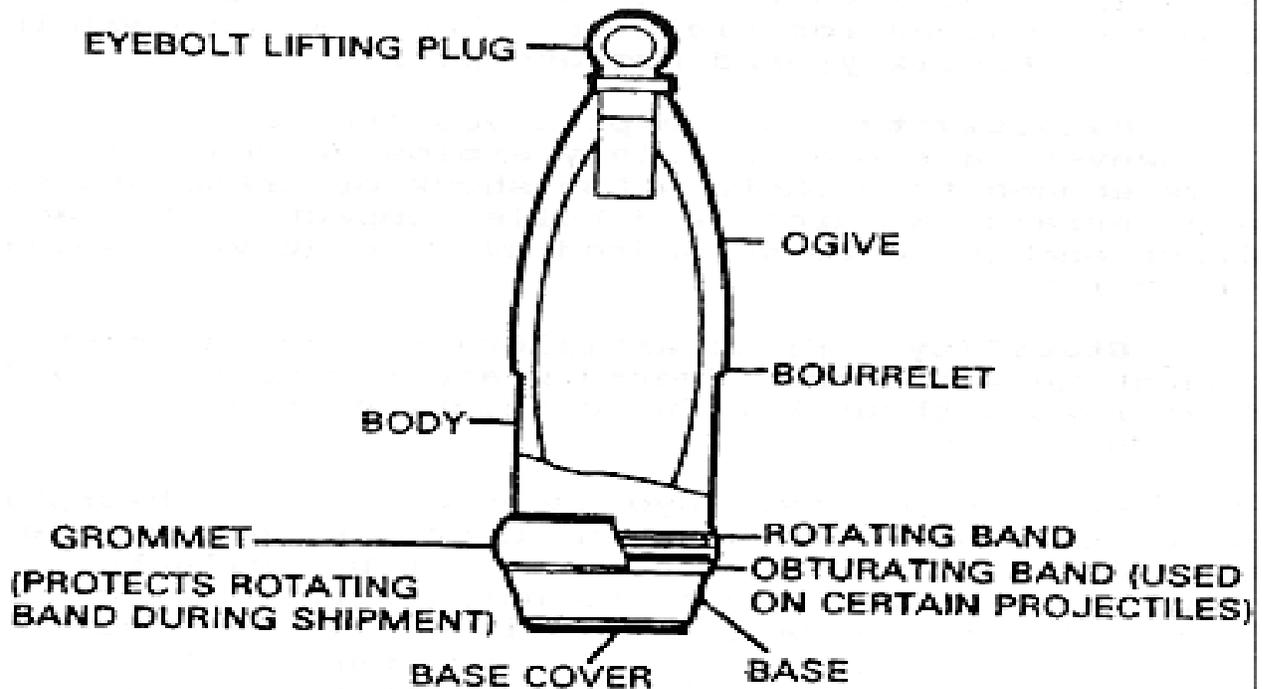


US ARMY FIELD ARTILLERY SCHOOL

FIELD ARTILLERY
CANNON AMMUNITION



THE ARMY INSTITUTE FOR PROFESSIONAL DEVELOPMENT
ARMY CORRESPONDENCE COURSE PROGRAM

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FIELD ARTILLERY AMMUNITION

Subcourse FA 3117

EDITION B

United States Army Field Artillery School
Fort Sill, Oklahoma 73503

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SUBCOURSE OVERVIEW

This subcourse is designed to enable you to select, inspect and assemble compatible field artillery ammunition components. This includes identifying the procedures for setting fuze options on currently fielded fuzes. You will also be able to identify the correct sequence of functioning for fuzes, projectiles, propellant, and primers.

There are no prerequisites for this subcourse.

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

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

TERMINAL LEARNING OBJECTIVE

ACTION: Verify the preparation of semi-fixed and separate loading ammunition.

CONDITION: Given the material contained in this lesson and the examination, verify the preparation of semi-fixed and separate loading ammunition.

STANDARD: To demonstrate competency in this task, you must achieve a minimum of 70% on the subcourse examination.

LESSON 1

FIELD ARTILLERY AMMUNITION CHARACTERISTICS

Critical Task: 061-266-1508/061-266-1506

OVERVIEW

LESSON DESCRIPTION

In this lesson you will learn to differentiate between semi-fixed and separate loading ammunition. You will also be able to identify the four components of a complete artillery round.

TERMINAL LEARNING OBJECTIVE:

ACTION: Differentiate between semi-fixed and separate loading ammunition and identify the four components of a complete round.

CONDITION: Given the material found in this lesson.

STANDARD: Correctly answer all questions in the practice exercise at the end of this lesson.

REFERENCES: This lesson is based on TM 43-0001-28, FM 6-50, and other materials approved for US Army Field Artillery School instruction; however, development and progress render the text continually subject to change. Therefore, base your examination answers on material presented in this text rather than individual or unit experience.

INTRODUCTION

The field artillery has the proud reputation of being the number one casualty producer on the battlefield. This distinction has earned the field artillery the name, "King of Battle". What makes the field artillery so powerful is its ammunition. However, ammunition will not cause the desired effects on the target unless the right fuze/shell combinations are assembled for firing. Therefore, it is necessary for field artillerymen to understand the different types of projectiles and fuzes, and which are compatible. Only through this knowledge can we maintain our reputation as the top casualty-producing branch, and safely deliver the firepower that influences the battlefield.

PART A - AMMUNITION BASICS

1. Artillery ammunition classification.

Ammunition is that class of supply containing a propellant and either an explosive or chemical filler. The dividing line between field artillery ammunition and small-arms ammunition is 37 millimeters (mm). Ammunition for weapons of 37-mm or greater is gun or artillery ammunition; ammunition for weapons of less than 37-mm is small-arms ammunition. Field artillery ammunition is classified according to use, filler, and type.

a. **Classification of ammunition according to use.**

Ammunition is classified according to its use as (Figure 1-1).

<u>USE</u>	<u>AMMUNITION CLASSIFIED BY:</u>	
	<u>FILLER</u>	<u>TYPE</u>
Service Ammunition	High Explosive	Semi-fixed Ammunition
Practice Ammunition	Chemical	Separate Loading
Blank Ammunition	Antipersonnel	
Drill Ammunition		

Figure 1-1. Classifications of Ammunition

(1) **Service ammunition.** Service ammunition is used in combat. Depending on the type of projectile, service ammunition may be high-explosive (HE), chemical (gas, smoke, or illuminating), canister, high-explosive plastic, antipersonnel flechette (APERS), or improved conventional munition (ICM).

(2) **Practice ammunition.** Practice ammunition is used in simulated combat and in training.

(3) **Blank ammunition.** Blank ammunition is used for firing salutes and simulated fire. It has no projectile.

(4) **Drill ammunition.** Drill (dummy) ammunition is used for training in handling and loading (service of the piece). Drill ammunition is inert.

b. **Classification of ammunition according to filler.** Field artillery ammunition is also classified according to its projectile filler as high-explosive, chemical, or antipersonnel.

(1) **High explosive.** HE fillers are chosen for their detonating or rapid decomposing ability. When the high-explosive filler is ignited, it decomposes rapidly and

violently, giving off heat, light, and gaseous products. The sudden expansion of gases formed by the decomposition of the HE filler causes the projectile to literally explode, producing the desired projectile fragmentation.

(2) **Chemical.** Chemical fillers for field artillery projectiles contain agents designed to produce harassing or lethal effects on personnel (chemical and white phosphorous), form smoke screens denying observation to the enemy, and provide illumination for adjusting fire and restricting enemy movement at night.

(3) **Antipersonnel.** Antipersonnel (APERS or Beehive) fillers used in field artillery projectiles contain thousands of steel flechettes (darts) or numerous grenades. These are dispersed over a large area when the projectile is activated. These produce a far greater casualty effect than the fragmentation of projectiles filled with high explosive.

C. Classification of ammunition according to type. There are three types of ammunition, fixed, semi-fixed and separate loading. Ammunition fired from small caliber weapons (i.e., rifle or pistol ammunition) is fixed. Classification of field artillery ammunition according to type is based on the preparation and assembly of the components (i.e., fuze, projectile, propellant, and primer) for firing. Complete rounds of field artillery ammunition are known as either semi-fixed or separate-loading rounds.

(1) **Semi-fixed ammunition** is characterized by having a projectile, loosely fitted to a cartridge that contains an adjustable propelling charge. The propellant is divided into increments, or charges. Each increment of propellant is contained in a cloth bag. The increments, or charges, are tied together and stored in the cartridge case. The howitzer crew adjusts the propelling charge by removing the projectile from the cartridge case, removing unneeded increments, and returning the projectile to the cartridge case. The primer is an integral part of the cartridge case, and, thus, the complete round can be loaded into the weapon in one operation. Semi-fixed ammunition is used in 105-mm howitzers and may be issued fuzed or unfuzed.

NOTE: The high-explosive plastic tracer (HEP-T) round does not have an *adjustable propelling charge*, but it is considered *semi-fixed ammunition*. It is used *against enemy tanks*. The *-T* in the abbreviation indicates the *round is equipped with a tracer element to allow the gunner to correct his aim against enemy targets*.

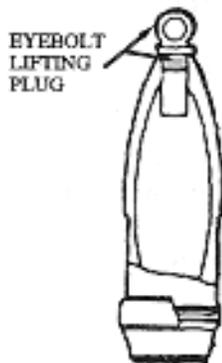


Figure 1-2. Eyebolt Lifting Plug

1-3

(2) **Separate-loading ammunition**

Has four separate components; primer, propellant, projectile, and fuze. These components are issued separately. At the firing point, the eyebolt-lifting plug (Figure 1-2) is removed from the projectile, the fuze installed, and the fuzed projectile is loaded. The primer and propellant are loaded in two separate operations.

Separate-loading ammunition is designed for use in large-caliber guns and howitzers such as the 155-mm and 203-mm howitzers.

d. **Ammunition terminology.** Fundamental to the study of any technical subject is an understanding of technical terms not commonly part of the vocabulary of the average student. A few terms, applicable to field artillery ammunition, are explained in (1) through (6) below.

(1) **Explosive.** An explosive is a gaseous or solid substance that, when affected by a sudden increase in pressure and/or temperature, undergoes a violent chemical reaction (decomposition). This results in the simultaneous release of great quantities of light, heat, and gas. The rate of decomposition of a mass or column of explosive under controlled conditions (in measurable feet or meters per second) determines whether the substance is classified as a high explosive or a low explosive.

(2) **Velocity.** Measured in feet or meters per second, velocity is the rate of decomposition of a solid substance. The rate of decomposition of a substance is controlled by the ingredients of the substance; by the design, size, and shape of the substance (powder grain); and by the chamber of the weapon for which a particular powder grain is designed. When the substance is a low explosive (i.e., propelling charges), the decomposition rate is called the deflagration velocity. When the substance is a high explosive (i.e., bursting charges), the decomposition rate is called detonating velocity.

(3) **Deflagration.** The process by which the outer layer of a substance burns and transmits the burning effect to the inner layers of the substance is called deflagration.

(4) **Detonation.** Detonation is the violent, noisy decomposition of a high explosive such as occurs with a high-explosive projectile.

(5) **Power.** Power is the ability of an explosive to displace or move its surrounding medium.

(6) **Brisance.** As opposed to power, brisance is the ability of an explosive to shatter its surrounding medium.

e. **Characteristics of explosives.** Certain characteristics are common to all explosives. Some of the more important characteristics required for field artillery cannon ammunition are sensitivity, stability, and hygroscopicity.

(1) **Sensitivity.** All explosives are sensitive to some degree. However, a field artillery explosive must be insensitive enough to withstand the shock of transportation over rough terrain, airdrop, and bullet impact. It also must be sensitive enough to be detonated by a relatively small detonator or fuze.

(2) **Stability.** Field artillery explosives must be stable enough to withstand adverse weather conditions and years of depot storage without harmful chemical or physical deterioration.

(3) **Hygroscopicity.** Hygroscopicity (the absorption and retention of moisture) can have an adverse effect on the stability, sensitivity, and reactivity of propellants. Moisture in a propellant slows its burning rate, which, in turn, affects the deflagration velocity of the propellant. It also affects the muzzle velocity of the weapon, and the distance that a projectile will travel through the air. Therefore, a substance with negligible hygroscopicity is used for artillery propelling charges to avoid the reduction of chamber pressure, muzzle velocity, and range caused by "wet" propellants.

2. Projectile Identification.

e. The exterior components of an artillery projectile are shown in Figure 1-3 and explained below.

(1) **Eyebolt lifting plug and fuze well plugs.** Separate-loading projectiles (155-mm, 203-mm) have an eyebolt lifting plug for lifting. It keeps the fuze well clean, dry, and free of foreign matter and protects the fuze well threads. 105-mm projectiles have a metal hex plug or plastic closing plug. The plug is removed and the appropriate fuze inserted. Some special-purpose semi-fixed projectiles (Beehive, for example) are issued with fuzes already assembled.

(2) **Ogive.** The ogive, which is the curved portion of a projectile between the fuze well and the bourrelet, streamlines the forward portion of the projectile.

