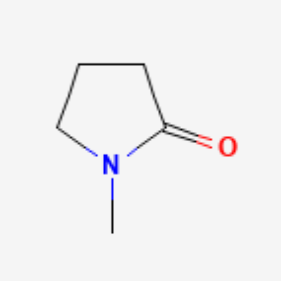
Updated EHS Summary of N-Methyl-pyrrolidone (NMP) for the MA TURA Science Advisory Board Meeting – March 19, 2026

CAS # 872-50-4  	**NAME: N-Methyl-2-pyrrolidone (NMP)** **Synonyms:** N-methylpyrrolidone; methyl pyrrolidone; 1-methyl-2-pyrrolidone **Molecular Weight**: 99.13 g/mol **Molecular Formula:** C_5H_9NO
PHYSICAL CHARACTERISTICS	
Primary Use	NMP is mainly used as a solvent for extraction in the petrochemical industry and as a reactive medium in polymeric and non-polymeric chemical reactions. NMP is used in cleaning products, graffiti and paint strippers in the occupational setting, and for cleaning applications in the microelectronics fabrication industry. It is also used as a formulating agent in pigments, dyes, and inks and as a formulating agent in insecticides, herbicides, and fungicides. NMP is also used as an intermediate in the pharmaceutical industry and as a vehicle in the cosmetics industry.
Physical state, odor at room temperature & pressure	dipolar aprotic solvent, clear colorless liquid with a fish-like odor.
Melting point; Boiling point	BP: 396°F (EPA, 2022)
Solubility	Completely miscible with water (ECHA, 2011)
Specific Gravity	
SAFETY/PHYSICAL HAZARDS	
Vapor Pressure	0.04 kPa at 25 °C (ECHA, 2011)
Flammability	
Flashpoint	204°F (EPA, 2020)
Flammability Rating	
Auto Ignition Point	
Combustion products	
Explosivity (UEL, LEL, shock sensitive)	
Oxidizer	
Corrosivity	
pH	
Reactivity	
Viscosity	
Odor Threshold	4 to 10 ppm (AIHA, 1989).
Other physical hazards associated with process: Heat, gases under	

pressure, noise, vibration, ergonomic hazard	
HEALTH HAZARDS	
Acute Toxicity	
Oral LD_{50}	Oral LD50 values reported by reasonably available studies in rats and mice ranged from 3,914 to 7,725 mg/kg-bw (Ansell and Fowler, 1988; Bartsch et al., 1976). (EPA, 2020)
Dermal LD_{50}	Dermal LD50 values in rats were reported as >5,000 mg/kg-bw (Clark et al., 1984). (EPA, 2020)
Inhalation LC_{50}	Following inhalation exposure, secondary sources report 4 hour LC50 was >5,100 mg/m3 (OECD, 2007). (EPA, 2020)
Intraperitoneal LD_{50}	
Chronic or Sub-chronic Toxicity	
IARC rating	
Carcinogenicity	
Neurotoxicity	
Developmental/Reproductive Toxicity	Several assessments have identified reproductive and developmental toxicity as the most sensitive effects of NMP (EPA, 2020; NICNAS, 2018; Danish EPA, 2015; ECHA, 2011) EPA considers that the fetal effects observed following NMP exposure are biologically relevant and might not have resulted solely as a secondary effect of maternal toxicity. In EPA's NMP risk characterization, the best representative endpoints were from acute (developmental toxicity) and chronic (reproductive toxicity) inhalation and dermal exposures for all conditions of use. Additional risks associated with other adverse effects (e.g., liver toxicity, kidney toxicity, immunotoxicity, neurotoxicity, irritation and sensitization) were identified for acute and chronic inhalation and dermal exposures. The NMP unreasonable risk determination uses reproductive and developmental toxicity as driving endpoints. (EPA, 2022) Page 227-230 for Summary Table of all studies used to drive conclusion; key studies noted below. Effect levels for developmental toxicity are similar across studies, with NOAELs reported in oral exposure studies typically ranging from 100-200 mg/kg-bw/day and NOAECs reported in inhalation exposure studies ranging from 206-360 mg/m3. **Developmental inhalation, oral and dermal exposures to NMP have been linked to a range of developmental effects, including decreased fetal and pup weights and increased embryo/fetal and pup mortality** (Sitarek et al., 2012; NMP

