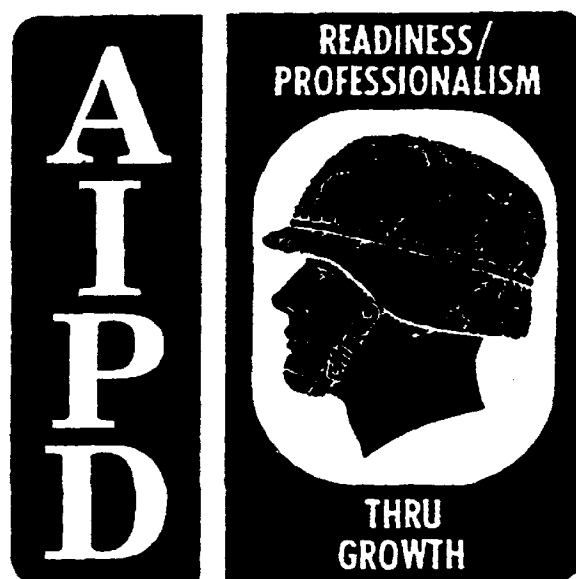


MAGAZINE STORAGE AREA SAFETY



US ARMY ORDNANCE
MISSILE AND MUNITIONS CENTER AND SCHOOL

THE ARMY INSTITUTE FOR PROFESSIONAL DEVELOPMENT
ARMY CORRESPONDENCE COURSE PROGRAM

MAGAZINE STORAGE AREA SAFETY

**Subcourse Number MM0149
EDITION A**

United States Army Ordnance Missile and Munitions
Center and School, Fort Lee, Virginia 23801-1809

2 Credit Hours

Edition Date: September 1992

SUBCOURSE OVERVIEW

This subcourse is designed to teach you the fundamental standards for magazine storage area (MSA) safety. This subcourse has instructions on fire safety, lightning protection systems, operational safety, personnel safety, and materials handling equipment (MHE) safety.

There are no prerequisites for this subcourse.

This subcourse reflects the current doctrine at the time the subcourse was prepared. In your own work situation, always refer to the latest publications.

Unless otherwise stated, the masculine gender of singular pronouns is used to refer to both men and women.

Terminal Learning Objective

Action: You will learn how to establish a safety program for an MSA to include planning requirements and considerations required for procedures associated with MSA, including fire divisions, fire symbols, chemical agents, lightning protection, and MHE safety.

Condition: You will require only the information contained in this subcourse.

Standard: To demonstrate competency of this task, you must achieve a minimum of 70 percent on subcourse examination.

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LESSON

MAGAZINE STORAGE AREA SAFETY

Critical Task: 03.4012.01-0007

OVERVIEW

Lesson Description

In this lesson you will learn to conduct, evaluate, or update the MSA safety plan for your unit. These actions include the review or development of the MSA standing operating procedure (SOP) to ensure that all safety considerations are addressed. The areas are fire safety, lightning protection systems, operational safety, personnel safety, and MHE safety.

Terminal Learning Objective

Action:	Develop or evaluate an MSA safety plan.
Condition:	You will have the information on MSA safety planning that is provided in this subcourse booklet. You will work without supervision.
Standard:	Evaluation of the MSA safety plan.
References:	The material contained in this subcourse was derived from these publications. You do not need these publications to complete this lesson. AR 385-64. AMC-R-385-100. TM 9-1300-206. FM 9-6. FM 9-13. FM 9-38.

INTRODUCTION

The most important consideration in an MSA is safety. As an ammunition officer assigned to a newly established MSA, you must be able to develop a sound MSA safety program. Personnel injury and property damage can disrupt tactical operations and prevent the completion of a mission. The concern for safety of personnel and property are paramount in Department of Defense and Department of the Army safety regulations. These regulations are written to ensure that the destructive potential of ammunition is not unleashed prematurely, and they prescribe universally applicable standards and practices. This information is addressed in the MSA SOP. The SOP should include fire plans to include fire prevention, fire protection, fire fighting, ammunition storage area lightning protection, operational safety, personnel safety, and MHE safety. The SOP should also address special safety requirements for high explosives, chemical agents, and conventional ammunition items.

SAFETY CONSIDERATIONS

All personnel engaged in operations involving explosives, ammunition, and other hazardous materials must be thoroughly knowledgeable of the SOPs established for each operation in the ammunition storage facility. They should be trained in safety precautions relating to mission accomplishment. They should be able to detect and recognize potential hazardous situations and conditions. Safety is everybody's responsibility.

All personnel must think safety and practice on-the-job safety as well. Attention to detail while working with ammunition, explosives, and other hazards must become a habit. It may save their lives.

Prompt actions must be taken by all personnel to eliminate or control any hazardous condition or situation. This may require the shutdown of operations and the evacuation of all personnel to a safe area. Operations will not be resumed until the hazard has been eliminated.

