

Ethylbenzene – A Common Air Pollutant

Background

Ethylbenzene (C₆H₅C₂H₅, CAS number 100-41-4), also known as ethylbenzol and phenylethane, is a highly flammable aromatic hydrocarbon. It is commonly found in the indoor environment at a higher concentration than found in the outdoor air. Burning of fuel (coal, gas, oil) and the use of ethylbenzene in manufacturing contributes to higher ambient air concentrations.

Indoors, ethylbenzene is commonly associated with numerous building and construction materials including adhesives and sealants, paints and coatings, flooring and wall systems, plastics, and furniture. Ethylbenzene has been detected in 3D printing emissions, especially when using feedstock with styrene and is common in the emissions from laser printers and photocopiers. It is a commonly found VOC in new construction with indoor levels ranging from 10- 60 µg/m³.

Health Concerns

Inhalation of ethylbenzene vapor at high levels causes eye, nose, and throat/chest irritation, depression, and dizziness. Dermal contact to ethylbenzene can be irritating and cause blisters. Ingestion of ethylbenzene can be fatal if swallowed and enters airways. Animal studies have shown long-term low-dose exposure to ethylbenzene to affect the blood, liver, and kidney, and lead to formation of testicular, lung, liver, and kidney tumors. While ethylbenzene has not been classified as to human carcinogenicity by the United States Environmental Protection Agency, International Agency for Research on Cancer lists ethylbenzene as a possible carcinogen and California Proposition 65 also lists it as a carcinogen.

Acceptable Exposure Levels

Below is a list of U.S. and global organizations with ethylbenzene odor threshold and/or exposure limits (Table 1).

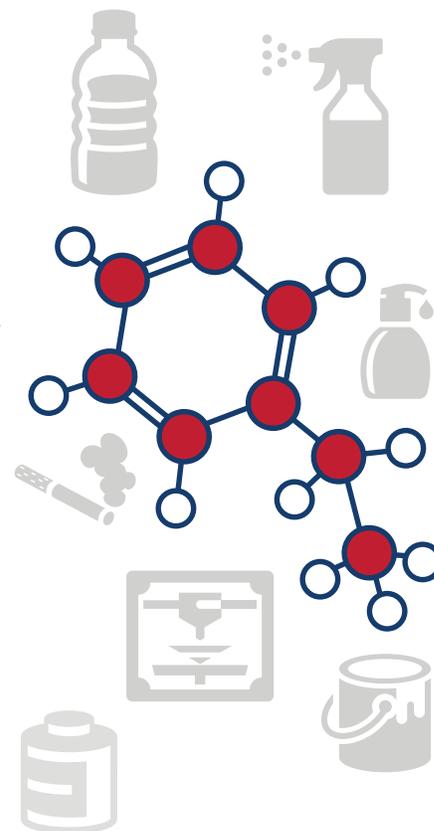


Table 1: Ethylbenzene Odor and Exposure Standards

Organization or Standard	Application	Exposure Limit	Additional Information
AgBB	General air/ Indoor air	196 ppb 850 µg/m ³	Ausschuss zur gesundheitlichen Bewertung von Bauprodukten (AgBB) sets Lowest Concentration of Interest (LCI) for VOC emissions from building products. LCI for ethylbenzene is 196 ppb (850 µg/m ³).
CA 01350 Specification	Product emissions	230 ppb 1000 µg/m ³	California Specification 01350 requires that emission levels for ethylbenzene from building products and materials be equal to or less than 1000 µg/m ³ within 14 days after installation. Certification programs like CHPS and GREENGUARD gold have adopted this requirement.
U.S. Green Building Council Leadership in Environment and Energy Design (LEED)	Indoor air	460 ppb 2000 µg/m ³	The LEED rating system specifies a maximum concentration of ethylbenzene in indoor air of 2000 µg/m ³ . This level applies to clearance testing of air levels before a building or school is occupied.
The United States Environmental Protection Agency (U.S. EPA)	Odor threshold	2.3 ppm or 2300 ppb 10,000 µg/m ³	The odor threshold of ethylbenzene is 2.3 ppm (10.0 mg/m ³).

Table 1 Continued: Ethylbenzene Odor and Exposure Standards

Organization or Standard	Application	Exposure Limit	Additional Information
The United States Environmental Protection Agency (U.S. EPA)	Inhalation and oral exposure	RfC: 1,000 µg/m ³ RfD: 0.1 mg/kg/day	The U.S. EPA maintains the Integrated Risk Information System (IRIS), a database on information on noncancer and cancer health effects that may result from exposure to various substances in the environment, based on toxicological reviews. Ethylbenzene has a reference concentration for inhalation exposure (RfC) of 1 mg/m ³ for developmental toxicity and a reference dose for oral exposure (RfD) of 0.1 mg/kg bw/day for liver and kidney toxicity. RfD is an estimate of a daily exposure to the human population that is likely to be without an appreciable risk of deleterious effects during a lifetime.
CDC's Agency for Toxic Substances and Disease Registry (ATSDR)	General air/ Indoor air	Inhalation: 5 ppm (acute), 2 ppm (intermediate), 0.06 ppm (chronic) Oral: 0.4 mg/kg/day (Intermediate)	The CDC's Agency for Toxic Substances and Disease Registry (ATSDR) has developed Minimal Risk Levels (MRLs) which estimate the daily level to which a substance may be exposed without the likelihood of adverse, non-cancer health effects. MRLs are derived for acute (1 - 14 days), intermediate (>14 - 364 days), and chronic (365 days and longer) exposure durations. The ethylbenzene MRL is 5 ppm for acute, 2 ppm for intermediate, 0.06 ppm for chronic inhalation exposure, and 0.4 mg/kg/day for oral intermediate exposure.
California Proposition 65 (Prop 65)	General air/ Indoor air	54 µg/day	Prop 65 No Significant Risk Level (NSRL) is the level developed by OEHHA to which if exposed to every day for 70 years will result in one excess case of cancer in 100,000 people. The NSRL for ethylbenzene is 54 µg/day for inhalation and 41 µg/day for ingestion.
California PEL - TWA	Occupational/ Indoor air Occupational/ Indoor air	5 ppm (5,000 ppb) 22 mg/m ³	California's Permissible Exposure Limits for Chemical Contaminants (CAPEL) has an 8 hr Time Weighted Average (TWA) of 5 ppm and short-term exposure limit of 30 ppm (130 mg/m ³) for ethylbenzene.
American Conference of Governmental Industrial Hygienists (ACGIH)	Occupational/ Indoor air	20 ppm (20,000 ppb) 87 mg/m ³	Threshold Limit Values (TLV®s) are guidelines for the level of exposure that the typical worker can be exposed to without adverse health effects. They are not quantitative estimates of risk at different exposure levels or by different routes of exposure. The ethylbenzene TLV-8-hr time weighted average is 20 ppm (87 mg/m ³).
OSHA PEL	Occupational/ Indoor air	100 ppm 435 mg/m ³	Occupational Safety Health Administration's permissible exposure limit (PEL) exposure averaged over an 8-hour work shift is 100 ppm.
NIOSH	Occupational/ Indoor air	REL: 100 ppm ST: 125 ppm	National Institute for Occupational Safety and Health's reference exposure level (REL) time weighted average is 100 ppm (435 mg/m ³), short term exposure limit of 125 ppm (543 mg/m ³).



References

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