

NIOSH Fact Sheet



EXPLODING FLASHLIGHTS:

ARE THEY A SERIOUS THREAT TO WORKER SAFETY?

Is it true that flashlights can, and have, exploded while in use by workers?

Yes. The National Institute for Occupational Safety and Health (NIOSH) has received reports of incidents where flashlights have exploded while in use by fire fighters. In December 1992, a flashlight used in a fire fighter training exercise exploded, slightly injuring one fire fighter. In January 1995, a flashlight carried in a fire fighter's pocket exploded, although he was not injured. Previous reports of exploding flashlights have appeared in the public safety literature.

What causes flashlights to explode?*

In the types of batteries most commonly used in flashlights—zinc/carbon batteries and alkaline batteries—hydrogen gas (H_2) is produced naturally as a product of the corrosion of the zinc electrode in the aqueous electrolyte. Differences in batteries, including cell design and charge rate, affect the rate and volume of H_2 generation. Excess hydrogen gas is more likely to be released if batteries are used incorrectly; that is, if different types or brands of batteries are mixed, damaged batteries are used, old batteries are mixed with new batteries, or batteries are inserted incorrectly so that polarity is reversed. Excess hydrogen gas may also be produced by rechargeable batteries during recharging. If H_2 accumulates within batteries or battery compartments without sufficient release, the buildup of pressure can cause the battery or compartment casing to rupture. Also H_2 and oxygen (O_2) mixtures are highly explosive, and if ignited by a spark or excessive heat can produce powerful explosions.

Can the accumulation of H_2 be prevented?

Many batteries or battery compartments are constructed to allow leakage and dissipation of H_2 . However, some battery compartments may be sealed tight against air and water by design. Some flashlights are constructed this way to enable their use by underwater divers and others who must have air- and water-tight equipment. Some manufacturers of equipment with air- and water-tight battery compartments have incorporated safeguards to prevent H_2 accumulation. For example, one-way relief valves may be incorporated in battery compartments to allow H_2 to escape. Or, chemicals may be used to absorb or recombine H_2 . However, even these safeguards may not be sufficient if batteries are used incorrectly and excessive levels of H_2 are produced.

*Levy SC, Bro P. [1994]. *Battery Hazards and Accident Prevention*. New York: Plenum Press. 351 pp.

Is there one particular brand, model, or type of flashlight that is more likely to explode?

NIOSH does not have sufficient information to determine whether the risks are higher with specific brands, models, or types of flashlights, than with others. However, the 1992 and 1995 explosions cited in this fact sheet involved one particular brand and model of flashlight: the Super SabreLite Submersible, Model 2000 series flashlight, manufactured by Pelican Products, Inc. (2255 Jefferson St., Torrance, CA 90501).

This flashlight features an air- and water-tight battery compartment, and is used by underwater divers, military personnel, fire fighters, hazardous materials workers, emergency response workers, and other public safety workers. The Model 2000C incorporates both a pressure relief valve, and a chemical catalyst to recombine H₂. These precautions did not prevent the January 1995 explosion, which involved a Model 2000C. An examination by the Mine Safety and Health Administration (MSHA) found that use of different brands of batteries, with presumably different charge states, contributed to the 1995 explosion by causing the release of hydrogen gas at a rate that exceeded the venting capacity of the pressure relief valve.

How serious is this hazard?

Any explosion creates the potential for injury due to the force exerted by the explosion itself, the potential that materials such as equipment components or pieces will fly outward from the source of the explosion with sufficient force to strike and injure someone, and the possibility that caustic or toxic substances could be released and come into contact with someone. In addition to the potential for injury, **an exploding flashlight could touch off a larger explosion in a flammable atmosphere.** The Super SabreLite Submersible Model 2000C is currently approved for use in flammable atmospheres by the Mine Safety and Health Administration (MSHA), the Factory Mutual Research Corporation (FM), and the Canadian Standards Association (CSA).

How can workers who use battery-powered flashlights protect themselves?

In order to protect themselves, workers should follow these precautions:

- Read and follow manufacturers' recommendations for product use
 - **DO NOT MIX** batteries of different brands
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- **DO NOT MIX** old and new batteries
 - **DO NOT MIX** alkaline with nonalkaline batteries
 - **DO NOT USE** damaged batteries
 - Ensure that proper polarity is observed when installing batteries
 - **PRIOR TO THEIR USE IN FLAMMABLE ATMOSPHERES**, inspect approved battery-powered flashlights to ensure that the batteries are in good condition, and that the proper batteries are installed correctly. Opening the battery compartment should allow any accumulated H₂ to dissipate. **DO NOT** inspect the flashlight in a hazardous area or near an open flame.

Are flashlights the only type of battery-powered equipment that can explode?

No. The potential for explosion may exist in battery-powered equipment other than flashlights. The accumulation of hydrogen gas within batteries or battery compartments may result in explosion of batteries themselves, or the explosion of the equipment in which they are housed. Due to the widespread use of battery-powered equipment in numerous occupational settings, NIOSH urges all employers and employees who use battery-powered equipment (including those with rechargeable batteries) to be aware of the potential explosion hazard described in this Fact Sheet.

Where can I get more information about this and other workplace hazards?

For more information about the hydrogen gas explosion hazard associated with batteries and battery-powered equipment, see *Levy SC, Bro P. [1994] Battery Hazards and Accident Prevention. New York: Plenum Press.* To obtain information about workplace hazards, contact the NIOSH toll-free number or website at the address shown below.

To order copies of NIOSH documents or to receive more information about other occupational safety and health problems, call **1-800-356-4674**. Visit the NIOSH Home Page on the World Wide Web at <http://www.cdc.gov/niosh/homepage.html>. NIOSH appreciates the assistance and cooperation of the Mine Safety and Health Administration (MSHA), the Occupational Safety and Health Administration (OSHA), the Consumer Product Safety Commission (CPSC), the International Association of Fire Fighters (IAFF), and Pelican Products, Inc., in the development of this fact sheet. This document may be freely copied or reprinted.



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