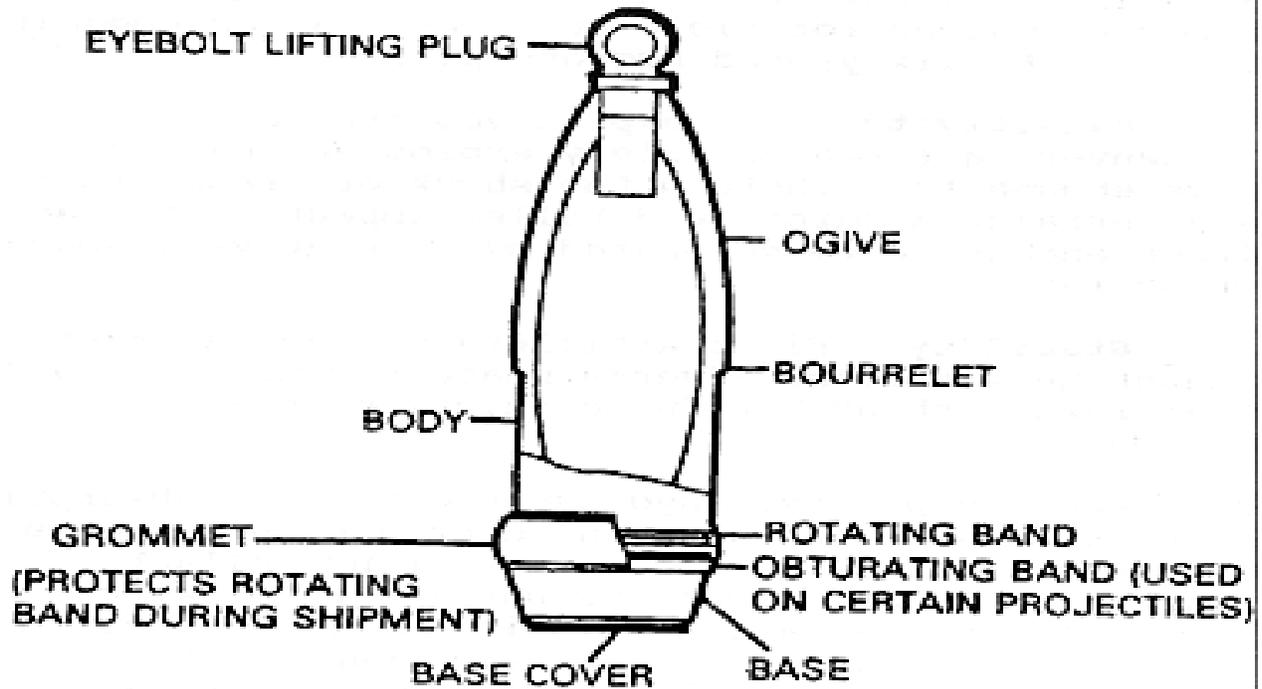


Figure 1-3. Exterior components of projectiles

(3) **Bourrelet.** The bourrelet is an accurately machined surface slightly larger than the body and located immediately to the rear of the ogive. It centers the forward part of the projectile in the tube and bears on (i.e., makes contact with) the lands of the tube. When the projectile travels through the bore, only the bourrelet and the rotating band of the projectile bear on the lands of the tube.

(4) **Body.** The body is the cylindrical portion of the projectile between the bourrelet and the rotating band. It is machined to a smaller diameter than the bourrelet to reduce the surface in contact with the lands of the bore. The body contains most of the projectile filler.

(5) **Rotating band.** The rotating band is a cylindrical ring of comparatively soft metal pressed into a knurled, or roughened, groove near the base of the projectile. It mates with the forcing cone of the tube to eliminate gas wash by making a seal between the round and the tube (forward obturation). The rotating band, in conjunction with the rifling of the tube, causes the projectile to rotate. It also prevents the escape of propelling gases past the moving projectile. A properly rammed separate loading projectile is held in the tube at all angles of elevation by the wedging action of the rotating band against the forcing cone.

(6) **Obturing band.** Some projectiles have a nylon obturing band below the rotating band to assist in forward obturation. Two examples of 155-mm projectiles with this type of band are the illuminating and high-explosive rocket-assisted (HE-RA) rounds.

(7) **Base.** The base is the portion of the projectile below the rotating band or obturing band. The most common is the boat tail base. This type streamlines the base of the projectile, and gives added stability in flight.

(8) **Base cover.** The base cover is a metal cover that is crimped, caulked, or welded to the base of the projectile to prevent hot gases of the propelling charge from coming in contact with the explosive filler of the projectile through possible flaws in the metal of the base.

b. **Projectile painting.** The primary reason for painting field artillery projectiles is to prevent rust; however, the use of color coding provides a prominent means of identification. A system of, contrasting color markings or bands is used in addition to the basic color to identify the particular type of high-explosive or chemical used as a filler. For many years, the basic colors used have been olive drab (OD) for high-explosive rounds, gray for chemical rounds, blue for practice rounds, and black for drill rounds. Color coding of recent production projectiles is somewhat different (Table 1-1). For example, illuminating and smoke rounds are no longer painted gray, the basic color for chemical shells. Illuminating rounds are now painted white or olive drab, and the smoke rounds are painted green. The basic color for drill (dummy) ammunition has been changed to bronze.

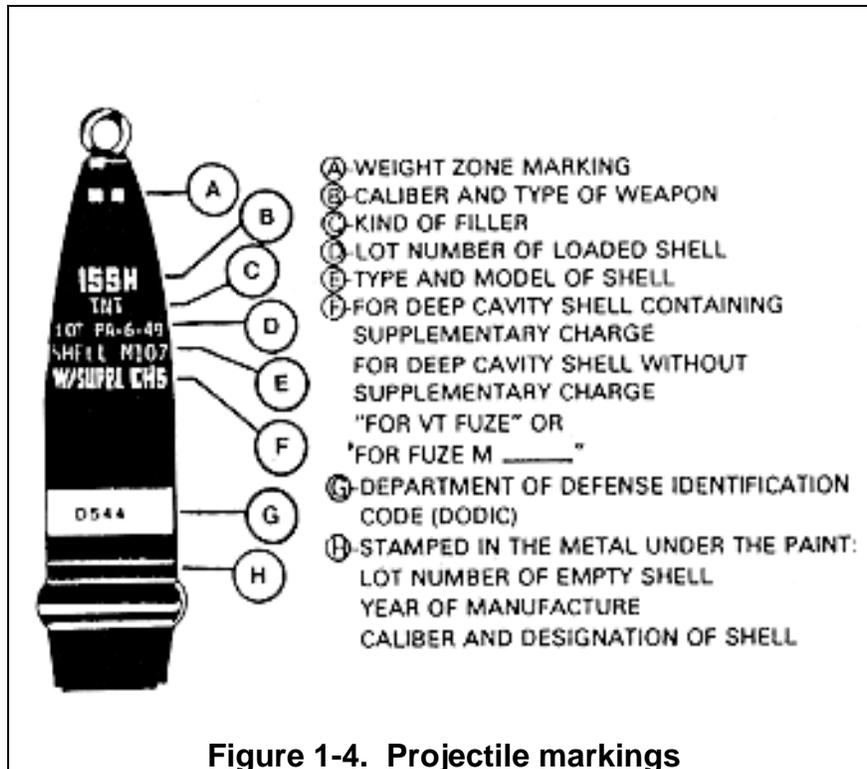
Ammunition	Painting and Marking of Ammo of Earlier Manufacture	Painting and Marking of Ammo of Recent Manufacture
HE HEAT HEP (over 40-mm)	Olive drab w/yellow marking Olive drab w/yellow marking Olive drab w/yellow marking	Olive drab w/yellow marking Black w/yellow marking Olive drab w/black band and yellow marking
Smoke (except WP or PWP)	Gray w/one yellow band and yellow marking	Light green w/black marking
Smoke (WP or PWP)	Gray w/one yellow band and yellow marking	Light green w/yellow band and light red marking
Illuminating (semifixed)	Gray w/one white band and white marking	White w/black marking
Illuminating (separate-loading)	Gray w/one white band and white marking	Olive drab w/white band and white marking
Practice wo/explosive filler	Blue or black w/white marking	Blue w/white marking
Practice w/high-explosive filler	Blue or black w/white marking	Blue w/yellow band and white marking
Practice w/low-explosive filler	Blue or black w/white marking	Blue w/brown band and white marking
Chemical:		
Persistent toxic agent	Gray w/two green bands and green marking	Gray w/two green bands and green marking (one yellow band w/explosive burster)
Nonpersistent toxic agent	Gray w/one green band and green marking	Gray w/one green band and green marking (one yellow band w/explosive burster)
Persistent irritant agent	Gray w/two red bands and red marking	Gray w/two red bands and red markings (one yellow band w/explosive burster)
Nonpersistent irritant agent	Gray w/one red band and red marking	Gray w/one red band and red marking (one yellow band w/explosive burster)
G and V series agents	Gray w/one green band for G series, two green bands for V series, and green marking	Gray w/three green bands and green marking (one yellow band w/explosive burster)
AP and APDS wo/filler	Black w/white marking	Black w/white marking
AP w/high-explosive filler	Black w/yellow marking	Black w/yellow marking
APERS w/flechattes	Black w/white marking	Olive drab w/yellow band, white marking, and white diamonds
Canister w/slugs	Black w/white marking	Olive drab w/white marking
Canister w/flechattes	Black w/white marking	Olive drab w/white marking and white diamonds
Dummy	Black or blue w/white marking	Bronze w/white marking

Table 1-1. Painting and marking ammunition

c. **Projectile marking.** In the marking of a projectile (Figures 1-4 and 1-5), each letter and number serves a specific purpose. At the top of a typical separate-loading projectile is the weight zone marking. Since variations in weight occur in the manufacture of projectiles containing explosive or chemical agents, most projectiles are marked to indicate their weight (squares). When increased accuracy in firing is required, the number of squares stenciled on the projectile are compared to data in the firing tables of the weapon to determine the appropriate ballistic corrections. Weight zone marking symbols for standard weight projectiles are as follows:

Caliber of projectile 105 – mm 155 – mm and 203 mm	Standard weight zone 2 squares  4 squares 
--	---

The marking (Figures 1-4 and 1-5) consists of a number (155 or 105), which is the weapon caliber, and a letter (H), which is the type of weapon (H for howitzer and G for gun).



The next marking designates the kind of filler in the projectile. In Figures 1-4 and 1-5, this filler is TNT.

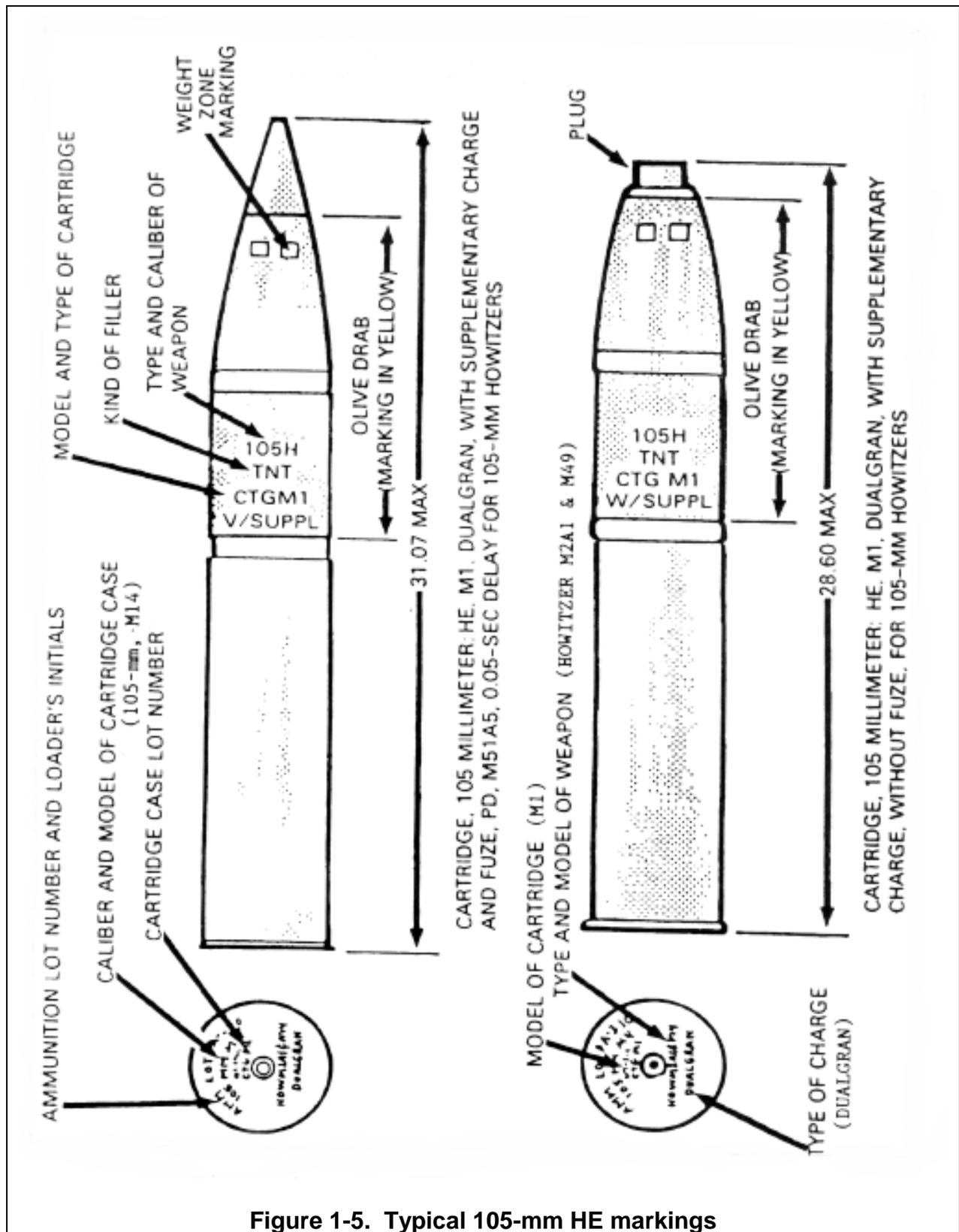


Figure 1-5. Typical 105-mm HE markings

- The number painted below the filler designation, is the lot number of the complete round (Separate loading ammunition, Figure 1-4) or the loaded projectile (semifixed ammunition, Figure 1-5), and is an essential part of the ammunition marking. It is required for all records, including reports on the ammunition condition and functioning, and on any accidents in which the ammunition is involved. All the components in any one lot are manufactured under conditions as identical as possible to ensure common functioning. When semi-fixed ammunition is fired, successive rounds should be of the same lot number (i. e., fuzes of the same lot number, and primers of the same lot number).

NOTE: The lot number is assigned when the projectile is *manufactured*.

- Markings indicating the type and model of the shell are self-explanatory.
- The marking "W/SUPPL CHG" indicates the projectile has a deep cavity with a supplementary charge.

