC on prior chemical risk evaluations such as the *Draft Risk Evaluation for 1,1-Dichloroethane* ([U.S. EPA, 2025, 2024b](#)). EPA did not assess dermal exposures to ONUs for *o*-dichlorobenzene as a liquid as EPA does not expect ONUs to directly handle liquid *o*-dichlorobenzene as part of their duties, and thus ONUs are not expected to have dermal exposures to liquid *o*-dichlorobenzene during the course of their work.

Specific details of the dermal exposure assessment for each OES can be found in Section 8.2 and equations for estimating dermal exposures can be found in Appendix M.

8.1.4.1 Acute, Intermediate, and Chronic (Non-Cancer) Dermal Exposure

For each COU, the estimated exposures were used to calculate acute, intermediate, and chronic (non-cancer) dermal doses. These calculations require additional parameter inputs, such as years of exposure, exposure duration, and exposure frequency. For the final exposure result metrics, each of the input parameters (*e.g.*, dermal doses, working years, exposure frequency) may be a point estimate (*i.e.*, a single descriptor or statistic such as central tendency or high-end) or a full distribution. EPA considered three general approaches for estimating the final exposure result metrics:

- **Deterministic Calculations:** EPA used combinations of point estimates of each parameter to estimate a central tendency and high-end for each final exposure metric result. The Agency documented the method and rationale for selecting parametric combinations to be representative of central tendency and high-end.
- **Probabilistic (Stochastic) Calculations:** EPA used Monte Carlo simulations using the full distribution of each parameter to calculate a full distribution of the final exposure metric results and selecting the 50th and 95th percentiles of this resulting distribution as the central tendency and high-end, respectively.
- **Combination of Deterministic and Probabilistic Calculations:** EPA had full distributions for some parameters but point estimates of the remaining parameters. For example, the Agency used Monte Carlo modeling to estimate exposure concentrations but only had point estimates of exposure duration and frequency. In this case, EPA documented the approach and rationale for combining point estimates with distribution results for estimating central tendency and high-end results.

Chronic (cancer) dermal dose, used to estimate cancer risk, was not calculated in this assessment because *p*-dichlorobenzene is not likely to be carcinogenic to humans. See the *Draft Human Health and Environmental Hazard Assessment for p-Dichlorobenzene* for more information ([U.S. EPA, 2026s](#)).

Equations and sample calculations for these exposures can be found in Appendix K and Appendix L, respectively.

8.1.5 Consideration of Engineering Controls and Personal Protective Equipment

For each OES EPA discusses PPE typically worn by workers and ONUs, if available. EPA's occupational exposure estimates do not assume the use of PPE. However, the effect of respiratory protection on EPA's occupational exposure estimates can be explored in the "Risk Reduction" tab of the *Draft Commercial Use Risk Calculator for o-Dichlorobenzene* ([U.S. EPA, 2026i](#)).

OSHA and NIOSH recommend employers utilize the hierarchy of controls to address hazardous exposures in the workplace. The hierarchy of controls strategy outlines, in descending order of priority, the use of elimination, substitution, engineering controls, administrative controls, and lastly personal protective equipment (PPE). The hierarchy of controls prioritizes the most effective measures first, which is to eliminate or substitute the harmful chemical (*e.g.*, use a different process, substitute with a less hazardous material), thereby preventing or reducing exposure potential. Following elimination and substitution, the hierarchy recommends engineering controls to isolate employees from the hazard (*e.g.*, source enclosure, local exhaust ventilation systems), followed by administrative controls (*e.g.*, do not open machine doors when running), or changes in work practices (*e.g.*, maintenance plan to check equipment to ensure no leaks) to reduce exposure potential. Administrative controls are policies and procedures instituted and overseen by the employer to limit worker exposures. Under 29 CFR 1910.1000, OSHA requires the use of engineering or administrative controls to bring exposures to the levels permitted under the air contaminants standard. The respirators do not replace engineering

controls, and they are implemented in addition to feasible engineering controls (29 CFR 1910.134(a)(1)). The PPE (e.g., respirators, gloves) could be used as the last means of control when the other control measures cannot reduce workplace exposure to an acceptable level.

Note that if gloves are worn by workers it may reduce dermal exposure. However, a quantitative protection factor cannot be assigned to different types of gloves, and durability and chemical resistance varies among glove types. Dermal exposure can also occur on skin outside of the hands if arms and legs are not covered, or if a worker touches skin on another part of their body with a glove contaminated with the chemical. Improper glove application, removal, or tears in the glove may also cause dermal exposure despite the use of gloves.

The remainder of this section discusses respiratory protection, including protection factors for various respirators. EPA's estimates of occupational exposure presented in this document do not assume the use of engineering controls or PPE; however, the effect of respiratory assigned protection factors on the Agency's occupational exposure estimates can be explored in the "Risk Reduction" tab of the *Draft Risk Calculator for o-Dichlorobenzene* ([U.S. EPA, 2026x](#)).

8.1.5.1 Respiratory Protection

OSHA's Respiratory Protection Standard (29 CFR 1910.134) requires employers in certain industries to address workplace hazards by implementing engineering control measures and, if these are not feasible, provide respirators that are applicable and suitable for the purpose intended. Engineering and administrative controls must be implemented whenever employees are exposed above the PEL. If engineering and administrative controls do not reduce exposures to below the PEL, respirators must be worn. Respirator selection provisions are provided in 29 CFR 1910.134(d) and require that appropriate respirators are selected based on the respiratory hazard(s) to which the worker will be exposed and workplace and user factors that affect respirator performance and reliability. Assigned protection factors (APFs) are provided in Table 1 under 29 CFR 1910.134(d)(3)(i)(A) (see below in Table 8-2) and refer to the level of respiratory protection that a respirator or class of respirators could provide to employees when the employer implements a continuing, effective respiratory protection program.

Respirators must meet or exceed the required level of protection listed in Table 8-2. Based on the APF, inhalation exposures may be reduced by a factor of 5 to 10,000 if respirators are properly worn and fitted.

For atmospheres that are immediately dangerous to life and health, workers must use a full facepiece pressure demand self-contained breathing apparatus (SCBA) certified by NIOSH for a minimum service life of 30 minutes or a combination full facepiece pressure demand supplied-air respirator (SAR) with auxiliary self-contained air supply. Respirators that are provided only for escape from an atmosphere that is immediately dangerous to life and health must be NIOSH-certified for escape from the atmosphere in which they will be used.

Table 8-2. Assigned Protection Factors for Respirators in OSHA Standard 29 CFR 1910.134

Type of Respirator	Quarter Mask	Half Mask	Full Facepiece	Helmet/Hood	Loose-Fitting Facepiece
1. Air-Purifying Respirator	5	10	50		
2. Power Air-Purifying Respirator (PAPR)		50	1,000	25/1,000	25
3. Supplied-Air Respirator (SAR) or Airline Respirator					
• Demand mode		10	50		
• Continuous flow mode		50	1,000	25/1,000	25
• Pressure-demand or other positive-pressure mode		50	1,000		
4. Self-Contained Breathing Apparatus (SCBA)					
• Demand mode		10	50	50	
• Pressure-demand or other positive-pressure mode (e.g., open/closed circuit)			10,000	10,000	
Source: 29 CFR 1910.134(d)(3)(i)(A)					

8.1.6 Evidence Integration for Occupational Exposure

Evidence integration for occupational exposures assessments includes analysis, synthesis and integration of information and data to produce estimates of occupational inhalation and dermal exposures. During evidence integration, EPA considered the likely location, duration, intensity, frequency, and quantity of exposures while also considering factors that increase or decrease the strength of evidence when analyzing and integrating the data. Sources are rated with one of four possibilities: high, medium, low, and uninformative.

Key factors EPA considered when integrating evidence include the following:

1. **Data Quality:** EPA only integrated data or information rated as high, medium, or low obtained during the data evaluation phase. Data and information rated as uninformative are not used for quantitative exposure estimates. In general, higher rankings are given preference over lower ratings; however, lower ranked data may be used over higher ranked data when specific aspects of the data are carefully examined and compared. For example, a lower ranked dataset that precisely matches the OES of interest may be used over a higher ranked study that does not as closely match the OES of interest.
2. **Data Hierarchy:** EPA used both measured and modeled data to obtain accurate and representative estimates (e.g., central-tendency, high-end) of the occupational exposures resulting directly from a specific source, medium, or product. If available, measured exposure data are given preference over modeled data, with the highest preference given to data that are both chemical-specific and directly representative of the OES/exposure source.

EPA considered both data quality and data hierarchy when determining evidence integration strategies. For example, if available, EPA gave preference to high quality modeled data over low-quality measured data to estimate exposures. The final integration of the occupational exposure evidence combined decisions regarding the strength of the available information, including information on plausibility and coherence across each evidence stream.

8.2 Occupational Exposure Assessment by OES

The following sections contain the specific details (worker activities, analysis for determining number of workers, exposure assessment approach and results) for the assessment for each OES.

Refer to Table 4-1 to see how each OES described below pairs with the COU stated in the *Final Scope of the Risk Evaluation for o-Dichlorobenzene; CASRN 107-46-7* ([U.S. EPA, 2020e](#))

For all OESs that have inhalation monitoring data, the annual and daily central tendencies and high-ends for these occupational exposures can be found in the “Inhalation Data” tab of the *Draft Risk Calculator for o-Dichlorobenzene* ([U.S. EPA, 2026x](#)).

For those OESs that use exposure modeling, and all dermal modeling see the following supplemental documents, as applicable:

- *Draft Dermal Modeling Results (liquid) for o-Dichlorobenzene* ([U.S. EPA, 2026n](#))
- *Draft Lubricants & Greases Inhalation Exposure Model for o-Dichlorobenzene* ([U.S. EPA, 2026v](#))
- *Draft Number of Workers for o-Dichlorobenzene* ([U.S. EPA, 2026w](#))
- *Draft Commercial Use Risk Calculator for o-Dichlorobenzene* ([U.S. EPA, 2026i](#))
- *Draft IECCU Commercial Modeling for o-Dichlorobenzene (air care)* ([U.S. EPA, 2026g](#))
- *Draft CEM Commercial Modeling for o-Dichlorobenzene (sheep branding)* ([U.S. EPA, 2026h](#))
- *Draft Fuels and Related Products Results for o-Dichlorobenzene* ([U.S. EPA, 2026q](#))
- *Draft Paints and Coatings Results for o-Dichlorobenzene* ([U.S. EPA, 2026y](#))
- *Draft CEM and Dermal Consumer Modeling o-Dichlorobenzene* ([U.S. EPA, 2026c](#))
- *Draft IECCU Consumer Modeling o-Dichlorobenzene* ([U.S. EPA, 2026k](#))
- *Draft Consumer-Indoor Air Inhalation and Dermal Acute and Chronic Risk Calculator o-Dichlorobenzene* ([U.S. EPA, 2026j](#)).

8.2.1 Manufacturing

As listed in Table 4-1, this OES includes the following COU: Domestic manufacture.

8.2.1.1 Worker Activities

Because *o*-dichlorobenzene is commonly produced as a byproduct with its isomer *p*-dichlorobenzene, EPA considered surrogate manufacturing exposure data from the occupational exposure assessment for *p*-dichlorobenzene to assess worker exposures during the manufacture of *o*-dichlorobenzene ([U.S. EPA, 2026f](#)). In the exposure assessment for *p*-dichlorobenzene, EPA did not identify any cases where *p*-dichlorobenzene is manufactured as a primary product within the United States. Using test order data from Westlake Corporation, the Agency EPA identified activities that exposed workers to *p*-dichlorobenzene that was manufactured as a byproduct during the production of VCM ([Exponent Inc., 2024](#)). Based on its physical-chemical properties, *p*-dichlorobenzene is typically a solid at standard temperature and pressure; however, in the described manufacturing process, the chemical is heated and present in liquid form ([U.S. EPA, 2019g](#)). *o*-Dichlorobenzene is expected to be in liquid form at standard temperature and pressure ([U.S. EPA, 2020d](#)). See Section 4.3.1.1 for a full manufacturing process description.

Based on the test order data from Westlake Corporation ([Exponent Inc., 2024](#)), which described worker activities from a single facility, SEGs involved in the manufacture of *p*-dichlorobenzene as a byproduct include the following occupational worker groups: Operators (VCM unit, Pre-Tri unit, and Waste Treatment), Shipping Tankerman, and Laboratory Technicians. SEGs for ONUs included the following groups: Maintenance (VCM unit and Per-Tri unit), Supervisors (VCM unit and Waste Treatment), and VCM Unit Engineer. Activities associated with each SEG that may result in exposures are provided below in Table 8-3.

5265 **Table 8-3. SEGs and Worker Activities Included in the Westlake Test Order Data**

Worker Designation ^a	Westlake Similar Exposure Group (SEG)	Worker Activities
Worker	VCM Unit (Operator)	Inhalation of vapors and dermal exposure to liquids during worker activities such as product sampling, equipment cleaning, container cleaning, reactor operation, or loading <i>p</i> -dichlorobenzene into reactors
Worker	Per-Tri Unit (Operator)	Inhalation of vapors and dermal exposure to liquids during worker activities such as product sampling, equipment cleaning, container cleaning, reactor operation, or loading <i>p</i> -dichlorobenzene into reactors.
Worker	Waste Treatment (Operator)	Inhalation of vapors and dermal exposure to liquids during worker activities such as product sampling, equipment cleaning, container cleaning, or disposing of waste containing <i>p</i> -dichlorobenzene.
Worker	Shipping Tankerman	Inhalation of vapors and dermal exposure to liquids during worker activities such as equipment cleaning, container cleaning, or packaging and loading of <i>p</i> -dichlorobenzene into transport containers for shipment.
Worker	Laboratory Technicians	Inhalation of vapors and dermal exposure to liquids during worker activities such as product sampling, analyzing samples, equipment cleaning, or container cleaning.
ONU	VCM Unit (Maintenance)	Inhalation of vapors while in an area where the chemical is present.
ONU	VCM Unit (Supervisor)	Inhalation of vapors while in an area where the chemical is present.
ONU	VCM Unit (Engineer)	Inhalation of vapors while in an area where the chemical is present.
ONU	Per-Tri Unit (Maintenance)	Inhalation of vapors while in an area where the chemical is present.
ONU	Waste Treatment (Supervisor)	Inhalation of vapors while in an area where the chemical is present.
^a (Exponent Inc., 2024)		

5266
5267 For this OES, EPA considered surrogate data from *p*-dichlorobenzene. The Agency expects that the
5268 SEGs and worker activities included in the surrogate manufacturing data are reasonably similar to those
5269 for *o*-dichlorobenzene manufacturing. Strengths and weaknesses pertaining to these assumptions are
5270 further discussed in Section 8.3.

5271 **8.2.1.2 Number of Workers and Occupational Non-Users**

5272 EPA identified four sites that reported releases due to the manufacture of *o*-dichlorobenzene as a
5273 byproduct; however, it was reported by Westlake Corporation that *o*-dichlorobenzene can be formed
5274 during reactions that form its isomer *p*-dichlorobenzene ([Exponent Inc., 2024](#)). Due to the uncertainty
5275 associated with reporting limits in the release databases, EPA believes that the number of sites reporting
5276 *o*-dichlorobenzene releases from the databases may be an underestimate, and therefore chose the
5277 estimation approach of using the number of workers and ONUs reported in 2020 CDR for *p*-
5278 dichlorobenzene as a surrogate estimate for the number of workers and ONUs for *o*-dichlorobenzene
5279 ([U.S. EPA, 2020e](#)). *p*-Dichlorobenzene is only manufactured in the United States as a byproduct of
5280 VCM production, so it is reasonable to assume that *o*-dichlorobenzene may be present as well.
5281 Therefore, EPA assessed 14 *o*-dichlorobenzene manufacturing sites, which is equal to the number of
5282 VCM manufacturers that reported to CDR in 2020 ([U.S. EPA, 2020e](#)). To calculate the number of
5283 workers and ONUs, EPA used a per-site average based on all VCM manufacturers that reported to CDR

in 2020. Of the 14 sites, 10 sites publicly reported the number of workers (4 sites claimed this information as CBI). Per CDR, a range of 1,960 to 5,101 workers are estimated over the 10 non-CBI sites, for a total of 196 to 510 workers per site. As there are typically more workers at sites than ONUs, EPA assessed the upper bound of 510 workers per site and the lower bound of 196 ONUs per site.

EPA could not identify worker count data for each SEG in the test order; therefore, EPA estimated the number of workers which includes the following SEGs: Operators (VCM unit, Pre-Tri unit, and Waste Treatment), Shipping Tankerman, and Laboratory Technicians. SEGs for ONUs included the following groups: Maintenance (VCM unit and Per-Tri unit), Supervisors (VCM unit and Waste Treatment), and VCM Unit Engineer. Table 8-4 summarizes the per site estimates for this OES based on the methodology described, including the number of sites identified in Section 4.2.2.

Table 8-4. Estimated Average Number of Workers per Site Potentially Exposed to *o*-Dichlorobenzene During Manufacturing

Potential Number of Sites	NAICS Code	Potentially Exposed Workers per Site	Potentially Exposed ONUs per Site
14	N/A – CDR used to estimate number of workers and ONUs	510	196

8.2.1.3 Occupational Inhalation and Dermal Exposure Results

EPA was unable to identify inhalation exposure data specific to the manufacture of *o*-dichlorobenzene. Because *o*-dichlorobenzene is commonly produced as a byproduct with *p*-dichlorobenzene and because the two isomers have similar physical chemical properties, the Agency considered surrogate exposure data from the occupational exposure Assessment for *p*-dichlorobenzene to assess worker exposures to *o*-dichlorobenzene ([U.S. EPA, 2026f](#)). EPA was provided with inhalation monitoring data from one facility under the control of Westlake Corporation, which manufactures *p*-dichlorobenzene as a byproduct of their VCM Per-Tri production process. The company also has stated that they produce *o*-dichlorobenzene as well but in lower amounts. The Westlake data includes 70 occupational full-shift personal air samples taken in total between April 2024 and July 2024 and 12 occupational task-based personal air samples. Task-based samples were below the limits of detection LODs ranged between 0.043 to 1.5 ppm with durations between 10 and 353 minutes. Of the full-shift samples taken 25 samples were classified as 8-hour TWAs (sample durations between 421–518 minutes) while the remaining 45 samples were classified as 12-hour TWAs (sample durations between 386–699 minutes). The collected samples were further classified into the SEGs discussed in Section 8.2.1.1 ([Exponent Inc., 2024](#)).

All inhalation data that was sampled were reported as non-detects (ND), with LOD ranging from 0.022 to 0.04 ppm for full-shift samples. Because of this, EPA assessed *p*-dichlorobenzene exposure at the maximum LOD and half the maximum LOD as the high-end and central tendency TWA exposure concentrations for each SEG, respectively.

When this analysis was completed for *p*-dichlorobenzene, even with the health-protective assumption of *p*-dichlorobenzene present at the LOD, the *Draft Risk Evaluation for p-Dichlorobenzene* ([U.S. EPA, 2026aa](#)) did not identify unreasonable risk for manufacturing of *p*-dichlorobenzene and all but one risk estimate were below the benchmark of 30 (1 high-end risk estimate due to chronic exposure was calculated as 29). Communications from Westlake Corporation indicated that *o*-dichlorobenzene makes up less than half of the byproduct mixture; *p*-dichlorobenzene comprises of 50% or more of the mixture and the remainder is comprised mostly of *o*-dichlorobenzene and a small amount of *m*-dichlorobenzene (which is an isomer of *p*- and *o*-dichlorobenzene). Therefore, while there is insufficient information available for quantifying air concentrations and dermal exposure estimates for *o*-dichlorobenzene,

exposures must be lower than they would be for *p*-dichlorobenzene, for which not a single measurement was detected above the LOD. Therefore, EPA has determined that exposures from manufacturing of *o*-dichlorobenzene as a byproduct are negligible and human health risks are unlikely.

EPA did not receive information from other processes that manufacture *o*-dichlorobenzene as a byproduct, and it is assumed the conditions during the VCM process are representative of all cases when *o*-dichlorobenzene is manufactured as a byproduct.

8.2.2 Repackaging

As listed in Table 4-1, this OES includes the following COU: Import and Repackaging.

8.2.2.1 Worker Activities

Worker activities during repackaging of *o*-dichlorobenzene were assessed using data provided in response to a Test Order by Sabic Innovative Plastics, a processor and user of *o*-dichlorobenzene. Worker inhalation samples were taken from this dataset for workers that were described as periodically disconnecting/connecting chemical transfer lines. These data were analyzed and used as analogous data for sites that repackage *o*-dichlorobenzene. Per the test order data and the 2020 CDR, *o*-dichlorobenzene is expected to be imported and repackaged as a liquid; see Section 4.3.2.1 for a full repackaging process description.

EPA assessed exposures based on exposure data provided by Sabic. Sabic grouped workers into four different SEGs and included job titles and brief worker activity descriptions in their data. The SEGs used in the Sabic data are listed below.

- SEG 1: High Performance Polymers – Polymer Chemical Operators;
- SEG 2: High Performance Polymers – Copolymer Chemical Operators;
- SEG 3: Sabic Maintenance Mechanics/Electricians; and
- SEG 4: High Performance Polymers Support Personnel (Engineers, Managers, etc.) ([SABIC, 2024](#)).

The Sabic data listed the first three SEGs as “workers” and the fourth as “ONUs.” The task descriptions for a subset of samples taken for SEGs 1 and 2 included “Connect/disconnect transfer hoses to intermodal containers.” One sample for a polymer resource engineer in SEG 4 also listed this task description ([SABIC, 2024](#)).

Based on this, EPA assessed three SEGs: “Polymer Chemical Operators,” “Copolymer Chemical Operators,” and “ONUs – Support Personnel.” All workers that were reported to have performed material loading and unloading, disconnecting, or connecting transfer hoses to containers were included in this assessment. EPA assumes that Support Personnel may be in the work area while these activities are performed. Activities associated with each SEG are provided below:

- Polymer Chemical Operators – Inhalation of vapors and dermal contact with liquids;
- Copolymer Chemical Operators – Inhalation of vapors and dermal contact with liquids during equipment cleaning or loading of repackaged containers; and
- ONUs – Inhalation of vapors while in an area where the chemical is present.

8.2.2.2 Number of Workers and Occupational Non-Users

EPA used data from BLS and the SUSB specific to the OES to estimate the number of workers and ONUs per site potentially exposed to *o*-dichlorobenzene during repackaging ([U.S. BLS, 2023a](#); [U.S. Census Bureau, 2017](#)). This approach involved first identifying the number of sites for this OES. EPA

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identified five sites that reported releases due to the repackaging or import of *o*-dichlorobenzene; however, due to the uncertainty associated with reporting limits in the release databases, the Agency believes that the number of sites reporting *o*-dichlorobenzene releases from the databases may be an underestimation. Because of this, EPA also estimated number of facilities using relevant NAICS codes for the OES. EPA assessed a bounding estimate of 21,140 sites for this OES based on the number of sites listed under the identified NAICS codes. Using a bounding estimate will overestimate the true number of sites that use *o*-dichlorobenzene for this OES. Relevant SOC codes were identified within the BLS data for the NAICS codes, from which total number of workers can be determined. This number is divided by the number of sites identified to obtain the exposed workers per site. Appendix J includes further details regarding methodology for estimating the number of workers and ONUs per site. EPA assigned the following NAICS codes for this OES:

- 325211 – Plastics Material and Resin Manufacturing
- 325991 – Custom Compounding of Purchased Resins
- 325199 – All Other Basic Organic Chemical Manufacturing
- 424610 – Plastics Materials and Basic Forms and Shapes Merchant Wholesalers
- 424690 – Other Chemical and Allied Products Merchant Wholesalers
- 424710 – Petroleum Bulk Stations and Terminals
- 424720 – Petroleum and Petroleum Products Merchant Wholesalers (except Bulk Stations and Terminals).

Table 8-5 summarizes the per site estimates for this OES based on the methodology described, including the number of sites identified in Section 4.2.2.

Table 8-5. Estimated Average Number of Workers per Site Potentially Exposed to *o*-Dichlorobenzene During Repackaging

Potential Number of Sites	NAICS Code	Potentially Exposed Workers per Site ^a	Potentially Exposed ONUs per Site ^a
21,140	325211 – Plastics Material and Resin Manufacturing	3	2
	325991 – Custom Compounding of Purchased Resins		
	325199 – All Other Basic Organic Chemical Manufacturing		
	424610 – Plastics Materials and Basic Forms and Shapes Merchant Wholesalers		
	424690 – Other Chemical and Allied Products Merchant Wholesalers		
	424710 – Petroleum Bulk Stations and Terminals		
	424720 – Petroleum and Petroleum Products Merchant Wholesalers (except Bulk Stations and Terminals)		
^a Number of workers and ONUs per site calculated by dividing the exposed number of workers or ONUs by the number of establishments.			

8.2.2.3 Occupational Inhalation Exposure Results

EPA was provided *o*-dichlorobenzene Test Order inhalation data for exposed workers and ONUs from Sabic Innovative Plastics. The test order data included a total of 28 8-hour personal air samples taken

between April and May of 2024, along with two occupational task-based personal air samples. Of these data, 15 8-hour samples and the two task-based samples had associated task descriptions containing “Connect/disconnect transfer hoses to intermodal containers”. These data points were deemed by EPA to be relevant to repackaging activities and included under this OES {Sabic, 2024, 13171505}. The task-based samples were both 15-minute samples that ranged from 0.85 to 0.87 ppm. The TWA data were split between three SEGs: Polymer Chemical Operators, Copolymer Chemical Operators, and ONUs. For 8-hour TWA concentrations for Polymer Chemical Operators, the Sabic data contained eight samples, and all samples were reported above the limit of detection. For this subset of data, the median and 95th percentile were used to represent a central tendency and high-end estimate, respectively. For Copolymer Chemical Operators, the Sabic data contained six samples, one sample was below the limit of detection – this ND sample was estimated as the LOD/ 2 due to the standard deviation of the dataset. For this subset of data, the median and 95th percentile were used to represent a central tendency and high-end estimate, respectively. There was a single ONU sample mapped to this OES, which was detected for *o*-dichlorobenzene. Because there was only one sample relevant to this OES, EPA presented the single exposure value instead of a high-end and a central tendency concentration {Sabic, 2024, 13171505}. (SABIC, 2024). Using these 8-hour TWA estimates, EPA calculated the AC, IADC, and ADC, as described in Appendix K. The results of these calculations are shown in Table 8-6.

Table 8-6. Summary of Worker Inhalation 8-Hour TWA Exposure to *o*-Dichlorobenzene During Repackaging

SEG	Exposure Concentration Type	Worker Inhalation Estimates (ppm)	
		Central Tendency	High-End
Polymer Chemical Operators	8-Hour time-weighted average (TWA) exposure concentrations	1.0E-02	0.12
	Acute exposure concentrations (AC) based on 8-hour TWA	6.9E-03	7.9E-02
	Intermediate average daily concentration (IADC) based on 8-hour TWA	5.1E-03	5.8E-02
	Average daily concentration (ADC) based on 8-hour TWA	4.7E-03	5.4E-02
Copolymer Chemical Operators	8-Hour TWA exposure concentrations	1.1E-02	0.10
	Acute exposure concentrations (AC) based on 8-hour TWA	7.4E-03	7.0E-02
	Intermediate average daily concentration (IADC) based on 8-hour TWA	5.4E-03	5.1E-02
	Average daily concentration (ADC) based on 8-hour TWA	5.1E-03	4.8E-02
ONUs	8-Hour TWA exposure concentrations	9.6E-03	9.6E-03
	Acute exposure concentrations (AC) based on 8-hour TWA	6.6E-03	6.6E-03
	Intermediate average daily concentration (IADC) based on 8-hour TWA	4.8E-03	4.8E-03
	Average daily concentration (ADC) based on 8-hour TWA	4.5E-03	4.5E-03

8.2.2.4 Occupational Dermal Exposure Results

Although operations for this OES are mostly performed in a closed system, worker activities like connecting and disconnecting hoses presents an opportunity for dermal exposure to workers’ hands. EPA estimated dermal exposures for this OES using a Monte Carlo simulation with 100,000 iterations. The Agency modeled dermal exposure using a fraction absorbed value of 0.04 for *o*-dichlorobenzene as a liquid and followed the processes discussed in Section 8.1.4 and Appendix M. There are not any reliable dermal absorption studies available for *o*-dichlorobenzene, however based on comparison of all available data it is expected that *o*-dichlorobenzene absorption will be similar to *p*-dichlorobenzene, and so *p*-dichlorobenzene data was used. The fraction absorbed value of 0.04 was obtained from data

submitted to satisfy EPA's Order to conduct an *in vitro* dermal absorption study on *p*-dichlorobenzene. The study indicated that an estimate of 0.04 (or 4%) absorption should apply to all formulations with a greater than 50% concentration of *p*-dichlorobenzene. For more details on this study, and rationale for its use as a surrogate for *o*-dichlorobenzene, see the *Draft Human Health and Environmental Hazard Assessment for o-Dichlorobenzene* ([U.S. EPA, 2026r](#)). EPA assessed the concentration of *o*-dichlorobenzene in the liquid product as a uniform distribution from 90 to 100% based on data provided by the 2020 CDR ([U.S. EPA, 2020a](#)).

Table 8-7 summarize the APDR, AAD, IAD, and CAD (non-cancer) for *o*-dichlorobenzene during repackaging. For the different repackaging scenarios, the SEG areas included in the "Average Adult Worker" category for *o*-dichlorobenzene during repackaging included Copolymer Chemical Operators and Polymer Chemical Operators.

These SEGs were grouped for the purposes of modeling as they are expected to have similar risks of dermal exposure. The high-ends are the 95th percentiles of the respective simulation output and the central tendency exposures are the 50th percentiles. Dermal exposures for ONUs for *o*-dichlorobenzene as a liquid are expected to be negligible as they do not directly handle the chemical and airborne mist is not expected to be generated by this use. OES-specific parameters for dermal exposures are described in Appendix M.

Table 8-7. Summary of Dermal Exposure Doses to *o*-Dichlorobenzene for Repackaging

Modeled Scenario	Exposure Concentration Type	Central Tendency	High-End
Average Adult Worker	Acute potential dose rate (APDR) (mg/day)	26	64
	Acute absorbed dose (AAD) (mg/kg-day)	0.32	0.80
	Intermediate absorbed dose (IAD), non-cancer (mg/kg-day)	0.22	0.55
	Chronic absorbed dose (CAD), non-cancer (mg/kg-day)	0.20	0.51

8.2.2.5 Exposure Controls and PPE

PPE documented in the Sabic test order data used by polymer and copolymer operators include: hardhats, fire retardant uniforms, chemical resistant suits, rubber boots, safety-toe boots, neoprene gloves, safety glasses and face shields. Other task-specific PPE included use of leather gloves, hearing protection, and safety shoes ([SABIC, 2024](#)). EPA did not identify data indicating whether this PPE would be applicable to repackaging sites. Exposure controls documented in the Sabic test order data used by workers when indoors include general ventilation and task-specific local exhaust ventilation.

8.2.3 Processing as a Reactant

As listed in Table 4-1, this OES includes the following COUs: Processing as a reactant and Intermediates in all other basic organic chemical manufacturing.

8.2.3.1 Worker Activities

EPA was unable to identify process information specific to processing *o*-dichlorobenzene as a reactant. Because of their similarities in chemical properties and expected applications, EPA used surrogate processing exposure data from the occupational exposure assessment for *p*-dichlorobenzene to assess worker exposures during processing of *o*-dichlorobenzene as a reactant ([U.S. EPA, 2026f](#)). In the ACC report "*p*-dichlorobenzene (*p*-DCB) Occupational Inhalation Exposure Study Conducted During Polyphenylene Sulfide Manufacture and Compounding," ACC gathered inhalation exposure data and worker activity descriptions for sites that process *p*-dichlorobenzene into polyphenylene sulfide (PPS).

The report states that *p*-dichlorobenzene arrives at the processing site in liquid form from a tank truck or rail car where it is unloaded into storage tanks. PPS is then formed by a reaction of *p*-dichlorobenzene and sodium sulfide in a polar solvent ([ACC, 2023](#)). Unreacted *p*-dichlorobenzene may be separated from the product stream and recycled back into the reactor to increase product purity and reaction yield. See Section 4.3.3.1 for a full processing as a reactant process description.

Based on the report from ACC, SEGs involved in the processing of *p*-dichlorobenzene included the following occupational worker groups: Material Handlers, Process Field Operators, and Laboratory Technicians. In the report, ONUs included the following occupational worker groups: Board Operator, Warehouse Technician Warehousing, and DCS Engineer. Activities associated with each SEG that may result in exposures are provided below:

- Material Handler – Inhalation of vapors and dermal exposure to liquids during worker activities such as unloading railcars and performing connecting and disconnecting activities;
- Process Field Operator – Inhalation of vapors and dermal exposure to liquids during worker activities such as adding raw materials into intermediate storage vessels when processing *p*-dichlorobenzene as an intermediate reactant and collecting process and slurry samples;
- Lab Technician – Inhalation of vapors and dermal exposure to liquids during worker activities such as analyzing samples, handline *p*-dichlorobenzene, and cleaning equipment or containers; and
- ONU – Inhalation of vapors while in an area where the chemical is present.

EPA assumed 200 exposure days per year for 12-hour shifts based on information provided from ACC. For other data that did not have industry-specific exposure days per year, EPA used the defaults of 250 days for 8-hour shifts, and 167 days for 12-hour shifts

8.2.3.2 Number of Workers and Occupational Non-Users

EPA used data from CDR, BLS, and the SUSB specific to the OES to estimate the number of workers and ONUs per site potentially exposed to *o*-dichlorobenzene during processing as a reactant ([U.S. BLS, 2023a](#); [U.S. EPA, 2020e](#); [U.S. Census Bureau, 2017](#)). This approach involved first identifying the number of sites for this OES. EPA identified three sites that reported releases due to processing of *o*-dichlorobenzene as a reactant; however, due to the uncertainty associated with reporting limits in the release databases, the Agency believes that the number of sites reporting *o*-dichlorobenzene releases from the databases may be an underestimation. Because of this, EPA also estimated number of facilities using relevant NAICS codes for the OES. The potential number of sites for this OES was then estimated based on CDR. In 2020, one CDR reporter (Lanxess Corporation) listed an industrial function category of “intermediate.” The reporter estimated a maximum of ten industry sites with this function. Relevant SOC codes within the BLS data were then identified for the applicable NAICS codes. From there, the total number of workers was determined which was then divided by the number of sites identified to obtain the number of exposed workers per site. Appendix J includes further details regarding methodology for estimating the number of workers and ONUs per site. EPA assigned the following NAICS codes for this OES:

- 325199 – All Other Basic Organic Chemical Manufacturing;
- 325211 – Plastics Material and Resin Manufacturing;
- 325110 – Petrochemical Manufacturing; and
- 325180 – Other Basic Inorganic Chemical Manufacturing.

EPA did not identify worker count data for each SEG in the data provided by 2020 CDR; therefore, EPA estimated a number of workers which include the SEGs Material Handler, Process Field Operator, Lab Technicians, and ONUs described in the provided surrogate *p*-dichlorobenzene data. ONUs include

Board Operator, Warehouse Technician Warehousing, and DCS Engineer. Table 8-8 summarizes the per site estimates for this OES based on the methodology described, including the number of sites identified in Section 4.2.2.

Table 8-8. Estimated Number of Workers Potentially Exposed to *o*-Dichlorobenzene During Processing as a Reactant

Potential Number of Sites	NAICS Code	Potentially Exposed Workers per Site ^a	Potentially Exposed ONUs per Site ^a
10	325199 – All Other Basic Organic Chemical Manufacturing	6,980	4,029
	325211 – Plastics Material and Resin Manufacturing		
	325110 – Petrochemical Manufacturing		
	325180 – Other Basic Inorganic Chemical Manufacturing		

^a Number of workers and ONUs per site calculated by dividing exposed number of workers or ONUs by establishments.

8.2.3.3 Occupational Inhalation Exposure Results

EPA identified two inhalation samples in the OSHA CEHD database for worker exposures to *o*-dichlorobenzene for the SIC code 2865 – Cyclic Organic Crudes and Intermediates, and Organic Dyes and Pigments. The samples were collected from a chemical plant in 1985 and reported concentrations of 2.2 and 5.7 ppm for *o*-dichlorobenzene with sample durations of 23 minutes and 57 minutes, respectively ([OSHA, 2019](#)). These sample durations were not sufficient to generate full-shift TWA estimates. EPA was unable to identify additional inhalation exposure data specific to processing *o*-dichlorobenzene as a reactant. Because of their similarities in chemical properties and expected applications, EPA used surrogate exposure data from the occupational exposure assessment for *p*-dichlorobenzene to assess worker exposures to *o*-dichlorobenzene ([U.S. EPA, 2026f](#)).

Occupational inhalation data for *p*-dichlorobenzene during processing as a reactant were provided via a data submission from the ACC, which includes processors of *p*-dichlorobenzene ([ACC, 2023](#)). EPA estimated inhalation exposures using 31 worker and 22 ONU full-shift PBZ samples from two processing facilities.

From this monitoring data, EPA calculated central tendency and high-end exposure estimates using the following methods:

- For Material Handlers, the ACC Consortium data contained five 12-hour TWA concentration samples. All five samples were above the method's LOD. For this subset of data, the median and maximum of the dataset were used to represent a central tendency and high-end estimate, respectively.
- For Process Field Operators, 26 samples were collected. Of the 26 samples, 24 were below the method's LOD. For the samples below the LOD, EPA assumed concentrations of half the LOD. EPA calculated the 50th and 95th percentile 12-hour TWA concentrations representing the central tendency and high-end estimate of potential occupational inhalation exposures, respectively.
- All nine Laboratory Technician (assessed as 12-hour TWA) datapoints were reported non-detects for *p*-dichlorobenzene (LOD range between 0.0041 and 0.057 ppm) in the ACC Consortium data. In this surrogate assessment, EPA used the maximum LOD (0.057) as the assumed high-

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end of exposure, and half the maximum LOD as the central tendency. All the inhalation data being non-detects adds uncertainty to the exposure but there is high confidence that the occupational exposure estimates are upper bound. Because of the lack of detected samples, EPA also estimated exposure from this SEG using surrogate monitoring data from 1,1,2-trichloroethane {Labcorp Early Development Laboratories Ltd, 2023, 11164566}. The Vinyl Institute provided the surrogate monitoring data for 1,1,2-trichloroethane to EPA in response to a test order. The data included a worker job title of “Laboratory Technician” which EPA determined as relevant to this OES. In total, the data provided by the Vinyl Institute included 29 full-shift worker PBZ air samples along with 23 short-term samples taken between July and October 2023. Vinyl Institute data for laboratory technicians included both 8-hour and 12-hour TWAs, and both results are presented in this assessment. For 8-hour TWA concentrations for Laboratory Technicians, the Vinyl Institute data contained seven samples, two were below the limit of detection. For 12-hour TWA concentrations for Laboratory Technicians, the Vinyl Institute data contained 22 samples, eight were below the limit of detection. All non-detect samples were estimated as the LOD/2 due to the standard deviation of the datasets (see Section 4.1). For this subset of data, the median and 95th percentile were used to represent a central tendency and high-end estimate, respectively.

- For estimating ONU exposures, EPA used the ACC Consortium data for *p*-dichlorobenzene as surrogate, which contained 22 ONU samples (12-hour TWA) were reported non-detects for *p*-dichlorobenzene (LOD range 0.0041–0.03 ppm). Because of this, EPA assessed the LOD and half the LOD as the high-end and central tendency TWA exposure concentrations, respectively ([ACC, 2023](#)).

Using these 12-hour TWA exposure concentrations and correcting for vapor pressure differences between the two isomers, EPA calculated the AC, IADC, and ADC as described in Appendix K. The results of these calculations are shown in and Table 8-9.

Table 8-9. Summary of Inhalation 12-Hour TWA Exposure to *o*-Dichlorobenzene During Processing as a Reactant

SEG	Exposure Concentration Type	Worker Inhalation Estimates (ppm)	
		Central Tendency	High-End
Material Handlers	12-Hour TWA exposure concentrations	1.5E-02	0.32
	Acute exposure concentrations (AC) based on 12-hour TWA	1.6E-02	0.33
	Intermediate average daily concentration (IADC) based on 12-hour TWA	7.7E-03	0.16
	Average daily concentration (ADC) based on 12-hour TWA	8.6E-03	0.18
Process Field Operators	12-Hour TWA exposure concentrations	2.1E-03	1.3E-02
	Acute exposure concentrations (AC) based on 12-hour TWA	2.2E-03	1.3E-02
	Intermediate average daily concentration (IADC) based on 12-hour TWA	1.1E-03	6.5E-03
	Average daily concentration (ADC) based on 12-hour TWA	1.2E-03	7.3E-03

SEG	Exposure Concentration Type	Worker Inhalation Estimates (ppm)	
		Central Tendency	High-End
Laboratory Technicians (<i>p</i> -dichlorobenzene surrogate)	12-Hour TWA exposure concentrations	3.0E-02	6.0E-02
	Acute exposure concentrations (AC) based on 12-hour TWA	3.0E-02	6.1E-02
	Intermediate average daily concentration (IADC) based on 12-hour TWA	1.5E-02	3.0E-02
	Average daily concentration (ADC) based on 12-hour TWA	1.7E-02	3.3E-02
Laboratory Technicians (1,1,2-TCA surrogate)	8-Hour TWA exposure concentrations	5.5E-05	5.1E-03
	Acute exposure concentrations (AC) based on 8-hour TWA	3.7E-05	3.4E-03
	Intermediate average daily concentration (IADC) based on 8-hour TWA	2.7E-05	2.5E-03
	Average daily concentration (ADC) based on 8-hour TWA	2.6E-05	2.4E-03
Laboratory Technicians (1,1,2-TCA surrogate)	12-Hour TWA exposure concentrations	1.3E-05	5.4E-04
	Acute exposure concentrations (AC) based on 12-hour TWA	1.3E-05	5.5E-04
	Intermediate average daily concentration (IADC) based on 12-hour TWA	6.2E-06	2.7E-04
	Average daily concentration (ADC) based on 12-hour TWA	5.8E-06	2.5E-04
ONUs	12-Hour TWA exposure concentrations	1.6E-02	3.1E-02
	Acute exposure concentrations (AC) based on 12-hour TWA	1.6E-02	3.2E-02
	Intermediate average daily concentration (IADC) based on 12-hour TWA	7.8E-03	1.6E-02
	Average daily concentration (ADC) based on 12-hour TWA	8.8E-03	1.8E-02

8.2.3.4 Occupational Dermal Exposure Results

EPA estimated dermal exposures for this OES using a Monte Carlo simulation with 100,000 iterations. The Agency modeled dermal exposure using a fraction absorbed value of 0.04 for *p*-dichlorobenzene as a liquid and followed the processes discussed in Section 8.1.4 and Appendix M. There are not any reliable dermal absorption studies available for *o*-dichlorobenzene, however based on comparison of all available data it is expected that *o*-dichlorobenzene absorption will be similar to *p*-dichlorobenzene, and so *p*-dichlorobenzene data was used. The fraction absorbed value of 0.04 was obtained from data submitted to satisfy EPA's Order to conduct an in vitro dermal absorption study on *p*-dichlorobenzene. The study indicated that an estimate of 0.04 (or 4%) absorption should apply to all formulations with a greater than 50% concentration of *p*-dichlorobenzene. For more details on this study, and rationale for its use as a surrogate for *o*-dichlorobenzene, see the *Draft Human Health and Environmental Hazard Assessment for o-Dichlorobenzene* ([U.S. EPA, 2026r](#)). EPA assessed the concentration of *o*-dichlorobenzene in the liquid product as a uniform distribution from 90 to 100% based on import data provided by the 2020 CDR as presumably the chemical arrives at site as a neat substance before it is processed as a reactant ([U.S. EPA, 2020a](#)).

Table 8-10 summarizes the APDR, AAD, IAD, and CAD (non-cancer) for *o*-dichlorobenzene during processing as a reactant. The high-ends are the 95th percentiles of the respective simulation output and the central tendency exposures are the 50th percentiles. The SEGs included in the "Average Adult Worker" category include material handlers, process field operators, and laboratory technicians. These SEGs were grouped for the purposes of modeling as they are expected to have similar risks of dermal exposure. Dermal exposures for ONUs are expected to be negligible as they do not directly handle the

chemical. OES-specific parameters for dermal exposures are described in Appendix M.

Table 8-10. Summary of Dermal Exposure Doses to *o*-Dichlorobenzene for Processing as a Reactant

Modeled Scenario	Exposure Concentration Type	Central Tendency	High-End
Average Adult Worker	Acute potential dose rate (APDR) (mg/day)	26	64
	Acute absorbed dose (AAD) (mg/kg-day)	0.32	0.80
	Intermediate absorbed dose (IAD), non-cancer (mg/kg-day)	0.16	0.39
	Chronic absorbed dose (CAD), non-cancer (mg/kg-day)	0.15	0.37

8.2.3.5 Exposure Controls and PPE

The data provided by ACC described the following PPE: flame resistant clothing, chemical resistant jackets, safety glasses, face shields, steel toe shoes, gloves, and hearing protection for material chemical handlers. The process field operator tasked with drumming out the process equipment was reported to wear SCBA for respiratory protection ([ACC, 2023](#)). EPA did not identify data indicating whether similar PPE would be used at sites processing *o*-dichlorobenzene as a reactant.

8.2.4 Incorporation into Soap, Cleaning Compound, and Toilet Preparation Manufacturing

As listed in Table 4-1, this OES includes the following COU: Incorporation into soap, cleaning compound, and toilet preparation manufacturing.

8.2.4.1 Worker Activities

EPA gathered information from OSHA CEHD pertaining to the incorporation of *o*-dichlorobenzene into soap, cleaning compound, and toilet preparation manufacturing. One facility (Coughlan Products Corporation) provided data for worker inhalation exposure ([OSHA, 2019](#)). Based on identified risk evaluations and product SDSs, EPA expects *o*-dichlorobenzene to be imported or manufactured as a liquid and incorporated into liquid and solid cleaning compounds as a deodorizer ([Home Depot, 2019](#); [ECHA, 2004](#)). Workers are employees that are expected to directly handle *o*-dichlorobenzene or *o*-dichlorobenzene containing materials during the formulation process. ONUs include employees who work in the process area/room in the vicinity of chemical-related activities and may be indirectly exposed to the chemical as part of their employment. Worker exposure to *o*-dichlorobenzene may occur via inhalation of particulates or vapors as well as dermal contact to liquids or solids during container cleaning and unloading, equipment cleaning, material handling, mixing, and packaging.

As OSHA CEHD data does not include worker descriptions, EPA evaluated the data for two SEGs, Average Adult Workers and ONUs. The “Average Adult Worker” exposure group includes employees directly handling *o*-dichlorobenzene during the formulation of cleaning compounds. ONUs include employees who do not directly handle the chemical but may inhale dust or vapors or come into dermal contact with settled dust while in an area where the chemical is present. See Section 4.3.7.1 for a full incorporation into soap, cleaning compound, and toilet preparation manufacturing process description.

8.2.4.2 Number of Workers and Occupational Non-Users

EPA used data from BLS and the SUSB specific to the OES to estimate the number of workers and ONUs per site potentially exposed to *o*-dichlorobenzene during incorporation into soap, cleaning compound, and toilet preparation manufacturing ([U.S. BLS, 2023a](#); [U.S. Census Bureau, 2017](#)). This approach involved first identifying the relevant NAICS codes for the OES. The potential number of sites

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for this OES was then estimated based on the number of reporting sites from SUSB for the identified NAICS codes. EPA didn't identify OES-specific data for the number of sites that use *o*-dichlorobenzene during incorporation into soap, cleaning compound, and toilet preparation manufacturing. Therefore, EPA assessed a bounding estimate of 12,398 sites for this OES based on the number of sites listed under the identified NAICS codes. Using a bounding estimate will overestimate the true number of sites that use *o*-dichlorobenzene for this OES. The next step is the identification of relevant SOC codes within the BLS data for the identified NAICS codes, from which total number of workers can be determined. This number is divided by the number of sites identified to obtain the exposed workers per site. Appendix J includes further details regarding methodology for estimating the number of workers and ONUs per site. EPA assigned the following NAICS codes for this OES:

- 325611 – Soap and Other Detergent Manufacturing
- 325612 – Polish and Other Sanitation Good Manufacturing
- 325620 – Toilet Preparation Manufacturing
- 424210 – Drugs and Druggists' Sundries Merchant Wholesalers.

Table 8-11 summarizes the per site estimates for this OES based on the methodology described, including the number of sites identified in Section 4.2.2.

Table 8-11. Estimated Average Number of Workers per Site Potentially Exposed to *o*-Dichlorobenzene During Incorporation into Soap, Cleaning Compound, and Toilet Preparation Manufacturing

Manufacturing			
Potential Number of Sites	NAICS Code	Potentially Exposed Workers per Site ^a	Potentially Exposed ONUs per Site ^a
12,398	325611 – Soap and Other Detergent Manufacturing	5	2
	325612 – Polish and Other Sanitation Good Manufacturing		
	325620 – Toilet Preparation Manufacturing		
	424210 – Drugs and Druggists' Sundries Merchant Wholesalers		
^a Number of workers and ONUs per site calculated by dividing the exposed number of workers or ONUs by number of establishments.			

8.2.4.3 Occupational Inhalation Exposure Results

EPA identified occupational inhalation data for *o*-dichlorobenzene during incorporation into soap, cleaning compound, and toilet preparation manufacturing in OSHA's CEHD database ([OSHA, 2019](#)). The data found included five full-shift PBZ samples taken in May 1994 from one site under the SIC code 2842 – Specialty Cleaning, Polishing, and Sanitations Preparations. None of the five samples were below the method's LOD.

From this monitoring data, EPA calculated the 50th percentile and maximum 8-hour TWA concentrations representing the central tendency and high-end estimate of potential occupational inhalation exposures, respectively, for this scenario. Using these 8-hour TWA exposure concentrations, EPA calculated the AC, IADC, and ADC as described in Appendix K. In absence of data specific to ONU exposure, the Agency assumed that worker central tendency exposure was representative of ONU exposure and used to generate estimates for ONUs. The results of these calculations are shown in Table 8-12.

Table 8-12. Summary of Inhalation 8-Hour TWA Exposure to *o*-Dichlorobenzene During Incorporation into Soap, Cleaning Compound, and Toilet Preparation Manufacturing

SEG	Exposure Concentration Type	Worker Inhalation Estimates (ppm)	
		Central Tendency	High-End
Average Adult Worker	8-hour TWA exposure concentrations	0.14	0.56
	Acute exposure concentrations (AC) based on 8-hour TWA	9.4E-02	0.38
	Intermediate average daily concentration (IADC) based on 8-hour TWA	6.9E-02	0.28
	Average daily concentration (ADC) based on 8-hour TWA	6.5E-02	0.26
ONUs	12-Hour TWA exposure concentrations	0.14	
	Acute exposure concentrations (AC) based on 12-hour TWA	9.4E-02	
	Intermediate average daily concentration (IADC) based on 12-hour TWA	6.9E-02	
	Average daily concentration (ADC) based on 12-hour TWA	6.5E-02	

8.2.4.4 Occupational Dermal Exposure Results

EPA estimated dermal exposures for this OES using a Monte Carlo simulation with 100,000 iterations. The Agency modeled dermal exposure using a fraction absorbed value of 0.04 for *o*-dichlorobenzene as a liquid and followed the processes discussed in Section 8.1.4 and Appendix M. There are not any reliable dermal absorption studies available for *o*-dichlorobenzene, however based on comparison of all available data it is expected that *o*-dichlorobenzene absorption will be similar to *p*-dichlorobenzene, and so *p*-dichlorobenzene data was used. The fraction absorbed value of 0.04 was obtained from data submitted to satisfy EPA's Order to conduct an in vitro dermal absorption study on *p*-dichlorobenzene. The study indicated that an estimate of 0.04 (or 4%) absorption should apply to all formulations with a greater than 50% concentration of *p*-dichlorobenzene. For more details on this study, and rationale for its use as a surrogate for *o*-dichlorobenzene, see the *Draft Human Health and Environmental Hazard Assessment for o-Dichlorobenzene* ([U.S. EPA, 2026r](#)). EPA assessed the concentration of *o*-dichlorobenzene in the liquid raw material as a uniform distribution from 90 to 100% based on import data provided by the 2020 CDR, as presumably the chemical arrives at site as a neat substance before it is formulated into the product ([U.S. EPA, 2020a](#)).

Table 8-13 summarizes the APDR, AAD, IAD, and CAD (non-cancer) for *o*-dichlorobenzene during incorporation into soap, cleaning compound, and toilet preparation manufacturing. The high-end values are the 95th percentiles of the respective simulation output and the central tendency exposures are the 50th percentiles. OES-specific parameters for dermal exposures are described in Appendix M.

Table 8-13. Summary of Dermal Exposure Doses to *o*-Dichlorobenzene for Incorporation into Soap, Cleaning Compound, and Toilet Preparation Manufacturing

Modeled Scenario	Exposure Concentration Type	Central Tendency	High-End
Average Adult Worker	Acute potential dose rate (APDR) (mg/day)	26	64
	Acute absorbed dose (ARD) (mg/kg-day)	0.32	0.80
	Intermediate absorbed dose (IAD), non-cancer (mg/kg-day)	0.24	0.59
	Chronic absorbed dose (CAD), non-cancer (mg/kg-day)	0.22	0.55

8.2.4.5 Exposure Controls and PPE

No engineering controls or documented PPE were available from the data.

8.2.5 Incorporation into Formulation, Mixture, or Reaction Product

As listed in Table 4-1, this OES includes the following COU: Processing – Incorporation into formulation, mixture or reaction product.

8.2.5.1 Worker Activities

EPA identified two sources during systematic review pertaining to the incorporation of *o*-dichlorobenzene into formulation, mixture, or reaction products. EPA expects *o*-dichlorobenzene to be incorporated into a printing ink, paint and coating, or synthetic dye and pigment as a solvent ([U.S. EPA, 2020a](#)) (EPA-HQ-OPPT-2018-0444-0035). Workers are employees that are expected to directly handle *o*-dichlorobenzene or *o*-dichlorobenzene containing materials. ONUs include employees who work in the process area/room in the vicinity of chemical-related activities and may be indirectly exposed to the chemical as part of their employment. Worker exposure to *o*-dichlorobenzene may occur via inhalation of vapors as well as dermal contact to liquids during container cleaning and unloading, equipment cleaning, material handling, mixing, and packaging.

Based on the limited data available from literature sources, EPA assessed two SEGs, Average Adult Workers and ONUs. The “Average Adult Worker” category includes employees directly handling *o*-dichlorobenzene during incorporation into formulation, mixture, or reaction product. ONUs include employees who do not directly handle the chemical but may inhale vapor from process operations.

See Section 4.3.4.1 for a full incorporation into formulation, mixture, or reaction product process description.

8.2.5.2 Number of Workers and Occupational Non-Users

EPA used data from BLS and the SUSB specific to the OES to estimate the number of workers and ONUs per site potentially exposed to *o*-dichlorobenzene during incorporation into formulation, mixture, or reaction product ([U.S. BLS, 2023a](#); [U.S. Census Bureau, 2017](#)). This approach involved first identifying the relevant NAICS codes for the OES. The potential number of sites for this OES was then estimated based on the number of reporting sites from SUSB for the identified NAICS codes. EPA didn’t identify OES-specific data for the number of sites that use *o*-dichlorobenzene during incorporation into formulation, mixture, or reaction product. Therefore, EPA assessed a bounding estimate of 2,915 sites for this OES based on the number of sites listed under the identified NAICS codes. Using a bounding estimate will overestimate the true number of sites that use *o*-dichlorobenzene for this OES. The next step is the identification of relevant SOC codes within the BLS data for the identified NAICS codes, from which total number of workers can be determined. This number is divided by the number of sites identified to obtain the exposed workers per site. Appendix J includes further details regarding methodology for estimating the number of workers and ONUs per site. EPA assigned the following NAICS codes for this OES:

- 325510 – Paint and Coating Manufacturing
- 325130 – Synthetic Dye and Pigment Manufacturing
- 325910 – Printing Ink Manufacturing
- 325998 – All Other Miscellaneous Chemical Product and Preparation Manufacturing.

Table 8-14 summarizes the per site estimates for this OES based on the methodology described, including the number of sites identified in Section 4.2.2.

Table 8-14. Estimated Average Number of Workers per Site Potentially Exposed to *o*-Dichlorobenzene During Incorporation into Formulation, Mixture, and Reaction Product

Potential Number of Sites	NAICS Code	Potentially Exposed Workers per Site ^a	Potentially Exposed ONUs per Site ^a
2,915	325510 – Paint and Coating Manufacturing	14	7
	325130 – Synthetic Dye and Pigment Manufacturing		
	325910 – Printing Ink Manufacturing		
	325998 – All Other Miscellaneous Chemical Product and Preparation Manufacturing		
^a Number of workers and ONUs per site calculated by dividing exposed number of workers or ONUs by number of establishments.			

