

National Institute for Occupational Safety and Health
Draft Criteria for a Recommended Standard: Occupational Exposure to 1-Bromopropane
Overview
March 8, 2016

What is 1-bromopropane?

1-Bromopropane (1-BP; CAS #106-94-5) is an organic solvent used in commercial and industrial applications, such as vapor degreasing operations, and dry cleaning facilities. Since the late 20th century, 1-BP has received increased global attention as an alternative to ozone-depleting substances and other regulated chemicals. In part, this is because 1-BP is reported to not persist in the upper regions of the atmosphere (the stratosphere) for more than 15 days. 1-BP also exhibits low potential for acting as a greenhouse gas. The number of workers exposed to 1-BP is unknown, but 1-BP has been identified as a high production volume substance. At least 1 million pounds of 1-BP are used annually in the United States.

How are workers exposed to 1-bromopropane?

1-BP is a volatile organic solvent, which means that it can be found as a vapor at room temperature. Workers who are exposed to 1-BP breathe in the vapor. 1-BP can be absorbed from the lungs into the bloodstream and distributed to the rest of the body, where it can have toxic effects. Workers can also be exposed through contact with liquid 1-BP on the skin, often as a result of spills or splashes.

How does 1-bromopropane affect worker health?

1-BP has been shown to cause cancer in laboratory animals and is designated as *reasonably anticipated to be a human carcinogen* by the National Toxicology Program. Experimental animal toxicity studies have shown that 1-BP can cause a wide spectrum of non-cancer health endpoints after short-term and chronic (long-term) inhalation exposures. These health endpoints include systemic and organ-specific toxicity such as neurotoxicity, reproductive toxicity, blood toxicity, hepatotoxicity, and immunotoxicity.

Approximately how many workers are exposed to 1-BP in their workplaces?

We note in our draft document that previously EPA [2007a] estimated the number of businesses using 1-BP data collected from trade organizations and manufactures. The EPA analysis indicated that 2,540 to 9,280 businesses use 1-BP resulting in the potential for exposure in 3,320 to 69,100 workers. The largest use is as a vapor degreaser within 500 to 2,500 businesses [EPA, 2007a]. The analysis indicated that 8,300 to 40,300 workers may be exposed to 1-BP in these businesses. The second largest use of 1-BP is as an adhesive in the manufacturing of foam cushions and laminates [EPA, 2007a]. The use of 1-BP as an adhesive occurs in 100 to 280 foam manufacturers with the potential of 400 to 9,800 workers exposed to 1-BP.

What is the purpose of the draft NIOSH document, “Criteria for a Recommended Standard: Occupational Exposure to 1-Bromopropane”?

NIOSH has critically evaluated the health hazards associated with occupational exposures to 1-BP. This draft document presents these results of the NIOSH assessment: (1) information about occupational exposures to 1-BP and the toxicity of 1-BP, (2) the rationale and justification for a NIOSH recommended exposure limit (REL) for 1-BP, derived with current quantitative risk assessment methodology, and (3) recommendations for eliminating or reducing workplace risks of exposure.

How did NIOSH predict the risks of exposure to 1-BP?

NIOSH evaluated the information about 1-BP in the scientific literature to determine the possible effects of 1-BP on human health. For those health effects of highest concern (cancer, neurotoxicity and reproductive health effects), NIOSH identified dose-response data. When possible, NIOSH uses human epidemiological studies to

assess the risk of exposure to workers. However, for 1-BP, animal studies provided the best data for analysis. NIOSH conducted quantitative risk assessment on the dose-response data for cancer, neurotoxicity and reproductive health effects. The most sensitive health effect was cancer, so that was used to develop the proposed NIOSH REL. The other quantitative risk assessments are contained in Appendix B of the draft NIOSH document.

What measures should employers take to protect workers?

The draft NIOSH document proposed that occupational exposures to airborne 1-BP be limited to 0.3 ppm (1.5 milligrams per cubic meter [mg/m³] of air) as an 8-hour time-weighted average (TWA) concentration during a 40-hour workweek. The proposed NIOSH REL of 0.3 ppm corresponds with an excess working lifetime risk of lung cancer of 1 per 1,000 workers. The proposed REL is based on the results of a quantitative assessment of cancer risks.

Maintaining airborne concentrations below 0.3 ppm is intended to reduce the risk of lung cancers associated with exposure to 1-BP in the workplace. It is expected that maintaining occupational exposures to airborne concentrations of 1-BP below the proposed REL should also reduce other health effects associated with 1-BP exposure, including neurotoxicity, reproductive toxicity, developmental effects, and hepatotoxicity. Keeping exposures within the risk limit of 1 in 1,000 is the minimum practical level of protection. NIOSH does not consider an exposure limit set at a risk level of 1 in 1,000 to be a safe level of exposure for workers because of the residual risk of lung cancer and other health effects at the proposed REL. Therefore, exposures should always be kept below a risk level of 1 in 1,000.

The draft NIOSH document recommends that all reasonable efforts be made to further reduce risks from worker exposures to 1-BP to levels significantly below the proposed REL through the use of the hierarchy of controls, including elimination, substitution, engineering controls and, when those methods do not adequately reduce exposures, personal protective equipment. NIOSH also recommends that a comprehensive safety and health program be implemented that includes worker education and training, hazard communication, and exposure monitoring.

How should employers monitor the workplace for 1-BP exposures?

The draft NIOSH document recommends that a strategy to monitor exposure should be developed and implemented for each specific process and group of workers potentially exposed to 1-BP. The goal of the proposed exposure monitoring program is to ensure a more healthful work environment where worker exposure does not exceed the proposed REL for 1-BP of 0.3 ppm. Such a program should include routine area and personal monitoring of airborne concentrations to assess the effectiveness of engineering controls, work practices, personal protective equipment, training, and other factors in controlling airborne concentrations of 1-BP. The monitoring program can identify specific work areas or job tasks where worker exposures exceed the proposed REL and therefore require additional efforts or changes in processes to reduce them. Supplemental factors such as the number of workers in the group, variability in their exposure, level of workplace controls, and environmental conditions must be considered during development of the exposure monitoring program.

What other Federal Agencies are concerned about 1-BP?

In addition to NIOSH, the U.S. Environmental Protection Agency (EPA) and the Agency for Toxic Substances and Disease Registry (ATSDR) are actively investigating the health hazards of 1-BP. EPA has released a draft [*Toxic Substances Control Act Work Plan Chemical Risk Assessment for 1-Bromopropane*](#), which provides a summary of health effects and exposure data for both workers and consumers for particular uses of 1-BP. EPA is concerned with consumer exposures to aerosol spray adhesives, aerosol spot removers and aerosol cleaners and degreasers. EPA is also concerned with workers exposed to 1-BP in occupational uses in spray adhesives, dry

cleaning facilities, vapor degreasing, cold cleaning and aerosol degreasing. ATSDR has also released a draft [ATSDR Toxicological Profile on 1-Bromopropane](#). ATSDR is concerned with general public exposures around Superfund sites.

The three agencies agree on the health hazards of 1-BP and coordinated their activities to ensure that their findings did not conflict. Each of the draft documents reflect the information relevant to the purpose and mission of the individual agencies. All three documents are currently available for public comment.