NOTE: The supplementary charge must be removed when using a long intrusion VT (*variable time*) fuze.

- In Figure 1-4, notice the marking D544. This is a Department of Defense Identification Code (DODIC) which is added to the National Stock Number (NSN). NSNs will appear on projectiles. National Stock Numbers **(for example, NSN 1320-00-529-7331)** have replaced the old Federal Stock Numbers (FSN), the old Ammunition Identification Codes (AIC), and ordnance stock numbers. Each item of supply has a different National Stock Number. The first four digits of an NSN are always the Federal Supply Classification (FSC) to which the item belongs. The next two digits identify the country of origin. Continental United States, for example, uses 00 and 01. Some of the other NATO countries use their assigned digits, for example, 12 for Germany, 15 for Italy, and 21 for Canada. The next seven digits constitute the National Item Identification Number (NIIN). The dash between the third and fourth digits of the NIIN serves to reduce errors in radio transmission. Each item has a different national item identification number. The DODIC is added as a suffix to the NSN, for example, 1320-00-529-7331 (D544). The Department of Defense Ammunition Code (DODAC) has eight characters, consisting of the four-character FSC code number and the DODIC; for example, 1320-D544. A typical DODAC consists of FSC, class 1320, and DODIC D544, which identifies a 155-mm high-explosive projectile, M107. The same DODIC suffixed to more than one NSN indicates items interchangeable for issue and use (Figure 1-4).

d. **Mnemonic identification.** The introduction of automated fire control systems like the Battery Computer System (BCS) and the Back-Up Computer System (BUCS) modified projectile and fuze written identification procedures. These new procedures use mnemonics--three or four-letter designations for particular projectiles and fuzes. Refer to Appendix A for a complete list of mnemonics. Note the only four-letter mnemonic is for the M557, M572, and M739 fuze. These fuzes are point-detonating with a delay option. They will be covered in Lesson 3.

PART B - EXPLOSIVE TRAINS.

1. Definition of Explosive Trains.

General. An explosive train is an arrangement of explosives, beginning with a small quantity of sensitive explosive and progressing through a large quantity of comparatively insensitive, though powerful, explosive (Figure 1-6). There are two explosive trains in each conventional round of artillery

ammunition--a propelling charge explosive train and a projectile explosive train (Figure 1-7a thru 1-7c). The function of the projectile in the target area depends on the type of projectile filler. For train of a complete round example, the explosive of HE ammunition consists of the propelling charge explosive train, (primer, igniter, and propellant) and the bursting charge explosive train (projectile explosive train), containing a fuze, a booster, and a bursting charge.

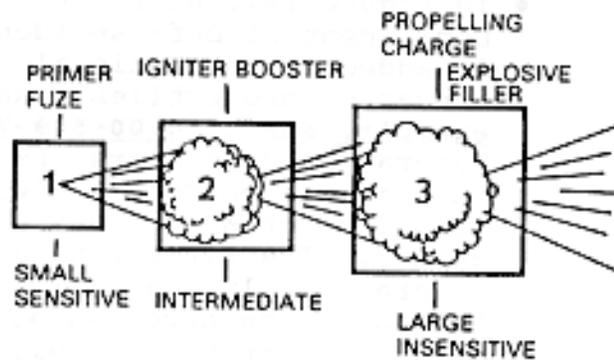


Figure 1-6. Explosive train principle

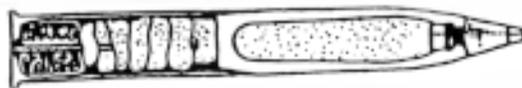


Figure 1-7a. Two explosive trains in an HE cartridge before firing

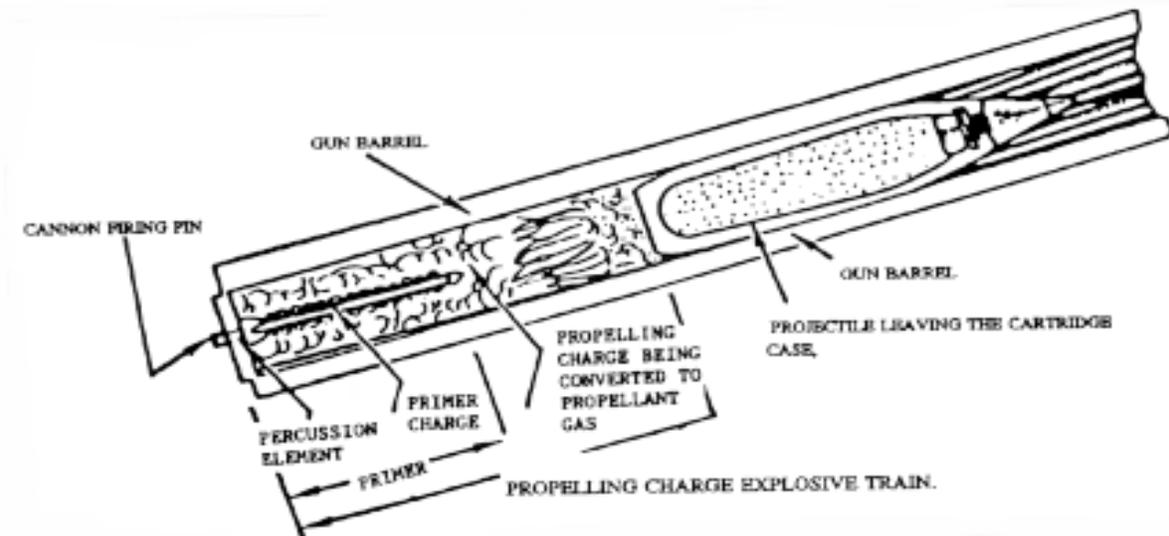


Figure 1-7b. Propelling charge explosive train upon firing

PROJECTILE AT INSTANT AFTER STRIKING TARGET (SUPERQUICK ACTION). FUZE AND BOOSTER ARE FUNCTIONING; BURSTING CHARGE IS ABOUT TO BURST THE PROJECTILE.

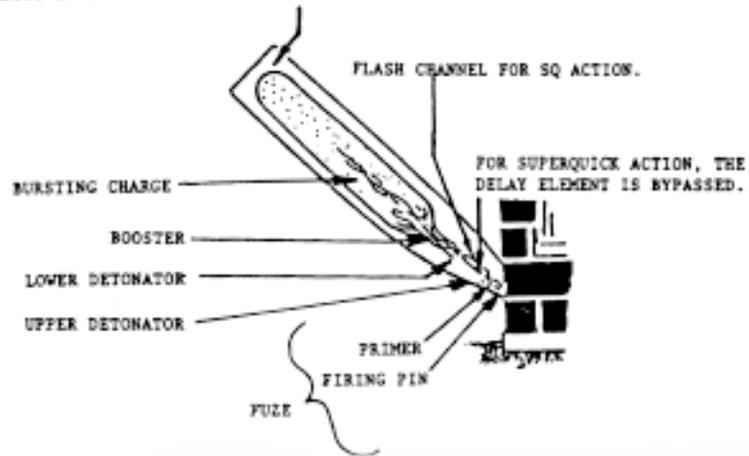


Figure 1-7c. Bursting charge explosive train on impact

2. Components of a Propelling charge explosive train.

a. **Primers.** The propelling charge explosive train is initiated by a small amount of a very sensitive explosive (such as, fulminate of mercury, lead azide, or lead styphnate) used as the percussion element, or primer. The primers are sensitive to shock, friction, spark, or flame; therefore, they must be protected and separated from other components. The primer for semi-fixed ammunition is an integral part of the cartridge case. It comes with the complete round and remains with it at all times. The primer for a round of separate-loading ammunition comes as a separate item of issue. It must be stored separately. The primer is not added to the round until the fuze projectile has been rammed into the powder chamber, the powder charge placed into the chamber, and the breechblock closed. The primer is then inserted into the firing mechanism and locked in position to fire the round.

b. **Igniters.** A charge of propellant in a powder chamber is ignited when the space between the grains of powder and the perforations in the powder grains are filled with flaming gas and hot particles. For many years, this ignition action was performed by the use of black powder. If kept dry, the powder retains its explosive properties indefinitely. However, black powder is very hygroscopic and deteriorates rapidly if it absorbs moisture. The introduction of Clean Burning Igniter (CBI) has eliminated the use of black powder in igniters.

(1) The igniter for a round of semi-fixed ammunition is an integral part of the primer.

It consists of a perforated tube filled with black powder, permanently mounted in the cartridge case.

(2) The igniter for a round of separate-loading ammunition is a red pancake-shaped bag

of either black powder or CBI. The igniter bag is sewn to the base charge of the propellant.

c. **Propellants.** A propellant only burns on the surface. The burning progresses as though the powder grain consisted of very thin layers--each layer burning and igniting the next layer. Under conditions of constant pressure, the burning progresses through the powder at a steady linear rate peculiar to the composition of the powder being used. The mass rate of burning of a propellant charge is determined by the physical form of the powder grain. Thus, through control of the form of the powder grain, the ballistic effect of a propellant charge is determined and kept within certain limits. Basically, the greater the capacity of the powder chamber, the larger the size of the powder grain used (Figure 1-8).

POWDER GRAIN FORMS

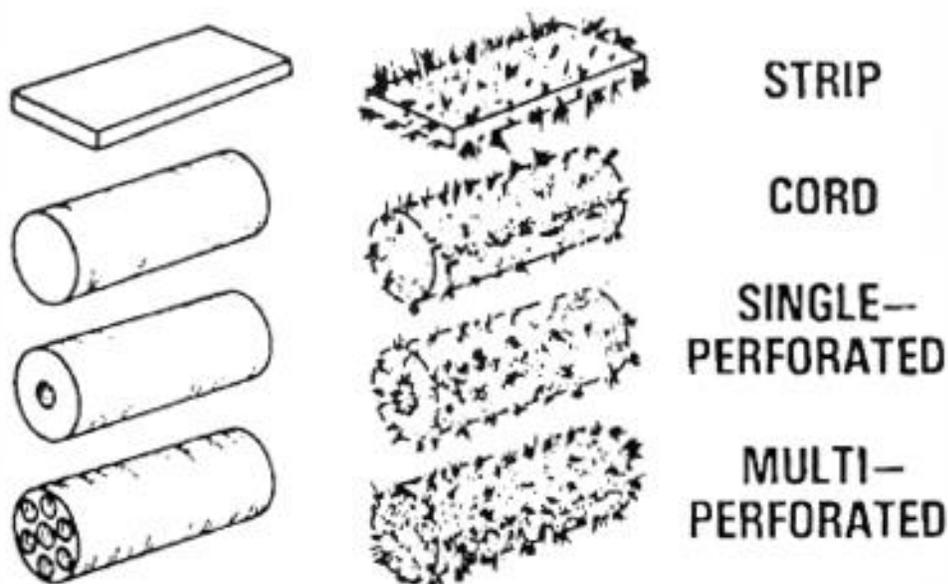


Figure 1-8. Types of powder grain

(1) **Forms of powder grain.** Powder grain used in current field artillery cannons are the single-perforated and the multiperforated propellant powder grains (Figure 1-8).

- **Single-perforated grain.** As the single-perforated grain burns, the outer surface decreases and the inner surface increases. As a result of these two actions, the initial diameter of the perforation can be controlled so that the total burning surface remains nearly constant until the powder grain has been consumed. Such burning is called neutral burning.
- **Multiperforated grain.** When multiperforated powder grain burns, the total surface area increases because the perforated grain burns from the inside and outside at the same time. This is called progressive burning. When a multiperforated grain is not completely consumed, portions of the grain remain in the form of slivers and usually are ejected from the weapon.

(2) **Uses of powder.** Both the single-perforated and multi perforated powder grains are used in field artillery cannons to obtain the optimum muzzle-velocity to chamber pressure ratio (NOTE: The M198 howitzer firing propelling charge M203AI will use the M31A1EI stick propellant). Table 1-2 shows the design and composition of the green bag and white bag powder charges used for the 155-mm and 203-mm field artillery weapons.

(3) **Flashless-smokeless powder.** Smoke from propelling charges has long been a problem for artillerymen because it reveals the location of the howitzer. Improvements in propellant composition has significantly reduced the smoke problem, but has created increased muzzle flash, which reveals the location of the howitzer at night. Whether a propelling charge is actually flashless or smokeless depends on a number of things--the weapon in which the charge is used, the type of ignition used, the wear on the tube of the weapon the temperature of the tube, and the quantity and propellant. Under standard conditions, flashless ammunition does not flash more than 5 percent of the time in average life. Smokeless ammunition produces less the amount of smoke produced by ammunition not so A complete round having both these characteristics is designated flashless-smokeless. Solvent is added to the finished powder grains to give the smokeless characteristic. A cooling agent is added to the propellant to cool the unburned gases below the kindling temperature and thereby reduce flash.

(4) **Arrangement and identification of propelling charges.** Semi-fixed or separate-loading ammunition and the form in which the charge is assembled depend upon the type of weapon in which it is to be fired.

- Semi-fixed ammunition is characterized-by an adjustable propelling charge divided into increments or charges contained in cloth bags. The bags are held together by a thin nylon string and stored in the cartridge case. The cartridge case is loosely fitted to the projectile which allows for quick disassembly to adjust the propelling charge. The charges consists of two increments (bags) of single- perforated grains (Increments 1 and 2) and five increments of multiperforated grains (Increments 3 through 7). The primer is an integrated part of this casing. Semifixed ammunition is used in 105-mm howitzer and may come fuzed or unfuzed.
- Separate-loading ammunition components (primer, propellant, projectile, and fuze) are issued separately. Propelling charges consist of a base charge and a number of additional increments, packed in either green bags (for inner zones) or white bags (for out zones). A recent innovation in the 155-mm charges is the introduction of the M203AI, using the M31A1E1 solid case stick propellant firing charge 8S.

It has a red jacket to distinguish it from other high zone charges. The configuration and size of the powder grains, which determine the force of the propelling charge, and the arrangement of the charge are designed to take advantage of the versatility of the weapon. They also assist in extending the life of the tube and minimize the wasted propellant. The arrangement and identification of separate-loading propelling charges for 155-mm and 203-mm howitzers are shown in Table 1-2. Lesson 2 has more details on propelling charges.

