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**OSHA/NIOSH Interim Guidance - (February 2006)**  
**Chemical - Biological - Radiological - Nuclear (CBRN)**  
**Personal Protective Equipment Selection Matrix for Emergency Responders**  
**Nerve 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 also may update this guidance as additional information becomes available in the future.

**Introduction**

Nerve agents consist of a group of very toxic organophosphate chemicals specifically designed for military warfare. These include the agents code-named [GA \(Tabun\)](#), [GB \(Sarin\)](#), [GD \(Soman\)](#), Cyclohexyl Sarin (GF), and [VX](#). Other organophosphate chemicals include commercial insecticides such as Malathion®. These chemicals all cause similar effects on the human body by disrupting how nerves communicate and control muscles, glands, and organs. Though they cause similar effects, nerve agents are more toxic than commercial insecticides -- so smaller amounts can cause effects of concern. Most of the nerve agents exist as liquids but some (such as GB) volatilize into the air on their own. VX is the least likely to become airborne, but in conditions involving explosions, it could vaporize and spread in the air.

**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 nerve agents. The National Research Council and EPA have published airborne limits to various agents called [Acute Exposure Guideline Levels \(AEGs\)](#) 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 nerve agent event, it seems appropriate to establish a target exposure limit at time weighted averages less than the lowest recommended AEG-1 level for a given exposure duration. The AEG-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 AEG-1 and AEG-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 AEG 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 tables below consolidate some information provided by other agencies relating to toxicity, exposure, 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. Respiratory protection and other PPE recommendations are presented in the table below as time-dependent exposure limits by multiplying the NIOSH current assigned protection factor (APF) of the type of respirator and the AEGL-1 target level. Exposures above the limit require a more protective respirator. It should be noted that OSHA's proposed rule on APFs indicate that some hooded or helmeted powered air-purifying respirators have much higher protection factors than the current APF of 25. However, this rulemaking is pending and subject to change. The US Army's Immediately Dangerous to Life or Health (IDLH) level is set as the ceiling limit for respirators other than SCBAs. Any exposures approaching the IDLH level should be regarded with extreme caution and the use of SCBAs for protection should be considered. All air purifying respirators require a change schedule for cartridges or canisters not to exceed the maximum eight hour exposure covered by the AEGLs. A recent estimation of percutaneous absorption of nerve agent vapor suggests that a hazardous dose from skin absorption through airborne exposures is unlikely unless levels are significantly greater than the IDLH levels listed below. Skin protection at lower levels should be designed to prevent skin contact with liquid or contaminated surfaces. Nerve agents are toxic in small amounts on the skin and some can persist in the environment for days.

<b>Summary of CDC and U.S. Army Airborne Exposure Limits</b>					
<b>Airborne Exposure Limits</b>	<b>Maximum Time of Exposure</b>	<b>Concentration of GA (mg/m<sup>3</sup>)</b>	<b>Concentration of GB (mg/m<sup>3</sup>)</b>	<b>Concentration of GD/GF (mg/m<sup>3</sup>)</b>	<b>Concentration of VX (mg/m<sup>3</sup>)</b>
<b>IDLH (Immediately Dangerous to Life/Health)</b>	one time exposure	0.1 <sup>a,b</sup>	0.1 <sup>a,b</sup>	0.05 <sup>a,c</sup>	0.003 <sup>a,b</sup>
<b>STEL (Short-Term Exposure Limit)</b>	15-minute exposure, limited to one occurrence per day	0.0001 <sup>a,b</sup> [1E-4]	0.0001 <sup>a,b</sup> [1E-4]	0.00005 <sup>a,c</sup> [5E-5]	0.00001 <sup>a,b</sup> [1E-5]
<b>WPL (Worker Population Limit)</b>	Time-weighted average (TWA) for 8 hr/day, 5 days/wk	0.00003 <sup>a,b,c</sup> [3E-5]	0.00003 <sup>a,b</sup> [3E-5]	0.00003 <sup>a,c</sup> [3E-5]	0.000001 <sup>a,b</sup> [1E-6]
<b>GPL (General Population Limit)</b>	Time-weighted average (TWA) for 24 hr/day, 7 days/wk, lifetime	0.000001 <sup>a,b</sup> [1E-6]	0.000001 <sup>a,b</sup> [1E-6]	0.000001 <sup>a,c</sup> [1E-6]	0.0000006 <sup>a,b</sup> [6E-7]
<b>Percutaneous Vapor Toxicity</b>					
<b>Calculated Minimal Effect Values for 2 hour Exposure Period</b>		2.7	1.5	0.375	0.03

