# Nitrobenzene

98-95-3

## Hazard Summary

Nitrobenzene is used to manufacture aniline. Acute (short-term) and chronic (long-term) inhalation, oral, and dermal exposure of humans to nitrobenzene result in effects on the blood (i.e., methemoglobinemia). At low nitrobenzene concentrations, symptoms include fatigue, weakness, dyspnea, headache, and dizziness. At higher concentrations, depressed respiration, bluish-gray skin, disturbed vision, and coma may occur. No information is available on the reproductive, developmental, or carcinogenic effects of nitrobenzene in humans. Animal studies indicate that inhalation exposure to nitrobenzene does not result in developmental effects, while reproductive effects, such as a decrease in fertility, reduced testicular weights, and decreased sperm production, have been noted. EPA has classified nitrobenzene as a Group D, not classifiable as to human carcinogenicity.

Please Note: The main sources of information for this fact sheet are EPA's Integrated Risk Information System (IRIS) (4), which contains information on chronic toxicity of nitrobenzene and the RfD, and the Agency for Toxic Substances and Disease Registry's (ATSDR's) Toxicological Profile for Nitrobenzene.(1)

## Uses

- The majority of nitrobenzene is used to manufacture aniline, which is a chemical used in the manufacture of polyurethane. Nitrobenzene is also used to produce lubricating oils and in the manufacture of dyes, drugs, pesticides, and synthetic rubber. (1)

## Sources and Potential Exposure

- Nitrobenzene has not been detected in ambient air or in drinking water. (1)
- Occupational exposure may occur in factories that produce nitrobenzene or use nitrobenzene to produce other products. (1)
- Exposure may also occur for those persons who live near a waste site where nitrobenzene has been disposed or near a manufacturing or processing plant. (1)

## Assessing Personal Exposure

- The levels of methemoglobin in the blood can be measured to determine recent exposure to nitrobenzene. However, this method is not specific for nitrobenzene, as many toxic chemicals produce methemoglobin. For long-term exposure to nitrobenzene, the presence of its breakdown products in the urine can be used as an indication of nitrobenzene exposure. (1)

## Health Hazard Information

Acute Effects:

- Acute inhalation, oral, and dermal exposure to nitrobenzene in humans produces methemoglobinemia, in which hemoglobin (which carries oxygen in the blood) is converted to methemoglobin, resulting in lowering the amount of oxygen released to the tissues of the body. This lowered oxygen capacity is associated with

fatigue, weakness, dyspnea, headache, and dizziness. At higher concentrations, depressed respiration, bluish-gray skin, disturbed vision, and coma may occur. (1,2,6)
- Animal studies have reported methemoglobinemia and effects on the liver, kidney, spleen, and central nervous system (CNS) from acute inhalation exposure to nitrobenzene. (1,2)
- Tests involving acute exposure of rats have shown nitrobenzene to have moderate acute toxicity from oral exposure. (3)

Chronic Effects (Noncancer):
- Chronic exposure to nitrobenzene in humans also results in methemoglobinemia. There is also some evidence that the human liver is damaged after chronic inhalation of nitrobenzene. (1)
- Chronic, inhalation exposure to nitrobenzene in animals results in methemoglobinemia, and effects on the liver and kidney. (1,4)
- EPA has calculated (by an alternate method) a provisional Reference Concentration (RfC) of 0.002 milligrams per cubic meter ($mg/m^3$) for nitrobenzene based on hematological, adrenal, renal, and hepatic effects in mice. The RfC is an estimate (with uncertainty spanning perhaps an order of magnitude) of a continuous inhalation exposure to the human population (including sensitive subgroups) that is likely to be without appreciable risk of deleterious noncancer effects during a lifetime. It is not a direct estimator of risk but rather a reference point to gauge the potential effects. At exposures increasingly greater than the RfC, the potential for adverse health effects increases. Lifetime exposure above the RfC does not imply that an adverse health effect would necessarily occur. The provisional RfC is a value that has had some form of Agency review, but it does not appear on IRIS. (5)
- The Reference Dose (RfD) for nitrobenzene is 0.0005 milligrams per kilogram body weight per day (mg/kg/d) based on hematologic, adrenal, renal, and hepatic lesions in rats and mice. (1)
- EPA has medium to low confidence in the study on which the RfD was based because it is not an oral study, a limited number of animals/sex/dose were tested, and a no-observed-adverse-effect level (NOAEL) for the critical toxic effect (i.e., adrenal toxicity) was not determined, although two species were used and many parameters were measured; low confidence in the database because chronic reproductive and teratology data are missing; and, consequently, low confidence in the RfD. (4)

Reproductive/Developmental Effects:
- No information is available on the reproductive or developmental effects of nitrobenzene in humans.
- Developmental effects, such as birth defects or embryotoxic effects, have not been reported in animal studies with inhalation exposure to nitrobenzene. However, reproductive effects, including a decrease in fertility, reduced testicular weights, and decreased sperm production have been noted in inhalation and oral animal studies. (1,2,6)