8.2.5.3 Occupational Inhalation Exposure Results

Occupational inhalation exposure data for *o*-dichlorobenzene during incorporation into formulation, mixture, and reaction product were assessed using data from two sources that EPA identified during the systematic review process. The first source EPA evaluated was Volume 73 of the “IARC Monographs on the Evaluation of Carcinogenic Risks to Humans”, which was drafted by the World Health Organization (WHO) International Agency for Research on Cancer (IARC) {IARC, 1999, 666726}. The IARC report cited data from two previous *o*-dichlorobenzene exposure studies and provided the ranges of concentrations measured. The first reference was a 1990 report by the German Chemical Society that measured airborne concentrations of *o*-dichlorobenzene used as a solvent in a dye manufacturing plant in Germany. Results from this study ranged from 0.3 to 14 mg/m³; however, the report does not provide information on whether these data are full-shift or task-based PBZ estimates. Because of this, these data points were not used in this assessment. The other study cited in the IARC report was a 1997 Japanese study by Kumagai and Matsunaga that presented 28 8-hour TWA PBZ samples for 10 workers collected at a plant that synthesized intermediate products for dyes. The measured *o*-dichlorobenzene concentrations ranged between 0.1 and 2.3 ppm (only the minimum and maximum were provided) {IARC, 1999, 666726}.

The second source EPA identified during systematic review was a 1984 industrial hygiene survey conducted by Dow Chemical at their Michigan Division Chlorobenzol Plant {Dow Chemical Company, 1984, 2048380}. A total of 77 PBZ full-shift TWA samples were taken, 76 of which were reported to have measured *o*-dichlorobenzene concentrations under 5 ppm, and 8 of which were below the method’s LOD. The study is a microfiche scan of the original document and the raw data presented is illegible; however, Table 4 in the report provides legible concentration ranges for the five exposure groups, representing 44 samples (6 of which were reported as non-detects), established by the researchers: Badger Operator (non-detect [ND]–0.18 ppm; 8 total samples with 1 ND), Chlorinator Operator (0.05–0.11 ppm, 6 total samples), Tri-Tetrachlor Operator (ND–0.17 ppm, 8 total samples with 1 ND), Still Operator (0.85–5.7 ppm, 9 total samples), and Chlorobenzol Operator (ND–0.06 ppm, 13 samples with 4 NDs). The remaining samples belonged to other categories that did not have ranges provided. The reported limit of detection was 0.05 ppm. The two data points from the IARC report fell within the range of values reported in the Dow Chemical survey, and so it was decided to combine the two sources to create a dataset for this OES consisting of 12 data points. Half the LOD (0.025) was used in place of the three “minimum” samples that were non-detects from the Dow Chemical survey. Using the 12 total samples, EPA calculated a central tendency value of 0.11 ppm using the 50th percentile of the data points; the high-end was calculated as 4.85 ppm, the 95th percentile of the maximums of each range

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reported by the studies. Note that when only considering the Dow Chemical survey, the exposure results lower slightly with the central tendency becoming 0.09 ppm, and the high-end becoming 4.60 ppm. In absence of data specific to ONU exposure, EPA assumed that worker central tendency exposure was representative of ONU exposures.

Using these 8-hour central tendency and high-end TWA exposure concentrations, EPA calculated the AC, IADC, and ADC as described in Appendix K. The results of these calculations are shown in Table 8-15 below. In absence of data specific to ONU exposure, the Agency assumed that worker central tendency exposure was representative of ONU exposure and used to generate estimates for ONUs.

Table 8-15. Summary of Inhalation 8-Hour TWA Exposure to *o*-Dichlorobenzene During Incorporation into Formulation, Mixture, or Reaction Product

SEG	Exposure Concentration Type	Worker Inhalation Estimates (ppm)	Worker Inhalation Estimates (ppm)
		Central Tendency	High-End
Average Adult Worker	8-Hour TWA exposure concentrations	0.11	4.9
	Acute exposure concentrations (AC) based on 8-hour TWA	7.5E-02	3.3
	Intermediate average daily concentration (IADC) based on 8-hour TWA	5.5E-02	2.4
	Average daily concentration (ADC) based on 8-hour TWA	5.1E-02	2.3
ONUs	8-Hour TWA exposure concentrations	0.11	
	Acute exposure concentrations (AC) based on 8-hour TWA	7.5E-02	
	Intermediate average daily concentration (IADC) based on 8-hour TWA	5.5E-02	
	Average daily concentration (ADC) based on 8-hour TWA	5.1E-02	

8.2.5.4 Occupational Dermal Exposure Results

EPA estimated dermal exposures for this OES using a Monte Carlo simulation with 100,000 iterations. The Agency modeled dermal exposure using a fraction absorbed value of 0.02 for *o*-dichlorobenzene as a liquid and followed the processes discussed in Section 8.1.4 and Appendix M. There are not any reliable dermal absorption studies available for *o*-dichlorobenzene, however based on comparison of all available data it is expected that *o*-dichlorobenzene absorption will be similar to *p*-dichlorobenzene, and so *p*-dichlorobenzene data was used. The fraction absorbed value of 0.02 was obtained from data submitted to satisfy EPA's Order to conduct an in vitro dermal absorption study on *p*-dichlorobenzene. The study indicated that an estimate of 0.02 (or 2%) absorption should apply to all formulations with a less than 50% concentration of *p*-dichlorobenzene. For more details on this study, and rationale for its use as a surrogate for *o*-dichlorobenzene, see the *Draft Human Health and Environmental Hazard Assessment for o-Dichlorobenzene* ([U.S. EPA, 2026r](#)). EPA assessed the concentration of *o*-dichlorobenzene in the liquid product as a uniform distribution from 1 to 30% based on data provided by the Sun Chemical as part of the 2020 CDR submission ([U.S. EPA, 2020a](#)).

Table 8-16 summarizes the APDR, AAD, IAD, and CAD (non-cancer) for *o*-dichlorobenzene during use of solvents in printing ink manufacturing; paint and coating manufacturing; synthetic dye and pigment manufacturing. The high-end exposures are the 95th percentiles of the respective simulation output and the central tendency exposures are the 50th percentiles. Dermal exposures for ONUs are expected to be negligible as they do not directly handle the chemical. OES-specific parameters for dermal exposures are described in Appendix M.

Table 8-16. Summary of Dermal Exposure Doses to *o*-Dichlorobenzene for Incorporation into Formulation, Mixture, or Reaction Product

Modeled Scenario	Exposure Concentration Type	Central Tendency	High-End
Average Adult Worker	Acute potential dose rate (APDR) (mg/day)	1.7	6.8
	Acute absorbed dose (AAD) (mg/kg-day)	2.1E-02	8.5E-02
	Intermediate absorbed dose (IAD), non-cancer (mg/kg-day)	1.5E-02	6.2E-02
	Chronic absorbed dose (CAD), non-cancer (mg/kg-day)	1.4E-02	5.8E-02

8.2.5.5 Exposure Controls and PPE

No engineering controls or documented PPE were available from the data.

8.2.6 Plastics Compounding

As listed in Table 4-1, this OES includes the following COU: Incorporation into solvents (which become part of product formulation or mixture in plastic material and resin manufacturing).

8.2.6.1 Worker Activities

EPA was unable to identify process information specific to use of *o*-dichlorobenzene in plastics compounding operations. Because of their similarities in chemical properties and expected applications, EPA used surrogate processing exposure data from the occupational exposure assessment for *p*-dichlorobenzene to assess worker exposures for this OES ([U.S. EPA, 2026f](#)). In the ACC report “*p*-Dichlorobenzene (*p*-DCB) Occupational Inhalation Exposure Study Conducted During Polyphenylene Sulfide Manufacture and Compounding,” the ACC gathered inhalation exposure data and worker activity descriptions for sites that compound PPS polymers. At a separate facility, *p*-Dichlorobenzene reacts with sodium sulfide in a polar solvent to manufacture PPS. After this process, compounding facilities receive the PPS polymers, blend them with additives, and extrude the mixture into pellets. Unreacted *p*-dichlorobenzene may remain in the compounded plastic as an impurity ([ACC, 2023](#)). See Section 4.3.5.1 for a full plastics compounding process description.

The ACC Consortium report describes one SEG for workers involved in PPS compounding: Compounding – Extrusion Operators, as well as ONUs which include Board Operator, DCS Engineer, Packaging/Warehouse, and Warehouse Technician. Activities associated with the SEGs that may result in exposures are provided below:

- Extrusion Operator – Inhalation of dust or vapors and dermal exposure to solids containing *p*-dichlorobenzene during operation of the extruder machines; and
- ONU – Inhalation of dust to solids in areas where the chemical is present.

EPA assumed that *p*-dichlorobenzene could be formulated into resin at a maximum initial concentration of 100% based on CDR reports for imported *p*-dichlorobenzene ([U.S. EPA, 2020a](#)). The concentration of *p*-dichlorobenzene in the manufactured PPS polymers was reported to be less than 100 ppm, based on this, the ACC Consortium report states that ONU exposure during compounding are not expected. However, EPA assumes ONUs may be exposed to *p*-dichlorobenzene via inhalation of dusts while in areas where the polymers are present. For this assessment, EPA assumes that *o*-dichlorobenzene is processed at a maximum of 30% concentration in the raw material and formulated to a maximum of 0.05% in the resin based on the 2020 CDR and the 2021 Generic Scenario for the Use of Additives in Plastic Compounding ([U.S. EPA, 2021c](#), [2020a](#)).

8.2.6.2 Number of Workers and Occupational Non-Users

EPA used data from BLS and the SUSB specific to the OES to estimate the number of workers and ONUs per site potentially exposed to *o*-dichlorobenzene during plastics compounding ([U.S. BLS, 2023a](#); [U.S. Census Bureau, 2017](#)). This approach involved first identifying the relevant NAICS codes for the OES. The potential number of sites for this OES was then estimated based on the number of reporting sites from SUSB for the identified NAICS codes. EPA didn't identify OES-specific data for the number of sites that use *o*-dichlorobenzene during plastics compounding. Therefore, EPA assessed a bounding estimate of 1,527 sites for this OES based on the number of sites listed under the identified NAICS codes. Using a bounding estimate will overestimate the true number of sites that use *o*-dichlorobenzene for this OES. The next step is the identification of relevant SOC codes within the BLS data for the identified NAICS codes, from which total number of workers can be determined. This number is divided by the number of sites identified to obtain the exposed workers per site. Appendix J includes further details regarding methodology for estimating the number of workers and ONUs per site. EPA assigned the following NAICS codes for this OES:

- 325211 – Plastics Material and Resin Manufacturing
 - 325991 – Custom Compounding of Purchased Resins.
- Table 8-17 summarizes the per site estimates for this OES based on the methodology described, including the number of sites identified in Section 4.2.2.

Table 8-17. Estimated Average Number of Workers per Site Potentially Exposed to *o*-Dichlorobenzene During Plastics Compounding

Potential Number of Sites	NAICS Code	Potentially Exposed Workers per Site ^a	Potentially Exposed ONUs per Site ^a
1,527	325211 – Plastics Material and Resin Manufacturing	20	13
	325991 – Custom Compounding of Purchased Resins		

^a Number of workers and ONUs per site calculated by dividing exposed number of workers or ONUs by number of establishments.

8.2.6.3 Occupational Inhalation and Dermal Exposure Results

EPA was unable to identify inhalation exposure data specific to the use of *o*-dichlorobenzene during plastics compounding. Because *o*-dichlorobenzene and *p*-dichlorobenzene are commonly present together and are isomers with similar physical chemical properties and expected functions in the process, the Agency considered surrogate exposure data from the occupational exposure assessment for *p*-dichlorobenzene to assess worker exposures to *o*-dichlorobenzene ([U.S. EPA, 2026f](#)). Occupational inhalation exposure data from one facility for *p*-dichlorobenzene during plastics compounding were provided via a data submission from the ACC, which includes compounding of polymers containing *p*-dichlorobenzene ([ACC, 2023](#)). *p*-Dichlorobenzene is expected to be present in the resin that enters the compounding facility at less than 100 ppm, and concentrations of *o*-dichlorobenzene would be present at even lower amounts. EPA identified 7 worker full-shift PBZ samples (durations 681–690 minutes) and 22 ONU PBZ samples (durations 595–745 minutes). All collected samples (12-hour TWA) reported non-detects for *p*-dichlorobenzene (the LOD was 0.026 ppm for workers and ranged from 0.0041–0.03ppm for ONUs) with sample durations ranging from 681 to 690 minutes. Because of this, EPA assessed *p*-dichlorobenzene exposure at the maximum LOD and half the maximum LOD as the high-end and central tendency TWA exposure concentrations for each SEG respectively.

When this analysis was completed for *p*-dichlorobenzene, even with the health-protective assumption of *p*-dichlorobenzene present at the LOD, the *Draft Risk Evaluation for p-Dichlorobenzene* did not identify unreasonable risk for plastic compounding. Therefore, while there is insufficient information available for quantifying air concentrations and dermal exposure estimates for *o*-dichlorobenzene, exposures are expected to be lower than they would be for *p*-dichlorobenzene, for which not a single measurement was detected above the LOD. Therefore, EPA has determined that exposures from plastic compounding of *o*-dichlorobenzene are negligible and human health risks are unlikely.

8.2.7 Plastics Converting

As listed in Table 4-1, this OES includes the following COU: Incorporation into plastic articles.

8.2.7.1 Worker Activities

EPA did not identify occupational exposure data relevant to use of *o*-dichlorobenzene in the plastics converting industry or surrogate data directly applicable to this OES. Because of this, EPA used surrogate plastics compounding exposure data for *p*-dichlorobenzene to assess worker exposures for plastics converting. This approach is consistent with the occupational exposure assessment for *p*-dichlorobenzene ([U.S. EPA, 2026f](#)). EPA used the ACC report “*p*-Dichlorobenzene (*p*-DCB) Occupational Inhalation Exposure Study Conducted During Polyphenylene Sulfide Manufacture and Compounding” to also describe worker activities for the Plastics Converting OES. The ACC gathered inhalation exposure data and worker activity descriptions for sites that compound PPS polymers. At a separate facility, *p*-dichlorobenzene reacts with sodium sulfide in a polar solvent to manufacture PPS. After this process, compounding facilities receive the PPS polymers and they are blended with additives and extruded into pellets. Unreacted *p*-dichlorobenzene may remain in the compounded plastic as an impurity ([ACC, 2023](#)). See Section 4.3.6.1 for a full plastics converting process description.

The ACC Consortium report describes one SEG for workers involved in PPS compounding: Compounding – Extrusion Operators, as well as ONUs which include Board Operator, DCS Engineer, Packaging/Warehouse, and Warehouse Technician. Activities associated with the SEGs that may result in exposures are provided below:

- Extrusion Operator – Inhalation of dust or vapors and dermal exposure to solids containing *p*-dichlorobenzene during operation of the extruder machines; and
- ONU – Inhalation of dust to solids in areas where the chemical is present.

Based on the concentration of *p*-dichlorobenzene in the manufactured PPS polymers (<100 ppm), the ACC Consortium report states that ONU exposure during compounding is not expected. However, EPA assumed ONUs may be exposed to *p*-dichlorobenzene via inhalation of dusts while in areas where the polymers are present. For this assessment, EPA assessed exposures to *o*-dichlorobenzene assuming a concentration range of 0.0005 to 0.08 kg additive/kg resin (0.05–8%). This is the default concentration range for solid additives in the Generic Scenario for the Use of Additives in Plastic Converting for cases where there are both release and exposure concerns for the chemical of interest ([U.S. EPA, 2021d](#)).

8.2.7.2 Number of Workers and Occupational Non-Users

EPA used data from BLS and the SUSB specific to the OES to estimate the number of workers and ONUs per site potentially exposed to *o*-dichlorobenzene during plastics converting ([U.S. BLS, 2023a](#); [U.S. Census Bureau, 2017](#)). This approach involved first identifying the relevant NAICS codes for the OES. EPA didn’t identify OES-specific data for the number of sites that use *o*-dichlorobenzene during plastics converting. Therefore, EPA assessed a bounding estimate of 7,380 sites for this OES based on the number of sites listed under the identified NAICS codes. Using a bounding estimate will overestimate the true number of sites that use *o*-dichlorobenzene for this OES. The next step is the

identification of relevant SOC codes within the BLS data for the NAICS codes, from which total number of workers can be determined. This number is divided by the number of sites identified to obtain the exposed workers per site. Appendix J includes further details regarding methodology for estimating the number of workers and ONUs per site. EPA assigned the following NAICS codes for this OES:

- 325199 – All Other Basic Organic Chemical Manufacturing
- 326100 – Plastics Product Manufacturing

Table 8-18 summarizes the per site estimates for this OES based on the methodology described, including the number of sites identified in Section 4.2.2.

Table 8-18. Estimated Average Number of Workers per Site Potentially Exposed to *o*-Dichlorobenzene During Plastics Converting

Potential Number of Sites	NAICS Code	Potentially Exposed Workers per Site ^a	Potentially Exposed ONUs per Site ^a
11,194	326100 – Plastics Product Manufacturing	47	7
	325199 – All Other Basic Organic Chemical Manufacturing		
^a Number of workers and ONUs per site calculated by dividing the exposed number of workers or ONUs by the number of establishments.			

8.2.7.3 Occupational Inhalation and Dermal Exposure Results

EPA was unable to identify inhalation exposure data specific to the use of *o*-dichlorobenzene during plastics converting. Because *o*-dichlorobenzene and *p*-dichlorobenzene are commonly present together and are isomers with similar physical chemical properties and expected functions in the process, EPA considered surrogate exposure data from *p*-dichlorobenzene in plastic compounding from the occupational exposure assessment for *p*-dichlorobenzene to assess worker exposures to *o*-dichlorobenzene ([U.S. EPA, 2026f](#)). Occupational inhalation exposure data from one facility for *p*-dichlorobenzene during plastics compounding were provided via a data submission from the ACC, which includes compounding of polymers containing *p*-dichlorobenzene ([ACC, 2023](#)). *p*-Dichlorobenzene is expected to be present in the resin that enters the compounding facility at less than 100 ppm, and concentrations of *o*-dichlorobenzene would be present at even lower amounts. EPA identified 7 worker full-shift PBZ samples (durations between 681–690 minutes) and 22 ONU PBZ samples (durations between 595–745 minutes). All collected samples (12-hour TWA) reported non-detects for *p*-dichlorobenzene (the LOD was 0.026 ppm for workers and ranged from 0.0041–0.03 ppm for ONUs) with sample durations ranging from 681 to 690 minutes. Because of this, EPA assessed *p*-dichlorobenzene exposure at the maximum LOD and half the maximum LOD as the high-end and central tendency TWA exposure concentrations for each SEG respectively.

When this analysis was completed for *p*-dichlorobenzene, even with the health-protective assumption of *p*-dichlorobenzene present at the LOD, the *Draft Risk Evaluation for p-Dichlorobenzene* did not identify unreasonable risk for plastic converting. Therefore, while there is insufficient information available for quantifying air concentrations and dermal exposure estimates for *o*-dichlorobenzene, exposures are expected to be lower than they would be for *p*-dichlorobenzene, for which not a single measurement was detected above the LOD. Therefore, EPA has determined that exposures from plastic converting of *o*-dichlorobenzene are negligible and human health risks are unlikely.

8.2.8 Functional Fluids (Closed System)

As listed in Table 4-1, this OES includes the following COU: Functional fluids (closed system) in all other basic chemical manufacturing.

8.2.8.1 Worker Activities

Worker activities during use of functional fluids containing *o*-dichlorobenzene were assessed using analogous data provided in response to a test order by Sabic Innovative Plastics, a processor and user of *o*-dichlorobenzene. Worker inhalation samples were taken from this dataset for workers that were described as periodically disconnecting/connecting chemical transfer lines. These data were analyzed and used as analogous data for sites that use *o*-dichlorobenzene in functional fluids. See Section 4.3.10.1 for a full functional fluids (closed system) process description.

EPA assessed exposures based on exposure data provided by Sabic. Sabic grouped workers into four different SEGs and included job titles and brief worker activity descriptions in their data. The SEGs used in the Sabic data are listed below:

- SEG 1: High Performance Polymers, Polymer Chemical Operators,
- SEG 2: High Performance Polymers, Copolymer Chemical Operators,
- SEG 3: Sabic Maintenance Mechanics/Electricians, and
- SEG 4: High Performance Polymers Support Personnel (Engineers, Managers, etc.) ([SABIC, 2024](#)).

The Sabic data listed the first three SEGs as “workers” and the fourth as “ONUs.” The task descriptions for a subset of samples taken for SEGs 1 and 2 included “Connect/disconnect transfer hoses to intermodal containers.” One sample for a polymer resource engineer in SEG 4 also listed this task description ([SABIC, 2024](#)).

For the purposes of inhalation estimates, EPA assessed two SEGs: “Average Adult Workers” and “ONUs.” All workers are reported to have performed material unloading and unloading, disconnecting, or connecting transfer hoses to containers. EPA assumes that ONUs may be in the work area while these activities are performed. Activities associated with each SEG are provided below:

- Average Adult Worker – Inhalation of vapors and dermal contact with liquids during container unloading, container cleaning, maintenance, or equipment cleaning; and
- ONUs – Inhalation of vapors while in an area where the chemical is present.

8.2.8.2 Number of Workers and Occupational Non-Users

EPA used data from BLS and the SUSB specific to the OES to estimate the number of workers and ONUs per site potentially exposed to *o*-dichlorobenzene during use in functional fluids processes ([U.S. BLS, 2023a](#); [U.S. Census Bureau, 2017](#)). This approach involved first identifying the relevant NAICS codes for the OES. EPA didn’t identify OES-specific data for the number of sites that use *o*-dichlorobenzene in functional fluids. Therefore, EPA assessed a bounding estimate of 841 sites for this OES based on the number of sites listed under the identified NAICS code. Using a bounding estimate will overestimate the true number of sites that use *o*-dichlorobenzene for this OES. The next step is the identification of relevant SOC codes within the BLS data for the identified NAICS codes, from which total number of workers can be determined. This number is divided by the number of sites identified to obtain the exposed workers per site. Appendix J includes further details regarding methodology for estimating the number of workers and ONUs per site. EPA assigned the following NAICS codes for this OES:

- 333415 – Air-Conditioning and Warm Air Heating Equipment and Commercial and Industrial Refrigeration Equipment Manufacturing

Table 8-19 summarizes the per site estimates for this OES based on the methodology described, including the number of sites identified in Section 4.2.2.

Table 8-19. Estimated Average Number of Workers per Site Potentially Exposed to *o*-Dichlorobenzene During Use of Functional Fluids

Potential Number of Sites	NAICS Code	Potentially Exposed Workers per Site ^a	Potentially Exposed ONUs per Site ^a
841	333415 – Air-Conditioning and Warm Air Heating Equipment and Commercial and Industrial Refrigeration Equipment Manufacturing	71	18
^a Number of workers and ONUs per site calculated by dividing exposed number of workers or ONUs by number of establishments.			

8.2.8.3 Occupational Inhalation Exposure Results

EPA was provided with *o*-dichlorobenzene test order inhalation data for exposed workers and ONUs from Sabic Innovative Plastics. Handling *o*-dichlorobenzene used industrially as a functional fluid (*e.g.*, a heat transfer fluid) during equipment maintenance involve similar liquid-handling operations as *o*-dichlorobenzene is handled during repackaging operations. Crucial steps include loading, unloading, temporary storage, transferring fluids through hoses and containers, draining residual materials, and cleaning equipment and vessels. In both OESs, potential releases may occur during transfer operations, equipment cleaning, spills, leaks, and hose connection or disconnection activities. Therefore, these OESs may present comparable release and worker exposure scenarios associated with liquid transfer and maintenance operations.

The high-end and central tendency worker inhalation exposure estimates for these OES are based on test order inhalation data from Sabic Innovative Plastics. The test order data included a total of 28 8-hour personal air samples taken between April and May of 2024, along with two occupational task-based personal air samples. Of these data, 15 8-hour samples and the two task-based samples had associated task descriptions containing “Connect/disconnect transfer hoses to intermodal containers”. These data points were deemed by EPA to be relevant to activities associated with the use of functional fluids and included under this OES {Sabic, 2024, 13171505}. The TWA data were split between two SEGs: Average Adult Workers and ONUs. For 8-hour TWA concentrations for Average Adult Workers, the Sabic data contained 15 samples, 1 of which was below the limit of detection, with sample durations ranging from 397 to 458 minutes. For the ND sample, EPA used the substitution method with the LOD divided by 2. For this subset of data, the median and 95th percentile were used to represent a central tendency and high-end estimate, respectively. The high-end inhalation exposures is only relevant for acute exposure since operations for this OES are only conducted during maintenance which occurs on a need basis (every 3–5 years). There was a single ONU sample mapped to this OES, which was detect for *o*-dichlorobenzene. Because of this, EPA presented the single exposure value instead of a high-end and a central tendency concentration {Sabic, 2024, 13171505}.

The test order data also provided two task-based PBZ samples, 15-minutes each. As these samples represented exposures of tasks instead of a TWA, these samples were not included in the 8-hour TWA estimates.

Using these 8-hour TWA estimates, EPA calculated the AC, IADC, and ADC as described in Appendix K. The results of these calculations are shown in Table 8-20 below.

Table 8-20. Summary of Worker Inhalation 8-Hour TWA Exposure to *o*-Dichlorobenzene During Use of Functional Fluids (Closed System)

SEG	Exposure Concentration Type	Worker Inhalation Estimates (ppm)	
		Central Tendency	High-End
Average Adult Worker	8-Hour TWA exposure concentrations	1.0E-02	0.13
	Acute exposure concentrations (AC) based on 8-hour TWA	7.0E-03	9.2E-02
	Intermediate average daily concentration (IADC) based on 8-hour TWA	2.3E-04	3.1E-03
	Average daily concentration (ADC) based on 8-hour TWA	1.2E-04	3.0E-03
ONUs	8-Hour TWA exposure concentrations	1.0E-02	
	Acute exposure concentrations (AC) based on 8-hour TWA	7.0E-03	
	Intermediate average daily concentration (IADC) based on 8-hour TWA	2.3E-04	
	Average daily concentration (ADC) based on 8-hour TWA	1.2E-04	2.3E-04

8.2.8.4 Occupational Dermal Exposure Results

EPA estimated dermal exposures for this OES using a Monte Carlo simulation with 100,000 iterations. The Agency modeled dermal exposure using a fraction absorbed value of 0.04 for *o*-dichlorobenzene as a liquid and followed the processes discussed in Section 8.1.4 and Appendix M. There are not any reliable dermal absorption studies available for *o*-dichlorobenzene, however based on comparison of all available data it is expected that *o*-dichlorobenzene absorption will be similar to *p*-dichlorobenzene, and so *p*-dichlorobenzene data was used. The fraction absorbed value of 0.04 was obtained from data submitted to satisfy EPA's Order to conduct an in vitro dermal absorption study on *p*-dichlorobenzene. The study indicated that an estimate of 0.04 (or 4%) absorption should apply to all formulations with a greater than 50% concentration of *p*-dichlorobenzene. For more details on this study, and rationale for its use as a surrogate for *o*-dichlorobenzene, see the *Draft Human Health and Environmental Hazard Assessment for o-Dichlorobenzene* ([U.S. EPA, 2026r](#)). EPA assessed the concentration of *o*-dichlorobenzene in functional fluids as 75% per company correspondence ([U.S. EPA, 2026ae](#)).

Table 8-21 summarizes the APDR, AAD, IAD, and CAD (non-cancer) for *o*-dichlorobenzene in functional fluids (closed system). The high-end represent the 95th percentiles of the respective simulation output and the central tendency exposures are the 50th percentiles. The SEG represented by the "Average Adult Worker" was the Material Handler SEG, as defined in the ACC Consortium data. Dermal exposures for ONUs are expected to be negligible as they do not directly handle the chemical. OES-specific parameters for dermal exposures are described in Appendix M.

Table 8-21. Summary of Dermal Exposure Doses to *o*-Dichlorobenzene for Functional Fluids (Closed System)

Modeled Scenario	Exposure Concentration Type	Central Tendency	High-End
Average Adult Worker	Acute potential dose rate (APDR) (mg/day)	20	51
	Acute absorbed dose (AAD) (mg/kg-day)	0.26	0.63
	Intermediate absorbed dose (IAD), non-cancer (mg/kg-day)	8.5E-03	2.1E-02
	Chronic absorbed dose (CAD), non-cancer (mg/kg-day)	3.9E-03	1.3E-02

8.2.8.5 Exposure Controls and PPE

PPE documented in the Sabic test order data used by polymer and copolymer operators include: hardhats, fire retardant uniforms, chemical resistant suits, rubber boots, neoprene gloves, safety glasses and face shields. Other task-specific PPE included use of leather gloves, hearing protection, and safety shoes ([SABIC, 2024](#)). EPA did not identify data indicating whether similar PPE would be used at sites using *o*-dichlorobenzene as a functional fluid.

8.2.9 Industrial Use of Solvents

As listed in Table 4-1, this OES includes the following COU: Non-Incorporative activities – Processing aids, not otherwise listed.

8.2.9.1 Worker Activities

Worker activities during use of *o*-dichlorobenzene as an industrial solvent were assessed using data provided in response to a test order by Sabic Innovative Plastics and WeylChem US Inc., two processors and users of *o*-dichlorobenzene. Both sites use *o*-dichlorobenzene as a solvent in the manufacturing of high-performance polymers and are expected to have similar processes. In the process, *o*-dichlorobenzene is used to dissolve other components in the process. This solution then is added to a reactor where a polymerization reaction occurs; *o*-dichlorobenzene is then recovered through distillation and recycled back into the process ([WeylChem, 2025](#); [SABIC, 2024](#)).

Worker inhalation samples were taken from this dataset for workers performing routine duties. Per the test order data and the 2020 CDR, *o*-dichlorobenzene is expected to be used as a pure liquid; see Section 4.3.8.1 for a full industrial use of solvents use process description.

Due to its high data quality, EPA assessed exposures based on exposure data provided by Sabic. Sabic grouped workers into four different SEGs and included job titles and brief worker activity descriptions in their data. The SEGs used in the Sabic data are listed below:

- SEG 1: High Performance Polymers - Polymer Chemical Operators;
- SEG 2: High Performance Polymers - Copolymer Chemical Operators;
- SEG 3: Maintenance Mechanics/Electricians; and
- SEG 4: High Performance Polymers Support Personnel (Operations/Process Engineers, Managers, Lab Technicians) ([SABIC, 2024](#)).

The Sabic data listed the first three SEGs as “workers” and the fourth as “ONUs.” The task descriptions for SEGs 1 and 2 included “Connect or disconnect hoses on *o*-DCB bulk containers to unloading pump system to above ground storage tanks,” “Equipment cleaning,” “Waste *o*-DCB drum filling,” “Minor leak response and repair,” and “Area rounds.” SEG 3 included tasks such as working on pumps/fans and performing routine rounds. SEG 4 tasks primarily included attending meetings and performing rounds; however, one lab technician sampled in SEG 4 reported performing the collection of a process sample and one “Polymer Resource Leader” reported connecting/disconnecting transfer lines to an intermodal container ([SABIC, 2024](#)).

Based on this data, EPA assessed four SEGs: “Polymer Chemical Operators,” “Copolymer Chemical Operators,” “Maintenance Mechanics/Electricians” and “ONUs – Support Personnel.” Potential exposure activities associated with each SEG are provided below:

- Polymer Chemical Operators – Inhalation of vapors and dermal contact with liquids during equipment cleaning, maintenance, or loading and unloading containers containing *o*-dichlorobenzene;

- Copolymer Chemical Operators – Inhalation of vapors and dermal contact with liquids during equipment cleaning, maintenance, or loading and unloading containers containing *o*-dichlorobenzene;
- Maintenance Mechanics/Electricians – Inhalation of vapors and dermal contact with liquids during maintenance activities; and
- ONUs – Inhalation of vapors while in an area where the chemical is present.

8.2.9.2 Number of Workers and Occupational Non-Users

EPA used data from BLS and the SUSB specific to the OES to estimate the number of workers and ONUs per site potentially exposed to *o*-dichlorobenzene during industrial use of solvents ([U.S. BLS, 2023a](#); [U.S. Census Bureau, 2017](#)). This approach involved first identifying the relevant NAICS codes for the OES. The next step is the identification of relevant SOC codes within the BLS data for the identified NAICS codes, from which total number of workers can be determined. This number is divided by the number of sites identified to obtain the exposed workers per site. Appendix J includes further details regarding methodology for estimating the number of workers and ONUs per site. EPA assigned the following NAICS codes for this OES:

- 325510 – Paint and Coating Manufacturing
- 325130 – Synthetic Dye and Pigment Manufacturing
- 325910 – Printing Ink Manufacturing
- 325998 – All Other Miscellaneous Chemical Product and Preparation Manufacturing

Table 8-22 summarizes the per site estimates for this OES based on the methodology described, including the number of sites identified in Section 4.2.2.

Table 8-22. Estimated Average Number of Workers per Site Potentially Exposed to *o*-Dichlorobenzene During Industrial Use of Solvents

Potential Number of Sites	NAICS Code	Potentially Exposed Workers per Site ^a	Potentially Exposed ONUs per Site ^a
30	325510 – Paint and Coating Manufacturing	14	7
	325130 – Synthetic Dye and Pigment Manufacturing		
	325910 – Printing Ink Manufacturing		
	325998 – All Other Miscellaneous Chemical Product and Preparation Manufacturing		
^a Number of workers and ONUs per site calculated by dividing the exposed number of workers or ONUs by the number of establishments.			

8.2.9.3 Occupational Inhalation Exposure Results

EPA was provided with *o*-dichlorobenzene test order inhalation data for exposed workers and ONUs from Sabic Innovative Plastics. The data included worker job titles and activity descriptions that matched worker activities relevant to this OES. The test order data included a total of 28 8-hour personal air samples taken between April and May of 2024, along with two occupational task-based personal air samples {Sabic, 2024, 13171505}. The TWA data were split between four SEGs: Polymer Chemical Operators, Copolymer Chemical Operators, Maintenance Mechanics/Electricians, and ONUs. For 8-hour TWA concentrations for Polymer Chemical Operators, the Sabic data contained nine samples, and zero non-detects. For Copolymer Chemical Operators, the Sabic data contained six samples, one of

which was below the limit of detection. For Maintenance Mechanics/Electricians, the Sabic data contained seven samples, two of which were below the limit of detection. There were six ONU samples mapped to this OES, one was non-detect for *o*-dichlorobenzene. The substitution method using the LOD divided by two was used to account for all non-detects due to the standard deviation of the dataset (see Section 4.1 to see more details on how number of samples and non-detects are accounted for in each dataset). The medians and 95th percentiles were calculated to represent central tendency and high-end estimates, respectively, for each SEG {Sabic, 2024, 13171505}.

Using these 8-hour TWA estimates, EPA calculated the AC, IADC, and ADC, as described in Appendix K. The results of these calculations are shown in Table 8-23 below.

Table 8-23. Summary of Worker Inhalation 8-Hour TWA Exposure to *o*-Dichlorobenzene During Use as an Industrial Solvent

SEG	Exposure Concentration Type	Worker Inhalation Estimates (ppm)	
		Central Tendency	High-End
Polymer Chemical Operators	8-Hour TWA exposure concentrations	1.0E-02	0.11
	Acute exposure concentrations (AC) based on 8-hour TWA	6.8E-03	7.4E-02
	Intermediate average daily concentration (IADC) based on 8-hour TWA	2.3E-04	2.5E-03
	Average daily concentration (ADC) based on 8-hour TWA	4.7E-03	5.1E-02
Copolymer Chemical Operators	8-Hour TWA exposure concentrations	1.1E-02	0.10
	Acute exposure concentrations (AC) based on 8-hour TWA	7.4E-03	7.0E-02
	Intermediate average daily concentration (IADC) based on 8-hour TWA	2.5E-04	2.3E-03
	Average daily concentration (ADC) based on 8-hour TWA	5.1E-03	4.8E-02
Maintenance Mechanics/Electricians	8-Hour TWA exposure concentrations	4.3E-03	5.5E-02
	Acute exposure concentrations (AC) based on 8-hour TWA	2.9E-03	3.7E-02
	Intermediate average daily concentration (IADC) based on 8-hour TWA	9.6E-05	1.2E-03
	Average daily concentration (ADC) based on 8-hour TWA	2.0E-03	2.6E-02
ONUs	8-Hour TWA exposure concentrations	7.6E-03	5.3E-02
	Acute exposure concentrations (AC) based on 8-hour TWA	5.1E-03	3.6E-02
	Intermediate average daily concentration (IADC) based on 8-hour TWA	1.7E-04	1.2E-03
	Average daily concentration (ADC) based on 8-hour TWA	3.5E-03	2.5E-02

8.2.9.4 Occupational Dermal Exposure Results

EPA estimated dermal exposures for this OES using a Monte Carlo simulation with 100,000 iterations. The Agency modeled dermal exposure using a fraction absorbed value of 0.04 for *o*-dichlorobenzene as a liquid and followed the processes discussed in Section 8.1.4 and Appendix M. There are not any reliable dermal absorption studies available for *o*-dichlorobenzene, however based on comparison of all available data it is expected that *o*-dichlorobenzene absorption will be similar to *p*-dichlorobenzene, and so *p*-dichlorobenzene data was used. The fraction absorbed value of 0.04 was obtained from data submitted to satisfy EPA's Order to conduct an in vitro dermal absorption study on *p*-dichlorobenzene. The study indicated that an estimate of 0.04 (or 4%) absorption should apply to all formulations with a greater than 50% concentration of *p*-dichlorobenzene. For more details on this study, and rationale for its use as a surrogate for *o*-dichlorobenzene, see the *Draft Human Health and Environmental Hazard Assessment for o-Dichlorobenzene* ([U.S. EPA, 2026r](#)). EPA assessed the concentration of *o*-

dichlorobenzene in industrial solvents as 100% per company correspondence ([U.S. EPA, 2026ae](#)).

Table 8-24 summarizes the APDR, AAD, IAD, and CAD (non-cancer) for *o*-dichlorobenzene in industrial use of solvents. The high-end represents the 95th percentiles of the respective simulation output and the central tendency exposures are the 50th percentiles. The SEGs represented by the “Average Adult Worker” include Polymer Chemical Operators, Copolymer Chemical Operators, and Maintenance Mechanics/Electricians, as defined in the Sabic Innovative Plastics test order data ([SABIC, 2024](#)). Dermal exposures for ONUs are expected to be negligible as they do not directly handle the chemical. OES-specific parameters for dermal exposures are described in Appendix M.

Table 8-24. Summary of Dermal Exposure Doses to *o*-Dichlorobenzene for Industrial Use of Solvents

Modeled Scenario	Exposure Concentration Type	Central Tendency	High-End
Average Adult Worker	Acute potential dose rate (APDR) (mg/day)	27	68
	Acute absorbed dose (AAD) (mg/kg-day)	0.34	0.85
	Intermediate absorbed dose (IAD), non-cancer (mg/kg-day)	0.25	0.62
	Chronic absorbed dose (CAD), non-cancer (mg/kg-day)	0.23	0.58

8.2.9.5 Exposure Controls and PPE

PPE documented in the Sabic test order data used by workers included: hardhats, fire retardant uniforms, chemical resistant suits, rubber boots, safety-toe boots, neoprene gloves, safety glasses and faceshields. Other task-specific PPE included use of leather gloves, hearing protection, and safety shoes. One Operations Engineer in SEG 4 was listed as only wearing “regular clothes” ([SABIC, 2024](#)). PPE documented in the Weylchem test order data used by workers performing activities with highest likelihood of exposure included: safety-toe shoes, full body Tyvek suit, PVC gloves, and full face organic vapor cartridge respirator, EPA did not identify data indicating whether similar PPE would be used at other sites using *o*-dichlorobenzene as an industrial solvent. Exposure controls documented in the Sabic test order data used by workers when indoors include general ventilation and task-specific local exhaust ventilation.

8.2.10 Use of Ink, Toner, and Colorant Products

As listed in Table 4-1, this OES includes the following COU: Use of Ink, Toner, and Colorant Products.

8.2.10.1 Worker Activities

EPA gathered information from OSHA CEHD pertaining to the use of *o*-dichlorobenzene into ink, toner, and colorant products. EPA identified data reported from one facility (Eastland Woolen Mill) reported data for worker inhalation exposure under SIC code 2211 - Broadwoven Fabric Mills, Cotton ([OSHA, 2019](#)). Based on reporting from the 2020 CDR and a comment from the AIA, EPA expects *o*-dichlorobenzene to be used as a solvent in ink, toner, and colorants ([U.S. EPA, 2020a](#)) ([EPA-HQ-OPPT-2018-0444-0004](#)). Worker exposure to *o*-dichlorobenzene may occur via inhalation of vapors as well as dermal contact to liquids during container cleaning and unloading, equipment cleaning, material handling, substrate application, or disposal of used materials.

As OSHA CEHD data does not include worker descriptions, EPA evaluated the data for two SEGs, Average Adult Workers and ONUs. The “Average Adult Worker” category includes employees directly handling *o*-dichlorobenzene during the use of ink, toner, and colorants products. ONUs include

employees who do not directly handle the chemical but may inhale vapors from process operations. See Section 4.3.11.1 for a full use of ink, toner, and colorant products process description.

8.2.10.2 Number of Workers and Occupational Non-Users

EPA used data from BLS and the SUSB specific to the OES to estimate the number of workers and ONUs per site potentially exposed to *o*-dichlorobenzene during use in ink, toner, and colorant products ([U.S. BLS, 2023a](#); [U.S. Census Bureau, 2017](#)). This approach involved first identifying the relevant NAICS codes for the OES. EPA didn't identify OES-specific data for the number of sites that use *o*-dichlorobenzene in ink, toner, and colorant products. Therefore, EPA assessed a bounding estimate of 23,585 sites for this OES based on the number of sites listed under the identified NAICS code. Using a bounding estimate will overestimate the true number of sites that use *o*-dichlorobenzene for this OES. The next step is the identification of relevant SOC codes within the BLS data for the identified NAICS codes, from which total number of workers can be determined. This number is divided by the number of sites identified to obtain the exposed workers per site. Appendix J includes further details regarding methodology for estimating the number of workers and ONUs per site. EPA assigned the following NAICS codes for this OES:

- 325992 – Photographic Film, Paper, Plate, and Chemical Manufacturing
- 323111 – Commercial Printing (except Screen and Books)
- 323113 – Commercial Screen Printing.

Table 8-25 summarizes the per site estimates for this OES based on the methodology described, including the number of sites identified in Section 4.2.2.

Table 8-25. Estimated Average Number of Workers per Site Potentially Exposed to *o*-Dichlorobenzene During Use of Ink, Toner, and Colorant Products

Potential Number of Sites	NAICS Code	Potentially Exposed Workers per Site ^a	Potentially Exposed ONUs per Site ^a
23,585	325992 – Photographic Film, Paper, Plate, and Chemical Manufacturing	6	1
	323111 – Commercial Printing (except Screen and Books)		
	323113 – Commercial Screen Printing		
^a Number of workers and ONUs per site calculated by dividing the exposed number of workers or ONUs by the number of establishments.			

8.2.10.3 Occupational Inhalation Exposure Results

EPA identified occupational inhalation data for *o*-dichlorobenzene during use of ink, toner, and colorant products in OSHA's CEHD database ([OSHA, 2019](#)). EPA estimated inhalation exposures using 23 partial-shift PBZ samples (22 non-detect) that equated to 4 full-shift TWA samples (total sample durations were 378–447 minutes). Samples were taken in May 1992 from one site under the SIC code 2211 – Broadwoven Fabric Mills, Cotton. Because 22 out of 23 samples were non-detects, EPA used a substitution method to quantify the 22 non-detects, substituting each non-detect value with its LOD divided by the square root of two, according to [Guidelines for Statistical Analysis of Occupational Exposure Data](#). In absence of data specific to ONU exposure, EPA assumed that worker central tendency exposure was representative of ONU exposures. Almost all the inhalation data being non-detects, adds uncertainty to the exposure and risk estimates. To assist in addressing this uncertainty, EPA has conducted a sensitivity analysis for this OES to explore the impacts of the non-detect assumptions. This analysis can be found in Appendix H in the *Draft Risk Evaluation for o-Dichlorobenzene* ([U.S. EPA, 2026aa](#)).

From this monitoring data, EPA calculated the 50th percentile and maximum 8-hour TWA concentrations representing the central tendency and high-end estimate of potential occupational inhalation exposures, respectively, for this scenario. Using these 8-hour TWA exposure concentrations, EPA calculated the AC, IADC, and ADC as described in Appendix K. In absence of data specific to ONU exposure, the Agency assumed that worker central tendency exposure was representative of ONU exposure and used to generate estimates for ONUs. The results of these calculations are shown in Table 8-26.

Table 8-26. Summary of Inhalation 8-Hour TWA Exposure to *o*-Dichlorobenzene During Use Inks, Toner, and Colorant Products

SEG	Exposure Concentration Type	Worker Inhalation Estimates (ppm)	
		Central Tendency	High-End
Average Adult Worker	8-Hour TWA exposure concentrations	8.3E-03	3.7E-02
	Acute exposure concentrations (AC) based on 8-hour time-weighted average (TWA)	5.7E-03	2.5E-02
	Intermediate average daily concentration (IADC) based on 8-hour TWA	1.9E-04	8.5E-04
	Average daily concentration (ADC) based on 8-hour TWA	3.9E-03	1.7E-02
ONUs	8-Hour TWA exposure concentrations	8.3E-03	
	Acute exposure concentrations (AC) based on 8-hour TWA	5.7E-03	
	Intermediate average daily concentration (IADC) based on 8-hour TWA	1.9E-04	
	Average daily concentration (ADC) based on 8-hour TWA	3.9E-03	

8.2.10.4 Occupational Dermal Exposure Results

EPA estimated dermal exposures for this OES using a Monte Carlo simulation with 100,000 iterations. The Agency modeled dermal exposure using a fraction absorbed value of 0.02 for *o*-dichlorobenzene as a liquid and followed the processes discussed in Section 8.1.4 and Appendix M. There are not any reliable dermal absorption studies available for *o*-dichlorobenzene, however based on comparison of all available data it is expected that *o*-dichlorobenzene absorption will be similar to *p*-dichlorobenzene, and so *p*-dichlorobenzene data was used. The fraction absorbed value of 0.02 was obtained from data submitted to satisfy EPA's Order to conduct an in vitro dermal absorption study on *p*-dichlorobenzene. The study indicated that an estimate of 0.02 (or 2%) absorption should apply to all formulations with a less than 50% concentration of *p*-dichlorobenzene. For more details on this study, and rationale for its use as a surrogate for *o*-dichlorobenzene, see the *Draft Human Health and Environmental Hazard Assessment for o-Dichlorobenzene* ([U.S. EPA, 2026r](#)). EPA assessed the concentration of *o*-dichlorobenzene in inks, toners, and colorant products as a triangular distribution between 1 and 30% with a mode of 14.4% based on 2016 CDR and one SDS identified in the Use Report ([U.S. EPA, 2016b; David Gray & Co. Pty Limited, 2004](#)).

Table 8-27 summarizes the APDR, AAD, IAD, and CAD (non-cancer) for *o*-dichlorobenzene in the use of ink, toner, and colorant products. The high-end represent the 95th percentiles of the respective simulation output and the central tendency exposures represent the 50th percentiles. Workers include employees who directly handle ink, toner, and colorant products containing *o*-dichlorobenzene. Dermal exposures for ONUs are expected to be negligible as they do not directly handle the chemical. OES-specific parameters for dermal exposures are described in Appendix M.

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Table 8-27. Summary of Dermal Exposure Doses to *o*-Dichlorobenzene for Use of Ink, Toner, and Colorant Products

Modeled Scenario	Exposure Concentration Type	Central Tendency	High-End
Average Adult Worker	Acute potential dose rate (APDR) (mg/day)	1.8	6.0
	Acute absorbed dose (AAD) (mg/kg-day)	2.3E-02	7.4E-02
	Intermediate absorbed dose (IAD), non-cancer (mg/kg-day)	1.7E-02	5.5E-02
	Chronic absorbed dose (CAD), non-cancer (mg/kg-day)	1.6E-02	5.1E-02

8.2.10.5 Exposure Controls and PPE

No engineering controls or documented PPE were available from the data.

8.2.11 Use of Paints and Coatings

As listed in Table 4-1, this OES includes the following COU: Use of Paints and Coatings.

8.2.11.1 Worker Activities

During the application of *o*-dichlorobenzene-containing paints and coatings, workers are potentially exposed to *o*-dichlorobenzene mist when roll or curtain coating and from inhalation of overspray generated during spray coating. Vapor inhalation exposures to *o*-dichlorobenzene for workers and ONUs may also occur from *o*-dichlorobenzene that volatilizes during product unloading, raw material sampling, application, curing and container and equipment cleaning. Workers may be exposed via dermal contact to liquids containing *o*-dichlorobenzene during product unloading into application equipment, application of the paints and coatings, raw material sampling, and container and equipment cleaning ([OECD, 2011b](#)).

For this OES, ONUs would include supervisors, managers, and other employees that do not directly handle paint or coating equipment but may be present in the spray application area. ONUs are potentially exposed via inhalation exposure to mists while present in the application area and dermal exposure to mists that settle onto surfaces that ONUs contact.

8.2.11.2 Number of Workers and Occupational Non-Users

EPA used data from BLS and the SUSB specific to the OES to estimate the number of workers and ONUs per site potentially exposed to *o*-dichlorobenzene during use of paints and coatings ([U.S. BLS, 2023a](#); [U.S. Census Bureau, 2017](#)). This approach involved first identifying the relevant NAICS codes for the OES. EPA didn't identify OES-specific data for the number of sites that use *o*-dichlorobenzene in industrial use of solvents. Therefore, EPA assessed a bounding estimate of 54,075 sites for this OES based on the number of sites listed under the identified NAICS codes. Using a bounding estimate will overestimate the true number of sites that use *o*-dichlorobenzene for this OES. The next step is the identification of relevant SOC codes within the BLS data for the identified NAICS codes, from which total number of workers can be determined. This number is divided by the number of sites identified to obtain the exposed workers per site. Appendix J includes further details regarding methodology for estimating the number of workers and ONUs per site. EPA assigned the following NAICS codes for this OES:

- 337126 – Household Furniture (except Wood and Upholstered) Manufacturing
- 337214 – Office Furniture (except Wood) Manufacturing
- 337127 – Institutional Furniture Manufacturing
- 337215 – Showcase, Partition, Shelving, and Locker Manufacturing

- 337122 – Nonupholstered Wood Household Furniture Manufacturing
- 337211 – Wood Office Furniture Manufacturing
- 337212 – Custom Architectural Woodwork and Millwork Manufacturing
- 337110 – Wood Kitchen Cabinet and Countertop Manufacturing
- 811120 – Automotive Body, Paint, Interior, and Glass Repair.

Table 8-28 summarizes the per site estimates for this OES based on the methodology described, including the number of sites identified in Section 4.2.2.

Table 8-28. Estimated Average Number of Workers per Site Potentially Exposed to *o*-Dichlorobenzene During Use of Paints and Coatings

Potential Number of Sites	NAICS Code	Potentially Exposed Workers per Site ^a	Potentially Exposed ONUs per Site ^a
54,075	337126 – Household Furniture (except Wood and Upholstered) Manufacturing	4	1
	337214 – Office Furniture (except Wood) Manufacturing		
	337127 – Institutional Furniture Manufacturing		
	337215 – Showcase, Partition, Shelving, and Locker Manufacturing		
	337122 – Nonupholstered Wood Household Furniture Manufacturing		
	337211 – Wood Office Furniture Manufacturing		
	337212 – Custom Architectural Woodwork and Millwork Manufacturing		
	337110 – Wood Kitchen Cabinet and Countertop Manufacturing		
	811120 – Automotive Body, Paint, Interior, and Glass Repair		

^a Number of workers and ONUs per site calculated by dividing exposed number of workers or ONUs by number of establishments.

8.2.11.3 Occupational Inhalation Exposure Results

EPA assessed inhalation exposure that is associated with spray application of paints/coatings. EPA did not identify any *o*-dichlorobenzene inhalation monitoring data for the application of paints and coatings during systematic review of literature sources. EPA used the Automotive Refinishing Spray Coating Mist Inhalation Model, which estimates worker inhalation exposure based on the concentration of the chemical of interest in the non-volatile portion of the sprayed product and the concentration of over sprayed mist/particles ([OECD, 2011a](#)). The model is based on PBZ monitoring data for mists during automotive refinishing. EPA used the 50th and 95th percentile mist concentration from the model along with the concentration of *o*-dichlorobenzene in the paint (a median of 10% for central tendency and a maximum of 50% for high-end, based on the identified products, and sources identified during systematic review) to estimate the central tendency and high-end inhalation exposures, respectively.

EPA did not identify information on the duration of exposure to *o*-dichlorobenzene via mists and therefore assessed exposure using spray applications occurring over a full 8-hour period. The

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Automotive Refinishing Spray Coating Mist Inhalation Model does not evaluate exposures from volatilization during coating activities; however, assessing exposure over an 8-hour period is expected to be protective of all worker exposures. EPA calculated the 50th percentile and maximum 8-hour TWA concentrations representing the central tendency and high-end estimate of potential occupational inhalation exposures, respectively, for this scenario. Using these 8-hour TWA exposure concentrations, EPA calculated the AC, IADC, and ADC as described in Appendix K. In absence of data specific to ONU exposure, the Agency assumed that worker central tendency exposure was representative of ONU exposure and used to generate estimates for ONUs. The results of these calculations are shown in Table 8-29.

Table 8-29. Summary of Inhalation 8-Hour TWA Exposure to *o*-Dichlorobenzene During Use of Paints and Coatings

SEG	Exposure Concentration Type	Worker Inhalation Estimates (ppm)	
		Central Tendency	High-End
Average Adult Worker	8-Hour TWA exposure concentrations	0.11	3.7
	Acute exposure concentrations (AC) based on 8-hour TWA	7.6E-02	2.5
	Intermediate average daily concentration (IADC) based on 8-hour TWA	2.5E-03	8.3E-02
	Average daily concentration (ADC) based on 8-hour TWA	5.2E-02	1.7
ONUs	8-Hour TWA exposure concentrations	0.11	
	Acute exposure concentrations (AC) based on 8-hour TWA	7.6E-02	
	Intermediate average daily concentration (IADC) based on 8-hour TWA	2.5E-03	
	Average daily concentration (ADC) based on 8-hour TWA	5.2E-02	

8.2.11.4 Occupational Dermal Exposure Results

EPA estimated dermal exposures for this OES using a Monte Carlo simulation with 100,000 iterations. The Agency modeled dermal exposure using a fraction absorbed value of 0.02 for *o*-dichlorobenzene as a liquid and followed the processes discussed in Section 8.1.4 and Appendix M. There are not any reliable dermal absorption studies available for *o*-dichlorobenzene, however based on comparison of all available data it is expected that *o*-dichlorobenzene absorption will be similar to *p*-dichlorobenzene, and so *p*-dichlorobenzene data was used. The fraction absorbed value of 0.02 was obtained from data submitted to satisfy EPA's Order to conduct an in vitro dermal absorption study on *p*-dichlorobenzene. The study indicated that an estimate of 0.02 (or 2%) absorption should apply to all formulations with a less than 50% concentration of *p*-dichlorobenzene. For more details on this study, and rationale for its use as a surrogate for *o*-dichlorobenzene, see the *Draft Human Health and Environmental Hazard Assessment for o-Dichlorobenzene* ([U.S. EPA, 2026r](#)). EPA assessed the concentration of *o*-dichlorobenzene in paints and coatings as a triangular distribution between 0.25 and 50% with a mode of 10% based on 2016 CDR and multiple SDS identified in the Use Report ([U.S. EPA, 2020f, 2016b](#)).

Table 8-30 summarizes the APDR, AAD, IAD, and CAD (non-cancer) for *o*-dichlorobenzene in the use of paints and coatings. The high-ends are the 95th percentiles of the respective simulation output and the central tendency exposures are the 50th percentiles. Workers include employees who directly handle paint and coating products containing *o*-dichlorobenzene. ONUs were included in this dermal assessment because, although they do not directly handle the chemical, they may be potentially come into contact with mist that settles on surfaces in the process area. The input assumptions for the ONU assessment is the same as for the worker assessment, except the surface area of exposed skin is assumed

to be a static value of 268 cm² (equivalent to the surface area of one palm). OES-specific parameters for dermal exposures are described in Appendix M.

Table 8-30. Summary of Dermal Exposure Doses to *o*-Dichlorobenzene for Use of Paints and Coatings

Modeled Scenario	Exposure Concentration Type	Central Tendency	High-End
Average Adult Worker	Acute potential dose rate (APDR) (mg/day)	2.2	8.7
	Acute absorbed dose (AAD) (mg/kg-day)	2.7E-02	0.11
	Intermediate absorbed dose (IAD), non-cancer (mg/kg-day)	2.0E-02	8.0E-02
	Chronic absorbed dose (CAD), non-cancer (mg/kg-day)	1.9E-02	7.5E-02
ONU	Acute potential dose rate (APDR) (mg/day)	1.3	3.4
	Acute absorbed dose (AAD) (mg/kg-day)	1.6E-02	4.2E-02
	Intermediate absorbed dose (IAD), non-cancer (mg/kg-day)	1.2E-02	3.1E-02
	Chronic absorbed dose (CAD), non-cancer (mg/kg-day)	1.2E-02	3.1E-02

8.2.11.5 Exposure Controls and PPE

EPA did not find information on the extent to which engineering controls and worker PPE are used at facilities that use *o*-dichlorobenzene-containing paints and coatings.