An incident or accident must be reported immediately through the proper chain of command. Fire fighters, medical personnel, and explosive ordnance disposal (EOD) personnel should be called to assist in eliminating the hazards.

FIRES AND EXPLOSIONS

Fire Plan

A fire plan, which is part of the SOP, is one of the first things an explosive storage area needs. The fire plan covers all aspects of fire safety. The fire plan describes what everyone is to do in the event of a fire. It designates the key individuals, alternates, and organizations, and defines their responsibilities, including who is responsible for the following tasks:

- Reporting the fire.
- Directing the orderly evacuation of personnel.
- Notifying nearby personnel of the impending danger.
- Initiating the means of extinguishing or controlling the fire.

Fire Prevention

Fire prevention in an ammunition storage area is the responsibility of all personnel who work in or enter the storage area. The storage area must be kept in such a condition as to prevent fires from starting and to prevent fires from entering from other areas. The following paragraphs describe some specific fire prevention measures.

Grass, weeds, undergrowth, and other flammables must be kept out of the storage areas. By controlling the growth of vegetation, the possible spread of any fire is limited. Weed killers, mowing, animal grazing, plowing, and cutting are methods used to control vegetation. However, the proper supervision of personnel is required when any method is used.

The burning of vegetation is not permitted within 50 feet of earth-covered magazines, nor within 200 feet of above-ground magazines or storage pads. All structure doors, windows, and ventilators must be closed during burning.

Firebreaks that are at least 50 feet wide and are free of flammable material must be maintained around above-ground magazines and storage pads.

Dunnage may not be stacked within 50 feet of magazines, and may never be stacked within the firebreaks.

Diesel- and gasoline-powered vehicles operating within 25 feet of a structure or magazine must be equipped with properly installed spark arresters.

Matches or other flame- or spark-producing devices will not be permitted in any ammunition storage area or explosives area except by written authority of the commanding officer or a designated representative.

Smoking within areas containing explosives, ammunition, highly combustible materials, or flammable items will be strictly regulated and controlled. Where it is believed that smoking can be safely regulated, specifically designated smoking locations, approved by the commander, must be established. The smoking area must be separated by a distance of at least 50 feet from the ammunition or explosive area. Suitable receptacles must be provided for cigarette butts.

Only permanently installed electrical lighters of approved types will be used in the designated smoking area. At least one class 1A-rated portable fire extinguisher will be provided at designated smoking locations.

Flashlights or storage-battery lamps used in buildings containing ammunition, explosives, or flammable vapors will be types approved by the United States Bureau of Mines.

Electrical lines serving explosives operating facilities should be installed underground from a point not less than 50 feet away from the facilities.

Gasoline or other highly flammable liquids will not be used for cleaning purposes.

Parking areas should be designated and preferably located outside of the restricted area.

Ammunition boxes, containers, dunnage, and lumber must be stacked in an orderly manner when in the vicinity of explosives renovation, handling, or storage operations.

Fire-Fighting Facilities

Fire-fighting facilities are of immediate importance to personnel within the MSA. Fighting fires in their beginning stages can prevent a major fire or a mass detonation of ammunition stocks. Keep in mind that personnel must not be exposed to the hazards of an imminent explosion. The fire-fighting equipment available varies depending on the permanency of the facility, the types of ammunition stored, and the availability of fire-fighting organizations.

Temporary facilities may be equipped with the following items:

- Water barrels.
- Pails.
- Sand boxes.
- Shovels.
- Water-type extinguishers.
- Backpack pumps.
- Other equipment (such as fire beaters).

Permanent facilities may be provided with the following items:

- 2.5-gallon water-type extinguishers.
- Four-gallon backpack pumps.
- Multi-purpose dry chemical extinguishers.

- Pumpers or brush trucks.
- Tank trucks.
- A fire map.

Both types of facilities should have an adequate supply of brooms, gunny sacks, hoses, grass beaters, and, where available, plows, graders, and bulldozers. Two hand extinguishers should be available for immediate use whenever ammunition or explosives are being handled.

Fire drills involving all available personnel should be held semiannually. Unannounced fire drills involving motorized emergency vehicles are prohibited.

A fire alarm should be available to aid in passing the warning and speeding evacuation. The alarm should be both audible and visual, but must at least be audible.

When evidence of a fire is noticed and the alarm has been given, at least one responsible messenger must be sent in the direction from which fire fighters are expected to arrive. This individual gives the responding units the location, nature, and extent of the fire.

Fire fighters must not approach fires involving ammunition or explosives unless they have accurate information concerning the hazards and have determined that doing so is justified.

Fire Hazard Markings

As a guide to fire fighters, ammunition and explosives are divided into four fire divisions according to the hazards encountered when fighting fires involving the various types of munitions. The four fire divisions are identified on placards by the numerals 1, 2, 3, and 4. Each placard has a different shape to provide for easier identification in darkness and at long range. The shapes and sizes of the fire hazard markings are shown in Figure 1.

