N-PROPANOL
Health-Base Assessment and Recommendation
for HEAC

Prepared by

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n-PROPANOL

CAS Number 71-23-8

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DRAFT 2

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I. IDENTIFICATION

Substance Name: n-propanol

CAS Number: 71-23-8

Synonyms: Ethyl carbinol; Propan-1-ol; 1-Propanol; n-Propyl Alcohol

Molecular Formula: C_3H_8O

Structural Formula: $CH_3CH_2CH_2OH$

II. CHEMICAL AND PHYSICAL PROPERTIES

Physical State and Appearance	Clear, colorles liquid with a sweet odor
Odor Threshold	2.6 ppm to 40 ppm
Molecular Weight	60.09 daltons
Specific Gravity	0.8053 at 20°C
Melting Point	-127°C
Boiling Point	97.2°C
Vapor Pressure	15 torr at 20°C
Flash Point	15°C, closed cup
Explosive Limits	UEL 13.5% , LEL 2.1% by volume in air
Solubility	Miscible in water
	Very soluble in alcohol, ether

Conversion Factors at 760 torr, 25°C

1 ppm = 2.46 mg/m³; 1 mg/m³ = 0.4 ppm

III. USES, APPLICATIONS, OCCURRENCE, EXPOSURES

Uses and Applications

n-Propanol is used as a solvent for waxes, vegetable oils, resins, cellulose esters, and ethers. It is found in inks, brake fluids and polishing compounds and has been used as a degreasing agent, an antiseptic, and a chemical intermediate. More recently, it is being used as a hand disinfectant by health care workers.

Occurrence and Exposures

It has been measured in airborne exposures during label printing and production operations.

IV. CURRENT EXPOSURE GUIDELINES

8 CCR 5155	200 ppm TWA, 250 ppm STEL
	500 mg/m³ TWA, 625 mg/m³ STEL
29 CFR 1910.1000	200 ppm TWA, 250 ppm STEL
ACGIH TLV	100 ppm TWA, A-4 not classifiable as a Human Carcinogen
NIOSH REL	200 ppm TWA, 250 ppm STEL
DFG MAK	200 ppm TWA, 250 ppm STEL

V. PRODUCTION INFORMATION

The global capacity for the production of 1-propanol in 1979 exceeded 130 000 tonnes with most of this capacity in the USA. In 1975, the total USA production amounted to 57 000 tonnes, and 6600 tonnes were exported. In 1979, 85 000 tonnes were produced. The production in the countries of the European Economic Community was estimated at 5100 tonnes in 1979 and 3300 tonnes over the first 9 months of 1983. The imports from the USA rose from 4000 tonnes in 1979 to 8700 tonnes over the first 9 months of 1983. 1-Propanol was not manufactured

in eastern Europe or in the Far East in 1979, but one company in Japan was reported to produce this compound by Kirk & Othmer. 1-Propanol is manufactured by the hydroformylation of ethene (reaction with carbon monoxide and hydrogen) to propionaldehyde, which is subsequently hydrogenated to 1-propanol. The compound can also be recovered commercially as a by-product of the high pressure synthesis of methanol from carbon monoxide and hydrogen. It has been produced by the vapor-phase oxidation of propane and during the reduction of propene-derived acrolein. Earlier, 1-propanol was fractionally distilled from the fuel oils that form in the yeast fermentation process for the manufacture of ethanol.

VI. MEASUREMENT INFORMATION

NIOSH 1405 collect on coconut shell charcoal, analyze by GC/FID

OSHA 07 collect on coconut shell charcoal, analyze by GC/FID

Limit of detection (LOD) both methods is about 0.04 ppm

VII. ORGANIZATIONAL SOURCES AND RECOMMENDATIONS

ACGIH

1966 proposed TLV 200 ppm TWA

1968 - 2006 TLV 200 ppm TWA

1974 - 2003 Skin notation

1976 - 2003 TLV 250 ppm STEL

1999 proposed A-3 confirmed animal carcinogen, with unkown relevance to humans, withdraw skin notation

2002 proposed TLV 200 ppm TWA, A3, no STEL

2003 proposed TLV 200 ppm TWA, 400 ppm STEL, A3, withdraw Skin notation

2004 TLV 200 ppm TWA, 400 ppm STEL, A3, withdraw Skin notation

2005 propose TLV 100 ppm TWA, 200 ppm STEL, A4

2006 propose TLV 100 ppm TWA, no STEL, A4

2007 TLV 100 ppm TWA, A4

AIHA no WEEL published for n-propanol

AIHA no ERPG published for n-propanol

VIII. ODOR THRESHOLD

Critiqued sources: 0.08 ppm - 269 ppm

Secondary sources: 1.1 ppm - 10,172 ppm

IX. HEAC HEALTH BASED ASSESSMENT AND RECOMMENDATIOIN

Recommendation for 100 ppm TWA (250 mg/m³ TWA)

This recommendation is based on avoiding acute sensory irritation. In acute animal studies, n-propanol is more toxic than 2-propanol (IPA). The respiratory depression test (RD_{50}) gave results that varied with the strain of the test animal and the duration of the exposure. Values of RD_{50} varied from 4,780 ppm for 5 minutes to 13,660 ppm for 30 minutes.[1, 2] Suggestions for an occupational exposure limit based on the RD_{50}, run from 1% to 10% of the RD_{50}, giving a range of 50 ppm to 400 ppm.[3] The geometric mean of this range is 141 ppm, which is then rounded to 100 ppm.[4] No data exist upon which to base a sensitizer (SEN) or Skin notation or to recommend a STEL.