8.2.12 Use of Paint Thinners and Removers

As listed in Table 4-1, this OES includes the following COU: Paints and coatings – Coatings and paints, thinners, paint removers.

8.2.12.1 Worker Activities

EPA identified one source during systematic review pertaining to the use of *o*-dichlorobenzene in paint thinners and removers. EPA expects *o*-dichlorobenzene to be used in paint thinners and removers based on the 2020 CDR and public comment submission from the AIA ([U.S. EPA, 2020a](#)) ([EPA-HQ-OPPT-2018-0444-0004](#)). The AIA states that *o*-dichlorobenzene is used as a component of a formulation of paint strippers. Workers are employees that are expected to directly handle *o*-dichlorobenzene or *o*-dichlorobenzene containing materials. ONUs include employees who work in the process area/room in the vicinity of chemical-related activities and may be indirectly exposed to the chemical as part of their employment. Worker exposure to *o*-dichlorobenzene may occur via inhalation of vapors as well as dermal contact to liquids during container cleaning and unloading, equipment cleaning, material handling, substrate application, or disposal of used materials.

The one source identified during systematic review did not provide worker descriptions ([NIOSH, 1981](#)). Therefore, EPA evaluated the data as two SEGs, Average Adult Workers and ONUs, and assumed that worker central tendency exposure was representative of ONU exposure and used to generate estimates for ONUs. The “Average Adult Worker” category includes employees directly handling *o*-dichlorobenzene during use of paint thinners and removers. ONUs include employees who do not directly handle the chemical but may inhale dust from process operations.

See Section 4.3.13.1 for a full use of paint thinners and removers process description.

8.2.12.2 Number of Workers and Occupational Non-Users

EPA used data from BLS and the SUSB specific to the OES to estimate the number of workers and ONUs per site potentially exposed to *o*-dichlorobenzene during use of paint thinners and removers ([U.S.](#)

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[BLS, 2023a](#); [U.S. Census Bureau, 2017](#)). This approach involved first identifying the relevant NAICS codes for the OES. EPA didn't identify OES-specific data for the number of sites that use *o*-dichlorobenzene in paint thinners and removers. Therefore, EPA assessed a bounding estimate of 1,760 sites for this OES based on the number of sites listed under the identified NAICS code. Using a bounding estimate will overestimate the true number of sites that use *o*-dichlorobenzene for this OES. The next step is the identification of relevant SOC codes within the BLS data for the identified NAICS codes, from which total number of workers can be determined. This number is divided by the number of sites identified to obtain the exposed workers per site. Appendix J includes further details regarding methodology for estimating the number of workers and ONUs per site. Based on a public comment from the AIA ([EPA-HQ-OPPT-2018-0444-0004](#)), EPA assigned the following NAICS codes for this OES:

- 336410 – Airspace Product and Parts Manufacturing.

Table 8-31 summarizes the per site estimates for this OES based on the methodology described, including the number of sites identified in Section 4.2.2.

Table 8-31. Estimated Average Number of Workers per Site Potentially Exposed to *o*-Dichlorobenzene During Use of Paint Thinner and Removers

Potential Number of Sites	NAICS Code	Potentially Exposed Workers per Site ^a	Potentially Exposed ONUs per Site ^a
1,760	336410 – Airspace Product and Parts Manufacturing	103	62
^a Number of workers and ONUs per site calculated by dividing the exposed number of workers or ONUs by the number of establishments.			

8.2.12.3 Occupational Inhalation Exposure Results

Occupational inhalation exposure data for *o*-dichlorobenzene during use of paint thinners and removers were assessed using data from one source that were identified during systematic review of literature. The source evaluated was the “Health Hazard Report – Metro Bus Maintenance Shop, Washington D.C.”, which was drafted by NIOSH ([NIOSH, 1981](#)). EPA assumes that inhalation exposures from the application of paint strippers and degreasers as a part of bus maintenance are comparable to exposures resulting from the application of paint strippers during aviation maintenance. Results from this study were below the limit of detection of *o*-dichlorobenzene. The reported limit of detection for the report was 0.005 ppm. EPA used this 8-hour TWA value to estimate inhalation exposures for this OES. EPA calculated a central tendency value of 0.0025 ppm equivalent to half of the limit of detection for the sample; the high-end was equivalent to the limit of detection reported by the study.

Using these 8-hour central tendency and high-end TWA exposure concentrations, EPA calculated the AC, IADC, and ADC as described in Appendix K. The results of these calculations are shown in Table 8-32 below. In absence of data specific to ONU exposure, the Agency assumed that worker central tendency exposure was representative of ONU exposure and used to generate estimates for ONUs.

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Table 8-32. Summary of Inhalation 8-Hour TWA Exposure to *o*-Dichlorobenzene During Use in Paint Thinners and Removers

SEG	Exposure Concentration Type	Worker Inhalation Estimates (ppm)	
		Central Tendency	High-End
Average Adult Worker	8-Hour TWA exposure concentrations	2.5E-03	5.0E-03
	Acute exposure concentrations (AC) based on 8-hour TWA	1.7E-03	3.4E-03
	Intermediate average daily concentration (IADC) based on 8-hour TWA	5.7E-05	1.1E-04
	Average daily concentration (ADC) based on 8-hour TWA	1.2E-03	2.3E-03
ONUs	8-Hour TWA exposure concentrations	2.5E-03	
	Acute exposure concentrations (AC) based on 8-hour TWA	1.7E-03	
	Intermediate average daily concentration (IADC) based on 8-hour TWA	5.7E-05	
	Average daily concentration (ADC) based on 8-hour TWA	1.2E-03	

8.2.12.4 Occupational Dermal Exposure Results

EPA estimated dermal exposures for this OES using a Monte Carlo simulation with 100,000 iterations. The Agency modeled dermal exposure using a fraction absorbed value of 0.02 for *o*-dichlorobenzene as a liquid and followed the processes discussed in Section 8.1.4 and Appendix M. There are not any reliable dermal absorption studies available for *o*-dichlorobenzene, however based on comparison of all available data it is expected that *o*-dichlorobenzene absorption will be similar to *p*-dichlorobenzene, and so *p*-dichlorobenzene data was used. The fraction absorbed value of 0.02 was obtained from data submitted to satisfy EPA's Order to conduct an in vitro dermal absorption study on *p*-dichlorobenzene. The study indicated that an estimate of 0.02 (or 2%) absorption should apply to all formulations with a less than 50% concentration of *p*-dichlorobenzene. For more details on this study, and rationale for its use as a surrogate for *o*-dichlorobenzene, see the *Draft Human Health and Environmental Hazard Assessment for o-Dichlorobenzene* ([U.S. EPA, 2026r](#)). EPA assessed the concentration of *o*-dichlorobenzene in paint thinners and removers as a uniform distribution between 1 and 30% based on 2016 CDR and multiple SDS identified in the Use Report ([U.S. EPA, 2020f, 2016b](#)).

Table 8-33 summarizes the APDR, AAD, IAD, and CAD (non-cancer) for *o*-dichlorobenzene in the use of paints and coatings. The high-ends are the 95th percentiles of the respective simulation output and the central tendency exposures are the 50th percentiles. Workers include employees who directly handle paint thinner and remover products containing *o*-dichlorobenzene. Dermal exposures for ONUs are expected to be negligible as they do not directly handle the chemical. OES-specific parameters for dermal exposures are described in Appendix M.

Table 8-33. Summary of Dermal Exposure Doses to *o*-Dichlorobenzene for Use of Paint Thinners and Removers

Modeled Scenario	Exposure Concentration Type	Central Tendency	High-End
Average Adult Worker	Acute potential dose rate (APDR) (mg/day)	1.7	6.8
	Acute absorbed dose (AAD) (mg/kg-day)	2.1E-02	8.5E-02
	Intermediate absorbed dose (IAD), non-cancer (mg/kg-day)	1.5E-02	6.2E-02
	Chronic absorbed dose (CAD), non-cancer (mg/kg-day)	1.4E-02	5.8E-02

8.2.12.5 Exposure Controls and PPE

No engineering controls or documented PPE were available from the data.

8.2.13 Use of Lubricants and Greases

As listed in Table 4-1, this OES includes the following COU: Lubricants and greases – Lubricants and greases.

8.2.13.1 Worker Activities

Submitters in CDR reported commercial use of *o*-dichlorobenzene added to fuels to reduce friction, heat generation, and wear between surfaces after it has been incorporated into the product or mixture ([U.S. EPA, 2020b](#), [2016b](#)). EPA identified two lubricant products that contain between 0.1 to 5 weight percent *o*-dichlorobenzene, as per their SDSs ([Marvel Oil Company, 2024a](#), [b](#); [Kleen-Flo Tumbler Ind. Ltd., 2017](#)). Per a public comment submission, EPA expects *o*-dichlorobenzene to be used at a weight fraction of 0.12% within engine oil in tools and small machines such as lawn mowers and snow blowers ([EPA-HQ-OPPT-2018-0444-0026](#)).

Workers are employees that are expected to directly handle *o*-dichlorobenzene or *o*-dichlorobenzene containing materials. ONUs include employees who work in the process area/room in the vicinity of chemical-related activities and may be indirectly exposed to the chemical as part of their employment. Worker exposure to *o*-dichlorobenzene may occur via inhalation oil vapors as well as dermal contact to liquids during container cleaning and unloading, equipment cleaning, material handling, or disposal of spent oil and other used materials. EPA did not identify information to determine detailed SEGs; therefore, EPA evaluated exposures as two SEGs, Average Adult Workers and ONUs.

See Section 4.3.15.1 for full use of lubricants and greases process description.

8.2.13.2 Number of Workers and Occupational Non-Users

EPA used data from BLS and the SUSB specific to the OES to estimate the number of workers and ONUs per site potentially exposed to *o*-dichlorobenzene during use of lubricants and greases ([U.S. BLS, 2023a](#); [U.S. Census Bureau, 2017](#)). This approach involved first identifying the relevant NAICS codes for the OES. EPA didn't identify OES-specific data for the number of sites that use *o*-dichlorobenzene in lubricants and greases. Therefore, EPA assessed a bounding estimate of 112,387 sites for this OES based on the number of sites listed under the identified NAICS codes. Using a bounding estimate will overestimate the true number of sites that use *o*-dichlorobenzene for this OES. The next step is the identification of relevant SOC codes within the BLS data for the identified NAICS codes. From there total number of workers can be determined. This number is divided by the number of sites identified to obtain the exposed workers per site. Appendix J includes further details regarding methodology for estimating the number of workers and ONUs per site. EPA assigned the following NAICS codes for this OES:

- 811111 – General Automotive Repair
- 811114 – Specialized Automotive Repair
- 811191 – Automotive Oil Change and Lubrication Shops
- 336100 – Motor Vehicle Manufacturing
- 336200 – Motor Vehicle Body and Trailer Manufacturing
- 336300 – Motor Vehicle Parts Manufacturing
- 336400 – Aerospace Product and Parts Manufacturing
- 336411 – Aircraft Manufacturing
- 336600 – Ship and Boat Building

- 336900 – Other Transportation Equipment Manufacturing.

Table 8-34 summarizes the per site estimates for this OES based on the methodology described, including the number of sites identified in Section 4.2.2.

Table 8-34. Estimated Average Number of Workers per Site Potentially Exposed to *o*-Dichlorobenzene During Use of Lubricants and Greases

Potential Number of Sites	NAICS Code	Potentially Exposed Workers per Site ^a	Potentially Exposed ONUs per Site ^a
112,387	336100 – Motor Vehicle Manufacturing	10	3
	336200 – Motor Vehicle Body and Trailer Manufacturing		
	336300 – Motor Vehicle Parts Manufacturing		
	336400 – Aerospace Product and Parts Manufacturing		
	336411 – Aircraft Manufacturing		
	336600 – Ship and Boat Building		
	336900 – Other Transportation Equipment Manufacturing		
	811111 – General Automotive Repair		
	811114 – Specialized Automotive Repair		
	811191 – Automotive Oil Change and Lubrication Shops		
^a Number of workers and ONUs per site calculated by dividing the exposed number of workers or ONUs by the number of establishments.			

8.2.13.3 Occupational Inhalation Exposure Results

EPA did not identify any *o*-dichlorobenzene inhalation monitoring data for the use of lubricants and greases during systematic review of literature sources. Therefore, the Agency estimated inhalation exposure using the 2020 *ESD on Chemical Additives in Automotive Lubricants* and Monte Carlo modeling ([OECD, 2020](#)).

EPA used vapor generation rate and exposure duration parameters from the 1991 CEB Manual ([CEB, 1991](#)) and the *EPA Mass Balance Inhalation Model* to model the exposure points described in the ESD, particularly for the unloading and cleaning of containers. The *EPA Mass Balance Inhalation Model* estimates the concentration of the chemical in the breathing zone of the worker based on a vapor generation rate (G) for each activity. The Agency assumes that a worker can perform each of these activities during a work-shift (EPA assumed an 8-hour work-shift). EPA estimated the TWA inhalation exposure for a full 8-hour work-shift as an output of the Monte Carlo simulation by: (1) summing the time-weighted inhalation exposures for each of the exposure points; and (2) assuming *o*-dichlorobenzene exposures were zero outside these activities. Appendix N describes model equations and other input parameters used in the Monte Carlo simulation to model worker exposures for the Use of Lubricants and Greases OES. EPA does not have an approach to model ONU exposures separately from workers exposures for this OES. Therefore, EPA used the central tendency from modeled workers inhalation exposures to represent ONU inhalation exposures.

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Using these concentrations, EPA calculated the AC, IADC, and ADC as described in Appendix K. The results of these calculations are shown in Table 8-35 below. The high-end values represent the 95th percentile and the central tendency values represent the 50th percentile of the simulation outputs.

Table 8-35. Summary of Inhalation 8-Hour TWA Exposure to *o*-Dichlorobenzene During Use in Lubricants and Greases

SEG	Exposure Concentration Type	Worker Inhalation Estimates (ppm)	
		Central Tendency	High-End
Average Adult Worker	8-Hour TWA exposure concentrations	6.5E-03	3.4E-02
	Acute exposure concentrations (AC) based on 8-hour TWA	4.4E-03	2.3E-02
	Intermediate average daily concentration (IADC) based on 8-hour TWA	1.54E-04	7.8E-04
	Average daily concentration (ADC) based on 8-hour TWA	3.1E-03	1.6E-02
ONUs	8-Hour TWA exposure concentrations	6.5E-03	
	Acute exposure concentrations (AC) based on 8-hour TWA	4.4E-03	
	Intermediate average daily concentration (IADC) based on 8-hour TWA	1.5E-04	
	Average daily concentration (ADC) based on 8-hour TWA	3.1E-03	

8.2.13.4 Occupational Dermal Exposure Results

EPA estimated dermal exposures for this OES using a Monte Carlo simulation with 100,000 iterations. The Agency modeled dermal exposure using a fraction absorbed value of 0.02 for *o*-dichlorobenzene as a liquid and followed the processes discussed in Section 8.1.4 and Appendix M. There are not any reliable dermal absorption studies available for *o*-dichlorobenzene, however based on comparison of all available data it is expected that *o*-dichlorobenzene absorption will be similar to *p*-dichlorobenzene, and so *p*-dichlorobenzene data was used. The fraction absorbed value of 0.02 was obtained from data submitted to satisfy EPA's Order to conduct an in vitro dermal absorption study on *p*-dichlorobenzene. The study indicated that an estimate of 0.02 (or 2%) absorption should apply to all formulations with a less than 50% concentration of *p*-dichlorobenzene. For more details on this study, and rationale for its use as a surrogate for *o*-dichlorobenzene, see the *Draft Human Health and Environmental Hazard Assessment for o-Dichlorobenzene* ([U.S. EPA, 2026r](#)). EPA assessed the concentration of *o*-dichlorobenzene in lubricants as a triangular distribution with a minimum value of 0.1%, a maximum value of 5%, and a mode of 1% based on multiple SDS identified in the Use Report ([U.S. EPA, 2020f](#)). The mode represents the mode of endpoints reported in the SDSs.

Table 8-36 summarizes the APDR, AAD, IAD, and CAD (non-cancer) for *o*-dichlorobenzene in the use of lubricants and greases. The high-ends are the 95th percentiles of the respective simulation output and the central tendency exposures are the 50th percentiles. Workers include employees who directly handle lubricants and greases containing *o*-dichlorobenzene. Dermal exposures for ONUs are expected to be negligible as they do not directly handle the chemical. OES-specific parameters for dermal exposures are described in Appendix M.

Table 8-36. Summary of Dermal Exposure Doses to *o*-Dichlorobenzene for Use of Lubricants and Greases

Modeled Scenario	Exposure Concentration Type	Central Tendency	High-End
Average Adult Worker	Acute potential dose rate (APDR) (mg/day)	0.22	0.87
	Acute absorbed dose (AAD) (mg/kg-day)	2.8E-03	1.1E-02
	Intermediate absorbed dose (IAD), non-cancer (mg/kg-day)	2.0E-03	8.0E-03
	Chronic absorbed dose (CAD), non-cancer (mg/kg-day)	1.9E-03	7.5E-03

8.2.13.5 Exposure Controls and PPE

EPA was unable to identify the use of engineering controls or documented PPE used at sites using *o*-dichlorobenzene in lubricants and greases.

8.2.14 Use of Fuels and Related Products

As listed in Table 4-1, this OES includes the following COU: Fuels and related products – Fuel additive.

8.2.14.1 Worker Activities

Submitters in CDR reported commercial use of *o*-dichlorobenzene added to fuels to improve properties such as stability, corrosion, oxygenation, and octane rating ([U.S. EPA, 2020b](#), [2016b](#)). EPA identified a single fuel additive product SDS containing *o*-dichlorobenzene ranging from 0.1 to 1 weight percent *o*-dichlorobenzene ([Marvel Oil Company, 2024b](#)). Per a public comment submission by Marvel Oil Company, EPA expects *o*-dichlorobenzene to be used as a partial replacement for normal two-cycle engine oil in tools and machines that use oil in gasoline for combustion ([Marvel Oil Company, 2024b](#)) ([EPA-HQ-OPPT-2018-0444-0026](#)).

Workers are employees that are expected to directly handle *o*-dichlorobenzene or *o*-dichlorobenzene containing materials. ONUs include employees who work in the process area/room in the vicinity of chemical-related activities and may be indirectly exposed to the chemical as part of their employment. Worker exposure to *o*-dichlorobenzene may occur via inhalation of gasoline and combustion vapors as well as dermal contact to liquids during container cleaning and unloading, equipment cleaning, material handling, or disposal of used materials. EPA was unable to identify worker descriptions during the use of fuels and related products, therefore, EPA evaluated the data as two SEGs, Average Adult Workers and ONUs. The “Average Adult Worker” category includes employees directly handling *o*-dichlorobenzene during use of fuels and related products. ONUs include employees who do not directly handle the chemical but may inhale vapors from process operations.

See Section 4.3.16.1 for a full use of fuels and related products process description.

8.2.14.2 Number of Workers and Occupational Non-Users

EPA used data from BLS and the SUSB specific to the OES to estimate the number of workers and ONUs per site potentially exposed to *o*-dichlorobenzene during use of fuels and related products ([U.S. BLS, 2023a](#); [U.S. Census Bureau, 2017](#)). This approach involved first identifying the relevant NAICS codes for the OES. EPA did not identify OES-specific data for the number of sites that use *o*-dichlorobenzene in fuels and related products. Therefore, EPA assessed a bounding estimate of 126,879 sites for this OES based on the number of sites listed under the identified NAICS codes. Using a bounding estimate will overestimate the true number of sites that use *o*-dichlorobenzene for this OES. The next step is the identification of relevant SOC codes within the BLS data for the identified NAICS codes, from which total number of workers can be determined. This number is divided by the number of

sites identified to obtain the exposed workers per site. Appendix J includes further details regarding methodology for estimating the number of workers and ONUs per site. EPA assigned the following NAICS codes for this OES:

- 221112 – Fossil Fuel Electric Power Generation
- 324199 – All Other Petroleum and Coal Products Manufacturing
- 457110 – Gasoline Stations with Convenience Stores
- 457120 – Other Gasoline Stations
- 457210 – Fuel Dealers
- 488190 – Other Support Activities for Air Transportation.

Table 8-37 summarizes the per site estimates for this OES based on the methodology described, including the number of sites identified in 4.2.2.

Table 8-37. Estimated Average Number of Workers per Site Potentially Exposed to *o*-Dichlorobenzene During Use of Fuels and Related Products

Monofluorobenzene During Use of Fuels and Related Products			
Potential Number of Sites	NAICS Code	Potentially Exposed Workers per Site ^a	Potentially Exposed ONUs per Site ^a
126,879	221112 – Fossil Fuel Electric Power Generation	1	5
	324199 – All Other Petroleum and Coal Products Manufacturing		
	457110 – Gasoline Stations with Convenience Stores		
	457120 – Other Gasoline Stations		
	457210 – Fuel Dealers		
	488190 – Other Support Activities for Air Transportation		
^a Number of workers and ONUs per site calculated by dividing the exposed number of workers or ONUs by the number of establishments.			

8.2.14.3 Occupational Inhalation Exposure Results

EPA did not identify *o*-dichlorobenzene inhalation monitoring data for the use of fuels and related products during systematic review of literature sources. Occupational inhalation exposures for *o*-dichlorobenzene during use of fuels and related products were assessed using the Use of Chemicals in Fuels and Related Products Generic Scenario ([U.S. EPA, 2021e](#)). The GS evaluates inhalation exposures to fuel additives using inhalation monitoring of VOCs collected during transfer of gasoline from transport containers and storage tanks and correcting for mole fraction and vapor pressure of the chemical of interest (*i.e.*, *o*-dichlorobenzene) in the vapor phase of gasoline. To do this, EPA used the “NCS Vapor Fraction Tables” presented in the GS, which requires the inputs of *o*-dichlorobenzene’s molecular weight and weight fraction in the liquid fuel to estimate a mole fraction in the vapor.

Based on the available SDSs, EPA expects *o*-dichlorobenzene to be used as a partial replacement for normal two-cycle engine oil at a ratio of one part *o*-dichlorobenzene-containing oil to three parts standard oil ([Marvel Oil Company, 2024b](#)) ([EPA-HQ-OPPT-2018-0444-0026](#)). Per similar products identified via internet search, engine oils are typically used in a ratio of 1 part oil to 50 parts gasoline. Using the SDS’s concentration range of 0.1 to 1% *o*-dichlorobenzene, the total weight fraction of *o*-dichlorobenzene in the liquid phase is 5.9×10^{-4} to 4.9×10^{-3} weight percent. This resulted in a high-end vapor fraction of 4.8×10^{-8} % and central tendency vapor fraction of 4.0×10^{-7} %. These values were then

multiplied by the total hydrocarbon exposure values of 170 ppm (high-end) and 66.1 ppm (central tendency) ([U.S. EPA, 2021e](#)) to estimate the *o*-dichlorobenzene 8-hour TWA exposure concentrations.

Using these concentrations, EPA calculated the AC, IADC, and ADC as described in Appendix K. The results of these calculations are shown in Table 8-38 below. In absence of data specific to ONU exposure, the Agency assumed that worker central tendency exposure was representative of ONU exposure and used to generate estimates for ONUs.

Table 8-38. Summary of Inhalation 8-Hour TWA Exposure to *o*-Dichlorobenzene During Use in Fuels and Related Products

SEG	Exposure Concentration Type	Worker Inhalation Estimates (ppm)	
		Central Tendency	High-End
Average Adult Worker	8-Hour TWA exposure concentrations	3.2E-06	6.9E-05
	Acute exposure concentrations (AC) based on 8-hour TWA	2.2E-06	4.7E-05
	Intermediate average daily concentration (IADC) based on 8-hour TWA	7.3E-08	1.6E-06
	Average daily concentration (ADC) based on 8-hour TWA	1.5E-06	3.2E-05
ONUs	8-Hour TWA exposure concentrations	3.2E-06	
	Acute exposure concentrations (AC) based on 8-hour TWA	2.2E-06	
	Intermediate average daily concentration (IADC) based on 8-hour TWA	7.3E-08	
	Average daily concentration (ADC) based on 8-hour TWA	1.5E-06	

8.2.14.4 Occupational Dermal Exposure Results

EPA estimated dermal exposures for this OES using a Monte Carlo simulation with 100,000 iterations. The Agency modeled dermal exposure using a fraction absorbed value of 0.02 for *o*-dichlorobenzene as a liquid and followed the processes discussed in Section 8.1.4 and Appendix M. There are not any reliable dermal absorption studies available for *o*-dichlorobenzene, however based on comparison of all available data it is expected that *o*-dichlorobenzene absorption will be similar to *p*-dichlorobenzene, and so *p*-dichlorobenzene data was used. The fraction absorbed value of 0.02 was obtained from data submitted to satisfy EPA's Order to conduct an in vitro dermal absorption study on *p*-dichlorobenzene. The study indicated that an estimate of 0.02 (or 2%) absorption should apply to all formulations with a less than 50% concentration of *p*-dichlorobenzene. For more details on this study, and rationale for its use as a surrogate for *o*-dichlorobenzene, see the *Draft Human Health and Environmental Hazard Assessment for o-Dichlorobenzene* ([U.S. EPA, 2026r](#)). EPA assessed the concentration of *o*-dichlorobenzene in fuels as a uniform distribution between 0.1 and 0.5% based on multiple SDS identified in the Use Report ([U.S. EPA, 2020f](#)).

Table 8-39 summarizes the APDR, AAD, IAD, and CAD (non-cancer) for *o*-dichlorobenzene in the use of fuels and related products. The high-ends are the 95th percentiles of the respective simulation output and the central tendency exposures are the 50th percentiles. Workers include employees who directly handle fuels and related products containing *o*-dichlorobenzene. Dermal exposures for ONUs are expected to be negligible as they do not directly handle the chemical. OES-specific parameters for dermal exposures are described in Appendix M.

Table 8-39. Summary of Dermal Exposure Doses to *o*-Dichlorobenzene for Use of Fuels and Related Products

Modeled Scenario	Exposure Concentration Type	Central Tendency	High-End
Average Adult Worker	Acute potential dose rate (APDR) (mg/day)	3.6E-02	0.12
	Acute absorbed dose (AAD) (mg/kg-day)	4.4E-04	1.5E-03
	Intermediate absorbed dose (IAD), non-cancer (mg/kg-day)	3.3E-04	1.1E-03
	Chronic absorbed dose (CAD), non-cancer (mg/kg-day)	3.0E-04	1.0E-03

8.2.14.5 Exposure Controls and PPE

EPA was unable to identify the extent engineering controls or documented PPE used at sites using fuels and related products from the data.

8.2.15 Use in Solid Air Care Products

As listed in Table 4-1, this OES includes the following COU: Air care products – Continuous action air fresheners.

8.2.15.1 Worker Activities

Worker exposures to *o*-dichlorobenzene are primarily expected to occur via the inhalation route from installation of urinal cakes and toilet deodorizers and inhalation of vapors during the cleaning of bathrooms during shifts. The magnitude of inhalation exposure depends upon the concentration of *o*-dichlorobenzene in the product, worker activity patterns (including frequency and duration of shifts) and product application methods.

8.2.15.2 Number of Workers and Occupational Non-Users

EPA used data from BLS and the SUSB specific to the OES to estimate the number of workers and ONUs per site potentially exposed to *o*-dichlorobenzene during use of solid air care products ([U.S. BLS, 2023a](#); [U.S. Census Bureau, 2017](#)). This approach involved first identifying the relevant NAICS codes for the OES. EPA didn't identify OES-specific data for the number of sites that use *o*-dichlorobenzene in solid air care products. Therefore, EPA assessed a bounding estimate of 69,698 sites for this OES based on the number of sites listed under the identified NAICS codes. This value represents the number of contracting firms that provide janitorial services, as opposed to the number of facilities cleaned by the firms. As one firm can clean multiple sites, this may underestimate the true number of sites that use *o*-dichlorobenzene for this OES. Conversely, using a bounding estimate may overestimate the true number of sites that use *o*-dichlorobenzene for this OES. The next step is the identification of relevant SOC codes within the BLS data for the identified NAICS codes, from which total number of workers can be determined. This number is divided by the number of sites identified to obtain the exposed workers per site. Appendix J includes further details regarding methodology for estimating the number of workers and ONUs per site. EPA assigned the following NAICS code for this OES:

- 561720 – Janitorial Services.

Table 8-40 summarizes the per site estimates for this OES based on the methodology described, including the number of sites identified in 4.2.2.

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Table 8-40. Estimated Average Number of Workers per Site Potentially Exposed to *o*-Dichlorobenzene During Use in Solid Air Care Products

Potential Number of Sites	NAICS Code	Potentially Exposed Workers per Site ^a	Potentially Exposed ONUs per Site ^a
60,280	561720 – Janitorial Services	1	1
^a Number of workers and ONUs per site calculated by dividing the exposed number of workers or ONUs by the number of establishments.			

8.2.15.3 Occupational Exposure Results

IECCU Version 1.1 ([U.S. EPA, 2019e](#)) was selected to model worker inhalation exposures to *o*-dichlorobenzene for the use of the toilet bowl deodorizer products, in line with the consumer exposure assessment for toilet bowl deodorizer products. For more information and details on the model, see the user guide([U.S. EPA, 2019e](#)).

As a conservative assumption, EPA selected to model a worker whose job is to clean a single bathroom during an entire 8-hour shift, such as at a large venue. Due to the availability of bathroom statistics at airports (number of toilets per concourse), EPA selected an airport as the venue and created a low- and high- exposure intensity scenario based on assumptions for a mid-size and large-size airport. As national level statistics on airport building characteristics are not available, EPA developed inputs based on a concourse from a sample mid-size airport (Raleigh-Durham International – Terminal 2) for the low exposure scenario and a sample large size airport (Denver International) for the high exposure scenario. The model inputs and results are described below.

8.2.15.3.1 Model Inputs

Source Model and Emission Inputs

EPA used the same emission profile as used for consumer exposure assessment for toilet bowl deodorizer in residential homes and described in detail in 0. Briefly, EPA used an exponential decay function fit to experimental emission data from a solid toilet bowl deodorizer product evaluated by ([Guerrero and Corsi, 2012](#)). The decay function was optimized such that the cumulative emitted mass did not exceed the original product mass and the difference between the experimental and modeled average emissions during the first three days was minimized. Although the experimental study was conducted using *p*-dichlorobenzene (*p*-DCB), the data were considered an appropriate surrogate for *o*-dichlorobenzene (*o*-DCB) because the two chemicals are structural isomers with the same molecular weight and similar volatility characteristics. Because the experimental product contained greater than 99% *p*-dichlorobenzene, the derived initial emission rate was adjusted to 1% to reflect the concentration of *o*-dichlorobenzene in the modeled product. Correspondingly, the First-Order Decay empirical model was selected in IECCU using an initial emission rate (E_0) of $5.00 \times 10^3 \mu\text{g}/\text{m}^2/\text{hour}$ and a decay constant (k) of $4.71 \times 10^{-3} \text{ h}^{-1}$, corresponding to approximately 4% of the original product mass remaining after 30 days. The source area was set to 1 m^2 as it is not a necessary input because the total mass of chemical in the test product is assumed to be the same as the modeled product. As mass of product is not a parameter of the first-order decay model equation, the direct IECCU outputs represent the use of one toilet bowl deodorizer product (in a toilet or urinal fixture) in the bathroom. The direct IECCU outputs were adjusted for use of multiple toilet bowl deodorizer products in a restroom, along with adjustments for the worker activity pattern. Refer to Section 8.2.15.3 for a description of these adjustments.

Air Zone Volume and Ventilation

The scenarios were modeled using two-zones, where Zone 1 represents a single restroom in the airport concourse and the Zone 2 represents the rest of the airport concourse associated with a set of restrooms (men's and women's). This approach of modeling a concourse segment was selected for ease of

modeling due to the availability of data supporting assumptions and to simplify unknown airflow dynamics in extremely large commercial buildings. EPA notes an airport is not a worst-case scenario when considering the large size of a terminal, high air-exchange rate of bathrooms, and standardized density of bathrooms. Exposures would likely be higher for smaller commercial buildings or with more toilets per bathroom (e.g., an arena or stadium).

Based on data from the sample airports and other assumptions, the Zone volumes and ventilation parameters used in modeling are shown in Table 8-41. Derivation of these inputs is described below the table.

Table 8-41. Air Zone Volume and Ventilation Inputs for IECCU – Commercial Toilet Bowl Deodorizers

Scenario	Zone 1 Volume (m ³)	Zone 2 Volume (m ³)	Air Exchange Flow Rate for Zone 0 to 1 (m ³ /h)	Air Exchange Flow Rate for Zone 0 to 2 (m ³ /h)	Air Exchange Flow Rate for Zone 1 to 2 (m ³ /h)
Mid-Size Airport	235	18,997	353	28,496	1,189
Large Airport	336	31,043	504	46,564	2,379

Restroom Volume (Number of Fixtures and Floor Area Per Fixture)

The volume of the restroom (Zone 1), 235 m³ for the low exposure scenario and 336 m³ for the high exposure scenario, was derived using an assumed number of fixtures (toilets or urinals) per bathroom, assumed area of floor space per fixture, and assumed ceiling height.

Number of Fixtures: The number of fixtures was set to 10 and 20 for the low and high exposure scenarios, respectively, based on information obtained from the Airport Passenger Terminal Planning and Design, Volume I Guidebook which recommends a minimum of 10 to 12 fixture (toilets and urinals) per sex in each restroom for domestic O&D airport concourses and 15 to 20 fixtures for concourses with domestic hubbing ([Transportation Research Board, 2010](#)).

Area Per Fixture: The floor space per fixture was assumed to be 70 ft² for the low exposure scenario based on the Airport Passenger Terminal Planning and Design, Volume I Guidebook which states that a typical restroom module of 10 to 12 fixtures/sex (including a companion care restroom and janitor closet) will average 60 to 70 ft². For the high exposure level, the area per fixture was assumed to be 50 ft² based on professional judgement considering the minimum area needed for a stall, sink, and circulation. This area approximately corresponds to ADA requirements.

Height: The ceiling height was assumed to be 12 ft, the typical height of ceilings for some types of commercial buildings ([U.S. EPA, 2019d](#)).

Terminal Volume

Zone 2 volumes, 18,997 m³ for the low exposure scenario and 31,043 m³ for the high exposure scenario, were derived from concourse dimensions associated with one bathroom set.

Length: First the number of bathroom sets in the whole concourse was determined from airport specific concourse maps (8 for both airports). Then the total length of the concourse was measured using Google Earth (2,175 ft for the mid-size airport and 3,175 ft for the large size airport). With these values, the

linear feet of concourse per bathroom set was determined to be 275 ft for the mid-size airport and 400 ft for the large size airport.

Width: The width of the concourse was also measured from Google Earth; 275 ft for the mid-size airport and 141 ft for the large size airport.

Height: The airport-specific heights were not available; thus, the ceiling height was assumed to be 20 ft, the typical height of ceilings for warehouses and enclosed malls according to ([U.S. EPA, 2019d](#)).

The length, width, and heights were multiplied to obtain the total concourse volume for a restroom set. These values were then adjusted to Zone 2 only volumes by subtracting out the volume of two restrooms (one for men's and one for women's). For contextual purposes, the total concourse values were calculated as 271,875 ft² and 468,095 ft² and correspond to 4.5 to 4.75 gates per bathroom sets, respectively, for the mid-size and large-size airports.

Air Exchange Flow Rates

Air exchange flow rates (m³/hour) from the outside (Zone 0) to Zone 1 and from Zone 0 to Zone 2 are calculated from an indoor air change rate of 1.5 per hour for commercial buildings (*Exposure Factors Handbook* ([U.S. EPA, 2011b](#)), Chapter 19)) and the corresponding Zone 1 and Zone 2 volumes discussed above.

Air exchange flow rates (m³/hour) between Zone 1 and Zone 2 are not available for an airport scenario which has a large Zone 2 volume. Therefore, EPA assumed a bathroom exhaust rate of 70 cubic feet per minute per fixture, based on recommended exhaust rates for heavy-use areas.

Simulation Conditions

IECCU was set to run a duration of 5,000 hours (6 months) and for 5,000 data points. This produces a time series of concentrations at 1-hour intervals which is sufficient to evaluate product use over the 30-day period (the length of time that the toilet bowl deodorizer is expected to last before fully sublimating).

8.2.15.3.2 Exposure Calculations

Outside of IECCU, the resulting zone concentrations were scaled to reflect the number of bathrooms per concourse segment and the amount of product used in the bathroom. These adjustments were possible by scaling because mass of chemical has a linear relationship in the modeling equations. Additionally, a time series of concentrations for the worker over the 30-day exposure period was produced by simulating the worker's activity pattern. These adjustments are described below.

Number of Restrooms Per Concourse Segment

Zone 2 concentration from the IECCU modeling reflects only the presence of one restroom as the worker will only be present in one restroom during the work-shift. The Zone 2 concentrations were scaled up by two to reflect the presence of a men's and women's restroom in a concourse segment.

Worker Activity Pattern

The modeling was conducted assuming an 8-hour work shift for 5 days in a row, followed by two days off work. This pattern was repeated for 30 days. For the 8-hour work shift it was assumed that worker would be in the bathroom for 3 hour (Zone 1), the rest of the terminal for 1 hour (Zone 2), and finally in the bathroom for another 4 hours (Zone 1).

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Amount of Product Per Restroom

As concentrations from IECCU are for one product, the worker concentrations were scaled up to reflect 10 products (1 per fixture) in the low exposure scenario and 20 products (1 per fixture) in the high exposure scenario.

8.2.15.3.3 Inhalation Exposure Results

The acute exposure concentrations were calculated as a maximum 24-hour average based on the modeled worker concentrations in the first 30 days of exposure. The 24-hour average is 9.66×10^{-3} mg/m³ for the low exposure scenario (mid-size airport) and 1.05×10^{-2} mg/m³ for the high exposure scenario (large size airport).

The chronic exposure concentrations were calculated as a 30-day average based on the modeled worker concentration in the first 30 days of exposure. The 30-day average is 2.40×10^{-3} mg/m³ for the low exposure scenario (mid-size airport) and 2.60×10^{-3} mg/m³ for the high exposure scenario (large size airport).

For detailed outputs and concentrations, see *Draft Commercial Exposure Analysis and Risk Calculator for o-Dichlorobenzene* ([U.S. EPA, 2026j](#)).

Table 8-42. Air Exchange Flow Rates (m³/h) to and from Different Zones

	To Zone 1	To Zone 2
From Zone 0 (ambient environment)	769.5	7,084.5
From Zone 1 (restroom)	N/A	2,564.6
From Zone 2 (rest of airport terminal)	2,564.6	N/A

Generally, the “First-order decay” model within IECCU was selected as the appropriate model to determine the decay rate of the *p*-dichlorobenzene emission rate from toilet bowl deodorizers. The initial emission factor, toilet bowl deodorizer source area, and first order decay constant were assumed to be the same as the consumer product. See the user guide for more information on the first-order decay equation and input information ([U.S. EPA, 2019e](#)).

Since the IECCU outputs for one toilet bowl deodorizer, the concentration in Zone 1 was multiplied by 10 or 20 to represent an airport terminal bathroom with multiple toilets with each toilet containing one toilet bowl deodorizer.

Table 8-43. Inhalation of Acute and Chronic Exposure Concentrations for Airport Commercial Scenarios

Scenarios

Exposure Intensity	Acute		Chronic	
	Exposure Metric	Exposure Concentration (mg/m ³)	Exposure Metric	Exposure Concentration (mg/m ³)
Low	Max 24-Hour TWA	9.66E-03	30-day TWA	2.40E-03
High		1.05E-02		2.60E-03
TWA = time-weighted average Low = Midsize airport, 10 toilets/bathroom High = Large airport, 20 toilets/bathroom				

8.2.15.3.4 Occupational Dermal Exposure Results

EPA estimated dermal exposures for this OES using a Monte Carlo simulation with 100,000 iterations. The Agency modeled dermal exposure using a fraction absorbed value of 0.02 for *o*-dichlorobenzene as a solid in an article and followed the processes discussed in Section 8.1.4 and Appendix M. EPA evaluated the concentration of *o*-dichlorobenzene in solid air care products as a uniform distribution with a lower bound of 0.1% and an upper bound of 1% based on compiled SDS information for solid air care products containing *o*-dichlorobenzene identified in the Use Report ([U.S. EPA, 2020f](#)).

Table 8-44 summarizes the APDR, AAD, IAD, and CAD (non-cancer) for *o*-dichlorobenzene during use in solid air care products. The high-ends are the 95th percentiles of the respective simulation output and the central tendency exposures are the 50th percentiles. OES-specific parameters for dermal exposures are described in Appendix M.

Table 8-44. Summary of Dermal Exposure Doses to *o*-Dichlorobenzene for Use in Solid Air Care Products

Modeled Scenario	Exposure Concentration Type	Central Tendency	High-End
Average Adult Worker	Acute potential dose rate (APDR) (mg/day)	5.3E-02	0.14
	Acute absorbed dose (AAD) (mg/kg-day)	6.6E-04	1.7E-03
	Intermediate absorbed dose (IAD), non-cancer (mg/kg-day)	4.9E-04	1.2E-03
	Chronic absorbed dose (CAD), non-cancer (mg/kg-day)	4.5E-04	1.2E-03
ONU	Acute potential dose rate (APDR) (mg/day)	1.8E-02	
	Acute absorbed dose (AAD) (mg/kg-day)	2.2E-04	
	Intermediate absorbed dose (IAD), non-cancer (mg/kg-day)	1.6E-04	
	Chronic absorbed dose (CAD), non-cancer (mg/kg-day)	1.5E-04	

Along with this fractional absorbed method, EPA obtained a second set of occupational dermal exposure estimates by using the same permeability equation (described in Section 7.4.2 as consumer dermal exposure as for occupational).

For dermal exposure, the permeability method was chosen as the best available model. See Section 7.4.2 for more information about the model as well as the inputs as they are the same as consumer. The difference is the frequency of events, for acute it is assumed that there are 20 toilets in a bathroom, and the janitor is cleaning 5 bathrooms per day. EPA assumes that 100 urinal cakes are being handled per day for acute for chronic (100 urinal cakes every month would equate to 1,200 urinal cakes per year). The acute dose is 2.11×10^{-1} and chronic dose is 6.94×10^{-3} . No further analysis was warranted because the MOEs were above the benchmark.

8.2.15.4 Exposure Controls and PPE

No engineering controls or documented PPE were found for this OES. However, the product manufacturer recommends the user wear protective gloves/clothing ([Willert Home Products, 2019](#)).

8.2.16 Use of Laboratory Chemicals

As listed in Table 4-1, this OES includes the following COU: Other Use – Laboratory Chemicals.

8.2.16.1 Worker Activities

EPA identified process information specific to the use of laboratory chemicals from surrogate data provided in response to a test order for 1,1,2-trichloroethane from the Vinyl Institute([Labcorp Early](#)

[Development Laboratories, 2023](#)). Worker inhalation samples was taken from this dataset for workers described as “Lab Technicians.” Due to the lack of readily available process information pertaining to worker exposure to *o*-dichlorobenzene, EPA used surrogate laboratory chemical exposure data from the *Draft Chemistry, Fate, Release and Exposure Assessment for 1,1,2-Trichloroethane* to assess worker exposures in liquid form ([U.S. EPA, 2026d](#)).

In using surrogate data, EPA assumes that worker activities during laboratory chemical use for *o*-dichlorobenzene are similar to those for 1,1,2-trichloroethane. The data provided by the Vinyl Institute describes an SEG for Laboratory Technicians. According to the Vinyl Institute, laboratory technicians may be exposed to 1,1,2-trichloroethane vapors during collection of field samples, sample preparation, and sample analysis ([Labcorp Early Development Laboratories, 2023](#)). ONU exposures specific to the laboratory setting are not addressed in this test order. However, EPA expects ONUs to have lower inhalation exposures than workers who handle 1,1,2-trichloroethane as a laboratory chemical and expects no dermal exposure to liquid 1,1,2-trichloroethane. This surrogate data is from four sites that produce 1,1,2-trichloroethane as a non-isolated byproduct during the manufacture of 1,2-dichloroethane. Therefore, an uncertainty of the data is that it isn’t from a dedicated laboratory, but on-site laboratories at manufacturing facilities. However, EPA expects that the exposures are representative of those at dedicated laboratories.

See Section 4.3.18.1 for a full use of laboratory chemicals process description.

8.2.16.2 Number of Workers and Occupational Non-Users

EPA used data from BLS and the SUSB specific to the OES to estimate the number of workers and ONUs per site potentially exposed to *o*-dichlorobenzene during use of laboratory chemicals ([U.S. BLS, 2023a](#); [U.S. Census Bureau, 2017](#)). This approach involved first identifying the relevant NAICS codes for the OES. EPA didn’t identify OES-specific data for the number of sites that use *o*-dichlorobenzene in laboratory chemicals. Therefore, EPA assessed a bounding estimate of 10,490 sites for this OES based on the number of sites listed under the identified NAICS codes. Using a bounding estimate will overestimate the true number of sites that use *o*-dichlorobenzene for this OES. The next step is the identification of relevant SOC codes within the BLS data for the identified NAICS codes, from which total number of workers can be determined. This number is divided by the number of sites identified to obtain the exposed workers per site. Appendix J includes further details regarding methodology for estimating the number of workers and ONUs per site. EPA assigned the following NAICS codes for this OES:

- 541380 – Testing Laboratories
- 541714 – Research and Development in Biotechnology (except Nanobiotechnology).

Table 8-45 summarizes the per site estimates for this OES based on the methodology described, including the number of sites identified in Section 4.2.2.

Table 8-45. Estimated Average Number of Workers per Site Potentially Exposed to *o*-Dichlorobenzene During Use of Laboratory Chemicals

Potential Exposure During Use of Laboratory Chemicals			
Potential Number of Sites	NAICS Code	Potentially Exposed Workers per Site ^a	Potentially Exposed ONUs per Site ^a
10,490	541380 – Testing Laboratories; and	3	7
	541714 – Research and Development in Biotechnology (except Nanobiotechnology)		
^a Number of workers and ONUs per site calculated by dividing the exposed number of workers or ONUs by the number of establishments.			

8.2.16.3 Occupational Inhalation Exposure Results

EPA was only able to identify a single source of process information specific to the use of laboratory chemicals containing *o*-dichlorobenzene, a test order by Sabic Innovative Plastics (8.2.16.1). This source contained a single applicable data point that was below the method limit of detection. Therefore, EPA estimated inhalation exposure to this OES using two surrogates with data from laboratory technicians in quality control laboratories within manufacturing or processing facilities. The first surrogate came from occupational inhalation monitoring data for *p*-dichlorobenzene during processing as a reactant provided via a data submission from the ACC Consortium {American Chemistry Council, 2023, 13006361}. This dataset came from two processing facilities, and contained an SEG for Lab Technicians. All nine Lab Technician (assessed as both 8-hour and 12-hour TWA) datapoints were reported non-detects for *p*-dichlorobenzene (LOD range between 0.0041 and 0.057 ppm) in the ACC Consortium data. In this surrogate estimate, EPA used the maximum LOD (0.057) as the assumed high-end of exposure, and half the LOD as the central tendency.

Because of the lack of detected samples, EPA also estimated exposure from this OES using surrogate monitoring data from 1,1,2-trichloroethane {Labcorp Early Development Laboratories Ltd, 2023, 11164566}. Although this chemical is not as favorable a surrogate option as *p*-dichlorobenzene, the dataset included detected monitoring data. EPA was provided this exposure data from the Vinyl Institute in response to a test order. The data included a worker job title of "Laboratory Technician" which EPA determined as relevant to this OES. In total, the data provided by the Vinyl Institute included 29 full-shift worker PBZ air samples along with 23 short-term samples taken between July and October 2023. Vinyl Institute data for laboratory technicians included both 8-hour and 12-hour TWAs, and both results are presented in this assessment. For 8-hour TWA concentrations for Laboratory Technicians, the Vinyl Institute data contained seven samples, and two of which were below the limit of detection. For 12-hour TWA concentrations for Laboratory Technicians, the Vinyl Institute data contained 22 samples, eight of which were below the limit of detection. All non-detect samples were estimated as the LOD/2 due to the standard deviation of the datasets. For this subset of data, the median and 95th percentile were used to represent a central tendency and high-end estimate, respectively.

In absence of data specific to ONU exposure from either surrogate source, the Agency assumed that worker central tendency exposure was representative of ONU exposure and used that to generate estimates for ONUs. These values were all corrected based on differences in vapor pressure and concentration ([CEB, 1991](#)). Using these 8- and 12-hour TWA estimates, EPA calculated the AC, IADC, and ADC as described in Appendix K. The results of these calculations are shown in Table 8-46 and Table 8-47 below.

Table 8-46. 8-Hour Duration of Inhalation Exposures to *o*-Dichlorobenzene During Use in Lab Chemicals

SEG	Exposure Concentration Type	Worker Inhalation Estimates (ppm)	
		Central Tendency	High-End
Average Adult Worker – 8-hour TWA	8-Hour TWA exposure concentrations	5.5E–05	5.1E–03
	Acute exposure concentrations (AC) based on 8-hour TWA	3.7E–05	3.4E–03
	Intermediate average daily concentration (IADC) based on 8-hour TWA	2.7E–05	2.5E–03
	Average daily concentration (ADC) based on 8-hour TWA	2.6E–05	2.4E–03
ONU – 8-hour TWA	8-Hour TWA exposure concentrations	5.5E–05	
	Acute exposure concentrations (AC) based on 8-hour TWA	3.7E–05	
	Intermediate average daily concentration (IADC) based on 8-hour TWA	2.7E–05	
	Average daily concentration (ADC) based on 8-hour TWA	2.6E–05	

Table 8-47. 12-Hour Duration of Inhalation Exposures to *o*-Dichlorobenzene During Use in Lab Chemicals

SEG	Exposure Concentration Type	Worker Inhalation Estimates (ppm)	
		Central Tendency	High-End
Average Adult Worker – 12-hour TWA (1,1,2-TCA surrogate)	12-Hour TWA exposure concentrations	1.3E–05	5.4E–04
	Acute exposure concentrations (AC) based on 12-hour TWA	1.3E–05	5.5E–04
	Intermediate average daily concentration (IADC) based on 12-hour TWA	6.2E–06	2.7E–04
	Average daily concentration (ADC) based on 12-hour TWA	5.8E–06	2.5E–04
Average Adult Worker – 12-hour TWA (<i>p</i> -dichlorobenzene surrogate)	12-Hour TWA exposure concentrations	3.0E–02	6.0E–02
	Acute exposure concentrations (AC) based on 12-hour TWA	3.0E–02	6.1E–02
	Intermediate average daily concentration (IADC) based on 12-hour TWA	1.5E–02	3.0E–02
	Average daily concentration (ADC) based on 12-hour TWA	1.7E–02	3.3E–02
ONU – 12-hour TWA (1,1,2-TCA surrogate)	12-Hour TWA exposure concentrations	1.3E–05	
	Acute exposure concentrations (AC) based on 12-hour TWA	1.3E–05	
	Intermediate average daily concentration (IADC) based on 12-hour TWA	6.2E–06	
	Average daily concentration (ADC) based on 12-hour TWA	5.8E–06	
ONU – 12-hour TWA (<i>p</i> -dichlorobenzene surrogate)	12-Hour TWA exposure concentrations	3.0E–02	
	Acute exposure concentrations (AC) based on 12-hour TWA	3.0E–02	
	Intermediate average daily concentration (IADC) based on 12-hour TWA	1.5E–02	
	Average daily concentration (ADC) based on 12-hour TWA	1.7E–02	

8.2.16.4 Occupational Dermal Exposure Results

EPA estimated dermal exposures for this OES using a Monte Carlo simulation with 100,000 iterations.

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The Agency modeled dermal exposure using a fraction absorbed value of between 0.02 and 0.04 for *o*-dichlorobenzene as a liquid and followed the processes discussed in Section 8.1.4 and Appendix M. There are not any reliable dermal absorption studies available for *o*-dichlorobenzene, however based on comparison of all available data it is expected that *o*-dichlorobenzene absorption will be similar to *p*-dichlorobenzene, and so *p*-dichlorobenzene data was used. The fraction absorbed value was obtained from data submitted to satisfy EPA's Order to conduct an in vitro dermal absorption study on *p*-dichlorobenzene. The study indicated that an estimate of 0.02 (or 2%) absorption should apply to all formulations with a less than 50% concentration of *p*-dichlorobenzene, and 0.04 (or 4%) absorption should apply to all formulations with more than 50% concentration of *p*-dichlorobenzene. For more details on this study, and rationale for its use as a surrogate for *o*-dichlorobenzene, see the *Draft Human Health and Environmental Hazard Assessment for o-Dichlorobenzene* ([U.S. EPA, 2026r](#)). EPA assessed the concentration of *o*-dichlorobenzene in laboratory chemicals as a uniform distribution with a lower bound of 0.002%, an upper bound of 100% based on compiled SDS information for liquid lab chemical products containing *o*-dichlorobenzene from the *o*-dichlorobenzene Use Report. The lower and upper bounds represent the minimum and maximum reported concentrations in the SDSs. ([U.S. EPA, 2020f](#)).

Table 8-48 summarizes the APDR, AAD, IAD, and CAD (non-cancer) for *o*-dichlorobenzene during the use of laboratory chemicals. The SEG areas included in the "Average Adult Worker" category for *o*-dichlorobenzene include laboratory technicians. Dermal exposures for ONUs are expected to be negligible for *o*-dichlorobenzene as a liquid as they do not directly handle the chemical. The high-end represents the 95th percentiles of the respective simulation output and the central tendency exposures represent the 50th percentiles. Dermal exposures for ONUs are expected to be negligible as they do not directly handle the chemical. OES-specific parameters for dermal exposures are described in Appendix M.

Table 8-48. Summary of Dermal Exposure Doses to *o*-Dichlorobenzene for Use of Laboratory Chemicals

Modeled Scenario	Exposure Concentration Type	Central Tendency	High-End
Average Adult Worker	Acute potential dose rate (APDR) (mg/day)	6.9	45
	Acute absorbed dose (AAD) (mg/kg-day)	8.6E-02	0.56
	Intermediate absorbed Dose (IAD), non-cancer (mg/kg-day)	5.1E-02	0.34
	Chronic absorbed dose (CAD), non-cancer (mg/kg-day)	4.8E-02	0.32

8.2.16.5 Exposure Controls and PPE

The Vinyl Institute documented that engineering controls such as fume hoods and localized exhaust are present in laboratories ([Labcorp Early Development Laboratories, 2023](#)). Laboratory technicians used PPE such as flame retardant coveralls, safety glasses, and nitrile gloves. Face shields are used during sample manipulation, and half-face organic respirators are worn when standards are weighed out. EPA did not identify data indicating whether similar PPE would be worn for *o*-dichlorobenzene use as a laboratory chemical.

8.2.17 Use of Cleaning and Furnishing Care Products

As listed in Table 4-1, this OES includes the following COU: Other use – Cleaning and furnishing care products.

8.2.17.1 Worker Activities

EPA gathered information from OSHA CEHD pertaining to the use of *o*-dichlorobenzene in cleaning

and furnishing products. One facility (Spic & Span Dry Cleaners) provided data for worker inhalation exposure ([OSHA, 2019](#)). EPA expects *o*-dichlorobenzene to be used as a solvent in cleaning and furnishing care products. Workers are employees that are expected to directly handle *o*-dichlorobenzene or *o*-dichlorobenzene containing materials. ONUs include employees who work in the process area/room in the vicinity of chemical-related activities and may be indirectly exposed to the chemical as part of their employment. Worker exposure to *o*-dichlorobenzene may occur via inhalation of vapors as well as dermal contact to liquids during container cleaning and unloading, equipment cleaning, material handling, substrate application, or disposal of used materials.

As OSHA CEHD data does not include worker descriptions, EPA evaluated the data for two SEGs, Average Adult Worker and ONU, and assumed that worker central tendency exposure was representative of ONU exposure and used to generate estimates for ONUs. The “Average Adult Worker” category includes employees directly handling *o*-dichlorobenzene during the use of cleaning and furnishing care products. ONUs include employees who do not directly handle the chemical but may inhale vapors from process operations.

See Section 4.3.19.1 for a full use of cleaning and furnishing care products process description.