Fire symbols are normally posted on buildings or storage sites. They are posted in such a manner as to make them easily visible to approaching fire fighters at the maximum distance. Half-size placards may be used on doors or lockers inside buildings, on motor vehicles, and on railroad cars.

In the interest of safety, installation commanders may designate blocks of earth-covered magazines as areas requiring only the placard for the most hazardous material present.

Removable placards may be used where the class of explosives present changes frequently. For long buildings, more than one placard per side may be needed.

Railroad cars and motor vehicles containing ammunition or explosives destined for off-post transportation must have either fire symbols or Department of Transportation (DOT) placards. Once off post, such railcars and motor vehicles must have DOT placards. Vehicles transporting small-arms ammunition only do not require DOT placarding, but while on an installation they should be regarded and marked as carrying fire division 4 material.

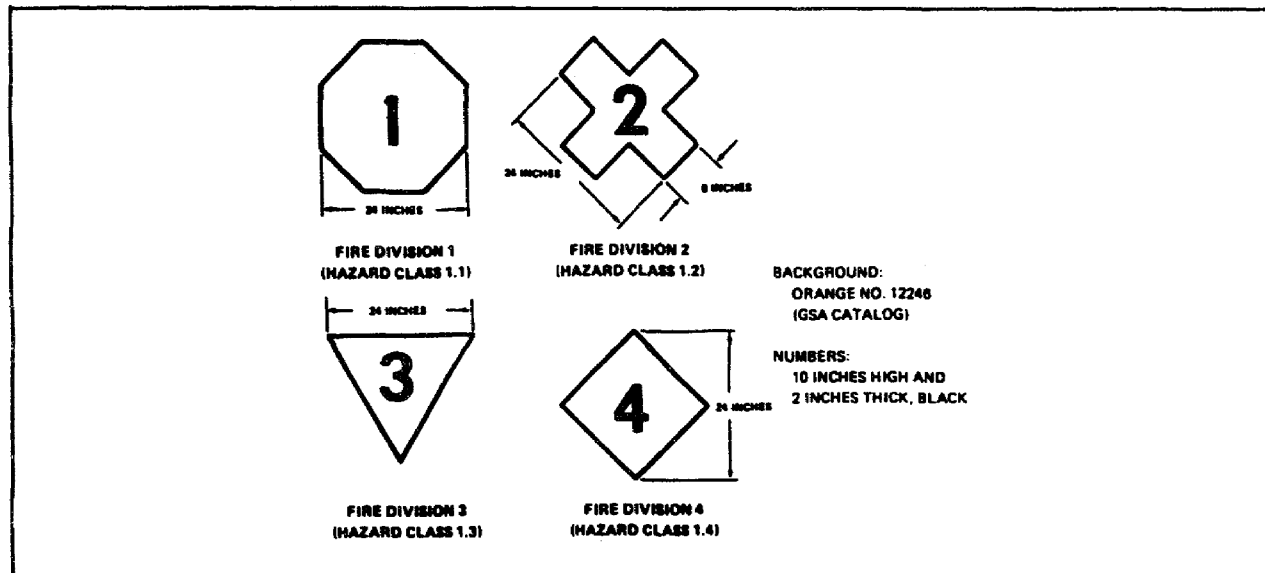
Fire divisions 1, 2, 3, and 4 correspond with Quantity Distance (QD) Hazard Classes 1.1, 1.2, 1.3, and 1.4. The lower the fire division number, the greater the hazard.

Fire division 1 indicates the potential for mass detonation. Examples of stocks in this division are bulk high explosives (such as TNT and C-4), blasting caps, and 155mm high explosive (HE) projectiles.

Fire division 2 indicates the potential for an explosion with a fragment hazard. Examples of munitions in this division are white phosphorous (WP) grenades, hand grenades, and rifle grenades; M16 antipersonnel mines; and M115A2 simulators.

Fire division 3 indicates a mass-fire hazard. Examples of stocks in this division are aluminum zinc oxide hexachlorethane (HC) grenades, smoke pots, rocket motors, and propellant grains.

Fire division 4 indicates a moderate fire hazard. Examples of stocks in this division are commercial squibs, M2 cartridge igniters, and small-arms ammunition.

