

Department of the Army  
Pamphlet 40-8

Medical Services

**Occupational  
Health Guidelines  
for the Evaluation  
and Control of  
Occupational  
Exposure to Nerve  
Agents GA, GB,  
GD, and VX**

Headquarters  
Department of the Army  
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**Unclassified**

# ***SUMMARY of CHANGE***

DA PAM 40-8

Occupational Health Guidelines for the Evaluation and Control of Occupational Exposure to Nerve Agents GA, GB, GD, and VX

This revision is a health related publications developed to complement existing and future Occupational Safety and Health Administration (OSHA) and safety requirements. It--

- o Adds occupational health information about the nerve agents GA, GD, VX (integrated throughout).
- o Updates occupational health information about agents GB (integrated throughout).
- o Explains how to request a waiver or exception (para 1-4).
- o Removes the pregnancy limitations, since teratogenicity studies for agents GB and VX have been negative.
- o Updates guidance about optical inserts (para 2-4c), contact lenses (para 2-4d), the selection of respiratory protection equipment (para 2-4e), exposure monitoring (para 2-5), recordkeeping requirements (para 3-1), hazard communication information (para 3-3d), and material safety data sheets (para 3-4).
- o Clarifies the policies with regard to qualitative fit testing using isoamyl acetate and irritant fume (para 2-4e and app C).
- o Aligns tables 2-1 and 2-2 with the format to be used in future Department of the Army safety regulations.
- o Reduces the number of atmospheric monitoring records that must be maintained in the occupational health record by defining criteria for exposure and potential exposure (para 3-1c (2)).
- o Redefines the nerve agent exposure categories A, B, C, and D (para 4-2).
- o Clarifies the role of the surety officer or safety officer in categorizing exposure potential (para 4-2).
- o Clarifies the roles of the installation or activity commander and installation medical authority or designated contract physician in the medical surveillance program (paras 4-4 and 4-5).
- o Establishes responsibility for provided cholinesterase (red blood cell-cholinesterase (RBC-ChE)) monitoring for Department of Defense (DOD) contractor employees (para 4-8b).
- o Provides guidance about cholinesterase (RBC-ChE) monitoring for transient visitors (para B-3).

- o Defines the examining physician's responsibilities regarding abnormal findings in the preplacement and periodic examinations (paras B-4 and B-8 respectively).
- o Updates guidance on establishing baseline RBC-ChE (para B-12).
- o Updates the diagnosis and treatment guidelines (app D).
- o Defines terms such as designated contract physician, agent operating area, and exposed worker.

Medical Services

Occupational Health Guidelines for the Evaluation and Control of Occupational Exposure to Nerve Agents GA, GB, GD, and VX

By Order of the Secretary of the Army:

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The Adjutant General

**History.** This UPDATE printing publishes a revision of this publication. This publication has been reorganized to make it compatible with the Army electronic publishing database. No content has been changed.

**Summary.** This pamphlet outlines medical

occupational policies and procedures pertinent to nerve agents GA, GB, GD, and VX. The medical policies and procedures have been aligned with AR 50-6.

**Applicability.** This pamphlet applies to all active U.S. Army commands, agencies, organizations, and DOD contractors with the nerve agent mission. The commander, per AR 385-10, is responsible for ensuring compliance with these guidelines. This included incorporating the guidance provided in this document into the procurement of contractor services initiated after the date of this publication. Preexisting contracts do not require modification.

**Proponent and exception authority.** Not applicable.

**Interim changes.** Interim changes to this pamphlet are not official unless they are authenticated by The Adjutant General. Users

will destroy interim changes on their expiration dates unless sooner superseded or rescinded.

**Suggested Improvements.** The proponent agency of this pamphlet is the Office of The Surgeon General. Users are invited to send comments and suggested improvements on DA Form 2028 (Recommended Changes to Publications and Blank Forms) directly to HQDA (SGPS-PSP), 5109 Leesburg Pike, Falls Church, VA 22041-3258.

**Distribution.** Distribution of this publication is made in accordance with the requirements of DA Form 12-09-E, block number 4259, intended for command level C for Active Army (Medical Services; Nuclear and Chemical Weapons and Materiel). This publication is not distributed to the Army National Guard or U.S. Army Reserve.

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## Chapter 1 Introduction

### 1-1. Purpose

a. To comply with AR 50-6 and AR 40-5 this pamphlet establishes a medical surveillance program for all personnel potentially exposed to nerve agents GA, GB, GD, and VX (hereinafter referred to as nerve agents).

b. This pamphlet-

(1) Provides occupational health guidance for the evaluation and control of exposures to the nerve agents in industrial, depot, and laboratory operations.

(2) Does not apply to battlefield operations.

### 1-2. References

Required and related publications and referenced forms are listed in appendix A.

### 1-3. Explanation of abbreviations and terms

Abbreviations and special terms used in this pamphlet are explained in the glossary.

### 1-4. Waivers and exceptions

a. As a minimum, submit the following information to request a waiver or exception:

(1) The reference to the specific standard and to the specific paragraph for which the waiver or exception is being made.

(2) The reasons why the standard cannot be met.

(3) The interim measure used that compensates for the inability to comply with the standard.

(4) The action being taken to meet the standard, and the estimated date the action will be completed.

(5) A statement of the impact if the waiver or exception is not approved.

b. Forward the request for waiver, extension of waiver, or exception through command channels to HQDA (SGPS-PSP), 5109 Leesburg Pike, Falls Church, VA 22041-3258.

## Chapter 2 Methods to Control Exposure

### 2-1. Exposure limits

Do not intentionally expose unprotected individuals to-

a. Nerve agent airborne concentrations exceeding the limits in table 2-1.

b. Direct eye or skin contact with any amount of nerve agent.

### 2-2. Hygiene practices and facilities

a. Individuals will not store, use, or consume food, beverages, tobacco products, cosmetics, and chewing products in an agent operating area.

b. Individuals required to wear protective clothing and equipment must use the clean change area and shower facility.

### 2-3. Contamination control

a. General

(1) Design airflow from nonagent to agent areas.

(2) Do not exhaust air to the external environment when it contains concentrations of nerve agents above the source emission limits in table 2-1.

(3) Introduce clean makeup air in sufficient volume (see AR 385-64) to-

(a) Maintain the appropriate negative pressure atmosphere in agent areas.

(b) Assure the correct operation of the local exhaust system.

(4) Decontaminated and containerize equipment, material, or other items removed from an agent area to preclude contamination of nonagent areas or the external environment.

(5) Ventilated hoods continually when nerve agents are present.

b. *Engineering controls.* When operationally feasible, use local exhaust ventilation as an engineering control.

(1) For new construction or modification, a laboratory-type hood must provide an average face velocity of 100 plus-or minus 10 linear feet per minute (fpm) through the fully open sash. Use existing laboratory hoods, designed and approved at 150 plus-or-minus 30 linear fpm, until they can be modified. However, verify containment by conducting smoke capture tests.

(a) Use a traverse of one measurement per square foot (approximately) to compute the average face velocity.

(b) Ensure that individual readings do not deviate from the average face velocity by more than 20 percent.

(c) Take measurements every 6 months or when the system has undergone major repairs.

(2) Glove boxes and similar isolated systems must have an average inward velocity of at least 50 linear fpm through open ports or doors or must have 0.25 inch of static pressure on a closed system.

(3) Hoods used only for the storage of double contained agents (that is, no operations) are not subject to upper limits on airflow when the hood sash is lowered and locked for security.

(4) As a minimum, and under both of the following conditions, perform smoke capture testing-

(a) When measurements are made, or when any process change has the potential to redirect air patterns.

(b) With personnel in their normal working position in front of the hood and with no obstruction to the front of the hood.

c. *Work practices.*

(1) Work practices drastically influence hood performance.