8.2.17.2 Number of Workers and Occupational Non-Users

EPA used data from BLS and the SUSB specific to the OES to estimate the number of workers and ONUs per site potentially exposed to *o*-dichlorobenzene during use of cleaning and furnishing care products {U.S. BLS, 2023, 12379303; U.S. Census Bureau, 2017, 12379302}. This approach involved first identifying the relevant NAICS codes for the OES. EPA didn’t identify OES-specific data for the number of sites that use *o*-dichlorobenzene in cleaning and furnishing care products. Therefore, EPA assessed a bounding estimate of 28,144 sites for this OES based on the number of sites listed under the identified NAICS codes. Using a bounding estimate will overestimate the true number of sites that use *o*-dichlorobenzene for this OES. The next step is the identification of relevant SOC codes within the BLS data for the identified NAICS codes, from which total number of workers can be determined. This number is divided by the number of sites identified to obtain the exposed workers per site. Appendix J includes further details regarding methodology for estimating the number of workers and ONUs per site. EPA assigned the following NAICS codes for this OES:

- 561740 – Carpet and Upholstery Cleaning Services; and
- 812320 – Drycleaning and Laundry Services (except Coin-Operated).

Table 8-49 summarizes the per site estimates for this OES based on the methodology described, including the number of sites identified in Section 4.3.19.2.

Table 8-49. Estimated Average Number of Workers per Site Potentially Exposed to *o*-Dichlorobenzene During Use of Cleaning and Furnishing Care Products

Potential Number of Sites	NAICS Code	Potentially Exposed Workers per Site ^a	Potentially Exposed ONUs per Site ^a
28,144	561740 – Carpet and Upholstery Cleaning Services	4	1
	812320 – Drycleaning and Laundry Services (except Coin-Operated)		
^a Number of workers and ONUs per site calculated by dividing the exposed number of workers or ONUs by the number of establishments.			

8.2.17.3 Occupational Inhalation Exposure Results

EPA identified occupational inhalation data for *o*-dichlorobenzene during use of cleaning and furnishing care products in OSHA's CEHD database ([OSHA, 2019](#)) based on relevant SIC codes. EPA estimated inhalation exposures using two PBZ samples taken in March 1995 from one site under the SIC code 7216 – Drycleaning Plants, Except Rug Cleaning. These two samples were from the same facility, date, and shared the same sample number in the CEHD database, and thus they were assumed to be two halves of a single full-shift sample.

As EPA estimated inhalation exposures using this one full-shift PBZ sample, EPA was unable to estimate a range of potential exposures during this scenario and presents only this one concentration. Using the 8-hour TWA exposure concentration, EPA calculated the AC, IADC, and ADC as described in Appendix K. As a central tendency of potential occupational inhalation exposure was not able to be estimated, EPA also did not generate estimates of ONU exposure; however, EPA assumes that ONU exposures would be equal to or less than estimated worker exposures. The results of these calculations are shown in Table 8-50.

Table 8-50. Summary of Inhalation 8-Hour TWA Exposure to *o*-Dichlorobenzene During Use of Cleaning and Furnishing Care Products

SEG	Exposure Concentration Type	Worker Inhalation Estimates (ppm)	
		Central Tendency	High-End
Average Adult Worker	8-Hour TWA exposure concentrations	0.15	
	Acute exposure concentrations (AC) based on 8-hour TWA	0.10	
	Intermediate average daily concentration (IADC) based on 8-hour TWA	3.3E-03	
	Average daily concentration (ADC) based on 8-hour TWA	6.9E-02	

Because only one data point was found relevant to this OES, EPA also used surrogate data to estimate exposure using information from a generic scenario, *Chemicals Used in Furnishing Cleaning Products* {U.S. EPA, 2022, 10368811}. This generic scenario presents monitoring data from a study that measured air concentration of volatile hydrocarbon substances during the use of various general cleaning products. The tested products were used in a chamber designed to simulate a typical residential environment, and then air concentrations were measured over 24 hours. Since EPA does not know the specific scenario that an *o*-dichlorobenzene product would be used in, the 50th and 95th percentile exposures from all the scenarios were used to estimate the central tendency and high-end exposure respectively. The central tendency of the volatile organic samples from different cleaning scenarios closely aligns with the single sample from the dry-cleaning industry (0.17 ppm 8-hour TWA from the surrogate data, compared to 0.15 ppm from the dry-cleaning industry), bolstering confidence in this exposure estimate. The high-end exposure obtained using the surrogate data from the generic scenario is an order of magnitude higher than the central tendency results (1.6 ppm 8-hour TWA).

8.2.17.4 Occupational Dermal Exposure Results

EPA estimated dermal exposures for this OES using a Monte Carlo simulation with 100,000 iterations. The Agency modeled dermal exposure using a fraction absorbed value of 0.04 for *o*-dichlorobenzene as a liquid and followed the processes discussed in Section 8.1.4 and Appendix M. There are not any reliable dermal absorption studies available for *o*-dichlorobenzene, however based on comparison of all available data it is expected that *o*-dichlorobenzene absorption will be similar to *p*-dichlorobenzene, and

so *p*-dichlorobenzene data was used. The fraction absorbed value of 0.04 was obtained from data submitted to satisfy EPA's Order to conduct an in vitro dermal absorption study on *p*-dichlorobenzene. The study indicated that an estimate of 0.04 (or 4%) absorption should apply to all formulations with a more than 50% concentration of *p*-dichlorobenzene. For more details on this study, and rationale for its use as a surrogate for *o*-dichlorobenzene, see the *Draft Human Health and Environmental Hazard Assessment for o-Dichlorobenzene* ([U.S. EPA, 2026r](#)). EPA assessed the *o*-dichlorobenzene concentration in cleaning and furnishing care products as a static value of 95% {OECD, 2001, 5185286}.

Table 8-51 summarizes the APDR, AAD, IAD, and CAD (non-cancer) for *o*-dichlorobenzene in the use of cleaning and furnishing care products. The high-end represent the 95th percentiles of the respective simulation output and the central tendency exposures represent the 50th percentiles. Workers include employees who directly handle cleaning and furnishing care products containing *o*-dichlorobenzene. Dermal exposures for ONUs are expected to be negligible as they do not directly handle the chemical. OES-specific parameters for dermal exposures are described in Appendix M.

Table 8-51. Summary of Dermal Exposure Doses to *o*-Dichlorobenzene for Use of Cleaning and Furnishing Care Products

Modeled Scenario	Exposure Concentration Type	Central Tendency	High-End
Average Adult Worker	Acute potential dose rate (APDR) (mg/day)	26	64
	Acute absorbed dose (AAD) (mg/kg-day)	0.32	0.80
	Intermediate absorbed dose (IAD), non-cancer (mg/kg-day)	0.24	0.59
	Chronic absorbed dose (CAD), non-cancer (mg/kg-day)	0.22	0.55

8.2.17.5 Exposure Controls and PPE

No engineering controls or documented PPE were available from the data.

8.2.18 Use of Other Cleaning Products

As listed in Table 4-1, this OES includes the following COU: Other use – Cleaning and furnishing care products.

8.2.18.1 Worker Activities

EPA did not find worker activities specific to septic tank cleaning, but EPA expects *o*-dichlorobenzene to be used in concentrated form in cleaning septic systems. Workers are expected to be present in a home or commercial facility when utilizing the product, and are expected to directly handle *o*-dichlorobenzene or *o*-dichlorobenzene containing materials. ONUs were not assessed for this OES. Worker exposure to *o*-dichlorobenzene may occur via inhalation of vapors as well as dermal contact to liquids during container cleaning and unloading, equipment cleaning, material handling, use of the product when pouring it into a toilet and flushing it, or disposal of used materials.

8.2.18.2 Number of Workers and Occupational Non-Users

EPA used data from BLS and the SUSB specific to the OES to estimate the number of workers and ONUs per site potentially exposed to *o*-dichlorobenzene during use of septic tank cleaner {U.S. BLS, 2023, 12379303; U.S. Census Bureau, 2017, 12379302}. This approach involved first identifying the relevant NAICS codes for the OES. EPA didn't identify OES-specific data for the number of sites that use *o*-dichlorobenzene in septic tank cleaner. Therefore, EPA assessed a bounding estimate of 3,545 sites for this OES based on the number of sites listed under the identified NAICS code. Using a

bounding estimate will overestimate the true number of sites that use *o*-dichlorobenzene for this OES. The next step is the identification of relevant SOC codes within the BLS data for the identified NAICS codes, from which total number of workers can be determined. This number is divided by the number of sites identified to obtain the exposed workers per site. Appendix J includes further details regarding methodology for estimating the number of workers and ONUs per site. EPA assigned the following NAICS code for this OES:

- 562991 – Septic Tank and Related Services.

Table 8-52 summarizes the per site estimates for this OES based on the methodology described, including the number of sites identified in Section 4.3.20.2.

Table 8-52. Estimated Average Number of Workers per Site Potentially Exposed to *o*-Dichlorobenzene During Use of Other Cleaning Products

Potential Number of Sites	NAICS Code	Potentially Exposed Workers per Site ^a	Potentially Exposed ONUs per Site ^a
3,545	562991 – Septic Tank and Related Services	3	1
^a Number of workers and ONUs per site calculated by dividing the exposed number of workers or ONUs by the number of establishments.			

8.2.18.3 Occupational Inhalation and Dermal Exposure Approach

EPA conducted a quantitative analysis of commercial workers that use septic tank cleaners containing *o*-dichlorobenzene in multiple homes in a day. CEM Version 3.2 ([U.S. EPA, 2023a](#)) was used to evaluate occupational exposure based on the available data for septic tank cleaners containing *o*-dichlorobenzene. Although CEM is intended for consumer uses, occupational exposure can be modeled by adjusting inputs specific for a worker scenario. See Section 7.3 for more information about the CEM model.

The following presents occupational COU information used in the CEM scenario. The model was generated to reflect specific use conditions as well as physical and chemical properties of the fluid. The emissions model was selected based upon physical and chemical properties of the product and application use method for products. Exposure pathways were selected to reflect the anticipated use of each product.

- **Occupational COU Category:** Other use (e.g., Laboratory chemicals; Sheep-branding fluid; Cleaning and furnishing care products)
- **Product:** Pro/pel Cesspool and Septic Tank Cleaner ([Utility Chemicals, 2014](#)), 99% *o*-dichlorobenzene
- **Emission Model:** E4 (emission from product added to water)
- **CEM Scenario:** Drain and toilet cleaners

EPA used the fractional absorbed dermal model for occupational exposure to the fluid. The fractional absorption method was identified as the most appropriate for these products as it calculates finite splash-type exposure, where there is instantaneous deposition onto the skin without deliberate contact with the product, such as application of the fluid. See Section 7.4.1 for more information about the model.

8.2.18.4 Key Parameters for Products Modeled in CEM

All products were assessed using the highest reported weight fraction identified in SDS or other literature that went through EPA's systematic review. For acute exposure, the high-end frequency of use and duration of product use were used, representing the highest exposure within 24 hours. For chronic exposure, the median frequency of use and duration of product use were selected because these values

represent the average exposure within a year. For model input parameters that were not identified, EPA relied upon default values within CEM (either directly or calculated using chemical properties) or used professional judgement define missing inputs for the product. Product density was not identified in the product and thus the CEM default was used.

8.2.18.5 Mass of Product Used, Duration, Frequency of Use and Environmental Parameters

For mass of product used, EPA identified a manuscript describing *o*-dichlorobenzene fate and transport in a domestic septic system that used a commercially available plumbing line cleaner/deodorizer, SAN-O-VAN, containing *o*-, *m*-, and *p*-dichlorobenzene at a ratio of 74:11:15, respectively {Robertson, WD, 1994, 5256137}. In the study, SAN-O-VAN was injected into the household plumbing at the recommended cleansing dose of 450 mL. To convert to grams, the 450 mL was multiplied by the density of *o*-dichlorobenzene of 1.30 g/cm³, which equates to 585 g. EPA acknowledges that the percent of *o*-dichlorobenzene used in this cleaner is 75%, compared to the identified SDS in the risk evaluation at 99% ([Utility Wonder Products, 2014](#)). However, EPA considers mass used to be consistent throughout all of these products. Therefore, EPA used 582 g of the cleaner as the mass and used 0.99 weight fraction in CEM modeling.

EPA did not identify duration of use for toilet or drain cleaners from the EFH. For both acute and chronic duration, EPA used a professional judgement of 5 minutes of use. EPA assumes that the worker will pour the product into a toilet, flush, and the task does not take a significant amount of time. For frequency of use, EPA used an assumption that a worker could use the product 8 times a day for acute exposure, using the product at 8 different homes during a work shift. For chronic exposure, EPA assumed 250 workdays, equal to 2,000 applications per year. EPA also conducted a bounding estimate based on commercial assumptions, where a worker may only use the product once a day, instead of 8 times, with all other inputs constant.

The scenario used to model *o*-dichlorobenzene exposure from the use of septic tank cleaners was a bathroom with a room volume of 15 m³ was based on CEM defaults.

8.2.18.6 Acute, Intermediate, and Chronic Non-Cancer Inhalation Results

This section summarizes the air concentrations from inhalation and dose estimates from dermal exposure to *o*-dichlorobenzene in septic tank cleaners. Exposure via the dermal route occurs from accidental or splashing of the product containing *o*-dichlorobenzene. The *Draft Occupational Risk Calculator for o-Dichlorobenzene* ([U.S. EPA, 2026x](#)) shows the inputs, models, and calculations for both inhalation and dermal exposures. EPA calculated the acute 24-hour TWA and for inhalation exposure and chronic average daily concentration (Table 8-53).

Table 8-53. Septic Tank Cleaner Inhalation Concentrations and Dermal Doses

Scenario	Concentration (mg/m ³) or Dose (mg/kg/day)
Acute Inhalation	29
Chronic Inhalation	20
Acute Dermal	4.96E-02
Chronic Dermal	3.40E-02

8.2.18.7 Occupational Dermal Exposure Results

EPA estimated dermal exposures for this OES using a Monte Carlo simulation with 100,000 iterations. The Agency modeled dermal exposure using a fraction absorbed value of 0.04 for *o*-dichlorobenzene as a liquid and followed the processes discussed in Section 8.1.4 and Appendix M. There are not any reliable dermal absorption studies available for *o*-dichlorobenzene, however based on comparison of all available data it is expected that *o*-dichlorobenzene absorption will be similar to *p*-dichlorobenzene, and so *p*-dichlorobenzene data was used. The fraction absorbed value of 0.04 was obtained from data submitted to satisfy EPA's Order to conduct an in vitro dermal absorption study on *p*-dichlorobenzene. The study indicated that an estimate of 0.04 (or 4%) absorption should apply to all formulations with more than 50% concentration of *p*-dichlorobenzene. For more details on this study, and rationale for its use as a surrogate for *o*-dichlorobenzene, see the *Draft Human Health and Environmental Hazard Assessment for o-Dichlorobenzene* ([U.S. EPA, 2026r](#)). EPA assessed the *o*-dichlorobenzene concentration in other cleaning products as a uniform distribution between 74 and 99% ([Robertson, 1994](#); [Utility Wonder Products, 2014](#)).

Table 8-54 summarizes the APDR, AAD, IAD, and CAD (non-cancer) for *o*-dichlorobenzene in the use of cleaning and furnishing care products. The high-end represent the 95th percentiles of the respective simulation output and the central tendency exposures represent the 50th percentiles. Workers include employees who directly handle cleaning and furnishing care products containing *o*-dichlorobenzene. Dermal exposures for ONUs are expected to be negligible as they do not directly handle the chemical. OES-specific parameters for dermal exposures are described in Appendix M.

Table 8-54. Summary of Dermal Exposure Doses to *o*-Dichlorobenzene for Use of Other Cleaning Products

Modeled Scenario	Exposure Concentration Type	Central Tendency	High-End
Average Adult Worker	Acute potential dose rate (APDR) (mg/day)	23	59
	Acute absorbed dose (AAD) (mg/kg-day)	0.29	0.74
	Intermediate absorbed dose (IAD), non-cancer (mg/kg-day)	0.21	0.54
	Chronic absorbed dose (CAD), non-cancer (mg/kg-day)	0.20	0.50

8.2.18.8 Exposure Controls and PPE

No engineering controls or documented PPE were available from the data.

8.2.19 Sheep Branding Fluid

As listed in Table 4-1, this OES includes the following COU: Paints and coatings – Coatings and paints, thinners, paint removers.

8.2.19.1 Worker Activities

Worker exposures to *o*-dichlorobenzene are primarily expected to occur via the inhalation and dermal routes from use of the product. The worker may have this product in an open container beside them as they apply the product to the sheep, which can cause inhalation exposure. They may also splash some of the product on their skin during use. The magnitude of inhalation exposure depends upon the concentration of *o*-dichlorobenzene in the product, worker activity patterns (including frequency and duration of work) and product application methods.

8.2.19.2 Number of Workers and Occupational Non-Users

EPA used data from BLS and the SUSB specific to the OES to estimate the number of workers and ONUs per site potentially exposed to *o*-dichlorobenzene during use of sheep branding fluid ([U.S. BLS, 2023a](#); [U.S. Census Bureau, 2017](#)). This approach involved first identifying the relevant NAICS codes for the OES. EPA did not identify OES-specific data for the number of sites that use *o*-dichlorobenzene in sheep branding fluid. Therefore, EPA assessed a bounding estimate of 4,758 sites for this OES based on the number of sites listed under the identified NAICS codes. Using a bounding estimate will overestimate the true number of sites that use *o*-dichlorobenzene for this OES. The next step is the identification of relevant SOC codes within the BLS data for the identified NAICS codes, from which total number of workers can be determined. This number is divided by the number of sites identified to obtain the exposed workers per site. Appendix J includes further details regarding methodology for estimating the number of workers and ONUs per site. EPA assigned the following NAICS codes for this OES:

- 112410 – Sheep Farming
- 115210 – Support Activities for Animal Production.

Table 8-55 summarizes the per site estimates for this OES based on the methodology described, including the number of sites identified in Section 4.2.2.

Table 8-55. Estimated Average Number of Workers per Site Potentially Exposed to *o*-Dichlorobenzene During Use of Sheep Branding Fluid

Potential Number of Sites	NAICS Code	Potentially Exposed Workers per Site ^a	Potentially Exposed ONUs per Site ^a
4,758	112410 – Sheep Farming	1	1
	115210 – Support Activities for Animal Production		
^a Number of workers and ONUs per site calculated by dividing the exposed number of workers or ONUs by the number of establishments.			

8.2.19.3 Occupational Inhalation and Dermal Exposure Approach

EPA conducted a quantitative analysis of commercial workers, such as farmers, that use sheep branding fluid containing *o*-dichlorobenzene on a large scale. CEM Version 3.2 ([U.S. EPA, 2023a](#)) was used to evaluate occupational exposure based on the available data for sheep branding fluid containing *o*-dichlorobenzene. Although CEM is intended for consumer uses, occupational exposure can be modeled by adjusting inputs specific for a worker scenario. See Section 7.3 for more information about the CEM model.

The following presents occupational COU information used in the CEM scenario. The model was generated to reflect specific use conditions as well as physical and chemical properties of the fluid. The emissions model was selected based upon physical and chemical properties of the product and application use method for products. Exposure pathways were selected to reflect the anticipated use of each product.

- **Occupational COU Category:** Other use (e.g., Laboratory chemicals; Sheep-branding fluid; Cleaning and furnishing care products)
- **Product:** SI-RO-MARK Sheep Branding Fluid ([Heiniger Australia Pty Ltd, 2016](#)), 30% *o*-dichlorobenzene
- **Emission Model:** E2
- **CEM Scenario:** Generic product E2

Within CEM, the E2 model was selected as it is appropriate for the fluid. The model is applicable for products applied to a surface and dry or cure over time, where there is an initial fast release of the chemical governed by evaporation and a later slower release. Based on the chemical properties of *o*-dichlorobenzene, the model assumes that a certain amount of the applied mass is released because a substantial fraction of the mass becomes trapped in the cured substrate when it dries. Section 7.3.1 also describes the E2 model in more detail.

EPA used the fractional absorbed dermal model for occupational exposure to the fluid. The fractional absorption method was identified as the most appropriate for these products as it calculates finite splash-type exposure, where there is instantaneous deposition onto the skin without deliberate contact with the product, such as application of the fluid. See Section 7.4.1 for more information about the model.

8.2.19.4 Key Parameters for Products Modeled in CEM

All products were assessed using the highest reported weight fraction identified in SDS or other literature that went through EPA's systematic review. For acute exposure, the high-end frequency of use and duration of product use were used, representing the highest exposure within 24 hours. For chronic exposure, the median frequency of use and duration of product use were selected because these values represent the average exposure within a year. For model input parameters that were not identified, EPA relied upon default values within CEM (either directly or calculated using chemical properties) or used professional judgement define missing inputs for the product. Product density was not identified in the product and thus the CEM default was used.

8.2.19.5 Mass of Product Used, Duration, Frequency of Use and Environmental Parameters

EPA did not identify information on the amount of product used and therefore EPA used professional judgement to estimate the amount. The size of the container is 1.06 gallons and EPA assumed that when using the applicator it would not take long for the user to apply the product. EPA identified that 69.5% of farms have 25 or less sheep and would manually use the paint to mark the sheep {Thorne, 2021, 13288946}. For farms with more sheep, EPA assumed that another individual would mark the sheep, or a machine would be used. Therefore, EPA estimated that given the container size of 1.06 gallons, only 100 mL of paint is needed for 25 sheep. This was multiplied by the density of the paint (1.09 g/cm³) to equate to EPA estimated 109 grams per use for both acute and chronic. This would account to around 35 sheep marked per container.

EPA's *Exposure Factors Handbook* ([U.S. EPA, 2011b](#)) was consulted to obtain duration of uses for acute and chronic exposures for commercial use of sheep branding fluid. For acute duration, the 95th percentile of 180 minutes and the 50th percentile for chronic of 10 minutes were used. For frequency of use, EPA used an assumption that a worker would use the product 4 times a day for acute. For chronic, EPA assumed that a worker could use the product once a week for a year, equaling to 52 times in a year.

The use environment was based on the expected room where a given product may be used, and EPA used outside in this scenario. Because the outside environment is essentially infinite, the volume entered into CEM is 1.0×10^{100} .

8.2.19.6 Inhalation and Dermal Exposure Results

This section summarizes the air concentrations from inhalation and dose estimates from dermal exposure to *o*-dichlorobenzene in sheep branding fluid. Exposure via the dermal route occurs from accidental or splashing of the product containing *o*-dichlorobenzene. The *Draft Occupational Risk Calculator for o-Dichlorobenzene* ([U.S. EPA, 2026x](#)) shows the inputs for both inhalation and dermal

exposures.

EPA calculated the acute 24-hour TWA and for inhalation exposure and chronic average daily concentration (Table 8-56). For intermediate inhalation exposure, the 1-hour TWA output was calculated from CEM, which represents a worker applying the product with a continuous 60-minute application time and multiplied by 4 to represent the amount of uses in a month.

EPA measured dermal exposures using the same consumer methods, using fractional absorption for sheep branding fluid. The acute scenario assumes accidental splashing four events a day, with contact area of 10% of the hand. The acute dose was 1.5×10^{-3} mg/kg/day. The chronic dose is 5×10^{-5} mg/kg/day, assuming 52 events/year and 10% hand contact as well.

Table 8-56. Sheep Branding Fluid Inhalation Concentrations and Dermal Doses

Scenario	Concentration (mg/m ³) or Dose (mg/kg/day)
Acute Inhalation	4.0E-03
Intermediate Inhalation	5.4E-04
Chronic Inhalation	9.2E-04
Acute Dermal	1.10E-03
Intermediate Dermal	3.66E-05
Chronic Dermal	3.91E-05

As a comparison, EPA also estimated dermal exposures for this OES using a fractional absorbed approach with a Monte Carlo simulation with 100,000 iterations. The Agency modeled dermal exposure using a fraction absorbed value of 0.02 for *o*-dichlorobenzene as a liquid and followed the processes discussed in Section 8.1.4 and Appendix M. There are not any reliable dermal absorption studies available for *o*-dichlorobenzene, however based on comparison of all available data it is expected that *o*-dichlorobenzene absorption will be similar to *p*-dichlorobenzene, and so *p*-dichlorobenzene data was used. The fraction absorbed value of 0.02 was obtained from data submitted to satisfy EPA's Order to conduct an in vitro dermal absorption study on *p*-dichlorobenzene. The study indicated that an estimate of 0.02 (or 2%) absorption should apply to all formulations with a less than 50% concentration of *p*-dichlorobenzene. For more details on this study, and rationale for its use as a surrogate for *o*-dichlorobenzene, see the *Draft Human Health and Environmental Hazard Assessment for o-Dichlorobenzene* ([U.S. EPA, 2026f](#)). EPA assessed the concentration of *o*-dichlorobenzene in sheep branding fluids as a static value of 14.4% based on a product SDS identified in the Use Report ([U.S. EPA, 2020f](#)).

Table 8-57 summarizes the APDR, AAD, IAD, and CAD (non-cancer) for *o*-dichlorobenzene in the use of sheep branding fluid. The high-end represent the 95th percentiles of the respective simulation output and the central tendency exposure represent the 50th percentiles. Workers include employees who directly handle sheep branding fluid containing *o*-dichlorobenzene. Dermal exposures for ONUs are expected to be negligible as they do not directly handle the chemical. OES-specific parameters for dermal exposures are described in Appendix M.

Table 8-57. Summary of Dermal Exposure Doses to *o*-Dichlorobenzene for Sheep Branding Fluid

Modeled Scenario	Exposure Concentration Type	Central Tendency	High-End
Average Adult Worker	Acute potential dose rate (APDR) (mg/day)	2.5	7.5
	Acute absorbed dose (AAD) (mg/kg-day)	3.2E-02	9.4E-02
	Intermediate absorbed Dose (IAD), non-cancer (mg/kg-day)	2.3E-02	6.9E-02
	Chronic absorbed dose (CAD), non-cancer (mg/kg-day)	2.2E-02	6.4E-02

8.2.19.7 Exposure Controls and PPE

No engineering controls or documented PPE were found for this OES.

8.2.20 Disposal

As listed in Table 4-1, this OES includes the following COU: Disposal.

8.2.20.1 Worker Activities

EPA was unable to identify process specific information for worker exposure to *o*-dichlorobenzene. Because of their similarities in chemical properties and expected applications, EPA used surrogate processing exposure data from the occupational exposure assessment for *p*-dichlorobenzene to assess worker exposures for this OES ([U.S. EPA, 2026e](#)). For disposal of *p*-dichlorobenzene, EPA was provided with inhalation monitoring data from Westlake Corporation for two SEGs: waste treatment operators, classified as workers, and waste treatment supervisors, classified as ONUs. Activities associated with each SEG that may result in exposures are provided below:

- Workers – Inhalation of vapors and dermal contact with liquids during container unloading, container cleaning, and equipment cleaning
- ONUs – Inhalation of vapors while in an area where the chemical is present.

ONUs do not directly handle the chemical and are therefore expected to have lower inhalation exposures than workers that engage in tasks related to the handling or treatment of waste containing *p*-dichlorobenzene, and no dermal exposures through contact with liquids.

See Section 4.3.21.1 for a full disposal process description.

8.2.20.2 Number of Workers and Occupational Non-Users

EPA used data from BLS and the SUSB specific to the OES to estimate the number of workers and ONUs per site potentially exposed to *o*-dichlorobenzene during disposal ([U.S. BLS, 2023a](#); [U.S. Census Bureau, 2017](#)). This approach involved first identifying the relevant NAICS codes for the OES. The next step is the identification of relevant SOC codes within the BLS data for the identified NAICS codes, from which total number of workers can be determined. This number is divided by the number of sites identified to obtain the exposed workers per site. Appendix J includes further details regarding methodology for estimating the number of workers and ONUs per site. EPA assigned the following NAICS codes for this OES:

- 562211 – Hazardous Waste Treatment and Disposal
- 562212 – Solid Waste Landfill
- 562213 – Solid Waste Combustors and Incinerators
- 562219 – Other Nonhazardous Waste Treatment and Disposal
- 562920 – Materials Recovery Facilities.

Table 8-58 summarizes the per site estimates for this OES based on the methodology described,

including the number of sites identified in Section 4.2.2.

Table 8-58. Estimated Average Number of Workers per Site Potentially Exposed to *o*-Dichlorobenzene During Disposal

Potential Number of Sites	NAICS Code	Potentially Exposed Workers per Site ^a	Potentially Exposed ONUs per Site ^a
35	562211 – Hazardous Waste Treatment and Disposal	2	5
	562212 – Solid Waste Landfill		
	562213 – Solid Waste Combustors and Incinerators		
	562219 – Other Nonhazardous Waste Treatment and Disposal		
	562920 – Materials Recovery Facilities		

^a Number of workers and ONUs per site calculated by dividing the exposed number of workers or ONUs by the number of establishments.

8.2.20.3 Occupational Inhalation Exposure Results

EPA used surrogate exposure data from the occupational exposure assessment for *p*-dichlorobenzene to assess worker exposures for this OES ([U.S. EPA, 2026f](#)). *p*-Dichlorobenzene was chosen as the most suitable surrogate for *o*-dichlorobenzene in this case due to the close similarities of the molecular weights (both 147 g per mol) and vapor pressures (1.36 torr for *o*-dichlorobenzene and 1.3 torr for *p*-dichlorobenzene). For disposal of *p*-dichlorobenzene, EPA was provided with inhalation monitoring data from Westlake Corporation for waste treatment operators and waste treatment supervisors. EPA identified 13 worker full-shift PBZ samples (durations 386–683 minutes) and 6 ONU occupational full-shift PBZ samples (durations 463–510 minutes and 492–580 minutes for 8- and 12-hour TWAs, respectively) from the Westlake dataset to estimate inhalation exposures for this OES. The samples were collected from waste treatment operators (workers) and waste treatment supervisors (ONUs) and were all below the LOD (the LOD concentrations corrected to account for *o*-dichlorobenzene's differing vapor pressure ranged from 0.023–0.042 ppm). The Westlake data also included 3 task-based samples for workers that were all below the LOD (corrected for *o*-dichlorobenzene the LODs ranged 0.14–1.6 ppm) with durations between 10 to 120 minutes.

From this monitoring data, EPA calculated the 50th and 95th percentile 12-hour TWA concentrations to represent a central tendency and high-end estimate of potential occupational inhalation exposures, respectively, for this scenario. These values were then corrected based on differences in vapor pressure ([CEB, 1991](#)). Using these 12-hour TWA exposure concentrations, EPA calculated the AC, IADC, and ADC as described in Appendix K. The results of these calculations are shown in Table 8-59.

Table 8-59. 8- and 12-Hour Duration of Inhalation Exposures to *o*-Dichlorobenzene During Disposal Based on the Westlake Corporation Test Order Data

SEG	Exposure Concentration Type	Worker Inhalation Estimates (ppm)	
		Central Tendency	High-End
Average Adult Worker – 12-hour TWA	12-Hour TWA exposure concentrations	1.1E–02	2.3E–02
	Acute exposure concentrations (AC) based on 12-hour TWA	1.2E–02	2.3E–02
	Intermediate average daily concentration (IADC) based on 12-hour TWA	3.8E–04	7.7E–04
	Average daily concentration (ADC) based on 12-hour TWA	5.3E–03	1.1E–02
ONU – 8-hour TWA	8-Hour TWA exposure concentrations	1.7E–02	3.2E–02
	Acute exposure concentrations (AC) based on 8-hour TWA	1.1E–02	2.2E–02
	Intermediate average daily concentration (IADC) based on 8-hour TWA	3.8E–04	7.4E–04
	Average daily concentration (ADC) based on 8-hour TWA	7.8E–03	1.5E–02
ONU – 12-hour TWA	12-Hour TWA exposure concentrations	1.1E–02	2.2E–02
	Acute exposure concentrations (AC) based on 12-hour TWA	1.1E–02	2.3E–02
	Intermediate average daily concentration (IADC) based on 12-hour TWA	5.5E–03	1.1E–02
	Average daily concentration (ADC) based on 12-hour TWA	5.2E–03	1.0E–02

8.2.20.4 Occupational Dermal Exposure Results

EPA estimated dermal exposures for this OES using a Monte Carlo simulation with 100,000 iterations. The Agency modeled dermal exposure using a fraction absorbed value of 0.02 for *o*-dichlorobenzene as a liquid and followed the processes discussed in Section 8.1.4 and Appendix M. There are not any reliable dermal absorption studies available for *o*-dichlorobenzene, however based on comparison of all available data it is expected that *o*-dichlorobenzene absorption will be similar to *p*-dichlorobenzene, and so *p*-dichlorobenzene data was used. The fraction absorbed value of 0.02 was obtained from data submitted to satisfy EPA’s Order to conduct an in vitro dermal absorption study on *p*-dichlorobenzene. The study indicated that an estimate of 0.02 (or 2%) absorption should apply to all formulations with a less than 50% concentration of *p*-dichlorobenzene. For more details on this study, and rationale for its use as a surrogate for *o*-dichlorobenzene, see the *Draft Human Health and Environmental Hazard Assessment for o-Dichlorobenzene* ([U.S. EPA, 2026r](#)). EPA assessed the concentration of *o*-dichlorobenzene as a uniform distribution with a minimum of 4% and a maximum of 6.4% based on literature identified during systematic review ([Midwest Research Institute, 1984](#)).

Table 8-60 summarizes the APDR, AAD, IAD, and CAD (non-cancer) for *o*-dichlorobenzene during disposal. The high-end represents the 95th percentiles of the respective simulation output and the central tendency exposure represent the 50th percentiles. The SEGs included in the “Average Adult Worker” category include waste treatment operators. These SEGs were grouped for the purposes of modeling as they are expected to have similar risks of dermal exposure. Dermal exposures for ONUs are expected to be negligible as they do not directly handle the chemical. OES-specific parameters for dermal exposures are described in Appendix M.

Table 8-60. Summary of Dermal Exposure Doses to *o*-Dichlorobenzene for Disposal

Modeled Scenario	Exposure Concentration Type	Central Tendency	High-End
Average Adult Worker	Acute potential dose rate (APDR) (mg/day)	0.70	1.8
	Acute absorbed dose (AAD) (mg/kg-day)	8.7E-03	2.2E-02
	Intermediate absorbed dose (IAD), non-cancer (mg/kg-day)	5.1E-03	1.4E-02
	Chronic absorbed dose (CAD), non-cancer (mg/kg-day)	4.8E-03	1.3E-02

8.2.20.5 Exposure Controls and PPE

Westlake Corporation documented waste treatment operators wearing dermal PPE such as nitrile gloves, glasses, face shields, boots, aprons, and fire-retardant clothing. There was no information provided indicating that waste treatment operators use respiratory protection. The work area had general ventilation present as an engineering control. Most ONUs wore glasses and boots as dermal PPE, and one ONU was documented to wear nitrile gloves and fire-retardant clothing during their shift. EPA did not identify data indicating whether similar PPE would be worn for *o*-dichlorobenzene disposal.

8.3 Weight of Scientific Evidence Conclusions for Occupational Exposures

For each OES, EPA considered the assessment approach, the quality of the data and models; and the strengths, limitations, assumptions, and key sources of uncertainties in the assessment results to determine a weight of scientific evidence (WOSE) rating. EPA also considered factors that increase or decrease the strength of the evidence supporting the release estimate (*e.g.*, quality of the data/information), the applicability of the release data to the OES (*e.g.*, temporal relevance, locational relevance) and the representativeness of the estimate for the whole industry. The Agency used the descriptors of robust, moderate, slight, or indeterminant to categorize the available scientific evidence using its best professional judgment, according to EPA's *Application of Systematic Review in TSCA Risk Evaluations* ([U.S. EPA, 2021a](#)). For example, EPA used moderate to categorize measured data from a limited number of sources such that there is a limited number of data points that may not cover most or all the sites within the OES. EPA used slight to describe limited information that does not sufficiently cover all sites within the OES, and for which the assumptions and uncertainties are not fully known or documented. See EPA's *Application of Systematic Review in TSCA Risk Evaluations* ([U.S. EPA, 2021a](#)) for additional information on weight of scientific evidence conclusions.

WOSE ratings for the occupational exposure estimates for each OES, including details on the basis EPA used to determine the rating, are provided in the sections and tables that follow.

EPA estimated occupational exposure using several sources of monitoring data; however, the sources used the most in this assessment were inhalation exposure monitoring studies submitted to EPA by Westlake Corporation, the American Chemistry Council, and the Vinyl Institute in response to Test Orders for *o*-dichlorobenzene, *p*-dichlorobenzene, and 1,1,2-trichloroethane ([SABIC, 2024](#); [Exponent Inc., 2024](#); [ACC, 2023](#); [Labcorp Early Development Laboratories, 2023](#)). These data sources were determined to have overall data quality ratings of high through EPA's systematic review process. Other studies used had data quality ratings of high or medium. Other sources of worker exposure data included OSHA CEHD data, which has a data quality rating of medium, and literature sources, which have data quality ratings of medium-to-high.

Number of Workers

There are several uncertainties surrounding the estimated number of workers potentially exposed to *o*-dichlorobenzene, as outlined below. Most are unlikely to result in a systematic underestimate or

overestimate but could result in an inaccurate estimate.

CDR data are used to estimate the number of workers associated with manufacturing. The data identified by EPA indicates that *o*-dichlorobenzene is only manufactured in the United States as a byproduct of VCM production, so EPA assessed the number of workers using VCM manufacturers that reported to CDR in 2020 ([U.S. EPA, 2020e](#)). To calculate the of workers and ONUs, EPA used a per-site average based on all VCM manufacturers that reported to CDR in 2020. There are inherent limitations to the use of CDR data as they are reported by manufacturers. Manufacturers are only required to report if they manufactured or imported VCM in excess of 25,000 lb at a single site during any calendar year; as such, CDR may not capture all sites and workers associated with any given chemical.

There are also uncertainties with BLS data, which are used to estimate the number of workers for the remaining conditions of use. First, BLS' Occupational Employment Statistics employment data for each industry/occupation combination are only available at the 3-, 4-, or 5-digit NAICS level, rather than the full 6-digit NAICS level. This lack of granularity could result in an overestimate of the number of exposed workers if some 6-digit NAICS are included in the less granular BLS estimates but are not likely to use *o*-dichlorobenzene for the assessed applications. EPA addressed this issue by refining the OES estimates using total employment data from the U.S. Census' SUSB. However, this approach assumes that the distribution of occupation types (SOC codes) in each 6-digit NAICS is equal to the distribution of occupation types at the parent 5-digit NAICS level. If the distribution of workers in occupations with *o*-dichlorobenzene exposure differs from the overall distribution of workers in each NAICS, then this approach will result in inaccuracy.

Second, EPA's judgments about which industries (represented by NAICS codes) and occupations (represented by SOC codes) are associated with the uses assessed in this report are based on the Agency's understanding of how *o*-dichlorobenzene is used in each industry. Designations of which industries and occupations have potential exposures is nevertheless subjective, and some industries/occupations with few exposures might erroneously be included, or some industries/occupations with exposures might erroneously be excluded. This would result in inaccuracy but would be unlikely to systematically either overestimate or underestimate the number of exposed workers.

Finally, EPA didn't identify OES-specific data for the number of sites for any OES except manufacturing. Here, EPA assessed bounding estimates for the number of sites based on the number of sites listed under the identified NAICS codes. Using a bounding estimate will overestimate the true number of sites that use *o*-dichlorobenzene for these OESs.

Analysis of Exposure Monitoring Data

For some of the OESs, *o*-dichlorobenzene test order monitoring data were used to estimate inhalation exposures. The primary strength of these data is the use of personal and directly applicable data, and the number of samples available for workers and ONUs. The primary limitation is that EPA assumed either 167 or 250 exposure days per year based on shift length and provided worker schedules; it is uncertain whether this captures actual worker schedules and exposures. In some cases, there is also uncertainty in the representativeness of the data. Where few data are available, the assessed exposure levels may not be representative of worker exposure across the entire job category or industry. Differences in work practices and engineering controls across sites can introduce variability and limit the representativeness of monitoring data.

For some OES, a subset of test order monitoring data was used as surrogate. For example, any data from the three test orders pertaining to loading or unloading of *o*-dichlorobenzene was compiled to assess the Repackaging and Functional fluids (closed system) OESs. For Plastics converting, surrogate data from the Plastics compounding OES was used. For four OESs, test order data from *p*-dichlorobenzene were used as surrogate. For one OES, test order data from 1,1,2-trichloroethane were used as surrogate (see Section 8.1.3.2.1). The principal limitation of the surrogate test order data is the uncertainty in the representativeness of the data. There is additional uncertainty in the factors and equation used to correct the data based on the differences in chemical concentration and physical chemical properties between *p*-dichlorobenzene and *o*-dichlorobenzene.

The CEB Manual ([CEB, 1991](#)) presents the following assumptions for the surrogate equation to be valid:

1. Vapor generation is driven by either evaporation from an open surface or the displacement of saturated vapors from a container.
2. The liquid temperature and mass transfer coefficients of the chemical of interest and surrogate chemical are similar.
3. The workplace environments are similar (*i.e.*, surface area of liquid pool, length of liquid-to-air interface, ventilation rates, mixing factors, air speeds, vapor saturation factors, container volumes, container loading rates, chemical throughputs, and ambient conditions are similar).
4. Raoult's Law is valid.

Dermal Loading and Absorption

Dermal loading is uncertain as it can vary across not only COUs and OESs, but also SEGs and even individual workers. EPA has not identified reasonably available information providing data on dermal loading. Therefore, the Agency has accounted for the variability and uncertainty in this estimate for workers by incorporating a wide range of skin surface area variability into the Monte Carlo model. The modeling estimate assumes an even distribution of skin surface exposed ranging from a surface area of 0 cm² to 1,070 cm², the upper bound of which is equivalent to the surface area of two full hands but also accounts for exposure to arms or other body regions. EPA believes that the Monte Carlo model captures the full range of potential surface area exposures for workers.

For dermal absorption, EPA primarily used data from a test order on the isomer *p*-dichlorobenzene that measured fractional absorption over a range of scenarios covering durations up to a full workday, at various concentrations (including as neat solid), and in two different solvents ([Charles River Laboratories, 2025](#)). Despite the range of scenarios tested, the data cannot account for all the variability that would be expected across workers performing different tasks and in different environments. Day-to-day variability may also impact absorption through factors such as the amount of sweat and how many times hands were washed (*e.g.*, such as from bathroom visits). The test order was unable to account for handwashing and was an *in vitro* system, however it did use human skin and simulated unoccluded exposure. Absorption estimates were pretty narrow, ranging from 2 to 4% for neat *p*-dichlorobenzene and 1 to 2% for *p*-dichlorobenzene in solution at 50% or lower concentration (solubility was limited above 40–50%). For simplifying the number of scenarios to consider and in order to be health-protective, EPA applied 4% fractional absorption for any formulation greater than 50% concentration and 2% for any solution less than 50% concentration.

Uncertainty remains for whether high-concentration solutions would absorb differently, and the use of read-across data adds additional uncertainty. Despite these uncertainties, EPA's approach represents the best available science considering the available data. In considering read-across to *p*-dichlorobenzene (1,4-dichlorobenzene), which is solid in neat form but otherwise has very similar physical-chemical

properties, the available data suggests that absorption is probably similar in both isomers. The K_p for *p*-dichlorobenzene from (U.S. EPA, 2004b) is 4.2×10^{-2} cm/h, almost identical to the estimate for *o*-dichlorobenzene (4.2×10^{-2}). Fractional absorption data from the test order (Charles River Laboratories, 2025) showed fractional absorption ranging from 1 to 2% for *p*-dichlorobenzene dissolved in an organic solvent and 2 to 4% for neat *p*-dichlorobenzene, comparable to the 2.4% calculated from a pig skin study conducted on a liquid form of dichlorobenzene (either *o*-, *m*-, or a mixture of isomers, (Riviere et al., 2000)). This further supports the validity of read-across to *p*-dichlorobenzene for use in risk assessment.

For Use of Solid Air Care Products, EPA determined that a permeability approach was most appropriate because exposure was based on contact with a large supply of *o*-dichlorobenzene in the form of a solid block that did not result in a measurable amount deposited on the skin. For this scenario, EPA used the K_p value for *p*-dichlorobenzene from (CPA, 2005). This study used “infinite” loading (meaning more solution was applied than could ever be absorbed for the duration of the experiment) of *p*-dichlorobenzene as a 10% concentration in solution, in an occluded setup to minimize the effect of volatility. Under these conditions, absorption rate was fastest over 10 minutes compared to both 1 hour and steady-state absorption over a full day. Since exposure to solid air care products occurs over the course of minutes, the 10-min K_p value of 3.75×10^{-4} cm/h was applied to apply the most relevant experimental value. There is remaining uncertainty however because data was not reasonably available for quantifying permeability from solid *o*-dichlorobenzene, which may have a slower lag time considering it must migrate both out of the product and into the skin.

An overview of each exposure determinant for determining the appropriateness of the using surrogate vapor monitoring data is presented in Table 8-61 below.

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Table 8-61. Summary of Exposure Determinants for Using Surrogate Vapor Monitoring Data

Exposure Determinant	Description of Exposure Determinant	Reason for Validity Between Surrogate Chemicals and <i>o</i> -Dichlorobenzene
Exposure source/ chemical processes	The source/process that generates the vapors. Different sources/processes may result in different vapor generation rates.	For each OES, EPA assumes the same or similar conditions of use with similar chemical throughputs, and thus similar exposure sources.
Mass transfer coefficient (K)	Parameter that relates the transfer rate, transfer area, and concentration change of the chemical. Can be experimentally or theoretically estimated. Theoretical estimates rely on the air speed (u), liquid temperature (T_{liquid}), MW, length of the air-liquid interface (D) and ambient air conditions (T and P).	<i>p</i> -Dichlorobenzene has the same MW as <i>o</i> -dichlorobenzene, and 1,1,2-trichloroethane has a similar MW to <i>o</i> -dichlorobenzene. All chemicals are used in similar work environments (<i>e.g.</i> , indoor vs. outdoor conditions and similar process equipment/ conditions).
Liquid temperature (T_{liquid})	Parameter that affects the vapor generation from displacement during container filling.	Chemicals/mixtures are expected to be the same physical state for each OES where surrogate data is used. <i>p</i> -Dichlorobenzene is a solid at room temperature and is manufactured at a higher temperature in order for it to be in liquid form. 1,1,2-trichloroethane is also a liquid at room temperature. EPA assumes that <i>o</i> -dichlorobenzene is also manufactured at this higher temperature since the Agency assumes that both chemicals are manufactured as biproducts of the same process.
Surface area of the open surface (A) and length of the air-liquid interface (D)	Parameters that describe the area of the liquid pool from which evaporation occurs.	Chemicals/mixtures expected to be used in similar container sizes or containers with similar opening sizes.
Ventilation rate (Q), mixing factor (k), and air speed (u)	Parameters the described the movement of air throughout the exposure area.	Processes for each chemical/mixture occur in similar work environments (<i>e.g.</i> , indoor vs. outdoor) and handled under similar local exhaust ventilation (LEV), if any.
Vapor saturation factor (F_{sat})	Parameter related to the saturation of displaced vapors from a container. Primarily a function of the loading process.	Chemicals/mixtures loaded/unloaded using similar processes (<i>e.g.</i> , bottom loading vs. splash loading) and with similar controls.
Volume of the container (V_{cont}) and container loading rate (r)	Parameters related to the size of the containers and the rate at which those containers are unloaded.	Chemicals/mixtures are expected to be transported using similar containers.
Ambient temperature (T) and pressure (P)	Ambient air conditions of the exposure area.	Processes for each chemical/mixture occur in similar work environments (<i>e.g.</i> , indoor vs. outdoor).
Type of mixtures	The type of mixture containing the surrogate chemical and chemical of interest determine how close to ideality the mixtures behave.	Mixture properties are expected to be similar for each OES assessed.

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7626 Finally, OSHA CEHD data was used to assess inhalation exposures. One limitation is that OSHA CEHD
7627 data does not include worker descriptions. EPA assessed the standard Average Adult Worker and ONU
7628 categories and assumed that worker central tendency exposure was representative of ONU exposure and
7629 used to generate estimates for ONUs.

7630
7631 For both inhalation and dermal, Table 8-62 summarizes the assessment method and weight of scientific
7632 evidence ratings for each occupational exposure scenario. Table 8-62 also summarizes EPA's overall
7633 confidence in the inhalation exposure estimates for each OES.

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Table 8-62. Summary of Assumptions, Uncertainty, and Overall Confidence in Occupational Inhalation Exposure Estimates by OES

OES	Weight of Scientific Evidence Conclusion in Occupational Inhalation Exposure Estimates
Manufacturing	For this OES, EPA did not identify inhalation exposure monitoring data. Based on available data, EPA uses surrogate data from a <i>p</i>-dichlorobenzene Test Order submission from Westlake Corporation (Exponent Inc., 2024). EPA considered the assessment approach, the quality of the data, and uncertainties in assessment results to determine a weight of scientific evidence conclusion for the 8- and 12-hour TWA inhalation exposure estimates for the Manufacturing OES. The primary strength is the consideration of personal breathing zone (PBZ) monitoring data, which are preferable to other information sources such as modeling or the use of OELs, as well as the presence of samples taken across a variety of SEGs and sampling periods. <i>p</i>-Dichlorobenzene and <i>o</i>-dichlorobenzene have the same molecular weights and similar vapor pressures (1.74 mm Hg vs. 1.36 mmHg for <i>o</i>-dichlorobenzene), and both <i>p</i>-dichlorobenzene and <i>o</i>-dichlorobenzene are manufactured in the United States as byproducts (both indicated as being present in the process from which this monitoring data originates), adding to the confidence that <i>p</i>-dichlorobenzene is an appropriate surrogate. The data source has a high data quality rating from the systematic review process. Another strength is that the data was submitted as response to a test order issued by EPA specifically designed to be fit-for-purpose for TSCA risk evaluations. The data included 77 full-shift personal air samples and 12 occupational task-based personal air samples. Of the full-shift samples taken, 32 samples were classified as 8-hour TWAs while the remaining 45 samples were classified as 12-hour TWAs. The primary limitation of this assessment is that it is based on data from a different chemical, which will cause inherent uncertainties due to differences in the chemical properties and possibly handling. Based on these strengths and limitations, EPA has concluded that the weight of scientific evidence for this assessment is moderate.
Repackaging	For this OES, EPA used inhalation monitoring data provided via a Test Order submission from Sabic (SABIC, 2024). EPA considered the assessment approach, the quality of the data, and uncertainties in assessment results to determine a weight of scientific evidence conclusion for the 8-hour TWA inhalation exposure estimates for the Repackaging OES. The primary strength is the use of PBZ and monitoring data directly applicable to the tasks that are expected to occur during this OES, which are preferable to other assessment approaches such as modeling or the use of OELs, as well as the presence of samples taken across a variety of SEGs and sampling periods. EPA used PBZ air concentration data to assess inhalation exposures with the data source having a high data quality rating from the systematic review process. Another strength is that the data was submitted as response to a test order issued by EPA specifically designed to be fit-for-purpose for TSCA risk evaluations. The data included 28 full-shift personal air samples and 2 occupational task-based personal air samples. Of these, 15 full-shift samples were deemed by EPA to be relevant for repackaging (<i>i.e.</i>, related to unloading/loading activities) and included under this OES. The primary limitation of the data is that it isn't from dedicated repackaging sites. Rather, the data is from workers performing tasks similar to those EPA expects to take place at repackaging sites, such as connecting and disconnecting transfer hoses from containers. EPA expects that the exposures are representative of those at repackaging sites. Finally, EPA assumed 250 exposure days/year for 8-hour shifts based on a typical worker schedule; it is uncertain whether this captures actual worker schedules and

OES	Weight of Scientific Evidence Conclusion in Occupational Inhalation Exposure Estimates
	exposures. Based on these strengths and limitations, EPA has concluded that the weight of scientific evidence for this assessment is robust.
Processing as a Reactant	For this OES, EPA did not identify inhalation exposure monitoring data. Based on available data, EPA uses surrogate data from a <i>p</i>-dichlorobenzene Test Order submission from the ACC Consortium (ACC, 2023). One SEG, Laboratory Technician, uses the <i>p</i>-dichlorobenzene dataset as well as a 1,1,2-trichloroethane Test Order submission from the Vinyl Institute (Labcorp Early Development Laboratories, 2023). EPA considered the assessment approach, the quality of the data, and uncertainties in assessment results to determine a weight of scientific evidence conclusion for the 12-hour TWA inhalation exposure estimates for the Processing as a reactant OES. The primary strength is the use of PBZ monitoring data, which are preferable to other assessment approaches such as modeling or the use of OELs, as well as the presence of samples taken across a variety of SEGs and sites. The data source has a high data quality rating from the systematic review process. <i>p</i>-Dichlorobenzene and <i>o</i>-dichlorobenzene also have the same molecular weights and similar vapor pressures (1.74 mm Hg vs. 1.36 mmHg for <i>o</i>-dichlorobenzene), adding to the confidence that <i>p</i>-dichlorobenzene is an appropriate surrogate. 1,1,2-Trichloroethane and <i>o</i>-dichlorobenzene also have similar molecular weights (133.4 g/mol vs. 147 g/mol for <i>o</i>-dichlorobenzene), adding to the confidence that it is an appropriate surrogate. Another strength is that the data was submitted as response to a test order issued by EPA specifically designed to be fit-for-purpose for TSCA risk evaluations. The <i>p</i>-dichlorobenzene data included 53 full-shift personal air samples and 31 occupational task-based personal air samples. For 1,1,2-trichloroethane, the data included 29 full-shift personal air samples and 23 occupational task-based personal air samples. The primary limitation of this assessment is that it is based on data from a different chemical, which will cause inherent uncertainties due to differences in the chemical properties and possibly handling. Finally, EPA assumed 200 exposure days/year for 12-hour shifts based on information provided from ACC, and for other data that did not have industry-specific exposure days per year, EPA used the defaults of 250 days for 8-hour shifts, and 167 days for 12-hour shifts; it is uncertain whether this captures actual worker schedules and exposures. Based on these strengths and limitations, EPA has concluded that the weight of scientific evidence for this assessment is moderate.
Incorporation into Soap, Cleaning Compound, and Toilet Preparation Manufacturing	For this OES, EPA used inhalation monitoring data from OSHA's CEHD (OSHA, 2019). EPA considered the assessment approach, the quality of the data, and uncertainties in assessment results to determine a weight of scientific evidence conclusion for the 8-hour TWA inhalation exposure estimates for the Incorporation into soap, cleaning compound, and toilet preparation manufacturing OES. The primary strength is the use of PBZ and directly applicable monitoring data, which are preferable to other assessment approaches such as modeling or the use of OELs. EPA used PBZ air concentration data to assess inhalation exposures with the data having a high data quality rating from the systematic review process. The data included 5 full-shift (8-hour TWA) personal air samples. A primary limitation of these data include uncertainty in the representativeness of the monitoring data in capturing the true distribution of inhalation concentrations for this OES, since the dataset is only comprised of five samples. Additionally, 1 use site is represented by the data which may not represent the overall industry. The samples were taken in 1994 and may not be reflective of current

OES	Weight of Scientific Evidence Conclusion in Occupational Inhalation Exposure Estimates
	operations. Finally, EPA assumed 8 exposure hours per day and 250 exposure days per year based on continuous exposure during each working day for a typical worker schedule; it is uncertain whether this captures actual worker schedules and exposures. Based on these strengths and limitations, EPA has concluded that the weight of scientific evidence for this assessment is moderate.
Incorporation into Formulation, Mixture, or Reaction Product	For this OES, EPA used inhalation monitoring data from 2 sources identified during the systematic review process (IARC, 1999; Dow Chemical, 1984). EPA considered the assessment approach, the quality of the data, and uncertainties in assessment results to determine a weight of scientific evidence conclusion for the 8-hour TWA inhalation exposure estimates for the Incorporation into formulation, mixture, or reaction product OES. The primary strength is the use of PBZ and directly applicable monitoring data, which are preferable to other assessment approaches such as modeling or the use of OELs. EPA used PBZ air concentration data to assess inhalation exposures with the data having high and medium data quality ratings from the systematic review process. The data included 12 full-shift (8-hour TWA) personal air samples. A primary limitation of these data include uncertainty in the representativeness of the monitoring data in capturing the true distribution of inhalation concentrations for this OES, since only 2 use sites are represented by the data. The samples were taken in 1984 and 1999 and may not be reflective of current operations. Next, the Dow Chemical report is a microfiche scan of the original document and the raw data presented is illegible, so only the endpoints of the ranges provided in another section are used. Similarly, the source identified in the IARC Monograph also only presented the endpoints of the dataset. Finally, EPA assumed 8 exposure hours per day and 250 exposure days per year based on continuous exposure during each working day for a typical worker schedule; it is uncertain whether this captures actual worker schedules and exposures. Based on these strengths and limitations, EPA has concluded that the weight of scientific evidence for this assessment is slight-to-moderate.
Plastics Compounding	For this OES, EPA did not identify inhalation exposure monitoring data. Based on available data, EPA uses surrogate data from a <i>p</i>-dichlorobenzene Test Order submission from the ACC Consortium (ACC, 2023). EPA considered the assessment approach, the quality of the data, and uncertainties in assessment results to determine a weight of scientific evidence conclusion for the 12-hour TWA inhalation exposure estimates for the Plastics compounding OES. The primary strength is the use of PBZ monitoring data, which are preferable to other assessment approaches such as modeling or the use of OELs. The data source has a high data quality rating from the systematic review process. <i>p</i>-Dichlorobenzene and <i>o</i>-dichlorobenzene also have the same molecular weights and similar vapor pressures (1.74 mm Hg vs. 1.36 mmHg for <i>o</i>-dichlorobenzene), adding to the confidence that <i>p</i>-dichlorobenzene is an appropriate surrogate. Another strength is that the data was submitted as response to a test order issued by EPA specifically designed to be fit-for-purpose for TSCA risk evaluations. The data included 29 full-shift (12-hour TWA) personal air samples. The primary limitation of this assessment is that it is based on data from a different chemical, which will cause inherent uncertainties

OES	Weight of Scientific Evidence Conclusion in Occupational Inhalation Exposure Estimates
	due to differences in the chemical properties and possibly handling. Next, all collected samples reported non-detects, so EPA assessed the LOD and half of the LOD as the high-end and central tendency TWA exposure concentrations, respectively. Finally, EPA assumed 200 exposure days/year for 12-hour shifts based on information provided from ACC; it is uncertain whether this captures actual worker schedules and exposures. Based on these strengths and limitations, EPA has concluded that the weight of scientific evidence for this assessment is slight-to-moderate.
Plastics Converting	For this OES, EPA did not identify inhalation exposure monitoring data. Due to expected similarities in process descriptions, the Agency used analogous surrogate monitoring data from the Plastics compounding OES. EPA considered the assessment approach, the quality of the data, and uncertainties in assessment results to determine a weight of scientific evidence conclusion for the 12-hour TWA inhalation exposure estimates for the Plastics converting OES. The primary strength is the use of PBZ monitoring data, which are preferable to other assessment approaches such as modeling or the use of OELs. The data source has a high data quality rating from the systematic review process. <i>p</i>-Dichlorobenzene and <i>o</i>-dichlorobenzene also have the same molecular weights and similar vapor pressures (1.74 mm Hg vs. 1.36 mmHg for <i>o</i>-dichlorobenzene), adding to the confidence that <i>p</i>-dichlorobenzene is an appropriate surrogate. The data included 29 full-shift (12-hour TWA) personal air samples. The primary limitation of this assessment is that it is based on data from a different chemical, and different occupational exposure scenario, which will cause inherent uncertainties due to differences in the chemical properties and possibly handling. Next, all collected samples reported non-detects, so EPA assessed the LOD and half of the LOD as the high-end and central tendency TWA exposure concentrations, respectively. Finally, EPA assumed 200 exposure days/year for 12-hour shifts based on information provided from ACC; it is uncertain whether this captures actual worker schedules and exposures. Based on these strengths and limitations, EPA has concluded that the weight of scientific evidence for this assessment is slight-to-moderate.
Functional Fluids (Closed System)	For this OES, EPA did not identify relevant inhalation monitoring data. Due to expected similarities in worker activities, the Agency used analogous monitoring data from the Repackaging OES. EPA considered the assessment approach, the quality of the data, and uncertainties in assessment results to determine a weight of scientific evidence conclusion for 8-hour TWA inhalation exposure estimates for the Functional fluids (closed system) OES. The primary strength is the use of PBZ monitoring data, which are preferable to other assessment approaches such as modeling or the use of OELs, as well as the similarity in worker activities between the analogous data and this OES. EPA used PBZ air concentration data to assess inhalation exposures with the data source having a high data quality rating from the systematic review process. The analogous data included 15 full-shift samples and 2 task-based samples that were deemed to be relevant and were included in this OES.

