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OSHA/NIOSH Interim Guidance (February 2006) Chemical - Biological - Radiological - Nuclear (CBRN) Personal Protective Equipment Selection Matrix for Emergency Responders Blister Agents

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NOTICE

This product is not a standard or regulation, and it has no effect on employers' legal obligations. The guidance is advisory in nature, informational in content, and is intended only as technical assistance to employers in providing a safe and healthful workplace during emergency response operations. This document does not enhance or diminish any existing obligations under the OSH Act. The information in this document is interim guidance only. It is anticipated that NIOSH CBRN approval for all classes of respirators will be available in the near future. This guidance will change at the time NIOSH CBRN certification standards are available for all respirator classes. OSHA may also update this guidance as additional information becomes available in the future.

Introduction

Blister Agents or vesicants are chemicals which have severely irritating properties and can produce irritated and reddened skin with progression to blisters, swelling and inflammation of tissues surrounding the eyes with progression to light sensitivity and lacrimation. High concentrations of vapor or direct liquid exposures to the eye can cause damage to the eye surface. Warm, moist tissues are most susceptible to damage and the tissues of the upper respiratory tract can also be affected. Symptoms of exposure may be delayed until hours or days after exposure depending on the magnitude of the absorbed dose. The major chemical warfare agents in this category are [sulfur mustard](#), [nitrogen mustards](#) and [Lewisite](#).

Personal Protective Equipment

The recommendations for [personal protective equipment \(PPE\)](#) should be based on a site-based job hazard analysis of possible hazards including skin contact, air concentrations, heat stress, etc. All PPE should be used with appropriate additional administrative controls including medical surveillance, employee training, respirator fit-testing, and decontamination procedures to limit the potential for unforeseen adverse effects.

There are no current OSHA Permissible Exposure Limits (PELs) for exposure to blister agents. The National Research Council and EPA have published airborne limits to various agents called [Acute Exposure Guideline Levels \(AEGLs\)](#) to characterize the risk to the general population during a one-time accident and emergency scenario with time limits not to exceed 8 hours of exposure. For emergency responders and support personnel to a blister agent event, it seems appropriate to establish a target exposure limit at time weighted averages less than the lowest recommended AEGL-1 level for a given exposure duration. The AEGL-1 tier is the mildest effect category above which the general population, including susceptible individuals, could experience noticeable eye discomfort, irritation, or non-sensory effects. However, the effects are not disabling and are reversible upon cessation of exposure. The AEGL-1 and AEGL-2 values are based upon direct vapor exposure to the human eye and tissues surround the eye (conjunctiva), which are considered the most sensitive organ/tissue for blister agent vapor exposure effects by the National Research Council and the National Academy of Sciences. The CDC has made recommendations for [worker exposure limits](#) [35 KB PDF, 5 pages] dealing with routine work processes such as demilitarization and transportation. Note: The CDC/NCEH worker exposure limits do not specifically include storage. These exposure standards may be substituted for work extending beyond the 8-hour AEGL limit if deemed appropriate after an incident.

The PPE ensemble selected depends on the level of knowledge available regarding the chemical agent. Respirators

chosen initially for responders into a known release area should be a positive pressure self-contained breathing apparatus (SCBA) with a Level A protective suit until monitoring results allow for other decisions. OSHA would generally require these respirators to be [NIOSH-certified CBRN SCBA respirators](#) for use by employees. Some chemical warfare agents have been shown to seriously degrade and damage some respirators. Respiratory protection specifically approved by NIOSH for CBRN exposures is highly desirable but where not available, the incident commander may allow alternative suitable respirators during emergency operations. These are, depending on exposure levels, other NIOSH approved SCBAs or full-face air purifying respirators, which have been specifically tested by the manufacturer as effective against chemical warfare agents. Respirators other than SCBAs may be selected based upon accurate monitoring results with appropriate limits of detection for the subject agent. When conditions have been determined to be appropriate for the use of air purifying respirators, a NIOSH-approved CBRN APR Full Facepiece Air Purifying Respirator (APR) with a CBRN Canister, or a Chemical Warfare Agents (CWA) tested full facepiece APR with a combination organic vapor/acid gas/particulate canister may be used. A list of CBRN approved SCBA and APR may be obtained from the NIOSH website - [APR](#) or [SCBA](#).

