# 2,4-Dinitrotoluene

121-14-2

## Hazard Summary

2,4-Dintirotoluene is used as an intermediate in the manufacture of polyurethanes. No information is available on the acute (short-term) effects of 2,4-dinitrotoluene in humans. Chronic (long-term) inhalation exposure to 2,4-dinitrotoluene affects the central nervous system (CNS) and blood in humans. A significant reduction in sperm count and normal sperm morphology was observed in one study of chronically exposed workers, while other studies have not reported this effect. No significant increase in cancer mortality was observed in a study of workers occupationally exposed to 2,4-dinitrotoluene by inhalation. Kidney, liver, and mammary gland tumors were observed in animals orally exposed to 2,4-dinitrotoluene. EPA has not classified 2,4-dinitrotoluene for potential 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 oral chronic toxicity and the RfD, and the Agency for Toxic Substances and Disease Registry's (ATSDR's) Toxicological Profile for 2,4 and 2,6--Dinitrotoluene (1), and EPA's Health Effects Assessment for 2,4-Dinitrotoluene. (5)

## Uses

- The predominant use of 2,4-dinitrotoluene is as an intermediate in the manufacture of polyurethanes. (1)
- 2,4-Dinitrotoluene is also used for the production of explosives, for which it is a gelatinizing and waterproofing agent. Other applications include uses as an intermediate in dye processes and in smokeless gunpowders. (1)

## Sources and Potential Exposure

- Human exposure to 2,4-dinitrotoluene appears to be primarily occupational, via inhalation or dermal contact. (1)

## Assessing Personal Exposure

- 2,4-Dinitrotoluene and its breakdown products can be detected in blood and urine to determine whether or not exposure has occurred. Testing must occur within 24 hours of exposure. (1)

## Health Hazard Information

Acute Effects:

- No information is available on the acute effects of 2,4-dinitrotoluene in humans.
- Animal studies have reported effects on the blood, liver, kidney, and central nervous system from acute oral exposure to 2,4-dinitrotoluene. (1)
- Animals acutely exposed to 2,4-dinitrotoluene by ingestion developed cyanosis and ataxia. (1)
- Acute animal tests in rats, mice, and guinea pigs have demonstrated 2,4-dinitrotoluene to have moderate to high acute toxicity from oral exposure. (2)

Chronic Effects (Noncancer):

- Chronic inhalation exposure to 2,4-dinitrotoluene affects the CNS, resulting in an unpleasant metallic taste in the mouth, muscular weakness, headache, appetite loss, giddiness, dizziness, nausea, insomnia, and tingling pains in the extremities in humans. (1,3)
- Effects to the blood, causing pallor, cyanosis, and anemia, have been reported among workers chronically exposed to high levels of 2,4-dinitrotoluene vapor. (1)
- Elevated mortality from heart disease has been reported among chronically exposed workers; however, this study was limited by a small cohort size. (1,3)
- Chronic oral exposure of dogs and mice has resulted in muscular incoordination, weakness, tremors, convulsions, ataxia, and paralysis. (1,4)
- Cyanosis has been observed in rats, and anemia has been observed in dogs, mice, and rats chronically exposed by ingestion. (1)
- Chronic oral exposure has been observed to cause effects on the liver and kidneys in animals. (1)
- EPA has not established a Reference Concentration (RfC) for 2,4-dinitrotoluene. (4)
- The Reference Dose (RfD) for 2,4-dinitrotoluene is 0.002 milligrams per kilogram body weight per day (mg/kg/d) based on effects on the CNS, blood, and liver in dogs. The RfD is an estimate (with uncertainty spanning perhaps an order of magnitude) of a daily oral 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 RfD, the potential for adverse health effects increases. Lifetime exposure above the RfD does not imply that an adverse health effect would necessarily occur. (4)
- EPA has high confidence in the study on which the RfD was based because the toxic effects are based on an adequate number of animals of both sexes and a variety of histological, hematologic, and clinical endpoints were evaluated; high to medium confidence in the database because there are numerous acute, subchronic, chronic, and lifetime studies in several mammalian species. However, developmental toxicity studies are lacking; and, consequently, high to medium confidence in the RfD. (4)
- The California Environmental Protection Agency (CalEPA) has calculated a chronic reference exposure level of 0.007 milligrams per cubic meter ($mg/m^3$) based on effects on the nervous system and liver in dogs. The CalEPA reference exposure level is a concentration at or below which adverse health effects are not likely to occur. (6)

Reproductive/Developmental Effects:

- A significant reduction in sperm counts and normal sperm morphology was observed in one study of chronically exposed workers while several other studies did not report these effects. (1)
- A small, but statistically significant, increase in spontaneous abortions was reported in one study of chronically exposed workers; several methodological problems with the study were noted. (1)
- In animals orally exposed to 2,4-dinitrotoluene, decreased fertility was reported. Decreased sperm production, testicular atrophy, and degenerated seminiferous tubules were observed in males, and ovarian atrophy and dysfunction were observed in female rats. (1,4,5)
- No birth defects were observed in the offspring of animals fed 2,4-dinitrotoluene in the diet. (1)

Cancer Risk:

- No significant increase in cancer mortality was observed in workers occupationally exposed to 2,4-dinitrotoluene by inhalation. (1)
- Renal tumors were observed in male mice and liver and mammary gland tumors were observed in rats orally exposed to 2,4-dinitrotoluene. (1,5)
- EPA has not classified 2,4-dinitrotoluene for potential carcinogenicity. However, EPA has classified the 2,4-/2,6-dinitrotoluene mixture as a Group B2, probable human carcinogen with an oral cancer slope factor of 0.68 $(mg/kg/d)^{-1}$. (6)
- CalEPA calculated an an inhalation unit risk factor of $8.9 \times 10^{-5}$ $(\mu g/m^3)^{-1}$ and an oral cancer slope factor of 0.31 $(mg/kg/d)^{-1}$. (7)

# Physical Properties

- The chemical formula for 2,4-dinitrotoluene is $C_7H_6N_2O_4$, and its molecular weight is 182.14 g/mol. (1)
- 2,4-Dinitrotoluene occurs as a yellow solid and has a solubility in water of 270 mg/L at 22 °C. (1)
- 2,4-Dinitrotoluene has a slight odor; the odor threshold has not been established. (1)
- The vapor pressure for 2,4-dinitrotoluene is 0.0051 mm Hg at 20 °C, and the log octanol/water partition coefficient (log $K_{ow}$) is 2.0. (1)

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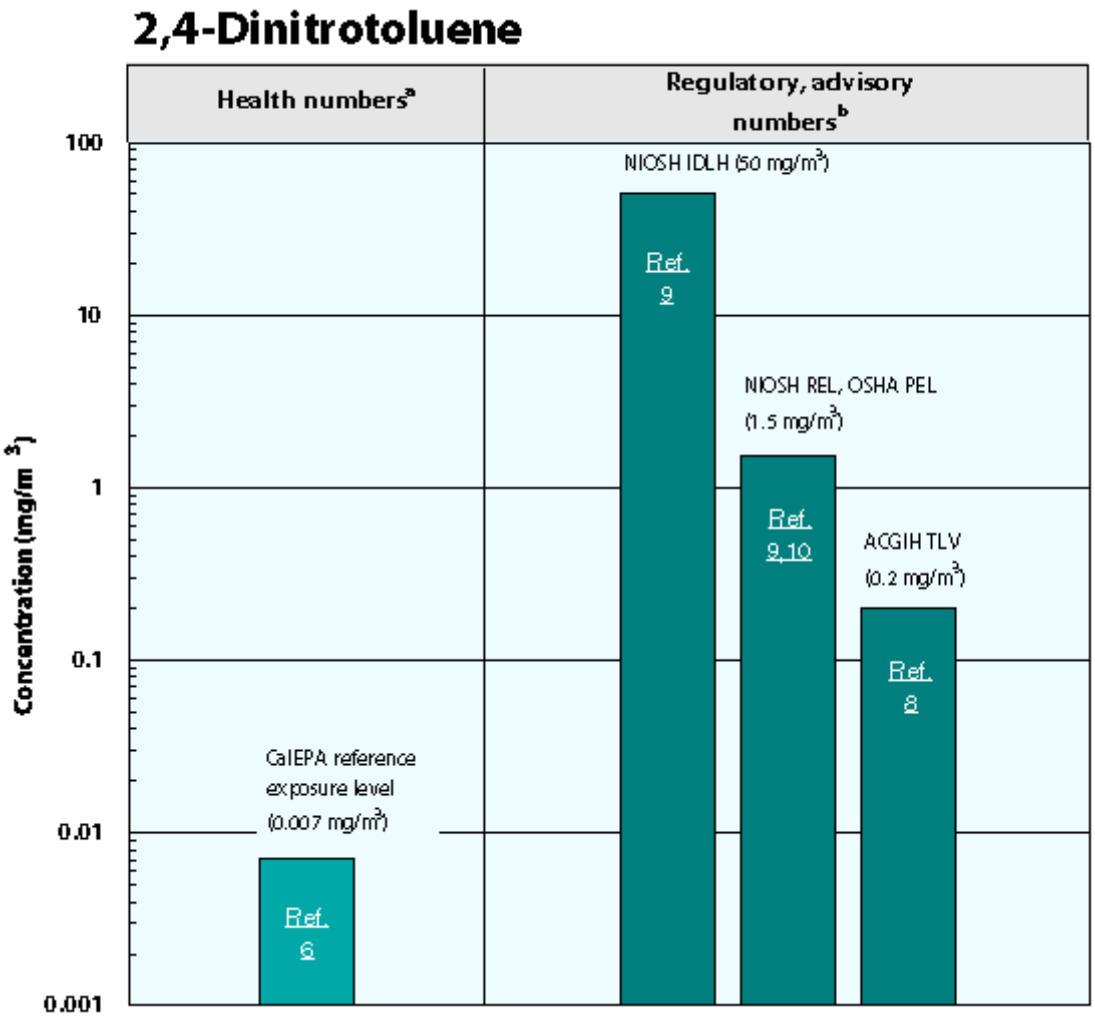
Conversion Factors (only for the gaseous form):
To convert concentrations in air (at 25 °C) from ppm to $mg/m^3$: $mg/m^3$ = (ppm) × (molecular weight of the compound)/(24.45). For 2,4-dinitrotoluene: 1 ppm = 7.45 $mg/m^3$.

## 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 or health limit; NIOSH recommended exposure limit to ensure that a worker can escape from an exposure condition that is likely to cause death or immediate or delayed permanent adverse health effects or prevent escape from the environment.
NIOSH REL--NIOSH's recommended exposure limit; NIOSH-recommended exposure limit for an 8- or 10-h time-weighted-average exposure and/or ceiling.

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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