



## Facts on Hazardous Cleaning Solvents and Recommended Replacements

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There seems to be a continuous flow of governmental restrictions, both state and national, on the usage of solvent cleaners. Most relate to environmental impact of such usage, for example, ozone depletion and VOC (Volatile Organic Compounds). There is a surprising dearth of restrictions related to personal hazards. The onus is on the organizations using solvents to select products carefully, and equip the users to safely handle the chemicals.

n-Propyl Bromide (nPB), TCE (Trichloroethylene), and Perchloroethylene (Perc) are three examples of harmful chemicals that are commonly used in aerosol cleaners in industrial applications. The facilities need to be acutely familiar with every chemical used on the floor, with special attention paid to the following:

- Exposure limits
- Exposure control methods and limitations
- Ramifications of exposure, i.e. severity of the exposure effects

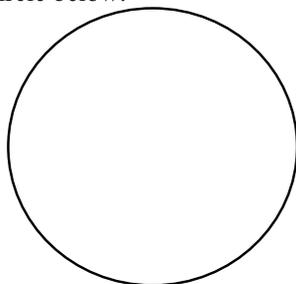
The lack of such knowledge and control can lead to employee ill health, downtime, and potential liability, no matter what the legal standing of a particular chemical.

### Exposure Limits

The personal hazard associated with a solvent is often defined using Threshold Limit Value (TLV), which are the recommended average exposure in an 8-hour per day, 40 hour work week. This is generally set by the American Conference of Governmental Industrial Hygienists (ACGIH). The unit of measure is Parts Per Million (PPM).

How can you visualize PPM, when it is not on an everyday scale like gallons and (outside the US) liters? Wikipedia defines PPM simply enough as “one particle of a given substance for every 999,999 other particles”. More specifically, one milligram (mg) of a solvent vapor or liquid per one million mg of air.

To help visualize, look at the circle below:



If that circle, roughly the size of a silver dollar, is one part, a million would be the area of an Olympic size swimming pool! This is a tiny unit of measurement. In the case of nPB, exposure needs to be controlled down to 10 of those units (per ACGIH) – very difficult even with the best of equipment.

The lower the TLV of a particular substance, the less a worker can be exposed to without harmful effects. TLV is stated on the MSDS of chemical products, in addition to recommended safety gear. Every organization using hazardous chemicals within their facility has the responsibility to equip their facility and personnel to maintain exposure levels below the TLV.

The following are three common industrial solvents and their exposure limits (source: ACGIH):

<u>SOLVENT</u>	<u>TWA (ppm)</u>
nPB	10
TCE	50
Perc	25

nPB, TCE, and Perc are commonly used as cleaning solvents because they are non-flammable, have high solvency, and are relatively inexpensive. Whether these exposure limits are acceptable or not depends on the ability to control fumes and atomized solvents.

### **Exposure Control Methods**

The use of solvents in spray applications poses much greater concern to worker safety than batch, vapor degreasing as workers are directly exposed to the solvent. The EPA commissioned ICF Consulting to perform a risk study on the issue of nPB, which was released at the May 2002 CleanTech exposition.

In evaluating spray adhesive applications, the ICF found, “Before installation of the spray booths, the overall mean concentration of nPB was 168.9 ppm, with main exposures in each work area ranging from 117.1 ppm in the Saw area to 197.0 ppm in the covers area. Following installation of the spray booths, the overall main nPB exposure concentration was 19 ppm, with individual measurements ranging from 1.2 to 58 ppm.” (*ICF 2002, Attachment A, pp. 26*)

Note that even with proper engineering controls, some workers outside the booth had exposure as high as 58 ppm. A spray booth is above-and-beyond typical ventilation control in a cleaning application, so open air spraying, or even spraying under a ventilation hood will most likely cause exposure well over the limits for nPB, TCE, and Perc.

The harm caused by excessive exposure depends on the material. The specifics are not generally covered in detail in MSDS, so facilities considering a particular chemical should do additional research if safety is in question. Multiple studies have shown excessive exposure to nPB, TCE, and Perc can cause severe health issues, so this should be taken very seriously.

### **Severity of Effects from Exposure**

#### **nPB**

In May 2007, the EPA proposed a ban of nPB used in adhesives or in aerosol solvents because, “...these end uses pose unacceptable risks to human health when compared with other substitutes that are available...If this proposal were to become final, it would be illegal to use nPB or blends of nPB...” (*EPA Federal Register, Vol. 72, No. 103, May 30, 2007, Proposed Rules, pp 30168, 30172*) Final approval of proposal is pending as of this writing.

The EPA’s proposal further explained the findings that led to their recommendation:

“Recent data collected from occupational settings indicate that severe, possibly irreversible, neurological effects may occur at sustained concentrations of approximately 100 ppm or greater (*Beck and Caravati, 2003; Majersik, 2004; Majersik, 2005*).

...