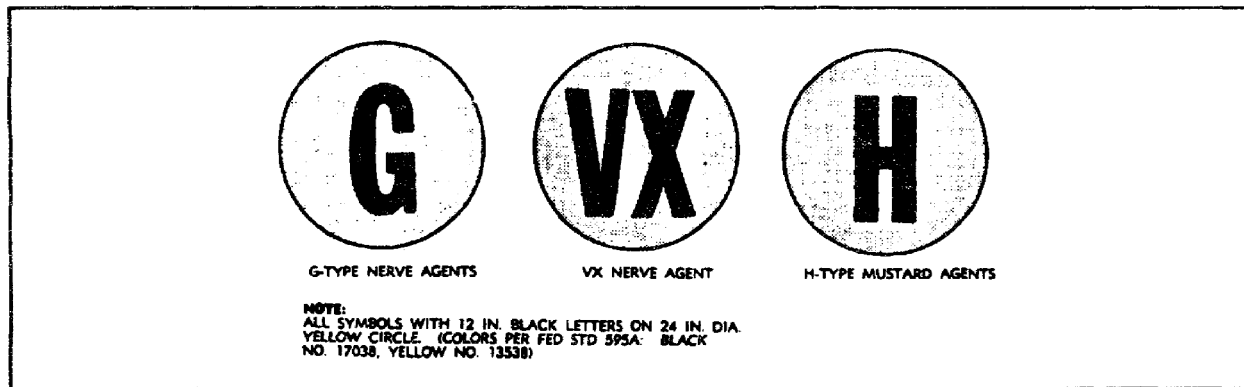


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Figure 1. Fire hazard markings.

Chemical Hazard Symbols

Chemical hazard symbols (Figure 2) are posted in addition to fire division symbols to identify any chemical agents or hazards in the marked locations. Their purpose is to alert personnel of the special hazards associated with chemical agents. Such added hazards require special preparation and precautions in case of fire or accident.



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Figure 2. Chemical hazard symbols.

Table 1 gives the protective clothing set and the chemical hazard symbol required for each chemical agent.

Table 1. Chemical agents and fillers contained in ammunition and the chemical hazard symbols required in storage.

Chemical Agents and Fillers Contained in Ammunition	Full Protective Clothing			Self-Contained Breathing Apparatus (SCBA)*	Apply No Water	G	VX	H
	Set 1	Set 2	Set 3					
GB	X			•		X		
VX	X			•			X	
H, HD, HT	X			•				X
CL, CG, CK, CN, CNS, CS, BBC, DA, DC, DM, FS, FM		X		•				
HC				X	X			
WP, PWP			X					
TH, PT				X	X			
IM, NP				X				
TEA, TPA			X		X			
Colored smokes				X				

*The SCBA must be used for all high levels of toxic contamination in IDLH (in danger of life or health) environments.

Wherever one of the symbols shown in Figure 2 is displayed, an additional symbol that pertains only to chemical hazards must also be displayed. These additional symbols are shown in Figure 3.

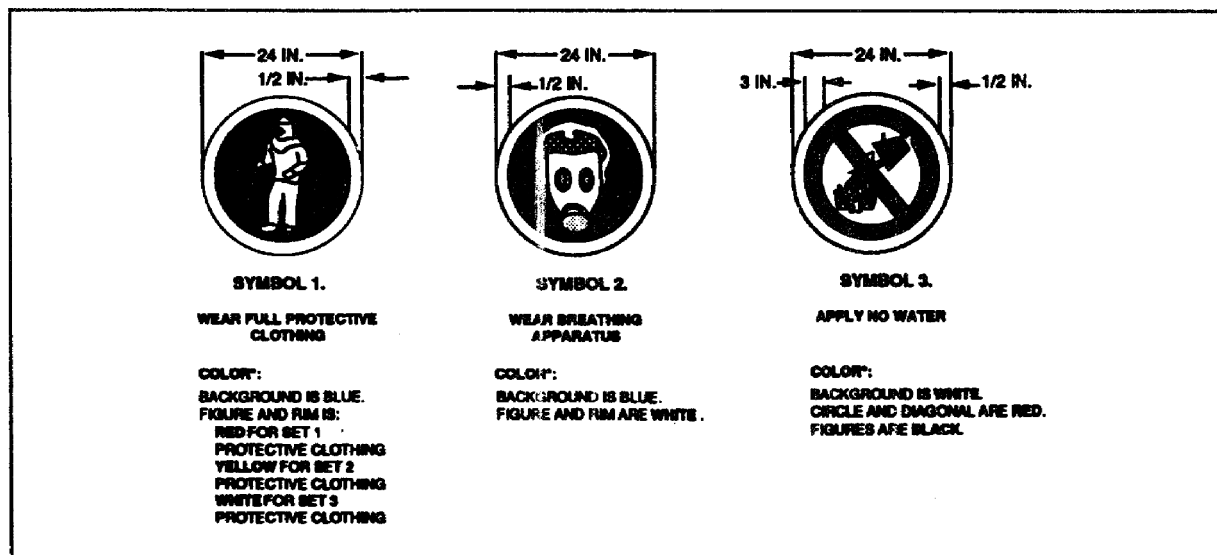


Figure 3. Chemical hazard symbols (fire fighting).