	Producers Group, 1999b, c; Hass et al., 1994; Exxon, 1991), **skeletal malformations, and incomplete skeletal ossification** (Saillenfait et al., 2002; E. I. Dupont De Nemours & Co, 1990; Becci et al., 1982). Most of the reasonably available developmental toxicity studies for NMP were performed in rats. Secondary sources also describe rabbit developmental studies that reported developmental toxicity, including increased resorptions and fetal malformations following gestational exposure to NMP (RIVM, 2013; OECD, 2007). **Evidence of developmental toxicity and dose-response information from studies identified as acceptable in the systematic review process is summarized in Table 3-2 and discussed in depth in Sections 3.2.4 and 3.2.5. (11 studies total - 7 Oral, 3 inhalation, 1 dermal)** Reproductive toxicity endpoints that have been observed following repeated exposure to NMP include reduced male fertility and female fecundity and testicular histopathology. Evidence of reproductive toxicity is inconsistent across studies. Three oral exposure studies in rats, including a paternal exposure study, a maternal exposure study, and a two-generation study in both sexes (Sitarek et al., 2012; Sitarek and Stetkiewicz, 2008; Exxon, 1991) report reduced male and/or female fertility in response to NMP. Three other two-generation studies in rats reported no significant effect on fertility. Two of these studies are two-generation dietary exposure studies in rats (NMP Producers Group, 1999b, c) with dose levels and study designs similar to the Exxon (1991) study. The third study is a two-generation whole-body inhalation exposure study (Solomon et al., 1995) that deviates substantially from EPA and OECD guidelines. In addition, several oral exposure studies have reported effects on testicular size or histopathology in male rats (Sitarek and Stetkiewicz, 2008; Malley et al., 2001; Malek et al., 1997), while several others find no effect (Malley et al., 1999; Becci et al., 1983; DuPont, 1982). **Evidence of reproductive toxicity is summarized in Table 3-3 and discussed in depth in Sections 3.2.4 and 3.2.5. (12 studies total - 10 oral, 2 inhalation)** **EU Substance of Very High Concern with basis - toxic for reproduction** **EU - REACH Annex XVII CMRs with basis – toxic for reproduction** “Developmental effects, including post implantation loss, foetal malformations and pup mortality, have been observed in rats, rabbits and mice following oral and/or dermal exposure. As the developmental effects reported are not considered secondary to maternal toxicity, the available data support the existing classification. The lowest reported

	LOAEL was 250 mg/kg bw/day (oral administration in rats) (OECD, 2009; SCCS, 2011)." (NICAS, 2018) "Collectively, decreased fetal and postnatal body weight, incomplete ossification, skeletal malformations and fetal and postnatal mortality are biologically relevant endpoints that provide important insight into NMP toxicity and may represent a coherent continuum of possibly related effects. The observed effects, even those from different studies, occur within a narrow range of doses of 100 to 1000 mg/kg bw/day (for oral exposures) or 470 to 669 mg/m³ (for inhalation exposures). In addition, these body weight and mortality effects appeared to persist, based on those studies that carried out the observations to PND 21." (EPA, 2015)
Genotoxicity/Mutagenicity	NMP has been evaluated in several in vitro and in vivo genotoxicity assays that cover a range of endpoints, including chromosomal aberration, DNA damage and repair, and point mutations. While the set of genotoxicity studies reasonably available to EPA is limited, negative results in reasonably available mammalian and bacterial test systems indicate that NMP is unlikely to be genotoxic. (EPA, 2020)
Endocrine Disruption	TEDX List
Thyroid	
Immunotoxicity	
Liver	Chronic oral exposure in rats was associated with centrilobular fatty change in the liver in males but not in females. This study identified a LOAEL of 678 mg/kg/day and a NOAEL of 207 mg/kg/day for liver toxicity in male rats (Malley et al., 2001). In mice, significantly increased liver weights as well as cellular alterations in the liver were reported in both male and female mice following oral exposure with a LOAEL of 173 mg/kg/day and NOAEL of 89 mg/kg/day for liver toxicity in male mice (Malley et al., 2001). A sub-chronic 90-day oral exposure study in rats and mice at higher doses found no effect on the liver (Malley et al., 1999), while a four-week oral exposure study found increased incidence of centrilobular hepatocellular hypertrophy in addition to increase serum total protein and albumin in female rats exposed to 2,268 mg/kg/day (Malek et al., 1997). (EPA, 2020)
Other organ toxicity	Chronic progressive nephropathy was reported in male but not female rats following chronic oral exposure to 678 mg/kg-bw/day and identified a NOAEL of 207 mg/kg/day based on kidney toxicity in male rats (Malley et al., 2001). Another study evaluated renal endpoints following four weeks of oral exposure in mice. Dark yellow urine was observed in all animals at