(a) During operations, keep nerve agents at least 20 centimeters (7.9 inches) inside the hood sash with the hood sash closed to the smallest opening practical.

(b) To ensure adequate airflow, minimize or eliminate storing reagents and equipment in hoods. Use ventilation cabinets when additional storage is needed.

(2) Personnel conducting performance testing and participating in facility design need to be aware of the effects of outside air movement on hood performance. Consider-

(a) Velocity and method of introducing makeup air.

(b) Drafts from open doors or windows.

(c) Flow patterns around the worker.

(d) Proximity to other hoods.

(e) Pedestrian traffic.

d. *Standing operating procedures (SOPs).*

(1) The supervisor-

(a) Develops an SOP for each nerve agent operation.

(b) Obtains the local safety officer's approval of each SOP.

(c) Posts the SOP in each agent area.

(d) Enforces the SOP requirements per AR 50-6, paragraph 6-3.

(2) All individuals working in nerve agent areas must be trained in emergency procedures and be familiar with the SOPs.

(3) All individuals entering nerve agent areas must be familiar with emergency requirements and be accompanied by appropriately trained personnel.

### 2-4. Respiratory protection

a. *Program.* The installation or activity commander establishes the respiratory protection for nerve agent operations according to AR 11-34 and TB MED 502/DLAM 1000.2.

b. *Medical evaluation.* Do not assign individuals to tasks requiring the use of respirators until the installation medical authority (IMA) or the designated contract physician-

(1) Performs the medical evaluation (see app B).

(2) Determines whether the-

(a) Individual is able to perform the necessary tasks while wearing a respirator, or

(b) Individual's use of a respirator impairs the safety or health of the individual or others.

c. *Optical inserts.*

(1) The installation or activity commander procures optical inserts according to the criteria in AR 40-3, paragraph 4-20, and AR 40-63/NAVMEDCOMINST 6810.1/AFR 167-3, table 1-1.

(2) The certifying official will not allow individuals to be assigned to or maintained in positions requiring access to nerve agent surety material if the person has poor visual acuity requiring the use of glasses but does not have mask or lens inserts. Mask issue personnel will not issue the respirator until the required inserts are available. The IMA or designated contract physician may make exceptions on an individual basis.

(3) Eye clinic or appropriately trained personnel will—

(a) Initially place the inserts in the respirator to ensure proper placement.

(b) Instruct the worker about the proper care and subsequent placement of the inserts.

(c) Instruct the mask issue personnel in the placement of optical inserts.

*d. Contact lenses.*

(1) Workers may not wear contact lenses under the respirator in areas where potential exposure to nerve agents exist.

(2) Infrequent visitors may wear contact lenses, even if full-facepiece respirators are worn. However, an escort must accompany them.

*e. Selection of respiratory protective equipment.*

(1) The selection of appropriate respiratory protection for nerve agent operations must take into account the—

(a) Exposure profile of the worker to the nerve agent.

(b) Oxygen content of the environment.

(c) Operational considerations of wearing particular types of respiratory protection. Qualitatively fit test all workers who wear respirator protection. Qualitatively fit test all workers who wear respiratory protective devices (see para C-1). If workers fail the odor sensitivity test for detecting isoamyl acetate, perform qualitative fit tests using the irritant fume protocol in paragraph C-2. Never wear air-purifying protective masks (for example, the M9, M17, or M40 series or other certified equivalent masks) in oxygen deficient atmospheres (that is, oxygen concentrations < 19.5 percent).

(2) The following are general guidelines for the use of respiratory protection in nerve agent operations.

(a) No unprotected agent worker will be intentionally exposed to 8-hour time weighted average (TWA) chemical agent concentrations exceeding 0.0001 mg/m<sup>3</sup> for GA or GB, 0.00003 mg/m<sup>3</sup> for GD, and 0.00001 mg/m<sup>3</sup> for VX.

(b) Exposure to airborne chemical agent concentrations greater than 2,000 times the nerve agent exposure limits in (a) above exceed the protective capability of the M9, M17, and M40 series masks. Under these conditions (that is, < 0.2 mg/m<sup>3</sup> for GA or GB, < 0.06 mg/m<sup>3</sup> for GD, < 0.02 mg/m<sup>3</sup> for VX as an 8-hour TWA), use respiratory protection devices with higher protection factors than 2,000 to ensure compliance with the health standards. The National Institute for Occupational Safety and Health/Mine Safety and Health Administration (NIOSH/MSHA) approved, pressure demand, full facepiece self-contained breathing apparatus (SCBA) or supplied air respirator with protective ensemble is recommended. Examples of such protective ensembles include the toxicologic agent protective ensemble, self-contained (TAPES), the self-contained toxic environment protective outfit—interim, and the demilitarization protective ensemble (DPE). For emergency masked escape from these atmospheres, the M9, M17, or M40 mask is acceptable.

(3) Table 2-2 provides the operational implementation of these general guidelines for the selection of respiratory protective equipment. DA safety is the proponent for this table. (See AR 385-61 and AR 385-64.)

*f. Respiratory facepiece seal.* Do not wear respirators equipped with a facepiece if facial hair—

(1) Comes between the sealing periphery of the facepiece and the face, or

(2) Interferes with valve functions. (See AR 11-34, American National Standard Institute (ANSI) Z88.2 standard, para 3.5.8 and TB MED 502/DLAM 1000.2, para 2-7b(4).)

## 2-5. Exposure monitoring

*a. Routine operations.*

(1) *Monitoring.* The installation or activity commander will conduct continuous monitoring as prescribed in the memorandum, DACS-SF, Office of the Chief of Staff, 2 February 1990, subject: Changes to Department of the Army (DA) Toxic Chemical Agent Safety Policy, to determine the appropriate level of worker protective clothing.

(2) *Air samples.*

(a) The installation or activity commander will collect representative general area air samples. Representative samples should be interpreted as meaning low level monitoring in the worker's immediate vicinity, at a sufficient number of points to capture the worker's exposure profile during those agent operations, and at a sampling height that reflects where the worker's breathing zone is expected to be. (Are agent operations being conducted with workers lying on the floor, sitting on chairs, or standing on ladders?)

(b) When technology is available, collect full-period consecutive samples from the breathing zone of individuals performing the agent operation tasks.

*b. New agent operations.*

(1) Monitor during the first 5 days to verify the adequacy of the engineering controls.

(2) *Remonitor—*

(a) Quarterly for 1 operating day, or

(b) Following any significant damage or repairs to the ventilation system, or

(c) Following significant changes in the operation (remonitoring is not required if the only change is to an agent of lower volatility).

*c. Cleanup after a spill or accidental release.* Conduct general area monitoring to confirm that the atmospheric concentrations do not exceed the exposure limits for the agent worker in table 2-1.

*d. Exposure measurements.* For airborne nerve agent monitoring equipment, use a method of measurement that—

(1) Has an accuracy of plus-or-minus 25 percent at the 95 percent confidence level.

(2) Demonstrates the accuracy and precision over the range of 0.5 to 2.0 times the airborne exposure limits in table 2-1. Table 2-1 (page 5) Table 2-2 (page 5)

**Table 2-1**  
**Airborne exposure limits for nerve agents GA, GB, GD, and VX<sup>1</sup>**

Scenario	Nerve agents (mg/m <sup>3</sup> )		
	GD	GA/GB	VX
Agent worker 8-hour TWA in any work shift	0.00003	0.0001	0.00001
General population 72-hour TWA Ceiling Value <sup>2</sup>	0.000003 0.00003	0.000003 0.0001	0.000003 0.00001
Source emission limit <sup>3</sup>	0.0001	0.0003	0.0003

Notes:

<sup>1</sup> No individual will be intentionally exposed to direct skin or eye contact with any amount of solid or liquid nerve agent or to any solid materials contaminated with agent.

