

DEPARTMENT OF THE ARMY SUPPLY BULLETIN

**RECEIPT, STORAGE, ISSUE AND DISPOSAL OF:
ROCKET, GAS, 115MM, M55,
ROCKET, TRAINING, DUMMY, 115MM, M60 (E49) AND
ROCKET, PRACTICE, SIMULANT, EG, 115MM, M61**

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1. Purpose. To provide information, methods and procedures for the receipt, storage, issue, and disposal of Rocket, Gas (GB or VX) 115MM, M55, Rocket, Training, Dummy, 115MM, M60- (E49), and Rocket, Practice, Simulant, EG, 115MM, M61.

2. Scope. The information, methods, and procedures prescribed herein are applicable to all activities and installations assigned responsibility for storing subject rockets.

3. Description. The M55, 115MM Gas Rocket consists of: (1) a motor, (2) a fin-assembly, (3) a warhead, and (4) a fuze. The rocket is packaged in a shipping-firing container and packed 15 to a wood interlocking-top crate.

See TB CML 73 for detailed description of components and characteristics.

a. *Fuze.* An M417 point detonating fuze is used with the M55 Gas Rocket.

b. *Warhead.* The warhead of the M55 Rocket is an extruded aluminum cylinder with an ogival nose. A central burster tube, which is threaded at one end to receive the fuze adapter and fuze, runs from the nose to the base of the warhead. The burster tube contains two modified Composition B bursters. Warhead contains approximately 11 pounds of agent under approximately 5 pounds per square inch of pressure.

c. *Motor.* The motor of the M55 Rocket is a cylindrical steel tube containing the propellant and an igniter assembly. The steel tube is threaded at each end to receive the warhead and the nozzle plate of the fin-nozzle assembly.

d. *Fin-nozzle Assembly.* The fin-nozzle assembly consists of a nozzle plate containing four exhaust nozzles. Four spring-loaded aluminum fins are attached to the nozzle plate. The lead wires from an electric squib in the igniter assembly of the rocket motor pass through one of the nozzles in the nozzle plate. These lead wires are readily available to the loader when the rear cap of the shipping and firing tube is removed.

e. *Shipping and Firing Container.* The M55, 115M:M Gas Rocket is packaged in a shipping and firing container. The container is made of fiberglass reinforced with plastic and is closed at each end with a removable cap. Each cap is fitted with a 3/8-inch Allen screw plug which is removed only to test for leakage during surveillance. An indexing ring circles the exterior of the shipping and firing container. The indexing ring insures proper positioning of the rockets in the cluster assembly of the M91 Rocket Launcher (TM 9-1055215-12).

4. Functioning. A 24-volt power source from a vehicle battery or a thermal cell in the remote firing box of the M91 Launcher fires the electric squib in the igniter assembly of the rocket motor. The igniter ignites the propellant grain. The burning propellant generates gases which are exhausted through the nozzles in the nozzle plate. The thrust developed by the exhaust propels the rocket to the target. The fuze functions on impact, causing the burster to detonate and burst the aluminum body of the warhead and disperse the chemical filling.

The chemical filling in the warhead is dispersed as an aerosol and is carried by the wind over the target area.

5. Packing. Fifteen M55 Rockets in their shipping and firing containers are packed in a wood crate. The crate is designed so that one crate can be interlocked on top of another to facilitate delivery by helicopter.

6. Identification. A decal identification label is affixed to the forward end of each shipping and firing container and to the back end of the warhead. This label gives the nomenclature, filling, lot number, and assembly date. Both the rocket and shipping and firing containers are marked with three green bands, and one yellow band.

7. Tabulated Data.

- a. *Length.*
Shipping and firing container..... 82 in.
M55, 115MM Rocket (fuzed) 77 15/16 in.
- b. *Diameter.*
Shipping and firing container..... 4.9 in.
M55, 115MM Rocket 4.5 in.
- c. *Weight.*
Shipping and firing container (with 74 lb. rocket).
M55, 115MM Rocket (fuzed) 58 lb.
Shipping and firing tube (empty) 16 lb.
Wood crate (filled with 15 rockets) 1,340 lb.
- d. *Dimensions of Wood Crate.*
Height (including skids)..... 28% in.
Length 83 in.
Width 30 in.
- e. *Fuze.*
Point Detonating M417
- f. *Federal Stock Numbers.*
GB-filled Rocket..... 1340-716-1450
VX-filled Rocket 1340-724-3567

8. Properties of GB. a. *General.* GB is a highly toxic, quick-acting nerve agent. It is readily absorbed through any body surface including the respiratory tract, skin, eyes, and gastro-intestinal tract. BB is a colorless, odorless liquid in a laboratory state and could be a slightly amber color in a stabilized state.

b. Chemical Properties. GB is a colorless, odorless, liquid at standard conditions.

- (1) Specific gravity at 68°F., 1.100
- (2) Vapor density, 4.86
- (3) Freezing point, -68°F.
- (4) Boiling point, 297°F.
- (5) Vapor pressure, 1.57mm Hg @68°F., 5.8mm Hg @104°F., and 760mm Hg @297°F.
- (6) Soluble in most organic solvents.
- (7) Hydrolyzes slowly in water.

c. Toxicity. GB is much more toxic by inhalation, skin contamination, and ingestion than most other standard casualty producing chemical agents. For example, the LCt-50 for GB vapor is 25-100 mg min/m³, depending on state of animation, as compared to 3200 mg min/m³ for Phosgene vapor.

The following table gives the conditions required to produce various dosages:

Distance in miles downwind, columns 2 and 3, for dosages listed in column 4, instantaneously release.*

Wt GB vapor released, lb.	Lapse -20°F. wind 15 mph	Inversion +20°F. wind 5 mph	Dosage Mg-Min/m ³	Remarks
100	0.1	1.8	100	Lethal
100	0.14	5.3	25	Mild incapacitation
100	0.2	18.0	5	Very mild effects

* The dosage of GB and other war agents is generally expressed at Ct where C is concentration (usually in terms of milligrams per cubic meter) and t is time in minutes. The dosage required to produce death of 50%e of those exposed is usually expressed ICt-60. It will be noted that the value of LCt-50 is not constant but falls with higher concentrations and shorter times.

d. *Threshold Symptom Dosage.*

- (1) A dosage of Ct of 2mg min/m³ of GB vapor can be expected to produce threshold symptoms in the average individual for exposure of 10 minutes or less. Threshold symptoms consist of a "running nose" and possible pupillary constriction.
- (2) Since the rate of detoxification of this agent is unknown, and since this is a cumulative agent, no concentration, however small, should be considered safe for continued exposure.

Note. It must be emphasized that data are not complete as to the cumulative exposure effect; therefore, the work assignment of each individual should be influenced by psychological and physiological considerations, particularly by individual cholinesterase levels.

Note. Area alarms should acuate at 0.1 milligrams GB per cubic meter in order to allow a few minutes for personnel to take appropriate action before the GB vapors reach a dangerous concentration.

e. *Physiological Effects.*

- (1) The vapors have no odor, are not irritating to breathe, and do not cause any lachrymation (tears).
- (2) Liquid GB on the skin does not burn, sting, or blister. Nevertheless, it penetrates the skin rapidly, especially through open wounds and mucous membranes.

f. *Fire.* GB can be destroyed by burning; however, its flash point is so high that it is not considered a flammable material. Its presence in the vicinity of a fire presents a great toxic hazard since it volatilizes readily upon mild heating, even that of body heat. GB should not be destroyed without first obtaining instructions from Commanding General, U. S. Army Edgewood Arsenal, Attn: Chief, Safety Office, Edgewood Arsenal, Md.

g. *Agent Stability.* Plant produced GB is stabilized with tributylamine and is stable for long periods. (Estimated minimum of 5 years).

9. Properties of VX. This information may be obtained upon written request to Commanding General, U. S. Army Edgewood Arsenal, Attn: Chief, Safety Officer, Edgewood Arsenal, Md.

10. Protective Equipment. a. *Impermeable Protective Outfits.* In any operation involving the possibility of body or respiratory tract contact with, or exposure to, liquid or vapor phases of GB or VX, complete protection is required. It is mandatory that a protective impermeable outfit be worn. There are two types of outfits that will provide the necessary protection:

Type I. This is a standard item of issue de- signed primarily for use by special troop details assigned to decontaminate contaminated

field areas. The outfit constitutes a complete body enclosure. There is no means provided for ventilation. In use the temperature and humidity build-up within the outfit is severe. For that reason development of excessive heat fatigue may occur if the outfit is worn for periods of time exceeding 45 minutes. An extension of tolerance time can be provided by use of water-saturated accessories known as cooling covers; these are worn over the protective ensemble. The Type I protective ensemble is available to plant personnel subject to agent exposure for short periods of time. Continue wear for extended periods of time is not recommended.

Type I Ensemble with Accessories:

- (1) Overall, Toxicological Agents Protective M3
- (2) Hood, Toxicological Agents Protective M3
- (3) Cover, Boot, Toxicological Agents Protective M1
- (4) Glove, Toxicological Agents Protective M4
- (5) Mask, Field Protective M9A1
- (6) Suit Cooling Jacket M1
- (7) Suit Cooling Trousers M1
- (8) Cover, Cooling, Toxicological Agents Protective, Gas Mask, Hood.