<b>Personal Protective Equipment (PPE) Selection Guide for                      Emergency/Accident Responses Based Upon                      EPA's Acute Exposure Guideline Levels</b>					
<b>One Time Emergency Exposure Not to Exceed 8 hours Total</b>					
<b>Effects for Exposures                      Above AEGLs and PPE                      Guidance</b>	<b>Maximum Time of                      Exposure                      (one time                      exposure for                      emergency/                      accident                      response)</b>	<b>Concentration                      of GA                      (mg/m<sup>3</sup>)</b>	<b>Concentration                      of GB                      (mg/m<sup>3</sup>)</b>	<b>Concentration                      of GD/GF                      (mg/m<sup>3</sup>)</b>	<b>Concentration                      of VX                      (mg/m<sup>3</sup>)</b>
<b>AIR: Less than AEGL-1 for stated duration times</b>  No Respirator required.  <b>SKIN:</b> Level D clothing if no splash or contact hazard. General washable work clothing or disposable coverall. Washable or disposable boots and gloves recommended for general purpose protection. If skin contact with liquid is a possibility, butyl rubber or layered impervious clothing which has received material and construction performance testing against specific chemical agents by the manufacturer, the government or a third party testing agency using an accepted protocol.	10 MIN	0.0069	0.0069	0.0035	0.00057
	30 MIN	0.0040	0.0040	0.0020	0.00033
	1 HR	0.0028	0.0028	0.0014	0.00017
	4 HR	0.0014	0.0014	0.00070	0.00010
	8 HR	0.0010	0.0010	0.00050	0.000071
<b>AIR: Less than 25 X 8 HR AEGL- 1</b>  (a) Any CBRN-approved or CWA tested Powered Air Purifying Loose Fitting Facepiece, hood or helmet and a NIOSH-approved CBRN filter or a combination organic vapor, acid gas, particulate cartridge/filter.  (b) Any CBRN-approved or CWA tested	<b>Maximum Time of                      Exposure                      (one time                      exposure for                      emergency/accident                      response)</b>	<b>Concentration                      of GA                      (mg/m<sup>3</sup>)</b>	<b>Concentration                      of GB                      (mg/m<sup>3</sup>)</b>	<b>Concentration                      of GD/GF                      (mg/m<sup>3</sup>)</b>	<b>Concentration                      of VX                      (mg/m<sup>3</sup>)</b>

<p>Continuous Flow respirator with a Loose Fitting Facepiece, hood or helmet.</p> <p><b>SKIN:</b> Level D if no splash or contact hazard. General washable work clothing or disposable coverall. Washable or disposable boots and gloves recommended for general purpose protection. If skin contact with liquid a possibility boots and gloves mandatory, other chemical clothing based on hazard assessment. Butyl rubber or layered impervious clothing which has received material and construction performance testing against specific chemical agents by the manufacturer, the government or a third party testing agency using an accepted protocol.</p>	30 MIN	<0.1(IDLH)	<0.1(IDLH)	<0.05(IDLH)	<0.003(IDLH)
	1 HR	<0.07	<0.07	<0.035	<0.003(IDLH)
	4 HR	<0.035	<0.035	<0.0175	<0.0025
	8 HR	<0.025	<0.025	<0.0125	<0.00178
<p><b>AIR: Less than 50 X 8 HR AEGL- 1</b></p> <p>(a) Any CBRN-approved or CWA tested Tight Fitting Air Purifying or Powered Air Purifying Full Facepiece.</p> <p><b>SKIN:</b> Level D if no splash or contact hazard. General washable work clothing or disposable coverall. Washable or disposable boots and gloves recommended for general purpose protection. If skin contact with liquid a possibility boots and gloves mandatory, other chemical clothing based on hazard assessment. Butyl rubber or layered impervious clothing which has received material and construction</p>	<p><b>Maximum Time of Exposure (one time exposure for emergency/accident response)</b></p>	<p><b>Concentration of GA (mg/m<sup>3</sup>)</b></p>	<p><b>Concentration of GB (mg/m<sup>3</sup>)</b></p>	<p><b>Concentration of GD/GF (mg/m<sup>3</sup>)</b></p>	<p><b>Concentration of VX (mg/m<sup>3</sup>)</b></p>
	30 MIN	<0.1(IDLH)	<0.1(IDLH)	<0.05(IDLH)	<0.003(IDLH)
	1 HR	<0.1(IDLH)	<0.1(IDLH)	<0.05(IDLH)	<0.003(IDLH)

performance testing against specific chemical agents by the manufacturer, the government or a third party testing agency using an accepted protocol.	4 HR	<0.07	<0.07	<0.035	<0.003(IDLH)
	8 HR	<0.050	<0.05	<0.025	<0.003(IDLH)
<p><b>AIR: Greater than 50 X 8 HR AEGL- 1</b>                      (a) Any CBRN-approved or CWA tested Self Contained Breathing Apparatus a Full Facepiece operated in a Pressure Demand Mode.</p> <p>(b) Any CBRN-approved or CWA tested Supplied Air Respirator with a Full Facepiece operated in a Pressure Demand Mode with an Auxiliary Escape Bottle.</p> <p><b>SKIN:</b> Level A/B. Level A if vapor concentration exceeds the levels listed above for percutaneous effects. Level A or B otherwise. Skin contact more likely with higher air levels. Butyl rubber or layered impervious clothing which has received material and construction performance testing against specific chemical agents by the manufacturer, the government or a third party testing agency using an accepted protocol.</p>	<p><b>Maximum Time of Exposure (one time exposure for emergency/accident response)</b></p>	<p><b>Concentration of GA (mg/m<sup>3</sup>)</b></p>	<p><b>Concentration of GB (mg/m<sup>3</sup>)</b></p>	<p><b>Concentration of GD/GF (mg/m<sup>3</sup>)</b></p>	<p><b>Concentration of VX (mg/m<sup>3</sup>)</b></p>
	8 HR	>0.050	>0.050	>0.025	>0.003(IDLH)

**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) [Final Recommendations for Protecting Human Health from Potential Adverse Effects of Exposure to Agents GA, GB, and VX.](#) Department of Health and Human Services (DHHS), Centers for Disease Control and Prevention (CDC) Federal Register, Vol. 68, No. 196, pp. 58348-58351, (2003, October 9). Also available as a 149 KB [PDF](#), 4 pages.
- c) *Memorandum Subject: Nerve Agent Percutaneous Exposure Criteria and Airborne Exposure Levels (AELs) for GD, GF in Use of Interim DA Guidance on Implementation of the New AELs.* Department of the Army Office of the Surgeon General (2004, June 29).

**Specific Hazard Information**

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

**Related Online Resources**

- [General References](#)

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Occupational Safety & Health Administration  
200 Constitution Avenue, NW  
Washington, DC 20210