<sup>2</sup> Ceiling value normally refers to the maximum exposure concentration at any time, for any duration. Practically, it may be an average value over the minimum time required to detect the specified concentration.

<sup>3</sup> Source emission limits are primarily an engineering guideline. These limits should—

- a. Be attainable by a well designed and well operated incineration facility;
- b. Give an early indication of upset conditions; and
- c. Be accurately measurable in a timely manner.

**Table 2-2**  
**Respiratory protective equipment for regulated areas<sup>1</sup>**

Occupational scenario	Employee exposure potential <sup>2</sup> to agents (mg/m <sup>3</sup> )		
	GD	GA/GB	VX
Unmasked agent workers A full facepiece, chemical canister, air-purifying protective mask will be on hand for escape. (The M9, M17, and M40 series are acceptable for this purpose. Other masks certified as equivalent may be used. <sup>4</sup> )	≤ 0.00003 <sup>3</sup>	≤ 0.0001 <sup>3</sup>	≤ 0.00001 <sup>3</sup>
Masked personnel in routine operations a. A NIOSH/MSHA-approved, pressure demand, full facepiece SCBA or supplied-air respirator with escape air cylinder may be used. b. Alternatively, full facepiece, chemical canister, air-purifying protective mask (that is, M9, M17, M40 series mask, or other mask certified as equivalent) is acceptable. <sup>4</sup>	> 0.00003 to ≤ 0.06	> 0.0001 to ≥ 0.2	> 0.00001 to ≥ 0.02
Personnel conducting emergency operations or operations in unknown but potentially high agent concentrations a. A NIOSH/MSHA-approved, pressure demand full facepiece SCBA or supplied-air respirator suitable for use in high agent concentrations with protective ensemble. <sup>5 6</sup> b. During emergency operations, use the best available respiratory protection and personnel ensemble. If protection in a above is not available, a full facepiece, chemical canister, air-purifying protective mask with hood is acceptable. Currently, only the M9 series protective mask with M11 canister or M40 series mask is acceptable.	> 0.06	> 0.2	> 0.02

Notes:

<sup>1</sup> Qualitatively fit test all workers required to wear respiratory protective devices. Quantitative fit testing may be performed using surrogate masks.

<sup>2</sup> Based on an 8-hour TWA measurement, All values on this table are 8-hour TWA unless otherwise noted. The stated or permissible TWA is the concentration to which nearly all workers may be repeatedly exposed, for a normal 8-hour workday, day after day, without adverse effect. TWAs permit excursions above the limit provided they are compensated by equivalent excursions below the limit during the workday. Excursions above the TWA should be controlled even where the 8-hour TWA is within recommended limits.

<sup>3</sup> Determined by continuous monitoring (see para 2-5a).

<sup>4</sup> Air-purifying masks may not be used in oxygen deficient atmospheres (that is, less 19.5 percent oxygen).

<sup>5</sup> Examples of such protective ensembles include TAPES and the DPE.

<sup>6</sup> For emergency masked escape, a full facepiece, chemical canister, air-purifying protective mask (M9, M17, M40, or other certified equivalent) is acceptable.



## Chapter 3 Administrative Requirements

### 3-1. Recordkeeping

*a. General.* The examining physician documents any potential exposure to nerve agents (including an estimate of exposure and the type of personal protective equipment (PPE) used) in the occupational health record if—

(1) An employee working in an agent operating area exhibits signs or symptoms of nerve agent intoxication.

(2) Medical surveillance findings or breaches in PPE suggest that properly protected workers were potentially exposed.

*b. Maintenance.* The IMA or designated contract physician ensures the employee's occupational health record is maintained for the duration of the individual's employment, plus 30 years. (See AR 25-400-2, AR 340-17, AR 340-21, sec 20, part 1910, title 29, Code of Federal Regulations (29 CFR 1910.20), and FPM Supplement 293-31.)

*c. Atmospheric monitoring records.* Documentation of atmospheric sampling, even for negligible results, is important in assessing the present and past exposure history and in meeting legal requirements.

(1) *The installation or activity commander—*

(a) Designates who maintains the monitoring records.

(b) Assures that the personnel are qualified to interpret, correlate, and forward the results to the IMA or designated contract physician.

(2) The IMA or designated contract physician incorporates atmospheric monitoring data on exposed workers or potentially exposed workers into the occupational health record using a DA Form 4700 (Medical Record-Supplemental Medical Data) or other appropriate forms. (See the definition of an exposed worker and potentially exposed worker in the glossary.) Any record of exposure or potential exposure above the levels prescribed in table 2-1, must include—

(a) The date, number, duration, location, and results of each of the samples taken.

(b) A written description of the sampling and analytical methods used, or a reference to a publication in the open literature describing these methods.

(c) They type of PPE used.

*d. Employee access.* The IMA or designated contract physician—

(1) Removes all personal identifiers from the atmospheric sampling results (after incorporating data into the occupational health record if appropriate) and forwards recommendations to the supervisor for posting in the work area.

(2) Provides the affected individuals, former employees, or their designated representatives access to the atmospheric sampling records.

(3) Makes available the medical examination records required by appendix B for inspection and copying per AR 40-66, AR 50-6, 29 CFR 1910.20, and FPM Supplement 293-31.

### 3-2. Information and reporting requirements

*a.* The surety officer, in coordination with other appropriate personnel, provides the following information to the examining physician:

(1) A copy of this pamphlet.

(2) A written description of the affected individual's duties as they relate to the potential exposure.

(3) The individual's potential exposure (measured or estimated).

(4) A description of any PPE used or to be used.

*b.* If an individual is removed from work because of signs and symptoms commonly associated with exposure to nerve agents, the IMA or designated contract physician ensures that the occurrence is—

(1) Immediately reported to the certifying official per AR 50-6.

(2) Reported in the Special Telegraphic Report of Selected Condition (RCS MED-16(R4)) as an occupationally related illness per AR 40-400.

(3) Noted in the remarks section of the DA Form 3076 (Army

Occupational Health Report) covering the exposure period per AR 40-5.

(4) Reported to the safety officer.

(5) Documented in the occupational health record.

### 3-3. Employee information and training

*a.* Employee health education program. The IMA or designated contract physician coordinates with the installation commander to establish a health education program to inform employees of—

(1) Contamination control (see para 2-3).

(2) Respiratory protection (see para 2-4).

(3) Purpose and description of the medical surveillance program (see chap 4 and app B).

*b.* Employee health training. The IMA or designated contract physician reviews and approves all SOP's related to employee training such as contamination avoidance, personal protection, decontamination procedures, buddy-aid, self-aid, and essential first aid practices.

*c.* Access to health education material. The IMA or designated contract physician coordinates with the installation commander to ensure that a copy of all materials used in the health education program or training are readily available to all individuals with the potential for exposure.

*d. Hazard communication information.*

(1) The installation commander, through a written hazard communication program, defines the mechanisms for training workers about the potential exposure to nerve agents and the protective measures necessary for the job.

(2) Include the following nerve agent-specific items in employee hazard communication training:

(a) An explanation of the types of operations in the individual's workplace that involve potential nerve agent exposure.

(b) Methods used by the installation to recognize and evaluate potential work area exposures.

(c) An explanation of the potential acute and chronic health effects associated with nerve agent exposure.

(d) Protective measures to include administrative and engineering controls, PPE, safe work practices, and emergency procedures to include self-aid, buddy-aid, first aid, and decontamination.

(e) An explanation of the nerve agent material safety data sheet (MSDS) and applicable SOP's to ensure that nerve agent material are handled and stored per SOP's and regulations.

(f) Emergency evacuation and notification procedures.

(3) Methods of instruction may include formal classes, work area meetings, and audiovisual presentations as appropriate. As a minimum, annually repeat health-related training ((2)(c) and (d) above). The IMA or designated contract physician will provide technical assistance, monitor selected training sessions, and approve, in writing, the program of instructions and lesson plans.

