Tech Article

# Safer Cleaning Choices Replace nPB in Aerosols for Worker Safety

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Many companies use aerosol degreasers containing a liquid called “normal propyl bromide” (nPB). Normal propyl bromide (also called nPB, 1-bromopropane, CAS #106-94-5) is a nonflammable organic industrial solvent based on the element bromine. The fluid has a molecular formula of C3H7B. It is a replacement for methylene chloride, perchloroethane (“perc”) and trichloroethylene. N-Propyl Bromide is an affordable and versatile industrial chemical. It is used in a wide variety of applications such as fire retardants, water purification, pesticides and drugs.

**How is nPB Used?**

nPB is a carrier fluid for adhesives and to clean fluxes from printed circuit boards. The solvent also degreases metal and ceramic parts and clean optics. It is also an intermediate product in the production of certain synthetic fibers. It has a very high Kb value and operates at higher temperatures than low-boiling solvents, which is useful in many applications.

In general, this is a great product: nonflammable, fast-drying, highly aggressive, cleans great and is very affordable. But it carries serious toxicity concerns.

**Toxicity Worries**

In 2014 the American Conference of Governmental Industrial Hygienists (ACGIH) concluded the 8-hour time-weighted average exposure limit for 1-bromopropane should be reduced from 10 parts per million (ppm) to 0.1 ppm. In 2016, the U.S. Environmental Protection Agency (EPA) added nPB to the Toxic Release Inventory. This requires companies using nPB to file an annual report on the emissions and disposal of nPB. Both encourage users to seek better alternatives.

The original nPB toxicity level (called a TLV, AEL or PEL) was set at 100 ppm. At that level, nPB could be safely used in aerosols. However, subsequent studies found nPB damages the nervous system. It also alters human DNA, impairs fertility and there is a risk of cancer. Based on these reports, in 2004 the US EPA recommended an exposure limit of 25 ppm. The American Conference of Industrial Hygienists (ACGIH) set a limit of 10 ppm. California set a workplace exposure limit of 5 ppm.

Then in 2014 the ACGIH lowered the exposure rating to 0.1 ppm. It is impossible to use nPB in an aerosol and stay below this recommended safety level. Because of the toxicity, MicroCare does not sell nPB in aerosol packages, but only in bulk form for use inside tightly-sealed vapor degreasers.

**Simplifying Toxicity Ratings**

David Ferguson, MicroCare Product Manager for Precision Cleaners, finds that most end users do not understand toxicity ratings, as they relate to their application.

“Most exposure limits are time-weighted, designed to prevent long-term damage from exposures lasting days, weeks or even years,” says Ferguson. “But this does consider how the chemical is used. For example, a chemical with a lower exposure may be acceptable when used in properly designed cleaning equipment. However, using this same chemical in a highly emissive application, such as spraying, could be very dangerous for workers.”

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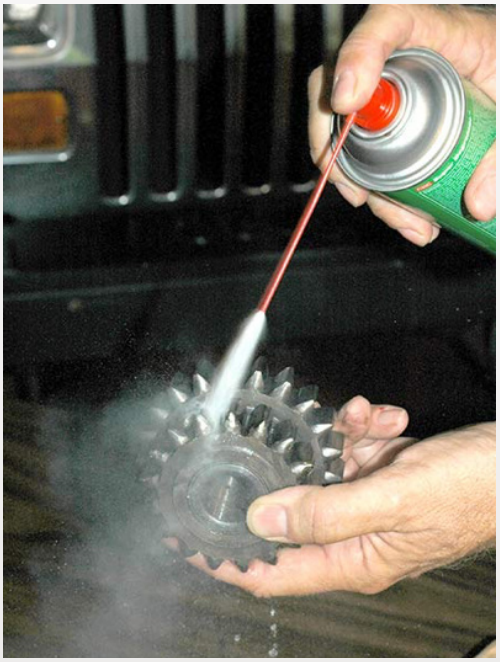

*As a solvent, nPB is a powerful degreaser that removes oil and grime quickly. Notice the over-spray from the high-pressure aerosol; this increases worker exposures.*

**What's wrong with these pictures?**
The photographs accompanying this report do not represent good cleaning fluid management. Best practices for handling any cleaning fluid — especially one with known toxicity issues should include the use of eye protection, solvent-resistant gloves, and procedures to capture waste solvent and contamination. Good ventilation is a "must." For more information about processes to keep your people safe, contact MicroCare.

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Toxicity ratings are expressed in parts-per-million (ppm). Like bowling scores, high scores are better — they indicate a safer product. High numbers, approaching 1,000 ppm, indicate a safe chemistry that is relatively harmless while lower numbers indicate a greater risk. The goal is to protect workers from dangerous exposures over 8-hour workdays and 40-hour work weeks over a 40-year working life. Here is the deception: The new toxicity rating for nPB is very low, 0.1 ppm. This creates a serious question about the safety of using it in aerosol packages.

**Toxicity Response**

A common response to the toxicity issue is legalistic. Some people suggest that since nPB is not regulated by any government agency, they don't have to control employee exposures. However, the courts see it differently, as a lawsuit from New England revealed in the 1990s.

The case involved a large metal-working manufacturer that used large quantities of trichloroethylene (TCE), a chlorinated solvent with known toxicity worries. The company was not concerned about chemical overexposures because, just like nPB today, TCE was not regulated. However, three decades later, former employees took the company to court due to cases of leukemia attributed to TCE overexposure. The company lost the battle and paid millions in reparations to victims — not to mention the damage to their reputation, the distraction and cost of the legal processes.