Symbol 1 in Figure 3 indicates that full protective clothing with a SCBA must be worn by all personnel in the hazard area. The protective clothing needed is indicated by the color of the outer edge of the symbol.

Symbol 2 in Figure 3 indicates that fire fighters must wear a gas mask or SCBA in areas so marked. This is usually because of the presence of incendiary or other highly-flammable chemical agents.

The meaning of symbol 3 in Figure 3 is clear. The use of water on the chemical marked with this symbol could spread the fire or cause an explosion. This usually involves chemicals such as oil-based incendiaries, metallic sodium, and triethyl aluminum (TEA) or HC smoke.

Protective Clothing Sets

When working on an accident in an area with a chemical hazard symbol 1 the individual should wear full protective clothing with an M40 series mask or SCBA, or a new self-contained toxic environment protective outfit (STEPO) that is currently issued to EOD, Tech Escort, and depot personnel for an IDLH or a highly toxic environment. Full protective clothing sets are divided into sets 1, 2, and 3. The different sets are indicated by different colors of the figure and of the rim. Note: Fire fighters equipped with normal heat-resistant bunker suits and SCBA do not need protective Clothing Sets 2 and 3.

Note: These sets are not mission-oriented protective posture (MOPP) gear.

Protective Clothing Set 1. Protective clothing set 1 is indicated by a red figure and rim. This is the toxicological agents protective (TAP) clothing set. It is used when working on accidents at sites marked with the G, VX, and H symbols. The items that must be worn are as follows:

- An M3 TAP suit with a protective mask or SCBA.
- An M2 TAP hood.
- Undergarments.
- Coveralls.
- Protective footwear.
- TAP gloves.

Protective Clothing Set 2. Protective Clothing Set 2 is indicated by a yellow figure and rim. This clothing set is used for incidents/accidents involving riot-control gases, blood and choking gases, or FS/FM smoke symbol. The items that must be worn are as follows:

- A protective mask or SCBA.
- Coveralls.
- Rubber gloves.

Protective Clothing Set 3. Protective Clothing Set 3 is indicated by a white figure and rim. This clothing set is used when fighting fires involving WP and TEA. Items that must be worn are as follows:

- A protective mask standard, special purpose, or SCBA.
- Flame-resistant coveralls.
- Flame-resistant gloves.

LIGHTNING PROTECTION SYSTEMS

Lightning protection systems are used in geographical locations that have more than five thunderstorm days per year. Lightning protection systems should be installed on buildings and other structures used for processing, handling, or storing explosives, ammunition, and other hazardous materials. Approved lightning systems are the integrally-mounted systems, the separately-mounted shielding systems (mast type), and the separately-mounted shielding systems (overhead-wire type).

Integrally-Mounted Systems

The integrally-mounted systems (Figure 4) consist of sharp or blunt-ground air terminals of 2-foot minimum height configured on the structure. Down conductors are as nearly vertical as possible without bends. Any bend must be as gradual as possible, having a minimum radius of 8 inches, and not exceeding 90 degrees.