(4) Document hazard communication training, in writing, to include the signature of both the trainee and the approving authority. Document training for all DA employees on DD Form 1556 (Request, Authorization, Agreement and Certification of Training and Reimbursement) or other appropriate forms, and incorporate it as a permanent part of the official personnel folder.

### 3-4. Material safety data sheets

*a.* The employee must have direct access to the MSDSs' content and location. The MSDSs are products of the material developer. To obtain copies of the current MSDSs, contact the Chief, Safety Office, U.S. Army Chemical Research, Development and Engineering Center, ATTN: SMCCR-SFS, Building E5101, Aberdeen Proving Ground, MD 21010-5423 (DSN/AUTOVON 584-4411).

*b.* Since the MSDSs' contents may change with time, the MSDSs may not always represent the medical guidance provided by the Office of the Surgeon General.

## Chapter 4 Medical Surveillance Program

### 4-1. General

a. The IMA or designated contract physician establishes the medical surveillance program for personnel with a significant potential for exposure to nerve agents (see app B). Personnel with a high risk of potential exposure will receive the most extensive examinations.

b. Table 4-1 presents the category specific medical surveillance requirements.

c. Appendix D provides the information on the diagnosis and treatment of nerve agent intoxication.

### 4-2. Categories

The surety officer or safety officer, in coordination with the IMA, categorizes all personnel with any potential for exposure.

a. Category A includes personnel with a high risk of potential exposure (see definition in glossary) due to the nature of the agent operations being conducted. Examples of such operations might include (but are not limited to) storage monitoring inspections of M55 rockets, periodic inspections, toxic chemical munition maintenance operations that involve movement of munitions from storage locations, work in known contaminated environments, and first entry monitoring. Category A personnel may be routinely required to work for prolonged periods in high level of nerve agents where the use of either of the following are required:

(1) Toxicological agents protective (TAP) ensembles, or

(2) Protective ensembles with self-contained or supplied-air breathing apparatus.

b. Category B includes personnel with (both)-

(1) A low risk or infrequent potential exposure to nerve agents in routine industrial, laboratory, or security operations. Examples of such operations might include (but are not limited to) daily site security checks and accident/incident response by initial response force members.

(2) Job requirements involving the prolonged wearing of protective ensembles during training and emergency responses.

c. Category C includes personnel with minimal probability of exposure to nerve agents even under accident conditions, but whose activities may place them in close proximity to agent areas.

d. Category D includes transient visitors to agent areas where there is a potential for exposure and who are not included in the medical surveillance program for nerve agents at the visited installation. (See para B-3c(1).)

### 4-3. Preplacement examination

a. *General.* All personnel assigned to work involving the potential exposure to nerve agents will receive a medical examination to document that they-

(1) Exhibit no physical, mental, or emotional impairment that may result in a higher vulnerability to nerve agent exposure.

(2) Are physically and mentally able to wear and use the required protective clothing and equipment.

b. *Requirements.*

(1) All medical procedures required by this document are-

(a) Performed by or under the supervision of the IMA or designated contract physician.

(b) Provided without cost to the employer.

(2) Appendix B, section I, details the preplacement examination requirements by category of potential exposure.

c. *Examination*

(1) An acceptable preplacement examination is-

(a) Any medical examination conducted within 90 days prior to work assignment involving the potential exposure to nerve agents.

(b) Consistent with the requirements outlined in appendix B, section I.

(2) If the medical examination described in (1)(a) above was not conducted specifically as a preplacement examination for work involving the potential exposure to nerve agents, the IMA or designated contract physician-

(a) Reviews the examination results.

(b) Renders a written opinion in the occupational health record as to its acceptability.

(3) If the medical examination described in (1)(a) above does not include all of the preplacement examination requirements described in appendix B, section I, the IMA or designated contract physician must perform the procedures which were omitted.

### 4-4. Periodic examination

The installation or activity commander ensures that all personnel assigned to work in areas involving potential exposure to nerve agents will receive the appropriate periodic examinations to include RBC-ChE monitoring. Appendix B, section II, details the periodic examination requirements by category of potential exposure. The IMA or designated contract physician performs the appropriate category specific or periodic examination and informs the installation or activity commander of those individuals who do not have up-to-date periodic examinations.

### 4-5. Termination examination

a. The IMA or designated contract physician performs a termination examination on individuals within 30 days before or after removal from the program. See appendix B, section III.

b. Individuals who are included in a medical surveillance program for 3 months or less do not require termination examinations, unless there has been documented evidence of exposure to nerve agents.

c. The installation or activity commander ensures that a termination examination to include RBC-ChE determination be given to workers who-

(1) Have been in the chemical surety program for more than 3 months.

(2) Are either permanently disqualified or administratively terminated from the chemical surety program. (See AR 50-6, chap 3, sec IV.)

### 4-6. Documentation of examination results

The examining physician records the written opinion in the occupational health record for each medical evaluation. This opinion includes-

a. The results of the medical examination and testing.

b. A statement about any detected medical condition that would place the individual's health at an increased risk of impairment if exposed to nerve agents.

c. Any recommended limitations on the potential exposure to nerve agents or on the use of protective clothing and equipment.

d. A statement that the employee has been informed of the above.

### 4-7. Accidental exposure

If an individual has been accidentally exposed or potentially exposed, the examining physician-

a. Provides the appropriate medical examinations, RBC-ChE monitoring, and emergency treatment.

b. Documents the occupational health records with an opinion of the exposure effect.

c. Records any atmospheric monitoring measurements in the occupational health record (see para 3-1c(2)).

### 4-8. Cholinesterase activity determinations

a. *Quality assurance.*

(1) The U.S. Army Quality Assurance and Referral Center for Cholinesterase Testing, Department of Pathology and Area Laboratory Services, Fitzsimons Army Medical Center manages the external quality assurance program for cholinesterase activity determinations.

(2) All activities performing RBC-ChE activity determinations according to this pamphlet must participate in this external quality assurance program.

b. *Monitoring RBC-ChE for DOD contractor employees.*

(1) The installation's Army medical treatment facility (MTF)

provides RBC–ChE monitoring for DOD contractor employees on a reimbursable basis per AR 40–3, paragraph 4–50.

(2) The MTF cholinesterase laboratory performing the test maintains the results in a log. Each log entry must include the patient’s name, social security number, and the absolute value in delta pH units. Keep this log for the duration of employment plus 30 years.

(3) The IMA forwards the RBC–ChE results to the designated contract physician handling the other portions of the contract employee’s medical surveillance examination.

(4) The designated contract physician follows up on any cholinesterase depression and maintains the RBC–ChE records per paragraphs 3–1a and b and B–14.

(5) The designated contract physician and IMA (responsible for the MFT cholinesterase laboratory) report significant cholinesterase depressions or other anomalies in RBC–ChE testing through the responsible contracting officer to the commander, who has ultimate responsibility per AR 385–10 for ensuring compliance with this document.

**Table 4–1**  
**Category specific medical surveillance<sup>1</sup>**

Category	Preplacement	Periodic <sup>2</sup>	Termination
A	Occupational history (OH) Medical history (MH) Physical exam (PE) EKG (over 35) PPE evaluation (includes spirometry) Audiometric exam Visual acuity/pupil rx Intraocular pressure (over 35) Baseline RBC–ChE	Interval OH Interval MH PE EKG (over 35) PPE evaluation Audiometric exam Visual acuity/pupil rx Intraocular pressure (over 35) RBC–ChE (monthly)	Interval OH Interval MH RBC–ChE
B	Same as category A	Same as category A except RBC–ChE is annually, or more frequently at the discretion of the IMA or designated contract physician	Same as category A
C	OH MH Baseline RBC–ChE	OH RBC–ChE	OH RBC–ChE
D	Baseline RBC–ChE		

Notes:

<sup>1</sup> Refer to appendix B for detailed guidance

<sup>2</sup> Denotes annual requirement unless otherwise mentioned

## Appendix A References

### Section I Related Publications

#### AR 11-34

The Army Respiratory Protection Program. (Cited in paras 2-4a and f(2).)