(5) **Flash reducers.** Since it is necessary to use some propellants, with a high rate of burning so muzzle velocity is not impaired, flash reducers (Figure 1-9), containing black powder and potassium sulfate, are used to further reduce or prevent flash. Flash reducers also speed up the combustion of unburned propellant gases, which prevents excessive muzzle blast. Naturally, flash reducers are used at night to reduce flash. However, they are also used during day and night firing with certain weapons to speed up the combustion of unburned propelling charge gases to prevent excessive muzzle blast. Flash reducers absorb moisture readily, so it is critical that they be kept dry. Keep them off damp ground and sealed in their containers until needed. Discarded flash reducers should be disposed of in the same manner as unused propellant bags and in the case of the propellant for the 8 inch, the igniter pads. Table 1-2 contains special instructions on using flash reducers with certain propelling charges.

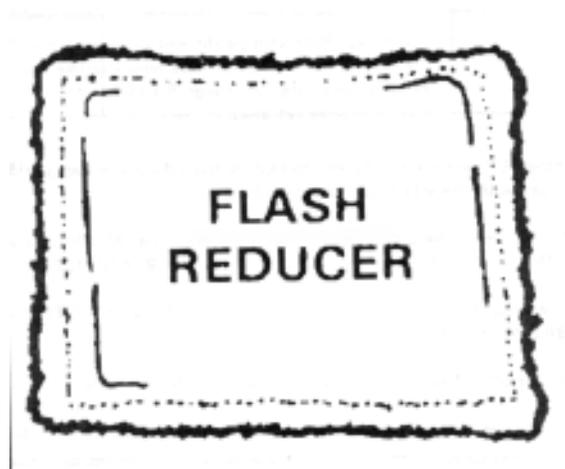
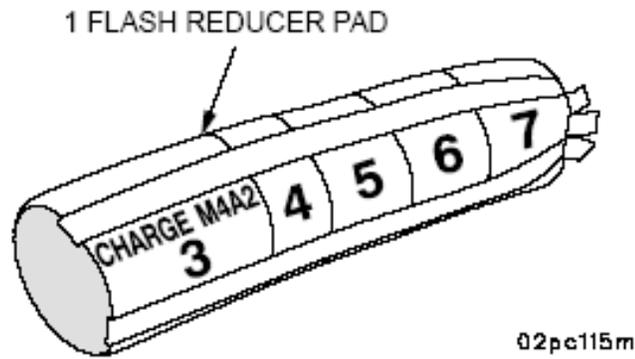
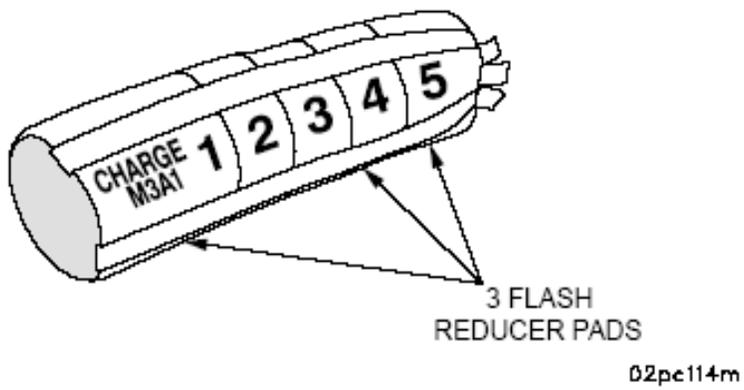


Fig. 1-9. Flash reducer



M4A2 PROPELLING CHARGE (WHITE BAG)



M3A1 PROPELLING CHARGE (GREEN BAG)

Table 1-2. Separate loading propelling charges

3. Components of the projectile explosive train.

a. **Types of fillers.** Every complete round fired to the target by the propelling charge explosive train also has a projectile explosive train to deliver the payload (filler) onto the target. There are many different types of fillers, to include high-explosive, chemical, gas, smoke, illuminant, grenade, and antipersonnel fillers. The projectile explosive train is activated by a fuze. In some rounds, the fuze has a booster, which amplifies the action of the fuze so that:

- the complete round is detonated (as in a conventional high-explosive round) or
- the booster tube is detonated (as in a chemical or white phosphorus [WP] round).

In other rounds, the fuze starts the action, and then the expelling charge either:

- ejects the payload in the target area (as in a base-ejection smoke round or an illumination round for a 105-mm or 155-mm howitzer), or:
- ejects a series of grenades (as in the improved conventional munitions rounds for all calibers of howitzers).

b. Types of projectile explosive trains.

(1) **Bursting charge explosive train.**

The second explosive train in a conventional round of high-explosive ammunition is a bursting charge explosive train (Figure 110). It consists of fuze, booster, and bursting charge. When the booster amplifies the detonation of the fuze through the explosive in the booster, the bursting charge explodes and shatters the projectile. The blast effect of the bursting charge and the fragmentation of the projectile send many small, jagged, sharp, irregularly shaped metal pieces flying through the target area. The bursting charge of a high-explosive projectile requires a powerful explosive force for detonation. The standard high-explosive fillers currently in use are trinitrotoluene (TNT) and Composition B (Comp B). Comp B produces 40 percent more fragmentation than TNT when used in standard high-explosive rounds. Special HE fillers include composition A3 (a high-explosive plastic), tritonal (a mixture of TNT and aluminum powder), tetryl, and tetrytol.

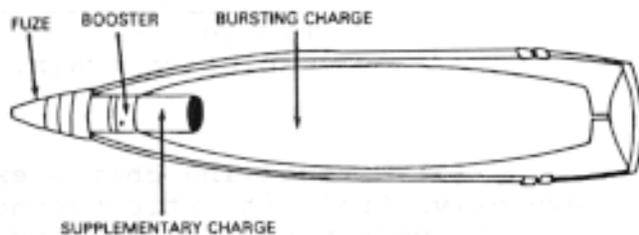


Figure 1.10 Bursting charge

(2) **Bursting tube explosive train.** The second explosive train in a chemical or white phosphorus round is a bursting tube explosive train (Figure 1-11). It consists of a fuze, a booster, and a small burster tube filled with tetryl or tetrytol. This tube extends through the longitudinal axis of the projectile. The shell contains gas or white phosphorus filler. When the fuze functions, the booster so amplifies the shock wave that the burster tube breaks open the projectile, allowing the chemicals to escape from the interior of the projectile and spread throughout the target area. These rounds are available for the 105-mm and 155-mm howitzers. The 203-mm howitzer does not have a white phosphorus round but has a gas-type round--the M426--that can be filled with either toxic nerve gas GB (nonpersistent) or VX (persistent).

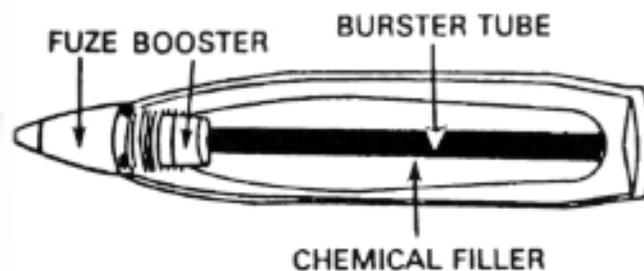


Figure 1-11. Bursting tube explosive train

(3) **Expelling charge explosive train.** The second explosive train in antipersonnel, smoke (including WP, and wick WP), illumination, and all ICM rounds is an expelling charge explosive train. The term "antipersonnel" refers to munitions designed to cause casualties, destroy materiel, or render equipment inoperable. There are three types of antipersonnel rounds used by the field artillery today; the flechette round, antipersonnel (APERS) M546 (Beehive) and two types of Improved Conventional Munitions (ICM) rounds. The M546 round differs from the rest of these rounds in that its payload is ejected forward; whereas, the payloads of other rounds are ejected through the base of the projectile. In all these rounds the action starts with the fuze and culminates in the pressure of the burning expelling charge that forces the payload onto the target.

NOTE: These and other *projectiles* that take advantage of the expelling *charge explosive train* [*Antipersonnel ICM (APICM)*, *Dual Purpose ICM (DPICM)*, *Extended Range DPICM (ERDPICM)*, *Area Denial Antipersonnel Munitions (ADAM)* and the *Remotely Activated Anti-tank Mine System (RAAMS)*] are discussed later in *Lesson 2*

PART C - FIELD ARTILLERY AMMUNITION HANDLING AND INSPECTION CRITERIA

1. Safety, Care and Handling.

A complete round of artillery ammunition contains all the components needed to get the round through the tube and to burst the round at the desired place and time. The key to proper ammunition functioning is protection from mud, heat, dampness, rough handling, fire hazards, etc.

a. **Safety.** Safety is a matter of concern for all battery personnel, and requires special attention where ammunition is concerned. Supervision is critical because improper care and handling can cause serious accidents as well as inaccurate fire. The following are some of the basic safety principles of proper ammunition handling:

- **Never tumble, drag, throw, or drop individual projectiles or boxes of projectiles.**
- **Do not allow smoking, open flame, or other fire hazards around ammunition storage areas.**
- **Inspect each round before it is loaded for firing. Dirty ammunition can damage the weapon, cause the breech not to close, or affect the accuracy of the round.**
- **Keep the ammunition dry and cool.**
- **Never make unauthorized alterations or mix components of one lot of propellant with another lot.**
- **If a round has been rammed and then must be extracted, *RETURN IT* to the battalion ammunition section. The rotating band or fuze may have been damaged. Fuzed rounds may be transported in the M992 vehicle.**
- **Leave the eyebolt lifting plug or closing plug screwed into the fuze well until the round is to be fuzed.**

b. Care and handling. Exercising care in the handling of ammunition is a matter of common sense. Explosive ammunition and components containing explosives should be handled with utmost care at all times. Explosive elements in primers and fuzes are particularly sensitive to shock and temperature extremes. Ammunition is packed to withstand conditions ordinarily encountered in the field. Waterproof metal containers or moisture-resistant containers and suitable packing boxes and crates are used to provide adequate protection for shipment and storage. General rules for the care of ammunition are listed below:

- **Prevent packing boxes from being broken or damaged. Repair all broken boxes immediately, and be sure that all markings on the original box are transferred to the repaired box.**
- **Protect ammunition and its components from mud, sand, moisture, frost, snow, ice, dirt, oil, grease, or other foreign matter. Wipe off wet or dirty ammunition at once, and remove any verdigris (discoloration) or light corrosion. Do not polish ammunition to make it look better.**
- **Do not break the moisture-resistant seal on a container until that ammunition is to be used. Ammunition removed from airtight containers, especially in damp climates, may corrode and become unserviceable.**
- **Protect ammunition, particularly fuzes and propelling charges, from sources of high temperature (e.g., direct rays of the sun).**

c. Keeping ammunition serviceable. The detailed precautions to be taken, and the detailed procedures to be followed in handling ammunition are described in pertinent technical manuals and field manuals for the weapon and ammunition used. The general rules listed below should be observed in order to keep ammunition in a serviceable condition and ready for immediate use.

- **Do not permit disassembly of components, such as fuzes and primers. Any alteration of ammunition, except by technically qualified personnel, is hazardous.**
- **Do not open sealed containers or remove protective or safety devices until just before use, except as required for inspection.**
- **Return ammunition that has been assembled but not fired to its original packing. Ensure all components are present and complete, and mark the packing appropriately. In subsequent firing, use repacked ammunition first. This will keep stocks of repacked ammunition containers to a minimum.**

2. Inspection Criteria.

a. **Projectiles.** Each projectile must be inspected to ensure there is no leakage of the contents, that the projectile is correctly assembled, and that the bourrelet and rotating band are smooth and free of burrs and large dents. If the rotating band is burred or nicked, it should be smoothed with a flat, fine-grained file or with crocus cloth backed with a small block of wood. The rotating band grommet must be secure and tight to prevent nicking and scarring the comparatively soft rotating band. Other points to remember concerning safety in the use of projectiles follow.

- **High-explosive projectiles issued for use with VT fuzes are standard projectiles. However, they have had their fuze booster cavities deepened to accommodate the longer VT fuze. The supplementary charge must be in place when the projectile is used with a mechanical time fuze, an impact fuze, short-intrusion VT fuze, or a electronic time fuze. It is removed only when the projectile is used with a long intrusion VT fuze.**

- **Do not attempt to remove the supplementary charge by any means other than the lifting loop. If the charge cannot be removed with the lifting loop, the round may be disposed of or fired with an impact fuze, a short-intrusion VT fuze, or a mechanical time fuze. The deep cavity might be lined with a paper tube and bottom cup, which help support the high-explosive filler. This lining should not be removed at any time.**

(1) **Semi-fixed ammunition.** The projectile, fuze, propellant, and primer for a semi-fixed round are placed in the same individual fiber shipping container (Figure 1-12). These have cork and felt padding to provide a tight fit for the round. Usually, two rounds (in fiber containers) are packed in a wooden box. Semi-fixed ammo box boxes have all the information required for complete identification of the contents stenciled on them. The primer for a semi-fixed round is an integral part of the cartridge case. Extra precautions are needed when removing the cartridge from its container. Dropping or striking the base on a sharp object could cause the primer to ignite.