Multiple benchmark analyses found a statistically significant decrease in the number of estrous cycles and increase in estrous cycle length associated with nPB exposure, consistent with other reproductive endpoints, namely reductions in sperm motility, decreased live litter size, and change in prostate weight (*ICF, 2002a; ICF, 2006a; Stelljes and Wood, 2004; TERA, 2004*).

...

Further, effects on sperm motility in the parental and offspring generations are seen at levels generally consistent with multiple reproductive effects seen in both generations and both sexes exposed to nPB, such as estrous cycle length, lack of estrous cycling, the number of estrous cycles in a given period of time, fertility indices, and the number of live pup births (*TERA, 2004; ICF, 2006a; SLR International, 2001*).”

(*ibid, pp 20152*)

## TCE

TCE is currently heavily restricted at the state and local level, with very few restriction imposed at the national level. As of December 31, 2006, TCE is prohibited in use as an adhesive remover, electrical cleaner, and graffiti remover in California (*California Environmental Protection Agency Air Resources Board, Advisory No. 341, November 2005*). Studies implicate TCE in cases of liver, kidney, and lung cancer:

“Some studies with mice and rats have suggested that high levels of trichloroethylene may cause liver, kidney, or lung cancer. Some studies of people exposed over long periods to high levels of trichloroethylene in drinking water or in workplace air have found evidence of increased cancer. Although, there are some concerns about the studies of people who were exposed to trichloroethylene, some of the effects found in people were similar to effects in animals.”

(*Dept of Health and Human Services, Agency for Toxic Substances & Disease Registry (ATSDR), <http://www.atsdr.cdc.gov/tfacts19.html>*)

In its 9th Report on Carcinogens, the National Toxicology Program (NTP) determined that trichloroethylene is “reasonably anticipated to be a human carcinogen.” The International Agency for Research on Cancer (IARC) has determined that trichloroethylene is “probably carcinogenic to humans.” (*Ibid*)

## Perc

Perc has been an ongoing health and safety issue in the dry cleaning industry (<http://www.cdc.gov/Niosh/97-150.html>), and the culprit for as many as 770 US Superfund clean-up sites ([http://www.uncsbrp.org/resources/superfund\\_contaminants.cfm?item=perc&section=resources](http://www.uncsbrp.org/resources/superfund_contaminants.cfm?item=perc&section=resources)). The use as an industrial aerosol cleaner is not as widely reported, but there is adequate research to define the health risks associated with such usage:

“Humans - Liver damage such as hepatomegaly, icterus, and elevated, serum SGOT and SGPT (no estimates of dose given), as well as altered renal function (14 year average; TWA of 10 ppm), have been reported for workers exposed occupationally to perchloroethylene (*ATSDR 1993*).”

(*Office of Pollution Prevention and Toxins, US Environmental Protection Agency, Aug 1994, Section III,B,1*)

Like TCE, Perc is prohibited in use as an adhesive remover, electrical cleaner, and graffiti remover in California. (*California Environmental Protection Agency Air Resources Board, Advisory No. 341, November 2005*).

## Safer Alternatives

Common industrial cleaning solvents nPB, TCE, and Perc should only be considered in the workplace if human exposure can be tightly controlled. The very nature of aerosol and hand (bucket) cleaning make it unlikely exposure can be maintained within safe parameters. The potential of costly liability suits and worker downtime, and the availability of effective alternatives, make the use of nPB, TCE, and Perc an unnecessary risk.

Solvent blends combining Versa-Trans with HFC-245fa, HFE, Vertrel, and other chemicals offer the safety of a non-flammable product, but with exposure limits that are much more realistic to maintain. The additional cost, if applicable, should be offset by reduced risk of downtime and litigation.

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*Techspray is a formulator and manufacturer of precision cleaners for industrial and electronic applications. More information of Techspray's alternative cleaners, such as G3, can be found at [www.techspray.com](http://www.techspray.com).*



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**G3® Industrial Maintenance Cleaner** is ideal where a safe, non-flammable, and cost effective aerosol cleaner is required.

This patented cleaner is much safer than the three most common industrial solvents: TCE, nPB, and Perc.

Perfect for all types of degreasing, metal cleaning, contact cleaning, and other maintenance cleaning. This innovative cleaner quickly blasts off oils, greases, silicones, dirt and grime.

Replaces:

- **HCFC-141b** (*dichlorofluoroethane*)
- **TCE** (*Trichloroethylene*)
- **nPB** (*n-Propyl Bromide*)
- **Perc** (*Perchloroethylene*)

The EPA (Environmental Protection Agency) has issued a manufacturing ban of HCFC-141b, a very common industrial solvent. Availability is becoming an issue and prices are skyrocketing. G3 Industrial Maintenance cleaner is an ideal replacement!

### Features/Benefits

- Non-Flammable Aerosol
- Much safer than most common industrial solvents – TCE, nPB, and Perc
- Powerful Cleaner – Ideal for Degreasing and Contact Cleaning
- Rapid Evaporation
- Low Residue
- Low Odor
- Non-Ozone Depleting