Type II. This is a standard item designed for use in plants by operators and maintenance personnel required to work in contaminated areas for extended periods of time. It is a combination of three end items assembled to provide a complete protective ensemble which, through a trailing hose, is supplied with approximately 8 cubic feet of air per minute for body cooling and breathing purposes.

Type II Equipment:

Suit Protective, Impermeable, Supplied Air, M5 consisting of the following end items:

- (1) Suit, Protective, Impermeable, Supplied-Air, M4.
- (2) Gloves, Protective, Impermeable, M4.
- (3) Boots, Protective, Impermeable, M2A1.

It should be noted that when Type I ensemble is worn in chemical plants, boot covers are not used. These are replaced by Boots, Protective, Impermeable M2A1.

b. Procedures. To afford proper protection, the equipment must be in good condition, free from contamination and properly donned. The impermeable protective garments shall be decontaminated and aerated overnight after each period of wear. Decontamination is usually accomplished by use of showers located in gas lock entries to contaminated work areas. The decontamination shower is followed by a water shower for removal of the decontaminant. The impermeable protective suit, hood, boots, boot cover, and gloves shall be carefully examined after each period of wear. The examination, where applicable, will be for holes, tears, weakening of seams, weakening of fabric especially where there is contact with fasteners, loose, corroded or insufficient buttons and buckles, poor closures, and for other physical and mechanical defects which might cause clothing and accessories to give inadequate protection. Assistance must be provided for the donning of the suit, hood, boots, and gloves. All closures shall be carefully inspected for completeness. Assistance will be required for removal of the impermeable material. See paragraph 41, TM 3-200.

- (1) *Impermeable Protective Ensemble.* In case of known contamination of the impermeable garments with liquid GB, the contaminant should be neutralized with 5 percent caustic or 10 percent sodium carbonate solutions or chlorinated lime slurry immediately and before removal of the garments. In case of VX, a 5 percent solution of Sodium Hyperchlorate will be used. Persons required to help remove contaminated protective outfit must wear mask, boots, and gloves as described above. A snout is provided on the M3 Impermeable Protective Hood, off-set right or left for enclosures of right- or left-cheek mountings of canisters of M9A1 Masks. The design provides sufficient flexibility for sealing around hose or hose-type masks. The hood is also provided with a shoulder skirt to be held in place by straps under the armpits.
- (2) *Protective Mask.* The mask is designed to furnish protection for the

respiratory organs and for the face. Each person working in an area where contamination might occur will have available for instant use a protective mask, previously tested by him and adjusted to fit his face. The M17 and M9A1 Field, Protective Masks are currently recognized as the most effective for use in handling GB or VX. This does not preclude, however, the use of oxygen breathing apparatus or the compressed air breathing apparatus.

- (a) Each individual will be provided with a mask of proper size.
- (b) Adjustment of the mask to the individual shall be made upon issue.
- (c) After masks have been fitted, they should be tested for leakage in a gas chamber. If available, chloropicrin is recommended as the preferred gas chamber agent, rather than chlorine or CN.
- (d) The use of canisters or filter element must be carefully controlled to insure effective protection. The canister in the M9A1 mask and the filter element in the M17 mask should be replaced after each exposure to toxic vapors. As a further check on canister and filter effectiveness, individuals should be constantly watched for the development of any physiological symptoms of poisoning.
- (e) The mask should be decontaminated and aerated after each period of wear. Care must be taken not to wet the inside of the canister, as this renders it ineffective. The supervisor will make at least weekly checks of each employee to insure that the mask is in good condition, is tested, and is properly fitted to the employee's face.
- (f) Because of the hazardous conditions involved, proper care and regular inspection of the mask is essential.

11. Detection. *a. Equipment.* The following detection devices may be utilized to identify and detect the presence of GB or VX agents:

AGO 6728A

- (1) *Detector Kit, Chemical Agent, M18A1.* The M18A1 Chemical Agent Detector Kit is a compact unit for use in detecting and identifying chemical agents. The kit will detect dangerous concentrations of chemical agents by color changes in tubes and enzyme ticket through which contaminated air has been drawn. Under controlled conditions, the M18A1 Kit will detect or confirm the presence or absence of the following agents: Mustard Gas (H), Nitrogen Mustard Gases (HN), Lewisite (L), Ethyldichloroarsine (ED), Hydrogen Cyanide (AC), Phosgene (CG), Cyanogen Chloride (CK), GB and VX agents. The kit, with respect to GB or VX agent vapors, will detect quantities in the amount of .2mg/m³. Complete description and use of this kit can be found in TM 3-6665-21212.
- (2) *Detector Kit, Chemical Agent, VGH, AN-15A1 and AN-15A1A.* The AN-M15A1 and AN-M15A1A Detector Kits are designed primarily for the detection of dangerous concentration of nerve agents (V and G) and of Mustard (H). Provisions are also included for detecting the presence of cyanogen chloride (CK) and phosgene oxime (CX). The tests which can be made with the kit have the following principal uses:
 - (a) For reconnaissance in areas suspected of contamination by toxic chemical agents.
 - (b) For indicating when it is safe to re- move masks after an attack by chemical agents.
 - (c) For testing for the presence of agent after decontamination. Complete description and use of the AN-M15A1 and AN-M15A1A kits can be found in TM 3-6665-211-12.
- (3) *The use of rabbits to indicate contamination.* The use of rabbits is an excellent supplement to other means of detection. Experience with use of rabbits has indicated the most desirable of these is the Belgian hare. This results from the fact that a very low

concentration of GB or VX will cause a myopic condition in the hare.

(4) *Symptomatic detection.* Individuals subjected to low concentrations of GB or VX agent will normally, but not necessarily, show the following symptoms in the order listed:

- (a) Contraction of the eye pupils and apparent dimming of lights.
- (b) Running nose, tightness of chest, extreme nervousness.

b. Procedures for Detection. Due to the characteristics of GB or VX, personnel entering an enclosed storage area of GB- or VX-filled items will consider the area contaminated until determined otherwise. Air exhausted from the natural or forced ventilation system should be tested for GB or VX as a preliminary precaution before entering the enclosure.

(1) *Open area.*

(a) *Vapor.*

1. The M18A1, M15A1, and M15A1A Kits are the most practical mechanical devices available for the detection of GB or VX in the field. In sampling, consideration should be given to the source of the vapor, direction and velocity of the wind, and amount of agent at source.

2. Rabbits (with large pinkeye's) should be placed around the periphery of storage areas as a means of detecting low concentration of GB agent vapor and should be examined prior to entering storage area. For VX, because of low vapor pressure, the use of rabbits is not recommended. However, where the ammunition containing VX is in enclosed areas, such as igloos, and rabbits have been exposed for at least 2 hours, they may be used as a means of indicating possible contamination.

3. Detection of leaking GB and VX Rockets in igloo storage can be most efficiently accomplished by placing two rabbits in each igloo, one in each end, at least 2 hours prior to entering for duty. After the 2-hour

period, the rabbits should be examined for symptoms as outlined under Detection. Employees will be fully protected at all times during detection period.

(2) *Munition leakage.* Leaking GB Rockets may be located by using hand pump or air-sampling bulb from the M18A1 Kit, equipped with a white-dot and blue-dot detector tube. Remove plugs from caps on both ends and insert the tube into the testing outlet at the nose end of the rocket, and withdraw air with sampling bulb. Add one drop of solution from the green bottle as directed in instructions of the kit. A yellow ring within 5 minutes indicates the presence of GB. A fresh chemical reagent solution should be prepared each day prior to the starting of the test. For leaking VX Rockets the same procedure will be used, except that detector ticket will be used instead of the detector tube.

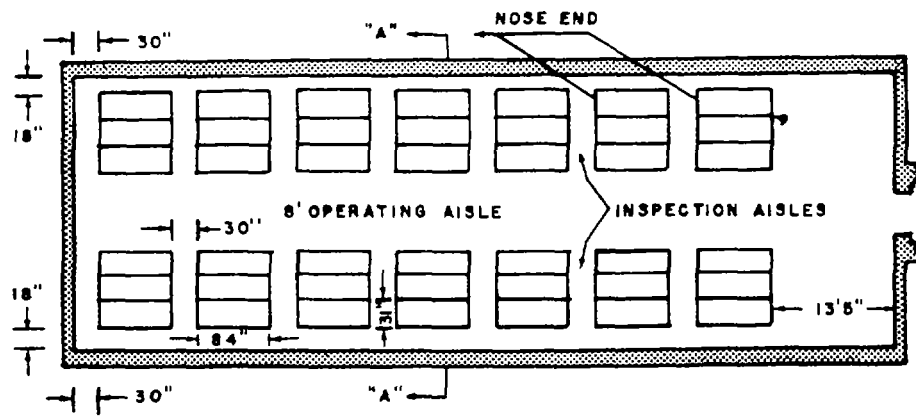
c. *Leakers.* The first consideration after locating a GB or VX leaking rocket is to control the leak pending disposal. Place the leaking rocket into the special container provided for GB or VX M55 Rockets. Only qualified personnel, fully protected, will accomplish disposal of these leakers.