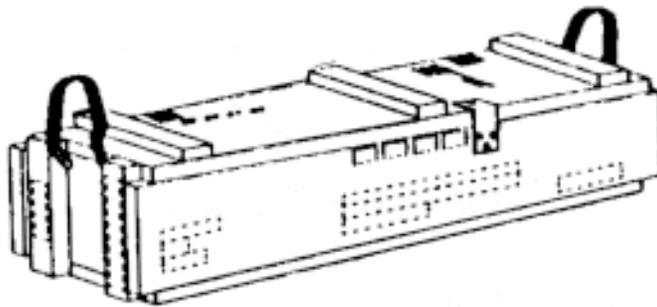


Figure 1-12 Semi-fixed ammo box

1-23

(2) **Separate-loading ammunition.** Separate-loading ammunition presents a different packing and safety problem from that encountered with semi-fixed ammunition. Separate-loading projectiles do not require any outer packing. They are shipped unfuzed with an eyebolt plug screwed into the fuze well and a protective grommet around the rotating band. Separate-loading projectiles are usually shipped pelletized to permit use of forklifts and other types of heavy material-handling equipment. This reduces handling time and labor in shipping and storage. Separate-loading ammunition propellants are packed in airtight metal storage containers for ease in handling and protection from the elements. An igniter cap of cloth or paper protects the igniter end of the propelling charge. Each packing container is marked so all essential information concerning the contents is available without breaking the container seal (Figure 1-13). Primers normally are packed 48 to a sealed metal can. The metal can is overpacked in a wooden box. All essential information to identify the contents is stenciled on the exterior of the container. Fuzes come packed in hermetically sealed metal containers overpacked in a wooden box. Complete identification of the contents of each container are painted on the box and metal container as well as on the individual container.

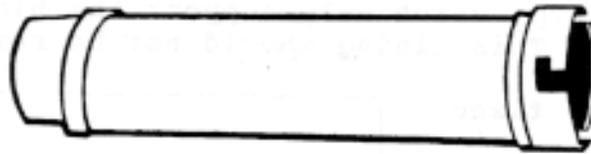


Figure 1-13. Metal container for separate loading propellant

b. **Propelling charges.** Propelling charges, like other components of ammunition, must be kept cool and dry. Powder containers must be tightly closed to keep moisture out. Propellant bags must be firm, clean, and well-laced or tied. The increments must be inserted in the proper sequence. If the bags are ripped or torn, they should be turned in. You may notice an aroma like ethyl alcohol when inspecting the propellant. This smell is normal; however, **if you smell a harsh or acrid aroma, this indicates unserviceable propellant that should not be used.**

c. **Propellant destruction.** Do not try to turn in or save unused powder increments. They should be moved to some storage area, preferably 30 to 40 feet from the nearest weapon, until they can be burned or otherwise disposed of. If powder is to be burned, the following procedures should be followed:

- **Select a burning site at least 200 feet from other personnel or equipment.**
- **Place charge increments in a row not more than 12 inches wide and no more than one layer high. The row should be formed so the powder will burn into the wind (Figure 1-14).**

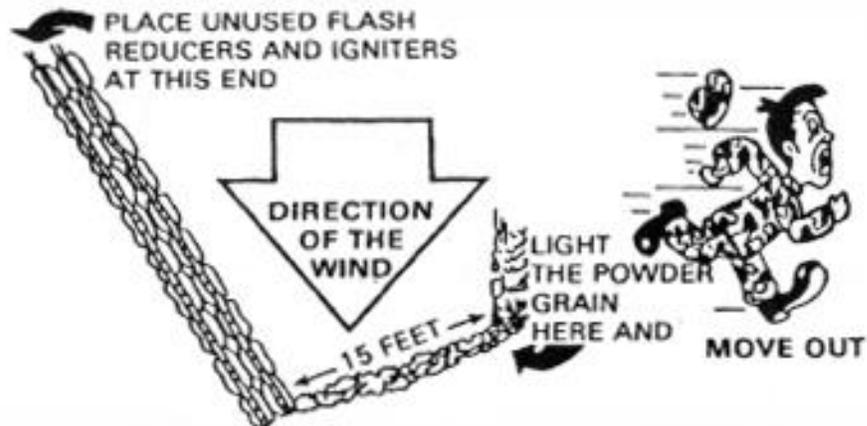


Figure 1-14. Propellant destruction

- **Lay a train of combustible material about 15 feet long perpendicular to, and at the downwind end of, the row of charge increments. Light this train at the end farthest from the charge increments. Place igniter powder in a train not more than 2 inches wide at the upwind end of the increments.**

NOTE: Propelling charges should be separated with nonsparking *materal* to prevent them from accidentally igniting.

Burning powder creates a very large flash and a lot of smoke. In a tactical environment, the executive officer must ensure burning powder does not compromise the camouflage and concealment effort.

The burning of powder in a dummy position, if established, may aid in the deception effort.

d. **cartridge cases.** The cartridge case of semi-fixed ammunition **should** be checked for corrosion. In **older** ammunition with brass canisters, light brown staining is normal oxidation; but black, green, yellow, or white stains mean heavy corrosion which must be cleaned off as soon as possible. Check new and old cartridges carefully for cracks, bulges, and burrs. The primer must **be** flush with the base of the case. If it sticks out too far, it's dangerous; if it sits in too far, the round will not fire (Figure 1-15).

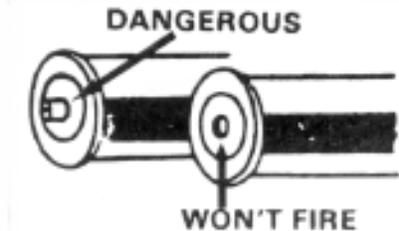


Figure 1-15. Unserviceable Primers

e. **Fuzes.** Following are specific safety precautions for handling fuzes:

- **Never fire a projectile without a fuze that is authorized for that projectile. The specific fuzes available for each weapon system are discussed in the technical manual for each weapon.**
- **Before fuzing a round, inspect the threads of the fuze and fuze well for cleanliness and crossed threads.**
- **The fuze should be screwed into the fuze well slowly until flush with the nose of the projectile. Using the appropriate fuze wrench, back the fuze up one-quarter turn; then snap the fuze wrench forward to secure the fuze.**

NOTE: *After tightening, check to ensure there is no gap between the nose of the projectile and the fuze. If there is, separate the projectile and fuze from other ammunition until they can be inspected by an ammunitions specialist.*

- **A projectile with a time fuze should not be lifted with a hand around the fuze. This might change the fuze setting.**
- **During hailstorms or heavy rainstorms, projectiles with fuzes containing superquick elements should not be used. It is possible for a fuze set on superquick to detonate when struck by hail or heavy rain; therefore, set the fuze on delay. A now rain-insensitive fuze (M739) has been introduced that will solve this problem.**

- To prevent accidental functioning of the point-detonating elements, the fuzes must not be dropped, rolled, or struck under any circumstances. Special care must be taken to ensure a fuzed round does not strike the breech of a weapon during loading.
- Any mechanical time fuze that is set and not fired must be reset to **SAFE**. The safety wires (if applicable) must be replaced before the fuze is repacked in the original carton.

f. **Primers.** Primers are sensitive to both-shock and moisture. Primers for separate-loading ammunition (Figure 1-16) should be kept away from the propellant bags and left in their sealed containers until needed. Primers for semi-fixed ammunition are attached to the base of the cartridge case. The best way to protect them is to leave them covered with a fiber container cap until needed. Inspect all primers prior to use for signs of corrosion. If a seal has been broken, it is likely the primer has been affected by moisture. Damaged primers should be turned in.

NOTE: There are two types of primers available for separate loading ammunition--the MK2A4 (for the M114A1/A2 howitzer) and the M82 (for all others). Make sure you have the correct one! These primers are discussed in Lesson 2.

Figure 1-16. Primer.

h. **Special handling precautions and procedures.** Some projectiles, because of their contents, require special handling and storage. These are the nuclear (NU), toxic chemical (CH), white phosphorus (WP), and antipersonnel (APERS) or Beehive shells.

- (1) When toxic chemical are being fired, all personnel in the area should wear protective masks. Anyone handling the shell should wear gloves. There should be an ample supply of decontaminating agent available close by. If possible, these shells should be stored away from other types of ammunition and downwind of the battery area.

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- (2) The WP round is always stored upright on its base, since the phosphorus inside will melt at 110 F. If the projectile is on its side, the melted phosphorus will run to that side. If such a projectile is fired, it will result in erratic flight of the round and a missed target. If a round of WP starts to leak, it becomes a fire hazard and should be immersed in water.

(3) Special handling precautions and procedures must be observed when handling the Beehive round to prevent damage to the projectile. Except for the hollow steel base, the projectile body is made of aluminum. Rough handling can cause extensive damage to the aluminum. Damage to Beehive projectiles can be prevented by observing the special precautions outlined below:

- **Ensure all personnel are aware of the greater possibility of damage to Beehive rounds. Since Beehive ammunition is reserved for special purposes, it may remain in the unit longer than other ammunition and thus may be handled many times before it is fired.**
- **Conduct frequent inspections to ensure adequacy of storage, proper storage of the Beehive rounds in the basic load, and proper handling procedures.**
- **Be extra careful in preventing the projectile from striking, or being struck by, sharp or heavy objects.**
- **Store (stow) Beehive ammunition separately from standard ammunition. If Beehive rounds must be stored with standard ammunition, [which may become necessary in certain tactical situations (e.g., airlift resupply)], place the Beehive rounds on the top of the stack. Beehive ammunition will be covered in detail in Lesson 2.**
- **Ensure adequate securing devices and protective materials are provided for rounds that have been removed from their containers. Ensure cannon crews understand how to use these devices.**

PART D - NEW AMMUNITION AND SYSTEMS UNDER DEVELOPMENT.

This information is provided to keep field artillerymen abreast of the new items that will reach the field in the near future.

1-28

1. New Ammunition Components.

a. **Electronic Time Fuzes, M762/M767.** This is an accurate, reliable and low-cost time fuze (Figure 1-17). It can be set manually or by an automated technique. The fuzes will be easier to operate because they can be hand set without tools by simply adjusting a liquid crystal display (LCD) . The fuzes are compatible with all fielded and developmental 105-

mm, and 155-mm. The M762 is designed for rounds that carry and dispense submunitions, such as mines and grenades. The M767 is designed for standard burstin projectiles and can be used with all existing 105-mm, and 155-mm. (Figure 1-17).



Figure 1-17 Electronic Time Fuze

b. **NK399 MOUT Fuze.** This fuze is intended for use in Military Operations in Urban Terrain (MOUT). It defeats urban targets by allowing a projectile to penetrate the target before functioning. It may be set for either point detonation or delay action, depending on the type of target. This round replaces the M78 concrete piercing fuze.

c. **Extended-Range Dual-Purpose Improved Conventional Munitions (ERDPICM), M864.** This 155-mm projectile takes advantage of "base bleed" technology to achieve a 20 to 30 percent increase in range over the M483AI DPICM. The base-bleed element ignites upon firing and creates a positive pressure behind the base of the projectile, which reduces atmospheric drag. It reaches ranges of up to 22 and 28 km when fired with the M119 and M203 propelling charges, respectively (Figure 1-18).



Figure 1-18- M864 ERDPICM

2. Systems Under Development.

a. **105-mm High Explosive Rocket Assisted (HERA).** The 105-mm cartridges (XM 913 and XM 927) consist of a HERA projectile mated with a standard cartridge case containing either the M67 or XM200 propelling charge. The projectile has a TNT-filled steel warhead and a selectable rocket motor containing a hydroxylterminated polybutadiene (HTPB)-based propellant. The XM913 (XM913 projectile and XM229 charge) cartridge is designed to be used in the M119 howitzer. The XM927 cartridge (XM927 projectile and M67 charge) can be fired in the M102 howitzers, and as well as the M119.

1-29

b. **SADARM.** The XM836 SADARM system was initially developed using a standard M509, 203-mm projectile body to deliver multiple submunitions over a target area. The 203-mm (8-inch) program was terminated in 1984. In 1985, it was redirected to include the 155-mm XM898 projectile and the Multiple launch Rocket System (MLRS). **Since this lesson is concerned with cannon ammunition, only the 155-mm SADARM will be considered.** The XM898 projectile consists of a carrier and the SADARM submunitions. The carrier consists of a projectile body and base, and

contains two submunitions. The projectile is assembled with an M577 series Mechanical Time Superquick (MTSQ) fuze. It is fired from 155-mm M109A2/A3 self-propelled, and M114A2 and M198 towed howitzers. The fuze functions at a preset time in the projectile flight, ejecting the SADARM submunitions over the target area. The submunitions search the area for target signatures. Once the signature is detected and the distance is within range of the submunition, it fires an explosively formed penetrator at the target.

SUMMARY

Rapid selection and correct assembly of the four major components of a complete round of field artillery ammunition--primer, propellant, projectile, and fuze--are necessary to load and fire a field artillery cannon and produce the desired effect on the target. This means field artillerymen must know their ammunition and how to select the proper components, inspect them, and prepare them for firing.

Field artillery ammunition is principally classified according to type, filler, and use. Classification of field artillery ammunition by type is based on the manner in which ammunition components are assembled for loading and firing. Complete rounds of field artillery ammunition are known as either semi-fixed or separate-loading.

There are two explosive trains in each conventional round of field artillery ammunition--the propelling charge explosive train and the projectile explosive train. Projectile fillers are classified as high-explosive, chemical, or anti-personnel.

Ammunition is field artillery; the weapon is merely the means of delivering the round to the target. To be effective and safe, the artilleryman must know which ammunition components may be used together. He must also learn to distinguish among different types of projectiles by using color codes and markings. Finally, he must know the procedures for selecting and cutting the correct powder charge.

1-30 LESSON 1

PRACTICE EXERCISE

The following items will test your grasp of the material covered in this lesson. There is only one correct answer for each item. When you complete the exercise, check your

answer with the answer key that follows. If you answer any item incorrectly, study again that part of the lesson which contains the portion involved.

1. The dividing line between field artillery ammunition and small-arms ammunition is:
 - A. 35 mm.
 - B. 90 mm.
 - C. 105 mm.
 - D. 37 mm.

 2. Complete rounds of field artillery ammunition are known as either:
 - A. service rounds or practice rounds.
 - B. semi-fixed or separate-loading.
 - C. unified or separate-loading.
 - D. fuzes or primers.

 3. Ammunition is classified according to;
 - A. type, caliber, and bursting charge.
 - B. fuze, booster and bursting charge.
 - C. use, filler, and type.
 - D. fuze, powder charge and projectile.

 4. As defined in lesson 1, velocity is measured in feet or meters per second and is the rate of:
 - A. decomposition of a solid substance.
 - B. speed of a projectile through an artillery tube.
 - C. oxidation of a metal.
 - D. brisance of a projectile.