OES	Weight of Scientific Evidence Conclusion in Occupational Inhalation Exposure Estimates
	The primary limitation of the data is that it isn't from dedicated sites that use functional fluids. Rather, the data is from workers performing tasks similar to those EPA expects to take place at such sites, such as connecting and disconnecting hoses. EPA expects that the exposures are representative of those at sites that use functional fluids. Finally, EPA assumed between 6–12 exposure days/year representing biannual to monthly fluid changeouts; it is uncertain whether this captures actual worker schedules and exposures. Based on these strengths and limitations, EPA has concluded that the weight of scientific evidence for this assessment is moderate-to-robust.
Industrial Use of Solvents	For this OES, EPA used inhalation monitoring data provided via a Test Order submission from Sabic (SABIC, 2024). EPA considered the assessment approach, the quality of the data, and uncertainties in assessment results to determine a weight of scientific evidence conclusion for the 8-hour TWA inhalation exposure estimates for the Industrial use of solvents OES. The primary strength is the use of PBZ and directly applicable monitoring data, which are preferable to other assessment approaches such as modeling or the use of OELs, as well as the presence of samples taken across a variety of SEGs and sampling periods. EPA used PBZ air concentration data to assess inhalation exposures with the data source having a high data quality rating from the systematic review process. Another strength is that the data was submitted as response to a test order issued by EPA specifically designed to be fit-for-purpose for TSCA risk evaluations. The data included 28 full-shift personal air samples and 2 occupational task-based personal air samples. The primary limitation of the data is that it is from a single site that uses <i>o</i>-dichlorobenzene in industrial solvents and may not be representative of all current sites. Finally, EPA assumed 250 exposure days/year for 8-hour shifts based on a typical worker schedule; it is uncertain whether this captures actual worker schedules and exposures. Based on these strengths and limitations, EPA has concluded that the weight of scientific evidence for this assessment is robust.
Use of Ink, Toner, and Colorant Products	For this OES, EPA used inhalation monitoring data from OSHA's CEHD (OSHA, 2019). EPA considered the assessment approach, the quality of the data, and uncertainties in assessment results to determine a weight of scientific evidence conclusion for the 8-hour TWA inhalation exposure estimates for the Use of ink, toner, and colorant products OES. The primary strength is the use of PBZ and directly applicable monitoring data, which are preferable to other assessment approaches such as modeling or the use of OELs. EPA used PBZ air concentration data to assess inhalation exposures with the data having a high data quality rating from the systematic review process. The data included 4 full-shift (8-hour TWA) personal air samples. A primary limitation of these data include uncertainty in the representativeness of the monitoring data in capturing the true distribution of inhalation concentrations for this OES, since only 1 use site is represented by the data. The samples were taken in 1992 and may not be reflective of current operations. Worker activity descriptions are not provided in the CEHD data and the activities associated with the samples may not capture typical worker activities in this industry. Also, EPA mapped the data to this OES based on the SIC code reported, but no other information on the use of <i>o</i>-dichlorobenzene was found in CEHD, so there is uncertainty in the applicability of

OES	Weight of Scientific Evidence Conclusion in Occupational Inhalation Exposure Estimates
	the data. Finally, EPA assumed 8 exposure hours per day and 250 exposure days per year based on continuous exposure during each working day for a typical worker schedule; it is uncertain whether this captures actual worker schedules and exposures. Based on these strengths and limitations, EPA has concluded that the weight of scientific evidence for this assessment is moderate.
Use of Paints and Coatings	For this OES, EPA did not identify inhalation exposure monitoring data. Based on available data, EPA assessed exposures via the <i>Automotive Refinishing Spray Coating Mist Inhalation Model</i> (OECD, 2011a). EPA considered the assessment approach, the quality of the data, and uncertainties in assessment results to determine a weight of scientific evidence conclusion for the 8-hour TWA inhalation exposure estimates for the Use of paints and coatings OES. The primary strength is the <i>Automotive Refinishing Spray Coating Mist Inhalation Model</i> is based on PBZ monitoring data for mists during automotive refinishing. In addition, EPA adjusted the data for the concentration of <i>o</i>-dichlorobenzene in paints and coatings per identified product SDSs. A primary limitation includes the uncertainty of the representativeness of modeled air concentrations toward the true distribution of inhalation concentrations for the industries and sites covered by this scenario, as this scenario is based on the typical exposure and work patterns that occur for automobile refinishing, which would not encompass other types of paint application settings. Finally, EPA assumed 8 exposure hours per day and 250 exposure days per year based on continuous exposure during each working day for a typical worker schedule; it is uncertain whether this captures actual worker schedules and exposures. Based on these strengths and limitations, EPA has concluded that the weight of scientific evidence for this assessment is moderate.
Use of Paint Thinners and Removers	For this OES, EPA used inhalation monitoring data from a NIOSH HHE identified during the systematic review process (NIOSH, 1981). EPA considered the assessment approach, the quality of the data, and uncertainties in assessment results to determine a weight of scientific evidence conclusion for the 8-hour TWA inhalation exposure estimates for the Use of paint thinners & removers OES. The primary strength is the use of PBZ and directly applicable monitoring data, which are preferable to other assessment approaches such as modeling or the use of OELs. EPA assumes that inhalation exposures from the application of paint strippers and degreasers as a part of bus maintenance are comparable to exposures resulting from the application of paint strippers during aviation maintenance. EPA used PBZ air concentration data to assess inhalation exposures with the data having a high data quality ratings from the systematic review process. The data included 1 full-shift (8-hour TWA) and five task length personal air samples. A primary limitation of these data includes uncertainty in the representativeness of the monitoring data in capturing the true distribution of inhalation concentrations for this OES, since only 1 use site is represented by the data. The samples were taken in 1981 and may not be reflective of current operations. Next, all collected samples reported non-detects, so EPA assessed the LOD and half of the LOD as the high-end and central tendency TWA exposure concentrations, respectively. Finally, EPA assumed 8 exposure hours per day and 250 exposure days per year based on continuous exposure during each working day for a typical worker schedule; it is uncertain whether this captures actual worker schedules and exposures.

OES	Weight of Scientific Evidence Conclusion in Occupational Inhalation Exposure Estimates
	Based on these strengths and limitations, EPA has concluded that the weight of scientific evidence for this assessment is slight-to-moderate.
Use of Lubricants and Greases	For this OES, EPA did not identify inhalation exposure monitoring data. Based on available data, EPA assessed exposures via the 2020 ESD on Chemical Additives in Automotive Lubricants and Monte Carlo modeling (OECD, 2020). EPA considered the assessment approach, the quality of the data, and uncertainties in assessment results to determine a weight of scientific evidence conclusion for the 8-hour TWA inhalation exposure estimates for the Use of lubricants and greases OES. The primary strength is that variation in model input values and a range of potential exposure values is more likely than a discrete value to capture actual exposure at sites. Other strengths of this model include the use of parameters derived from applicable exposure scenarios such as the 2020 ESD on Chemical Additives in Automotive Lubricants, and the use of known <i>o</i>-dichlorobenzene concentration data from products currently on the market. A primary limitation includes the uncertainty of the representativeness of modeled air concentrations toward the true distribution of inhalation concentrations for the industries and sites covered by this scenario, as this scenario is based on the typical exposure and work patterns that occur for automotive lubricants. Based on these strengths and limitations, EPA has concluded that the weight of scientific evidence for this assessment is moderate.
Use of Fuels and Related Products	For this OES, EPA did not identify inhalation exposure monitoring data. Based on available data, EPA assessed exposures via the <i>Use of Chemicals in Fuels and Related Products Generic Scenario</i> (U.S. EPA, 2021e). EPA considered the assessment approach, the quality of the data, and uncertainties in assessment results to determine a weight of scientific evidence conclusion for the 8-hour TWA inhalation exposure estimates for the Use of fuels and related products OES. The primary strength is the <i>Use of Chemicals in Fuels and Related Products Generic Scenario</i> is based on PBZ monitoring data for total Volatile Organic Compound concentrations at fueling stations and bulk terminals. In addition, EPA adjusted the data for the concentration of <i>o</i>-dichlorobenzene in gasoline via vapor fraction tables and identified product SDSs. A primary limitation includes the uncertainty of the representativeness of adjusted vapor concentrations toward the true distribution of inhalation concentrations for the sites covered by this scenario, as this scenario is based on the typical exposure and work patterns that occur for bulk terminals and gasoline fueling stations only. Finally, EPA assumed 8 exposure hours per day and 250 exposure days per year based on continuous exposure during each working day for a typical worker schedule; it is uncertain whether this captures actual worker schedules and exposures. Based on these strengths and limitations, EPA has concluded that the weight of scientific evidence for this assessment is moderate.
Use in Solid Air Care Products	For this OES, EPA used IECCU Version 1.1 to model the inhalation exposure to workers for the Use in solid air care products OES. This method is typically used to assess consumer exposure but used in this case for occupational exposure as well due to the similarities in the exposures expected by each group. EPA considered the assessment approach, the quality of the data, and uncertainties in assessment results to determine a weight of scientific evidence conclusion for the inhalation exposure estimates (note

OES	Weight of Scientific Evidence Conclusion in Occupational Inhalation Exposure Estimates
	that due to the nature of the model used, where the use occurs once a month and the remainder of the month has decreasing exposures over time, there was no 8-hour TWA found for this use). The primary limitation of the data is that multiple inputs were obtained from EPA’s <i>Exposure Factors Handbook</i> (EFH) (U.S. EPA, 2011b) defaults, rather than from information that is specific to the chemical. However, EPA expects that the exposures are representative of sites that have workers handling solid air care products. Overall confidence in this inhalation exposure estimate is moderate.
Use of Laboratory Chemicals	For this OES, EPA did not identify inhalation exposure monitoring data. Based on available data, EPA uses surrogate data from a 1,1,2-trichloroethane Test Order submission from the Vinyl Institute (Labcorp Early Development Laboratories, 2023) and from a <i>p</i>-dichlorobenzene Test Order submission from the ACC Consortium (ACC, 2023). EPA considered the assessment approach, the quality of the data, and uncertainties in assessment results to determine a weight of scientific evidence conclusion for the 8- and 12-hour TWA inhalation exposure estimates for the Use of laboratory chemicals OES. The primary strength is the use of PBZ monitoring data, which are preferable to other assessment approaches such as modeling or the use of OELs, as well as the presence of samples taken across a variety of SEGs and sites. The data source has a high data quality rating from the systematic review process. The primary strength is the use of PBZ monitoring data, which are preferable to other assessment approaches such as modeling or the use of OELs. The data source has a high data quality rating from the systematic review process. 1,1,2-Trichloroethane and <i>o</i>-dichlorobenzene have similar molecular weights (133.4 g/mol vs. 147 g/mol for <i>o</i>-dichlorobenzene), adding to the confidence that 1,1,2-trichloroethane is an appropriate surrogate. <i>p</i>-Dichlorobenzene and <i>o</i>-dichlorobenzene also have the same molecular weights and similar vapor pressures (1.74 mm Hg vs. 1.36 mmHg for <i>o</i>-dichlorobenzene), adding to the confidence that <i>p</i>-dichlorobenzene is also an appropriate surrogate. Another strength is that the data was submitted as response to a test order issued by EPA specifically designed to be fit-for-purpose for TSCA risk evaluations. For 1,1,2-trichloroethane, the data included 29 full-shift personal air samples and 23 occupational task-based personal air samples. Of the full-shift samples taken, seven samples were classified as 8-hour TWAs while the remaining 22 samples were classified as 12-hour TWAs. The <i>p</i>-dichlorobenzene data included 53 full-shift personal air samples and 31 occupational task-based personal air samples. The primary limitation of this assessment is that it is based on data from a different chemical, and different occupational exposure scenario, which will cause inherent uncertainties due to differences in the chemical properties and possibly handling. The monitoring data isn’t from a dedicated laboratory. Rather, the data are from an on-site laboratory at a manufacturing site. EPA expects that the exposures are representative of those at dedicated laboratories. Finally, EPA assumed 167 exposure days/year for 12-hour shifts, or 250 exposure days/year for 8-hour shifts based on a typical worker schedule; it is uncertain whether this captures actual worker schedules and exposures. Based on these strengths and limitations, EPA has concluded that the weight of scientific evidence for this assessment is moderate.
Use of Cleaning	For this OES, EPA used inhalation monitoring data from OSHA’s CEHD (OSHA, 2019). EPA considered the assessment approach,

OES	Weight of Scientific Evidence Conclusion in Occupational Inhalation Exposure Estimates
and Furnishing Care Products	the quality of the data, and uncertainties in assessment results to determine a weight of scientific evidence conclusion for the 8-hour TWA inhalation exposure estimates for the Use of cleaning and furnishing care products OES. The primary strength is the use of PBZ and directly applicable monitoring data, which are preferable to other assessment approaches such as modeling or the use of OELs. EPA used PBZ air concentration data to assess inhalation exposures with the data having a high data quality rating from the systematic review process. The data included 1 full-shift (8-hour TWA) personal air samples. A primary limitation of these data include uncertainty in the representativeness of the monitoring data in capturing the true distribution of inhalation concentrations for this OES, since the dataset is only comprised of 2 samples. Additionally, only 1 use site is represented by the data, which may not represent the overall industry. The samples were taken in 1995 and may not be reflective of current operations. Worker activity descriptions are not provided in the CEHD data and the activities associated with the samples may not capture typical worker activities in this industry. Also, EPA mapped the data to this OES based on the SIC code reported, but no other information on the use of <i>o</i>-dichlorobenzene was found in CEHD, so there is uncertainty in the applicability of the data. Finally, EPA assumed 8 exposure hours per day and 250 exposure days per year based on continuous exposure during each working day for a typical worker schedule; it is uncertain whether this captures actual worker schedules and exposures. The use of surrogate data to estimate exposure using information from a generic scenario, <i>Chemicals Used in Furnishing Cleaning Products</i> {U.S. EPA, 2022, 10368811}, and finding the two results comparable, bolsters EPA’s confidence in the exposure results for this OES. Based on these strengths and limitations, EPA has concluded that the weight of scientific evidence for this assessment is moderate.
Use of Other Cleaning Products	CEM Version 3.2 (U.S. EPA, 2023a) was used to evaluate occupational exposure based on the available data for septic tank cleaners containing <i>o</i>-dichlorobenzene. Although CEM is intended for consumer uses, occupational exposure can be modeled by adjusting inputs specific for a worker scenario. EPA considered the assessment approach, the quality of the data, and uncertainties in assessment results to determine a weight of scientific evidence conclusion for the inhalation exposure estimates. One product was assessed for this COU. Maximum reported weight fraction and high-end product use pattern inputs were obtained from SDS, EFH or CEM default values. There is, however, uncertainty about the frequency and duration of use used for both products, requiring professional judgement. The mass of product used was based on use directions. Therefore, the overall confidence in this COU inhalation exposure estimate is moderate.
Sheep Branding Fluid	CEM Version 3.2 (U.S. EPA, 2023a) was used to evaluate occupational exposure based on the available data for sheep branding fluid containing <i>o</i>-dichlorobenzene. Although CEM is intended for consumer uses, occupational exposure can be modeled by adjusting inputs specific for a worker scenario. EPA considered the assessment approach, the quality of the data, and uncertainties in assessment results to determine a weight of scientific evidence conclusion for the inhalation exposure estimates. Two products were assessed for this COU (1 paint thinner and 1 sheep-branding fluid). Maximum reported weight fraction and high-

OES	Weight of Scientific Evidence Conclusion in Occupational Inhalation Exposure Estimates
	end product use pattern inputs were obtained from SDS, EFH or CEM default values. There is, however, uncertainty about the frequency and duration of use used for both products, requiring professional judgement. The mass of product used was also based on professional judgement. The sheep branding fluid scenario was not listed in EFH, so the paint thinners frequency and duration of use were used instead. Therefore, the overall confidence in this COU inhalation exposure estimate is moderate.
Disposal	For this OES, EPA did not identify inhalation exposure monitoring data. Based on available data, EPA uses surrogate data from a <i>p</i>-dichlorobenzene Test Order submission from Westlake Corporation (Exponent Inc., 2024). EPA considered the assessment approach, the quality of the data, and uncertainties in assessment results to determine a weight of scientific evidence conclusion for the 8- and 12-hour TWA inhalation exposure estimates for the Disposal OES. The primary strength is the use of PBZ monitoring data, which are preferable to other assessment approaches such as modeling or the use of OELs, as well as the presence of samples taken across a variety of SEGs and sampling periods. The data source has a high data quality rating from the systematic review process. <i>p</i>-Dichlorobenzene and <i>o</i>-dichlorobenzene also have the same molecular weights and similar vapor pressures (1.74 mm Hg vs. 1.36 mmHg for <i>o</i>-dichlorobenzene), adding to the confidence that <i>p</i>-dichlorobenzene is an appropriate surrogate. Another strength is that the data was submitted as response to a test order issued by EPA specifically designed to be fit-for-purpose for TSCA risk evaluations. The data included 22 full-shift personal air samples and 3 occupational task-based personal air samples. Of the full-shift samples taken, four samples were classified as 8-hour TWAs while the remaining 18 samples were classified as 12-hour TWAs. The primary limitation of this assessment is that it is based on data from a different chemical, and different occupational exposure scenario, which will cause inherent uncertainties due to differences in the chemical properties and possibly handling. Next, all collected samples reported non-detects, so EPA assessed the LOD and half of the LOD as the high-end and central tendency TWA exposure concentrations, respectively. Finally, EPA assumed either 167 exposure days/year for 12-hour shifts or 250 exposure days/year for 8-hour shifts based on a typical worker schedule; it is uncertain whether this captures actual worker schedules and exposures. Based on these strengths and limitations, EPA has concluded that the weight of scientific evidence for this assessment is slight-to-moderate.

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EPA estimated dermal exposures using modeling methodologies, which are supported by moderate evidence. The Agency used the EPA *Dermal Exposure to Volatile Liquids Model* combined with Monte Carlo modeling to calculate the dermal absorbed dose to liquids. For solids, EPA used the same calculations as the *Dermal Exposure to Volatile Liquids Model* but adjusted the parameter for quantity of chemical on the skin to reflect solid skin loading conditions based on identified literature ([Marquart et al., 2006](#); [Lansink et al., 1996](#)). A strength of the Monte Carlo modeling approach is that variation in model input values and a range of potential exposure values is more likely than a discrete value to capture actual exposure at sites. The primary limitation is the uncertainty in the representativeness of values toward the true distribution of potential dermal exposures. Also, EPA utilized surrogate *p*-dichlorobenzene fraction absorbed values from test order data ([Charles River Laboratories, 2025](#)). Therefore, the weight of scientific evidence for the modeling methodologies for all OES is moderate.

Note that EPA did not assess dermal exposures to ONUs from liquids, as EPA does not expect ONUs to directly handle *o*-dichlorobenzene as part of their duties, and thus ONUs are not expected to have routine dermal exposures to liquids during the course of their work. However, EPA addressed dermal exposures to ONUs from solids, as ONUs may come into contact with dust that settles on surfaces.

Table 8-63 summarizes EPA's overall confidence in the dermal exposure estimates for each OES; Table 8-64 summarizes the weight of scientific evidence ratings for occupational exposures

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Table 8-63. Summary of Assumptions, Uncertainty, and Overall Confidence in Occupational Dermal Exposure Estimates by OES

OES	Weight of Scientific Evidence Conclusion in Occupational Dermal Exposure Estimates
Manufacturing	The exposure scenarios and exposure factors underlying the dermal assessment are supported by moderate-to-robust evidence. Exposure factors for occupational dermal exposure include amount of material on the skin, surface area of skin exposed, and absorption of <i>o</i> -dichlorobenzene through the skin. These exposure factors were informed by literature sources, the ChemSTEER User Guide (U.S. EPA, 2015a) for standard exposure parameters, and test order data (Charles River Laboratories, 2025) with ratings from medium-to-high. A source of uncertainty includes that the dermal exposure was not quantified for <i>o</i> -dichlorobenzene, and the exposure results for <i>p</i> -dichlorobenzene (which are expected to be higher) were used to conclude minimal dermal exposure from this OES. Based on these strengths and limitations, EPA concluded that the weight of scientific evidence for the dermal exposure assessment is moderate for the Manufacturing OES.
Repackaging	The exposure scenarios and exposure factors underlying the dermal assessment are supported by moderate-to-robust evidence. Exposure factors for occupational dermal exposure include amount of material on the skin, surface area of skin exposed, and absorption of <i>o</i> -dichlorobenzene through the skin. These exposure factors were informed by literature sources, the ChemSTEER User Guide (U.S. EPA, 2015a) for standard exposure parameters, and test order data (Charles River Laboratories, 2025) with ratings from medium-to-high. Based on these strengths and limitations, EPA concluded that the weight of scientific evidence for the dermal exposure assessment is moderate for the Repackaging OES.
Processing as a Reactant	The exposure scenarios and exposure factors underlying the dermal assessment are supported by moderate-to-robust evidence. Exposure factors for occupational dermal exposure include amount of material on the skin, surface area of skin exposed, and absorption of <i>o</i> -dichlorobenzene through the skin. These exposure factors were informed by literature sources, the ChemSTEER User Guide (U.S. EPA, 2015a) for standard exposure parameters, and test order data (Charles River Laboratories, 2025) with ratings from medium-to-high. Based on these strengths and limitations, EPA concluded that the weight of scientific evidence for the dermal exposure assessment is moderate for the Processing as a reactant OES.
Incorporation into Soap, Cleaning Compound, and Toilet Preparation Manufacturing	The exposure scenarios and exposure factors underlying the dermal assessment are supported by moderate-to-robust evidence. Exposure factors for occupational dermal exposure include amount of material on the skin, surface area of skin exposed, and absorption of <i>o</i> -dichlorobenzene through the skin, which were updated for solids dermal exposure. These exposure factors were informed by literature sources (Marquart et al., 2006 ; Lansink et al., 1996), the ChemSTEER User Guide (U.S. EPA, 2015a) for standard exposure parameters, and test order data (Charles River Laboratories, 2025) with ratings from medium-to-high. Based on these strengths and limitations, EPA concluded that the weight of scientific evidence for the dermal exposure assessment is moderate for the Incorporation into soap, cleaning compound, and toilet preparation manufacturing OES.
Incorporation into Formulation, Mixture, or Reaction Product	The exposure scenarios and exposure factors underlying the dermal assessment are supported by moderate-to-robust evidence. Exposure factors for occupational dermal exposure include amount of material on the skin, surface area of skin exposed, and absorption of <i>o</i> -dichlorobenzene through the skin. These exposure factors were informed by literature sources, the ChemSTEER User Guide (U.S. EPA, 2015a) for standard exposure parameters, and test order data (Charles River Laboratories, 2025) with ratings from medium-to-high. Based on these strengths and limitations, EPA concluded that the weight of scientific evidence for the dermal exposure assessment is moderate for the Incorporation into formulation, mixture, or reaction product OES.
Plastics Compounding	The exposure scenarios and exposure factors underlying the dermal assessment are supported by moderate-to-robust evidence. Exposure factors for occupational dermal exposure include amount of material on the skin, surface area of skin exposed, and absorption of <i>o</i> -dichlorobenzene through the skin, which were updated for solids dermal exposure. These exposure factors were informed by literature sources (Marquart et al., 2006 ; Lansink et al., 1996), the ChemSTEER User Guide (U.S. EPA, 2015a) for standard exposure parameters,

OES	Weight of Scientific Evidence Conclusion in Occupational Dermal Exposure Estimates
	and test order data (Charles River Laboratories, 2025) with ratings from medium-to-high. Based on these strengths and limitations, EPA concluded that the weight of scientific evidence for the dermal exposure assessment is moderate for the Plastics compounding OES.
Plastics Converting	The exposure scenarios and exposure factors underlying the dermal assessment are supported by moderate-to-robust evidence. Exposure factors for occupational dermal exposure include amount of material on the skin, surface area of skin exposed, and absorption of <i>o</i> -dichlorobenzene through the skin, which were updated for solids dermal exposure. These exposure factors were informed by literature sources (Marquart et al., 2006 ; Lansink et al., 1996), the ChemSTEER User Guide (U.S. EPA, 2015a) for standard exposure parameters, and test order data (Charles River Laboratories, 2025) with ratings from medium-to-high. Based on these strengths and limitations, EPA concluded that the weight of scientific evidence for the dermal exposure assessment is moderate for the Plastics converting OES.
Functional Fluids (Closed System)	The exposure scenarios and exposure factors underlying the dermal assessment are supported by moderate-to-robust evidence. Exposure factors for occupational dermal exposure include amount of material on the skin, surface area of skin exposed, and absorption of <i>o</i> -dichlorobenzene through the skin. These exposure factors were informed by literature sources, the ChemSTEER User Guide (U.S. EPA, 2015a) for standard exposure parameters, and test order data (Charles River Laboratories, 2025) with ratings from medium-to-high. Based on these strengths and limitations, EPA concluded that the weight of scientific evidence for the dermal exposure assessment is moderate for the Functional fluids (closed system) OES.
Industrial Use of Solvents	The exposure scenarios and exposure factors underlying the dermal assessment are supported by moderate-to-robust evidence. Exposure factors for occupational dermal exposure include amount of material on the skin, surface area of skin exposed, and absorption of <i>o</i> -dichlorobenzene through the skin. These exposure factors were informed by literature sources, the ChemSTEER User Guide (U.S. EPA, 2015a) for standard exposure parameters, and test order data (Charles River Laboratories, 2025) with ratings from medium-to-high. Based on these strengths and limitations, EPA concluded that the weight of scientific evidence for the dermal exposure assessment is moderate for the Industrial use of solvents OES.
Use of Ink, Toner, and Colorant Products	The exposure scenarios and exposure factors underlying the dermal assessment are supported by moderate-to-robust evidence. Exposure factors for occupational dermal exposure include amount of material on the skin, surface area of skin exposed, and absorption of <i>o</i> -dichlorobenzene through the skin. These exposure factors were informed by literature sources, the ChemSTEER User Guide (U.S. EPA, 2015a) for standard exposure parameters, and test order data (Charles River Laboratories, 2025) with ratings from medium-to-high. Based on these strengths and limitations, EPA concluded that the weight of scientific evidence for the dermal exposure assessment is moderate for the Use of ink, toner, and colorant products OES.
Use of Paints and Coatings	The exposure scenarios and exposure factors underlying the dermal assessment are supported by moderate-to-robust evidence. Exposure factors for occupational dermal exposure include amount of material on the skin, surface area of skin exposed, and absorption of <i>o</i> -dichlorobenzene through the skin. These exposure factors were informed by literature sources, the ChemSTEER User Guide (U.S. EPA, 2015a) for standard exposure parameters, and test order data (Charles River Laboratories, 2025) with ratings from medium-to-high. Based on these strengths and limitations, EPA concluded that the weight of scientific evidence for the dermal exposure assessment is moderate for the Use of paints and coatings OES.
Use of Paint Thinners Removers	The exposure scenarios and exposure factors underlying the dermal assessment are supported by moderate-to-robust evidence. Exposure factors for occupational dermal exposure include amount of material on the skin, surface area of skin exposed, and absorption of <i>o</i> -dichlorobenzene through the skin. These exposure factors were informed by literature sources, the ChemSTEER User Guide (U.S. EPA, 2015a) for standard exposure parameters, and test order data (Charles River Laboratories, 2025) with ratings from medium-to-high. Based on these strengths and limitations, EPA concluded that the weight of scientific evidence for the dermal exposure assessment is moderate for the Use of paint thinners & removers OES.

OES	Weight of Scientific Evidence Conclusion in Occupational Dermal Exposure Estimates
Use of Lubricants and Greases	The exposure scenarios and exposure factors underlying the dermal assessment are supported by moderate-to-robust evidence. Exposure factors for occupational dermal exposure include amount of material on the skin, surface area of skin exposed, and absorption of <i>o</i> -dichlorobenzene through the skin. These exposure factors were informed by literature sources, the ChemSTEER User Guide (U.S. EPA, 2015a) for standard exposure parameters, and test order data (Charles River Laboratories, 2025) with ratings from medium-to-high. Based on these strengths and limitations, EPA concluded that the weight of scientific evidence for the dermal exposure assessment is moderate for the Use of lubricants and greases OES.
Use of Fuels and Related Products	The exposure scenarios and exposure factors underlying the dermal assessment are supported by moderate-to-robust evidence. Exposure factors for occupational dermal exposure include amount of material on the skin, surface area of skin exposed, and absorption of <i>o</i> -dichlorobenzene through the skin. These exposure factors were informed by literature sources, the ChemSTEER User Guide (U.S. EPA, 2015a) for standard exposure parameters, and test order data (Charles River Laboratories, 2025) with ratings from medium-to-high. Based on these strengths and limitations, EPA concluded that the weight of scientific evidence for the dermal exposure assessment is moderate for the Use of fuels and related products OES.
Use in Solid Air Care Products	The exposure scenarios and exposure factors underlying the dermal assessment are supported by moderate-to-robust evidence. Exposure factors for occupational dermal exposure include amount of material on the skin, surface area of skin exposed, and absorption of <i>o</i> -dichlorobenzene through the skin, which were updated for solids dermal exposure. These exposure factors were informed by literature sources (Marquart et al., 2006 ; Lansink et al., 1996), the ChemSTEER User Guide (U.S. EPA, 2015a) for standard exposure parameters, and test order data (Charles River Laboratories, 2025) with ratings from medium-to-high. Based on these strengths and limitations, EPA concluded that the weight of scientific evidence for the dermal exposure assessment is moderate for the Use in solid air care products OES.
Use of Laboratory Chemicals	The exposure scenarios and exposure factors underlying the dermal assessment are supported by moderate-to-robust evidence. Exposure factors for occupational dermal exposure include amount of material on the skin, surface area of skin exposed, and absorption of <i>o</i> -dichlorobenzene through the skin. These exposure factors were informed by literature sources, the ChemSTEER User Guide (U.S. EPA, 2015a) for standard exposure parameters, and test order data (Charles River Laboratories, 2025) with ratings from medium-to-high. Based on these strengths and limitations, EPA concluded that the weight of scientific evidence for the dermal exposure assessment is moderate for the Use of laboratory chemicals OES.
Use of Cleaning and Furnishing Care Products	The exposure scenarios and exposure factors underlying the dermal assessment are supported by moderate-to-robust evidence. Exposure factors for occupational dermal exposure include amount of material on the skin, surface area of skin exposed, and absorption of <i>o</i> -dichlorobenzene through the skin. These exposure factors were informed by literature sources, the ChemSTEER User Guide (U.S. EPA, 2015a) for standard exposure parameters, and test order data (Charles River Laboratories, 2025) with ratings from medium-to-high. Based on these strengths and limitations, EPA concluded that the weight of scientific evidence for the dermal exposure assessment is moderate for the Use of cleaning and furnishing care products OES.
Sheep Branding Fluid	The exposure scenarios and exposure factors underlying the dermal assessment are supported by moderate-to-robust evidence. Exposure factors for occupational dermal exposure include amount of material on the skin, surface area of skin exposed, and absorption of <i>o</i> -dichlorobenzene through the skin. These exposure factors were informed by literature sources, the ChemSTEER User Guide (U.S. EPA, 2015a) for standard exposure parameters, and test order data (Charles River Laboratories, 2025) with ratings from medium-to-high. Based on these strengths and limitations, EPA concluded that the weight of scientific evidence for the dermal exposure assessment is moderate for the Sheep branding fluid OES.

OES	Weight of Scientific Evidence Conclusion in Occupational Dermal Exposure Estimates
Disposal	The exposure scenarios and exposure factors underlying the dermal assessment are supported by moderate-to-robust evidence. Exposure factors for occupational dermal exposure include amount of material on the skin, surface area of skin exposed, and absorption of <i>o</i> -dichlorobenzene through the skin. These exposure factors were informed by literature sources, the ChemSTEER User Guide (U.S. EPA, 2015a) for standard exposure parameters, and test order data (Charles River Laboratories, 2025) with ratings from medium-to-high. Based on these strengths and limitations, EPA concluded that the weight of scientific evidence for the dermal exposure assessment is moderate for the Disposal OES.

Table 8-64. Summary of the Weight of Scientific Evidence Ratings for Occupational Exposures

Occupational Exposure Scenario (OES)	Inhalation Exposure									Dermal Exposure		
	<i>o</i> -Dichlorobenzene Data ^a						Modeling		WOSE Conclusion	Modeling		WOSE Conclusion
	Worker	# Samples ^b (# Below Detection); LOD Range (ppm)	ONU	# Samples (# Below Detection); LOD Range (ppm)	Data Quality Ratings	Monitoring, Analogous, or Surrogate Data ^a	Worker	ONU		Worker	ONU	
Manufacturing	Not quantitatively assessed				High	Surrogate	N/A	N/A	Moderate	Not quantitatively assessed		Moderate
Repackaging	✓	14 (1); 3.0E-03	✓	1 (0)	High	Analogous	N/A	N/A	Robust	✓	NQ	Moderate
Processing as Reactant	✓	40 (33); 4.1E-03 to 5.7E-02	✓	22 (22); 4.1E-03 to 3.0E-02	High	Surrogate	N/A	N/A	Moderate	✓	NQ	Moderate
Incorporation into Soap, Cleaning Compound, and Toilet Preparation Manufacturing	✓	5 (0)	CT-AAW ^c	N/A	High	Monitoring	N/A	N/A	Moderate	✓	NQ	Moderate
Incorporation into Formulation, Mixture or Reaction Product	✓	12 (3); 5.0E-02	CT-AAW	N/A	High/Medium	Monitoring	N/A	N/A	Slight-to-Moderate	✓	NQ	Moderate

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Occupational Exposure Scenario (OES)	Inhalation Exposure									Dermal Exposure		
	<i>o</i> -Dichlorobenzene Data ^a						Modeling		WOSE Conclusion	Modeling		WOSE Conclusion
	Worker	# Samples ^b (# Below Detection); LOD Range (ppm)	ONU	# Samples (# Below Detection); LOD Range (ppm)	Data Quality Ratings	Monitoring, Analogous, or Surrogate Data ^a	Worker	ONU		Worker	ONU	
Plastics Compounding	Not quantitatively assessed				High	Surrogate	N/A	N/A	Slight-to-Moderate	Not quantitatively assessed		Moderate
Plastics Converting	Not quantitatively assessed				High	Surrogate	N/A	N/A	Slight-to-Moderate	Not quantitatively assessed		Moderate
Functional Fluids (Closed System)	✓	15 (1); 3.0E-03	CT-AAW	N/A	High	Analogous	N/A	N/A	Moderate-to-Robust	✓	NQ	Moderate
Industrial Use of Solvents	✓	22 (3); 3.0E-03 to 4.0E-03	✓	6 (1); 3.0E-03	High	Monitoring	N/A	N/A	Robust	✓	NQ	Moderate
Use of Ink, Toner, and Colorant Products	✓	23 (22); 1.1E-02 to 4.4E-02	CT-AAW	N/A	High	Monitoring	N/A	N/A	Moderate	✓	NQ	Moderate
Use of Paints and Coatings	N/A	N/A	N/A	N/A	N/A	N/A	✓	CT-AAW	Moderate	✓	✓	Moderate
Use of Paint Thinners and Removers	✓	1 (1); 4.99E-03	CT-AAW	N/A	High	Monitoring	N/A	N/A	Slight-to-Moderate	✓	NQ	Moderate
Use of Lubricants and Greases	N/A	N/A	N/A	N/A	N/A	N/A	✓	CT-AAW	Moderate	✓	NQ	Moderate
Use of Fuels and Related Products	N/A	N/A	N/A	N/A	N/A	N/A	✓	CT-AAW	Moderate	✓	NQ	Moderate
Use in Solid Air Care Products	N/A	N/A	N/A	N/A	N/A	N/A	✓	✓	Moderate	✓	✓	Moderate
Use of Laboratory Chemicals	✓	29 (10); 7.6E-06 to 1.2E-05	CT-AAW	N/A	High	Surrogate	N/A	N/A	Moderate	✓	NQ	Moderate

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Occupational Exposure Scenario (OES)	Inhalation Exposure									Dermal Exposure		
	<i>o</i> -Dichlorobenzene Data ^a						Modeling		WOSE Conclusion	Modeling		WOSE Conclusion
	Worker	# Samples ^b (# Below Detection); LOD Range (ppm)	ONU	# Samples (# Below Detection); LOD Range (ppm)	Data Quality Ratings	Monitoring, Analogous, or Surrogate Data ^a	Worker	ONU		Worker	ONU	
Use of Cleaning and Furnishing Care Products	✓	1 (0)	NE	N/A	High	Monitoring	N/A	N/A	Moderate	✓	NQ	Moderate
Use of Sheep Branding Fluid	N/A	N/A	N/A	N/A	N/A	N/A	✓	✓	Moderate	✓	NQ	Moderate
Use of Other Cleaning Products	N/A	N/A	N/A	N/A	N/A	N/A	✓	✓	Moderate	✓	NQ	Moderate
Disposal	✓	13 (13); 2.2E-02 to 2.2E-02	✓	6 (6); 2.6E-02 to 3.3E-02	High	Surrogate	N/A	N/A	Slight-to-Moderate	✓	NQ	Moderate

NQ = dermal exposures for ONUs for *o*-dichlorobenzene are expected to be negligible because they do not directly handle the chemical and this OES does not generate airborne mists.
NE = EPA did not generate estimates of ONU exposure; however, EPA assumes that ONU exposures would be equal to or less than estimated worker exposures.
✓ indicates EPA performed occupational exposure assessment for this OES and its corresponding worker and ONU
^a “Monitoring data” refers to data from the same chemical and corresponding OES. “Analogous data” refers to data from the same chemical and similar (but not the same) OES. “Surrogate data” refers to data from a different chemical and the same or similar OES.
^b Only full-shift samples included in data point counts.^c CT-AAW: In absence of data specific to ONU exposure, the Agency assumed that central tendency of average adult worker (CT-AAW) exposure was representative of ONU exposure and used to generate estimates for ONUs.

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8.4 Occupational Exposure Assessment Conclusions

EPA considered all reasonably available information identified through its systematic review process under TSCA ([U.S. EPA, 2026ab](#)) to characterize the occupational exposure of *o*-dichlorobenzene. *o*-Dichlorobenzene has a total PV in the United States of less than one million lb from the 2020 CDR reporting period and it is primarily used in solvents and air care products ([U.S. EPA, 2020d](#)).

EPA evaluated occupational exposures for each OES, which are developed based on a set of occupational activities and conditions such that similar occupational exposures are expected from the use(s) covered under each OES. The Agency provided occupational exposure results for each OES, which are expected to be representative of the population of workers and sites for the given OES in the United States. EPA used inhalation monitoring data, including directly applicable data obtained through test orders, to evaluate acute, intermediate, and chronic exposures to workers and ONUs for eight of the 20 OESs. Analogous data from other OESs were used for one OES (Functional Fluids [Closed System]). Surrogate data from *p*-dichlorobenzene were used for six OESs. Probabilistic modeling was performed for one OES (Use of Lubricants and Greases) and GS/ESDs were used to assess exposures for two OESs (Use of Paints and Coatings; Use of Fuels and Related Products) where no air monitoring data were available. EPA's Consumer Exposure Model was adjusted for occupational use when no monitoring data were available for three OESs (Use in Solid Air Care Products; Use in Other Cleaning Products; and Sheep Branding Fluid). Dermal exposure was modeled for all OESs using surrogate *p*-dichlorobenzene fraction absorbed values from Westlake Corporation Test Order data.

Both inhalation and dermal exposures to *o*-dichlorobenzene are highest during Repackaging, Processing OESs (Processing as a Reactant; Incorporation into Soap, Cleaning Compound, and Toilet Preparation Manufacturing; Incorporation into Formulation, Mixture, or Reaction Product), Use of Paints and Coatings, Use of cleaning and furnishing care products, and Use of other cleaning products.

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APPENDICES

Appendix A CONSUMER INHALATION EXPOSURE MODELING

CEM predicts indoor air concentrations from consumer product use by implementing a deterministic, mass-balance calculation utilizing an emission profile determined by implementing appropriate emission scenarios. The model uses a two-zone representation of the building of use (*e.g.*, residence, school, office), with Zone 1 representing the room where the consumer product is used (*e.g.*, a utility room) and Zone 2 being the remainder of the building. The product user is placed within Zone 1 for the duration of use. Otherwise, product users and bystanders follow prescribed activity patterns throughout the simulated period. In some instances of product use, concentration of product is expected to be higher very near the product user; CEM addresses this by further dividing Zone 1 into near-field, with a default volume of 1 m³, and far-field, which reflects the remainder of Zone 1. Each zone is considered well-mixed. Product users are exposed to airborne concentrations estimated within the near-field during the time of use and otherwise follow their prescribed activity pattern. Background concentrations are generally set to zero, unless there is a scenario where there is concentration of chemical present in the use environment.

For acute exposure scenarios, emissions from each incidence of product usage are estimated over a period of 24 hours using the following approach that account for how a product is used or applied, the total applied mass of the product, the weight fraction of the chemical in the product, and the molecular weight and vapor pressure of the chemical.

The general steps of the calculation engine within the CEM model include the following:

- Introduction of the chemical (*i.e.*, *o*-dichlorobenzene) into the room of use (Zone 1) through consumer use of the product.
- Transfer of the chemical to the rest of the house (Zone 2) due to exchange of air between the different rooms.
- Exchange of the house air with outdoor air.
- Compilation of estimated air concentrations in each zone as the modeled occupant moves about the house per prescribed activity patterns.

As the user moves to Zone 2 after use, the associated zonal air concentrations at each 30-second time step were compiled to reflect the air concentrations the user would be exposed to throughout the simulation period. Time-weighted averages (TWAs) were then computed based on these user exposed concentration time series per available human health hazard data. For *o*-dichlorobenzene, 24-hour TWAs were quantified for use in the draft risk evaluation based on alignment relevant acute human health hazard endpoints, and chronic average daily concentrations over a year were used based on chronic human health endpoints.

A.1 Description of Emission Equation for the Toilet Bowl Deodorizer COU

EPA used ([Guerrero and Corsi, 2012](#)) to determine the emission profile to use in the IECCU air modeling. In their experiments, the authors purchased a toilet bowl deodorizer product from “the largest manufacturer of such products in the United States”; the product contained 99% or more *p*-dichlorobenzene by weight. Because the experimental product contained greater than 99% *p*-dichlorobenzene, the derived initial emission rate was adjusted to 1% to reflect the concentration of *o*-dichlorobenzene in the modeled product. EPA judged that the product was a suitable match to the COU being modeled here. The authors placed the product in an enclosed chamber at a height that simulated a toilet bowl and measured the subsequent emission rate every 3 to 7 days for a month in a set of 3

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independent trials.

The emission rate (mg/hour) through time is available in Figure 1 of ([Guerrero and Corsi, 2012](#)), which shows the mean emission rate as well as error bars representing the standard deviation across the three trials. The shape of the emission curve is largely constant across the first two measurements (measured at approximately 3 and 6 days) and then decreases approximately linearly across the remaining portion of the experiment. The error bars across the three trials are wide for the first measurement at 3 days, making the shape at the beginning of the experiment somewhat uncertain. EPA digitized the figure using PlotDigitizer.com.

The shape of the curve does not fit commonly used functional forms for the emission rate, including those available in IECCU. To determine an appropriate emission profile based on the experimental data, EPA fit three different functional forms to the experimental data:

1. Model 1: An exponential decay function, $E(t) = E_o e^{-kt}$. This function was fit to the experimental data using the Excel Solver function to change E_o and k (the initial emission rate and the decay rate) until the sum of the squared differences between the experimental data and the model fit was minimized.
2. Model 2: A linear decay function, $E(t) = E_o - mt$. This function was fit to the experimental data using the Excel Solver function to change E_o and m (the initial emission rate and the linear slope) until the sum of the squared differences between the experimental data and the model fit was minimized.
3. Model 3: An exponential decay function, $E(t) = E_o e^{-kt}$. This function was fit to the experimental data using the Excel Solver function to change E_o and k (the initial emission rate and the decay rate) until the total amount emitted did not exceed the original mass of the product (4 oz) and the difference between the experimental and modeled average emission across the first three days was minimized (see below).

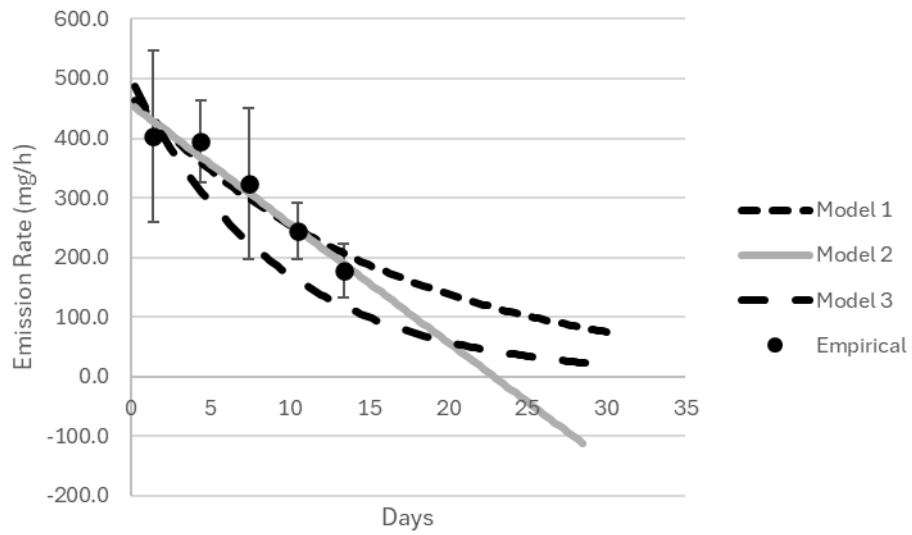
Figure_Apx A-1 shows a comparison of Models 1, 2, and 3 with the data from the experiment. The best fitting model (the smallest sum of the squared errors) is the linear model, Model 2; this model is consistent with approximately constant decrease in the height of the cylinder as it decays. However, integrating the curves over 30 days, both the exponential Model 1 and linear Model 2 emit more mass than was originally in the 4-ounce product. Also, IECCU does not offer a linear decay model. Model 3 was fit to specifically ensure the total mass emitted was not more than 4 oz and so that the difference between the empirical and modeled average emission rate over the first 3 days (the time of the first measurement) is as small as possible. Model 3 thus will capture the peak as well as possible for the acute calculation while also ensuring the chronic calculation is not an overestimate. Model 3 is largely within one standard deviation from the experimental data and is judged to be the most appropriate model for the toilet bowl deodorizer COU.

The final functional form is:

$$E(t) = E_o e^{-kt}$$

Where:

$E(t)$	=	Time varying emission rate in mg/hour
E_o	=	Initial emission rate in mg/h = 5.00×10^3 μ g/hour
k	=	De decay constant in $\text{h}^{-1} = 0.00471 \text{ h}^{-1}$



Figure_Apx A-1. Comparison of Models 1, 2, and 3 with the
([Guerrero and Corsi, 2012](#)) Experimental Data

Appendix B ACUTE AND NON-CANCER CHRONIC CONCENTRATION

The acute 24-hour and chronic average daily concentration were calculated with the equation below. The concentrations for Zone 1 was used when the user was expected to be in the same room as the product, and Zone 2 during non-use. It is important to note that CEM calculates chronic over 60 days, and extrapolates the concentrations to 1 year, assuming the same use every day over the year.

Equation_Apx B-1. Acute Average Daily Concentration for Inhalation of Product Used in an Environment

$$ADC = \frac{C_{twa} \times ED}{AT}$$

Where:

ADC	=	Average daily concentration (mg/m ³)
C_{twa}	=	Time-weighted average air concentration (mg/m ³)
ED	=	Exposure duration (hours)
AT	=	Averaging time (24 hours)

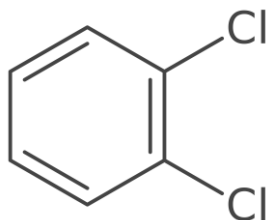
Equation_Apx B-2. Chronic Average Daily Concentration for Inhalation of Product Used in an Environment

$$ADC = \frac{C_{twa} \times EF \times ED}{AT}$$

Where:

ADC	=	Average daily concentration (mg/m ³)
C_{twa}	=	Time-weighted average air concentration (mg/m ³)
EF	=	Exposure frequency (days/year)
ED	=	Exposure duration (1 year)
AT	=	Averaging time (365 days)

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Appendix C EPI SUITE™ MODEL INPUTS AND OUTPUTS**1,2-DICHLOROBENZENE**

CAS	000095-50-1
Name	1,2-DICHLOROBENZENE
Systematic Name	Benzene, 1,2-dichloro-
SMILES	<chem>C1=CC(=C(C=C1)Cl)Cl</chem>
Molecular Weight	147.002
Molecular Formula	C6H4Cl2
Predicted Log Kow	3.282
Experimental Log Kow	3.430
Predicted Melting Point	-8.135e+0
Experimental Melting Point	-1.670e+1
Predicted Boiling Point	195.911
Experimental Boiling Point	180.000
Predicted Vapor Pressure (mmHg at 25 °C)	0.951
Predicted Vapor Pressure (Pa at 25 °C)	126.844
Predicted Sub-cooled Vapor Pressure (mmHg at 25 °C)	0.865
Predicted Sub-cooled Vapor Pressure (Pa at 25 °C)	115.281
Experimental Vapor Pressure (mmHg at 25 °C)	1.360
Predicted HLC, VP/WSOL Method (atm-m3/mol at 25 °C)	0.002
Predicted HLC, Bond Method (atm-m3/mol at 25 °C)	0.003
Predicted HLC, Group Method (atm-m3/mol at 25 °C)	0.004
Experimental HLC (atm-m3/mol at 25 °C)	0.002
Predicted Log Kaw	-1.110e+0
Predicted Log Koa	4.490
Experimental Log Koa	4.360
Predicted Water Solubility, WSKow (mg/L)	142.540
Predicted Water Solubility, WaterNT (mg/L)	104.130
Experimental Water Solubility (mg/L)	156.000
Acid-Catalyzed Rate Constant (L/mol-sec at 25 °C)	
Base-Catalyzed Rate Constant (L/mol-sec at 25 °C)	
Hydrolysis Half-Life in Days (ph7, base-catalyzed)	
Hydrolysis Half-Life in Days (ph7, acid-catalyzed)	
Hydrolysis Half-Life in Days (ph7, phosphorus ester)	
Hydrolysis Half-Life in Days (ph7, acid-catalyzed, trans-isomer)	
Hydrolysis Half-Life in Days (ph8, base-catalyzed)	
Volatilization Half-Life in Hours (Lake Model)	119.252
Volatilization Half-Life in Hours (River Model)	1.611

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Dermal Absorbed Dose per Event (mg/cm ² -event)	1.034e+4
Dermal Absorbed Dose (mg/kg-day)	1.093e+6
Bioconcentration Factor (L/kg wet-wt)	78.910
Biotransformation Half Life in Days	0.500
Bioaccumulation Factor (L/kg wet-wt)	214.240
BioWin1 (Linear Model Prediction)	0.313
BioWin2 (Non-Linear Model Prediction)	0.043
BioWin3 (Ultimate Biodegradation Timeframe)	2.461
BioWin4 (Primary Biodegradation Timeframe)	3.305
BioWin5 (MITI Linear Model Prediction)	0.246
BioWin6 (MITI Non-Linear Model Prediction)	0.094
BioWin7 (Anaerobic Model Prediction)	-3.502e-1
Hydrocarbon Biodegradation Half Life in Days	
Predicted Log Koc (L/kg)	2.583
Experimental Log Koc (L/kg)	2.560
Predicted Photolytic/Hydroxyl Radical Reaction Rate Constant	4.005e-13
Experimental Photolytic/Hydroxyl Radical Reaction Rate Constant	4.200e-13
Predicted Atmospheric Half Life in Hours (Photolytic/Hydroxyl Radical Reaction, 1.5E6 molecules/cm ³)	320.496
Atmospheric Half Life in Hours from Experimental Rate Constant (Photolytic/Hydroxyl Radical Reaction, 1.5E6 molecules/cm ³)	305.556
Predicted Atmospheric Half Life in Days (Photolytic/Hydroxyl Radical Reaction, 12-hour days, 1.5E6 molecules/cm ³)	26.708
Atmospheric Half Life in Days from Experimental Rate Constant (Photolytic/Hydroxyl Radical Reaction, 12-hour days, 1.5E6 molecules/cm ³)	25.463
Predicted Ozone Reaction Rate Constant	
Experimental Ozone Reaction Rate Constant	
Predicted Atmospheric Half Life in Hours (Ozone Reaction, 7E11 molecules/cm ³)	
Atmospheric Half Life in Hours from Experimental Rate Constant (Ozone Reaction, 7E11 molecules/cm ³)	
Predicted Atmospheric Half Life in Days (Ozone Reaction, 24-hour days, 7E11 molecules/cm ³)	
Atmospheric Half Life in Days from Experimental Rate Constant (Ozone Reaction, 24-hour days, 7E11 molecules/cm ³)	
Predicted Atmospheric Half Life in Hours (Hydroxyl and Ozone Reactions)	320.496
Fugacity Model Air Mass Percentage	6.165e-17
Fugacity Model Water Mass Percentage	27.963
Fugacity Model Soil Mass Percentage	71.590
Fugacity Model Sediment Mass Percentage	0.447
STP Model Air Mass Percentage	39.624
STP Model Sludge Mass Percentage	8.289
STP Model Biodegradation Mass Percentage	0.108
STP Model Effluent Mass Percentage	48.021
User-Provided Log Kow	3.380
User-Provided Melting Point	-1.720e+1
User-Provided Boiling Point	180.300

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User-Provided Water Solubility	141.000
User-Provided VaporPressure	1.350
User-Provided Henry's Law Constant	0.002
User-Provided LogKoa	
User-Provided LogKoc	2.450
User-Provided Hydroxyl Reaction Rate Constant	1.500e+6
User-Provided Dermal Permeability Coefficient	
User-Provided Atmospheric Hydroxyl Radical Concentration	1.500e+6
User-Provided Atmospheric Ozone Concentration	7.000e+11
User-Provided Atmospheric Daylight Hours	12.000
User-Provided Stp Half-Life Primary Clarifier	1.000e+4
User-Provided Stp Half-Life Aeration Vessel	1.000e+4
User-Provided Stp Half-Life Settling Tank	1.000e+4
User-Provided Fugacity Half-Life Air	
User-Provided Fugacity Half-Life Water	
User-Provided Fugacity Half-Life Soil	
User-Provided Fugacity Half-Life Sediment	
User-Provided Fugacity Emission Rate Air	1000.000
User-Provided Fugacity Emission Rate Water	1000.000
User-Provided Fugacity Emission Rate Soil	1000.000
User-Provided Fugacity Emission Rate Sediment	
User-Provided Fugacity Advection Time Air	100.000
User-Provided Fugacity Advection Time Water	1000.000
User-Provided Fugacity Advection Time Soil	
User-Provided Fugacity Advection Time Sediment	5.000e+4

8451

Appendix D PROCEDURES FOR MAPPING FACILITIES FROM STANDARD ENGINEERING SOURCES TO OCCUPATIONAL EXPOSURE SCENARIOS AND CONDITIONS OF USE

D.1 Standard Sources Requiring Facility Mapping

EPA utilizes release data from EPA programmatic databases and exposure data from standard sources to complete occupational exposure and environmental release assessments, which are described, with hyperlinks (all accessed August 11, 2025) below:

[Chemical Data Reporting \(CDR\)](#), to which import and manufacturing sites producing the chemical at or above a specified threshold must report. EPA uses CDR to identify COUs, OESs, sites that import or manufacture the chemical, and for information on physical form and concentration of the chemical. In addition, EPA is currently developing the Tiered Data Reporting (TDR) rule, which would establish reporting requirements, including changes to CDR, to collect information that better meets data needs for the TSCA existing chemical program. The rule is expected to have reporting requirements tiered to specific stages of existing chemical assessments (*e.g.*, prioritization, risk evaluation) and harmonized to the OECD risk assessment framework, which would help to better inform uses of chemicals and improve upon the OES mapping procedures in this draft TSD.

