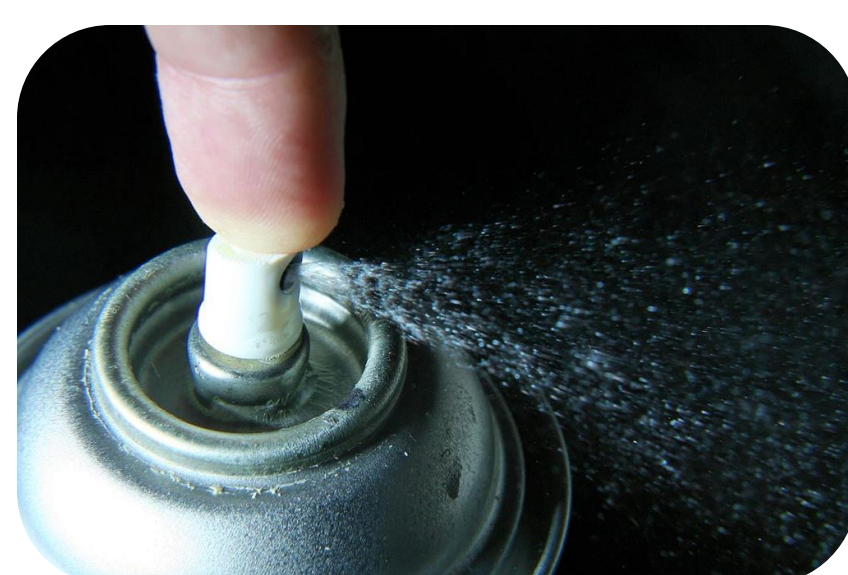


n-Propyl bromide (nPB) is a toxic chemical although it may be inaccurately marketed as a "green," or nonhazardous solvent.

What are common uses of nPB?



- Metal finishing & metal working
- Precision cleaning
- Auto parts cleaning
- A solvent carrier in adhesives
- Dry cleaning

- Removing solder flux residue in electronic parts manufacturing
- As a chemical processing intermediate or extraction solvent
- nPB is generally found where solvents such as trichloroethylene (TCE), perchloroethylene (perc), and methylene chloride were once used. *However, scientific evidence indicates that nPB is not a safer substitute for these chemicals.*

Products Containing nPB

nPB products are sold under many different trade names, including the ones listed below. This list is not comprehensive, and product formulations may change at any time. If there is a question as to whether a specific product contains nPB, check the material safety data sheet (MSDS). A number of additional nPB-containing products are no longer on the market, but may still be present in your workplace.

Degreasing, Lubrication, Extraction & Cleaning Agents

Abzol (Albemarle)	Metalnox M6960 (Kyzem)
Alpha VaporEDGE 1000 (Cookson Electronics)	Misty Safety Solvent 2000 (Amrep)
Contact Cleaner (Blaster)	nPB Heavy Duty Cleaner Degreaser (MG Chemicals)
DrySolv (Envirotech)	Pensolv PB2000 (West Pentone)
Ensolv A, CW, EX, GCS & Ionic (Envirotech)	Solvon (Poly Systems)
Entron and Entron-Aero (Reliance)	Techtride NPB (Parts Cleaning Technologies)
GenTech (Reliance)	Triagen (Ecolink)
Hypersolve (Ecolink)	VDS-3000 (SuperKleen/Albatross)
Instant Super Degreaser II, NoFlash, Electra-X (LPS)	X-CEL, XCEL IC (Western Chemical International)
Lenium ES, GS, XS, RV (Petroferm)	

Adhesives

Whisper Spray (Henkel)	Endurabond Normac 900R-NPB (Blair Rubber Co)
K-Grip 501 Spray Adhesive (Maple Leaf Sales II)	Soft Seam Adhesive (Spectrum Adhesives, formerly Mid-South Adhesives)

What are the health, safety and environmental effects?

Health concerns and increased regulation of TCE (for degreasing and metal cleaning) and perc (for garment cleaning) have resulted in increasing use of nPB as a relatively inexpensive and unregulated drop-in substitute for these two chlorinated solvents. *However, scientific evidence indicates that nPB is not a safer substitute for toxic solvents, such as TCE, perc, or methylene chloride.*

Workers may unknowingly be exposed to hazardous levels, as nPB has been marketed as a "green" product.

One recent study of multiple dry cleaning facilities found that nPB levels in the breathing zone of dry cleaning operators were routinely high — over twice to 10 times the exposure limit of 5 ppm (TWA) set by the California Occupational Safety and Health Standards Board (currently the lowest occupational exposure limit).¹

The current American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Value is 10 ppm. However, ACGIH is considering lowering that limit.