12. Storage. a. General.

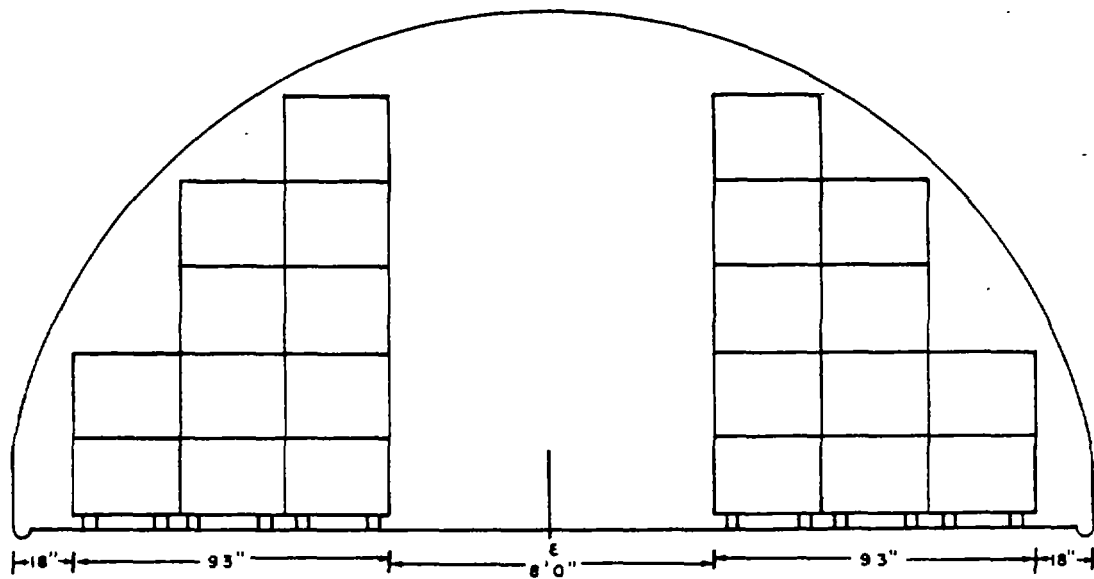
(1) Regulations for storage of GB- or VX- filled rockets are basically the same as those concerning other highly toxic agents, with the following points emphasized:

(a) The regulations for storage of explosive hazard, Class 4, Storage Compatibility, Group A, Chemical Munitions as specified in TM-9- 1903, will govern the storage of this ammunition, except that:

(b) Rockets will be stored in igloo-type (earth-covered) magazines. The magazine floor must be other than wood, asphalt, or porous surfaces. Concrete floors will not require special treatment.



PLAN VIEW 80' IGLOO



SECTION "AA"

DETAIL FOR UNIT PACK

Dimensions: 83" long × 31" wide × 27¾" high

Gross Weight: 1300 lbs

Cube: 42.75

Quantity: 154 crates @ 15 each = 2310 rockets

NOTE: Storage of M55 Rockets: Nose end of rockets will be pointing toward rear wall of igloo

Figure 1.

- (c) Rockets will be stored in a horizontal position with the heads pointed toward the rear of the magazine (fig. 1).
 - (2) The primary consideration in operating the storage area will be to limit exposure to the least number of personnel for the shortest period of time and to the smallest amount of GB and VX possible. In order to accomplish this, the following rules will be observed.
 - (a) Only work related to storage will be performed within the storage area.
 - (b) Unauthorized personnel will not be permitted in the area.
 - (c) Responsible personnel will be appointed as monitors to enforce regulations.
 - (3) Local standing operating procedure will be established to implement this document.
 - (4) The location of storage areas will be selected to afford maximum protection to the general public and will not be located in or near inhabited areas.
 - (5) Stringent control will be exercised over all personnel practices in the area.
 - (6) Leakers will be handled only by specially trained personnel.
- b. *Procedure.*
- (1) The package of 15 rockets will be lifted by materials handling equipment that meets the standards established in TM 9-1903.
 - (2) Due to the length of the rocket package, it will be necessary to use roller conveyor in moving rockets through most igloo or boxcar doors. Double tracks of conveyors will be required with support spaced at such distances to carry the load safely. Conveyors must be assembled and used in accordance with the criteria in TM 9-1903.
 - (3) Transportation of rockets within the confines of the storage depot will be by tractor-drawn semitrailer (preferably inclosed). The rocket package will be moved within the van by means of roller conveyor.
 - (4) Transportation of rockets from the storage depot will be by standard railroad box car.
 - (5) All railroad cars entering the storage depot will be immediately moved to "suspect Car Spur Track" (TM 9-1903). Appropriate tests and inspections will be conducted to assure that rockets are not damaged and that agent is not leaking.
 - (6) As soon as incoming cars have been inspected and found to be satisfactory (no damage or leakage), the cars should be moved directly to a loading dock within the area designated for storage of GB-or VX-filled rockets. A loading dock located immediately adjacent to the designated storage area may be used if none are available within the storage area.
- c. *Facilities.*
- (1) The storage arrangement for rockets will be such that rockets may be easily inspected for possible leakers and any leakers discovered may be removed without difficulty. Distances between the aisles must be such that lift-trucks may be used to handle palletized rockets.
 - (2) Storage areas shall be enclosed by a cyclone-type fence, and warning signs shall be posted every 250 feet. Lighting of the area is desirable.
 - (3) Guards should be maintained on a 24-hour basis and should patrol the perimeter of the storage area.
 - (4) Field telephones and gas alarms, or other means of communication, shall be maintained to contact headquarters in case of emergency.
 - (5) Detection equipment, medical facilities, decontamination equipment, and decontamination solutions shall be available at all times to permit the detection and handling of leakers.
 - (6) Change houses and showering facilities, either stationary or mobile, shall be provided at the storage area.

- (7) Storage magazines shall be of fireproof construction, be provided with louvers for ventilation and a lightning protection system.

13. Shipment. *a. Responsibilities.* This section emphasizes the requirements which are essential to the proper handling and transporting of GB or VX filled munitions and containers. These provisions do not supersede, but further implement, the instructions set forth in TM 3-250.

- (1) For shipment, GB- or VX-filled munitions and containers are considered as ICC Class A, "Extremely Dangerous Poison". Shipments will be placarded with "Poison Gas" and "explosive" placards in accordance with ICC regulation.
- (2) The escort of shipments of GB or VX is the responsibility of the Commanding Officer, Technical Escort Unit.
- (3) The activity or installation originating the shipment is responsible for requesting the services of Technical Escort Unit and for protecting the shipment for safety and security up to the point where the shipment is received by the Technical Escort Unit.
- (4) Correspondence requesting technical escort should be submitted in triplicate, directly to the Commanding Officer, U. S. Army Technical Escort Unit (9715), Edgewood Arsenal, Md., not less than 14 days prior to the desired shipping date. Emergency requests may be transmitted by telephone or teletype, followed by confirmation in writing. All requests for technical escort service will contain the following information:
 - (a) Item(s) and quantity to be shipped, to include:
 1. Agent, cubage, weight,
 2. Type of munition or container, and
 3. Security classification of shipment.
 - (b) Pick-up point and destination.
 - (c) Name of individual (s), title (s), and telephone number(s) to contact at pick-up point and at designated place of shipment.

- (d) Date shipment is desired by consignee and consignor.
- (e) Special requirements placed on shipment by consignee.
- (5) The activity or installation receiving the shipment is responsible for protecting it in all respects after delivery has been made.
- (6) The, activity or installation desiring shipment must determine the mode of transportation.
- (7) The shipping route will be carefully planned to avoid congested areas as much as possible and to insure maximum availability of emergency equipment.
- (3) Arrangements will be made to provide standby emergency equipment at loading and unloading sites and, if possible, enroute.

b. U. S. Army Technical Escort Unit.

- (1) *General.* The Technical Escort Unit is a separate, Class II, field activity of U. S. Army Edgewood Arsenal. It is organized, trained, and equipped to furnish details of experienced officers and enlisted men to accompany shipments of hazardous-type chemical munitions and related items to their destination. It has additional missions applicable to storage, transfer, destruction, and demilitarization of CBR munitions and related items, and in the safety and protection of plants. The following missions are the responsibility of the Technical Escort Unit when dangerous chemical munitions are shipped:
 - (a) To escort and guard shipments of toxic throughout the period of transit, with special emphasis on the safety and security of the cargo.
 - (b) To protect all personnel, both military and civilian, who handle or come in contact with the shipment.
 - (c) To repair or dispose of leakers during shipment.
 - (d) To decontaminate, thoroughly and completely, all objects or areas contaminated during shipment.

(2) Authority. Each detail accompanying a shipment has complete responsibility for the shipment, except as follows:

- (a) For rail shipments, the detail has no authority over the train crew or train operations.
- (b) For water shipments, the detail has no authority over the ship crew or ship operations.
- (c) For air shipments, the detail has no authority over the plane crew or plane operations.
- (d) For highway shipments by military vehicle, the Technical Escort Unit has no authority over civilian truck drivers or convoy operations unless the officer in charge of the detail is the senior officer present or is specifically detailed as convoy commander. Military truck drivers are under the direction of military commanders at all times.
- (e) For all shipments and types of transportation, the escort detail will exercise those measures necessary to insure the safety and security of the cargo.