[Toxics Release Inventory \(TRI\)](#), to which facilities handling a chemical covered by the TRI program at or above a specified threshold must report. EPA uses TRI data to quantify air, water, and land releases of the chemical undergoing risk evaluation.

[National Emissions Inventory \(NEI\)](#), a compilation of air emissions of criteria pollutants, criteria precursors and hazardous air pollutants from point and non-point source air emissions. EPA uses NEI data to quantify air emissions of the chemical undergoing risk evaluation. However, *o*-dichlorobenzene is not listed as a CAA-HAP and facilities do not report *o*-dichlorobenzene air releases to NEI. Therefore, NEI database is not used for any industrial/commercial *o*-dichlorobenzene release estimation.

[Discharge Monitoring Report \(DMR\)](#), a periodic report required of National Pollutant Discharge Elimination System (NPDES) permitted facilities discharging to surface waters. EPA uses NEI data to quantify surface water discharges of the chemical undergoing risk evaluation.

Occupational Safety and Health Administration (OSHA): [Chemical Exposure Health Data \(CEHD\)](#), a compilation of industrial hygiene samples taken when OSHA monitors worker exposures to chemical hazards. EPA uses OSHA CEHD to quantify occupational inhalation exposures to the chemical undergoing risk evaluation.

National Institute of Occupational Safety and Health (NIOSH): [Health Hazard Evaluations \(HHEs\)](#), a compilation of voluntary employee, union, or employer requested evaluations of health hazards present at given workplace. EPA uses NIOSH HHE data to quantify occupational inhalation exposures to the chemical undergoing risk evaluation.

To utilize the data from these sources, the facilities that report to each must first be mapped to an OES. There may be other sources of data for specific facilities that require mapping the facilities to an OES; however, this draft TSD covers the most common data sources. Additionally, EPA often uses data from sources such as public and stakeholder comments, generic scenarios, and process data that are usually

not specific to an individual site; therefore, unlike the above sources, they do not involve the mapping of specific sites to an OES.

Mapping procedures for the above sources are discussed in detail in the subsequent sections; however, Table_Apx D-1 includes a summary of the type of information reported by companies in each database that helps to inform OES and COU mapping. This includes industrial classification codes such as those associated with the [North American Industry Classification System \(NAICS\)](#) and [Standard Industrial Classification](#) (SIC) system (both URLs accessed August 11, 2025). Note that the U.S. government replaced SIC codes with NAICS codes in 1997; however, SIC codes are still used in DMR and are applicable for data from all listed sources for years prior to 1997. Additionally, some of the sources in Table_Apx D-1 have specific reporting requirements that include flags for the type of processes that occur at the site.

Assessors should be sure that a facility that reports to multiple databases/sources is consistently mapped to the same OES, as applicable. This is not applicable if the facility reports separately for different areas/processes of their facility (*e.g.*, a large chemical plant may report 1 block of unit operations separate from another such that they have different OESs).

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Table Apx D-1. EPA Programmatic Database Information That Aids OES/COU Mapping

Source	Reported Information Useful for Mapping OES/COU	Reporting Frequency	Notes
CDR	- Indication if the chemical is imported or domestically manufactured - Indication if the chemical is imported but never at the site, used on-site, or exported	- Facilities must report to CDR every 4 years - New data sets take years to become publicly available - Latest reporting year with available data: 2020	- While CDR also includes information on downstream processing and use, it does not include site identities for these operations; thus, it does not inform reporting site OES/COU mapping. - Claims of confidential business information (CBI) can limit data transparency in risk evaluations.
TRI	- NAICS codes - Flags for uses and subuses of the chemical - Release media information	- Facilities must report to TRI annually - New data sets become publicly available in October for the previous year - Latest reporting year with available data: 2021	- Reporters must select from specific uses (<i>e.g.</i>, manufacture, import, processing) and subuses (<i>e.g.</i>, formulation additive, degreaser, lubricant). - Subuse information is only available in data sets starting in 2018. - Facilities may report with a Form A under certain circumstances; ^a Form A's do not require use/sub-use reporting.
DMR	- SIC codes - NPDES) permit numbers	- Facilities must report to DMR at the frequency specified in their NPDES permit, which is typically monthly - Data typically flows through the State DMR reporting platform to EPA's ECHO database continuously	- Sites that only report non-detection of the chemical for the year are generally excluded from mapping. - NPDES permit numbers can sometimes indicate the type of general permit, which can inform mapping (<i>e.g.</i>, remediation general permit).
OSHA	- NAICS or SIC codes	- OSHA conducts monitoring as-needed for site investigations - Monitoring data is available in CEHD when the investigation and any subsequent litigation cases are closed - Latest year in CEHD with data: 2021	- CEHD includes data from 1984 and forward.
NIOSH HHE	- Facility process information - Worker activities	- NIOSH conducts HHEs upon request - HHEs are published online when NIOSH is completed with the evaluation - Latest year with a published HHE: 2023	- NIOSH HHEs generally include narrative descriptions of facility processes and worker activities, with specific information on how the chemical being monitored for is used.
^a Facilities may report using a Form A if the annual reportable release amount of the chemical did not exceed 500 lb for the reporting year, and the amounts manufactured, or processed, or otherwise used did not exceed 1 million lb for that year.			

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D.2 OES Mapping Procedures

This section contains procedures for mapping facilities to OES for each source discussed in Section D.1.

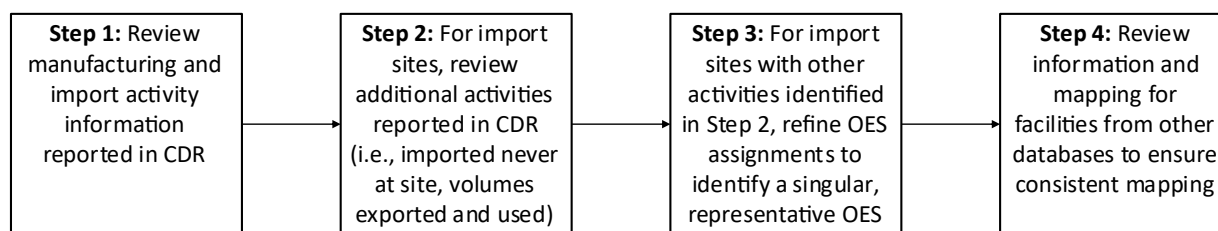
D.2.1 Chemical Data Reporting (CDR)

The only facilities required to report to CDR are those that manufacture or import specific chemicals at or above a specified threshold.⁹ Therefore, sites that report for the chemical of interest in CDR will generally be mapped to either the Manufacturing or Import/repackaging OES. These sites must also report the processing and uses of the chemical; however, these procedures are specific to mapping of the reporting site and not downstream processing or use sites.

CDR, under TSCA, requires manufacturers (including importers) to provide EPA with information on the production and use of chemicals in commerce. These facilities must report to CDR every 4 years. For risk evaluations conducted under the amended TSCA, EPA has primarily used 2016 and 2020 CDR. The procedures in this document are applicable to both 2016 and 2020 CDR data; however, there are some data elements that are only applicable to 2020 CDR, which are called out in the procedures where applicable. These procedures should be applicable to future CDR reporting, depending on changes to reporting requirements. If the TDR rule is promulgated, these procedures will be updated accordingly.

Chemical data reported under CDR is classified using Industrial Function Category (IFC) codes and/or commercial/consumer use product categories (PCs). CDR IFC codes describe the “intended physical or chemical characteristics for which a chemical substance or mixture is consumed as a reactant; incorporated into a formulation, mixture, reaction product, or article, repackaged; or used.” Alternatively, PCs describe the consumer and commercial products in which each reportable chemical is used. EPA typically uses these CDR codes to identify the COUs for the chemical in the published scope documents.

Figure_Apx D-1 depicts the steps that should be followed to map CDR reporting sites to OES. Each step is explained in the text below the figure. Additionally, Section 4.1 shows step-by-step examples for using the mapping procedures to determine the OES for three example CDR reporting facilities.



Figure_Apx D-1. OES Mapping Procedures for CDR

To map sites reporting to CDR, the following procedures should be used with the non-CBI CDR:

1. **Review Manufacturing and Import Activity Information:** The first step in the process is to review the reported activity information to identify if the facility imports or manufactures the chemical.

⁹ See [2020 CDR reporting instructions](#) (accessed August 11, 2025) for further information, including descriptions on the information required to be reported.

- 8547 a. If the facility reports domestic manufacturing, the manufacturing OES should be
8548 assigned, even if the facility also reports importation or the facility may conduct other
8549 operations with the chemical. This is because manufacturing of the chemical is expected
8550 to be the primary operation, with any other processing or uses being ancillary operations.
- 8551 b. If the chemical is being manufactured as a byproduct (this is a voluntary reporting
8552 element starting in 2020 CDR), this may need to be considered separately from non-
8553 byproduct manufacturing depending on assessment needs for the chemical.
- 8554 c. If the facility does not manufacture the chemical and only imports the chemical, check if
8555 additional processes occur at the site as described in the subsequent steps.
- 8556 2. ***For Importation Sites, Review Fields for “Imported Never at Site,” “Volume Exported,” and***
8557 ***“Volume Used”***: The next step is to review these additional fields to determine if the reporting
8558 facility conducts more than just importation activities.
- 8559 a. If the facility imports the chemical, they must report if it is imported but never physically
8560 at the reporting site. If the facility indicates the chemical is imported and never at site, the
8561 facility does not handle the chemical and the only applicable OES is importation. In such
8562 cases, the assessor should proceed to Step 4. If the facility does not indicate the chemical
8563 is imported and never at site, proceed to Step 2b.
- 8564 b. If the facility reports a quantity for “volume exported” and this quantity is the same as
8565 that imported, no additional OES occurs at the site beyond importation. In such cases, the
8566 assessor should proceed to Step 4. If the exported quantity is not equal to volume
8567 imported, assessors should check if any of the chemical is used at the reporting site per
8568 Step 2c.
- 8569 c. If the facility reports a quantity for “volume used,” additional OES may be applicable to
8570 the facility beyond manufacturing or importation. Proceed to Step 3 to identify and refine
8571 additional OES.
- 8572 3. ***Refine OES Assignments***: If multiple OES were identified from the previous steps, a single
8573 primary OES must be selected using additional facility information. OES determinations should
8574 be made with the following considerations:
- 8575 a. 6-digit NAICS code reported by the facility in CDR – note that this is only a requirement
8576 starting in 2020 CDR (e.g., for a facility that reported NAICS code was 325520,
8577 Adhesive Manufacturing, the incorporation into a formulation, mixture, or reaction
8578 product OES may be appropriate; for a facility reporting a NAICS code starting in
8579 424690, Other Chemical and Allied Products Merchant Wholesalers, only the
8580 repackaging OES is likely applicable).
- 8581 b. Downstream processing and use information reported in CDR. The reporting site must
8582 provide information on downstream processing and use of the chemical for all sites,
8583 meaning it cannot be distinguished which processing and use information includes the
8584 reporting site operations versus downstream site operations. However, this information
8585 may still help inform the operations at the reporting site and should be reviewed.
8586 Specifically, for a given processing/use activity, if the submitter reports “Fewer than 10
8587 sites” for the “number of sites” field (which is the lowest number of sites that can be
8588 reported), there is a likelihood that the facility’s operations may be included in this
8589 processing/use activity. In such cases, review the corresponding fields for “type of
8590 processing or use operation,” “industrial sector,” and “function category” to help identify
8591 the OES. The greater number of sites that are reported, the more likely that the associated

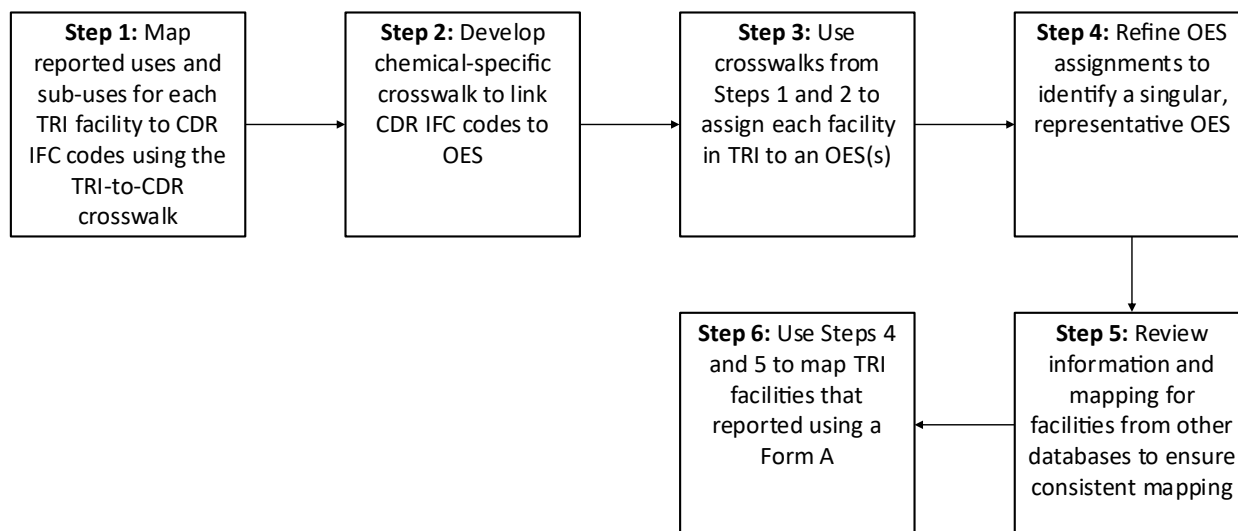
- processing and use information includes information from downstream sites and the less reliable the information is for mapping OES to the reporting site.
- c. Internet research of the types of products made at the facility (*e.g.*, if a facility's website indicates the facility manufactures plastic products, the chemical may be used as a processing aid or component in the plastic products, depending on the known uses of the chemical within the plastics industry).
 - d. Information from other reporting databases as described in Step 2c.
 - e. An evaluation of the OES that is most likely to result in a release (*e.g.*, for facilities that reported importation and may also conduct formulation per the reported NAICS code, the formulation OES may be assigned, because, in most cases, importation would have a lower likelihood of a release).
 - f. Grouped OES for similar uses (*e.g.*, multiple facilities that may conduct formulation operations based on the reported NAICS code may be assigned a grouped formulation OES that covers all types of formulation [*e.g.*, adhesives, paints, cleaning products])).
4. **Review Information from Other Databases:** Other databases/sources (such as TRI and DMR) should be checked to see if the facility has reported to these. If so, the OES determined from the mapping procedures for those databases (discussed in other sections of this document) should also be used. It is important that the same facility is mapped consistently across multiple databases/sources. The facility's TRI identification number (TRFID) and Facility Registry Services identification number (FRS ID) can be used to identify sites that report to TRI and DMR, and NEI. If the facility does not report to these databases, but additional OES are possible per Step 2, the assessor should search available facility information on the internet.

Given the information available in CDR, EPA expects that, for most chemicals, 100% of the sites reporting to CDR can feasibly be mapped to an OES.

D.2.2 Toxics Release Inventory (TRI)

TRI reporting is required for facilities that manufacture (including import), process, or otherwise use any TRI-listed chemical in quantities greater than the established threshold in the calendar year AND have 10 or more full-time employee equivalents (*i.e.*, a total of 20,000+ hours) and are included in a covered NAICS code. Therefore, unlike CDR reporters that are primarily manufacturers and importers, TRI reporters can be mapped to a variety of different OES.

Figure_Apx D-2 depicts the steps that should be followed to map TRI reporting sites to OES. Each step is explained in the text below the figure. Additionally, Section 4.1 shows step-by-step examples for using the mapping procedures to determine the OES for three example TRI reporting facilities.



Figure_Apx D-2. OES Mapping Procedures for TRI

To map sites reporting to TRI, the following procedures should be used:

1. **Assign Chemical Data Reporting Codes Using TRI-to-CDR Crosswalk:** The first step in the TRI mapping process is to map the uses and sub-uses reported by each facility to one or more 2016 CDR IFC codes. To do this, first compile all TRI uses/sub-uses for the reporting facility into a single column, then map them to CDR IFC codes using the TRI-to-CDR Use Mapping crosswalk. This is a universal crosswalk that applies to all chemicals.
2. **Develop Chemical-Specific Crosswalk to Link CDR Codes to OES:** The next step is to develop a separate CDR IFC code-to-OES crosswalk that links CDR IFC codes to OES for the chemical. To create this crosswalk, match the COU categories and subcategories from the COU table in the published scope documents to the list of 2016 CDR IFC codes in the CDR reporting instructions.¹⁰ The categories and subcategories of COUs typically match the IFC code category. Recent examples of already completed CDR IFC code-to-OES crosswalk can be found for the fenceline chemicals (1-bromopropane, methylene chloride, n-Methylpyrrolidone, carbon tetrachloride, perchloroethylene, trichloroethylene, and 1,4-dioxane).
3. **Assign OESs:** Each TRI facility is then mapped to one or more OES using the CDR IFC codes assigned to each facility in Step 1 and the CDR IFC code-to-OES crosswalk developed in Step 2.
4. **Refine OES Assignments:** If a facility maps to more than one OES in Step 3, a single primary OES must be selected using additional facility information. OES determinations should be made with the following considerations:
 - a. 6-digit NAICS codes reported by the facility in TRI (e.g., for a facility that reported TRI uses for both formulation and use as cleaner, EPA assigned the Formulation OES if the NAICS code was 325199, All Other Basic Organic Chemical Manufacturing; another example is NAICS codes 562211, Hazardous Waste Treatment and Disposal, and 327310, Cement Manufacturing, almost always correspond to the disposal OES, regardless of the reported TRI uses and sub-uses).

¹⁰ IFC codes and their definitions can be found in Table 4-11 of the CDR reporting instructions: <https://www.epa.gov/chemical-data-reporting/instructions-reporting-2016-tsca-chemical-data-reporting> (accessed August 11, 2025).

- b. Internet research of the types of products made at the facility (*e.g.*, if a facility's website indicates the facility manufactures metal parts, the facility is likely to use chemicals for degreasing or in a metalworking fluid) and information from sources cited in the COU table and scoping document, such as public and stakeholder comments (*i.e.*, EPA will review sources cited in the COU table and scoping document to see if there is any information specific to the reporting site that can be used to inform the mapping).
- c. Information from other reporting databases as described in Step 5.
- d. An evaluation of the OES that is most likely to result in a release (*e.g.*, facilities that reported both importation and formulation may be assigned a formulation OES, because, in most cases, importation would have a lower likelihood of a release).
- e. Grouped OES for similar uses/sub-uses (*e.g.*, facilities that reported cleaner and degreaser sub-uses may be assigned a grouped OES that covers both cleaning and degreasing because the specific cleaning/degreasing operation cannot be determined from the TRI data).
5. **Review Information from Other Databases:** Other databases/sources (including CDR, NEI, and DMR) should be checked to see whether the facility has reported to these. If so, the OES determined from the mapping procedures for those databases (discussed in other sections of this document) should also be used. It is important that the same facility is mapped consistently across multiple databases/sources. The facility's TRFID and FRS ID can be used to identify sites that report to TRI, DMR, and NEI.
6. Note that facilities that submit using a TRI Form A do not report TRI uses/sub-uses. To determine the OES for these facilities, EPA will use information from Steps 4 and 5 above.

Given the information available in TRI, EPA expects that, for most chemicals, 100% of the sites reporting to TRI can feasibly be mapped to an OES.

D.2.3 Discharge Monitoring Report (DMR)

Facilities must submit DMRs for chemicals when the following two conditions are met: (1) the facility has an NPDES permit for direct discharges to surface water, and (2) the NPDES permit contains monitoring requirements for the chemical of interest. Indirect discharges (*e.g.*, those sent to an off-site wastewater treatment plant or publicly owned treatment works) are not covered under the NPDES program.

If a facility has discharge monitoring requirements for the chemical of interest, these requirements are either technology-based or water-quality based. Typically, a facility has NPDES monitoring requirements for a chemical because the facility somehow manufactures, processes, or uses the chemical. However, it is possible for a facility to have monitoring requirements for a chemical they do not handle if the facility falls within a guideline containing requirements for that chemical, as described below.

- **Technology-Based Guidelines:** If the facility falls within a certain industrial sector, it may be covered by a national effluent guideline. Effluent guidelines are industry-specific and contain treatment technology-based guidelines for discharges of specified pollutants (chemicals) commonly found within that industry.¹¹ A common effluent guideline containing requirements for chemicals that have or are currently undergoing risk evaluation is the Organic Chemicals,

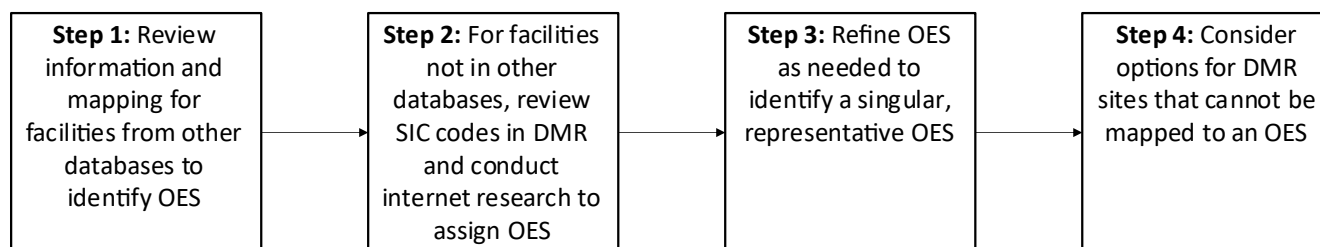
¹¹ A list of the industries for which EPA has promulgated effluent guidelines is available at: <https://www.epa.gov/eg/industrial-effluent-guidelines#existing> (accessed August 11, 2025).

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Plastics & Synthetic Fibers (OCPSF) effluent guideline. Alternatively, if there is no applicable effluent guideline for the facility, the permitting authority may establish technology-based guidelines using best professional judgment. If a facility falls within an existing effluent guideline, the permitting authority will generally include monitoring requirements in the facility's NPDES permit that are consistent with the effluent guideline, even if the facility does not handle all the chemicals for which there are monitoring requirements. Therefore, under this reasoning, it is possible that a facility reporting for the chemical of interest in DMRs does not actually handle the chemical.¹²

- *Water Quality-Based Guidelines:* The receiving water for the facility's discharges is impaired such that the permitting authority sets general water-quality based effluent limits and monitoring requirements for chemicals that may further impair the water quality. It is possible that the permitting authority uses these same general water-quality based requirements for all facilities that discharge to the water body. Therefore, under this reasoning, it is possible that a facility reporting for the chemical of interest in DMRs does not actually handle the chemical.⁵

Figure_Apx D-3 depicts the steps that should be followed to map DMR reporting sites to OESs. Each step is explained in the text below the figure. Additionally, Section 4 shows step-by-step examples for using the mapping procedures to determine the OES for two example DMR reporting facilities.



Figure_Apx D-3. OES Mapping Procedures for DMR

To map sites reporting to DMR, the following procedures should be used:

1. **Review Information from Other Databases:** Given the limited facility information reported in DMRs, the first step for mapping facilities reporting to DMR should be to check other databases/sources (including CDR, TRI, and NEI). If so, the OES determined from the mapping procedures for those databases (discussed in other sections of this document) should be used. It is important that the same facility is mapped consistently across multiple databases/sources. The facility's TRFID and FRS ID can be used to identify sites that report to TRI, DMR, and NEI.
2. **Assign OESs:** If the facility does not report to other databases, the following information should be used to assign an OES.
 - a. 4-digit SIC codes reported by the facility in DMR (*e.g.*, a facility that reported SIC code 2891, Adhesives and Sealants, likely formulates these products; a facility that reported SIC code 4952, Sewerage Systems, likely treats wastewater). Note that SIC codes can be crosswalked to NAICS codes, which are often more useful for mapping OES because they are more descriptive than SIC codes.
 - b. Internet research of the types of products made at the facility (*e.g.*, if a facility's website indicates the facility manufactures metal parts, the facility is likely to use chemicals for

¹² Note that a facility may request to have monitoring requirements reduced or removed from the permit where historical sampling demonstrates that these chemicals are consistently measured below the effluent limits. Thus, it is possible for a facility to cease monitoring for the chemical of interest upon approval by the permitting authority.

- degreasing or in a metalworking fluid) and information from sources cited in the COU table and scoping document, such as public and stakeholder comments (*i.e.*, EPA will review sources cited in the COU table and scoping document to see if there is any information specific to the reporting site that can be used to inform the mapping).
3. **Refine OES:** If the specific OES still cannot be determined using the information in Step 2, the following should be considered.
- a. NPDES permit numbers reported in DMR. The permit number generally indicates if the permit is an individual permit or a general permit.¹³ If the permit is a general permit, the permit number can often indicate the type of general permit, which can provide information on the operations at the facility.
 - Individual NPDES permits are numbered in the format of the state abbreviation followed by a 7-digit number (*e.g.*, VA0123456). General permits are usually numbered in the format of state abbreviation followed by one letter then a 6-digit number (*e.g.*, VAG112345 or MAG912345).
 - Since each state is slightly different in their general permit numbering, the general permit number should be searched on the internet to determine the type of general permit. For the general permit number examples provided above, a permit number beginning in “VAG11” signifies Virginia’s general permit for concrete products facilities and a permit number beginning with “MAG91” signifies Massachusetts’ general permit for groundwater remediation. Other common general permit types include those for construction sites, mining operations, sites that only discharge non-contact cooling water, and vehicle washes.
 - b. Searching for the permit online. If the specific NPDES permit for the facility can be found online, it may contain some general process information for the facility that can help inform the OES mapping. However, NPDES permits may be difficult to find online and do not generally contain much information on process operations.
 - c. An evaluation of the OES that is most likely to result in a water release (*e.g.*, for facilities that report an SIC code for the production of metal products, both vapor degreasing and metalworking fluid OES are applicable; in such cases, the metalworking fluid OES may be assigned because it is more likely to result in water releases than vapor degreasing).
 - d. Grouped OES for similar uses (*e.g.*, multiple facilities that may conduct formulation operations based on the reported SIC code may be assigned a grouped formulation OES that covers all types of formulation [*e.g.*, adhesives, paints, cleaning products]).
4. **Consider Options for DMR Sites That Cannot be Mapped to an OES:** Given the limited information available in DMR, it may not always be feasible to achieve mapping of 100% of the sites reporting to DMR to an OES. In such cases, multiple options may be appropriate depending on assessment needs, such as:
- a. Assigning the sites as having an unknown OES with 250 release days/year. This allows for subsequent exposure modeling and the assessment of risk. For sites with identified risk, the OES can then be mapped using the below resources.
 - b. Contacting the state government for the NPDES permit, permit applications, past inspection reports, and any available information on facility operations. Note that

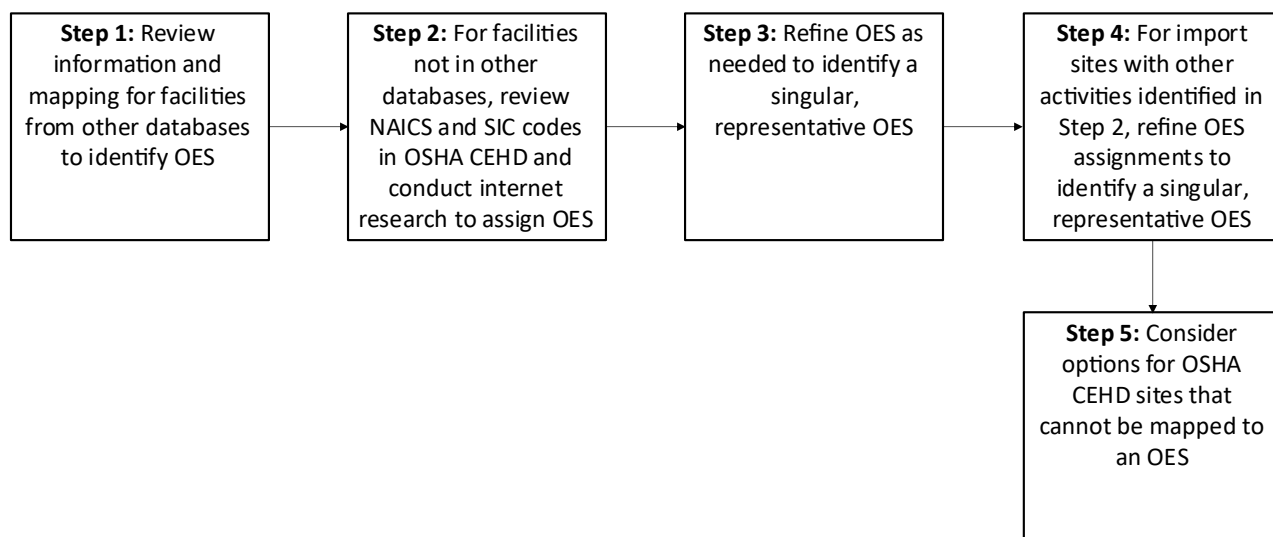
¹³ Information on individual and general NPDES permits can be found at: <https://www.epa.gov/npdes/npdes-permit-basics>

- information requests such as these may require an ICR if 10 or more entities are contacted.
- c. Contacting the facility for clarification on the use of the chemical. ICR requirements also apply when contacting 10 or more facilities.

D.2.4 Occupational Safety and Health Administration CEHD Data

OSHA CEHD is a compilation of industrial hygiene samples (*i.e.*, occupational exposure data) taken when OSHA monitors worker exposures to chemical hazards. OSHA will conduct monitoring at facilities that fall within targeted industries based on national and regional emphasis programs.¹⁴ OSHA conducts monitoring to compare against occupational health standards. Therefore, unlike CDR, TRI, NEI, and DMR, facilities are not required to report data to OSHA CEHD. Also, OSHA only visits selected facilities, so the amount of OSHA data available for each OES is often limited.

Figure_Apx D-4 depicts the steps that should be followed to map OSHA CEHD sites to OES. Each step is explained in the text below the figure. Additionally, Section 4.1 shows step-by-step examples for using the mapping procedures to determine the OES for two example OSHA CEHD facilities.



Figure_Apx D-4. OES Mapping Procedures for OSHA CEHD

Within the OSHA CEHD data, there may be sites for which all air sampling data are non-detect (below the limit of detection) for the chemical. In these cases, if there is also no bulk sampling data indicating the presence of the chemical, there is no evidence that the chemical is present at the site. OSHA may have sampled for the chemical based on a suspicion or pre-determined sampling plan, and not because the chemical was present at the site. Therefore, these sites do not need to be mapped to OES. To map sites for which there is OSHA CEHD data that are not all non-detect for the chemical, the following procedures should be used:

1. **Review Information from Other Databases:** Given the limited facility information reported in OSHA CEHD, the first step for mapping facilities should be to check other databases/sources (including CDR, TRI, NEI, and TRI). If so, the OES determined from the mapping procedures for those databases (discussed in other sections of this document) should be used. It is important

¹⁴ More information on OSHA CEHD can be found at: <https://www.osha.gov/opengov/health-samples> (accessed August 11, 2025).

that the same facility is mapped consistently across multiple databases/sources. Because facility identifiers such as TRFID and FRS ID are not available in the CEHD, the name of the facility in the CEHD will need to be compared to the facility names in other databases to identify if the facility is present in multiple databases/sources.

2. **Assign OES:** If the facility does not report to other databases, the following information should be used to assign an OES.
 - a. 4-digit SIC and 6-digit NAICS codes reported in the CEHD (e.g., a facility that reported SIC code 2891, Adhesives and Sealants, likely formulates these products; a facility that reported NAICS code 313320, Fabric Coating Mills, likely uses the chemical in fabric coating).
 - b. Internet research of the types of products made at the facility (e.g., if a facility's website indicates the facility manufactures metal parts, the facility is likely to use chemicals for degreasing or in a metalworking fluid) and information from sources cited in the COU table and scoping document, such as public and stakeholder comments (i.e., EPA will review sources cited in the COU table and scoping document to see if there is any information specific to the reporting site that can be used to inform the mapping).
3. **Refine OES:** If the specific OES still cannot be determined using the information in Step 2, the following should be considered.
 - a. An evaluation of the OES that is most likely to result in occupational exposures (e.g., for facilities that report an SIC code for janitorial services, multiple OES may be applicable, such as cleaning, painting (e.g., touch-ups), other maintenance activities; in such cases, the cleaning OES may be assigned for volatile chemicals because it has the highest exposure potential).
 - b. Grouped OES for similar uses (e.g., multiple facilities that may conduct formulation operations based on the reported NAICS or SIC code may be assigned a grouped formulation OES that covers all types of formulation [e.g., adhesives, paints, cleaning products]).
4. **Consider Options for OSHA CEHD Sites That Cannot be Mapped to an OES:** Given the limited information available in OSHA CEHD, it may not always be feasible to achieve mapping of 100% of the sites in the database to an OES. In such cases, multiple options may be appropriate depending on assessment needs, such as:
 - a. Assigning the sites as having an unknown OES with 250 exposure days/year. This allows for subsequent health modeling and the assessment of risk. For workers with identified risk, the OES can then be mapped using the below resources.
 - b. Contacting OSHA for additional information on the facility from the OSHA inspection/monitoring.
 - c. Contacting the facility for clarification on the use of the chemical. Note that information requests such as these may require an ICR if 10 or more entities are contacted.
 - d. As discussed previously, sites for which all air monitoring data is non-detect for the chemical and for which there is no bulk data indicating the presence of the chemical do not need to be mapped to an OES. This is because the data do not provide evidence that the chemical is present at the site.

D.2.5 National Institute of Occupational Safety and Health (NIOSH) Health Hazard Evaluation (HHE)

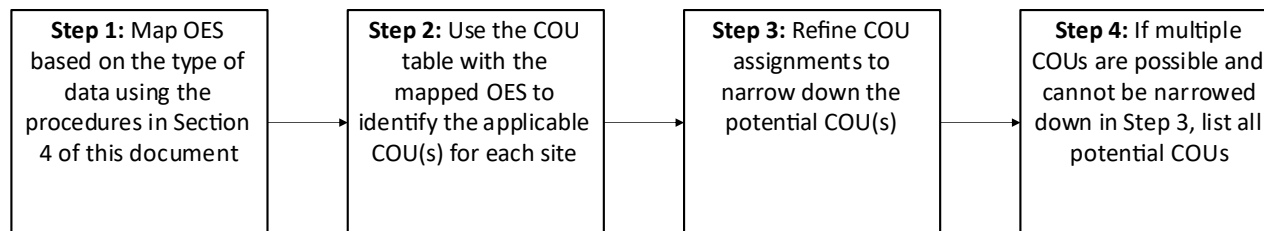
NIOSH conducts HHEs at facilities to evaluate current workplace conditions and to make recommendations to reduce or eliminate the identified hazards.¹⁵ NIOSH conducts HHEs at the request of employers, unions, or employees in workplaces where employee health and wellbeing is affected by the workplace. Therefore, unlike CDR, TRI, NEI, and DMR, facilities are not required to report data to NIOSH under the HHE program. Also, NIOSH only visits selected facilities where an HHE was requested, so the number of NIOSH HHEs available for each OES is often limited.

To map a facility that is the subject of a NIOSH HHE, the information in the HHE report should be used. Specifically, the HHE report typically includes general process information for the facility, information on how the chemical is used, worker activities, and the facility's SIC code. This information should be sufficient to map the facility to a single representative OES. Additionally, given the extent of information available about the subject facilities in NIOSH HHE reports, 100% of these facilities can be mapped to an OES. Additionally, Section 4 shows two examples of how to map NIOSH HHE facilities to OES.

D.3 COU Mapping Procedures

As discussed in Section 4, there is not always a one-to-one mapping between COUs and OESs.

Figure_Apx D-5 depicts the steps that should be followed to map sites from the standard sources discussed in this document to COUs, using the OES mapping completed in Appendix D. Each step is explained in the text below the figure. Additionally, Section 4.1 shows step-by-step examples for using the mapping procedures to determine the COU for three example facilities.



Figure_Apx D-5. COU Mapping Procedures for Standard Sources Already Mapped to OES

To map facilities from standard sources (*i.e.*, CDR, TRI, NEI, DMR, OSHA CEHD, NIOSH HHE) to COUs, the following procedures should be used:

1. **Map the Facility to an OES:** To map a facility from a standard source to a COU, the facility should first be mapped to an OES following the procedures for the specific source of data.
2. **Use the COU Table with Mapped OES to Assign COUs:** At the point of the risk evaluation process where EPA are mapping data from standard sources to OES and COU, EPA have already mapped OES to each of the COUs from the scope document, like is shown in Table 4-1. This crosswalk between COUs and OES should be used to identify the COU(s) for the facility using the OES mapped per Section 4.1.

¹⁵ More information about NIOSH HHEs is available at: <https://www.osha.gov/opengov/health-samples> (accessed August 11, 2025) <https://www.cdc.gov/niosh/hhe/about.html>.

- 8882 3. ***Refine the COU Assignment:*** In some instances, more than one COU may map to the facility. In
8883 such cases, the following information should be used to try to narrow down the list of potentially
8884 applicable COUs:
- 8885 a. Information from the standard sources (*e.g.*, if EPA assigned a grouped OES like
8886 “Industrial Processing Aid” and the facility’s NAICS code in TRI or NEI is related to
8887 battery manufacturing, the COU can be identified as the “Processing Aid” category and
8888 Process solvent used in battery manufacture” subcategory).
- 8889 b. Internet research of the types of products made at the facility (*e.g.*, if a facility’s website
8890 indicates the facility makes adhesives, the COU category of “Processing – Incorporation
8891 into formulation, mixture or reaction product” and subcategory of “Adhesives and sealant
8892 chemicals” can be assigned and the remaining subcategories [*e.g.*, solvents for cleaning
8893 or degreasing, solvents which become part of the product formulation or mixture] are not
8894 applicable) and information from sources cited in the COU table and scoping document,
8895 such as public and stakeholder comments (*i.e.*, EPA will review sources cited in the COU
8896 table and scoping document to see if there is any information specific to the reporting site
8897 that can be used to inform the mapping).
- 8898 4. ***List all Potential COUs:*** Where the above information does not narrow down the list of
8899 potentially applicable COUs, EPA will list all the potential COUs and will not attempt to select
8900 just one from the list where there is insufficient information to do so.

Appendix E ESTIMATING DAILY WASTEWATER DISCHARGES FROM DISCHARGE MONITORING REPORTS AND TOXICS RELEASE INVENTORY DATA

This appendix provides steps and examples for estimating daily wastewater discharges from industrial and commercial facilities manufacturing, processing, or using chemicals undergoing risk evaluation under the TSCA. Wastewater discharges are reported either via DMRs under the NPDES or TRI.

The following estimation methods are provided:

- average daily wastewater discharge rate (kg/site-day);
- high-end daily wastewater discharge rate (kg/site-day);
- 1-day maximum wastewater discharge rate (kg/site-day); and
- trends over 5 years for a facility including the minimum, maximum, and median wastewater discharge rate that has occurred for a facility within the past 5 years.

These estimates will be used in modeling to estimate surface water concentrations in receiving waters for the assessment of risks to aquatic species and to the general population from drinking water.

E.1 Collecting and Mapping Wastewater Discharge Data to COUs and OESs

The first step in estimating daily releases is obtaining and mapping the relevant data to the TSCA COUs for the chemical that were identified in the scoping document. Some COUs may be broad categories of use and additional steps may be taken in the draft risk evaluation to further define the COUs into more specific OESs. A methodology for how to do this mapping step has been developed and the key steps are described below.

1. Query the Loading Tool and TRI for each of the past 5 years, starting with the most recent calendar year for which TRI data are available. In general, when a facility reports under both the NPDES program and TRI, EPA will perform comparisons of the data to determine if any discrepancies exist and, if so, which data are more appropriate to use in the risk evaluation. However, the two data sets are not updated concurrently. The Loading Tool automatically and continuously checks ICIS-NPDES for newly submitted DMRs. The Loading Tool processes the data weekly and calculates pollutant loading estimates; therefore, water discharge data (DMR data) are available on a continual basis. Although the Loading Tool process data weekly, each permitted discharging facility is only required to report their monitoring results for each pollutant at a frequency specified in the permit (*e.g.*, monthly, every 2 months, quarterly). TRI data is only reported annually for the previous calendar year and is typically released in July (*i.e.*, 2020 TRI data is released in July 2021). To ensure EPA is making an appropriate comparison between the two data sets, EPA should only use data for years where data from both data sets are available.
2. Remove the following DMR facility types from further analysis:
 - a. Facilities reporting zero discharges for the chemical of interest for each of the 5 years queried as EPA cannot confirm if the pollutant is present at the facility.
3. Map each remaining facility to a COU and OES; the OES will inform estimates of average operating days per year for the facility.

E.2 Estimating the Number of Facility Operating Days per Year

The number of operating days per year (days/year) for each facility that reports wastewater discharges

may be available but will most likely be unknown. An approach has been developed for use in TSCA risk evaluations for estimating the number of facility operating days before and is described in Section 4.2.5.

E.3 Approach for Estimating Daily Discharges

After the initial steps of selecting and mapping of the water discharge data and estimating the number of facility operating days/year have been completed, the next steps in the analysis are to make estimates of daily wastewater discharges. This guidance presents approaches for making the following estimates:

- Average daily wastewater discharges – this approach averages out the yearly discharges into an average daily discharge rate for the entire year for the facility
- High-end daily wastewater discharges – this approach estimates a high-end daily discharge rate that may take place for a period of time during the year for the facility
- 1-Day maximum discharge rate – this approach estimates a discharge rate that may represent a 1-day maximum rate for the facility.

E.3.1 Average Daily Wastewater Discharges

The following steps should be used to estimate the average daily wastewater discharge for each facility for each year:

1. Obtain total annual loads calculated from the Loading Tool and reported annual surface water discharges in TRI.
2. For facilities with both TRI and DMR data, compare the annual surface water discharges reported to each to see if they agree. If not, select the data representing the highest annual discharge.
3. Divide the annual discharge over the number of estimated operating days for the OES to which the facility has been mapped. The number of operating days will differ for each OES and chemical but typically ranges from 200 to 350 days/year (see Section 4 for approach to estimating operating days/year).

This approach can be used for both direct discharges to surface water and indirect discharges to POTW or non-POTW WWT. However, special care should be given to facilities reporting transfers to POTW or non-POTW WWT plants in TRI as the subsequent discharge to surface water from these transfers may already be accounted for in the receiving facilities DMRs.

E.3.2 High-End Daily Direct Discharge for Facilities with DMR Data

The following steps should be used to estimate the high-end daily direct discharge for each facility with DMR data for each year:

1. Use the Loading Tool to obtain the reporting periods (*e.g.*, monthly, bimonthly, quarterly, biannually, annually) and required reporting statistics (*e.g.*, average monthly concentration, max daily concentration) for each external outfall at each facility. When there is one outfall reported in the Loading Tool, assume it is an external outfall. If multiple outfalls are reported in the Loading Tool, further investigation to determine the external outfall would be required, such as a review of facility's permits.
2. For each external outfall at each facility, calculate the average daily load for each reporting period by multiplying the period average concentration by the period average wastewater flowrate. If there is one outfall reported in the Loading Tool, assume it is an external outfall. Further investigation is needed if multiple outfalls are reported in the Loading Tool to determine the external outfall, such as a review of the facility's permit.

3. Sum the average daily loads from each external outfall for each period.
4. Select the period with the highest average daily load across all external outfalls as an estimate of the high-end daily discharge assessed over the number of days in the period. The number of days in the reporting period does not necessarily equate to the number of operating days in the reporting period. For example, for a plant that operates 200 days/year, use 200 rather than 365 days/year for average daily discharge. Therefore, discharges will not occur every day of the reporting period, but only for a fraction ($200 \div 365 = 68\%$). The number of days of the reporting period should be multiplied by this factor to maintain consistency between operating days/year and operating days/reporting period.

E.3.3 High-End Daily Direct Consecutive Discharge for Facilities Without DMRs

Some facilities may report surface water discharges to TRI but are not required to monitor or report those discharges under the NPDES. In such cases, EPA will only have the annual discharge value and not discharge values from multiple periods throughout the year. To estimate the high-end daily direct discharges for these facilities the following steps should be used:

1. Identify facilities that report under the NPDES program for the same chemical, same year, and same OES as the TRI facility and report DMRs monthly. Note: if no monthly reporters exist, reporters with less frequent reporting can be substituted provided the number of release days per year are adjusted in subsequent steps.
2. For each facility identified in #1, calculate the percentage of the total annual discharge that occurred in the highest one-month period.
3. Calculate a generic factor for the OES as the average of the percentages calculated in #2.
4. Estimate the high-end daily discharge for each facility without DMRs by multiplying the annual discharge by the generic factor from #3. For example, a facility reports 500 lb released per year and has a generic factor of 15% for the OES from #3. The estimated high-end chronic daily discharge for the facility would be ($500 \text{ lb} \times 15\% = 75 \text{ lb/month}$).
5. Use the value calculated in #4 as an estimate of the high-end daily discharge assessed over 30 days per year. For example, the high-end daily discharge assessed over 30 days per year for the facility with the estimated high-end chronic daily discharge of 75 lb/month (from #4 above) is ($75 \text{ lb/month} \div 30 \text{ days} = 2.5 \text{ lb/day for 30 days}$).

This approach can also be applied to facilities that have less frequent reporting periods under the NPDES program (e.g., facilities that report quarterly or biannually). Use the facility specific permit data for less frequent reporting periods. Refer to Section 4 for additional details.

E.3.4 High-End Daily Indirect Discharges

In general, EPA is unlikely to have detailed information to estimate high-end daily indirect discharges to POTWs or non-POTW WWT plants and will only be able to calculate average daily discharges. However, in some cases, EPA may have site-specific information that allows for the estimation of a range for the release days per year (e.g., such information can be found in ECHO). In such instances, EPA can calculate the high-end daily discharge as the annual discharge divided by the minimum number of release days per year.

E.3.5 1-Day Discharges

Facilities required to report under the NPDES may sometimes be required to report a daily maximum discharge concentration for the period. These values can be used to estimate 1-day discharges by multiplying the maximum daily concentration by the corresponding month's maximum daily wastewater

9024 flow rate.

9025 **E.4 Trends in Wastewater Discharge Data – 5 Year Data Characterization**

9026 Wastewater discharge data may vary from year to year for a facility due to factors including the
9027 economy. A trend of the releases from each facility can be used to characterize results and develop a
9028 range of potential discharges from each site. A 5-year period will be used for this analysis. Prior to
9029 calculating the 5-year statistics, it is recommended that an evaluation be done of whether the 5-year
9030 range includes any outlier years and remove them from the analysis to ensure no atypical years are being
9031 included in the statistics. The interquartile rule for outliers can be used for this analysis.

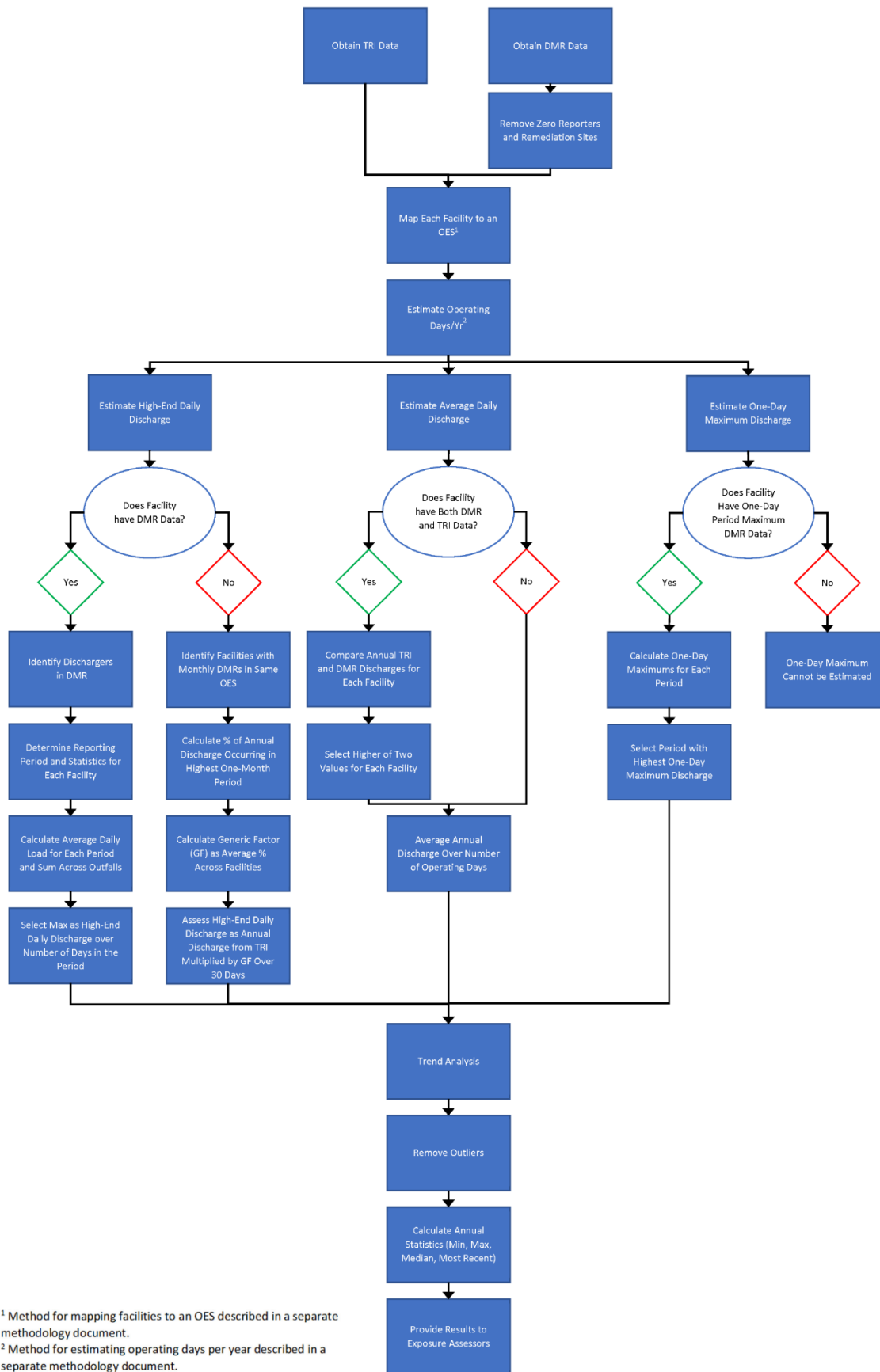
9032
9033 The interquartile rule for outliers states that if the distance between a data point and the first or third
9034 quartile is greater than 1.5 times the interquartile range (IQR), the data point is an outlier. The IQR is the
9035 difference between the third quartile (*i.e.*, 75th percentile) and first quartile (*i.e.*, 25th percentile) of a
9036 dataset. Therefore, any values less than 25th percentile minus 1.5 IQR or values exceeding the 75th
9037 percentile plus 1.5 IQR would be considered outliers.

9038
9039 After any outliers are removed, the following 5-year statistics should be determined for each facility:

- 9040 1. Minimum, maximum, median, and most recent (if different than the maximum) annual
9041 discharge;
- 9042 2. Minimum, maximum, median, and most recent (if different than the maximum) average chronic
9043 daily discharge;
- 9044 3. Minimum, maximum, median, and most recent (if different than the maximum) high-end chronic
9045 daily discharge; and
- 9046 4. Minimum, maximum, median, and most recent (if different than the maximum) acute 1-day
9047 discharge.

9048 **E.4.1 Decision Tree for DMR and TRI Wastewater Discharge Estimates**

9049 A Decision Tree for Wastewater Discharge Estimates Using TRI and/or DMR Data, provided as
9050 Figure_Apx E-1 below, helps visualize the process for estimating daily discharges.



¹ Method for mapping facilities to an OES described in a separate methodology document.

² Method for estimating operating days per year described in a separate methodology document.

Figure_Apx E-1. Decision Tree for Wastewater Discharge Estimates Using TRI and DMR Data

Appendix F GUIDANCE FOR USING THE TOXICS RELEASE INVENTORY FOR ESTIMATING AIR RELEASES

This appendix provides guidance for using EPA's TRI data to estimate air releases for certain chemicals undergoing risk evaluation under TSCA. These estimates will be used as inputs to air modeling for the purpose of estimating ambient air concentrations. Note that in prior risk evaluation reports, EPA uses NEI data to quantify air emissions of the chemical undergoing risk evaluation. However, *o*-dichlorobenzene is not listed as a CAA-HAP, and facilities do not report *o*-dichlorobenzene air releases to NEI. Therefore, NEI database is not used for any industrial/commercial *o*-dichlorobenzene release estimation.

F.1 Background

EPA's TRI compiles facility-reported airborne chemical releases (including some TSCA-evaluated chemicals) with details on sources, magnitudes, and release types (*e.g.*, stack vs. fugitive). These data can support air-release estimates for relevant OESs; this appendix outlines the approach for using TRI data.

F.2 Obtaining Air Emissions Data

F.2.1 Obtaining TRI Data

TRI data may be downloaded from EPA's public TRI Program and [TRI Data and Tools website](#). Once the csv file(s) has (have) been downloaded, the data are filtered by the chemical of interest using the CAS number and/or chemical name. Relevant TRI data fields include reporting year, facility identifying information (*e.g.*, name, address, FRS ID, and TRIFID), chemical information (chemical name, CASRN), primary NAICS codes, fugitive air releases, and stack air releases.

F.3 Mapping TRI Data to Occupational Exposure Scenarios

Once TRI data is obtained, the next step is to map the data to OESs. For procedures for mapping facilities from TRI and NEI to OESs, refer to Table 4-1.

F.4 Estimating Air Releases Using TRI Data

EPA will use the mapped TRI data to develop facility- and/or release-point-specific emissions estimates for chemicals undergoing TSCA risk evaluation. The data summary will include pertinent information for risk evaluation and emission modeling, such as facility location, annual releases, daily releases, operating information, release type (*i.e.*, stack vs. fugitive), and stack parameters. EPA will review the TRI data to ensure that facilities with records are assigned to a consistent OES.

F.4.1 Evaluation of Sub-Annual Emissions

As air emissions data in TRI is reported as annual values, sub-annual (*e.g.*, daily) emissions must be calculated from information on release duration, release days, and release pattern. TRI does not report information on release duration or pattern, but this information may be estimated from other sources of release duration and pattern information, such as GSs and ESDs, literature sources, process information, and standard engineering methodology for estimating number of release days. These sources are described in further detail below, in order of preference.