#### AR 25-400-2

The Modern Army Recordkeeping System (MARKS). (Cited in para 3-1b.)

#### AR 40-3

Medical, Dental, and Veterinary Care. (Cited in paras 24c(1) and 4-8b(1).)

#### AR 40-5

Preventive Medicine. (Cited in paras 1-1a, 3-2b(3), B-5b(2), B-6, and B-10.)

#### AR 40-63/NAVMEDCOMINST 6810.1/AFR 167-3

Ophthalmic Services. (Cited in para 2-4c(1).)

#### AR 40-66

Medical Record and Quality Assurance Administration. (Cited in paras 3-1d(3), and B-14b and c.)

#### AR 40-400

Patient Administration. (Cited in para 3-2b(2).)

#### AR 50-6

Nuclear and Chemical Weapons and Materiel, Chemical Surety. (Cited in the summary paragraph and in paras 1-1a, 2-3d(1)(d), 2-4e(1), 3-1d(3), 3-2b(1), 4-5c(2), B-1a(2) and c(2)(b), B-4b, and B-8b.)

#### FPM Supplement 293-31

Basic Personnel Records and Files System, (Cited in paras 3-1b and d(3).)

#### TB MED 501

Hearing Conservation. (Cited in para B-1c(3).)

#### TB MED 502/DLAM 1000.2

Respiratory Protection Program. (Cited in paras 2-4a and f(2).)

#### TB MED 509

Spirometry in Occupational Health Surveillance. (Cited in para B-1c(2)(a).)

#### Unnumbered publication

Memorandum, DACS-SF, Office of the Chief of Staff, 2 February 1990, subject: Changes to Department of the Army (DA) Toxic Chemical Agent Safety Policy. (Cited in para 2-5a(1).) (Copies are available from the Commander, USAEHA, ATTN: HSHB-MS Aberdeen Proving Grounds, MD 21010-5422.)

### Section II Related Publications

A related publication is merely a source of additional information. The user does not have to read it to understand this pamphlet.

#### ANSI Z87.1

Practice for Occupational and Educational Eye and Face Protection

#### ANSI Z88.2

Practices for Respiratory Protection

#### AR 340-17

Release for Information and Records from Army Files.

#### AR 340-21

The Army Privacy Program.

#### AR 385-10

Army Safety Program.

#### AR 385-40

Accident Reporting and Records.

#### AR 385-61

Safety Studies and Reviews of Chemical Agents and Associated Weapon Systems.

#### AR 385-64

Ammunition and Explosives Safety Standards.

#### 29 CFR 1910.20

Access to Employee Exposure and Medical Records. (Copies are available from the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402.)

#### MIL-STD 282

Filter Units, Protective Clothing, Gas-Mask Components and Related Products: Performance- Test Methods.

#### TB MED 503

The Army Industrial Hygiene Program.

#### Unnumbered publication

Message, U.S. Army Safety Center, CSSC-PROCEDURES, 162000Z Nov 88, DOD Explosives Safety Board (DDESB). (Copies are available from the Commander, USAEHA, ATTN: HSHB- MS, Aberdeen Proving Ground, MD 21010-5422.)

### Section III Referenced Forms

#### DA Form 3076

Army Occupational Health Report.

#### DA Form 4700

Medical Record-Supplemental Medical Data.

#### DD Form 1556

Request, Authorization, Agreement, and Certification of Training and Reimbursement.

#### OF 23

Charge-out Record.

#### SF 512

Clinical Record-Plotting Chart.

## Appendix B Medical Surveillance Program for Personnel With a Significant Potential for Exposure to Nerve Agents

### Section I Preplacement Examinations

#### B-1. Category A and category B personnel

The examining physician-

a. Obtains a comprehensive-

(1) Occupational history, with specific emphasis on prior potential exposures to cholinesterase-inhibiting substances (for example, organophosphate) and chemicals associated with cardiovascular, pulmonary, neurological, or psychiatric disease.

(2) Medical history and review of systems, focusing on the skin, eyes, pulmonary, cardiovascular, and neurologic systems, and any potentially disqualifying factors identified in AR 506–6, chapter 3.

*b.* Administers a general physical examination—

(1) With emphasis on the diagnosis of possible disqualifying cardiovascular or pulmonary disease.

(2) To detect any significant abnormalities in visual acuity or hearing, the skin, or neurologic system.

*c.* Performs specific evaluations to include a (an)—

(1) Electrocardiogram (EKG) at rest for individuals age 35 and older. At the discretion of the examining physician, and individual may obtain a stress EKG if the individual is to perform strenuous activities using protective clothing and equipment.

(2) Evaluation of the individual's physical ability to perform work involving potential exposure to nerve agents using the respiratory PPE. This evaluation uses reliable evidence such as history (for example, recent successful completion of a mask confidence exercise) or observations (for example, a 'use' test) that show the individual can safely and effectively use the required respiratory PPE and that no physiologic or psychologic conditions impair the individual's ability to use this equipment. For this evaluation, document this evidence and the physician's written opinion of the individual's ability to use such equipment in the individual's occupational health record.

(*a*) The examining physician must document baseline pulmonary function tests including, as a minimum, the forced vital capacity (FVC), and the 1-second forced expiratory volume (FEV1). (See TB MED 509.) Subsequent evaluations of physiologic capability to wear a respirator do not require repeated documentation of pulmonary function studies unless specifically required by the examining physician. Abnormal pulmonary function tests alone are not grounds for (a) disqualification. If there are abnormal pulmonary function tests, consider the following before disqualifying an individual from respiratory PPE use: The individual's medical history, age, the nature of the work to be performed while wearing respiratory PPE, the type of respiratory PPE employed, the results of the tests of cardiovascular status and, if necessary, a 'use' test.

(*b*) The examining physician must inform the certifying official, in a confidential manner, of any individual who is physically unable to wear respiratory PPE. (See AR 50–6, chap 3.) If work practices require activities to be performed in full protective clothing (that is, TAP ensemble and protective mask), document, in the individual's occupational health record, the individual's ability to withstand heat stress and to withstand sustained use of the PPE.

(3) Audiometric examination to determine the individual's auditory acuity per TB MED 501.

(4) Determination of the near and distant visual acuity, pupillary reactivity and, for workers over age 35, intraocular pressure. Elevated intraocular pressure requires an ophthalmologist's evaluation and clearance to work in areas where potential exposure to nerve agent exists.

(*a*) All individuals will have corrected near and distant visual acuity of 20/40 or better in at least one eye.

(*b*) If corrective lenses are required to provide this acuity, order corrective lenses prior to the individual's placement in the workplace.

(*c*) Provide individuals working in eye hazardous areas or jobs with appropriate protective eyewear meeting the ANSI Z87.1 standards (to include, but not to be limited to, prescription and plano industrial safety glasses and chemical splash goggles).

(*d*) Instruct individuals on the importance of wearing eyewear and the proper use of these items (whether protective or merely to correct visual acuity), including optical inserts for the protective mask (if required).

(5) Determination of the individual's baseline RBC–ChE activity as required by paragraph B–12.

## **B–2. Category C personnel**

*a.* No physical examination is required. However, the IMA or designated contract physician will obtain an occupational history

with specific emphasis on prior potential exposures to cholinesterase-inhibiting substances.

*b.* The examining physician will also obtain an MH and a review of systems, focusing on the skin and eyes, cardiovascular, pulmonary, neurological, and psychiatric systems.

*c.* A determination of the individual's baseline RBC–ChE activity is required per paragraph B–12.