The requirements for skin protection from above the AEGL-1 but below the AEGL-2 should be focused initially on reducing the potential for contact with liquid agent residue. As airborne exposure rises above the AEGL-2 level, the potential for significant vapor absorption through the skin is possible and exposed skin should be minimized with the use of chemically protective clothing, preferably vapor tight encapsulating suits. Above AEGL-3, the incidence and severity of skin burns will increase and the use of encapsulating suits should be mandatory.

The tables below consolidate some information relating to AEGL exposure levels and the relative protection provided by certain types of respirators and clothing. These limits are for planning purposes and are not recommendations for particular work schedules. Any work schedules should be reviewed by a competent occupational health professional skilled in use of exposure limits and PPE. All air purifying respirators require a change schedule for cartridges or canisters not to exceed the maximum eight-hour exposure covered by the AEGLs.

Summary of CDC and U.S. Army Airborne Exposure Limits			
Airborne Exposure Limits	Maximum Time of Exposure	Concentration of Sulfur Mustard (HD) mg/m³	Concentration of Lewisite (L) mg/m³
IDLH (Immediately Dangerous to Life/Health)	one time exposure	0.7 ^{a,b}	N/A
STEL (Short-Term Exposure Limit)	15-minute exposure, limited to one occurrence per day	0.003 ^{a,b} [3E-3]	N/A
WPL (Worker Population Limit)	Time-weighted average (TWA) for 8 hr/day, 5 days/wk	0.0004 ^{a,b} [4E-4]	0.003 ^{c,d}
GPL (General Population Limit)	Time-weighted average (TWA) for 24 hr/day, 7 days/wk, lifetime	0.00002 ^{a,b} [2E-5]	0.003 ^{c,d}

Personal Protective Equipment (PPE) Selection Guide for Emergency/Accident Responses Based Upon EPA's Acute Exposure Guideline Levels			
One Time Emergency Exposure Not to Exceed 8 hours Total			
Effects for Exposures Above AEGLs and PPE Guidance	Maximum Time of Exposure (one time exposure for emergency/accident response)	Concentration of Sulfur Mustard (HD) mg/m³	Concentration of Lewisite (L) mg/m³
Greater Than AEGL-1: Threshold for			

<p>conjunctival injection and minor discomfort with no functional decrement in human volunteers.</p> <p>Respiratory: Any NIOSH CBRN approved or Chemical Warfare Agents (CWA) tested SCBA or a NIOSH-approved CBRN APR Full Facepiece Air Purifying Respirator (APR) with CBRN Canister, or a Chemical Warfare Agents (CWA) tested full facepiece APR with a combination organic vapor/acid gas/particulate canister.</p> <p>Skin protection: Protect against contact with liquid residues. Minimize exposed skin and protect high contact potential skin areas using gloves and boots. Butyl rubber or impervious construction are desirable.</p>	10 MIN	0.40	N/A
	30 MIN	0.13	N/A
	1 HR	0.067	N/A
	4 HR	0.017	N/A
	8 HR	0.0083	N/A
<p>Greater Than AEGL- 2: Threshold for well-marked generalized conjunctivitis, edema photophobia and eye irritation. Potentially impacting functional abilities or ability to escape; delayed recovery. Some studies indicate an increased potential for delayed skin burns from vapor exposure.</p> <p>Respiratory: Any NIOSH CBRN-approved or CWA tested SCBA or a NIOSH-approved CBRN APR Full Facepiece Air Purifying Respirator (APR) with a CBRN Canister, or a Chemical Warfare Agents (CWA) tested full facepiece APR with a combination organic vapor/acid gas/particulate canister.</p> <p>Skin Protection: An encapsulating Level A type suit which provides skin vapor protection constructed of butyl rubber or layered impervious clothing which has received material and construction testing against specific CBRN agents by the manufacturer, the government or a third party testing agency using an accepted protocol. The NFPA 1991 Standard on Vapor-Protective Ensembles for Hazardous Materials Emergencies and the NFPA 1994 Standard on protective Ensembles for Chemical/Biological Terrorism Incidents require mandatory testing against chemical warfare agents.</p>	10 MIN	0.60	N/A
	30 MIN	0.20	N/A
	1 HR	0.10	N/A
	4 HR	0.025	N/A
	8 HR	0.013	N/A
<p>Greater Than AEGL- 3 Life threatening; Threshold for sulfur mustard inhalation lethality in mice. Some studies indicate severe skin vesication from vapor exposure is likely above this level.</p> <p>Respiratory: Any NIOSH CBRN-approved or CWA tested SCBA.</p> <p>Skin Protection: An encapsulating Level A type suit which provides skin vapor protection. A butyl rubber or layered impervious clothing which has received</p>	10 MIN	3.9	N/A
	30 MIN	2.7	N/A
	1 HR	2.1	N/A