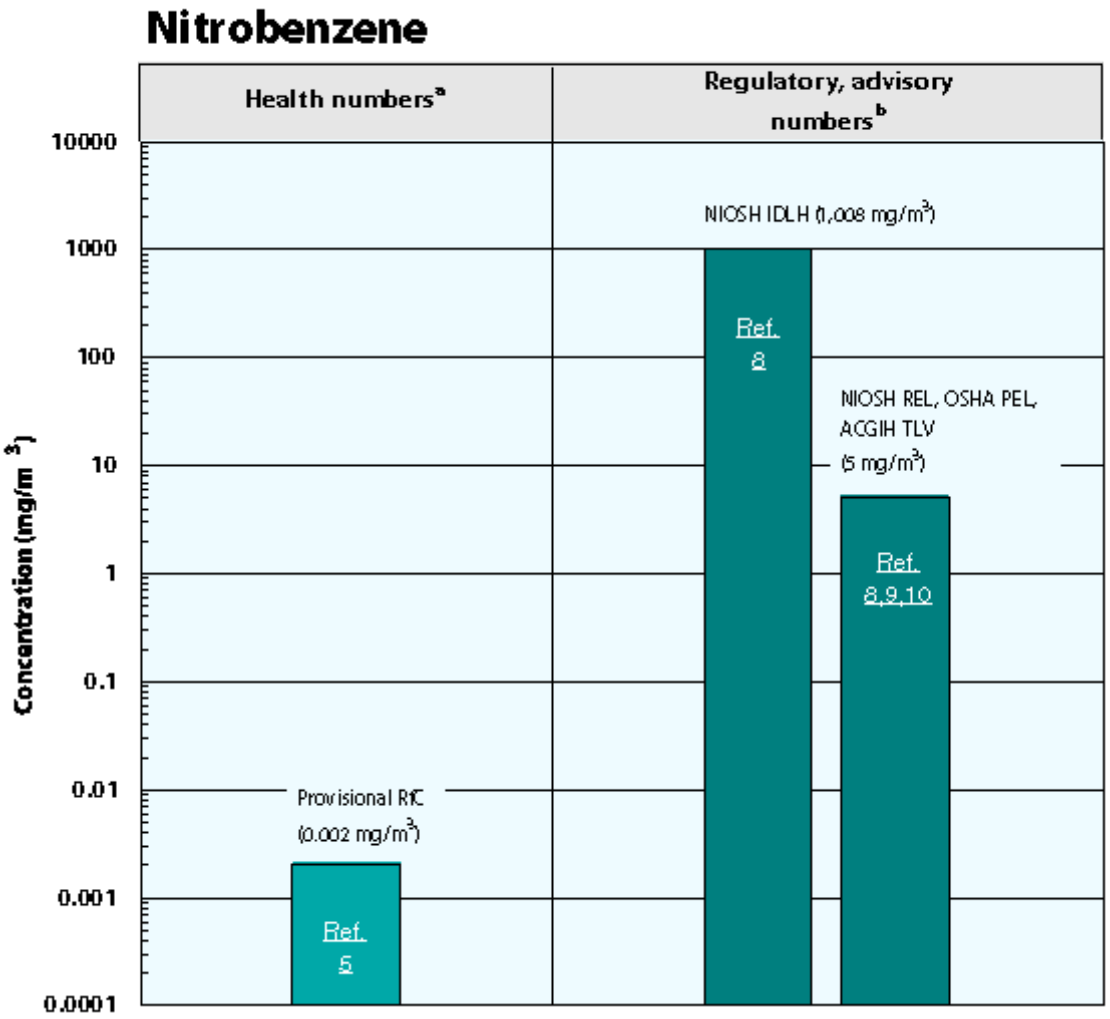
Cancer Risk:
- No information is available regarding cancer in humans or animals from nitrobenzene exposure. (1)
- EPA has classified nitrobenzene as a Group D, not classifiable as to human carcinogenicity. (4)

# Physical Properties

- Nitrobenzene is an oily yellow liquid with an almond-like odor. (1)
- The odor threshold for nitrobenzene is 0.018 parts per million (ppm). (7)
- The chemical formula for nitrobenzene is $C_6H_5NO_2$, and the molecular weight is 123.11 g/mol. (1)
- The vapor pressure for nitrobenzene is 0.15 mm Hg at 20 °C, and it has a log octanol/water partition coefficient (log $K_{ow}$) of 1.87. (1)

Conversion Factors:
To convert concentrations in air (at 25 °C) from ppm to $mg/m^3$: $mg/m^3$ = (ppm) × (molecular weight of the compound)/(24.45). For nitrobenzene: 1 ppm = 5.04 $mg/m^3$.

## Health Data from Inhalation Exposure




ACGIH TLV--American Conference of Governmental and Industrial Hygienists' threshold limit value expressed as a time-weighted average; the concentration of a substance to which most workers can be exposed without adverse effects.
NIOSH IDLH--National Institute of Occupational Safety and Health's immediately dangerous to life and health; NIOSH recommended concentration representing the maximum level of a pollutant from which an individual could escape within 30 minutes without escape-impairing symptoms or irreversible health effects.
NIOSH REL--NIOSH's recommended exposure limit; NIOSH-recommended exposure limit for an 8- or 10-h time-weighted-average exposure.
OSHA PEL--Occupational Safety and Health Administration's permissible exposure limit expressed as a time-weighted average; the concentration of a substance to which most workers can be exposed without adverse effect averaged over a normal 8-h workday or a 40-h workweek.

The health and regulatory values cited in this factsheet were obtained in December 1999.
[a] Health numbers are toxicological numbers from animal testing or risk assessment values developed by EPA.
[b] Regulatory numbers are values that have been incorporated in Government regulations, while advisory numbers

are nonregulatory values provided by the Government or other groups as advice. OSHA numbers are regulatory, whereas NIOSH and ACGIH numbers are advisory.

Summary created in April 1992, updated January 2000

References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