## **B–3. Category D personnel**

*a.* No preplacement examination is necessary

*b.* A determination of the individual's RBC–ChE baseline is required per paragraph B–12. An RBC–ChE baseline does not necessarily have to be established at the installation visited.

*c.* Base the need for a baseline cholinesterase determination on the likelihood, frequency, and level of potential nerve agent exposure. The surety officer or IMA should not assume, for example, that all chemical surety inspectors or all foreign diplomats will require a baseline, since the risk of exposure may vary greatly from case to case. As general guidance—

(1) Transient visitors who are required to observe, review, or inspect agent operations (where engineering controls do not completely preclude the risk of accidental exposure) should be considered category D personnel.

(2) Casual visitors who may be receiving familiarization or orientation tours through facilities where agent operations are not ongoing or exposures are precluded by engineering controls need not be considered category D personnel.

## **B–4. Abnormal findings**

In the event of abnormal findings on the preplacement examination, the examining physician—

*a.* Determines what (if any) work practice or personal protective clothing limitations are necessary to protect the health of the worker.

*b.* Informs the certifying official of these limitations in a confidential manner, after discussing these findings with the worker. (See AR 50–6, chap 3.)

## **Section II**

### **Periodic Job-Related Medical Surveillance**

#### **B–5. Category A and category B personnel**

*a.* All workers in categories A and B will receive an annual examination to determine their continued fitness, and to review their occupational exposure histories during the preceding year. (1) Pay special attention to the possibility of nonoccupationally related exposures to other substances producing effect similar to nerve agent effects, such as cholinesterase-inhibiting pesticides.

(1) Pay special attention to the possibility of nonoccupationally related exposures to other substances producing effects similar to nerve agent effects, such as cholinesterase-inhibiting pesticides.

(2) Obtain a complete history concerning signs, symptoms, or adverse effects that may be connected to nerve agent exposure, heat stress, or continued use of PPE.

*b.* As a minimum, perform a review and update of work and MHs in addition to the examinations listed in B–1b and c(1) through (5) above.

(1) Perform category specific RBC–ChE monitoring according to the schedule provided in B–13 below.

(2) These tests should supplement other job specific surveillance tests indicated by worker exposures (if any) to substances other than nerve agent. (See AR 40–5, chap 5.)

#### **B–6. Category C personnel**

No annual medical examination is necessary other than for RBC–ChE monitoring and annually obtaining an occupational exposure history for the preceding year to determine job specific surveillance tests (if any) for substances other than nerve agents. (See AR 40–5, chap 5.) Perform category specific RBC–ChE monitoring according to the schedule provided in B–13 below.

### **B-7. Category D personnel**

No periodic medical examination is required.

### **B-8. Abnormal findings**

In the event of abnormal findings on the periodic examination, the examining physician—

*a.* Determines what (if any) work practice or personal protective clothing limitations are necessary to protect the health of the worker.

*b.* Informs that certifying official of these limitations in a confidential manner, after discussing these findings with the worker. (See AR 50-6, chap 3.)

## **Section III Termination Examination**

### **B-9. Category A and B personnel**

The IMA or designated contract physician will update the occupational exposure history and medical review of systems as previously described in paragraph B-5. If at any of the previous examinations the individual was referred for specialty consultation, refer the individual again for followup evaluation. Perform a termination RBC-ChE.

### **B-10. Category C personnel**

No special medical examination before termination of employment is necessary, other than updating the occupational exposure history for job specific surveillance tests (if any) for substances other than nerve agents. (See AR 40-5, chap 5.) Perform a termination RBC-ChE.

### **B-11. Category D personnel**

No termination examination is required.

## **Section IV RBC-ChE Monitoring**

### **B-12. RBC-ChE baseline**

A determination of the individual's baseline RBC-ChE activity is required as defined by the average value of two separate measurements obtained at least 24 hours or no more than 14 working days apart. During the time between the two RBC-ChE measurements, the individual should not be allowed to enter agent operating areas and should be warned to avoid exposure to any cholinesterase-inhibiting substances. If these two determinations vary by more than 0.05 delta pH units, obtain a third determination. In that case, the baseline RBC-ChE activity will then be the average value of all three measurements.

### **B-13. Frequency of RBC-ChE monitoring**

*a. Category A personnel.*

(1) Perform RBC-ChE determinations monthly and following any requirement for individuals to work in heavily contaminated atmospheres of nerve agents where unknown or potentially high concentrations exist. (See table 2-2.)

(2) In addition, perform RBC-ChE determinations on any individual who has experienced a compromise in PPE or deficient engineering controls that have potentially resulted in exposure. Cholinesterase determinations are not required to perform as immediate laboratory procedures; however, potentially exposed personnel who are experiencing symptoms possibly related to nerve agent exposure should have RBC-ChE monitoring performed as soon as practicable. Asymptomatic individuals, potentially at risk for RBC-ChE depression by virtue of their recent work history, should not reenter heavily contaminated atmospheres until laboratory verification of baseline RBC-ChE levels have been obtained.

*b. Category B personnel.*

(1) Perform RBC-ChE determinations at least annually or more frequently at the discretion of the IMA or designated contract physician. Limit the frequency of RBC-ChE monitoring to the frequency

of potential exposure, recognizing that the RBC-ChE, after irreversible inhibition by nerve agent regenerates at the replacement rate for red blood cells (that is, roughly 1 percent increase in RBC-ChE activity per day).

(2) In addition, perform RBC-ChE determinations on any individual who has experienced a compromise in PPE or engineering control that has potentially resulted in exposure. Cholinesterase determinations are not required to be performed as immediate laboratory procedures; however, potentially exposed personnel who are experiencing symptoms possibly related to nerve agent exposure should have RBC-ChE monitoring performed as soon as practicable. Asymptomatic individuals, potentially at risk for RBC-ChE depression by virtue of their recent work history, should not reenter heavily contaminated atmospheres until laboratory verification of baseline RBC-ChE levels has been obtained.

*c. Category C personnel.* RBC-ChE determinations are performed annually.

*d. Category D personnel.* No periodic RBC-ChE monitoring is required.

### **B-14. Recording RBC-ChE monitoring results**

*a.* Plot the results on a graph (SF 512 (Clinical Record-Plotting Chart)) showing either the actual RBC-ChE values or the percentage RBC-ChE value expressed in percent of baseline versus time. If percentage values are plotted, not the absolute RBC-ChE values above the respective data points.

*b.* Incorporated the SF 512 into the outpatient occupational health record per AR 40-66. In the event the SF 512 is maintained separately from the outpatient occupational health record, insert an OF 23 (Charge-out-Record) into the record identifying the responsible custodian.

*c.* On termination of employment (that is, either a permanent change of duty status involving a change in surveillance requirements or a permanent change in duty station), place the SF 512 in the outpatient record per AR 40-66.

### **B-15. Action levels**

*a.* In the event the RBC-ChE activity drops below 75 percent of the baseline value, remove the affected individual(s) from further actual or potential nerve agent exposure. Perform RBC-ChE determinations weekly until the affected individual(s) return to work. Do not permit an individual to return to work until the—

(1) RBC-ChE has reached a value of at least 80 percent of the individual's baseline value.

(2) Individual has been asymptomatic for at least 1 week. Note the period of removal from work on the graph referred to in B-14 above.

*b.* Determine RBC-ChE activity when signs and symptoms of systematic uptake of nerve agents are apparent. In addition, local (minor) signs such as mitosis or localized sweating will necessitate an immediate RBC-ChE sample collection and removal from further potential exposure until the results of the determination are known.