(3) *Responsibilities.*

(a) *Protective and Safety Provisions.* The Technical Escort Unit commander is responsible for insuring the observance of protective and safety provisions applying to munitions filled with GB or VX. He is also responsible for the observance of the following precautions:

1. Personnel will not be assigned to accompany a shipment unless they are trained in handling toxicological agents, in administering first aid, and decontaminating GB or VX according to the proper procedures.
 2. Personnel will wear appropriate and complete protective clothing when handling leakers or suspected leakers.
- (b) Reports. In emergencies the officer in charge of the escort mission will notify the COTEAU immediately. He, in turn, will notify by telephone

the Commanding General, USA Edgewood Arsenal, Attn: Chief, Safety Office. Delays of more than 12 hours will be reported immediately, through channels, to the Transportation and Traffic Management Office, U. S. Army Edgewood Arsenal, Edgewood Arsenal, Md.

(4) *Transportation of escort detail.*

- (a) The service requesting that a shipment be accompanied by an escort detail will furnish the transportation officer the information necessary to comply with the provisions in AR 55-201.
- (b) Transportation requests are not required for the portion of the journey during which the detail will ride on freight trains with the shipments. Transportation on passenger trains, occurring in connection with freight and express shipments, will be arranged and obtained separately in accordance with pertinent regulations.

c. *Air Shipments.*

- (1) No Class A chemical munitions (GB or VX) shall be carried by commercial aircraft.
- (2) For shipment of GB or VX by military aircraft, refer to TM 38-250.

d. *Intra-post Shipment.* The commanding officer or activity engaged in the intra-post shipment of GB or VX will be responsible for insuring compliance with the provisions in this document. In the absence of a technical escort, shipment will be inspected by a safety representative of the activity involved or by a qualified person designated by the chief of the activity.

14. Disaster Planning. a. *Plan.* A written plan outlining the emergency conditions that could arise shall be prepared by each installation and be made available to bulk storage areas and to all areas handling quantities of GB- or VX-filled items. This plan should be integrated into the local area-disaster plans.

- (1) The plan should-
 - (a) Set forth the duties and responsibilities

- of all personnel and groups involved,
- (b) Establish a command at the scene,
- (c) Establish an operation center,
- (d) Provide communication channels and procedures, and
- (e) Categorize emergencies as to their seriousness and prescribe appropriate action for each.
- (2) The plan should specify the extent of coordination that should be effected with nearby communities.

b. *Detection.* Appropriate detection means will be provided wherever GB or VX is stored in bulk or in munitions.

c. *Alarms.* Alarms must be adequate to insure the alerting of all endangered personnel. Various signals may be used to indicate the nature or severity of the emergency, but the number of signals should be kept to a minimum.

d. *Training.*

- (1) All personnel should be thoroughly instructed in the various aspects of the emergency plan and, particularly, in their individual responsibilities.
- (2) Periodic and realistic drills should be conducted to test the plan and familiarize personnel with their responsibilities. Evaluations of such drills should be made by competent reviewing officials.
- (3) A protective reserve supply station should be established at some distance from the storage area housing emergency protective clothing, detecting equipment, protective masks, and the like.

15. Leakers. a. Since all agent-filled munitions and munition containers should be treated as possible leakers, a protective mask should be carried when agent-filled munitions are to be handled.

b. When a leaking munition or shipping container is located, the main problem is to control the leaking liquid or vapors pending ultimate disposal.

16. Decontamination. a. *Decontaminating Equipment.*

(1) *Decontaminating Apparatus, Portable, DS2, 1 1/2-Quart, ABC-Mil.* An apparatus approximately 14 inches long and 4 inches in diameter, it consists of a cylindrical container, which holds the DS2 decontaminating agent and a head assembly which comprises the spraying mechanism. A nitrogen cylinder supplies the pressure for expelling the decontaminating solutions. The apparatus has an effective spray range 6 to 8 feet, which will cover an-- area of approximately 15 square feet.

(2) *Decontaminating Apparatus, Power- Driven, Truck-Mounted, M9.* An apparatus equipped with a 400-gallon steel tank, a centrifugal pump, and the necessary valves, spray guns and piping, all mounted on a 2 1/2-ton truck chassis. The pump is powered by a take-off from the engine and pressure system for filling and spraying. The unit is capable of a spray rate of approximately 50 gallons per minute (gpm). Two spray nozzles mounted on the front bumpers can spray a path 12 feet wide. See TM 3-4230-203-12 for functioning care and maintenance.

(3) *Decontaminating Apparatus, Power- Driven, Truck-Mounted, M3A3.* An apparatus which is equipped with a 400-gallon steel tank, a pump, and the necessary valve, spray guns and piping, all mounted on a 2 1/2-ton truck chassis. The pump is powered by a take-off from the engine and provides a suction and pressure system for filling and spraying. The unit is capable of a spray rate of approximately 30 gpm with an average coverage per filling of 1,300 square yards. See TM 3-4230-200-12 for functioning, care and maintenance.

b. *Decontaminants.*

(1) DANC solution is NOT suitable for decontamination of GB but is effective with VX. DANC is toxic and very corrosive to metals.

(2) The following materials listed in order of effectiveness may be used as decontaminates of GB or VX:'

- (a) GB-odium hydroxide (also known as caustic soda or lye) dissolved in water. Decontamination rate is proportional to the concentration of the solution. The recommended solution is 5% sodium hydroxide by weight.
- (b) GB-Sodium carbonate (also known as washing soda, soda ash, sal soda and laundry soda) dissolved in water-5% by weight for personnel, 10% by weight for materiel.
- (c) GB and VX-Chlorinated lime and STB. Mix one (1) part of chlorinated lime in three (3) parts of water to form slurry.
- (d) VX-Sodium Hypochlorite (5% aqueous solution).
- (e) VX-DS2 Decontaminating Agent is a pale amber liquid, which will decontaminate all toxic chemical agents. It flows freely at moderate temperatures but thickens at low temperatures. DS2 is noncorrosive to most metals but will damage animal fibers (leather, silk, wood). DS2 is nontoxic. It is slightly irritating to the skin; however, if removed by washing with water, it will not cause skin irritation. This decontaminant is used with the Decontaminating Apparatus, Portable, 1/2 Quart M11, and is also available in 5-gallon drums.
- (f) Spraying decontaminating agent is much better than sloshing.
- (g) A full face shield, butyl gloves and aprons, will be worn when spraying or handling caustic solution. Spills on the skin will be blotted immediately in order to restrict the area of contamination, and then flushed with large volumes of water. If caustic solution should splash in the eyes, the eyes will be irrigated for 15 minutes with water.
- (h) If above decontaminants are not available, *cold water* may be used as an effective substitute in decontamination of GB or VX.

17. Disposal. a. *General.* The M55 Rocket containing GB or VX agent will be demilitarized (disassembled) and destroyed only on approval by the Commanding General, USA Edgewood Arsenal, except that the local commander may determine that immediate destruction of damaged or deteriorated rockets is necessary for protection of life and property. In this event:

- (1) The disposal sites for GB or VX must be located not less than 1-mile distance from magazines, inhabited buildings, operating buildings, training areas, public highways, railways, and the like. Exceptions must be approved by the Commanding General, USA Edgewood Arsenal, Edgewood Arsenal, Maryland.
- (2) Material awaiting destruction will be protected from accidental ignition or explosion caused by grass fires or burning embers. A suitable storage space at a safe distance from the disposal pit will be provided for munitions awaiting destruction. This storage space will be large enough to receive truck deliveries. The amount of agent delivered to the disposal site will be limited to that intended for the scheduled disposal.
- (3) The number of persons engaged in a disposal operation will be kept as low as is consistent with safety, but in no case will it be less than two. Adequate warning signs must be posted, restricting the area, and suitable guards must be established to insure appropriate segregation of activities.
- (4) Since the destruction of toxic agents will necessarily be performed in an isolated area, an ambulance or first-aid vehicle, properly equipped to handle possible accident victims, must be immediately available. There must also be available a decontamination truck and a means of communication with Headquarters, (telephone or radio).
- (5) When GB or VX is to be disposed of in large quantities, the safety director will submit a detailed report outlining the various conditions and situations

experienced. This report will be forwarded to the Commanding Officer of the parent organization with a copy to the Commander General, USA Edgewood Arsenal, Attn: Chief, Safety Office, Edgewood Arsenal, Md.

b. *Demilitarization.* The method of demilitarization will depend on whether agent is leaking (vapor or liquid from the rocket head).

(1) Non-leakers.

(a) Rocket should be disassembled by removing fuze and bursters. The motor closure and fin assembly will be screwed off the motor assembly. Igniter lead wire will be cut and shorted just prior to removing the fin assembly. The igniter and propellant will easily slide out of the motor tube. Prior to disassembly, the rocket must be secured in a manner to assure that the rocket remains in place in event of accidental ignition of the propellant. Fuze and closure should be removed by remote control.

(b) Fuze, bursters, igniter, and motor propellant will be destroyed by detonation and burning in accordance with prescribed Ordnance procedures.

(c) The best method at this time for destruction of GB or VX contained in the rocket head is by burning.

(d) The amount of agent to be destroyed in one fire will be limited to 100 pounds and only after prior approval is obtained from the Commanding General, U.S. Army Edgewood Arsenal, Edgewood Arsenal, Md.

(e) Destruction pits should be 15 feet deep by 10 feet wide and of sufficient length to accommodate the materiel to be destroyed. Present procedures require that 12 pounds of oil-soaked wood be used for each pound of GB or VX destroyed in lots of 100 pounds or less. Eight pounds of wood are required for each pound of agent in lots of 1000 pounds or

more. This amount of wood should be sufficient to heat the munitions or containers to a temperature of 1000° F. for a period of 1 hour.

