

Web Publication Date: November 15, 2010

Chemical Name: 1,3 Butadiene**CAS: 106-99-0****Synonyms: biethylene, bivinyll****Non-Cancer Health Based Value (HBV_{acute}) = “Not Derived”****Non-Cancer Health Based Value (HBV_{subchronic}) = “Not Derived”****Chronic Health Based Value (HBV) = 0.2 µg/m³**

$$\begin{aligned} &= \frac{[\text{BMC}^1] * [\text{unit conversion}] * [\text{additional lifetime risk}^2]}{[\text{BMC adjustment}] * [\text{BMC incidence}^a] * [\text{ADAF}^c]} \\ &= \frac{0.254 \text{ ppm} * 2,210 \text{ µg/m}^3 / \text{ppm} * 0.00001}{2 * 0.01 * (((10 * 2) + (3 * 14) + (1 * 54)) / 70)} \\ &= \mathbf{0.17 \text{ rounded to } 0.2 \text{ µg/ m}^3} \end{aligned}$$

Source of Toxicity Value: MDH 2004
Critical Study: Delzell et al., 1996 study of butadiene rubber workers
Point of Departure: 0.254 ppm (1 percent cancer incidence)
Total Uncertainty/Adjustment: 2
UF/AF Allocation: An adjustment factor of 2 is applied for multiple cancer sites and possible increased female susceptibility
Critical Effect(s): Cancer
Tumor Site(s): Leukemia
Cancer Classification: Carcinogenic to humans by inhalation (US EPA IRIS 2002)
Hazard Index Targets: Not applicable

Volatile: Yes, highly volatile**Summary of Guidance Value History:**

¹ BMC is Benchmark Concentration. The BMC of 0.254 ppm is the estimated air concentration (95 percent lower confidence limit) associated with a 1 percent (1 in 100 probability) cancer incidence.

² 0.00001 is the mathematical expression of an additional lifetime cancer risk of 1 cancer case in a population of 100,000 exposed persons.

^cADAF is the set of age-dependent adjust factors that are used when cancer potency from a study of adults is used to develop a health protective value for all ages in the population. See

<https://www.health.state.mn.us/communities/environment/risk/docs/guidance/adafrecmd.pdf>.

The chronic HBV (0.2 ug/m³) is one-third lower than the 2004 HBV (0.3 ug/m³) as the result of: 1) more recent review of available toxicity studies; 2) application of age-dependent early-life cancer sensitivity adjustment factors; and 3) rounding to one significant figure.

Summary of toxicity testing for health effects identified in the Health Standards Statute:

	Endocrine	Immunotoxicity	Development	Reproductive	Neurotoxicity
Tested?	No	Yes	Yes	Yes	No
Effects?	--	No ¹	Yes ²	Yes ³	--

Note: Even if testing for a specific health effect was not conducted for this chemical, information about that effect might be available from studies conducted for other purposes. Most chemicals have been subject to multiple studies in which researchers identify a concentration where no effects were observed, and the lowest concentration that caused one or more effects. A toxicity value based on the effect observed at the lowest concentration across all available studies is considered protective of all other effects that occur at higher concentrations.

Comments on extent of testing or effects:

¹High exposures (1250 ppm) of mice for up to 12 weeks appeared to have no impact on immune system function (Thurmond et al., 1986 as reported in EPA, 2002).

²Studies detailing 1,3-butadiene effects on developmental endpoints are reviewed by EPA (2002) and Health Canada (2000). Exposures of pregnant mice dams to 40 ppm for 10 days during gestation have been shown to cause reduction of fetal (male) body weights (Hackett et al., 1987, reported in EPA, 2002 and elsewhere). These data suggest that developmental endpoints may be the most sensitive for short-term exposure to 1,3-butadiene. There is no evidence of teratogenicity following exposure in mice up to 1000 ppm. Offspring of pregnant rats exposed during pregnancy to 8000 ppm 1,3-butadiene showed “major” abnormalities. Abnormalities, believed to be related to retarded embryonic growth, have been observed in 200 and 1000 ppm exposed groups. Signs of maternal toxicity were generally observed in dams exposed 200 ppm and greater.

³1,3-Butadiene has been shown to cause ovarian atrophy and toxicity in two-year mouse studies at levels that induce tumors (6.25 ppm) and not far below levels that can cause severe effects and mortality (20 ppm). California has developed a chronic REL (CA OEHHA, 2000) and the EPA developed an RfC from these data (EPA, 2002).

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