## **Appendix C Qualitative Protective Mask Fit Testing**

### **C-1. Isoamyl acetate test**

*a. Overview.*

(1) The test depends on the odor of isoamyl acetate, so-called banana oil because of its odor

(2) The test consists of two parts, odor sensitivity check and mask fit check

(3) The test location should be free of sources of ignition because isoamyl acetate is flammable. The flash point is 77°F and the lower explosive limit in air is 1 percent. The safe limit in air is 0.25 percent.

(4) The test chamber should be in a well ventilated room separate

from where the facepiece selection and sensitivity checks are performed to avoid olfactory fatigue.

(5) The test chamber consists of a plastic enclosure about 24 inches in diameter that covers the head and upper body of the test subject. A clear 55-gallon drum liner suspended upside down on a suitable frame is adequate.

*b. Equipment and supplies.*

- (1) 55-gallon drum liner and suitable frame.
- (2) Supply of 4- by 5-inch pieces of absorbent paper.
- (3) Small bottle (2 to 4 ounces) of isoamyl acetate, eyedroppers calibrated in milliliter (ml), and a supply of cotton-tipped swabs.
- (4) Four 1-liter glass jars with metal lids (for example, Mason or Ball jars).
- (5) A stock solution of 1 ml of isoamyl acetate in 800 ml of odor-free water in a 1 liter container (from (4) above). Fresh solutions will be made up weekly.

(6) Two 1-liter containers (from (4) above, each containing 500 ml of odor-free water. These will be the blank solutions in the sensitivity test.

(7) A sensitivity solution of 0.5 ml of stock solution in 500 ml of odor-free water in a 1 liter container (from (4) above). Fresh solutions will be made daily.

(8) Preparation or expiration date should be marked on the containers of the stock and sensitivity solutions.

*c. Odor sensitivity test.*

(1) In a room separate from the test chamber, set up the two containers of blank solutions and the container of the sensitivity solution in random order.

(2) Instruct the test subject to identify the container of the sensitivity solution (isoamyl acetate solution) by opening lids and smelling. If the subject is unable to distinguish between the odor of the liquid in containers, olfactory impairment is assumed and C-2 below applies.

(3) Don and adjust protective mask prior to entering the test chamber room.

*d. Fit check.*

(1) Hang absorbent paper that has been folded in half and wetted with 0.5 ml of isoamyl acetate, on the hook in the top of the chamber (the examiner may accomplish this prior to the subject being tested).

(2) Wait 2 minutes before allowing the test subject to enter the chamber. This allows the isoamyl acetate concentration to reach the required level of 150 parts per million (nominal).

(3) Instruct the test subject to enter the test chamber and perform each exercise listed below for 30 seconds:

- (a) Normal breathing.
- (b) Deep breathing. Be certain breaths are deep and regular.
- (c) Turn the head from side to side. Be certain movement is complete, with one turn every second. Avoid bumping of the respirator on the shoulders.
- (d) Nod the head up and down. Be certain motions are complete and made about every second. Avoid bumping of the respirator on the chest.

(e) Talking. Read a paragraph that incorporates the full range of speech sounds such as the so-called rainbow passage used by speech therapists. Be certain the paragraph is read aloud and slowly.

*(f) Normal breathing.*

(4) Consider the mask fit adequate if the isoamyl acetate (banana oil) odor is not detected at any time during the fit test.

(5) Terminate the test if the isoamyl acetate odor is detected at any point during the test. Detection of the banana oil odor of the isoamyl acetate by the subject indicates that the mask does not fit or is defective.

(6) Remove the wetted paper after the subject leaves the test chamber and deposit in a closed container.

(7) If the test is not passed satisfactorily, either because of improper mask size or the mask is found to be defective, instruct the test subject to obtain a new mask and repeat the entire fit test sequence.

(8) If the mask is found to be defective, issue a new mask and turn in the defective mask as unserviceable.

## **C-2. Irritant fume protocol**

*a.* When an individual's olfactory senses are impaired, test the mask for fit and leakage with irritant smoke.

*b.* Allow the test subject to smell a weak concentration of the irritant smoke to become familiar with the characteristic odor of each.

*c.* Have the test subject properly don the mask and wear it for at least 10 minutes before starting the fit test.

*d.* Review this protocol with the test subject before testing.

*e.* Instruct the test subject to perform the conventional positive pressure and negative pressure fit checks. Failure of either check is cause to select an alternate respirator.

*f.* Break both ends of a ventilation smoke tube containing stannic oxychloride, such as the MSA part no. 5645, or equivalent. Attached a short length of tubing to one end of the smoke tube. Attach the other end of the smoke tube to a low pressure air pump set to deliver 200 ml per minute.

*g.* Advise the test subject that the smoke can be irritating to the eyes and instruct the test subject to keep the eyes closed while the test is performed.

*h.* Direct the stream of irritant smoke from the tube towards the face seal area of the test subject. Begin at least 12 inches from the facepiece and gradually move to within 1 inch, moving around the whole perimeter of the mask.

*i.* Instruct the test subject to perform each exercise for 1 minute while the mask seal is being challenged by the smoke:

- (1) Normal breathing.
- (2) Deep breathing. Be certain breaths are deep and regular.
- (3) Turn the head from side to side. Be certain movement is complete. Alter the test subject not to bump the mask on the shoulders. Have the test subject inhale when the head is at either side.
- (4) Nod the head up and down. Be certain motions are complete. Alter the test subject not to bump the mask on the chest. Have the test subject inhale when the head is in the fully up position.
- (5) Talk slowly and distinctly, count backwards from 100.
- (6) Normal breathing.

*j.* If the irritant smoke produces an involuntary reaction (cough) by the test subject, stop the test. In this case, reject the tested respirator and select another one.

*k.* Give each test subject passing the smoke test, without evidence of a response, a sensitivity check of the smoke from the same tube to determine whether the test subject reacts to the smoke. Failure to evoke a response will void the fit test.

*l.* Perform steps, e, h, and i above in this protocol in a location with exhaust ventilation sufficient to prevent general contamination of the testing area by the irritant smoke.

*m.* Use masks successfully tested by the protocol in contaminated atmospheres. (See AR 385-61, table 2-3.)

## **Appendix D Diagnosis and Treatment of Nerve Agent Intoxication: General Information for Healthcare Providers**

### **D-1. General**

*a.* This appendix provides general information to medical personnel treating nerve agent intoxication from both surety and research, development, test, and evaluation (RDTE) materiel. Although RDTE dilution materiel may be significantly less hazardous than surety materiel, RDTE solutions may represent significant exposure potential to highly hazardous substances.

*b.* This appendix is not intended to provide doctrine on self-aid, buddy-aid, or first aid to nonmedical personnel.

## D-2. Routes of entry

The routes of entry are through inhalation and eye and skin absorption. Ingestion is rarely a route of entry.

## D-3. Toxicology

*a.* Nerve agents GA, GB, GD, and VX are readily absorbed and hazardous through all routes of exposure, in both liquid and vapor forms. The most prominent physiological effects result from inhibition of the cholinesterase enzymes distributed throughout the nervous system. The resultant excess acetylcholine at the site of the parasympathetic nerve endings produces—

(1) Characteristic muscarine-like effects including mitosis, rhinorrhea, broncho-constriction, and increase gastrointestinal motility.

(2) Nicotine-like effects including muscle fasciculation, weakness, or flaccid paralysis. The accumulation of excessive acetylcholine in the brain and spinal cord results in characteristic central nervous system effects such as difficulty in concentrating, anxiety, depression of respiratory center, convulsions, or coma.

*b.* A few controlled studies were conducted in an attempt to scientifically document potential long-term psychoneurological effects such as memory loss, decreased alertness, decreased problem-solving abilities, language problems, and decreased eye-hand coordination. No long-term effects from repeated low level exposure to nerve agents were identified except slowed electroencephalogram wave changes without clinical correlation.

*c.* Although certain organophosphate pesticides were shown to be teratogenic in animals, these effects were not documented in carefully controlled toxicological evaluations for nerve agents.