(f) In this method of destruction, it is most important to vent each rocket head and start the fire simultaneously. This can be accomplished by fastening an explosive charge (of sufficient strength to rupture the top of each container but not the bottom) to each munitions, together with an M14 incendiary grenade to provide ignition for the fuel in the pit. The contents of the pit shall be ignited by remote control, as there will be a flash of flame at the time of ignition.

(g) For large-scale disposal of GB or VX by burning, the operating personnel shall maintain a distance of 500 yards upwind and 5 miles downwind. The operating personnel must be sure that the area is free of all people and livestock prior to burning the GB or VX. Roads leading to the burning area shall be blocked and marked to prohibit trespassing. Wind speeds should not exceed 10 miles per hour during burning of these agents.

(h) After the burning, the pit and its contents should be allowed to cool 24 hours or more as may be required. The surrounding area and pit should then be tested by a fully protected operator with an M18A1 Kit for GB or VX contamination. Should the surrounding area or the contents of the pit indicate the presence of GB or VX, a 5 percent caustic solution shall be used to decontaminate or the material shall be reburned.

(i) Scrap metal must be removed from the original burning pit and re-burned in a non-contaminated pit at a temperature not under 1000° F. for 20 minutes.

(j) The cooled scrap metal must show a negative test with the M18A1 Kit.

If the test is not negative, the metal shall be returned until a negative test is obtained.

- (2) *Leakers*. Leaking rockets will be disassembled and destroyed in the same manner as non-leakers with the following exceptions.
 - (a) If possible, the fuze and bursters should be removed from the rocket head when the rocket is only partially removed from its shipping container.
 - (b) For disassembly, the same procedure will be used as for non-leakers, except that the holding device and other equipment will be arranged so that the leaking rocket head can be positioned in a container of decontaminant.
 - (c) Destruction will be the same manner as for non-leakers except that the leaking rocket head must be kept in a decontaminant until just prior to detonation of the explosive charge and ignition of the combustible material.

18. Rocket Training, Dummy, 115MM, M60 (E49). S/N 1340-861-9817. This rocket is identical in weight and appearance to the M55 rocket and will be used for training rocket crews in the loading and handling of rockets with the M91 Launcher.

The M60 training rocket is a modification of the M55 rocket in which the M417 PD fuze is replaced by a dummy fuze made of aluminum alloy conforming to the exterior shape of the M417 model. The warhead is identical to the M56 warhead. However, it is filled with ethylene glycol as a simulant for GB and VX, and the M34 and M36 bursters are replaced by concrete forms of the required shape and weight. The M67 rocket motor and the M150 fin assembly are the same as on the live round, except that a metal tube of the same weight replaces the M28 repellent. The M62 igniter and small booster with M2 squibs are deleted from the assembly. The M60 rocket is provided with the standard M441 shipping and firing container, 15 of which are packed in a crate as specified for the M55 rocket. The weight of a filled crate is 1340 pounds and the cubage is 42.7 cu. ft.

These rockets should be stored under cover for protection against the elements.

Disposal of the M60 rocket will be accomplished by mutilation and burning.

19. Rocket, Practice, Simulant EG, 115MM, M61 (E50). S/N 1340-858-5780. This rocket is (1) ballistically identical to the M55 Rocket, (2) visible for more than 3000 meters when functioning, (3) as safe to handle as any other nontoxic munition, and (4) suitable for both day and night training. This rocket consists of the following described components:

a. Rocket Motor, 115MM, M67. This is a cylindrical steel tube about 34 inches long by 4 7/16 inches in diameter that is threaded at one end to receive the warhead and at the other end to hold the nozzle plate that contains four 1/2-inch diameter nozzles.

(1) *Propellant Rocket, M28.* This is a double-base, cast-grain solid, held in place by a bearing pad and head spring of the anti-resonance assembly and nozzle plate of the fin assembly; 19.3 pounds of propellant are required. Dimensions are approximately 31 inches long by 4 3/16 inches in diameter.

(2) *Igniter, Rocket, M62.* This is a polyethylene bag containing pellets of potassium-perchlorate and magnesium with a small booster with two M2 electrical squibs. Lead wires from the igniter boosters pass through the propellant and out one of the motor nozzles.

(3) *Fin Assembly, Rocket Motor, M150.* This consists of four aluminum fins attached to the nozzle plate of the motor so designed to provide maximum stability with minimum flight resistance. Each fin has two torsion springs that rotate the fins to proper flight position and are also provided with a spring-actuated detent which holds the fin at a 60° angle to the line of flight.

b. Warhead, 115MM Rocket, Gas, M56. This is an extruded aluminum cylinder 28.3 inches long by 4.42 inches in diameter having an ogival nose and consisting of a body, burster casing,

and adapter. The space between the burster casing and body wall retains the liquid agent filling. The adapter provides a fuze well and holds the burster in place.

(1) *Simulant Agent, EG.* This is a mixture of inhibited ethylene glycol and antifreeze and isopropyl alcohol that has a specific gravity 1.008 at 700F.; 11.4 pounds are required to fill the warhead allowing for the prescribed void.

(2) *Burster, Rocket, M34.* This is a steel tube approximately 22 inches long by 13/4 inches OD that is filled with a charge of 7030 Comp B. There is a 3-inch void in the filling in which the M36 burster is partially contained. The M36 burster provides the main charge for disseminating the agent filling.

(3) *Burster, Rocket, M36.* This is a plastic tube 6.0 inches long by 1.5 inches in diameter that is filled with Comp B and assembled in the upper end of the rocket warhead immediately below the M417 PD Fuze and before the M34 burster.

c. Fuze, Rocket, Point Detonating, M417. This is a superquick point-detonating fuze in which the safety and arming mechanisms are controlled by acceleration, thereby requiring no presetting. This fuze requires use of a 41/2.- inch-long adapter that screws into the upper end of the M56 warhead.

d. Container, Shipping and Firing, 115MM Rocket, M441. This is a plastic tube approximately 81.5 inches long by 4.9 inches OD that serves both as a packaging container and launching tube. It is provided with front and rear cap assemblies each of which has a surveillance plug for leakage detection. The electrical lead from the rocket igniter is secured to the side of this tube and is provided with an extension cable that permits connection to the 24-volt power source used with the launcher. Although expendable, this container is reused whenever practicable.

e. Tabulated Data.

Rocket Weight-74 lbs.

Packed (15 in a wooden crate) Weight-1,340 lbs.

42.7 cu. ft.

f. Storage. The M61 Rocket is a class 4 item requiring igloo storage with a distance of 185 feet barricaded and 360 feet unbarricaded, in accordance with TM 9-1903.

g. Shipments. Tech Escort will not be required when transporting the M61 Rocket.

h. Disposal. The M61 Rocket will be demilitarized prior to disposal.

20. Medical Aspects of GB. *a. Effects and*

Symptoms. The lethal effect of GB is brought about by the disruption of parts of the autonomic and central nervous systems which depend on the formation of acetylcholine for transmission of nerve impulses. Acetylcholine is hydrolyzed by the enzyme cholinesterase. GB destroys the ability of cholinesterase to hydrolyze acetylcholine, thus permitting it to accumulate. Exposure to GB, therefore, results in an excess of acetylcholine with subsequent intoxication. The physiological effects are dilation of the blood vessels, sweating, slowing of the heart rate, constriction of the bronchioles or air passages in the lungs, intestinal cramps, and constriction of the pupils (myosis). There is also inhibition of respiration in cases of serious exposures. When the blood cholinesterase is reduced to very low levels at least 30 days are required for it to return to normal. Diagnosis is made from the symptoms. "Precaution Exposure" to high concentrations of GB may incapacitate a person so rapidly that he may be unable to take individual protective measures.

(1) Effects of Vapor.

(a) Minimal exposure for a few minutes to trace concentrations, unrecognizable by odor, causes a "running nose," lasting several hours and possible pupillary constriction lasting 1 to 3 days. *It should be noted that in some instances, pupillary constriction does not develop.*

(b) Approximately double this minimal exposure causes pupillary constriction and possibly a tight feeling in the chest, which comes on very quickly in most subjects and lasts one to several days.

(c) At approximately eight times minimal exposure the zone of true casualty production is reached. Tight-

ness of the chest may be so continuous and breathing so difficult that the victim is unable to carry on normal duties.

(d) At fifteen to twenty times minimal exposure, all unprotected personnel would be expected to be casualties, many with alarming symptoms. The subject may be seized with panic in his struggle for air. As his anoxia increases, he becomes more confused and may fall exhausted and unconscious.

(e) At two to three times the severe casualty dosage, the median lethal range is reached. The clinical picture of the fatal case is similar to that of the severe casualty, but increased in tempo and severity.

1. The LCt-50 for personnel at rest is estimated to be of the order of 100mg min/ms.

2. The LCt-50 for personnel performing laborious tasks is estimated to be of the order of 25 mg min/m³.

(f) Exposure to a high concentration of GB vapor may result in inhalation of an incapacitating or lethal dose before any warning symptoms appear.

(g) Except in very high concentrations, the absorption of GB vapors through the skin from a single exposure is not expected to significantly affect properly masked men. However, the nerve agents are cumulative agents, and repeated exposures at intervals of 24 hours or less may cause the development of symptoms. The incapacitating Ct50 by skin absorption of vapor through normal clothing is estimated to be 8,000mg min/ m³.