material and construction testing against specific CBRN agents by the manufacturer, the government or a third party testing agency using an accepted protocol. The NFPA 1991 Standard on Vapor-Protective Ensembles for Hazardous Materials Emergencies requires mandatory testing against chemical warfare agents.	4 HR	0.53	N/A
	8 HR	0.27	N/A

References

- a) Memorandum Subject: Implementation Guidance Policy for New Airborne Exposure Limits for GB, GA, GD, GF, VX, H, HD, and HT. Department of the Army OASA (I&E), (2004, June 18).
- b) [Interim Recommendations for Airborne Exposure Limits for Chemical Warfare Agents H and HD \(Sulfur Mustard\)](#). US Department of Health and Human Services (DHHS), Centers for Disease Control and Prevention (CDC) Federal Register, Vol. 69, No. 85, pp. 24164-2468, (2004, May 3). Also available as a 35 KB [PDF](#), 5 pages.
- c) [Recommendations for Protecting Human Health and Safety Against Potential Adverse Effects of Long-Term Exposure to Low-Doses of Agents GA, GB, VX, Mustard Agents \(H, HT, HD\) and Lewisite \(L\)](#). US Department of Health and Human Services (DHHS), Centers for Disease Control and Prevention (CDC) Federal Register, Vol. 53, No. 50, p. 8504, (1988, March 15).
- d) *AR 385-61: The Army Chemical Agent Safety Program*. US Department of the Army, (2001, October 12), 185 KB [PDF](#), 34 pages.
- e) CSEPP Policy Paper Number 20 (Revised): Adoption of Acute Exposure Guideline Levels (AEGs). Chemical Stockpile Emergency Preparedness Program, Federal Emergency Management Agency and Department of the Army, (February, 2003).
- f) CSEPP Planning Guidance (Draft). Chemical Stockpile Emergency Preparedness Program (CSEPP) Steering Committee, Federal Emergency Management Agency (FEMA), Washington, DC (IEM/TEC05-005, June 2005).
- g) Evaluation of Chemical Warfare Agent Percutaneous Vapor Toxicity: Derivation of Toxicity Guidelines for Assessing Chemical Protective Ensembles. Oak Ridge National Laboratory Technical Memo ORNL/TM-2003/180. Oak Ridge National Laboratory, Oak Ridge, TN, (2003, July).
- h) Acute Exposure Guideline Levels for Selected Airborne chemicals, Vol 3. "Nerve Agents GA, GB, GD, GF, and VX" pp.15-300; "Sulfur Mustard (Agent HD)," pp, 301-383. National Research Council Committee on Toxicology Subcommittee on Acute Exposure Guideline Levels. National Academy Press, Washington, DC, (2003).
- i) Standing Operating Procedures for Developing Acute Exposure Guideline Levels for Hazardous Chemicals. National Research Council Committee on Toxicology Subcommittee on Acute Exposure Guideline Levels. National Academy Press, Washington, DC, (2001).
- j) Veterans at Risk: The Health Effects of Mustard Gas and Lewisite. National Academy of Sciences, Institute of Medicine, Committee to Survey the Health Effects of Mustard Gas and Lewisite. National Academy Press, Washington, DC., (1993).
- k) Review of Acute Human-Toxicity Estimates fro Selected Chemical-Warfare Agents. National Research Council Committee on Toxicology Subcommittee on Toxicity Values for Selected Nerve and Vesicant Agents. National Academy Press, Washington, DC, (1997).

Specific Hazard Information

- [Nerve Agents](#)
- [Radiological Dispersal Devices](#)

Related Online Resources

- [General References](#)

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