Sources for Estimating Release Duration

1. *Models* – Models used to estimate air emissions and associated inhalation exposures (e.g., Tank Truck and Railcar Loading and Unloading Release and Inhalation Exposure Model, Open-Top Vapor Degreasing Near-Field/Far-Field Inhalation Exposure Model, Spot Cleaning Near-Field/Far-Field Inhalation Exposure Model, models from GS/ESDs) sometimes include data on release duration, which are usually either cited from literature or based on generic assumptions about the activity being modeled. Release duration information from models may be presented with non-modeled air emission data from TRI, if the model is applicable and expected to represent the primary release source for the OES (e.g., release duration from the Tank Truck and Railcar Loading and Unloading Release and Inhalation Exposure Model may be used with estimates of air emissions for a facility in the Repackaging OES). For models that calculate release duration as a distribution, such as from Monte Carlo simulations, the mean and range of release durations from the model should be presented with the air emission estimate.
2. *Literature* – Literature sources from systematic review, including GS/ESDs, are another source of information for release duration. Often, release duration information from literature sources may be broad, such as a range of durations for a given operation. Alternatively, literature sources may describe release duration qualitatively, such as “on and off throughout the day” or “over half the day.” Therefore, literature sources may inform release duration at the OES-level, as opposed to at the facility-level. All details from literature sources on release duration, including qualitative descriptions, should be presented with air emission estimates if they are available and there is no other source of this data.
3. *List as “Unknown”* – Often, no information on release duration is available at either the facility or OES-level from the above sources. In these cases, engineers should list that the release duration is unknown.

Sources for Estimating Release Pattern

1. *Models* – Models used to estimate air emissions (e.g., Tank Truck and Railcar Loading and Unloading Release and Inhalation Exposure Model, Open-Top Vapor Degreasing Near-Field/Far-Field Inhalation Exposure Model, Spot Cleaning Near-Field/Far-Field Inhalation Exposure Model, models from GS/ESDs) sometimes, but rarely, include data on release pattern from the underlying data sources. Release pattern information from models may be presented with non-modeled air emission data (e.g., TRI) if the model is applicable and expected to represent the primary release source for the OES (e.g., release pattern from the Tank Truck and Railcar Loading and Unloading Release and Inhalation Exposure Model may be used with estimates of air emissions for a facility in the Repackaging OES).
2. *Literature* – Literature sources from systematic review, including GS/ESDs, are another source of information for release pattern. Often, literature sources provide general release pattern information for a given operation. Therefore, literature sources may inform release pattern at the OES-level, as opposed to at the facility-level. All details from literature sources on release pattern, even if general and/or limited, should be presented with air emission estimates, if they are available and there is no other source of this information.
3. *List as “Unknown” and Provide Operating Days* – Often, no information on release pattern is available at either the facility or OES-level from the above sources. In these cases, engineers should do the following:
 - a. List that the release pattern is unknown.
 - b. Provide the number of operating days for the facility based on project-level engineering methodology, which is summarized below.

- c. Provide any information based on process knowledge (e.g., commercial aerosol degreasing using cans may occur on/off throughout a day and year).

Estimating Number of Operating Days for Point Sources

For major sources reporting data in TRI, EPA will estimate operating hours using the data sources described above. A hierarchical approach for estimating the number of facility operating days per year is described below.

1. *Facility-Specific Data* – Use facility-specific data, if available.
 - a. If possible, calculate operating days per years as: $\text{days/yr} = \text{hours per year} \div \text{hours per day}$.
 - b. If hours per year and/or hours per day are not reported, calculate days per year as: $\text{days/yr} = \text{days per week} \times \text{weeks per year}$.
2. *Facility-Specific Use Rates* – If information on facility-specific use rates is available, estimate days/year using one of the following approaches:
 - a. If facilities have known or estimated average daily use rates, calculate the days/year as: $\text{Days/yr} = \text{Estimated Annual Use Rate for the Site (kg/yr)} \div \text{average daily use rate from sites with available data (kg/day)}$.
 - b. If sites without days/year data do not have known or estimated average daily use rates, use the average number of days/year from the sites with such data.
3. *Industry-Specific Data* – Industry-specific data may be available in the form of GSs, ESDs, trade publications, or other relevant literature. In such cases, these estimates should take precedent over other approaches, unless facility-specific data are available.
4. *Manufacture of Large-PV Commodity Chemicals* – For the manufacture of the large-PV commodity chemicals, a value of 350 days/year should be used. This assumes the plant runs 7 day/week and 50 week/yr (with 2 weeks down for turnaround) and assumes that the plant is always producing the chemical.
5. *Manufacture of Lower-PV Specialty Chemicals* – For the manufacture of lower-PV specialty chemicals, it is unlikely the chemical is being manufactured continuously throughout the year. Therefore, a value of 250 days/year should be used. This assumes the plant manufactures the chemical 5 days/week and 50 weeks/year (with 2 weeks down for turnaround).
6. *Processing as Reactant (Intermediate Use) in the Manufacture of Commodity Chemicals* – As noted above, the manufacture of commodity chemicals is assumed to occur 350 days/year such that the use of a chemical as a reactant to manufacture a commodity chemical will also occur 350 days/year.
7. *Processing as Reactant (Intermediate Use) in the Manufacture of Specialty Chemicals* – As noted above, the manufacture of specialty chemicals is not likely to occur continuously throughout the year. Therefore, a value of 250 days/year can be used.
8. *Other Chemical Plant OES (e.g., Processing into formulation and Use of industrial processing aids)* – For these OESs, it is reasonable to assume that the chemical of interest is not always in use at the facility, even if the facility operates 24/7. Therefore, a value of 300 days/year can be used, based on the European Solvent Industry Group's "SpERC fact sheet – Formulation & (re)packing of substances and mixtures – Industrial (Solvent-borne)" default of 300 days/year for the chemical industry. However, in instances where the OES uses a low volume of the chemical of interest, 250 days/year can be used as a lower estimate for the days/year.

9. *All Other OESs* – Regardless of facility operating schedule, other OESs are unlikely to use the chemical of interest every day. Therefore, a value of 250 days/year should be used for these OESs.

Estimating Number of Operating Days for Area Sources

For area sources, EPA will also estimate operating days per year using general information about the OES, and values from literature. Facility operating days per year will be used to calculate daily emissions from the TRI annual emissions data, as follows:

$$\text{Daily emissions (kg/day)} = \text{Annual emissions (kg/yr)} \div \text{Operating days per year (days/year)}$$

Appendix G AIR MONITORING CONCENTRATIONS FOR *o*-DICHLOROBENZENE

G.1.1 Air Quality System (AQS) Monitoring Data

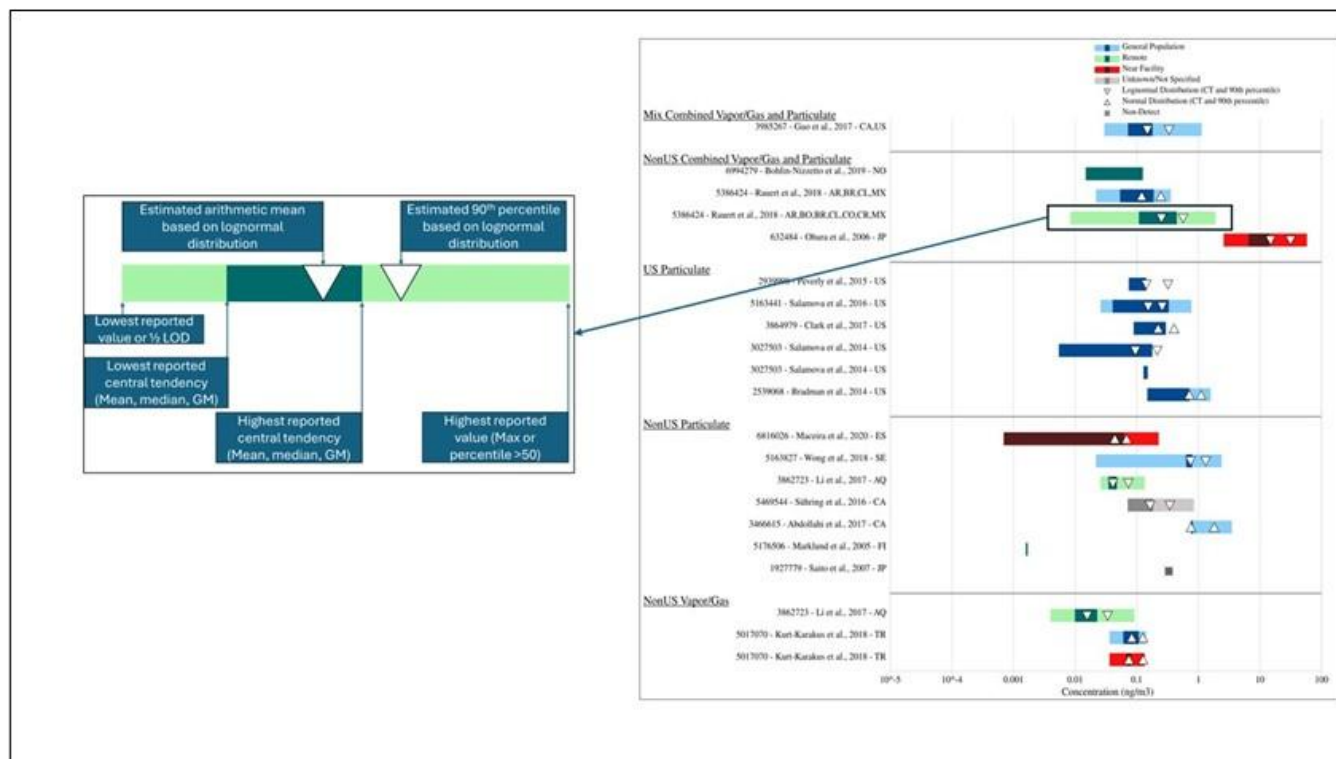
Table_Apx G-1. Summary of AQS Monitoring Data 2019–2023 for *o*-Dichlorobenzene

Air Quality System							
Chemical	Sample Duration	Statistic (µg/m ³)	Year				
			2019	2020	2021	2022	2023
<i>o</i> -Dichlorobenzene	24-Hour	Maximum	2.31E01	1.88E01	7.04E00	1.50E00	2.46E00
		Arithmetic Mean	3.17E–02	2.83E–02	2.22E–02	2.44E–02	7.78E–03
		Without Zeros	1.95E–01	1.45E–01	1.15E–01	1.06E–01	4.44E–02
		Geometric Mean	0.00E00	0.00E00	0.00E00	0.00E00	0.00E00
		Without Zeros	4.42E–02	3.70E–02	3.07E–02	3.34E–02	1.92E–02
		Median	0.00E00	0.00E00	0.00E00	0.00E00	0.00E00
		Without Zeros	4.21E–02	2.00E–02	2.00E–02	1.50E–02	1.00E–02
		Minimum	0.00E00	0.00E00	0.00E00	0.00E00	0.00E00
		Without Zeros	6.01E–03	1.00E–02	6.01E–03	1.00E–02	1.00E–02
		Total Samples	6,602	6,212	6,601	6,462	5,211
		Total Zeros	5,526	4,997	5,330	4,976	4,299
		Zeros %	83.7%	80.4%	80.7%	77%	82.5%

Appendix H SUPPLEMENTAL INFORMATION OF PEER-REVIEWED LITERATURE AND STUDY RATINGS FOR MEASURED CONCENTRATIONS OF *o*-DICHLOROBENZENE

H.1 Environmental Monitoring Concentrations Reported by Media Type

H.1.1 Tornado Plot Interpretations and Methods



Figure_Apx H-1. Example Tornado Plot

Tornado plots display exposure data from studies identified during systematic review. An example is provided in Figure_Apx H-1. In this draft TSD, there is one tornado plot for every media type where chemical concentrations are plotted on a logarithmic scale.

The y-axis of the tornado plot is a list of each study aggregate representing a media sampled in a similar micro-environment and location type and reported on the same unit/weight basis. A study may have more than one aggregate representation dependent on how the data is reported; for example, if a study reports exposure data for two different location types separately, the data would be plotted as two separate aggregates.

Exposure data is classified into a variety of location types:

- **Indoor Air Classifications**

- Indoor air samples are classified based on sampling location micro-environments such as commercial buildings, residential homes, public buildings (offices, schools), and vehicles. If the reported study data represent a combination of more than one of these

micro-environments, then they are classified as mixed use.

H.2 Groundwater, Sediment, Soil and Surface Water Classifications

Near Facility

Near Facility exposures are collected near buildings or activities that are industrial in nature (including manufacturing, mining, pulp and paper mill, wastewater treatment plants, fire training facilities, ports), commercial activities known to use chemicals (such as dry cleaners, gas stations, and construction sites), residential areas near a facility (these areas may be referred to as “fence-line communities” or “highly-exposed communities”), or ocean samples from a port or contaminated area. Near facility samples are not strictly contaminated sites and may be site-specific or not site-specific.

General Population

General population exposures are ambient measurements taken in areas near residential populations with no known near facility sources nearby. The data often represents widely distributed releases to the environment.

Remote

Remote exposures are measurements taken in areas away from residential and industrial activity and have no known sources of contamination beyond long-range transport. Examples of remote exposures include samples collected from polar regions, samples from oceans (not including ports), and sample locations specifically described as remote.

Drinking Water Classifications: Drinking water samples will indicate their sampling location at the drinking water plant or distribution system.

Wastewater Classifications: Wastewater samples will indicate their sampling location at the wastewater processing facility.

Each study on the y-axis is reported with its HERO ID, a short citation, and the country abbreviation of data collection. The studies are grouped by country (United States or Canada) and by unit/weight basis, and sorted in descending order by latest sample collection year.

Every study has a colored bar stretching across the x-axis. The color of the bar corresponds to the location type of the exposure data. The lighter bar represents the range of the reported concentrations, and the darker bar represents the range of reported central tendencies. A study with only dark bars indicates that the only data reported was a measure of central tendency.

Using the reported exposure data, we attempted to represent the arithmetic mean and 90th percentile. If sufficient central tendency and variance data were reported, the mean and 90th percentile were calculated directly from the study values where we could assume data were normally or lognormally distributed. When at least a central tendency and percentile value were provided, they were estimated by fitting the data to a lognormal distribution to all available data within the study aggregate. When fitting a lognormal distribution was not possible, a normal distribution was fit. The central tendency and 90th percentile of each distribution are plotted as triangles. Lognormal values are shown as upside-down triangles, while normal values are shown as right-side up. A study with no triangles indicates that there was insufficient data to fit a distribution.

A study may not have reported concentrations because all data is below the limit of detection. In these circumstances, the plot will show a circle with an X through it plotted at half the reported limit of detection. The color of the symbol will correspond to the color of the data's location type.

H.3 Supplemental Information of Peer-Reviewed Literature for Measured Concentrations of *o*-Dichlorobenzene

Table_Apx H-1. Summary of Peer-Reviewed Literature That Measured *o*-Dichlorobenzene ($\mu\text{g}/\text{m}^3$) Levels in the Vapor/Gas Fraction of Indoor Air

Reference	Country	Location Type	Sampling Years	Sample Size (Frequency of Detection)	Detection Limit ($\mu\text{g}/\text{m}^3$)	Overall Quality Level
Chin et al. (2014)	US	Residential	2009–2010	325 (0.02)	0.01	High
NYIEQ (2005)	US	Residential	2001–2003	130 (0.06)	N/R	Medium
Lindstrom et al. (1995)	US	Residential	1992–1993	36 (0.06)	2.4	Medium
Li et al. (2019)	CA	Residential	2012–2013	3524 (0.17)	0.018	High
CA = Canada; N/R = not reported; US = United States						

Table_Apx H-2. Summary of Peer-Reviewed Literature That Measured *o*-Dichlorobenzene ($\mu\text{g}/\text{L}$) Levels in Drinking Water

Reference	Country	Location Type	Sampling Years	Sample Size (Frequency of Detection)	Detection Limit ($\mu\text{g}/\text{L}$)	Overall Quality Level
Hopple et al. (2009)	US	Drinking water treatment plant or distribution system	2004–2005	71 (0)	0.048	High
Kingsbury et al. (2008)	US	Drinking water treatment plant or distribution system	2002–2004	147 (0)	0.048	High

Table_Apx H-3. Summary of Peer-Reviewed Literature That Measured *o*-Dichlorobenzene ($\mu\text{g}/\text{L}$) Levels in Surface Water

Reference	Country	Location Type	Sampling Years	Sample Size (Frequency of Detection)	Detection Limit ($\mu\text{g}/\text{L}$)	Overall Quality Level
Coiner et al. (2010)	US	Near Facility	2007–2008	8 (0)	11.8	High
Chen and Zoltek (1995)	US	Near Facility	1989–1993	12 (0.50)	N/R	Medium
N/R = not reported						

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Table_Apx H-4. Summary of Peer-Reviewed Literature That Measured *o*-Dichlorobenzene (µg/L) Levels in Groundwater

Reference	Country	Location Type	Sampling Years	Sample Size (Frequency of Detection)	Detection Limit (µg/L)	Overall Quality Level
Hopple et al. (2009)	US	General Population	2002–2005	292 (0)	0.048	High
Westinghouse Savannah River Company (1997)	US	Near Facility	1995–1996	304 (0.07)	0.05	Medium
Chen and Zoltek (1995)	US	Near Facility	1989–1993	8 (0.75)	N/R	Medium
Heck et al. (1992)	US	Near Facility	1990	13 (0.23)	0.2	Medium
N/R = not reported; US = United States						

Table_Apx H-5. Summary of Peer-Reviewed Literature That Measured *o*-Dichlorobenzene (µg/L) Levels in Wastewater

Reference	Country	Location Type	Sampling Year	Sample Size (Frequency of Detection)	Detection Limit (µg/L)	Overall Quality Level
Conn et al. (2006)	US	Treated Effluent	2003–2004	90 (0)	0.5	Medium
Sauer and Tyler (1996)	US	Treated Effluent	1991–1992	85 (0.13)	N/R	Medium
N/R = not reported; US = United States						

Table_Apx H-6. Summary of Peer-Reviewed Literature That Measured *o*-Dichlorobenzene (ng/g) Levels in the Dry Fraction of Sediment

Reference	Country	Location Type	Sampling Years	Sample Size (Frequency of Detection)	Detection Limit (ng/g)	Overall Quality Level
Coiner et al. (2010)	US	Near Facility	2007–2008	19 (0)	1460	High
Yun and Kannan (2011)	US	General Population	2002–2004	57 (N/R)	0.02	Medium
Yun and Kannan (2011)	US	Near Facility	2002	18 (N/R)	0.02	Medium

Table_Apx H-7. Summary of Peer-Reviewed Literature That Measured *o*-Dichlorobenzene (ng/g) Levels in Soil

Reference	Country	Location Type	Sampling Year	Sample Size (Frequency of Detection)	Detection Limit (ng/g)	Overall Quality Level
Dry						
Yun and Kannan (2011)	US	General Population	2002–2004	32 (N/R)	0.02	Medium
Yun and Kannan (2011)	US	Near Facility	2002	6 (N/R)	0.02	Medium
Not specified						
Jang and Townsend (2001)	US	Near Facility	2001	12 (0.08)	5	Medium

Appendix I INTEGRATED INDOOR/OUTDOOR AIR CALCULATOR MODELING

I.1.1 IIOAC Screening Assessment Results

A total of 22 TRI form R reporting facilities reported releases of *o*-dichlorobenzene to the ambient air. The following two OESs had the highest modeled 95th percentile concentrations relative to the other calculated exposure concentrations evaluated:

- Industrial use of solvents (26.2 µg/m³) and;
- Waste handling, treatment and disposal (4.78 µg/m³).

IIOAC-modeled exposure concentrations results were used to calculate non-cancer risk estimates in the following section as a screening tool to determine whether refined analyses and higher-tier modeling were warranted.

I.1.2 Risk Calculations

I.1.2.1 Inhalation Margin of Exposure

EPA used a margin of exposure (MOE) approach using high-end exposure estimates to determine if the pathway analyzed is a pathway of concern. The MOE is the ratio of the non-cancer hazard value (or point of departure [POD]) divided by a human exposure concentration. The chronic MOEs for non-cancer inhalation risks were calculated using Equation_Apx I-1 below.

Equation_Apx I-1. Margin of Exposure Calculation

$$MOE = \frac{\text{Non - cancer Hazard Value (POD)}}{\text{Human Exposure}}$$

Where:

<i>MOE</i>	=	Margin of exposure for acute, short-term, or chronic risk comparison (unitless)
<i>Non-cancer Hazard Value (POD)</i>	=	Human equivalent concentration (HEC, µg/m ³)
<i>Human Exposure</i>	=	Exposure estimate (µg/m ³)

MOE risk estimates may be interpreted in relation to benchmark MOEs. Benchmark MOEs are typically the total uncertainty factor for each non-cancer POD. The MOE estimate is interpreted as a human health risk of concern if the MOE estimate is less than the benchmark MOE (*i.e.*, the total uncertainty factor). On the other hand, for this screening-level analysis, if the MOE estimate is equal to or exceeds the benchmark MOE, the exposure pathway is not analyzed further. Typically, the larger the MOE, the more unlikely it is that a non-cancer adverse effect occurs relative to the benchmark. When determining whether a chemical substance presents unreasonable risk to human health or the environment, calculated risk estimates are not “bright-line” indicators of unreasonable risk, and EPA has the discretion to consider other risk-related factors in addition to risks identified in the risk characterization. Briefly, after considering hazard identification and evidence integration, dose-response evaluation, and weight of the scientific evidence of POD candidates, EPA chose a non-cancer endpoint for general population acute exposure with a human equivalent concentration (HEC) value of 0.45 ppm (2,700 µg/m³). A benchmark of 30 was used for acute screening-level risk estimates. For more details on the non-cancer hazard values used to screen for risk, see the *Draft Human Health and Environmental Hazard Assessment for o-Dichlorobenzene* ([U.S. EPA, 2026r](#)). All calculated acute MOEs were above the benchmark at the 100, 100 to 1,000, and 1,000 m distances.

Appendix J ESTIMATING NUMBER OF WORKERS AND OCCUPATIONAL NON-USERS

This appendix summarizes the methods that EPA/OPPT used to estimate the number of workers who are potentially exposed to *o*-dichlorobenzene in each of its conditions of use (COU) under TSCA. The method consists of the following steps:

1. Identify the North American Industry Classification System (NAICS) codes for the industry sectors associated with each condition of use.
 - a. Refine the identification of applicable NAICS codes by reviewing Chemical Data Reporting (CDR) data for the chemical.
 - b. Refine the identification of applicable NAICS codes by referencing EPA/OPPT Generic Scenarios (GSs) and Organisation for Economic Co-operation and Development (OECD) Emission Scenario Documents (ESDs).
2. Estimate total employment by industry/occupation combination using the latest Bureau of Labor Statistics' (BLS) occupational employment statistics data ([U.S. BLS, 2023a](#)).
3. Refine the occupational employment statistics estimates where they are not sufficiently granular by using the latest U.S. Census' Statistics of U.S. Businesses (SUSB) data on total employment by 6-digit NAICS.
4. Estimate the percentage of employees likely to be using the chemical of interest instead of other chemicals (*i.e.*, the market penetration of the chemical of interest in the condition of use).
 - a. Conduct market penetration research through a top-down approach.
 - b. Conduct market penetration research through a bottom-up approach.
5. Estimate the number of sites and number of potentially exposed employees per site.
6. Estimate the number of potentially exposed employees within the condition of use.

Step 1: Identifying Affected NAICS Codes

As a first step, EPA/OPPT identified NAICS industry codes associated with each COU. EPA/OPPT generally identified NAICS industry codes for a COU by:

- Querying the U.S. Census Bureau's NAICS Search tool ([U.S. Census Bureau, 2022](#)) using keywords associated with each COU to identify NAICS codes with descriptions that match the condition of use.

EPA generally supplements this query by reviewing other relevant sources of information such as the most recently published CDR data and applicable GSs and ESDs. For each condition of use, EPA will provide a list of the relevant NAICS codes and a description of how EPA determined them in either the risk evaluation reports or their related technical support documents.

Refine NAICS Codes Using CDR Data

EPA reviewed the most recently reported CDR Data for the chemical of interest. EPA/OPPT generally identifies NAICS industry codes through CDR data by reviewing the most recently published CDR data for the chemical of interest and identifying the industrial sector codes reported for downstream industrial uses, and matching those industrial sector codes using Table D-2 provided in the CDR reporting instructions ([U.S. EPA, 2016a](#)).

CDR data may provide information on the range of number of workers potentially exposed to the chemical of interest for each respective reporter only if the reporter did not claim confidential business information (CBI) on that portion of their submission. If an assessment is tied directly to an entity reporting to CDR, the number of workers reported are assumed to be for that individual reporting site and not for further downstream use. The number of workers reported in CDR for downstream use (*i.e.*

Processing and Use data) are often secondhand reporting and not coming directly from the facilities handling the chemical of interest. The hierarchy of the approach for estimating the number of workers using CDR data is as follows:

1. If the assessment is tied directly to a CDR reporter, the upper bound for the number of workers cited by the reporting entity within CDR if it is not claimed as CBI should be used in the assessment.
2. If the assessment is tied directly to a CDR reporter but they claim the number of workers as CBI, follow the approach outlined in this section.
3. If the assessment is tied to a downstream use of the chemical of interest, follow the approach outlined in this section.
4. If the assessment is tied to a downstream use of the chemical of interest and there is no relevant BLS and SUSB data, the upper bound for the number of workers cited in the relevant downstream use within CDR should be used in the assessment

Refine NAICS Codes Using Generic Scenario and Emission Scenario Documents

EPA/OPPT generally identifies NAICS industry codes through GSs and ESDs by reviewing the existing GSs and ESDs that are relevant to the condition of use for the chemical of interest and identifying NAICS codes cited by the GS or ESD. NAICS industry codes are updated every 5 years, so some GSs and ESDs may contain outdated NAICS codes. EPA conducts a query search on the U.S. Census Bureau's NAICS Search tool to confirm the stated NAICS code in the GS or ESD is still accurate. If the NAICS code is inaccurate or has changed, EPA reviews the relevant Industry Code Crosswalk to identify the most up-to-date NAICS industry code.

EPA/OPPT GSs and OECD ESDs may give their own estimate of the number of workers for their respective scenario however the underlying approach may either align with this approach or deviate from it. EPA considers the following when using an EPA/OPPT GS or OECD ESD for estimating the number of workers:

- If the GS or ESD uses the same data (from the same source and date) and approach described in this guidance document, EPA determines if further NAICS granularity or market penetration adjustments are needed. If no adjustment to the data are needed, then the data on number of workers can be used directly in the assessment.
- If the GS or ESD uses the same data and approach described in this guidance document, but the data is outdated (*i.e.* uses outdated publications of BLS and SUSB data), EPA uses the approach described in the guidance document.
- If the GS or ESD uses an alternative source of data on the number of workers such as surveys of relevant workplaces, industry reports, trade organization reports, or other relevant literature, then EPA assesses the quality of that data. The assessment of this data is scored through Systematic review and should the underlying data receive a score of medium or higher, EPA uses the approach described in the GS or ESD. Should the underlying data receive a score of low, EPA uses the approach described in this guidance document.

Step 2: Estimating Total Employment by Industry (NAICS) and Occupation (SOC)

The next step in determining the number of workers for a condition of use is to use a combination of NAICS and Standard Occupational Classification (SOC) codes to estimate total employment. This method provides more accurate estimates for the number of workers rather than using NAICS codes alone. Using only NAICS codes to estimate the number of workers typically results in an overestimation because not all workers employed in that industry sector will be exposed. In some cases, however, BLS only provides employment data at the 4- or 5-digit NAICS level; therefore, further refinement of this approach may be needed.

Among the relevant NAICS codes (identified previously), EPA/OPPT reviewed the occupation description and identified those occupations (SOC codes) where workers are potentially exposed to *o*-dichlorobenzene. Table_Apx J-1 shows the SOC codes by NAICS codes EPA/OPPT classified as occupations potentially exposed to *o*-dichlorobenzene for an example associated with 4-digit NAICS code 336400 Aerospace Product and Parts Manufacturing. These occupations are classified as workers (W) and occupational non-users (O) by NAICS code. All relevant SOC codes by NAICS codes combinations can be found in supplemental file *Draft Number of Workers for o-Dichlorobenzene* ([U.S. EPA, 2026w](#)) on sheet “Affected SOC codes” and all other SOC codes by NAICS codes combinations are assumed to represent occupations where exposure is unlikely.

After identifying relevant NAICS and SOC codes, EPA/OPPT used BLS data to determine total employment by industry and by occupation based on the NAICS and SOC combinations. For example, there are 100 employees associated with 4-digit NAICS 336400 (Aerospace Product and Parts Manufacturing) and SOC 19-2031 (Chemists).

Using a combination of NAICS and SOC codes to estimate total employment provides more accurate estimates for the number of workers than using NAICS codes alone. Using only NAICS codes to estimate number of workers typically result in an overestimate, because not all workers employed in that industry sector will be exposed. However, in some cases, BLS only provide employment data at the 4- or 5-digit NAICS level; therefore, further refinement of this approach may be needed (see next step).

Step 3: Refining Employment Estimates to Account for Lack of NAICS Granularity

The third step in EPA/OPPT’s methodology was to further refine the employment estimates by using total employment data in the U.S. Census Bureau’s SUSB ([U.S. Census Bureau, 2017](#)). In some cases, BLS Occupational Employment Statistics’ occupation-specific data are only available at the 4- or 5-digit NAICS level, whereas the SUSB data are available at the 6-digit level (but are not occupation-specific). Identifying specific 6-digit NAICS will ensure that only industries with potential *o*-dichlorobenzene exposure are included. EPA/OPPT generally further refines the employment estimates as follows:

- Review the most recent U.S. Census Bureau’s SUSB data for the relevant 6-digit NAICS code level employment data applicable to the chemical of interest and condition of use that falls under the BLS occupational employment statistics 4- or 5-digit NAICS code level being evaluated.
- Determine the total employment percentage that the relevant 6-digit NAICS code comprises of under the BLS occupational employment statistics 4- or 5-digit NAICS code level (*i.e.* divide the SUSB 6-digit NAICS code level employment by the BLS occupational employment statistics 4- or 5-digit NAICS code level employment and format as a percentage).
- Multiply the total employment percentage by the 4- or 5-digit NAICS code level employment from the BLS occupational employment statistics occupation-specific data to estimate employment by SOC at the 6-digit NAICS code level.

As an example, Occupational Employment Statistics data are available for the 4-digit NAICS 336400 Aerospace Product and Parts Manufacturing, which includes several 6-digit NAICS:

- NAICS 336411 Aircraft Manufacturing
- NAICS 336412 Aircraft Engine and Engine Parts Manufacturing
- NAICS 336413 Other Aircraft Parts and Auxiliary Equipment Manufacturing
- NAICS 336414 Guided Missile and Space Vehicle Manufacturing
- NAICS 336415 Guided Missile and Space Vehicle Propulsion Unit and Propulsion Unit Parts Manufacturing

- NAICS 336419 Other Guided Missile and Space Vehicle Parts and Auxiliary Equipment Manufacturing.

In this example, two of the listed NAICS are of interest: 336411 Aircraft Manufacturing and 336412 Aircraft Engine and Engine Parts Manufacturing. In the case that not all NAICS are relevant, the Census data allow EPA/OPPT to calculate employment in the specific 6-digit NAICS of interest as a percentage of employment in the BLS 4-digit NAICS.

The 6-digit NAICS 336411 comprises 42.5% of total employment under the 4-digit NAICS 3364. This percentage can be multiplied by the occupation-specific employment estimates given in the BLS Occupational Employment Statistics data to further refine the Agency's estimates of the number of employees with potential exposure. Table_Apx J-1 illustrates this granularity adjustment for NAICS 336411.

Table_Apx J-1. Estimated Number of Potentially Exposed Workers and ONUs Under NAICS 336411

NAICS	SOC CODE	SOC Description	Occupation Designation	Employment by SOC at 4-Digit NAICS Level	% of Total Employment	Estimated Employment by SOC at 6-Digit NAICS Level
336411	11-3050	Industrial Production Managers	O	7,090	42.5	3,012
336411	11-9040	Architectural and Engineering Managers	O	10,200	42.5	4,333
336411	17-2010	Aerospace Engineers	O	26,400	42.5	11,216
336411	17-2040	Chemical Engineers	O	120	42.5	51
336411	17-2110	Industrial Engineers, Including Health and Safety	O	23,040	42.5	9,788
336411	17-2130	Materials Engineers	O	2,670	42.5	1,134
336411	17-2140	Mechanical Engineers	O	11,160	42.5	4,741
336411	17-3010	Drafters	O	1,360	42.5	578
336411	17-3020	Engineering Technologists and Technicians, Except Drafters	O	14,190	42.5	6,029
336411	19-2031	Chemists	O	100	42.5	42
336411	19-4000	Life, Physical, and Social Science Technicians	O	350	42.5	149
336411	49-1000	Supervisors of Installation, Maintenance, and Repair Workers	O	1,710	42.5	726
336411	49-2000	Electrical and Electronic Equipment Mechanics, Installers, and Repairers	W	9,150	42.5	3,887
336411	49-3000	Vehicle and Mobile Equipment Mechanics, Installers, and Repairers	W	23,850	42.5	10,133

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NAICS	SOC CODE	SOC Description	Occupation Designation	Employment by SOC at 4-Digit NAICS Level	% of Total Employment	Estimated Employment by SOC at 6-Digit NAICS Level
336411	49-9000	Other Installation, Maintenance, and Repair Occupations	W	9,590	42.5	4,074
336411	51-1000	Supervisors of Production Workers	O	9,500	42.5	4,036
336411	51-2010	Aircraft Structure, Surfaces, Rigging, and Systems Assemblers	W	25,460	42.5	10,817
336411	51-2020	Electrical, Electronics, and Electromechanical Assemblers	W	5,630	42.5	2,392
336411	51-2040	Structural Metal Fabricators and Fitters	W	530	42.5	225
336411	51-2090	Miscellaneous Assemblers and Fabricators	W	19,150	42.5	8,136
336411	51-2090	Miscellaneous Assemblers and Fabricators	W	19,150	42.5	8,136
336411	51-4000	Metal Workers and Plastic Workers	W	39,290	42.5	16,692
336411	51-8000	Plant and System Operators	O	400	42.5	170
336411	51-9020	Crushing, Grinding, Polishing, Mixing, and Blending Workers	W	1,030	42.5	438
336411	51-9030	Cutting Workers	W	60	42.5	25
336411	51-9040	Extruding, Forming, Pressing, and Compacting Machine Setters, Operators, and Tenders	W	230	42.5	98
336411	51-9050	Furnace, Kiln, Oven, Drier, and Kettle Operators and Tenders	W	230	42.5	98
336411	51-9060	Inspectors, Testers, Sorters, Samplers, and Weighers	W	20,710	42.5	8,799
336411	51-9110	Packaging and Filling Machine Operators and Tenders	W	100	42.5	42
336411	51-9120	Painting Workers	W	4,920	42.5	2,090
336411	51-9191	Adhesive Bonding Machine Operators and Tenders	W	1,520	42.5	646
336411	51-9192	Cleaning, Washing, and Metal Pickling	W	110	42.5	47

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NAICS	SOC CODE	SOC Description	Occupation Designation	Employment by SOC at 4-Digit NAICS Level	% of Total Employment	Estimated Employment by SOC at 6-Digit NAICS Level
		Equipment Operators and Tenders				
336411	51-9194	Etchers and Engravers	W	110	42.5	47
Total Potentially Exposed Employees				289,110		122,827
Total Workers						76,821
Total ONUs						46,006
W = worker; O = occupational non-user						
Note: numbers may not sum exactly due to rounding. ** Not reported for this NAICS code.						
Source: U.S. Census, 2017 (U.S. Census Bureau, 2017); U.S. BLS, 2023 (U.S. BLS, 2023a).						

Step 4: Estimate the Percentage of Workers Using the Chemical of Interest via Market Penetration

The next step in EPA/OPPT's methodology is to account for the market share of the chemical of interest in a particular industry by applying a factor to the number of workers determined in Step 3. This accounts for the fact that the chemical of interest may be only one of multiple chemicals used for the conditions of use. EPA/OPPT generally uses a top-down or bottom-up approach to estimate the percentage of workers.

The top-down approach is the preferable method for estimating the percentage of workers for a chemical of interest however, market penetration data may be scarce or unavailable to EPA. In this case, the bottom-up approach should be utilized and is often the most common method that EPA utilizes to estimate market penetration of a chemical of interest.

In the absence of market penetration data for a given COU, EPA/OPPT assumed *o*-dichlorobenzene may be used at up to all sites and by up to all workers calculated in this method as a bounding estimate. This assumes a market penetration of 100%.

Step 5: Estimating the Number of Workers and Occupational Non-Users (ONUs) per Site

EPA/OPPT calculated the number of workers and ONUs in each industry/occupation combination using the formula below (granularity adjustment is only applicable where SOC data are not available at the 6-digit NAICS level):

$$\text{Number of Workers or ONUs in NAICS/SOC (Step 2)} \times \text{Granularity Adjustment Percentage (Step 3)} = \text{Number of Workers or ONUs in the Industry/Occupation Combination}$$

EPA/OPPT then estimated the total number of establishments by obtaining the number of establishments reported in the U.S. Census Bureau's SUSB ([U.S. Census Bureau, 2017](#)) data at the 6-digit NAICS level. In this example, there are 317 establishments associated with 6-digit NAICS code 336411 Aircraft Manufacturing.

EPA/OPPT then summed the number of workers and ONUs over all occupations within a NAICS code and divided these sums by the number of establishments in the NAICS code to calculate the average number of workers and ONUs per site.

Step 6: Estimating the Number of Workers and ONUs, and Sites for a COU

EPA/OPPT estimated the number of workers and ONUs potentially exposed to *o*-dichlorobenzene and

the number of sites that use *o*-dichlorobenzene in a given COU through the following steps:

- 6.A. Obtaining the total number of establishments by:
 - i. Obtaining the number of establishments from SUSB at the 6-digit NAICS level (Step 5) for each NAICS code in the COU and summing these values; or
 - ii. Obtaining the number of establishments from the TRI, DMR, NEI, or literature for the COU.
- 6.B. Estimating the number of establishments that use *o*-dichlorobenzene by taking the total number of establishments from Step 6.A and multiplying it by the market penetration factor from Step 4.
- 6.C. Estimating the number of workers and ONUs potentially exposed to *o*-dichlorobenzene by taking the number of establishments calculated in Step 6.B and multiplying it by the average number of workers and ONUs per site from Step 5.

Appendix K EQUATIONS FOR CALCULATING ACUTE, INTERMEDIATE, AND CHRONIC (NON-CANCER) INHALATION AND DERMAL EXPOSURES

This draft TSD assesses *o*-dichlorobenzene inhalation exposures to workers in occupational settings, presented as 8- and 12-hour (*i.e.*, full-shift) time-weighted averages (TWAs). The full-shift TWA exposures are then used to calculate acute exposure concentrations (AC), intermediate average daily concentrations (IADC), and average daily concentrations (ADC) for chronic, non-cancer risks.

This report also assesses *o*-dichlorobenzene dermal exposures to workers in occupational settings, presented as a dermal acute potential dose rate (APDR). The APDRs are then used to calculate acute absorbed doses (AAD), intermediate absorbed doses (IAD), and chronic absorbed doses (CAD) for chronic non-cancer risks.

This appendix presents the equations and input parameter values used to estimate each exposure metric.

K.1 Equations for Calculating Acute, Intermediate, and Chronic (Non-Cancer, and Cancer) Inhalation Exposures

AC is used to estimate workplace inhalation exposures for acute risks (*i.e.*, risks occurring as a result of exposure for <1 day), per Equation_Apx K-1.

Equation_Apx K-1.

$$AC = \frac{C \times ED \times BR}{AT_{acute}}$$

Where:

AC	=	Acute exposure concentration
C	=	Contaminant concentration in air (TWA)
ED	=	Exposure duration (h/day)
BR	=	Breathing rate ratio (unitless)
AT_{acute}	=	Acute averaging time (h)

IADC is used to estimate workplace exposures for intermediate risks and is estimated as follows:

Equation_Apx K-2.

$$IADC = \frac{C \times ED \times EF_{intermediate} \times BR}{AT_{intermediate}}$$

Equation_Apx K-3.

$$AT_{intermediate} = D_{intermediate} \times 24 \frac{h}{day}$$

Where:

$IADC$	=	Intermediate average daily concentration
$EF_{intermediate}$	=	Intermediate exposure frequency
$AT_{intermediate}$	=	Averaging time (h) for intermediate exposure
$D_{intermediate}$	=	Days for intermediate duration (day)

ADC is used to estimate workplace exposures for chronic non-cancer risks. These exposures are

estimated as follows:

Equation_Apx K-4.

$$ADC = \frac{C \times ED \times EF \times WY \times BR}{AT_c}$$

Equation_Apx K-5.

$$AT = WY \times 365 \frac{\text{day}}{\text{yr}} \times 24 \frac{\text{h}}{\text{day}}$$

Where:

<i>ADC</i>	=	Average daily concentration used for chronic non-cancer risk calculations
<i>ED</i>	=	Exposure duration (h/day)
<i>EF</i>	=	Exposure frequency (day/yr)
<i>WY</i>	=	Working years/lifetime (yr)
<i>AT</i>	=	Averaging time (h) for chronic, non-cancer risk

K.2 Equations for Calculating Acute, Intermediate, and Chronic (Non-Cancer) Dermal Exposures

AAD is used to estimate workplace dermal exposures for acute risks and are calculated using Equation_Apx K-6.

Equation_Apx K-6,

$$AAD = \frac{APDR}{BW}$$

Where:

<i>AAD</i>	=	Acute absorbed dose (mg/kg-day)
<i>APDR</i>	=	Acute potential dose rate (mg/day)
<i>BW</i>	=	Body weight (kg)

IAD is used to estimate workplace dermal exposures for intermediate risks and is estimated using Equation_Apx K-7.

Equation_Apx K-7.

$$IAD = \frac{APDR \times EF_{\text{intermediate}}}{BW \times D_{\text{intermediate}}}$$

Where:

<i>IAD</i>	=	Intermediate average daily dose (mg/kg-day)

CAD is used to estimate workplace dermal exposures for non-cancer and are calculated using Equation_Apx K-8.

Equation_Apx K-8.

$$CAD = \frac{APDR \times EF \times WY}{BW \times 365 \frac{\text{days}}{\text{yr}} \times WY}$$

K.3 Acute, Intermediate, and Chronic (Non-Cancer) Equation Inputs

The input parameter values in Table_Apx K-1 are used to calculate each of the above acute, intermediate, and chronic exposure estimates. Where exposure is calculated using probabilistic modeling, the calculations are integrated into the Monte Carlo simulation. Where multiple values are provided for ED, it indicates that EPA may have used different values for different conditions of use. The EF and EF_{intermediate} used for each OES can differ and the values used are described in the appropriate sections of this report. The maximum values used in the equations as well as a general summary for these differences are described below in this section.

Table_Apx K-1. Parameter Values for Calculating Inhalation Exposure Estimates

Parameter Name	Symbol	Value	Unit
Exposure Duration	ED	8 or 12	h/day
Breathing Rate Ratio	BR	2.04	unitless
Exposure Frequency	EF	6–250 ^a	days/year
Exposure Frequency, intermediate	EF _{intermediate}	Set at 22 if EF ≥ 22, otherwise equal to EF	days
Days for intermediate duration	D _{intermediate}	30	days
Working years	WY	31 (50th percentile) 40 (95th percentile)	years
Averaging Time, intermediate	AT _{intermediate}	720	h
Averaging Time, non-cancer	AT	271,560 (central tendency) ^b 350,400 (high-end) ^c	h
Body Weight	BW	80 (average adult worker) 72.4 (female of reproductive age)	kg
^a Depending on OES			
^b Calculated using the 50th percentile value for working years (WY)			
^c Calculated using the 95th percentile value for working years (WY)			

K.3.1 Exposure Duration (ED)

EPA generally uses an exposure duration of 8 or 12 hours/day for averaging full-shift exposures.

K.3.2 Breathing Rate Ratio

EPA uses a breathing rate ratio, which is the ratio between the worker breathing rate and resting breathing rate, to account for the amount of air a worker breathes during exposure. The typical worker breathes about 10 m³ of air in 8 hours, or 1.25 m³/h (CEB, 1991) while the resting breathing rate is 0.6125 m³/h (CEB, 1991). The ratio of these two values is equivalent to 2.04.

K.3.3 Exposure Frequency (EF)

EPA generally uses a maximum exposure frequency of 250 days/year. The estimation of the exposure frequency and associated distributions for each OES are described in the relevant section of this report.

EF is expressed as the number of days/year a worker is exposed to the chemical being assessed. In some cases, it may be reasonable to assume a worker is exposed to the chemical on each working day. In other cases, it may be more appropriate to estimate a worker's exposure to the chemical occurs during a subset of the worker's annual working days. The relationship between exposure frequency and annual working days can be described mathematically as follows:

Equation_Apx K-9.

$$EF = f \times AWD$$

Where:

EF	=	Exposure frequency, the number of days/year a worker is exposed to the chemical (day/yr)
f	=	Fractional number of annual working days during which a worker is exposed to the chemical (unitless)
AWD	=	Annual working days, the number of days/year a worker works (day/yr)

BLS (2016) provides data on the total number of hours worked and total number of employees by each industry NAICS code. These data are available from the 3- to 6-digit NAICS level (where 3-digit NAICS are less granular and 6-digit NAICS are the most granular). Dividing the total, annual hours worked by the number of employees yields the average number of hours worked/employee per year for each NAICS.

EPA has identified approximately 140 NAICS codes applicable to the multiple conditions of use for the ten chemicals undergoing risk evaluation. For each NAICS code of interest, the Agency looked up the average hours worked per employee/year at the most granular NAICS level available (*i.e.*, 4-digit, 5-digit, or 6-digit). EPA converted the working hours/employee to working days/year per employee assuming employees work an average of 8 hours/day. The average number of days/year worked, or AWD, ranges from 169 to 282 days/year, with a 50th percentile value of 250 days/year. EPA repeated this analysis for all NAICS codes at the 4-digit level. The average AWD for all 4-digit NAICS codes ranges from 111 to 282 days/year, with a 50th percentile value of 228 days/year. 250 days/year is approximately the 75th percentile. In the absence of industry- and *o*-dichlorobenzene specific data, EPA assumes the parameter f is equal to one for all conditions of use.

K.3.4 Intermediate Exposure Frequency ($EF_{\text{intermediate}}$)

For *o*-dichlorobenzene, the $D_{\text{intermediate}}$ was set at 30 days. EPA estimated the maximum number of working days within the $D_{\text{intermediate}}$, using the following equation and assuming 5 working days/wk:

Equation_Apx K-10.

$$EF_{\text{intermediate}}(\text{max}) = 5 \frac{\text{working days}}{\text{wk}} \times \frac{30 \text{ total days}}{7 \frac{\text{total days}}{\text{wk}}} = 21.4 \text{ days, rounded up to 22 days}$$

If the exposure frequency for an OES is greater than or equal to 22 days/year, EPA assesses an intermediate exposure frequency of 22 days/year. If the exposure frequency for an OES is less than 22 days/year, EPA assesses an intermediate exposure frequency equal to the exposure frequency.

K.3.5 Intermediate Duration ($D_{\text{intermediate}}$)

EPA assessed an intermediate duration of 30 days based on the available health data.

K.3.6 Working Years (WY)

EPA has developed a triangular distribution for working years. EPA has defined the parameters of the triangular distribution as follows:

- Minimum value: BLS CPS tenure data with current employer as a low-end estimate of the number of lifetime working years: 10.4 years;
- Mode value: The 50th percentile tenure data with all employers from SIPP as a mode value for the number of lifetime working years: 36 years; and
- Maximum value: The maximum average tenure data with all employers from SIPP as a high-end

estimate on the number of lifetime working years: 44 years.

This triangular distribution has a 50th percentile value of 31 years and a 95th percentile value of 40 years. EPA uses these values for central tendency and high-end ADC calculations, respectively.

The BLS ([U.S. BLS, 2014](#)) provides information on employee tenure with *current employer* obtained from the Current Population Survey (CPS). CPS is a monthly sample survey of about 60,000 households that provides information on the labor force status of the civilian non-institutional population age 16 and over; CPS data are released every two years. The data are available by demographics and by generic industry sectors but are not available by NAICS codes.

The U.S. Census' ([U.S. Census Bureau, 2019a](#)) Survey of Income and Program Participation (SIPP) provides information on *lifetime tenure with all employers*. SIPP is a household survey that collects data on income, labor force participation, social program participation and eligibility, and general demographic characteristics through a continuous series of national panel surveys of between 14,000 and 52,000 households ([U.S. Census Bureau, 2019a](#)). EPA analyzed the 2008 SIPP Panel Wave 1, a panel that began in 2008 and covers the interview months of September 2008 through December 2008 ([U.S. Census Bureau, 2019a, b](#)). For this panel, lifetime tenure data are available by Census Industry Codes, which can be cross-walked with NAICS codes.

SIPP data include fields for the industry in which each surveyed, employed individual works (TJBIND1), worker age (TAGE), and years of work experience *with all employers* over the surveyed individual's lifetime.¹⁶ Census household surveys use different industry codes than the NAICS codes used in its firm surveys, so these were converted to NAICS using a published crosswalk. EPA calculated the average tenure for the following age groups: (1) workers age 50 and older, (2) workers age 60 and older, and (3) workers of all ages employed at time of survey. The Agency used tenure data for age group "50 and older" to determine the high-end lifetime working years, because the sample size in this age group is often substantially higher than the sample size for age group "60 and older." For some industries, the number of workers surveyed, or the *sample size*, was too small to provide a reliable representation of the worker tenure in that industry. Therefore, EPA excluded data where the sample size is less than five from the Agency's analysis.

Table_Apx K-2 summarizes the average tenure for workers age 50 years and older from SIPP data. Although the tenure may differ for any given industry sector, there is no significant variability between the 50th and 95th percentile values of average tenure across manufacturing and non-manufacturing sectors.

¹⁶ To calculate the number of years of work experience EPA took the difference between the year first worked (TMAKMNYR) and the current data year (*i.e.*, 2008). The Agency then subtracted any intervening months when not working (ETIMEOFF).

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Table_Apx K-2. Overview of Average Worker Tenure from U.S. Census SIPP (Age Group 50+)

Industry Sectors	Working Years			
	Average	50th Percentile	95th Percentile	Maximum
All industry sectors relevant to the first 10 chemicals that have undergone a risk evaluation	35.9	36	39	44
Manufacturing sectors (NAICS 31–33)	35.7	36	39	40
Non-manufacturing sectors (NAICS 42–81)	36.1	36	39	44
Source: (U.S. Census Bureau, 2019a)				
Note: Industries where sample size is <5 are excluded from this analysis				

BLS CPS data provides the median years of tenure that wage and salary workers had been with their current employer. Table_Apx K-3 presents CPS data for all demographics (men and women) by age group from 2008 to 2012. To estimate the low-end value on number of working years, EPA uses the most recent (2014) CPS data for workers ages 55 to 64 years, which indicates a median tenure of 10.4 years with their current employer. The use of this low-end value represents a scenario where workers are only exposed to the chemical of interest for a portion of their lifetime working years, as they may change jobs or move from one industry to another throughout their career.

Table_Apx K-3. Median Years of Tenure with Current Employer by Age Group

Age (years)	January 2008	January 2010	January 2012	January 2014
16+	4.1	4.4	4.6	4.6
16–17	0.7	0.7	0.7	0.7
18–19 years	0.8	1.0	0.8	0.8
20–24 years	1.3	1.5	1.3	1.3
25+	5.1	5.2	5.4	5.5
25–34 years	2.7	3.1	3.2	3.0
35–44 years	4.9	5.1	5.3	5.2
45–54 years	7.6	7.8	7.8	7.9
55 to 64 years	9.9	10.0	10.3	10.4
65+	10.2	9.9	10.3	10.3
Source: (U.S. Census Bureau, 2015)				

K.3.7 Body Weight (BW)

EPA assumes a body weight of 80 kg for average adult workers. EPA assumed a body weight of 72.4 kg for females of reproductive age, per Chapter 8 of the *Exposure Factors Handbook* ([U.S. EPA, 2011a](#)).

Appendix L SAMPLE CALCULATIONS FOR ACUTE AND CHRONIC (NON-CANCER) INHALATION EXPOSURES

Sample calculations correcting for the use of surrogate data are presented in Section L.1 below for high-end exposure estimates for the SEG – Worker, VCM Unit (Operator) under the Manufacturing OES. An explanation for the parameters and parameters used are provided in Section 8.1.3.2.1. Sample calculations for high-end and central tendency acute and chronic (non-cancer) exposure concentrations for the SEG – Worker, VCM Unit (Operator) under the Manufacturing OES, are demonstrated in Sections L.2 and L.3 below. Explanations for the equations and parameters used for these equations are provided in Appendix K.

L.1 Example Surrogate Inhalation Monitoring Correction Calculation

$$C_{v2} = C_{v1} \times \frac{VP_2 \times X_2}{VP_1 \times X_1}$$

$$C_{v2} = 0.025 \text{ ppm} \times \frac{1.35 \text{ torr} \times 0.02}{1 \text{ torr} \times 0.02}$$

$$C_{v2} = 0.034 \text{ ppm}$$

L.2 Example High-End AC, IADC, and ADC Calculations

Calculate AC_{HE} :

$$AC_{HE} = \frac{C_{HE} \times ED \times BR}{AT_{acute}}$$

$$AC_{HE} = \frac{0.034 \text{ ppm} \times 8 \text{ hr/day} \times 2.04}{24 \text{ hr/day}} = 0.0231 \text{ ppm}$$

Calculate $IADC_{HE}$:

$$IADC_{HE} = \frac{C_{HE} \times ED \times EF_{SC} \times BR}{AT_{sc}}$$

$$IADC_{HE} = \frac{0.034 \text{ ppm} \times 8 \frac{\text{hr}}{\text{day}} \times 22 \frac{\text{days}}{\text{year}} \times 2.04}{24 \frac{\text{hr}}{\text{day}} \times 30 \frac{\text{days}}{\text{year}}} = 0.0170 \text{ ppm}$$

Calculate ADC_{HE} :

$$ADC_{HE} = \frac{C_{HE} \times ED \times EF \times WY \times BR}{AT}$$

$$ADC_{HE} = \frac{0.034 \text{ ppm} \times 8 \frac{\text{hr}}{\text{day}} \times 250 \frac{\text{days}}{\text{year}} \times 40 \text{ years} \times 2.04}{40 \text{ years} \times 365 \frac{\text{days}}{\text{yr}} \times 24 \frac{\text{hr}}{\text{day}}} = 0.0158 \text{ ppm}$$

L.3 Example Central Tendency AC, IADC, and ADC Calculations

Calculate AC_{CT} :

$$AC_{CT} = \frac{C_{CT} \times ED \times BR}{AT_{acute}}$$

$$AC_{CT} = \frac{0.017 \text{ ppm} \times 8 \text{ hr/day} \times 2.04}{24 \text{ hr/day}} = 0.012 \text{ ppm}$$

Calculate $IADC_{CT}$:

$$IADC_{CT} = \frac{C_{CT} \times ED \times EF_{SC} \times BR}{AT_{sc}}$$

$$IADC_{CT} = \frac{0.017 \text{ ppm} \times 8 \frac{\text{hr}}{\text{day}} \times 22 \frac{\text{days}}{\text{year}} \times 2.04}{24 \frac{\text{hr}}{\text{day}} \times 30 \frac{\text{days}}{\text{year}}} = 0.0085 \text{ ppm}$$

Calculate ADC_{CT} :

$$ADC_{CT} = \frac{C_{CT} \times ED \times EF \times WY \times BR}{AT}$$

$$ADC_{CT} = \frac{0.017 \text{ ppm} \times 8 \frac{\text{hr}}{\text{day}} \times 250 \frac{\text{days}}{\text{year}} \times 31 \text{ years} \times 2.04}{31 \text{ years} \times 365 \frac{\text{days}}{\text{yr}} \times 24 \frac{\text{hr}}{\text{day}}} = 0.0079 \text{ ppm}$$

Appendix M DERMAL EXPOSURE ASSESSMENT METHOD

This appendix presents the modeling approach and equations to estimate occupational dermal exposures. This method was developed through review of relevant literature and consideration of existing exposure models, such as EPA/OPPT models and the ECETOC TRA.

M.1 Dermal Dose Equation

EPA used the following equation to estimate the acute potential dose rate (APDR) from occupational dermal exposures:

Equation_Apx M-1.

$$APDR = S \times Q_u \times f_{abs} \times Y_{derm} \times FT$$

Where:

S	=	Is the surface area of skin in contact with the chemical formulation (cm ²)
Q_u	=	Is the dermal load (<i>i.e.</i> , the quantity of the chemical formulation on the skin after the dermal contact event, mg/cm ² -event)
f_{abs}	=	Is the fractional absorption of the chemical formulation into the stratum corneum, accounting for evaporation of the chemical from the dermal load, Q_u (unitless, $0 \leq f_{abs} \leq 1$)
Y_{derm}	=	Is the weight fraction of the chemical of interest in the liquid (unitless, $0 \leq Y_{derm} \leq 1$); and
FT	=	Frequency of events (integer number/day).

The inputs to the dermal dose equation are described in Appendix M.2.

M.2 Model Input Parameters

Table_Apx M-1 summarizes the model parameters and their values for estimating dermal exposures. Additional explanations of EPA's selection of the inputs for each parameter are provided in the subsections after the following table.