(2) *Effects of liquid GB.*

(a) Liquid GB is absorbed rapidly by the eyes and the mucous membranes of the nose or mouth, by which routes it is extremely toxic.

(b) Usually, the first sign to appear following skin contamination is localized sweating

and sometimes muscular twitching at the site of the contamination. This is soon followed by tightness of the chest and salivation, then mental confusion and excitement, then generalized clonic convulsions (alternating spasms and relaxations). Myosis does not appear until the poisoning is well advanced if the eyes have been protected from direct exposure to the liquid agent or its vapor.

(3) *Effects of ingestion of contaminated food or water.* Ingestion of contaminated substances first induces salivation, nausea, and intestinal cramps, which may be followed by vomiting and diarrhea. Marked salivation, very slow pulse, low blood pressure, tightness in the chest and cyanosis, muscular twitching and convulsions are diagnostic signs of importance in the more severe cases.

b. *Safety Facilities and Equipment.*

(1) First aid equipment, including atropine ampins or syrettes, must be readily accessible and available in adequate quantities to cope with possible exposures.

(a) GB first aid kits presently in use include directive for administering first aid, one bottle of alkali solution, one bottle of alcohol, one container of cotton, two boxes of atropine ampins, and a compartment containing items to be used only by a physician. These items are in Gas, Casualty Kit Treatment, M2; TM 8- 285, Treatment of Chemical Warfare Casualties, is the authoritative reference for the treatment of GB casualties.

(b) Protection and Treatment Set, Chemical Agents, M5A3, contains one ampin or syrette for treatment of GB casualties.

(c) Adequate absorbent material such as cotton or blotting paper, water, and solution supplies will be kept available for first aid requirements.

- (2) A dispensary staffed with personnel competent to treat GB cases will be maintained on active status during all times when exposure of personnel to GB might occur.

c. *Procedures.*

(1) *Precautionary.*

- (a) At least two employees should be assigned to jobs where there is a possibility of exposure to GB and each should be instructed to observe the other for signs and symptoms of exposure.
- (b) All personnel who at any time may be exposed to GB shall be given self-aid and first aid instruction by qualified personnel before being permitted to enter areas of possible contamination. These first aid and self-aid instructions shall be repeated at six-month intervals.
- (c) All personnel leaving an area where exposure might have occurred will be given an eye check by a responsible person properly trained in recognizing symptoms for any indication of myosis (constriction of the pupils). In addition, these personnel known to have been in a contaminated area will be required to remain in a known "clear area under observation" for a minimum of 2 hours. Personnel whose duties normally take them into areas where exposures may occur will be required to wear identification bracelets/chains or carry emergency medical treatment cards which prescribe procedures to be followed in the event the bearer is overcome by the effects of the agent after duty hours.
- (d) 1. All personnel will be given a complete physical examination prior to assignment to duty, and the examining physician will - evaluate the results to determine if any existing physical defect will prohibit assigning the subject to this type of work.

2. Personnel subject to a possibility of

repeated exposures will have periodic determinations of their red blood cell cholinesterase, to be determined by base cholinesterase level test. If there is significant decrease in cholinesterase after an exposure, the individual will be removed from work involving any kind of contact with G-agent until the cholinesterase level has returned to normal.

3. Cuts or abrasions of the skin must be covered to the satisfaction of the medical officer before the involved individual can engage in work where exposure to GB is possible.

(2) *First Aid and Self-Aid.*

- (a) In the event of exposure to GB, the following steps must be taken immediately:
1. Have someone else summon medical aid, giving the location of the incident.
 2. Start the following first aid and self-aid procedures.
 3. First aid attendants must be provided with protective masks and protective clothing to avoid becoming casualties themselves.
- (b) For mild vapor exposures resulting in "running nose," dimness of vision, and some difficulty in breathing, the patient will be taken to the dispensary or a designated point for evaluation and treatment by medical personnel.
- (c) In the event of a more serious exposure causing the patient marked difficulty in breathing, one ampule or syringe of atropine should be administered by qualified personnel and the patient taken to the dispensary. If for some reason medical aid is not readily available and the symptoms are not improved or are worse 15 minutes after the injection of atropine, another injection may be given. This may be repeated again, but no more than three ampules or syringes of atropine (6mg

equivalent of atropine sulphate) may be given except on orders from medical personnel. As a precautionary measure, it is advised to insert the empty syrettes in the lapel of the patient so that an account of the injections can be maintained during the treatment period.

- (d) In case of a splash with liquid GB, contaminated area should be blotted with absorbent cotton or blotting paper. Blotting must be done immediately and its purpose is to prevent spread of the agent over an area larger than that already contaminated. Immediately after blotting, the contaminated area should be flushed with large quantities of water, such as from a shower. An ampin or syrette of atropine should be given if any symptoms appear. In any event, the patient will be taken to the dispensary immediately by a person familiar with the details of the case.
- (e) If the liquid GB should splash into the eye it should be flushed immediately and thoroughly with water. Three injections of atropine will be given at once and medical help obtained as quickly as possible.
- (f) Artificial respiration will be given if breathing has stopped. A mechanical respirator should be used; otherwise, the mouth-to-mouth resuscitation should be started at once. Important: If the victim has not been removed from the contaminated area, artificial respiration must be given with a mask in place.
- (g) Caution: GB agent desorbes slowly from clothing and contaminated equipment. Contaminated clothing will be removed prior to entry into inclosures.

21. Effects and Symptoms of VX. *a. Cause of Lethal Effect.* The lethal effect of VX is brought about by the disruption of parts of the automatic and central nervous systems, which depend upon the formation of acetylcholine for transmission of nerve impulses.

Acetylcholine is hydrolyzed by the enzyme cholinesterase. VX destroys the ability of cholinesterase to hydrolize acetylcholine. Exposure to VX, therefore, results in an excess of acetylcholine with subsequent intoxication.

b. Symptoms of VX Poisoning and Effects of Vapor.

- (1) *Symptoms.* The physiological effects of VX poisoning are dilation of the blood vessels, sweating, slowing of the heart rate, constriction of the bronchioles or air passages in the lungs, intestinal cramps, and constriction of the pupils of the eye (myosis). There is also inhibition of respiration in cases of serious exposure. When the blood cholinesterase is reduced to a very low level, at least 30 days are required for it to return to normal. Exposure to a high concentration of VX may incapacitate a person so rapidly that he may be unable to take protective measures.
- (2) *Effects of vapor.*
 - (a) Minimal or threshold exposure for a few minutes to trace concentrations (mg min/m³) causes a running nose, which lasts several hours, and possible pupillary constriction which lasts from 1 to 3 days. In some instances, pupillary constriction does not develop.
 - (b) At approximately double this minimal exposure, the symptoms are pupillary constriction and, possibly, a tight feeling in the chest, which comes on very quickly in most subjects and lasts from one to several days.
 - (c) At approximately eight times the minimal exposure, the zone of true casualty production is reached. Tightness of the chest may be so severe and breathing so difficult that the victim is unable to carry on normal duties.
 - (d) At 15 to 20 times the minimal exposure (moderate incapacitation), all unprotected personnel could be expected to be casualties, many with

alarming symptoms. The subject may be seized with panic in his struggle for air. As his anoxia increases, he becomes more confused and may fall exhausted and unconscious.

- (e) At two to three times the severe casualty dosage, the median lethal range is reached. The clinical picture of the fatal case is similar to that of the severe casualty, but increased in tempo and severity. The LCt-50 (median lethal dosage) for personnel at rest is estimated to be of the order of 50mg min/m³.
- (f) Exposure to high concentrations of VX vapor may result in inhalation of an incapacitating or lethal dose before any warning symptoms appear.

22. Treatment for Exposure to VX. a. First Aid Equipment. The requirement for first aid equipment has been divided into three categories, depending upon the need for the respective item.

- (1) The Protection and Treatment Set, Chemical Warfare Agent, M5A3, is intended for self-treatment.
- (2) The Emergency VX First Aid Kit, for use by relatively untrained personnel, contains the following:

Quantity	Description of item
8	Atropine injections, 2mg/cc (ampin or syrette).
1	Homatropine Ophthalmic Solution Sterile (2%), 15cc dropper bottle.
2	Sodium bicarbonate solution (3%), 175cc bottle.
2	Rubber tubing for tourniquet.
1	Merthiolate swabs (1:1000), 10 per pack.
12 inches.	Sterile gauze pads, packaged, 4 by 8 inches.
1	First aid instructions.

The following items are to be packaged separately and labeled "For Use by Physicians Only."

Quantity	Description of item
1	Atropine sulfate solution sterile (0.2c/c), 25cc/ bottle 8mg/cc.
2	Syringe, glass, 5cc, with No. 21 hypodermic needle (11 inches long) in a needle steritube.

Note. In labeling the steritube, indicate size of needle on label.