Acute (Short-Term) Health Effects

The following effects have been reported among workers with high exposures to nPB:²⁻⁴

- Eye, nose, throat, or lung irritation
- Headache, fatigue, dizziness, nausea, malaise

Chronic (Long-Term) Health Effects

• **Neurotoxicity:** *Peripheral and central nervous system toxicity have occurred in workers exposed to nPB, and in animals.*

In several studies, exposed workers exhibited the following symptoms:³⁻⁷

- Joint pain or leg weakness and pain leading to difficulty with standing and walking (stumbling);
- Muscle twitching or numbness, tingling & prickling in the hands or feet, loss of vibration sense;
- Anxiety, apathy, insomnia, and memory and concentration difficulties.

A recent study demonstrates nervous system damage in workers exposed to levels of nPB as low as 1.28 ppm.⁵



• **Developmental and Reproductive Effects:** The National Toxicology Program's (NTP) Center for the Evaluation of Risks to Human Reproduction concluded in 2003 that *nPB is a developmental and reproductive toxicant* based on animal studies.⁸ nPB affected a number of reproductive endpoints that can result in impaired fertility or sterility in both females and males, as well as delayed growth in the offspring of animals exposed during pregnancy. While no epidemiological study has examined the developmental and reproductive effects of nPB in humans, some case studies of female workers occupationally exposed to nPB reported altered menstrual periods.

• **Liver toxicity:** Based on evidence in studies using mice, *exposures may harm the liver.*⁹

• **Hematological effects:** Studies of workers indicate that *exposures can result in lowered red blood cell count.*⁵

• **Cancer:** Results from a 2-year inhalation cancer study conducted by NTP show that *nPB can cause malignant large intestinal tumors* in female rats, and possibly certain intestinal tumors in male rats and malignant lung/bronchial tumors in female mice.¹⁰ The NTP study also suggests that *cancerous tumors of the skin, pleura (e.g., mesothelioma), and pancreas in rats may be related to nPB exposure.* Because nPB is a new solvent, and cancer takes a long time to develop, studies of cancer associated with nPB exposure among workers or the public have not been conducted.

ENVIRONMENTAL

According to the Environmental Protection Agency (EPA), nPB has a *low tendency to concentrate in living organisms*, is moderately mobile in soil and tends to volatilize and break down easily in water. EPA recommends that nPB be disposed of similarly to other halogenated solvents in order to avoid damage to aquatic life.

Are There Alternatives?

Degreasing

Safer alternatives to nPB-based degreasing include *aqueous and semi-aqueous processes*, including the use of soaking or ultrasonic equipment. In addition, some facilities may be able to redesign their processes to eliminate the need for degreasing steps.

Other alternatives for metal degreasing include hydrocarbon solvents, such as terpenes, alcohols, acetone, ketones and acetates. However, exposure to these solvents can result in acute or chronic health effects, such as eye and respiratory irritation, dizziness, nausea, confusion, and liver and kidney problems. Many such solvents also are highly flammable.

Other drop-in substitutes, such as hydrofluoroethers and volatile methyl siloxanes, are effective, but have been less studied in terms of their health and environmental impacts.

Dry Cleaning

The least toxic alternatives to nPB in dry cleaning applications are carbon dioxide (CO₂) and professional wet cleaning systems.

Adhesives

Hot melt adhesives appear to be the least toxic alternative to nPB-based adhesives. They are suitable for some, but not all, applications.

Aqueous-based carriers using latex or latex-synthetic blends are non-solvent-based alternatives, but there are worker sensitization concerns associated with latex. Some aqueous-based carriers may contain ammonia which can irritate the eyes, respiratory tract and skin.

Some solvent adhesive formulations use acetone, and while they are generally low in toxicity, they have a very low flashpoint so systems must be in place to minimize the chance of fire or explosion.

How can I find out more?

- **Safe working practices**, Massachusetts Department of Labor Standards, On-Site Consultation Program: 508-616-0461; marvin.lewiton@state.ma.us
- **Massachusetts Toxic Use Reduction Act regulatory compliance**, Massachusetts Department of Environmental Protection: 617-292-5500; www.mass.gov/dep/toxics/toxicsus.htm
- **Confidential toxics use reduction technical assistance**, MA Office of Technical Assistance and Technology: 617-626-1078; www.mass.gov/eea/ota
- **Technical assistance regarding safer cleaning alternatives**, TURI Lab: 978-934-3133; www.cleansolutions.org
- **General toxics use reduction policy & technical questions**, TURI: 978-934-3275; www.turi.org

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