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Table Apx M-1. Summary of Model Input Values

Input Parameter	Symbol	Unit	Deterministic Values	Uncertainty Analysis Distribution Parameters				Rationale
			Value	Lower Bound	Upper Bound	Mode	Distribution Type	
Surface Area – Average Adult Worker	S	cm ²	1,070	0	1,070	–	Uniform	See Appendix M.2.1
Surface Area – ONU	S _{ONU}	cm ²	268	–	–	–	Static	See Appendix M.2.1
Dermal Load (liquid)	Q _u	mg/cm ² -event	2.1	0.7	2.1	–	Uniform	See Appendix M.2.2
Dermal Load (solid, article)	Q _{event}	mg/event	450	100	1,100	450	Triangular	See Appendix M.2.2
Fractional Absorption (>50% weight)	f _{abs,highwf}	unitless	0.04	–	–	–	Static	See Appendix M.2.3
Fractional Absorption (<50% weight)	f _{abs,lowwf}	unitless	0.02	–	–	–	Static	See Appendix M.2.3
Weight Fraction – Manufacturing OES (liquid)	Y _{derm,1}	unitless	0.02	–	–	–	Static	See Appendix M.2.4
Weight Fraction – Repackaging OES (liquid)	Y _{derm,2}	unitless	1	0.9	1	–	Uniform	See Appendix M.2.4
Weight Fraction – Processing as a Reactant OES (liquid)	Y _{derm,3}	unitless	1	0.9	1	–	Uniform	See Appendix M.2.4
Weight Fraction – Incorporation into Soap, Cleaning Compound, and Toilet Preparation Manufacturing (liquid)	Y _{derm,4}	unitless	1	0.9	1	–	Uniform	See Appendix M.2.4
Weight Fraction – Incorporation into Soap, Cleaning Compound, and Toilet Preparation Manufacturing (solid, article)	Y _{derm,4}	unitless	0.01	0.001	0.01	–	Uniform	See Appendix M.2.4

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Input Parameter	Symbol	Unit	Deterministic Values	Uncertainty Analysis Distribution Parameters				Rationale
			Value	Lower Bound	Upper Bound	Mode	Distribution Type	
Weight Fraction – Incorporation into Formulation, Mixture, or Reaction Product OES (liquid)	$Y_{\text{derm},5}$	unitless	0.3	0.01	0.3	–	Uniform	See Appendix M.2.4
Weight Fraction – Plastics Compounding OES (liquid)	$Y_{\text{derm},6}$	unitless	0.3	0.01	0.3	–	Uniform	See Appendix M.2.4
Weight Fraction – Plastics Compounding OES (solid, article)	$Y_{\text{derm},6}$	unitless	0.08	0.0005	0.08	–	Uniform	See Appendix M.2.4
Weight Fraction – Plastics Converting OES (solid, article)	$Y_{\text{derm},7}$	unitless	0.08	0.0005	0.08	–	Uniform	See Appendix M.2.4
Weight Fraction – Recycling OES (liquid)	$Y_{\text{derm},8}$	unitless	1	0.9	1	–	Uniform	See Appendix M.2.4
Weight Fraction – Functional Fluids (closed systems) OES (liquid)	$Y_{\text{derm},10}$	unitless	0.75	–	–	–	Static	See Appendix M.2.4
Weight Fraction – Industrial Use of Solvents (liquids)	$Y_{\text{derm},11}$	unitless	1	–	–	–	Static	See Appendix M.2.4
Weight Fraction – Use of Ink, Toner, and Colorant Products OES (liquid)	$Y_{\text{derm},12}$	unitless	0.144	0.01	0.30	0.144	Triangular	See Appendix M.2.4
Weight Fraction – Use of Paints and Coatings OES (liquid)	$Y_{\text{derm},13}$	unitless	0.10	0.0025	0.50	0.10	Triangular	See Appendix M.2.4
Weight Fraction – Use of Paint Thinners and Removers (liquid)	$Y_{\text{derm},14}$	unitless	0.30	0.01	0.30	–	Uniform	See Appendix M.2.4
Weight Fraction – Use of Lubricants and Greases OES (liquid)	$Y_{\text{derm},15}$	unitless	0.01	0.001	0.05	0.01	Triangular	See Appendix M.2.4

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Input Parameter	Symbol	Unit	Deterministic Values	Uncertainty Analysis Distribution Parameters				Rationale
			Value	Lower Bound	Upper Bound	Mode	Distribution Type	
Weight Fraction – Use of Fuels and Related Products OES (liquid)	$Y_{\text{derm},16}$	unitless	0.005	0.001	0.005	–	Uniform	See Appendix M.2.4
Weight Fraction – Use in Solid Air Care Products OES (solid, article)	$Y_{\text{derm},17}$	unitless	0.01	0.001	0.01	–	Uniform	See Appendix M.2.4
Weight Fraction – Use of Laboratory Chemicals OES (liquid)	$Y_{\text{derm},18}$	unitless	0.001	0.00002	0.09	0.001	Triangular	See Appendix M.2.4
Weight Fraction – Use of Cleaning and Furnishing Care Products OES (liquid)	$Y_{\text{derm},19}$	unitless	0.01	0.001	0.05	0.01	Triangular	See Appendix M.2.4
Weight Fraction – Sheep Branding Fluid OES (liquid)	$Y_{\text{derm},20}$	unitless	0.144	–	–	–	Static	See Appendix M.2.4
Weight Fraction – Disposal OES (liquid)	$Y_{\text{derm},21}$	unitless	0.064	0.04	0.064	–	Uniform	See Appendix M.2.4
Exposure Days – Manufacturing OES (liquid)	EF1	days/year	250	167	250	250	Discrete	See Appendix M.2.5
Exposure Days – Repackaging OES (liquid)	EF2	days/year	260	173	261	260	Triangular	See Appendix M.2.5
Exposure Days – Processing as a Reactant OES (liquid)	EF3	days/year	167	–	–	–	Static	See Appendix M.2.5
Exposure Days – Incorporation into Soap, Cleaning Compound, and Toilet Preparation Manufacturing (liquid)	EF4	days/year	250	–	–	–	Static	See Appendix M.2.5

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Input Parameter	Symbol	Unit	Deterministic Values	Uncertainty Analysis Distribution Parameters				Rationale
			Value	Lower Bound	Upper Bound	Mode	Distribution Type	
Exposure Days – Incorporation into Formulation, Mixture, or Reaction Product OES (liquid)	EF5	days/year	250	–	–	–	Static	See Appendix M.2.5
Exposure Days – Plastics Compounding OES (liquid)	EF6	days/year	250	–	–	–	Static	See Appendix M.2.5
Exposure Days – Plastics Converting OES (solid, article)	EF8	days/year	167	–	–	–	Static	See Appendix M.2.5
Exposure Days – Recycling OES (liquid)	EF9	days/year	250	–	–	–	Static	See Appendix M.2.5
Exposure Days – Functional Fluids (closed systems) OES (liquid)	EF10	days/year	6	0	13	6	Triangular	See Appendix M.2.5
Exposure Days – Industrial Use of Solvents (liquids)	EF11	days/year	250	–	–	–	Static	See Appendix M.2.5
Exposure Days – Use of Ink, Toner, and Colorant Products OES (liquid)	EF12	days/year	250	–	–	–	Static	See Appendix M.2.5
Exposure Days – Use of Paints and Coatings OES (liquid)	EF13	days/year	250	–	–	–	Static	See Appendix M.2.5
Exposure Days – Use of Paint Thinners and Removers (liquid)	EF14	days/year	250	–	–	–	Static	See Appendix M.2.5
Exposure Days – Use of Lubricants and Greases OES (liquid)	EF15	days/year	250	–	–	–	Static	See Appendix M.2.5
Exposure Days – Use of Fuels and Related Products OES (liquid)	EF16	days/year	250	–	–	–	Static	See Appendix M.2.5

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Input Parameter	Symbol	Unit	Deterministic Values	Uncertainty Analysis Distribution Parameters				Rationale
			Value	Lower Bound	Upper Bound	Mode	Distribution Type	
Exposure Days – Use in Solid Air Care Products OES (solid, article)	EF18	days/year	250	–	–	–	Static	See Appendix M.2.5
Exposure Days – Use of Laboratory Chemicals OES (liquid)	EF19	days/year	250	167	250	250	Discrete	See Appendix M.2.5
Exposure Days – Use of Cleaning and Furnishing Care Products OES (liquid)	EF20	days/year	250	–	–	–	Static	See Appendix M.2.5
Exposure Days – Sheep Branding Fluid OES (liquid)	EF21	days/year	250	–	–	–	Static	See Appendix M.2.5
Exposure Days – Disposal OES (liquid)	EF2	days/year	250	167	250	250	Discrete	See Appendix M.2.5
Frequency of Events	FT	events/day	1	–	–	–	–	See Appendix M.2.6

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M.2.1 Surface Area

EPA used an exposed skin surface area (S) for workers of 1,070 cm² for the upper bound based on the mean two-hand surface area for adult males ages 21 or older from Chapter 7 of EPA's *Exposure Factors Handbook* ([U.S. EPA, 2011a](#)). For the lower bound, EPA assumed the exposure surface area was equal to zero, such that any range of potential surface area, from less than one palm to two full hands, may be accounted for. Regarding surface area of dermal exposure to ONUs experiencing incidental contact to mist or dust deposited on surfaces, EPA assumed a representative exposure surface area equivalent to the mean value for one palm (*i.e.*, 268 cm²) of adult males ([U.S. EPA, 2011a](#)).

It should be noted that while the surface area of exposed skin is derived from data for hand surface area, EPA did not assume that only the workers hands may be exposed to the chemical. Nor did EPA assume that the entirety of the hands is exposed for all activities. Rather, EPA assumed that dermal exposures occur to some portion of the hands plus some portion of other body parts (*e.g.*, arms) such that the total exposed surface area is approximately equal to the surface area of one or two hands for the central tendency and high-end exposure scenario, respectively.

M.2.2 Dermal Load

The dermal load (Q_u) is the quantity of chemical on the skin after the dermal contact event. This value represents the quantity remaining after the bulk chemical formulation has fallen from the hand that cannot be removed by wiping the skin (*e.g.*, the film that remains on the skin). To estimate the dermal load from each activity, EPA used data from references cited by EPA's September 2013 engineering policy memorandum: *Updating CEB's Method for Screening-Level Assessments of Dermal Exposure* ([U.S. EPA, 2013](#)). That memorandum provides for the following dermal exposure scenarios:

- Routine and incidental contact with liquids (*e.g.*, maintenance activities, manual cleaning of equipment, filling drums, connecting transfer lines, sampling, and bench-scale liquid transfers);
- Routine immersion in liquids (*e.g.*, handling of wet surfaces and spray painting);
- Routine contact with container surfaces (*e.g.*, handling closed or empty bags of solid materials); and
- Routine, direct handling of solids (*e.g.*, filling/dumping containers of powders/flakes/granules, weighing powder/scooping/mixing, handling wet or dried material in a filtration and drying process).

For liquids, the memorandum uses values of 0.7 to 2.1 mg/cm²-event for routine or incidental contact with liquids and 1.3 to 10.3 mg/cm²-event for routine immersion in liquids ([U.S. EPA, 2013](#)). EPA used the maximum from each range to estimate high-end dermal loads. The memorandum does not provide recommended values for a central tendency dermal loading estimate. Therefore, the Agency analyzed data from EPA's technical report *A Laboratory Method to Determine the Retention of Liquids on the Surface of the Hands* ([U.S. EPA, 1992b](#)) that served as the basis for the liquid dermal loads provided in the 2013 memorandum. To estimate central tendency liquid dermal loading values, EPA used the 50th percentile of the dermal loading results from the study for each type of activity (*i.e.*, routine/incidental contact and immersion). The 50th percentile was 1.7 mg/cm²-event for routine/incidental contact with liquids and 3.8 mg/cm²-event for routine immersion in liquids.

For *o*-dichlorobenzene as a liquid, EPA applied a uniform distribution of 0.7 to 2.1 mg/cm²-event, respectively, for each OES ([U.S. EPA, 2013](#)).

For *o*-dichlorobenzene in a solid article, EPA applied a triangular distribution of 100 to 1,100 mg/event with a mode of 450 mg/event ([Marquart et al., 2006](#); [Lansink et al., 1996](#)).

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For ONU dermal exposures to solids, the distribution remained triangular, but the maximum was replaced by the mode for both the powder and article case. ONUs include employees who do not directly handle the chemical but may come into contact with dust that settles on surfaces. There are no dermal exposures expected for ONUs for *o*-dichlorobenzene as a liquid because ONUs likely will not come into contact with liquid during their work activities.

M.2.3 Fractional Absorption

EPA assumed a fractional absorption (f_{abs}) of 0.02 to 0.04 dependent on the OES. There are not any reliable dermal absorption studies available for *o*-dichlorobenzene, however based on comparison of all available data it is expected that *o*-dichlorobenzene absorption will be similar to *p*-dichlorobenzene. Test order data for neat *p*-dichlorobenzene indicated 4% adsorption and up to 2% adsorption in organic solvents containing 50% or less of *p*-dichlorobenzene ([Charles River Laboratories, 2025](#)). Therefore, for Occupational Exposure Scenarios with a concentration of *o*-dichlorobenzene exceeding 50% in formulation, 4% adsorption was assumed with 2% adsorption assumed otherwise.

M.2.4 Weight Fraction of Chemical

The weight fraction of *o*-dichlorobenzene, Y_{derm} , refers to the concentration of *o*-dichlorobenzene in the formulation the worker's skin is exposed to. EPA generally assumes that this concentration will be equal to the weight fraction of *o*-dichlorobenzene in the chemical products being handled within the OES. EPA assessed concentrations of *o*-dichlorobenzene in the chemical products being handled using available test order data, CDR data, Generic Scenarios, Emission Scenario Documents, product safety data sheets, and the *o*-dichlorobenzene Use Report ([U.S. EPA, 2020f](#)). Table_Apx M-2 summarizes the basis for the concentration values used in assessing worker exposure to *o*-dichlorobenzene.

Table_Apx M-2. Summary of Weight Fraction of *o*-Dichlorobenzene Sources by OES

OES	Distribution Type	Source
Manufacturing	Static Value	Surrogate from <i>p</i> -dichlorobenzene data (Exponent Inc., 2024)
Repackaging	Uniform	Based on 2020 CDR (U.S. EPA, 2020b)
Processing as a Reactant	Uniform	Based on 2020 CDR (U.S. EPA, 2020b)
Incorporation into Soap, Cleaning Compound, and Toilet Preparation Manufacturing	Uniform	Presumably <i>o</i> -dichlorobenzene arrives at the site as a neat substance before it is formulated into the product. Assume same as Repackaging (U.S. EPA, 2020b).
Incorporation into Formulation, Mixture, or Reaction Product	Uniform	Based on 2020 CDR (U.S. EPA, 2020b)
Plastics Compounding	Static Value	Based on 2020 CDR (U.S. EPA, 2020b)
Plastics Converting	Uniform	Based on the Generic Scenario on Additives Used in Plastic Converting (U.S. EPA, 2021c)
Recycling	Uniform	Surrogate from Processing as a reactant (U.S. EPA, 2020b).
Functional Fluids (closed systems)	Static Value	Per company correspondence
Industrial Use of Solvents	Static Value	Sabic Test Order Data (SABIC, 2024)
Use of Ink, Toner, and Colorant Products	Triangular	Based on 2016 CDR, SDSs identified in the <i>o</i> -dichlorobenzene Use Report (U.S. EPA, 2020f, 2016b)

OES	Distribution Type	Source
Use of Paints and Coatings	Triangular	Based on 2016 CDR, SDSs identified in the <i>o</i> -dichlorobenzene Use Report, and a literature source (U.S. EPA, 2020f , 2016b ; OECD, 2011a)
Use of Paint Thinners and Removers	Uniform	Surrogate from Incorporation into Formulation, Mixture, or Reaction Product (U.S. EPA, 2020b).
Use of Lubricants and Greases	Triangular	Per SDSs identified in <i>o</i> -dichlorobenzene Use Report (U.S. EPA, 2020f)
Use of Fuels and Related Products	Uniform	Per SDSs identified in <i>o</i> -dichlorobenzene Use Report (U.S. EPA, 2020f)
Use in Solid Air Care Products	Uniform	Per SDSs identified in <i>o</i> -dichlorobenzene Use Report (U.S. EPA, 2020f)
Use of Laboratory Chemicals	Triangular	Per SDSs identified in <i>o</i> -dichlorobenzene Use Report (U.S. EPA, 2020f)
Use of Cleaning and Furnishing Care Products	Triangular	Per SDSs identified in <i>o</i> -dichlorobenzene Use Report (U.S. EPA, 2020f)
Sheep Branding Fluid	Static	Per SDSs identified in <i>o</i> -dichlorobenzene Use Report (U.S. EPA, 2020f)
Disposal	Uniform	Based on a literature source (Midwest Research Institute, 1984)

M.2.5 Exposure Days

The exposure days refer to the number of potential days of exposure per year. Depending on the OES, workers may be dermally exposed for different ranges of days during the year. EPA assessed exposure days of *o*-dichlorobenzene in the chemical products being handled using available test order data, CDR data, Generic Scenarios, Emission Scenario Documents, product safety data sheets, and relevant *p*-dichlorobenzene surrogate data. Table_Apx M-3 summarizes the basis for the exposure days values used in assessing worker exposure to *o*-dichlorobenzene.

Table_Apx M-3. Summary of Exposure Days of *o*-Dichlorobenzene Sources by OES

OES	Distribution Type	Source
Manufacturing	Discrete	Surrogate from <i>p</i> -dichlorobenzene.
Repackaging	Triangular	Based on the Repackaging Generic Scenario (U.S. EPA, 2022a)
Processing as a Reactant	Static	Based on typical worker schedule.
Incorporation into Soap, Cleaning Compound, and Toilet Preparation Manufacturing	Static	Based on typical worker schedule.
Incorporation into Formulation, Mixture, or Reaction Product	Static	Based on typical worker schedule.
Plastics Compounding	Static	Surrogate from <i>p</i> -dichlorobenzene.
Plastics Converting	Static	Surrogate from <i>p</i> -dichlorobenzene.

OES	Distribution Type	Source
Recycling	Static	Based on typical worker schedule.
Functional Fluids (closed systems)	Discrete	Assume annual (1 day/yr) to monthly (12 days/year) changeout of functional fluids.
Industrial Use of Solvents	Static	Based on typical worker schedule.
Use of Ink, Toner, and Colorant Products	Static	Based on typical worker schedule.
Use of Paints and Coatings	Static	Based on typical worker schedule.
Use of Paint Thinners and Removers	Static	Based on typical worker schedule.
Use of Lubricants and Greases	Static	Based on typical worker schedule.
Use of Fuels and Related Products	Static	Based on the GS for the Use of Chemicals in Fuels and Related Products(U.S. EPA, 2021e)
Use in Solid Air Care Products	Static	Based on typical worker schedule and 12-hour shift duration.
Use of Laboratory Chemicals	Discrete	Surrogate from <i>p</i> -dichlorobenzene.
Use of Cleaning and Furnishing Care Products	Static	Based on typical worker schedule.
Sheep Branding Fluid	Static	Based on typical worker schedule.
Disposal	Discrete	Surrogate from <i>p</i> -dichlorobenzene.

M.2.6 Frequency of Events

The frequency of events, FT, refers to the number of dermal exposure events/day. Depending on the OES, workers may perform multiple activities throughout their shift that could potentially result in dermal exposures. Equation_Apx M-1 shows a linear relationship between FT and APDR; however, this fails to account for time between contact events. Because the chemical simultaneously evaporates from and absorbs into the skin, dermal exposure is a function of both the number of contact events/day and the time between contact events. Subsequent dermal exposure events may only meaningfully increase the dermal dose if there is sufficient time between the contact events to allow for significant evaporation/absorption of the previous exposure event. EPA did not identify information on how many contact events may occur and the time between contact events. Therefore, the Agency assumes a single contact event/day for estimating dermal exposures for all OESs.

Appendix N MODEL APPROACHES AND PARAMETERS

This appendix presents the modeling approach and model equations used in estimating occupational exposures for each of the applicable OESs. Note that though this assessment focuses only on occupational exposure, the models often include environmental release estimates as well, and these are also presented here so the entirety of the models used can be portrayed. The models were developed through review of the literature and consideration of existing EPA/OPPT models, ESDs, and/or GSs. An individual model input parameter could either have a discrete value or a distribution of values. EPA assigned statistical distributions based on reasonably available literature data.

N.1 Use of Paints and Coatings Model Approach and Parameters

This section presents the modeling approach, and equations used to estimate occupational exposures for *o*-dichlorobenzene during the use of paints and coatings OES. This approach utilizes the Automotive Refinishing Spray Coating Mist Inhalation Model from the ESD on Coating Application via Spray-Painting in the Automotive Refinishing Industry (OECD, 2011a). The model estimates worker inhalation exposure based on the concentration of the chemical of interest in the non-volatile portion of the sprayed product and the concentration of over sprayed mist/particles. The model is based on PBZ monitoring data for mists during automotive refinishing. EPA used the 50th and 95th percentile mist concentration along with the concentration of *o*-dichlorobenzene in the paints and coatings products to estimate the central tendency and high-end inhalation exposures, respectively.

N.1.1 Model Design Equations

The *Automotive Refinishing Spray Coating Mist Inhalation Model* calculates the 8-hour TWA exposure to *o*-dichlorobenzene present in mist and particulates using the following equation:

Equation_Apx N-1.

$$C_{o-DCB,8hr-TWA} = \frac{C_{mist} \times F_{oDCB} \times ED}{8 \text{ hrs}}$$

Where:

$C_{o-DCB,8hr-TWA}$	=	8-hour TWA inhalation exposure to <i>o</i> -dichlorobenzene (mg/m ³)
C_{mist}	=	Over sprayed product mist concentration in the air within worker's breathing zone (mg/m ³)
F_{oDCB}	=	Mass fraction of <i>o</i> -dichlorobenzene in the non-volatile portion of the spray (mg _{<i>o</i>-DCB} /mg _{non-volatile components})
ED	=	Exposure Duration (h)

N.1.2 Model Parameters

Table_Apx N-1 summarizes the input model parameters and their values for the Automotive Refinishing Spray Coating Mist Inhalation Model. Additional explanations of EPA's selection of the values for each parameter are provided after this table.

Table Apx N-1. Summary of Parameter Values Used in the Spray Inhalation Model

Input Parameter	Symbol	Unit	Parameter Value	
			Central Tendency	High-End
Concentration of Mist	C_{mist}	mg/m ³	3.38	22.10
<i>o</i> -Dichlorobenzene Concentration in Product	F_{oDCB_prod}	kg/kg	0.1	0.5
<i>o</i> -Dichlorobenzene Concentration of Non-volatile Components (Calculated)	F_{oDCB}	mg/mg	0.2	1.00
Exposure Duration	ED	hours	8	

N.1.3 Concentration of Mist

EPA utilized coating mist concentrations within spray booths obtained through a search of available OSHA In-Depth Surveys of the Automotive Refinishing Shop Industry and other relevant studies, as published in the ESD on Coating Application via Spray-Painting in the Automotive Refinishing Industry ([OECD, 2011a](#)). The data is divided into various combinations of spray booth types (*e.g.*, downdraft and crossdraft) and spray gun types (*e.g.*, conventional, high-volume low-pressure). EPA expects there to be a variety of facility types and substrates being coated such that a variety of spray booth and spray gun combinations may be used to apply the products. Due to this, EPA used mist concentrations from all scenarios for this parameter. The scenarios included combinations of crossdraft and downdraft booths with either conventional spray guns or HVLP spray guns. Central tendency and high-end scenario parameters represent the 50th and 95th percentile mist concentrations, respectively. The central tendency mist concentration was 3.38 mg/m³ and the high-end concentration was 22.1 mg/m³.

N.1.4 *o*-Dichlorobenzene Product Concentration

EPA compiled *o*-dichlorobenzene concentration information from eight SDSs of paints and coatings products, a report to the 2016 CDR, and the ESD on Coating Application via Spray-Painting in the Automotive Refinishing Industry ([U.S. EPA, 2020f](#), [2016b](#); [OECD, 2011a](#)). These sources provided an *o*-dichlorobenzene concentration range of 0.25 to 50% in paint and coating products. Based on this information, EPA estimated exposure using a high-end and central tendency product concentration of 50% and 10% *o*-dichlorobenzene respectively. The high-end estimate represents the maximum concentration of *o*-dichlorobenzene listed in the product SDSs ([Duncan Enterprises, 2010](#)). The central tendency value represents the median of listed endpoints of *o*-dichlorobenzene product concentration ranges.

N.1.5 Concentration of Non-Volatile Solids in the Spray Product

The ESD on Coating Application via Spray-Painting in the Automotive Refinishing Industry cites data from Volume 6 of the *Kirk-Othmer Encyclopedia of Chemical Technology* stating that non-volatile solids in a spray paint or coating product can range from 0.15 to 0.50 kg/kg ([OECD, 2011a](#); [Bryant, 1993](#)). EPA used the ESD recommended value of 0.50 kg/kg and the upper bound of the underlying distribution of 0.25 kg/kg for the central tendency and high-end parameters, respectively ([OECD, 2011a](#)).

N.1.6 *o*-Dichlorobenzene Concentration in Non-Volatile Components

The mass fraction of *o*-dichlorobenzene in the non-volatile portion of the sprayed product is calculated using the following equation:

Equation_Apx N-2.

$$F_{oDCB} = \frac{F_{oDCB\_prod}}{F_{solids\_prod}}$$

Where:

F_{oDCB}	=	Mass fraction of <i>o</i> -dichlorobenzene in the non-volatile portion of the sprayed product (kg _{oDCB} /kg _{non-volatile components})
F_{oDCB_prod}	=	Mass fraction of <i>o</i> -dichlorobenzene in the paint and coating product, spray-applied (kg _{oDCB} /kg _{sprayed product})
F_{solids_prod}	=	Mass fraction of non-volatile components within the sprayed product (kg _{non-volatile components} /kg _{sprayed product})

The results of this equation were a central tendency *o*-dichlorobenzene concentration of 0.20 and a high-end concentration of 1.00 kg/kg. To maximize the high-end value, the high-end mass fraction of *o*-dichlorobenzene in the paint and coating product is divided by the minimum mass fraction of non-volatile components and capped at a maximum mass fraction of 1.

N.1.7 Exposure Duration

EPA did not identify *o*-dichlorobenzene-specific data on spray application duration. Due to this, the exposure duration was assessed at a full eight-hour shift. There is some uncertainty in the full-shift assumption since workers may have other activities (*e.g.*, container unloading and cleaning) during their shift. Additionally, those activities may result in exposures to *o*-dichlorobenzene vapors. An eight-hour duration for spraying is used and assumed to be protective of any contribution to exposures from vapors.

N.2 Use of Lubricants and Greases Model Approach and Parameters

This appendix presents the modeling approach and equations used to estimate exposures for *o*-dichlorobenzene during the Use of Lubricants and Greases OES (Section 8.2.13.3). This approach utilizes the 2020 ESD on Chemical Additives in Automotive Lubricants and Monte Carlo modeling (OECD, 2020). A Monte Carlo simulation (a type of stochastic simulation) was conducted to capture variability in the model input parameters. The simulation was conducted using the Latin hypercube sampling method in @Risk Industrial Edition, Version 8.12. The Latin hypercube sampling method generates a sample of possible values from a multi-dimensional distribution and is considered a stratified method, meaning the generated samples are representative of the probability density function (variability) defined in the model. EPA performed the model at 100,000 iterations to capture a broad range of possible input values, including values with low probability of occurrence.

Based on the ESD, EPA identified the following inhalation exposure points:

- Exposure Point A: Exposure during Container Unloading
- Exposure Point B: Exposure during Container Cleaning.

Occupational exposures for *o*-dichlorobenzene during the use of lubricants and greases are a function of the chemical's physical properties, container size, mass fractions, and other model parameters. While physical properties are fixed, some model parameters are expected to vary. EPA used a Monte Carlo simulation to capture variability in the following model input parameters for occupational exposures: *o*-dichlorobenzene concentration, saturation factor, air speed, ventilation rate, and mixing factor.

EPA used the 95th and 50th percentile Monte Carlo simulation result values for assessment. The 95th percentile value represents the high-end release amount or exposure level, whereas the 50th percentile value represents the typical release amount or exposure level. The following subsections detail the

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model design equations and parameters for each of the OESs.

N.2.1 Model Equations

Table_Apx N-2 provides the models and associated variables used to calculate occupational exposures for each exposure point within each iteration of the Monte Carlo simulation. EPA used these occupational exposures to develop a distribution of exposure outputs for the Use of Lubricants and Greases OES. The Agency assumed that the same worker performed each exposure activity resulting in a total exposure duration of up to 8 hours/day. The variables used to calculate each of the following exposure concentrations and durations include deterministic or variable input parameters, known constants, physical properties, conversion factors, and other parameters.

The Monte Carlo simulation calculated an 8-hour TWA exposure concentration for each iteration using the exposure concentration and duration associated with each activity and assuming exposures outside the exposure activities were zero. EPA then selected 50th percentile and 95th percentile values to estimate the central tendency and high-end exposure concentrations, respectively.

Table_Apx N-2. Models and Variables Applied for Exposure Points in the Use of Lubricants and Greases OES

Exposure Point	Model(s) Applied	Variables Used
Exposure Point A: Exposure during Container Unloading	EPA/OPPT Mass Balance Inhalation Model with vapor generation rate from EPA/OAQPS AP-42 Loading Model	Vapor Generation Rate: F_{oDCB} ; VP ; $F_{saturation\_unloading}$; MW ; $V_{smallcont}$; R ; T ; $RATE_{fill\_smallcont}$; Q ; k ; Vm ; $F_{correction\_factor}$ Exposure Duration: $RATE_{fill\_smallcont}$
Exposure Point B: Exposure during Container Cleaning	EPA/OPPT Mass Balance Inhalation Model with vapor generation rate from EPA/OPPT Penetration Model or EPA/OPPT Mass Transfer Coefficient Model, based on air speed	Vapor Generation Rate: F_{oDCB} ; MW ; VP ; $RATE_{air\_speed}$; $D_{opening}$; T ; P ; Q ; k ; Vm ; $F_{correction\_factor}$ Exposure Duration: $RATE_{cont\_clean}$

N.2.2 Model Input Parameters

Table_Apx N-3 summarizes the model parameters and their values for the Use of Lubricants and Greases Monte Carlo simulation. Additional explanations of EPA's selection of the distributions for each parameter are provided after the following table.

Table_Apx N-3. Summary of Parameter Values and Distributions Used in the Use of Lubricants and Greases Model

Input Parameter	Symbol	Unit	Deterministic Values	Uncertainty Analysis Distribution Parameters				Rationale/Basis
			Value	Lower Bound	Upper Bound	Mode	Distribution Type	
Air Speed	RATE _{air_speed}	cm/s	10	1.3	202.2	–	Lognormal	See Section N.2.2.5
Saturation Factor Unloading	F _{saturation_unloading}	unitless	0.5	0.5	1.45	0.5	Triangular	See Section N.2.2.6
Ventilation Rate	Q	ft ³ /min	3,000	500	10,000	3,000	Triangular	See Section N.2.2.7
Mixing Factor	k	unitless	0.5	0.1	1	0.5	Triangular	See Section N.2.2.8
Concentration of <i>o</i> -Dichlorobenzene in Lubricants	F _{oDCB}	kg/kg	0.01	0.001	0.05	0.01	Triangular	See Section N.2.2.9
Annual Facility Throughput	Q _{lubricant}	kg/site-yr	40,000	–	–	–	–	See Section N.2.2.1
Operating Days	OD	days/yr	253	–	–	–	–	See Section N.2.2.3
<i>o</i> -Dichlorobenzene Molecular Weight	MW	g/mol	147	–	–	–	–	Physical property
Temperature	T	Kelvin	298	–	–	–	–	Process parameter
Pressure	P	torr	760	–	–	–	–	Process parameter
Gas Constant	R	L*torr/(mol*K)	62.636	–	–	–	–	Universal constant
<i>o</i> -Dichlorobenzene Vapor Pressure	VP	torr	1.36	–	–	–	–	Physical property
Lubricant Density	ρ _{lubricant}	kg/L	1	–	–	–	–	See Section N.2.2.10
Container Volume	V _{smallcont}	gal/container	5	–	–	–	–	See Section N.2.2.11
Container Cleaning Rate	RATE _{cont_clean}	containers/h	20	–	–	–	–	See Section N.2.2.12
Fill Rate of Small Container	RATE _{fill_smallcont}	containers/h	60	–	–	–	–	See Section N.2.2.12
Diameter of Opening for Container Cleaning	D _{opening}	cm	5.08	–	–	–	–	See Section N.2.2.13

N.2.2.1 Annual Facility Throughput

The 2020 ESD on Chemical Additives in Automotive Lubricants estimates the annual facility throughput from data obtained through the U.S. Census Bureau, as well as production data from automotive servicing shops. EPA did not find OES-specific data on throughput for the Use of Lubricants and Greases so the estimate of 40,000 kg/site-year from Automotive Lubricants ESD was used as surrogate data for this model ([OECD, 2020](#)).

N.2.2.2 Number of Containers per Year

The number of containers of lubricant used by a site per year is calculated using the following equation:

Equation_Apx N-3.

$$N_{cont\_yr} = \frac{Q_{lubricant}}{V_{smallcont} * \rho_{lubricant} * \left(3.78541 \frac{L}{gal}\right)}$$

Where:

$Q_{lubricant}$	=	Throughput of lubricant per site (kg lubricant/site-year)
$\rho_{lubricant}$	=	Lubricant density (kg/L)
$V_{smallcont}$	=	Small container volume (gal/container)
N_{cont_yr}	=	Annual number of containers (container/site-year)

See Appendices N.2.2.10 and N.2.2.11 for the discussion of lubricant density and container volume parameter values.

N.2.2.3 Operating Days

The 2020 ESD on Chemical Additives in Automotive Lubricants estimates the number of operating days from employment data obtained through the U.S. Bureau of Labor Statistics (BLS) Occupational Employment Statistics. Dividing the average employee annual wage by the mean hourly wage yields an estimated average of 253 days/year, assuming an eight-hour workday ([OECD, 2020](#)).

N.2.2.4 Exposure Duration

EPA estimated exposure durations using calculations and parameters provided by the 2020 ESD on Chemical Additives in Automotive Lubricants ([OECD, 2020](#)) and *ChemSTEER User Guide* ([U.S. EPA, 2015a](#)). The operating time for container unloading (Exposure Point A) is calculated using the following equation:

Equation_Apx N-4.

$$Time_A = \frac{N_{cont\_yr}}{RATE_{fill\_smallcont} \times OD}$$

Where:

$Time_A$	=	Operating time for exposure point A (h/shift-day)
N_{cont_yr}	=	Annual number of containers (container/site-year)
$RATE_{fill\_smallcont}$	=	Fill rate of small containers (containers/h)
OD	=	Operating days (days/year)

For the emptying of small containers, the *ChemSTEER User Guide* ([U.S. EPA, 2015a](#)) indicates a rate of 60 containers/hour based on the Chemical Engineering Branch Manual for the Preparation of Engineering Assessments, Volume 1 (CEB Manual) ([CEB, 1991](#)). For the cleaning of small containers, the *ChemSTEER User Guide* ([U.S. EPA, 2015a](#)) indicates a rate of 60 containers/hour. EPA did not

identify any other information on container filling or cleaning rates; therefore, EPA used a single deterministic value.

N.2.2.5 Air Speed

Baldwin and Maynard measured indoor air speeds across a variety of occupational settings in the United Kingdom ([Baldwin and Maynard, 1998](#)), specifically, 55 work areas were surveyed. EPA analyzed the air speed data from Baldwin and Maynard and categorized the air speed surveys into settings representative of industrial facilities and representative of commercial facilities. EPA fit separate distributions for these industrial and commercial settings and used the industrial distribution for this OES.

EPA fit a lognormal distribution for the dataset as consistent with the authors' observations that the air speed measurements within a surveyed location were lognormally distributed and the population of the mean air speeds among all surveys were lognormally distributed ([Baldwin and Maynard, 1998](#)). Because lognormal distributions are bound by zero and positive infinity, the Agency truncated the distribution at the largest observed value among all of the survey mean air speeds.

EPA fit the air speed surveys representative of industrial facilities to a lognormal distribution with the following parameter values: mean of 22.414 cm/s and standard deviation of 19.958 cm/s. In the model, the lognormal distribution is truncated at a minimum allowed value of 1.3 cm/s and a maximum allowed value of 202.2 cm/s (largest surveyed mean air speed observed in Baldwin and Maynard) to prevent the model from sampling values that approach infinity or are otherwise unrealistically small or large ([Baldwin and Maynard, 1998](#)).

Baldwin and Maynard ([Baldwin and Maynard, 1998](#)) only presented the mean air speed of each survey. The authors did not present the individual measurements within each survey. Therefore, these distributions represent a distribution of mean air speeds and not a distribution of spatially variable air speeds within a single workplace setting. However, a mean air speed (averaged over a work area) is the required input for the model. EPA converted the units to ft/min prior to use within the model equations.

N.2.2.6 Saturation Factor

The Chemical Engineering Branch Manual for the Preparation of Engineering Assessments, Volume 1 (CEB Manual) indicates that during splash filling, the saturation concentration was reached or exceeded by misting with a maximum saturation factor of 1.45 ([CEB, 1991](#)). The CEB Manual indicates that saturation concentration for bottom filling was expected to be about 0.5 ([CEB, 1991](#)). The underlying distribution of this parameter is not known; therefore, EPA assigned a triangular distribution based on the lower bound, upper bound, and mode of the parameter. Because a mode was not provided for this parameter, EPA assigned a mode value of 0.5 for bottom filling as bottom filling minimizes volatilization ([CEB, 1991](#)). This value also corresponds to the typical value provided in the *ChemSTEER User Guide* for the EPA/OAQPS AP-42 Loading Model ([U.S. EPA, 2015a](#)).

N.2.2.7 Ventilation Rate

The CEB Manual ([CEB, 1991](#)) indicates general ventilation rates in industry range from 500 to 10,000 ft³/min, with a typical value of 3,000 ft³/min. The underlying distribution of this parameter is not known; therefore, EPA assigned a triangular distribution based on an estimated lower bound, upper bound, and mode of the parameter. EPA assumed the lower and upper bound using the industry range of 500 to 10,000 ft³/min and the mode using the 3,000 ft³/min typical value ([CEB, 1991](#)).

N.2.2.8 Mixing Factor

The CEB Manual ([CEB, 1991](#)) indicates mixing factors may range from 0.1 to 1, with 1 representing ideal mixing. The CEB Manual references the 1988 ACGIH Ventilation Handbook, which suggests the following factors and descriptions: 0.67 to 1 for best mixing; 0.5 to 0.67 for good mixing; 0.2 to 0.5 for fair mixing; and 0.1 to 0.2 for poor mixing ([CEB, 1991](#)). The underlying distribution of this parameter is not known; therefore, EPA assigned a triangular distribution based on the defined lower and upper bound and estimated mode of the parameter. The mode for this distribution was not provided; therefore, the Agency assigned a mode value of 0.5 based on the typical value provided in the *ChemSTEER User Guide* for the EPA/OPPT Mass Balance Inhalation Model ([U.S. EPA, 2015a](#)).

N.2.2.9 Concentration of *o*-Dichlorobenzene in Lubricants

EPA modeled *o*-dichlorobenzene concentrations in the lubricants and greases using compiled SDS information. EPA identified two lubricant products containing *o*-dichlorobenzene ([Marvel Oil Company, 2024b](#); [Kleen-Flo Tumbler Ind. Ltd., 2017](#)). EPA assumed a triangular distribution with a lower-bound of 0.1%, upper-bound of 5%, and mode of 1%. The lower and upper bounds represent the minimum and maximum reported concentrations in the SDSs. The mode represents the mode of endpoints reported in the SDSs.

N.2.2.10 Lubricant Density

The 2020 ESD on Chemical Additives in Automotive Lubricants assumes a default lubricant density of 1 kg/L ([OECD, 2020](#)).

N.2.2.11 Container Volume

The 2020 ESD on Chemical Additives in Automotive Lubricants assumes a container volume of 5 gallons per container for each of the assessed worker activities ([OECD, 2020](#)). The 5-gallon container assumption comes from the *ChemSTEER User Guide* value for small containers, which are assumed to be the type of containers used in unloading of lubricants and container cleaning activities ([U.S. EPA, 2015a](#)).

N.2.2.12 Container Cleaning and Fill Rates

The *ChemSTEER User Guide* ([U.S. EPA, 2015a](#)) provides a typical fill rate 60 containers per hour for containers with less than 20 gallons of liquid and for all container cleaning activities.

N.2.2.13 Diameter of Opening

The *ChemSTEER User Guide* indicates diameters for the openings for various vessels that may hold liquids in order to calculate vapor generation rates during different activities ([U.S. EPA, 2015a](#)). For container cleaning activities, the *ChemSTEER User Guide* indicates a single default value of 5.08 cm ([U.S. EPA, 2015a](#)). Therefore, EPA could not develop a distribution of values for this parameter and used the single value 5.08 cm from that user guide.

N.3 Use of Fuels and Related Products Model Approach and Parameters

This appendix presents the modeling approach and equations used to estimate exposures for *o*-dichlorobenzene during the Use of Fuels and Related Products OES (Section 4). This approach utilizes monitoring data compiled in the Use of Chemicals in Fuels and Related Products Generic Scenario ([U.S. EPA, 2021e](#)). The GS evaluates inhalation exposures to fuel additives using inhalation monitoring of VOCs collected during transfer of gasoline from transport containers and storage tanks and correcting for mole fraction and vapor pressure of the chemical of interest (*i.e.*, *o*-dichlorobenzene) in the vapor phase of gasoline. EPA used the typical and worst-case monitored VOC concentrations along with the concentration of *o*-dichlorobenzene in the vapor phase of fuel to estimate the central tendency and high-

end inhalation exposures, respectively.

N.3.1 Model Design Equations

The Use of Chemicals in Fuels and Related Products Generic Scenario calculates the 8-hour TWA exposure to *o*-dichlorobenzene present in fuels and related products using the following equation:

Equation_Apx N-5.

$$C_{o\text{-DCB},8hr\text{-TWA}} = \frac{C_{VOC} \times F_{o\text{DCB\_vapor}} \times ED}{8 \text{ hrs}}$$

Where:

$C_{o\text{-DCB},8hr\text{-TWA}}$	=	8-hour TWA inhalation exposure to <i>o</i> -dichlorobenzene (mg/m ³)
C_{VOC}	=	Concentration of VOCs in the worker breathing zone (mg/m ³)
$F_{o\text{DCB\_vapor}}$	=	Weight fraction of <i>o</i> -dichlorobenzene in the vapor phase of gasoline (kg <i>o</i> -dichlorobenzene/kg VOC vapor)
ED	=	Exposure Duration (h)

N.3.2 Model Parameters

Table_Apx N-4 summarizes the input model parameters and their values from the Use of Chemicals in Fuels and Related Products Generic Scenario. Additional explanations of EPA's selection of the values for each parameter are provided after this table.

Table_Apx N-4. Summary of Parameter Values Used to Estimate Inhalation Exposure to Fuels and Related Products

Input Parameter	Symbol	Unit	Parameter Value	
			Central Tendency	High-End
Concentration of VOCs in the worker breathing zone	C_{VOC}	mg/m ³	66.1	170
Weight fraction of all engine oils in fuel	F_{oils_fuel}	kg/kg	0.0196	
Weight fraction of <i>o</i> -dichlorobenzene-containing engine oil in fuel	$F_{o\text{DCB\_oils\_fuel}}$	kg/kg	0.25	
Concentration of <i>o</i> -dichlorobenzene in engine oil	$F_{o\text{DCB\_fuel}}$	kg/kg	0.0012	0.01
Adjusted <i>o</i> -dichlorobenzene concentration in fuel (calculated)	$F_{o\text{DCB\_fuel\_adjusted}}$	kg/kg	5.9E-04	4.9E-03
Weight fraction of <i>o</i> -dichlorobenzene in the vapor phase of fuel	$F_{o\text{DCB\_vapor}}$	kg/kg	4.8E-08	4.0E-07
Exposure duration	ED	hours/day	8	

N.3.3 Concentration of Volatile Organic Carbon (VOC) in Worker Breathing Zone

In the Use of Chemicals in Fuels and Related Products Generic Scenario, EPA identified several literature studies related to worker exposures during unloading of gasoline tank trucks ([U.S. EPA, 2021e](#)). EPA compiled these data, removing duplicates between the data sets and data that were unrelated to loading/unloading. All data were 8-hour time-weighted averages (TWAs). Using these data, EPA calculated typical and worst-case values. Some of the data included the use of vapor recovery systems at the fuel handling sites. The GS suggests that if the use of vapor recovery systems is unknown,

that all data be used in calculating the typical and worst-case values. The typical value of 66.1 mg/m³ represents the average of the means of the identified data. The worst-case value of 170 mg/m³ represents the average of the maximum values of the identified data ([U.S. EPA, 2021e](#)).

N.3.4 Weight Fraction of All Engine Oils in Fuel

Engine oils may be added to gasoline as a fuel additive to reduce sludge and varnish buildup that impedes engine performance (EPA-HQ-OPPT-2018-0444-0026). EPA did not identify specific information on the weight fraction of *o*-dichlorobenzene-containing engine oils added to fuels. However, per similar engine oil fuel additive products identified via internet search, engine oils are typically used in a ratio of 1 part oil to 50 parts gasoline. This corresponds to a weight fraction of engine oil in fuel as 0.0196.

N.3.5 Weight Fraction of *o*-Dichlorobenzene-Containing Engine Oil in Fuel

Based on a public comment from Marvel Oil Company, EPA expects *o*-dichlorobenzene to be used as a partial replacement for normal two-cycle engine oil at a ratio of one part *o*-dichlorobenzene-containing oil to three parts standard oil (EPA-HQ-OPPT-2018-0444-0026). Therefore, the weight fraction of *o*-dichlorobenzene-containing engine oil in fuel is equal to 0.25.

N.3.6 Concentration of *o*-Dichlorobenzene in Engine Oil

EPA compiled *o*-dichlorobenzene concentration information from one SDS and a public comment ([Marvel Oil Company, 2024b](#)) (EPA-HQ-OPPT-2018-0444-0026). The identified SDS provided an *o*-dichlorobenzene concentration range of 0.1 to 1% in engine oils used as fuel additives. In addition, a public comment from Marvel Oil Company stated that the amount of *o*-dichlorobenzene in their product is less than 0.12% by weight. Based on this information, EPA estimated exposure using a high-end and central tendency product concentration of 1% and 0.12% *o*-dichlorobenzene respectively. The high-end estimate represents the maximum concentration of *o*-dichlorobenzene listed in the product SDSs ([Marvel Oil Company, 2024b](#)). The central tendency value represents the specified concentration from Marvel Oil Company's public comment (EPA-HQ-OPPT-2018-0444-0026).

N.3.7 Adjusted *o*-Dichlorobenzene Concentration in Fuel

The mass fraction of *o*-dichlorobenzene in fuels is calculated using the following equation:

Equation_Apx N-6.

$$F_{oDCB\_fuel\_adjusted} = F_{oils\_fuel} \times F_{oDCB\_oils\_fuel} \times F_{oDCB\_fuel}$$

Where:

$F_{oDCB\_fuel\_adjusted}$	=	Weight fraction of <i>o</i> -dichlorobenzene in the fuel (kg _{oDCB} /kg _{fuel})
F_{oils_fuel}	=	Weight fraction of all engine oils in fuel (kg _{engine oil} /kg _{fuel})
$F_{oDCB\_oils\_fuel}$	=	Weight fraction of <i>o</i> -dichlorobenzene-containing engine oil in fuel (kg _{oDCB oils} /kg _{engine oil})
F_{oDCB_fuel}	=	Concentration of <i>o</i> -dichlorobenzene in engine oil (kg _{oDCB} /kg _{oDCB oils})

The results of this equation were a central tendency *o*-dichlorobenzene concentration of 5.9×10⁻⁶ and a high-end concentration of 4.9×10⁻⁵ kg/kg, or a weight percent of *o*-dichlorobenzene of 5.9×10⁻⁴ to 4.9×10⁻³.

N.3.8 Weight Fraction of *o*-Dichlorobenzene in Vapor Phase of Fuel

In order to estimate inhalation exposures, the concentration of *o*-dichlorobenzene in the vapor phase

10231 must be calculated. The Use of Chemicals in Fuels and Related Products Generic Scenario provides a
10232 vapor weight fraction conversion table ([U.S. EPA, 2021e](#)). Here, vapor mole fraction can be calculated
10233 from the weight fraction or weight percent component composition, the partial pressure of each
10234 component in liquid, and the liquid mole fraction using Raoult's law. To use the table, EPA input *o*-
10235 dichlorobenzene's molecular weight and weight fraction in the liquid fuel (see Section N.3.7), and the
10236 tables calculate the mole fraction in the fuel vapor. This resulted in a high-end vapor fraction of 4.8E-08
10237 and central tendency vapor fraction of 4.0×10^{-7} . Table_Apx N-5 and Table_Apx N-6 provide the *o*-
10238 dichlorobenzene vapor weight fraction conversion tables for central tendency and high-end
10239 concentrations, respectively.

10240

Table Apx N-5. Central Tendency Calculation of F_{oDCB} vapor in Fuels

CAS Number	Compound			Step 1 - Original	Step 1 - Adjusted	Step 2	Step 3	Step 4	Step 5	Step 6	Step 7
		A	B	C	C	D = C/A	E = D/(ΣD)	F = E*B	G = F/(ΣF)	H = G*A	G = H/(ΣH)
		MolWt	Pvap at 77°F (psia)	Gasoline Liquid (wt%)	Gasoline Liquid (wt%)	Gasoline Liquid (moles/100 g)	Gasoline Liquid (mole fraction)	Gasoline Partial Pressure (psia)	Gasoline Vapor (mole fraction)	MolWt Contribution Gasoline Vapor (g/mol)	Gasoline Vapor (wt fract)
71-43-2	Benzene	78.11	1.840	0.80	0.79	1.01E-04	9.30E-03	1.71E-02	3.54E-03	2.77E-01	0.0040
110-54-3	Hexane	86.18	2.928	1.36	1.35	1.56E-04	1.43E-02	4.19E-02	8.68E-03	7.48E-01	0.0109
108-88-3	Toluene	92.14	0.550	7.0	6.93	7.52E-04	6.90E-02	3.79E-02	7.85E-03	7.24E-01	0.0105
1330-20-7	Xylene	106.14	0.169	7.31	7.23	6.81E-04	6.25E-02	1.06E-02	2.19E-03	2.32E-01	0.0034
100-41-4	Ethylbenzene	106.17	0.184	1.26	1.25	1.17E-04	1.08E-02	1.98E-03	4.10E-04	4.36E-02	0.0006
540-84-1	2,2,4-Trimethylpentane	114.23	0.954	1.098	1.09	9.51E-05	8.73E-03	8.32E-03	1.72E-03	1.97E-01	0.0029
98-82-8	Cumene	120.19	0.089	0.19	0.19	1.56E-05	1.44E-03	1.28E-04	2.64E-05	3.18E-03	0.0000
91-20-3	Naphthalene	128.17	0.005	0.21	0.21	1.62E-05	1.49E-03	7.44E-06	1.54E-06	1.97E-04	0.0000
106-97-8	n-Butane	58.12	35.220	4.7	4.65	8.00E-04	7.34E-02	2.59E00	5.35E-01	3.11E01	0.4515
72-28-5	Isobutane	58.12	13.294	1.7	1.68	2.89E-04	2.66E-02	3.53E-01	7.31E-02	4.25E00	0.0616
109-66-0	Pentane	72.15	10.285	3.9	3.86	5.35E-04	4.91E-02	5.05E-01	1.04E-01	7.54E00	0.1094
78-78-4	Isopentane	72.15	3.670	7.9	7.82	1.08E-03	9.94E-02	3.65E-01	7.55E-02	5.45E00	0.0791
	C6 surrogate	86.18	4.094	10.08	9.97	1.16E-03	1.06E-01	4.35E-01	9.00E-02	7.76E00	0.1126
	C7 surrogate	100.2	1.274	7.21	7.13	7.12E-04	6.53E-02	8.32E-02	1.72E-02	1.73E00	0.0251
	C8 surrogate	114.23	0.522	3.21	3.18	2.78E-04	2.55E-02	1.33E-02	2.76E-03	3.15E-01	0.0046
	C9 surrogate	120.19	0.039	7.29	7.21	6.00E-04	5.51E-02	2.15E-03	4.45E-04	5.34E-02	0.0008
	Other VOC	100.20	0.884	34.78	34.41	3.43E-03	3.15E-01	2.79E-01	5.77E-02	5.78E00	0.0839
95-50-1	<i>o</i> -dichlorobenzene	147	0.029	2.2E-04	5.9E-04	4.0E-08	3.7E-06	1.1E-07	2.2E-08	3.3E-06	4.8E-08
						nT		PtotalVP		MWvap	
	Sums			100	100	0.0109	1	4.77	1	67.49	1

10241

10242 **Table Apx N-6. High-End Calculation of F_{oDCB_vapor} in Fuels**

CAS Number	Compound			Step 1 - Original	Step 1 - Adjusted	Step 2	Step 3	Step 4	Step 5	Step 6	Step 7
		A	B	C	C	D = C/A	E = D/(ΣD)	F = E*B	G = F/(ΣF)	H = G*A	G = H/(ΣH)
		MolWt	Pvap at 77°F (psia)	Gasoline Liquid (wt%)	Gasoline Liquid (wt%)	Gasoline Liquid (moles/100 g)	Gasoline Liquid (mole fraction)	Gasoline Partial Pressure (psia)	Gasoline Vapor (mole fraction)	MolWt Contribution Gasoline Vapor (g/mol)	Gasoline Vapor (wt fract)
71-43-2	Benzene	78.11	1.840	0.80	0.79	1.01E-04	9.30E-03	1.71E-02	3.54E-03	2.77E-01	0.0040
110-54-3	Hexane	86.18	2.928	1.36	1.35	1.56E-04	1.43E-02	4.19E-02	8.68E-03	7.48E-01	0.0109
108-88-3	Toluene	92.14	0.550	7.0	6.93	7.52E-04	6.90E-02	3.79E-02	7.85E-03	7.24E-01	0.0105
1330-20-7	Xylene	106.14	0.169	7.31	7.23	6.81E-04	6.25E-02	1.06E-02	2.19E-03	2.32E-01	0.0034
100-41-4	Ethylbenzene	106.17	0.184	1.26	1.25	1.17E-04	1.08E-02	1.98E-03	4.10E-04	4.36E-02	0.0006
540-84-1	2,2,4-Trimethylpentane	114.23	0.954	1.098	1.09	9.51E-05	8.73E-03	8.32E-03	1.72E-03	1.97E-01	0.0029
98-82-8	Cumene	120.19	0.089	0.19	0.19	1.56E-05	1.44E-03	1.28E-04	2.64E-05	3.18E-03	0.0000
91-20-3	Naphthalene	128.17	0.005	0.21	0.21	1.62E-05	1.49E-03	7.44E-06	1.54E-06	1.97E-04	0.0000
106-97-8	n-Butane	58.12	35.220	4.7	4.65	8.00E-04	7.34E-02	2.59E00	5.35E-01	3.11E01	0.4515
72-28-5	Isobutane	58.12	13.294	1.7	1.68	2.89E-04	2.66E-02	3.53E-01	7.31E-02	4.25E00	0.0616
109-66-0	Pentane	72.15	10.285	3.9	3.86	5.35E-04	4.91E-02	5.05E-01	1.04E-01	7.54E00	0.1094
78-78-4	Isopentane	72.15	3.670	7.9	7.82	1.08E-03	9.94E-02	3.65E-01	7.55E-02	5.45E00	0.0791
	C6 surrogate	86.18	4.094	10.08	9.97	1.16E-03	1.06E-01	4.35E-01	9.00E-02	7.76E00	0.1126
	C7 surrogate	100.2	1.274	7.21	7.13	7.12E-04	6.53E-02	8.32E-02	1.72E-02	1.73E00	0.0251
	C8 surrogate	114.23	0.522	3.21	3.18	2.78E-04	2.55E-02	1.33E-02	2.76E-03	3.15E-01	0.0046
	C9 surrogate	120.19	0.039	7.29	7.21	6.00E-04	5.51E-02	2.15E-03	4.45E-04	5.34E-02	0.0008
	Other VOC	100.20	0.884	34.78	34.41	3.43E-03	3.15E-01	2.79E-01	5.77E-02	5.78E00	0.0839
95-50-1	<i>o</i> -dichlorobenzene	147	0.029	1.8E-03	4.9E-03	3.3E-07	3.1E-05	8.8E-07	1.9E-07	2.7E-05	4.0E-07
						nT		PtotalVP		MWvap	
	Sums			100	100	0.0109	1	4.77	1	67.49	1

N.3.9 Exposure Duration

In the Use of Chemicals in Fuels and Related Products Generic Scenario, all data compiled from literature studies on worker exposures during unloading of gasoline tank trucks were 8-hour TWAs. Therefore, the exposure duration was assessed as a full eight-hour shift. There is some uncertainty in the full-shift assumption since fueling station workers may perform other activities that do not result in *o*-dichlorobenzene exposures during their shift.