## D-4. Signs and symptoms

*a.* The onset of the signs and symptoms of exposure to nerve agents may occur within several minutes of the exposure, but lower levels of exposure may delay the onset for several hours. The time interval between exposure and the onset of symptoms depends on the degree and route of exposure, as well as the type of agent involved.

*b.* Local symptoms may be the first noted effects.

(1) With minimal vapor exposure, the first effects may be evidenced in the eye or respiratory tract. Evidence of ocular exposure with marked mitosis and associated symptoms may be unilateral. Respiratory system effects vary from minor local upper respiratory congestion to significant respiratory embarrassment including chest tightens, wheezing, increased bronchial secretions, respiratory arrest, or death depending on biologically absorbed doses.

(2) Local sweating, with fasciculation, may occur as a result of localized cutaneous exposure and may precede more significant signs and symptoms of agent absorption.

(3) Other effects of exposure may include changes in heart rate or blood pressure, or involuntary micturition, depending on the route and dose of exposure.

## D-5. Treatment

*a.* Prior to rendering aid, take steps for self protection, such as donning a protective mask and other protective equipment.

(1) Immediately remove the casualty from the source of exposure and decontaminate to minimize the spread of contamination.

(2) Remove any nerve agent in the casualty's eye by flushing with copious amounts of water.

(3) Remove all clothing.

(4) Immediately decontaminate the patient with 5 percent hypochlorite (bleach) while protecting the airway and assuring appropriate placement of the mask over the uncontaminated face. Do not use the bleach solution on open chest or abdominal wounds, or in the mouth or eyes. Wash these areas with copious amounts of water.

*b.* Administer atropine with the onset of systemic effects or respiratory embarrassment. It may be necessary to administer large doses of atropine to maintain a satisfactory respiratory status.

(1) In severe nerve agent intoxication, the effect of each injection

of atropine may be transient, lasting only minutes. Therefore, observe the patient as closely as possible and readminister atropine at appropriate intervals to relieve the muscarinic and central nervous system effects of the nerve agent.

(2) A therapeutic oxime, pralidoxime chloride (2-PAC C1), may be useful in the treatment of GA, GB, GD, and VX nerve agent intoxication.

*c.* Initiate appropriate measures, such as artificial respiration, administration of oxygen, and removal of bronchial secretions, as indicated. Draw a blood sample for RBC-ChE determinations. Treat any evidence of seizure disorder with intravenous or intramuscular diazepam as quickly as possible to attempt to avoid sequelae of uncontrolled convulsions. Give 5 to 10 mg of diazepam slowly and intravenously, to control convulsions in this event. Do not administer morphine to nerve agent intoxicated patients because it intensifies and prolongs the depressant effect of the anticholinesterases on ventral horn cells of the spinal cord, resulting in general motor paralysis.

*d.* Ocular symptoms, produced by local absorption of nerve agents, do not respond to the systemic administration of atropine. Relieve ocular pain or discomfort by local instillation of 2 or 5 percent homatropine solution, repeated as needed at intervals of several hours for 1 to 3 days. Severe symptoms may require the local instillation of 1 percent atropine sulfate ointment.



## Glossary

### Section I Abbreviations

#### ANSI

American National Standards Institute

#### CAS

chemical abstracts service

#### CFR

Code of Federal Regulations

#### DA

Department of the Army

#### DOD

Department of Defense

#### DPE

demilitarization protective ensemble

#### DSN

defense switched network

#### EKG

electrocardiogram

#### FEV<sub>1</sub>

forced expiratory volume in 1 second

#### fpm

feet per minute

#### FVC

forced vital capacity

#### IMA

installation medical authority

#### m

meter

#### mg

milligram(s)

#### MH

medical history

#### ml

milliliters

#### MSDS

material safety data sheet

#### MTF

medical treatment facility

#### NIOSH/MSHA

National Institute for Occupational Safety and Health/Mine Safety and Health Administration

#### OH

occupational history

#### PE

physical examination

#### PPE

personal protective equipment

#### RBC-ChE

red blood cell cholinesterase

#### RDTE

research, development, test, and evaluation

#### SCBA

self-contained breathing apparatus

#### SOP

standing operating procedure

#### TAP

toxicological agent protective

#### TAPES

toxicologic agent protective ensemble, self-contained

#### TWA

time-weighted average

### Section II Terms

#### Agent area

A physical location where entry and exit are restricted and controlled; and where agents GA, GB, GD, and VX are manufactured, processed, packaged, repackaged, demilitarized, released, handled, stored, used, and/or disposed.

#### Agent GA

The chemical dimethyl phosphoramidocyanidate, chemical abstracts service (CAS) registry number 77-81-6, in pure form and in the various impure forms that may be found in storage as well as in industrial, depot, or laboratory operations.

#### Agent GB

The chemical isopropyl methylphosphonofluoridate, CAS registry number 107-44-8, in pure form and in the various impure forms that may be found in storage as well as in industrial, depot, or laboratory operations.

#### Agent GD

The chemical phosphonofluoridic acid, methyl-1, 2, 2-trimethylpropyl ester, CAS registry number 96-64-0, in pure form and in the various impure forms that may be found in storage as well as in industrial, depot, or laboratory operations.

#### Agent operating area

That portion of an agent area where workers are actively conducting nerve agent operations.

#### Agent VX

The chemical phosphonothioic acid, methyl-S- (2- (bis (1-methylethyl) amino) ethyl) 0-ethyl ester, CAS registry number 50782-69-9, in pure form and in the various impure forms that may be found in storage as

well as in industrial, depot, or laboratory operations.

#### Agent worker

An individual assigned to exposure category A, B, or C.

#### Airborne exposure limits

Allowable concentrations in the air for occupational and general population exposures.

#### Ceiling value

Normally refers to the maximum exposure concentration at any time, for any duration. Practically, it may be an average value over the minimum time required to detect the specified concentration.

#### Certifying official

For military and DA civilian personnel, the immediate commander (or, if civil service, the director) who is responsible for the operation or security, or both, of chemical weapons or materiel. If the commander or director is a colonel or a GM/GS-15, or above, he or she may delegate subordinates to act as organization certifying officials. Such designees should be supervisors who and feasibly cause sufficient personal contact to be maintained with personnel to continually evaluate them. For Army contractor personnel, the Army official so designated in the contract is the certifying official. The certifying official certifies that personnel being considered for assignment to chemical surety duties meet the qualifications requirements of the chemical personnel reliability program.

#### Designated contract physician

U.S. civilian physician under contract to provide occupational health services to employees at U.S. Government-owned facilities.

#### Exposed worker

a. An exposed worker is an individual who -

- (1) Exhibits clinical signs or symptoms of nerve agent intoxication, or
- (2) Has cholinesterase depression, consistent with nerve agent effect (see para D-3).

b. A potentially exposed worker is an individual who works in an agent operating area where levels of nerve agent -

- (1) Exceed the protective capability of the PPE, or
- (2) Are detectable and there is a breach in PPE or engineering controls

#### Impervious

Providing protection by precluding penetration of nerve agents (as demonstrated by methods prescribed in MIL-STD 282) for the useful life of the item concerned.

#### Installation medical authority.

IMA refers to the unit surgeon, command surgeon, U.S. Army medical department activity/U.S. Army medical center commander, or the installation director of health services

or representative, responsible for the provision of medical support at the unit, command, or installation concerned.

**Laboratory-type hood**

An enclosed ventilation device that does not require the insertion of any portion of the individual's body other than the hands and arms, and that is designed, constructed, and maintained as described in appropriate portions of this pamphlet.

**Potential exposure (see exposed worker)**

**Source emissions**

All intentional, uncontrolled release of nerve agents GA, GB, GD, and VX to include stack emissions.

**Section III**

**Special Abbreviations and Terms**

This section contains no entries.

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