Quantity	Description of item
(3)	Hypodermic needle No. 21 (1/2 inches long) in needle steritube.
	The Medical Treatment Kit, for use by physicians and thoroughly trained personnel, contains the following:

Quantity	Description of item
8	Atropine injections 2mg/cc (ampin or syrette).
1	Atropine sulfate solution sterile (0.2%), 25cc/ bottle 8 mg/cc.
50	Atropine sulfate tablets, 1 mg.
1	Homatropine Ophthalmic solution (2%), 15cc dropper bottle.
2	Sodium Bicarbonate solution (3%), 175cc bottle.
2	Syringe, glass, 5cc, with No. 21 hypodermic needle (1/2 inches long) in needle steritube.
4	Hypodermic needle No. 21 (1/2 inches long) in needle steritube.
2	Rubber tubing for tourniquet.
1	Merthiolate swabs (1:1000), 10 per pack.
24	Sterile gauze pads, packaged, 4 by 8 inches.
2	Bite blocks.
2	Oral airway.
2	Magill cuffed endotracheal tubes, No. 32, French Laryngoscope with 2 spare-batteries and bulbs.
1	Toomey cystoscopic evacuator.
or	
1	Ambu suction apparatus.
2	Pharyngeal suction catheter, No. 22, French.
2	Mask-to-mask resuscitators (nonstandard CWL model).
1	Instructions for first aid and treatment of severe casualties.
1	Mechanical resuscitator (nonstandard CWL model).
2	M3 Impermeable Outfit.

b. Procedures.

(1) Precautionary measures.

- (a) All personnel who at any time may be exposed to VX shall be given self-aid and first aid instructions by qualified medical personnel before being permitted to enter areas of possible contamination. These first aid and self-aid instructions shall be repeated at 6-month intervals.
- (b) All personnel leaving an area where exposure might have occurred will be given an eye check for an indication of myosis. Contact with liquid VX is much more probable and hazardous than VX vapors. The reason

for this is that VX is not a readily volatile liquid.

(c) All personnel will be given a physical examination prior to assignment to duty. The following steps will be included for those working with VX:

1. Base cholinesterase levels for individuals will be established under the same environmental conditions under which they will work.
2. Personnel subject to a possibility of repeated exposure will receive periodic determinations of their red blood cell cholinesterase. If there is a significant decrease in the cholinesterase after an exposure, the individual will be removed from any work involving contact with the agent until the cholinesterase level has returned to normal.
3. Cuts or abrasions of the skin must be covered to the satisfaction of the medical officer before an individual may engage in work which involves possible exposure to VX.

(2) *First aid and self-aid.*

(a) In the event of exposure of an individual to VX, the following steps will be taken immediately:

1. The victim will be removed from contaminated area; medical aid will be obtained; if able to do so, the casualty will begin self-aid procedures; and
2. Nearby personnel will start first aid procedures. (First aid attendants must wear protective masks to avoid becoming casualties themselves. The necessity for wearing protective clothing will depend upon the situation.)

(b) In case of mild exposure by inhalation to VX resulting in a running nose, dimness of vision, and some difficulty in breathing, the patient will be taken to the dispensary or to a designated point for treatment by medical personnel.

(c) In the event of a more serious exposure by inhalation causing the patient marked difficulty in breathing, one ampin or syrette of atropine should be given and the patient taken to the dispensary. If medical aid is not readily available and the symptoms are as pronounced 15 minutes after the injection of atropine as they were prior to the injection; another injection of atropine may be given. If there is still no improvement, after 20 minutes a third injection may be given; but not more than three ampins or syrettes of atropine (6mg equivalent to atropine sulphate) may be given, except on orders from medical personnel or from those authorized by medical personnel. As a precautionary measure, it is advisable to insert the empty syrettes in the lapel or pocket flap of the casualty's jacket so that a count of the injections can be maintained during the treatment period. The instructions in this paragraph are limited to production, technical, and medical personnel, or to those authorized by medical personnel.

(d) In case of contamination by a splash of liquid VX, the contaminated area should be blotted immediately with absorbent cotton or blotting paper to prevent spread of the agent. Immediately after blotting, the area should be thoroughly flooded with water. If any VX symptoms appear, an ampin or syrette of atropine should be given and the patient taken to the dispensary immediately, accompanied by a person familiar with the details of the accident. Instructions in this paragraph have the same limitations as (c) above.

(e) Artificial respiration should be given if breathing has stopped. A mechanical resuscitator should be used; otherwise, begin immediately the mouth-to-mouth, mouth-to-mask, mouth-to-nose, mask-to-mask, or mouth-to-airway method of artificial respiration. Do not wait for the arrival

rival of the mechanical resuscitator; artificial respiration should be started whether or not atropine has been administered.

- (f) Anticonvulsive medication should be given if convulsions are not controlled by atropine and are endangering life.

(3) *Effects of atropine.*

- (a) Atropine should not be administered for preventive purposes prior to possible exposure to nerve gas, as this will increase respiratory absorption of nerve gas vapor by inhibiting bronchoconstriction and other compensatory actions which protect the body against poisons.

- (b) Noticeable effects of 2mg of atropine sulfate or tartrate injected intramuscularly appear about 8 minutes after injection and are maximal about 35 minutes after injection. The effects of this same dose injected intravenously begin within 1 minute after injection and are maximal within 6 minutes. When this dose is administered orally, the effects begin about 15 to 20 minutes after administration and are maximal in about 50 minutes. While the rates of absorption of like doses of atropine administered by these various routes differ, the effects of the drug are generally the same after absorption has occurred.

- (c) A dose of 2mg of atropine administered to a subject who has absorbed little or no nerve gas produces the following mild effects: dryness of the mouth and pharynx, resulting in slight difficulty in swallowing; subjective warmth; slight flushing; slight tachycardia; some hesitancy of urination; and an occasional desire to belch. The pupils may be slightly dilated, but they react to light. In some subjects, there may be mild drowsiness; slowness of memory and recall; subjective slowing of motor activity; and blurring of near vision, particularly after the

intravenous administration of atropine. Some subjects may have mild postural hypotension. These effects should not interfere with ordinary activity, except in those occasional individuals who may be unusually reactive to the central neural effects of atropine. These individuals are likely to become drowsy and may suffer from other neural effects

(4) *Means of administering atropine.*

- (a) The syrette is a tin or plastic tube containing 2mg of atropine tartrate in solution (1.2ml). Before the injection can be given, the seal between the needle and the container must be punched by the stylet that is in place with the needle. The syrette is used as follows:

1. If the liquid is likely to be frozen, thaw by contact with hands or other warm portions of the body, or by holding it in the mouth.
2. Twist and remove the slim plastic sleeve which covers the needle, avoiding touching the needle with the fingers or other object.
3. With the needle pointing upward, push the stylet of the needle in until the seal is felt to have been punctured and the stylet moves easily toward the container.
4. Remove and discard the stylet.
5. If possible, raise the trouser leg to expose the thigh, or the sleeve to expose the upper arm, or slit the clothing to expose one of these areas. If this cannot be done, the injection may be given through the clothing. At very low temperatures, as in the Arctic, the bare skin should not be exposed lest the casualty suffer frostbite.
6. Hold the syrette needle by the hub, where it is attached to the tube, and plunge the needle deep into the thigh, triceps (muscle of the upper arm), or deltoid muscle. The point of the needle should be at least a half inch under the skin surface.

7. Squeeze the tube firmly between the first and second fingers until the contents have been entirely squeezed into the muscle.
 8. Remove the needle from the flesh with a quick pull and attach the syrette to the breast pocket flap so others may know the amount of atropine that has been injected.
 9. If time permits, massage the area of injection for several minutes to hasten absorption.
- (b) The ampin is a glass ampoule containing 2mg of atropine sulfate in solution (1.2ml). The ampoule is pressurized by helium gas at 2.5 atmospheres. The liquid is forced from the ampin by the pressure of the helium gas when the ampin is inverted and the glass tip broken. The ampin is used as follows:
1. Remove the ampin from its plastic cone. If contents are frozen, thaw as described in (a) 1 above.
 2. Remove the plastic sleeve covering the needle, as in (a)2 above.
 3. Expose muscle, as in (a) 5 above.
 4. Hold the needle by the hub, where it is attached to the rubber tube; tilt the needle vertically to the skin surface; and plunge the needle into the muscle. The point of the needle should be at least a half inch under the skin surface.
 5. Tilt the glass ampoule with one hand so that the bottom points straight up and the slim neck in the rubber tube points straight down.
 6. With the other hand crush the tip of the glass ampoule in the rubber tube by squeezing the middle of the rubber tube between the thumb and the first finger, bending the rubber tube slightly, if necessary.
 7. Hold the glass ampoule with the bottom up until all the liquid has been forced out of it by the compressed helium gas.
 8. Remove the needle from the flesh with a quick pull and attach the

ampin to the breast pocket so others may know the amount of atropine that has been injected.

9. If time permits, massage the area of the injection for several minutes to hasten absorption.

(c) Atropine sulfate solution (2mg/ml), syringes, and needles are available in the Emergency VX First Aid Kit and in the Medical Treatment Kit.

(d) Atropine sulfate tablets (1mg each) are available in the Medical Treatment Kit. These tablets may be administered orally, or they may be dissolved in sterilized water for intramuscular or intravenous administration.

(e) The ampin and syrette will be replaced in the near future with an automatic injector.

c. *Medical Treatment for VX.*

(1) If the casualty is not wearing a protective mask, one should be put on him immediately if the atmosphere is still contaminated. If a mask is not available, the casualty's face should be covered with a cloth saturated with water. If the airway is not clear, the tongue should be extended and saliva and mucous cleared from the mouth and pharynx. If there is marked weakness or coma, an oropharyngeal airway should then be inserted while the casualty is in the prone position with the head to one side.

(2) Any liquid VX on the skin or clothing should be removed. If soap is available, the skin should be washed with soap and large amounts of water. If ingestion of gas is known to have occurred, gastric lavage with water should be carried out, if possible.