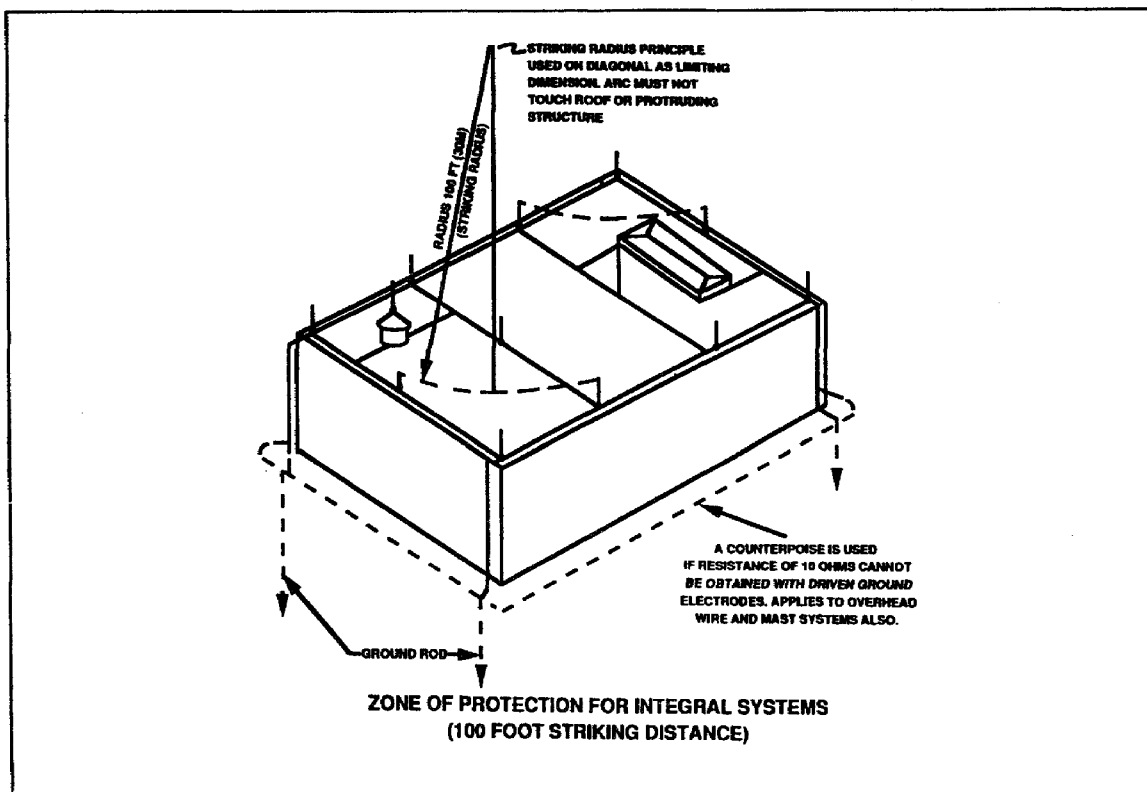
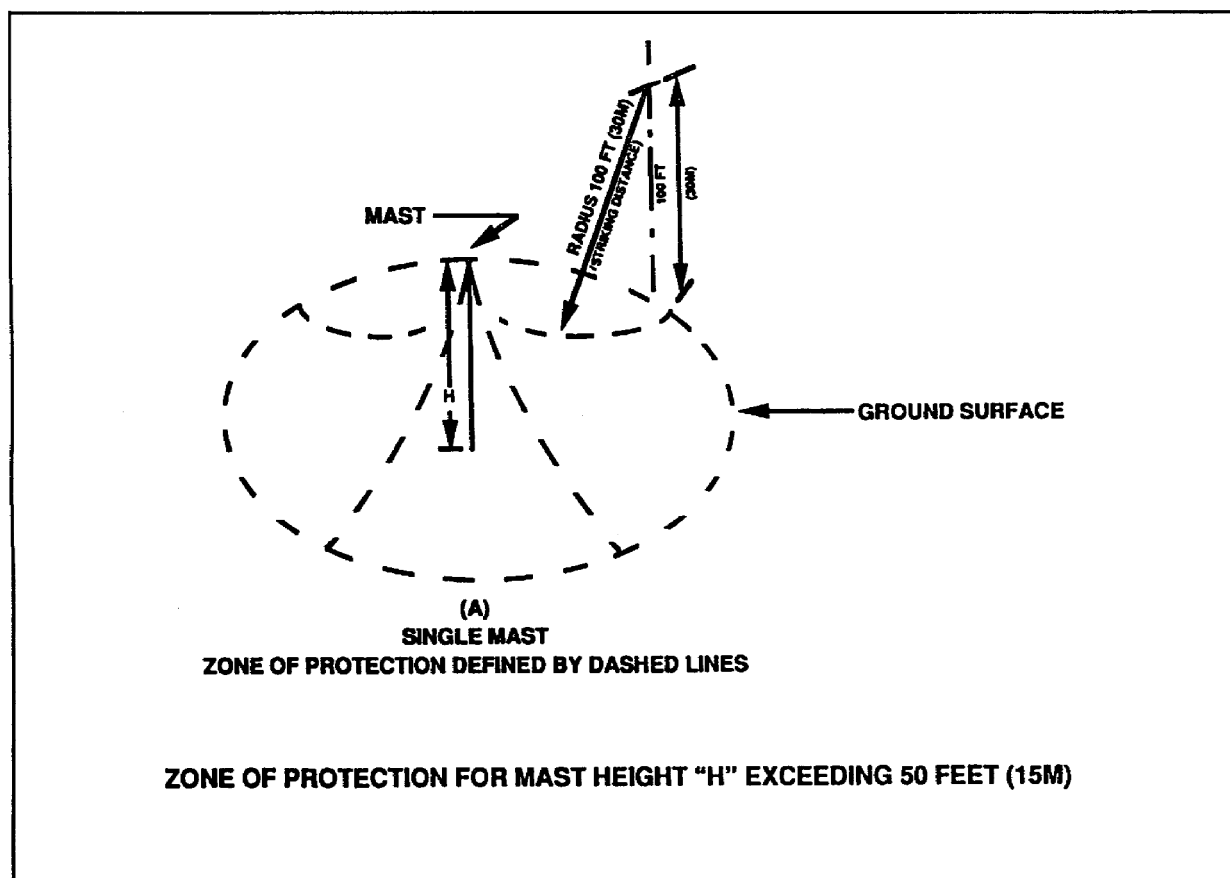


Figure 4. Integrally-mounted lightning protection system.