	2,970 and 4,060 mg/kg-bw/day. Cloudy swelling of the distal renal tubule was observed in 3/5 females at 4,060 mg/kg-bw/day. This study identified a NOAEL for renal effects of 920 mg/kg-bw/day in females and 720 in males (NMP Producers Group, 1994). A separate oral exposure study in which male rats received 500 mg/kg/day five days a week for five weeks reported mottled kidneys in all rats at all doses and decreased creatinine. The NOAEL for decreased creatinine in male rats this study was 250 mg/kg/day (Gopinathan et al., 2013). (EPA, 2020)
Skin, Eye and Respiratory Effects	
*Irritant – **S**kin, **E**ye, or **R**espiratory*	Animal studies show that NMP is a skin, eye, and respiratory irritant (ECHA, 2022; EPA, 2020; Danish EPA, 2015).
*Corrosive – **S**, **E**, or **R***	
*Permanent Damage – **S**, **E**, or **R***	
*Sensitizer– **S** & **R***	
Asthmagen – Initiator or Exacerbator	
Skin Absorption, Kp	
LOAEL	
NOAEL	
Benchmark Dose Response (BMD)	
Toxicokinetics	
Metabolites	The biological plausibility for effects of NMP on male fertility is supported by mechanistic data. NMP is a bromodomain inhibitor (Gjoksi et al., 2016; Gjoksi et al., 2015b) that has been shown to bind the BRDT (bromodomain testis-specific) protein (Shortt et al., 2014). NMP is metabolized into 5-hydroxy-N-methyl-2-pyrrolidone (5-HNMP)
Synergistic or Antagonistic Effects	
Environmental and Human Health Exposure and Risk Values	
RfC/RfD	
ATSDR-MRL	
Adverse Effect Levels: DNEL, PNEC, PNEL	In the Annex XV restriction dossier DNEL were derived for workers. An inhalation chronic systemic DNEL of 10 mg/m3 is derived for workers and an inhalation developmental toxicity DNEL of 5.0 mg/m3 is derived for pregnant workers. For dermal exposure, a dermal chronic systemic DNEL of 4.6 mg/kg bw/day and a dermal developmental toxicity DNEL of 2.4 mg/kg bw/day are derived for pregnant workers (Annex XV Restriction dossier, 2013).