X. HEALTH HAZARD DATA

Many acute toxicology studies with n-propanol find acute LD_{50} ranging from 1.9 g/kg to 6.5 g/kg. Inhalation studies find acute LC_{50} ranging from 4,100 ppm to 24,500 ppm.[5]

n-Propanol is not irritating to the skin of rabbits. Dermal toxicity ranged from 4 g/kg to 6.7 g/kg. The US EPA measured human skin permeability to range from 1.3×10^{-3} cm/hour to 1.7×10^{-3} cm/hour.

n-Propanol yielded negative results in genotoxicity studies. Reproductive and developmental toxicity studies found exposures of 7000 to 10,000 ppm 7 hours per day found maternal toxicity and reduced mean fetal body weights. Exposure to

3,500 ppm produced no evidence of maternal toxicity or developmental impairment. The no-observed-adverse-effect level (NOAEL) for developmental toxicity in rats was 3,500 ppm.[7,8]

Human exposure studies found eye and nose irritation in the range of 4,000 to 16,000 ppm. One fatality was attributed to acute ingestion of n-propanol.

XI. NOTABLE STUDIES

1-Propanol is rapidly absorbed and distributed throughout the body following ingestion. Data on the absorption rate following inhalation are lacking but, in view of the physical properties of the compound, it is also expected to be rapid. Dermal absorption is expected to be slow. [5]

1-Propanol exhibits low acute toxicity for animals (based on lethality estimates), whether exposed via the dermal, oral, or respiratory route.[9] Exposure to potentially lethal levels may occur in the general population through accidental or intentional ingestion. However, only one case of lethal poisoning by 1-propanol has been reported, which probably reflects its low toxicity and limited use by the public. The principal toxic effect of 1-propanol following a single exposure is depression of the central nervous system. Quantitative exposure- effect data on human beings are not available. The most likely acute effects of 1-propanol in man are alcoholic intoxication and narcosis. Animal studies indicate that 1-propanol is 2 - 4 times as intoxicating as ethanol.[13]

A controlled human study has indicated that 1-propanol may be irritating to hydrated skin. However, the potential of 1-propanol as a respiratory irritant is low. Data are inadequate for evaluation of the irritating properties of this compound for the skin, eye, and respiratory tract in human beings, or for evaluation of its sensitizing potential.

The results of limited drinking-water studies on animals suggest that oral exposure to 1-propanol is unlikely to pose a serious health hazard under the usual conditions of human exposure.

Inhalation exposure to a concentration of 15 220 mg/m^3 (6187 ppm) caused impaired reproductive performance in male rats, but exposure to 8610 mg/m^3 (3500 ppm) did not. In pregnant rats, 9001 mg/m^3 (3659 ppm) was a NOEL and 14 893 mg/m^3 (6054 ppm) was a LOEL for both maternal and developmental toxicity.

[7] Behavioral effects were not detected in offspring whose mothers were exposed during pregnancy to 15 220 mg/m^3, but oral dosing of neonatal rats produced biochemical changes in the brain that were detected 10 days after the last treatment.[9] Inhalation exposure to high concentrations of 1-propanol produced reproductive and developmental toxic effects in male and female rats. These effects occurred in the presence of other overt signs of toxicity in the exposed animals and 1-propanol does not appear to be selectively toxic to male or female reproductive processes. The concentrations required to produce these effects in rats were higher than those likely to be encountered under normal conditions of human exposure.[10]

1-Propanol was negative in assays for point mutations in bacteria. It did not increase the incidence of sister chromatid exchange or micronuclei in mammalian cells in vitro. Although these findings suggest that the substance does not have any genotoxic potential, no adequate assessment of mutagenicity can be made on the basis of the limited data available. The results of an in vitro test said to predict promotional activity were negative. The available study is inadequate to evaluate the carcinogenicity of 1-propanol in experimental animals. No data are available on the long-term exposure of human populations to 1-propanol. Hence, the carcinogenicity of 1-propanol in human beings cannot be evaluated.[12] Apart from one case of fatal poisoning following ingestion of half a litre of 1-propanol, there are practically no reports on adverse health effects from exposure to 1-propanol either in the general population or in occupational groups.

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