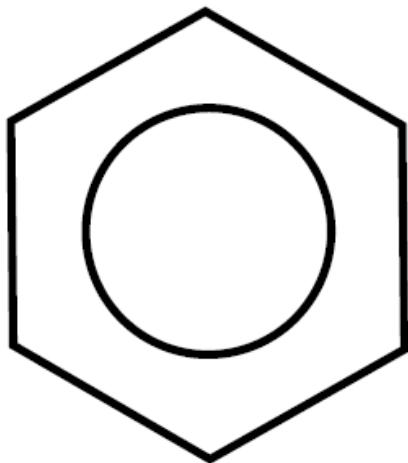


Benzene Risk:
Determining Carcinogenic Health Risk Concentration Levels for Benzene in
Ambient Air at EPA, TCEQ and the City of Houston



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A carcinogenic health risk concentration level in ambient air is an air concentration level associated with a specified risk of contracting cancer. The Clean Air Act mandates that the incremental excess lifetime cancer risk (IELCR) associated with exposure to toxics in ambient air be limited to a range of 1 cancer case in 10,000 people to 1 cancer case in 1 million people with the goal of achieving the more protective end of the range. The IELCR is the risk of developing cancer specifically associated with exposure to ambient air toxics. It is *excess* risk on top of an individual's risk from other sources such as genetic predisposition or life style. This risk is involuntary, because it is not a choice to breathe ambient (outside air) while other risk factors (e.g., smoking) are an individual's choice or voluntary.

EPA Clean Air Act Risk Range		
Least health protective end of the range	1 case in 10,000 people	1×10^{-4}
Midpoint of range	1 case in 100,000 people	1×10^{-5}
Most health protective end of the range	1 case in 1,000,000 people	1×10^{-6}

The concentration associated with a cancer risk is dependent upon the toxicity of the chemical. A more toxic chemical would have a lower concentration associated with the same level of risk than a less toxic chemical. The EPA publishes the toxicity of a chemical in its Integrated Risk Information System (IRIS) after extensively reviewing all of the available evidence. The toxicity of the chemical is published along with an indication of the degree of certainty associated with the carcinogenic evidence. The air toxic benzene has been classified as a class A human carcinogen. The class A rating is the highest level of certainty that EPA assigns to toxics. The toxicity of benzene in IRIS is posted as a range.

EPA's IRIS states the increase in lifetime risk of an individual who is exposed for a lifetime to 1 microgram per cubic meter ($1 \mu\text{g}/\text{m}^3$) benzene in air is "a range of 2.2×10^{-6} to 7.8×10^{-6} " (<http://www.epa.gov/ncea/iris/subst/0276.htm>). This is referred to as unit risk, or the carcinogenic risk posed by exposure to 1 unit, or in this case, of $1 \mu\text{g}/\text{m}^3$ of benzene in air. Because EPA uses a range instead of one number, there is a range of risk associated with each unit of ($1 \mu\text{g}/\text{m}^3$) benzene in air.

EPA also publishes in IRIS the concentrations associated with the risk levels specified in the Clean Air Act. Because of the range of toxicity associated with benzene, there are two numbers for each specified risk range.

EPA Clean Air Act Risk Range			Benzene ($\mu\text{g}/\text{m}^3$) most protective end of toxicity range	Benzene ($\mu\text{g}/\text{m}^3$) least protective end of toxicity range
Least health protective end of the risk range	1 case in 10,000 people	1×10^{-4}	13.0	45.0
Midpoint of risk range	1 case in 100,000 people	1×10^{-5}	1.3	4.5
Most health protective end of the risk range	1 case in 1,000,000 people	1×10^{-6}	0.13	0.45

The EPA Office of Air Quality Planning & Standards (OAQPS) publishes only one toxicity value instead of the range of values listed in EPA's IRIS. The value that EPA OAQPS recommends is the most protective end of the toxicity range. Roy L. Smith, Ph.D., of the EPA Office of Air Quality Planning & Standards (OAQPS) explains that these values are used in screening risk assessments and since "some reasonable number of false positives are acceptable but false negatives are not acceptable, we used the conservative end of the range."¹

Since there are no federal ambient air standards for air toxic concentrations for chemicals such as benzene, states are faced with establishing their own health concentration levels. The Texas Commission of Environmental Quality does not have a benzene ambient air standard but it does have some guidance in the form of what is called an "effects screening level" (ESL). The ESL is an ambient air guideline used in some permits requiring modeled emissions as well as to locate hotspots in the ambient monitoring data record. In evaluating the health of the air, the City of Houston uses the toxicity value recommended by the EPA OAQPS. The TCEQ does not use the toxicity published by EPA OAQPS. Instead, the TCEQ uses its own derived concentration which is equivalent to the least conservative, least health protective toxicity value.

The table below lists the carcinogenic risk-based concentrations for the range of risk levels and toxicity. The concentrations are provided in two sets of units: ppb and $\mu\text{g}/\text{m}^3$. The concentrations used by TCEQ are identified. To convert a concentration from $\mu\text{g}/\text{m}^3$ to ppbV: $\mu\text{g}/\text{m}^3 = 0.0409 \times \text{concentration (ppb)} \times \text{molecular weight}$.

¹ Email from Smith.Roy@epamail.epa.gov
Sent: Tuesday, May 27, 2008 6:54 AM¹

EPA Clean Air Act Risk Range			Benzene (ppb) most protective end of toxicity range		Benzene (ppb) least protective end of toxicity range	
			µg/m ³	ppb	µg/m ³	ppb
Least health protective end of the risk range	1 case in 10,000 people	1x10 ⁻⁴	13.0	4.0	45.0	14.0
Midpoint of risk range	1 case in 100,000 people	1x10 ⁻⁵	1.3*	0.4*	4.5**	1.4**
Most health protective end of the risk range	1 case in 1,000,000 people	1x10 ⁻⁶	0.13	0.04	0.45	0.14

*Concentration developed using EPA recommended toxicity, City of Houston number for same risk level

** TCEQ number

The TCEQ risk-based ESL number for benzene is over 3x less conservative and health protective than the risk-based concentration limit developed using the toxicity value recommended by EPA OAQPS at the mid level risk range and over 30x less conservative and health protective than the risk-based concentration limit developed using the toxicity value recommended by EPA OAQPS and the EPA Clean Air Act risk goal. The City of Houston uses the toxicity value recommended by EPA OAQPS at each risk range point to evaluate benzene in the airshed.