 5. Brisance is the ability of an explosive to:
 - A. displace or move its surrounding medium.
 - B. shatter its surrounding medium.
 - C. burn from the inside and the outside at the same time.
 - D. absorb and retain moisture.
- 1-31
6. Hygroscopicity is the:
 - A. ability of an explosive to move its surrounding medium.
 - B. absorption and retention of moisture.
 - C. ability of an explosive to remain stable at high altitudes.
 - D. ability of an explosive to shatter its surrounding medium.

7. Separate-loading projectiles have a (an) _____ for lifting and to keep the fuze well clean, dry, and free of foreign matter.
- A. windshield
 - B. ogive
 - C. bourrelet
 - D. eyebolt lifting plug
8. The bourrelet is an accurately machined surface that is slightly larger than the body and located immediately to the rear of the _____.
- A. Windshield
 - B. eyebolt lifting plug.
 - C. rotating band
9. Only the _____ and the _____ of the projectile bear on the lands of the tube.
- A. ogive, bourelet
 - B. ogive, rotating band
 - C. bourrelet, rotating band
 - D. ogive, projectile body
10. The primary reason for painting field artillery projectiles is to:
- A. prevent rust.
 - B. provide color coding as a means of identification.
 - C. assist the smooth travel of the projectile through the artillery tube.
 - D. provide a background for identification markings.
11. The lot number painted on a 155-mm howitzer projectile is that of the:
- A. projectile filler.
 - B. empty shell.
 - C. loaded shell.
 - D. complete round.

1-32

12. The standard weight zone marking symbol for the 105-mm projectile is _____ squares; whereas, for the 155-mm projectile, it is _____ squares.
- A. 1, 3
 - B. 2, 3

- C. 1, 4
- D. 2, 4

13. The two explosive trains in each conventional round of artillery ammunition are:

- A. propelling charge explosive train and burster charge explosive train.
- B. booster charge explosive train and projectile explosive train.
- C. in the fuze and in the projectile.
- D. propelling charge explosive train and projectile explosive train.

14. The propelling charge explosive train is initiated by the:

- A. primer.
- B. igniter.
- C. booster.
- D. propellant.

15. The controlled burning of the propellant inside the powder chamber is called:

- A. detonation.
- B. velocity.
- C. deflagration.
- D. stability.

16. The forms of powder grain used in current field artillery cannon propelling charges are the _____ and the _____ propellant powder grains.

- A. single-perforated, multiperforated
- B. black powder, CBI
- C. green bag type, white bag type
- D. flashless, smokeless

17. The projectile explosive train is activated by a:

- A. booster.
- B. igniter
- C. primer
- D. fuze.

1-33

18. The bursting charge explosive train consists of a _____, a _____, and a _____.

- A. fuze, booster, projectile filler
- B. primer, fuze, bursting charge
- C. fuze, booster, bursting charge

D. fuze, igniter, booster

19. Composition B produces _____ percent more fragmentation than TNT when used in standard high-explosive rounds.

- A. 30
- B. 40
- C. 50
- D. 60

20. Identify safety principles of proper ammunition handling from the group below.

- (1) Never tumble, drag, throw, or drop projectiles.
- (2) Do not allow smoking or open flames around ammunition storage areas .
- (3) Always use clean, light-grade petroleum to lubricate ammunition before loading.
- (4) Always keep ammunition dry and cool.

- A. (1) and (3) only.
- B. (1), (2) and (3).
- C. (1), (2), and (4).
- D. (1), (2), (3), and (4).

21. How are separate-loading projectiles shipped?

- A. Inside cork and felt padded containers.
- B. Inside rectangular wooden boxes.
- C. Inside cylindrical metal containers.
- D. Without any outer packing.

22. Do not try to save or turn in unused powder increments. They should be moved feet _____ from the nearest weapon, until they can be disposed of?

- A. 20 to 30 feet.
- B. 30 to 40 feet.
- C. 40 to 50 feet.
- D. 50 to 60 feet.

1-34

23. If unused powder increments are to be burned, select a burning site at least _____ from other personnel and equipment?

- A. 50 feet.
- B. 100 feet.
- C. 150 feet.

D. 200 feet.

24. When checking the brass cartridge cases for corrosion, the correct color of the cartridge case after normal oxidation is:

- A. light brown.
- B. green.
- C. yellow.
- D. white.

25. The primer of a 105-mm round that is recessed too far is:

- A. dangerous.
- B. normal.
- C. not hazardous.
- D. unable to fire.

26. Which of the following statements about primers are true?

- (1) Primers are generally insensitive to shock and moisture.
- (2) Because of their stability, primers may be stored with propellant bags in order to be more accessible to the gun crew.
- (3) The M82 is used with the M198, and M109 only.
- (4) Primers for semi-fixed ammunition are attached to the base of the cartridge case.

- A. (1) and (2)
- B. (2) and (3)
- C. (3) and (4)
- D. (1) and (3)

27. The purpose of flash reducers is:

- A. to reduce muzzle flash at night and to slow down the combustion of propellant.
- B. to reduce muzzle flash at night and to speed up the combustion of unburned propellant gases.
- C. to reduce muzzle flash only. Other uses are not based on fact.
- D. to insure ignition of the propellant charge explosive train.

1-35

28. The white phosphorus round must be stored:

- A. upright on its base.
- B. in a special cylindrical metal container.
- C. in its original shipping carton.
- D. on its side in the shade.

29. Why were two new 105-mm HERA rounds designed?

- A. To provide two fixed-charge rounds that could be fired quickly at pre-set ranges (the XM913 has a shorter range than the XM927).
- B. The XM913 cartridge is designed to be used in the M119 howitzer and the XM927 cartridge can be fired only in the M101 and M102 howitzers.
- C. The XM913 cartridge is designed to be used in the M119 howitzer and the XM927 cartridge can be fired in the M101, M102 and M119 howitzers.
- D. The XM927 cartridge is designed to be used in the M119 howitzer and the XM913 cartridge can be fired in the M101, M102 and M119 howitzers.

1-36
LESSON I

PRACTICE EXERCISE

ANSWER KEY AND FEEDBACK

Item Correct Answer and Feedback

1. D. 37 mm.

The dividing line between field artillery ammunition and small-arms ammunition is 37 millimeters (mm). Ammunition for weapons of 37-mm or greater is artillery ammunition. (page 1-2, para 1).

2. B. semi-fixed or separate-loading.

Classification of field artillery ammunition according to type is based on preparation and assembly of the components for firing. Complete rounds of field artillery ammunition are known as either semi-fixed or separate loading rounds. (page 1-3, para 1c).

3. C. use, filler, and type.

Field artillery ammunition is classified according to **use, filler** and **type**. (page 1-2, para 1).

4. A. decomposition of a solid substance.

Measured in feet or meters per second, velocity is the rate of decomposition of a solid substance. (page 1-4, para 1d(2)).

5. B. shatter its surrounding medium.

As opposed to power, brisance is the ability of an explosive to shatter its surrounding medium. [page 1-5, para 1d(6)].

6. B. absorption and retention of moisture.

Hygroscopicity (the absorption and retention of moisture) can have an adverse effect on the stability, sensitivity, and reactivity of propellants. (page 1-5, para 1e(3)).

1-37

7. D. eyebolt lifting plug

Separate-loading projectiles (155-mm,203-mm) have an eyebolt lifting plug for lifting; to keep the fuze well clean, dry, and free of foreign matter; and to protect the fuze well threads. (page 1-5, para 2a (l)).

8. B. ogive

The bourrelet is an accurately machined surface slightly larger than the body and located immediately to the rear of the ogive. (page 1-6, para 2a(3)).

9. C. bourrelet, rotating band

When the projectile travels through the bore, only the bourrelet and the rotating band of the projectile bear on the lands of the tube. [page 1-6, para 2a(3)].

10. A. to prevent rust

The primary reason for painting field artillery projectiles is to prevent rust; however, the use of color coding provides a prominent means of identification. (page 1-7, para 2b).

11. D. complete round.

The number painted below the filler designation, is the lot number of the complete round (Separate loading ammunition) or the loaded projectile (semi-fixed ammunition), and is an essential part of the ammunition marking. (page 1-11, para 2c).

12. D. 2, 4

Most projectiles are marked to indicate their weight with squares. When increased accuracy in firing is required, the number of squares stenciled on the projectile are compared to data in the firing tables of the weapon to determine the appropriate ballistic corrections. (page 1-8 and 1-9, para 2c).

13. D. propelling charge explosive train and projectile explosive train.

There are two explosive trains in each conventional round of artilleryammunition--a propelling charge explosive train and a projectile explosive train. (page 1-12, para 1).

1-38

14. A. primer.

The propelling charge explosive train is initiated by a small amount of a very sensitive explosive (such as, fulminate of mercury, lead azide, or lead styphnate) used as the percussion element, or primer. (page 1-14, para 2a).

15. C. deflagration.

The controlled burning of the propellant inside the powder chamber is called deflagration. (page 1-4, para id(3)).

16. A. single-perforated, multiperforated

Powder grain used in current field artillery cannons are the single-perforated and the multiperforated propellant powder grains. [page 1-15, para lc(l)].

17. D. fuze.

Every complete round fired to the target by the propelling charge explosive train also has a \ projectile explosive train to deliver the payload (filler) onto the target. The projectile explosive train is activated by a fuze. (page 1-19, para 3a).

18. C. fuze, booster, bursting charge.

The second explosive train in a conventional round of high-explosive ammunition is a bursting charge explosive train (Figure 1-8). It consists of a fuze, a booster, and a bursting charge. [page 1-19, para 3b(l)].

19. B. 40

Standard high-explosive fillers currently in use are TNT and Comp B. Comp B produces 40 percent more fragmentation than TNT when used in standard high-explosive rounds. [page 1-20, para 3b(l)].

20. C. 1, 2, and 4.

- Never tumble, drag, throw, or drop individual projectiles or boxes of projectiles.
- Do not allow smoking, open flame, or other fire hazards around ammunition storage areas.
- Keep the ammunition dry and cool. (page 1-21, para la).

1-39

21. D. containers without any outer packing.

Separate-loading ammunition presents a different packing and safety problem from that encountered with semi-fixed ammunition. Separate-loading projectiles do not require any outer packing. [page 1-24, para 2a(2)).

22. B. 30 to 40 feet.

Do not turn in or save unused powder increments. They should be moved to some storage area, preferably 30 to 40 feet from the nearest weapon, until they can be burned or otherwise disposed of. (page 1-25, para 2c).

23. D. 200 feet

Select a burning site at least 200 feet from other personnel or equipment. page 1-25, para 2c).

24. A. light brown.

In older ammunition with brass cannisters, light brown staining is normal oxidation; but black, green, yellow, or white stains mean heavy corrosion which must be cleaned off as soon as possible. page 1-26, para 2d).

25. D. unable to fire.

The primer must be flush with the base of the case. If it sticks out too far, it's dangerous; if it sits in too far, the round will not fire. (page 1-26, para 2d).

26. C. (3) and (4)

Primers are sensitive to both shock and moisture. Primers for separate-loading ammunition should be kept away from the propellant bags and left in their sealed containers until needed. Primers for semi-fixed ammunition are attached to the base of the cartridge case. (page 1-27, para 2f).

27. B. to reduce muzzle flash at night and to speed up the combustion of unburned propellant gasses.

Flash reducers reduce or prevent flash. Flash reducers also speed up the combustion of unburned propellant gases, which prevents excessive muzzle blast. However, they are also used during day and night firing with certain weapons to speed up the combustion of unburned propelling charge gases to prevent excessive muzzle blast. [page 1-17, para 2c(5)].

1-40

28. A. upright on its base.

The WP round is always stored upright on its base, since the phosphorus inside will melt at 1100 F. If the projectile is on its side, the melted phosphorus will run to that side. If such a projectile is fired, it will result in erratic flight of the round and a missed target. [page 1-28, para 2h(2)].

29. C. The XM913 cartridge is designed to be used in the M119 howitzer and the XM927 cartridge can be fired in the M101, M102 and M119 howitzers.

The XM913 (XM913 projectile and XM229 charge) cartridge is designed to be used in the M119 howitzer. The XM927 cartridge (XM927 projectile and M67 charge) can be fired in the M101 and M102 howitzers, as well as the M119. (page 1-29, para 2a).

1-41
LESSON 2

WEAPON SYSTEMS, PROJECTILES AND PROPELLANTS

Critical Task: 01-2660.01-0052
061-266-1508

OVERVIEW

LESSON DESCRIPTION

In this lesson you will learn to identify authorized weapon systems, the projectiles authorized for those systems and the propellants used with separate loading ammunition.

TERMINAL LEARNING OBJECTIVE

ACTION: Identify authorized weapon systems and the authorized powder/shell combinations used each.

CONDITION: Given the material contained in this lesson.

STANDARD: Correctly answer all questions in the practice exercise at the end of this lesson.

References: This lesson is based on TM 43-0001-28, FM 6-50 and other materials approved for U.S. Army Field Artillery School instruction; however, development and progress render the text continually subject to change. Therefore, base your examination answers on material presented in this text rather than individual or unit experience.

INTRODUCTION

U.S. Army field artillery (cannon) is currently organized around two calibers of weapon systems. These are the 105-mm, and the 155mm cannon. This lesson will briefly discuss each of the authorized weapons of each caliber. Then a description of ammunition used in each will be given. It will also discuss the propellant and charges used with each type of ammunition.

PART A - CHARACTERISTICS OF 105-mm HOWITZERS AND AMMUNITION

M102 howitzer

The 105 mm towed light M102 howitzer consists of the 105 mm howitzer cannon and the 105-mm howitzer recoil mechanism mounted on the carriage (Figure 2-2). The weapon is traversed and elevated by hand wheels located on the sides of the carriage. A 6,400-mil traverse capability is provided because the carriage pivots around the center of a circular base by means of a roller located at the rear of the trail assembly. The weapon can be airlifted and may be towed at 35 miles per hour (mph) over hard surfaced roads. The 105-mm M102 howitzer has a very low silhouette when in the firing position. The M102 howitzer and, at charge 7, will fire a 33 pound round 11,500 meters.