In short, if you have good, people-safe chemical alternatives, deploy them early and document your efforts and keep your workers safe.

**Aerosols Containing nPB**

While nPB has been an acceptable choice for precision cleaning in tightly-sealed cleaning systems for years, the use of nPB in aerosols is still "proposed" as unacceptable. Even after all these years the final ruling has not been published. So, the chemical can still be legally packaged in an aerosol can because the rule has not been finalized. The simple reason for worry from the US EPA is that it is virtually impossible to use nPB in an aerosol package and keep exposures below 10 ppm– much less the new exposure level of 0.1 ppm.

Testing at MicroCare years ago determined that under the best of circumstances, exposures for workers using aerosol cans are in the 10-20 ppm range (with a TriggerGrip™ dispenser from MicroCare or similar tool) and one could expect uncontrolled, high-pressure aerosols to generate substantially higher exposures. MicroCare has never packaged nPB in aerosol packages, but many other companies have. To determine if you are using nPB-based aerosol cleaner, examine the aerosol can or the safety data sheet. Specifically, look for an ingredient with the Chemical Abstract Number (CAS #) 106-94-5, that is nPB.

nPB in an aerosol can presents a serious safety hazard to workers. MicroCare offers advice and engineering expertise to customers to help them replace nPB and other solvents safely. MicroCare, through their state-of-the-art critical cleaning laboratory works with engineers through cleaning studies to specify cleaning processes that are effective and safe. Product safety, storage and handling procedures, fluid selection and operator training are all part of the MicroCare program.

*Here the operator cleans a similar gear to excellent results using an HFC-based formulation with a much safer toxicity rating.*

**Good News – Alternatives Exist!**

What can replace nPB? For the answer, a simple field test seemed well-justified. Most companies using aerosol degreasers use a simple "visual inspection" to confirm that parts are clean enough. MicroCare felt that a good location to test cleaning results was at a local auto transmission repair shop, which was kind enough to open its workshop to our cleaners.

Heavily contaminated auto parts with dirty lubricating oils are typical of the industrial cleaning applications in almost every factory around the world. Dust and debris coats gears, levers, push-rods, conveyor systems and actuators of all sorts over time. Cleaning them before repair is a must.

**Real-World Test Results**

In this real-world field test, a variety of transmission parts were cleaned with two different nPB aerosol cleaners and one Hydrofluorocarbon, or HFC-based aerosol cleaner. Scrubbing the parts with a still brush enhanced the cleaning. Operators judged the cleaning effectiveness as very good on all three products, even with baked-in residue. With the parts placed side-by-side after cleaning, operators could not detect a difference between parts cleaned with nPB and those cleaned with an HFC-based cleaner.

Neither type of chemistry is "plastic-safe." In a side-by-side test of their cleaning strength, the sprays were aimed at a soft plastic foam product. Both destroyed the foam instantly. This suggests that, in terms of cleaning strength, the materials operate in a highly similar manner.

Operators observed a few interesting differences. The nPB filled aerosols had higher pressures than the HFC-based aerosol, causing cleaning fluids to come out at a higher pressure and blast the surfaces. This obviously is a function of the packaging and not the cleaners themselves.

**Operator Feedback**

The operators also commented that the HFC-based cleaner evaporated faster than the nPB-based cleaners. Since nPB boils at 70°C, about 40°C higher than HFC blends, it should evaporate more slowly. One operator found the fast-drying convenient, and allowed him to work more efficiently.

Both operators noticed the HFC-based cleaner had far less aroma than the nPB-based cleaners. Both felt this was a significant improvement. Nobody, it seems, likes smelly chemicals, even when they work well. MicroCare provides air monitoring badges to clients using nPB purchased from MicroCare, so during the tests, one tech wore a badge on the lapel of his work shirt. This unobtrusive device "sniffs" the air and provides insights into the environment surrounding the operator. After cleaning, the sealed badge went to the lab for testing.

Results indicated operator exposure to approximately 20 ppm of nPB during the 2-hour test session. This suggests the exposure from even this simple test put operators over the latest OSHA, EPA and ACGIH exposure limits, putting employers using nPB at substantial liability.

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*The air quality monitoring badge.*


*There are a wide variety of options on the market today that don't require compromise or sacrifice of safety.*

**The Safe and Effective Choice**

While the reasons to switch away from nPB-based aerosols continue to mount, many industrial customers need a strong, nonflammable aerosol degreaser. Although these tests were not rigorously scientific, and conducted with a very small sample, these admittedly anecdotal conclusions strongly suggest that today there are viable choices on the market that are substantially safer than nPB.

It seems reasonable that any well-informed company buying an aerosol with nPB should be looking to change as soon as possible. MicroCare offers a number of alternative cleaners with superior toxicity ratings. They are much safer and used in aerosol cans without health risks. While companies may pay a small premium up-front for HFC-based cleaning fluids or HFO-based cleaning fluids, they more than make up for it with exceptional cleaning power and long-term safety.

**About the Author:**

*Mike Jones, retired Vice President of International Sales for MicroCare, has over 30 years of experience in the critical cleaning industry. He is a prolific writer and educator focusing on critical cleaning in general and vapor degreasing and benchtop cleaning in particular. For more information, visit www.microcare.com.*

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