Health Based Exposure Limits	
NIOSH-REL/IDLH/Ceiling Limits	
OSHA-PEL	CAL OSHA PEL: 1 ppm (4 mg/m³) In Denmark the OEL for NMP is 20 mg/m3 (8 hour average). The EU has set indicative OEL-values of 40 mg/m3 (8 hour average) and 80 mg/m3 (15 minutes peak). (Danish EPA, 2015)
ACGIH TLV-TWA	
TLV-STEL	Australia workplace standard of 103 mg/m (25 ppm) TWA and 309 mg/m (75 ppm) STEL. The exposure standard includes a notation that absorption through the skin may be a significant source of exposure (NICNAS, 2018).
Biomonitoring Action Limits	
Drinking Water Standards	
Other	Prop 65 listing basis – toxic for reproduction
ENVIRONMENTAL & ECO-SYSTEM HAZARDS	
PBT	
Bioaccumulation	Based on the low log Kow (0.38) accumulation in organisms is not expected. The calculated adsorption coefficient (Koc) of 9.6 demonstrates that NMP will not adsorb to sludge (Danish EPA, 2015). The measured log Pow of -0.46 (25 °C) and the calculated BCF of 3.16 do not indicate a potential for bioaccumulation (OECD, 2007)
BAF	
BCF	
BMF	
Ecological Toxicity	
Aquatic Toxicity: LC_{50}, EC_{50}, ErC_{50}, NOAEC/NOEC	The acute 96-hour LC50 values for fish range from >500 mg/L to 4,030 mg/L. The acute EC50/LC50 for aquatic invertebrates range from 1,107 mg/L to 4,897 mg/L. For fresh water green algae, the 72-hour EC50 values were 600 mg/L (Biomass) and 673 mg/L (Growth rate). EPA calculated the acute COC to be 100,000 µg/L (10 mg/L). (EPA, 2020)
Mammalian Toxicity: LC_{50}, EC_{50}, ErC_{50}, NOAEC/NOEC	
Wildlife Toxicity: LC_{50}, EC_{50}, ErC_{50}, NOAEC/NOEC	
Breakdown/degradation /combustion products	
Anaerobic degradation	

Aerobic degradation	
Other observable ecological effects (e.g. BOD)	
Fate and Transport: Aquatic	
Fate and Transport: Terrestrial	
Fate and Transport: Atmospheric	
Transport Issues	
Factors affecting bioavailability	
Global Environmental Impacts	
Ozone Depletion Potential (ODP)	
Global Climate Change	
Greenhouse Gas Production	
Acid Rain Formation	
Special Reports	
EU/Other Countries	REACH Restrictions for NMP: 1. Shall not be placed on the market as a substance on its own or in mixtures in a concentration equal to or greater than 0,3 % after 9 May 2020 unless manufacturers, importers and downstream users have included in the relevant chemical safety reports and safety data sheets, Derived No-Effect Levels (DNELs) relating to exposure of workers of 14,4 mg/m3 for exposure by inhalation and 4,8 mg/kg/day for dermal exposure. 2. Shall not be manufactured, or used, as a substance on its own or in mixtures in a concentration equal to or greater than 0,3 % after 9 May 2020 unless manufacturers and downstream users take the appropriate risk management measures and provide the appropriate operational conditions to ensure that exposure of workers is below the DNELs specified in paragraph 1. NMP is found on Danish EPA List of Undesirable Substances (2015) Health Canada concluded that NMP meets the criteria under paragraph 64(c) of CEPA indicating a potential risk to human health. (Canada, 2024)

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5. European Chemicals Agency. (ECHA) 1-methyl-2-pyrrolidone (CAS 872-50-4). *ECHA CHEM database*. Retrieved January 30, 2026, from https://chem.echa.europa.eu/100.011.662/dossier-view/c6ec0d64-26ed-4e3f-9e47-3e6595a6f200/2fd66072-9166-43bd-8832-81b21f510aba_2fd66072-9166-43bd-8832-81b21f510aba?searchText=872-50-4
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7. U.S. Environmental Protection Agency (2015) TSCA Work Plan Chemical Risk Assessment N-Methylpyrrolidone: Paint Stripper Use CASRN: 872-50-4. EPA Document# 740-R1-5002
8. U.S. Environmental Protection Agency (2020). *Risk evaluation for N-methylpyrrolidone (NMP)* (EPA-HQ-OPPT-2016-0743). https://www.regulations.gov/document/EPA-HQ-OPPT-2019-0236-0081