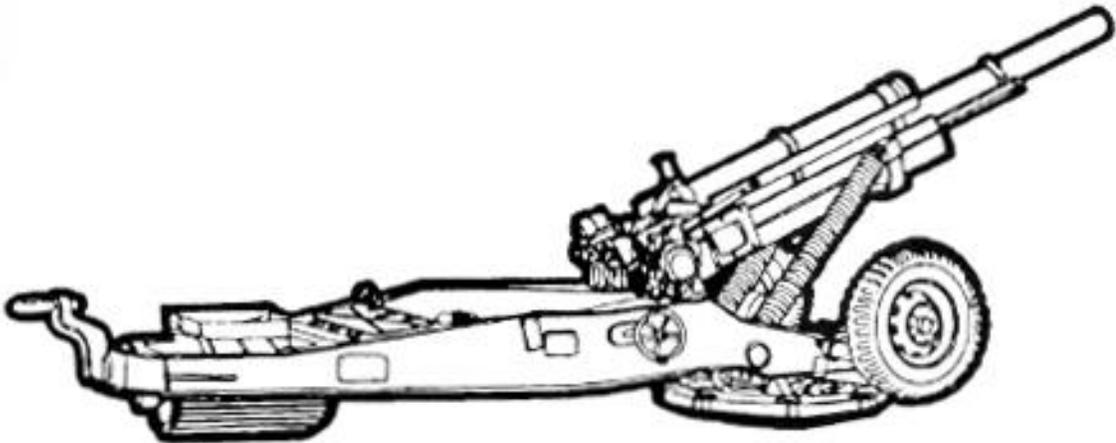


Figure 2-2. 105-mm M102 howitzer

TABULATED DATA (M102 HOWITZER).

- Muzzle velocity -----494 meters per second
- Maximum range -----11,500 meters
- Type breechblock -----Vertical sliding wedge
- Type firing mechanism -----Spring-actuated inertia percussion
- Maximum rate of fire -----10 rounds per minute for the first 3 minutes
- Sustained rate of fire -----3 rounds per minute thereafter

M119 105-mm light towed howitzer

The M119 is a light towed field artillery weapon system. It weighs 4520 pounds (including BII). The prime mover is the HMMWV (hum-vee) truck although a new 10,000-pound (gross weight) prime mover is in development. The M119 is air transportable with its basic load of ammunition by the UH-60 Black Hawk helicopter. Two of these weapons can be lifted at once by the CH-47 Chinook helicopter. It fires all conventional 105-mm ammunition out to a range of 14 km and with the M548 High Explosive Rocket Assisted (HERA) projectile, out to 15.1 km. This capability will be enhanced by the fielding of two ammunition projectiles: the XM913 HERA, giving the M119 a range of 19 km, and the XM915 Dual Purpose Improved Conventional Munitions (DPICM), giving it a range of 15 km.

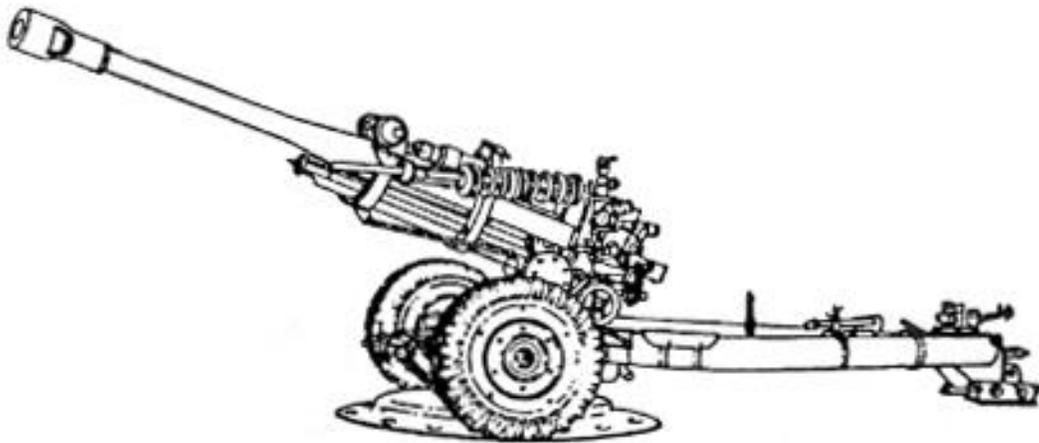


Figure 2-3. M119 light towed howitzer

TABULATED DATA (M119 HOWITZER)

- Muzzle velocity -----(to be determined)
- Maximum range -----11,500 meters (charge 7), 14,000 meters (charge 8)
19,000 meters (RAP)
- Type breechblock -----Vertical sliding wedge
- Type firing mechanism -----Mechanically-activated percussion
- Maximum rate of fire -----6 rounds per minute for the first 2 minutes
- Sustained rate of fire -----3 rounds per minute for 30 minutes.

4. Ammunition components for 105-mm howitzers

Ammunition for the 105-mm howitzers (M102 and M119A1/M119A2) is classified as semifixed. The types of projectiles and authorized fuzes for the 105-mm howitzers (M102 and M119A1/M119A2) are given in Appendix A. TM 430001-28 lists about 20 different types of rounds authorized for the 105-mm howitzer including five high explosive (HE) rounds, 2 dummy rounds, 2 blank rounds, 3 chemical rounds, two illuminating rounds, 1 smoke round and a mixture of other rounds. Descriptions of some representative rounds follow.

a. **High Explosive M1 round.** The projectile of the M1 cartridge (Figure 2-4) contains high explosive and is used for fragmentation and blast in support of ground troops and armored units. The M1 consists of a hollow steel forging with a boattail base, a streamlined ogive, and gilding metal rotating band. The HE filler within the projectile may be either cast TNT or Composition B. A fuze cavity is either drilled or formed in the filler at the nose end of the projectile. This cavity may be either shallow or deep. The cartridge case contains a percussion primer assembly and seven individually bagged and numbered propelling charge increments.

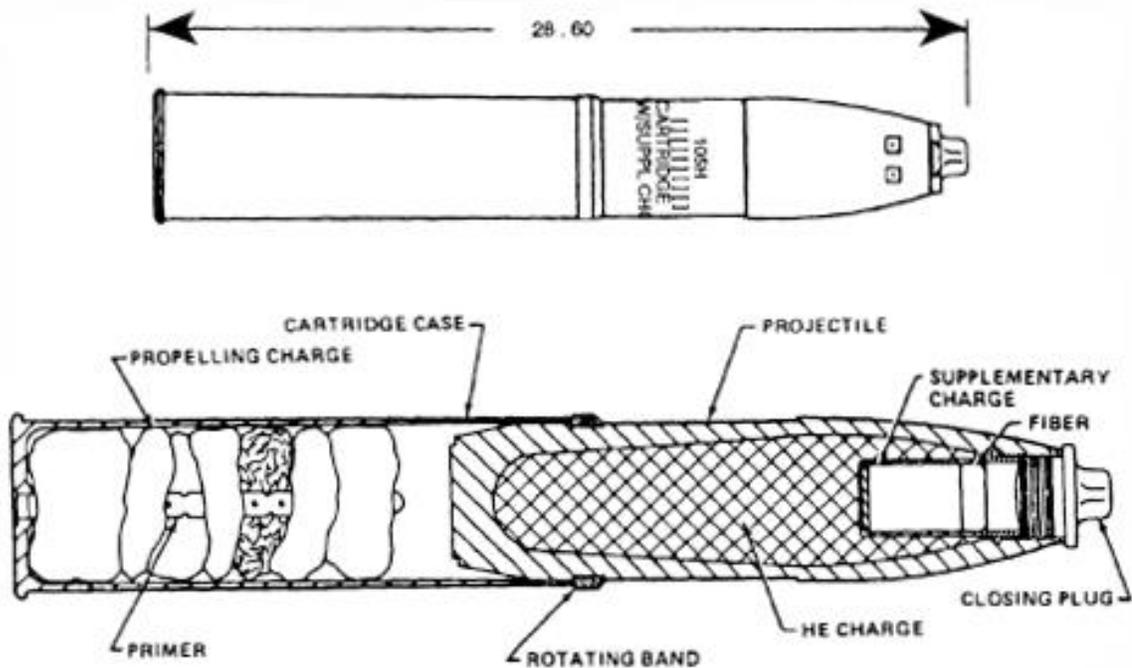


Figure 2-4. 105-mm HE round, M1

b. **APERS-T M546 (flechette) round** The 105-mm APERS-T M546 (flechette) round, commonly referred to as the Beehive round (Figure 2-5), is designed for use against personnel in direct fire, muzzle action and in direct fire with a time setting other than muzzle action. It is effective against personnel in the open or in dense foliage. The projectile consists of a two-piece aluminum body, an aluminum fuze adapter, and a hollow steel base. The projectile body is loaded with 8,000, 8-grain steel flechettes (darts) . A mechanical time fuze is assembled with the projectile. On firing, the fuze starts to arm immediately and will function as set, either on leaving the cannon muzzle, called Muzzle Action (MA), or at a preset time.

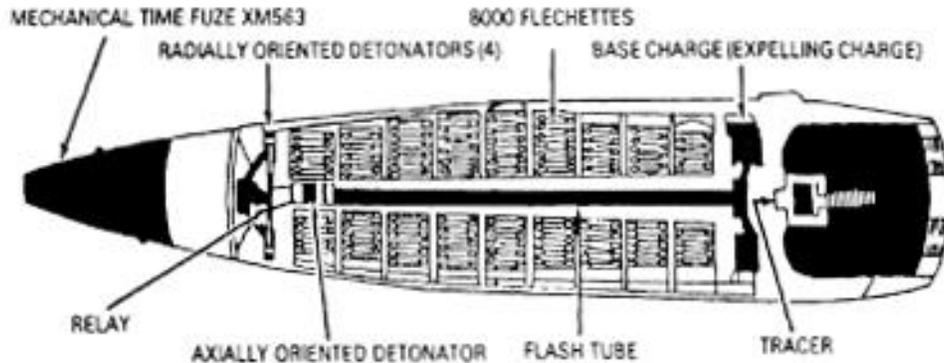


Figure 2-5. APERS flechette (Beehive) projectile

WARNING

FIRING BEHIVE ROUNDS OVER THE HEADS OF EXPOSED FRIENDLY TROOPS IS PROHIBITED.

c. **Illuminating round.** Illuminating rounds, which are available for the 105-mm and 155-mm weapons, are used for signaling or for illuminating a designated area or for marking an area (Figure 2-6). The 105-mm M314 illumination projectile is made from a steel forging and fitted with a soft metal rotating band, a pinned base plug, an expelling charge, and an illuminating canister and time fuze. When the fuze functions, the expelling charge is ignited, and the canister, with parachute, is ejected into the airstream. Characteristics of the luminants are as follows:

WEAPONS	105-mm	155-mm
Projectile	M314A3	M485
Burning Time	60 seconds	120 seconds
Candlepower	450,000	1,000,000
Rate of descent	30 ft per second	15 ft per second

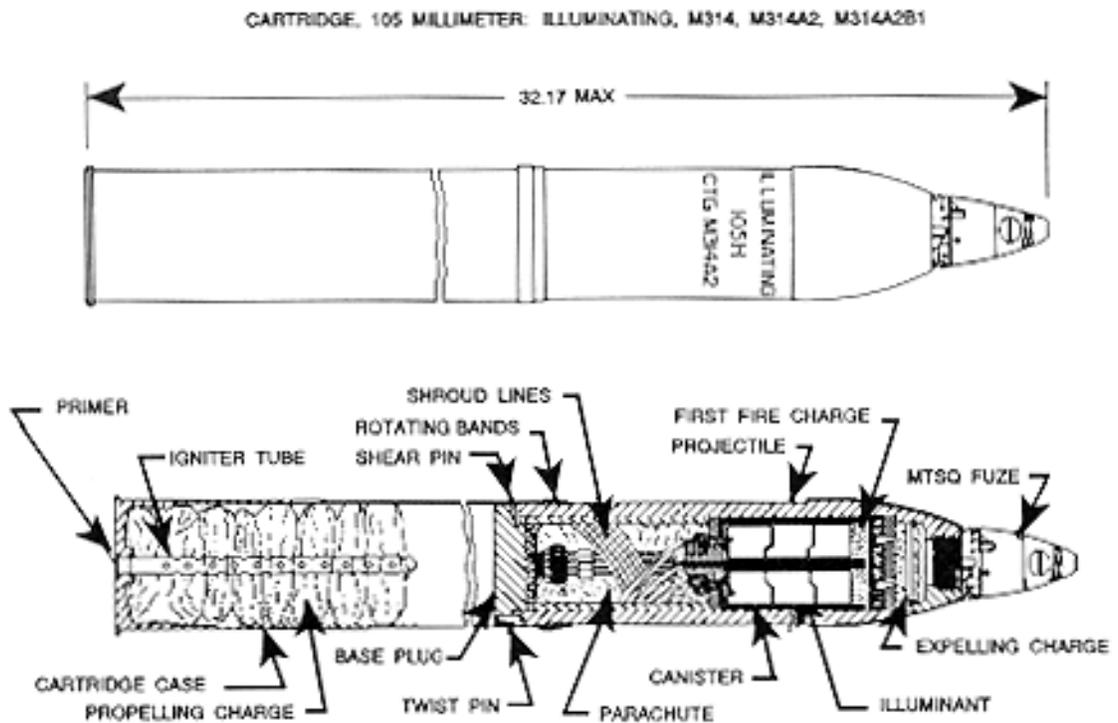


Figure 2-6. Illuminating projectile

d. Smoke round.

Smoke rounds are available for 105-mm and 155-mm howitzers only, and are used for spotting, screening, and signaling purposes. For illustration purposes, a 155-mm smoke projectile is shown.