Separately-Mounted Shielding Systems (Mast Type)

The separately-mounted shielding systems (mast type)(Figure 5) uses masts that are remote from the structure to provide the primary attachment point of a lightning discharge.



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Figure 5. Separately-mounted shielding system (mast type).

The height of this system ensures that the entire structure is enclosed in a zone of protection. This system is separated at least 6 feet from the structure and is increased by 1 foot for every 10 feet of structure height above 50 feet.

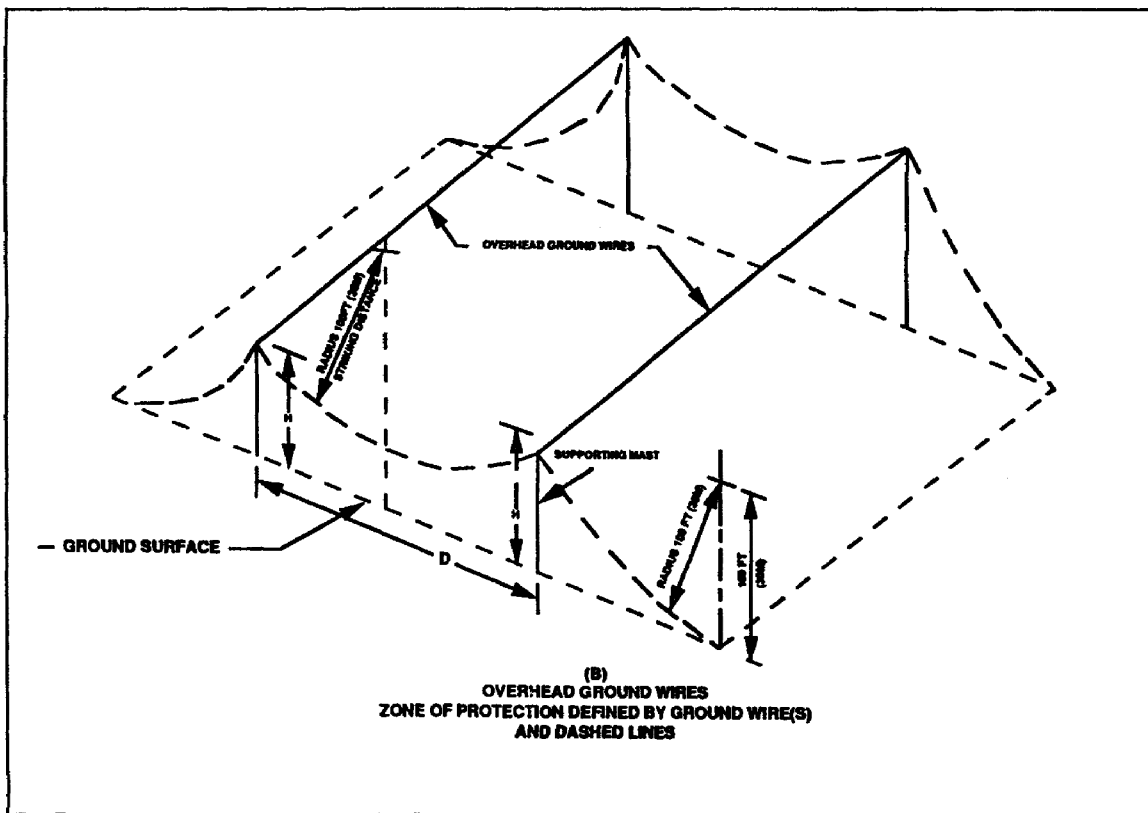
Separately-Mounted Shielding Systems (Overhead-Wire Types)

The separately-mounted shielding system (overhead-wire type)(Figure 6) consists of grounded, elevated horizontal metallic wires stretched between the mast surrounding the structure. This system minimizes hazardous side flashes. This system is often recommended especially for structures with perimeters greater than 300 feet.

Grounding, Bonding, and Surge Protection

Grounding. When a ground rod is necessary a resistance of 10 ohms or less to ground for a lightning protection system is the desired optimum. If ohms resistance cannot be achieved with ground rods alone, a counterpoise system is acceptable even if it is greater than 10 ohms.

Bonding. The bonding of metallic bodies is required to ensure that voltage potentials due to lightning are equal everywhere in the facility. The resistance of any metal object bonded to the lightning project is equal to 1 ohm \pm 10 percent of the system.



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Figure 6. Separately-mounted shielding system (overhead-wire type).

Surge Protection. A lightning protection system for structures housing sensitive materials shall be designed for surge protection as well as lightning strokes interception. Lightning flashes may produce electromagnetic pulses that may couple internal and external power.

Inspecting and Testing

Lightning protection systems must be visually inspected every seven months. They must be tested for continuity and grounding every 14 months.

Test Instruments

Only test instruments designed specifically for earth and ground mast system testing should be used. The instrument must be able to measure 10 ohms \pm 10 percent for bonding testing.