(3) If the casualty has symptoms of moderate nerve gas poisoning, 2mg of atropine should be injected intramuscularly. If the symptoms of the gas poisoning are not relieved, and if signs of mild atropinization (dry mouth and skin) do not appear, one or two additional injections should be given. If

two additional atropine injections are given, 20 minutes should elapse between them. A mild degree of atropinization should then be maintained for at least 24 hours by the intramuscular or oral administration of 1 or 2mg of atropine at intervals of 1/2 to 4 hours. The authority to inject the second and third dose of atropine is limited to those working in the manufacturing plant, to laboratory technical personnel, to bulk-storage yard personnel, to medical personnel, and to those authorized by medical personnel.

- (4) Smoking should be avoided until the symptoms of VX poisoning are no longer observed.
- (5) Should the casualty have severe symptoms of nerve gas poisoning, 4 to 6mg atropine should be injected intravenously, or if this is not feasible, intramuscularly. If the symptoms continue, and if signs of atropinization do not appear, the intravenous injection of atropine in doses of 2mg should be repeated at 3- to 8-minute intervals until atropinization does occur. A mild degree of atropinization should be maintained for at least 48 hours.
- (6) If the casualty is in severe respiratory distress when found, or is convulsing, 4 to 6mg of atropine should be injected intravenously, or, if this is not feasible, intramuscularly. If relief does not occur and if bronchial secretions and salivation do not decrease, 2mg of atropine should be administered intravenously (or if this is not feasible, intramuscularly) at 3- to 8-minute intervals until relief is obtained and the secretion diminishes. In severe nerve gas poisoning, the effect of each injection of atropine may be transient, lasting only 10 to 20 minutes. The casualty must be observed as closely as possible, and atropine repeated at appropriate intervals, in order to relieve the central neural effects of the nerve gas and to maintain a mild degree of atropinization for at least 48 hours.
- (7) Should the casualty have excessive

bronchial secretion and salivation, he should be placed in a prone position, and the foot of the litter or bed elevated, if possible, to promote drainage. If airway obstruction is occurring, the collar should be loosened, the tongue extended, and saliva and mucous cleared periodically from the mouth and pharynx by means of suction from a syringe and catheter. An oropharyngeal airway may then be inserted and suction carried on intermittently, as needed, through and around the airway. If the upper airway remains obstructed and a deepening cyanosis develops because of inadequate exchange of air, in spite of sustained efforts to carry out artificial respiration, an endotracheal catheter may be inserted. This should be attempted only on a subject who is cyanotic or in a moribund condition because of airway obstruction, and who is also either unconscious or extremely weak and unable to struggle and to resist efforts at intubation. The subject is placed on his back, with the head hyperextended over the side of a bed or table. The mouth is opened wide, and under direct vision and with the aid of a flashlight, a wooden tongue depressor is passed down the dorsum of the tongue until the end is under the epiglottis. The tongue depressor is then gently lifted anteriorly to expose the glottis. The endotracheal tube, lubricated with water-soluble jelly, is inserted into the glottis and gently passed into the larynx and trachea for a distance of about 3 inches. When the tube is in place, a roll of gauze is inserted between the teeth to prevent the tube from being bitten when the subject regains consciousness, and a string or strip of gauze is tied about the endotracheal tube and gauze roll (separately) and then tied around the back of the upper neck. Suction may then be carried out by means of a No. 16 catheter passed through the endotracheal tube. If air exchange through the endotracheal tube is not evident.

the tube should be removed, and, if the airway is still obstructed, another attempt should be made to pass it. If the subject is able to struggle and to resist passage of the endotracheal tube, attempts to pass the tube should be discontinued, as this will be difficult and may result in injury and edema to the larynx. An endotracheal tube that has been in place for several hours should be removed when the subject regains consciousness and some degree of strength and is breathing spontaneously. It should seldom be left in place more than 24 hours, and never more than 48 hours, as it may result in such edema of the larynx as to result in airway obstruction after the tube is removed, requiring immediate performance of tracheotomy, or reinsertion of the tube until a tracheotomy can be carried out.

d. Artificial Respiration. If respiration is severely impaired, or if it ceases, cyanosis will ensue and death will occur in a matter of minutes unless an effective method of artificial respiration is begun immediately and maintained until spontaneous respiration is resumed. In severe casualties, several hours of continuous artificial respiration may be required. Since the nerve gases may produce peripheral flaccid paralysis of the muscles of respiration, the chest is collapsed and there is very little expiratory reserve. Hence, methods of artificial respiration which depend upon compression of the chest and elastic recoil (e.g., Shaefer prone pressure method) are not sufficient. For this special condition, mouth-to-mouth, mouth-to-mask, mouth-to-nose, mask-to-mask, and mouth-to-airway methods are more effective.

- (1) If the casualty can be removed from the contaminated area quickly enough (5 minutes or less from the time respiration ceases), direct mouth-to-mouth breathing can be used as an emergency measure for a short time, while resuscitation equipment is being brought to the patient, or while the patient is being transported to resuscitation equipment. In either contaminated or uncontaminated areas, indirect

mouth-to-mouth artificial respiration can be employed by means of a special rubber tube connecting the inlet of the patient's mask with the outlet of the operator's mask.

- (2) Resuscitation must be continued until spontaneous respiration begins. This may require from a half hour to several hours, which makes the procedure very difficult to apply to more than a few casualties during combat operations.
- (3) When the patient reaches an installation where oxygen and a mechanical respirator of either the positive pressure or negative pressure "iron lung" type is available, these should be employed continuously until adequate spontaneous respiration is resumed.

e. Management of Convulsion. Observation of experimental and accidental cases of nerve gas poisoning of humans indicated that generalized convulsions are not likely to be a frequent clinical problem. Persons who are poisoned severely enough to develop convulsions usually progress rapidly to unconsciousness and generalized muscular weakness or flaccid paralysis, at which point external evidences of convulsion cease. Continuing grandmal status has not been observed to occur, and return of convulsions during recovery has not been noted. Furthermore, adequate atropinization tends to prevent or diminish convulsions, but may not control them completely. If, despite adequate atropine, convulsions should be prolonged and severe enough to interfere with respiration or to physically exhaust the patient, they may be controlled with the usual anticonvulsive drugs. Paraldehyde may be administered intravenously at the rate of 1/2 to 1cc per minute until convulsions cease, up to a maximum of 8cc. A 2.5 percent solution of thiopental sodium also may be administered intravenously at the same rate until convulsions are controlled, avoiding excessive dosage, as the barbiturates are synergistic with nerve gas in depressing respiration. For milder intermittent seizures, sodium phenobarbital in a dosage of 0.2 gram every 4 hours may be used for prolonged control.

f. Relief of Apprehension. If the patient is very apprehensive, he may be given a barbiturate

rate by mouth by a physician in a dose sufficient to allay apprehension and to produce mild sedation. but not sufficient to produce marked drowsiness. This may be achieved by 0.1 gram of sodium phenobarbital by mouth, repeated in 1 hour and then every 6 hours, if necessary. Morphine should not be administered, as it depresses respiration.

g. Treatment of Ocular Symptoms. Ocular symptoms produced by the local absorption of nerve gas do not respond to the administration of atropine but are relieved by a 2 percent homatropine ointment, repeated as needed at intervals of several hours for 1 to 3 days. Several symptoms may require the local instillation of 1 percent atropine sulfate ointment. If local ocular effects of nerve gas are present, the size of the pupil cannot be used as an indicator of the systemic effects of nerve gas or atropine.

h. Summary of Treatment for VX.

(1) Lifesaving measures.

- (a) Termination of exposure. Place a mask on the casualty and remove him from the contaminated area. The victim should then be flushed with large amounts of cold water, particular care being taken not to flood the canister of his protective mask. Next, the victim's clothing should be removed and his skin thoroughly washed with water, or preferably, with soap and water. If necessary, atropine and artificial respiration should have been administered prior to the second decontamination.
- (b) Artificial respiration. Start artificial respiration immediately as a first aid measure for the paralyzed, nonbreathing casualty. Continue until natural breathing is restored.

(c) *Atropine.* First give 2mg of atropine as a first aid or self-aid measure, as soon as symptoms are noted. Additional atropine, up to a total (dosage of 6mg, will be given by qualified personnel; dosages larger than 6mg will be given by a medical officer.

(2) Symptomatic treatment.

(a) Anticonvulsive drugs. Anticonvulsive drugs are given to control convulsions not controlled by atropine.

(b) Sedative drugs. Atropine or homatropine are given to overcome myosis and ciliary spasm.

i. Prognosis. The effects of nerve gas poisoning are prolonged because recovery depends mainly upon the regeneration of cholinesterase enzymes in the tissues and this process occurs slowly over a period of 30 or more days. If exposure to many times the lethal dose has occurred, or if treatment has been too long delayed, death may occur in spite of efforts to save the patient. This emphasizes the importance of prompt masking and if poisoning occurs, it will be complete, unless anoxia or convulsions have been allowed to go unchecked for so long a time that irreversible central nervous system changes have occurred because of the lack of oxygen.

23. References.

- a. TM 743-200.
- b. TM 743-200-1.
- c. TM 3-250.
- d. TM 3-220.
- e. TM 9-1903.
- f. TB CML 73.

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NG: State AG (3).


USAR: None.

For explanation of abbreviations used, see AR 320-50.

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