OPERATIONAL SAFETY

Personnel charged with responsibilities for ammunition must be motivated and reminded continuously that their safety, as well as that of others, depends upon the care they use in performing their assigned duties. They must ensure that:

- The minimum number of personnel are exposed for the minimum amount of time to the smallest quantities of explosives consistent with safety and efficiency.
- Only required personnel work on an operation.
- Safety precautions are observed and enforced rigorously.

- Safety signs are posted in work areas.
- Careless workers are disciplined and careful workers are rewarded.
- No unauthorized operations are performed.
- All operations are supervised properly.

PERSONNEL SAFETY

Hazard Assessment

Assessment of risk will be performed on all new or modified industrial operations and facilities involving ammunition and explosives. The assessment should include the following factors:

- Initiation sensitivity.
- Quantity of materials.
- Heat output.
- Rate of burning.
- Potential ignition and ignition source.
- Personal exposure.

Permissible Exposure

Workers should be protected from potential blast overpressures, fragments, thermal effects, and circulatory hazards.

Blast Overpressure. Blast overpressure refers to the violent release of energy from a detonation that gives rise to a sudden increase in gas pressure. This sudden increase is the blast or shock wave. The blast wave, with concurrent overpressure, rises rapidly at its source, reaches a peak and then decreases as it radiates out from its source, acting on structures and personnel.

Fragment Distance. The fragment distance for a particular ammunition or explosive item is based on the range and density equal to at least 58 foot-pounds of impact energy per fragment in an area of 600 square feet or less.

Thermal Effects. Thermal shielding should be used if available. This may be a fire blanket or thermal protective clothing as used by the fire department.

Circulatory Hazards. Individuals in the area should have the current service mask or a SCBA when working in a highly toxic or oxygen deficient environment.

MATERIALS HANDLING EQUIPMENT SAFETY

Operation of MHE requires extreme caution. The design and size of this equipment often limits vision and makes movement awkward. Signs should be posted in the immediate area where MHE is operating. Safety rules should be established for MHE operators and those working near such equipment, and should be enforced. For example, personnel should never be allowed to approach MHE from the operator's blind side. Size and load limits must be established and enforced. Operators must be aware of the danger and responsibility involved.

The following basic rules should be followed:

- Keep hazardous material moving uniformly through the process steps.
- Minimize rehandling.
- Eliminate heavy manual lifting.
- Reduce transportation distances whenever possible.
- Provide special handling equipment where practicable.

PRACTICE EXERCISE

The following items will test your grasp of the material covered in this subcourse. There is only one correct answer for each item. When you complete the exercise, check your answers with the answer key that follows. If you answered any item incorrectly, study again that part of the lesson that contains the portion involved.

1. How many fire divisions are there for ammunition and explosives?
 - A. One.
 - B. Two.
 - C. Three.
 - D. Four.

2. When may half-size fire placards be used?
 - A. On motor vehicles or railcars carrying munitions.
 - B. To identify a block of magazines with similar hazards.
 - C. On individual stacks of ammunition.
 - D. When authorized by the local commander and fire marshall.

3. What are the four types of lightning protection systems?
 - A. The positive-ground systems, the negative-ground systems, and the free-style systems.
 - B. The integrally-mounted systems, the separately-mounted shielding systems (mast type), and the separately-mounted shielding systems (overhead-wire type).
 - C. The separately-mounted shielding systems (mast types), the integrally-mounted systems (overhead-wire types), and the integrally-mounted systems (mast type).
 - D. The positive-ground systems, the negative-ground systems, and the overhead-wire systems.

4. What color are the figure and rim of the chemical hazard symbol (fire fighting) that requires Clothing Set 2?
 - A. Red.
 - B. Blue.
 - C. Yellow.
 - D. Green.

5. How frequently must an ammunition storage facility's lightning protection system be tested for continuity and grounding?
 - A. Every 12 months.
 - B. Every 14 months.
 - C. Every 16 months.
 - D. Every 18 months.

PRACTICAL EXERCISE ANSWERS AND FEEDBACK

1. D. As a guide to fire fighters, ammunition and explosives are divided into four fire divisions according to the hazard encountered. (Page 4, para 6).
2. A. Half-size fire placards may be used on doors or lockers inside buildings, on motor vehicles, and on railcars. (Page 4, para 7).
3. C. Approved lightning protection systems are the integrally-mounted systems, the separately-mounted shielding systems (mast type), and the separately-mounted shielding systems (overhead-wire type). (Page 8, para 1).
4. C. The color of the figure and rim of the chemical hazard symbol (fire fighting) that requires Clothing Set 2 is yellow. (Page 7, para 6).
5. B. An ammunition storage facilities lightning protection system must be tested for continuity and grounding every 14 months. (Page 10, para 2).