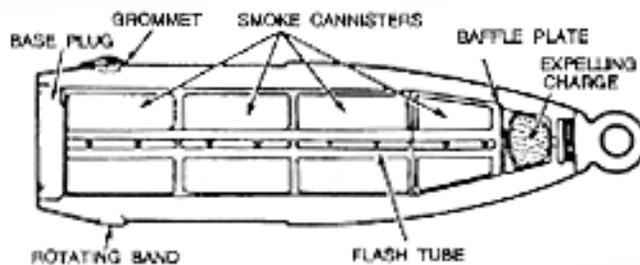


Figure 2-7. Smoke round

However, 105-mm projectiles have a similar manufacture with 3 smoke canisters surrounding a flash tube. The base-ejection smoke round is similar in external configuration to the high-explosive round. The 105-mm M84, M84AI and M84BI projectiles are fitted with a mechanical time fuze. The three smoke canisters are steel encased, have a centrally located flash tube, and contain HC (white) smoke. The fuze ignites the expelling charge and concurrently ignites the smoke canisters. This produces gases that blow out the base plug and eject the burning canisters into the airstream. The canisters emit smoke for a period of 40 to 90 seconds.

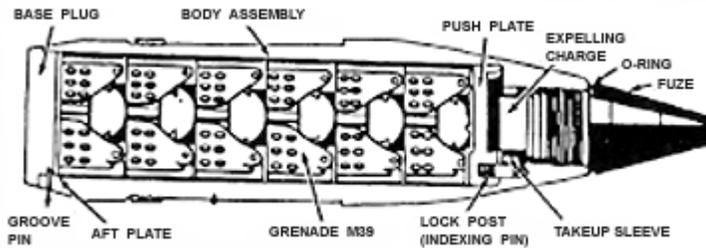


Figure 2-8. ICM projectile

e. Improved conventional munitions rounds (Figure 2-8).

There are two types of ICM rounds available for field artillery howitzers: the old single-purpose antipersonnel round for the 105-mm, 155-mm, and the new dual-purpose, Antipersonnel-antimateriel round (dual purpose ICM or DPICM) for the 155-mm howitzers. **There are not antipersonnel-antimateriel rounds for the 105-mm howitzer.** The ICM (and DPICM) is designed to transport its internal payload of grenades to the target.

f. Antipersonnel. Round. The M39 grenades (Figure 2-9) used in the 105-mm antipersonnel round contain steel balls filled with explosive. The 105-mm projectile contains 18 M39 grenades. When the fuze in the projectile functions, it ignites the black powder expelling charge in the projectile. The burning black powder builds up pressure that forces all of the grenades out through the base of the projectile. Small vanes on each grenade flip upward and arm the grenade. The vanes keep the armed grenade in a vertical position as it falls through the air so that the striker plate at the base of the grenade strikes the ground.

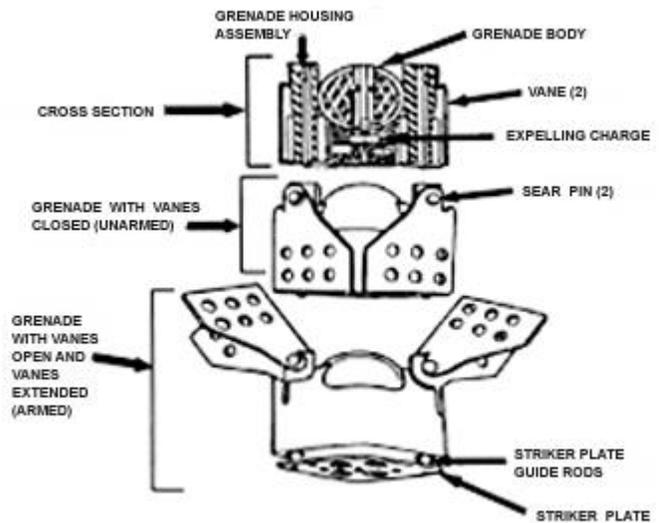


Figure 2-9. M39 ICM grenade

This action causes the expelling charge in the grenade to hurl the steel ball 4 to 6 feet in the air. High explosive shatters the metal ball and scatters metal fragments over the target area.

g. High Explosive Rocket-Assisted (HERA) M548 round. The M548 is a high explosive, rocket-assisted round with extended range capability. It is used for fragmentation, and blast effects in support of infantry and armored units. The projectile portion of the cartridge consists of two pieces--a streamlined warhead and a rocket motor body in a boattail design. The warhead is filled with cast Composition B with a deep cavity and supplementary charge. The rocket motor body contains the rocket grain and rocket ignition system inside a spike at the rear of the body (Figure 2-10). The cartridge case contains a primer and five individually bagged and numbered propelling charge increments.

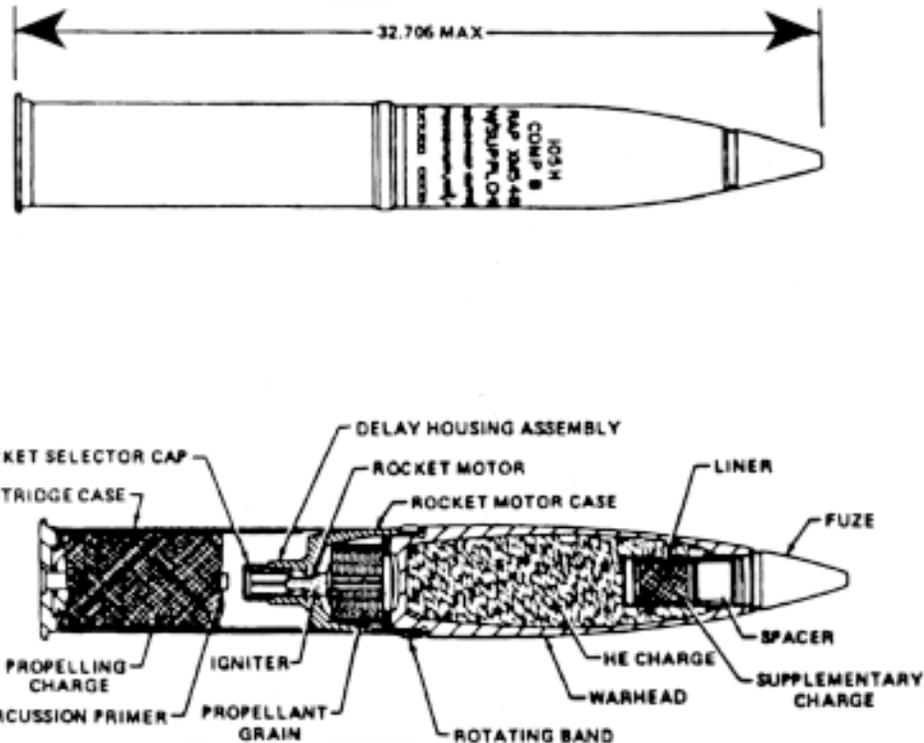


Figure 2-10. 105-mm HERA, M548 round

5. Fuzing

a. Base-detonating fuzes. Base-detonating (BD) fuzes M62A1, M62, M91A1, or M91 do not require setting or other adjustment before firing. These fuzes are used with high-explosive plastic (HEP) rounds.

b. Fuze removal. Certain rounds are supplied fuzed. 105-mm HE rounds M1 and HERA M548 may be shipped with fuzes, which must be removed if time or proximity (VT) fuze action is desired. A more complete discussion of fuzes is in Lesson 3.

6. Preparing charges

a. **Cartridge case.** Cartridges are assembled with the M14-series cartridge cases, which include the M14 (brass), M14BI (steel), M14B2 (5-piece, spiral-wrapped steel) M14B3 (5-piece, spiral wrapped steel) and M14B4 (3-piece, spiral wrap steel) cartridge cases. Blank cartridges are assembled with the M15 (brass), M15BI (steel) or M15B2 (aluminum) cartridge cases.

b. **Primer.** M14 series cartridges do not require preparation of the primer. Percussion primers are used with these cartridges and come as an integral part of the cartridge case.

c. **Propelling charge.** Most 105-mm cartridges contain the M67 propelling charge, which contains zoned charges (seven increments) of M1, dual granulation (DUALGRAN) propellant. (Some of these propelling charges are of older manufacture and are made with M1 single-granulation propellant.) HEP, TP, and TP-T cartridges contain a single, nonadjustable bag charge of M1 single-granulation propellant. The antipersonnel with tracer cartridge (APERS-T) contains a two-zone propelling charge of M3OEI dual-granulation propellant. As stated above, the High Explosive Rocket Assisted (HERA) cartridge contains a five-zone white bag charge of dual-granulation propellant in increments 3, 4, 5, 6, and 7.

CAUTION

UNDER NO CONDITIONS WILL THE FIXED CHARGES OF THE HIGH-EXPLOSIVE PLASTIC (HEP), AND TARGET PRACTICE WITH TRACER (TP-T) ROUNDS BE ALTERED. MAXIMUM PENETRATION OF ARMORED TARGETS IS SECURED WITH THE FIXED CHARGES FURNISHED.

WARNING

FIRE COMPLETE ROUND ONLY WITH PROJECTILE, CARTRIDGE CASE, AND PROPELLING CHARGE TYPE AS ORIGINALLY PACKED.

CAUTION

IN AMMUNITION ASSEMBLED WITH THE M14B2 (MI4EI) CARTRIDGE CASE, THE MOUTH OF THE CASE CAN BE EXPANDED SLIGHTLY BY UNCOILING. THIS MAKES IT EASIER TO INSERT THE PROJECTILE IN THE MOUTH OF THE CASE. HOWEVER, IF THE LOADER IS NOT CAREFUL TO GRASP THE PROJECTILE AT ITS POINT OF BALANCE, THE COMPLETE ROUND MAY SAG EXCESSIVELY IN THE CENTER. IF THE LIP OF THE MOUTH OF THE CASE IS ON THE BOTTOM, IT MAY PROTRUDE ENOUGH TO CATCH ON THE LIP OF THE LOWER EXTRACTOR RECESS IN THE CHAMBER. THE MOUTH WILL THEN BEND BACK, MAKING IT IMPOSSIBLE TO CHAMBER THE ROUND. TO PREVENT THIS, THE PROJECTILE MUST BE GRASPED AT ITS BALANCE POINT TO KEEP THE COMPLETE ROUND FROM SAGGING.

7. Mnemonic identification of 105-mm ammunition.

Mnemonics are a shorthand method of identifying ammunition and its components. Ammunition mnemonics are most often associated with field artillery automated fire direction systems such as BCS, BUCS, and TACFIRE. Appendix B provides you with the mnemonics for 105-mm, and 155-mm projectiles and fuzes. While it is important for you to know what these mnemonics look like, there are numerous references at the unit level to assist automated fire direction system users in inputting the correct mnemonics into these system. These references include battalion and battery SOP'S, technical manuals, and job aids.

PART B – CHARACTERISTICS OF 155-MM HOWITZERS AND AMMUNITION

1. 155-MM M198 towed howitzer.

The M198 155-mm towed howitzer (Figure 2-12) is designed to provide direct support (DS) field artillery fire in the light infantry divisions. The M198 is an extended-range, split-trail weapon that can be towed by vehicle or airlifted by a CH-47D helicopter. The carriage has a retractable suspension system and a top carriage, which can be rotated 3,200 mils to decrease overall length for shipment or storage. The lightweight M198 howitzer has a low profile, may be emplaced rapidly, and has a 6,400-mil speed shift assembly.

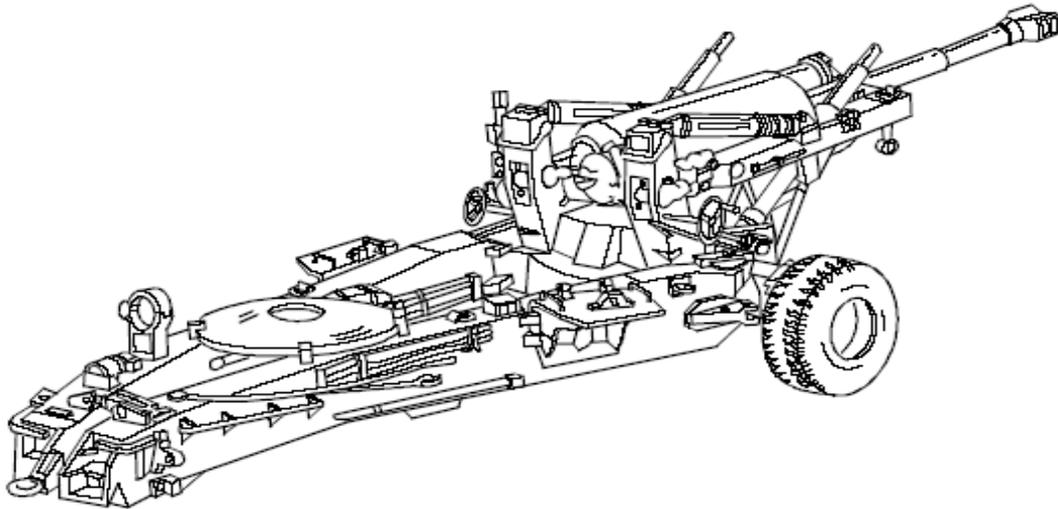


Figure 2-12. M198 howitzer in the towed position

TABULATED DATA (155-MM M198 TOWED HOWITZER)

Muzzle velocity -----	826 meters per second
Maximum ranges -----	24,000 meters (other than RAP)
	30,000 meters (RAP)
Type of breechblock -----	Threaded, interrupted screw
Type of firing mechanism -----	Continuous pull, M35
Maximum rate of fire -----	4 rounds per minute for 3 minutes
Sustained rate of fire -----	2 rounds per minute for 30 minutes thereafter

2. 155-MM M109A5 self-propelled (SP) howitzers.

The 155-mm M109A5 (Figure 2-13) is a highly mobile, armored, self-propelled, medium howitzer. It has a cruising range of 217 (aprox) miles at speeds up to 35 miles per hour. Combat loaded, the weapon weighs 55,000 pounds. The M109A5 is equipped with the longer M284 cannon and achieves a range of 22,000 meters (with the RAP round 30,000 meters). The weapon is equipped with a 24-volt electrical system, with four 12-volt batteries connected in series-parallel. A hydraulic system provides power for traversing and elevating the cannon, ramming the projectile, and for the equilibrator system.

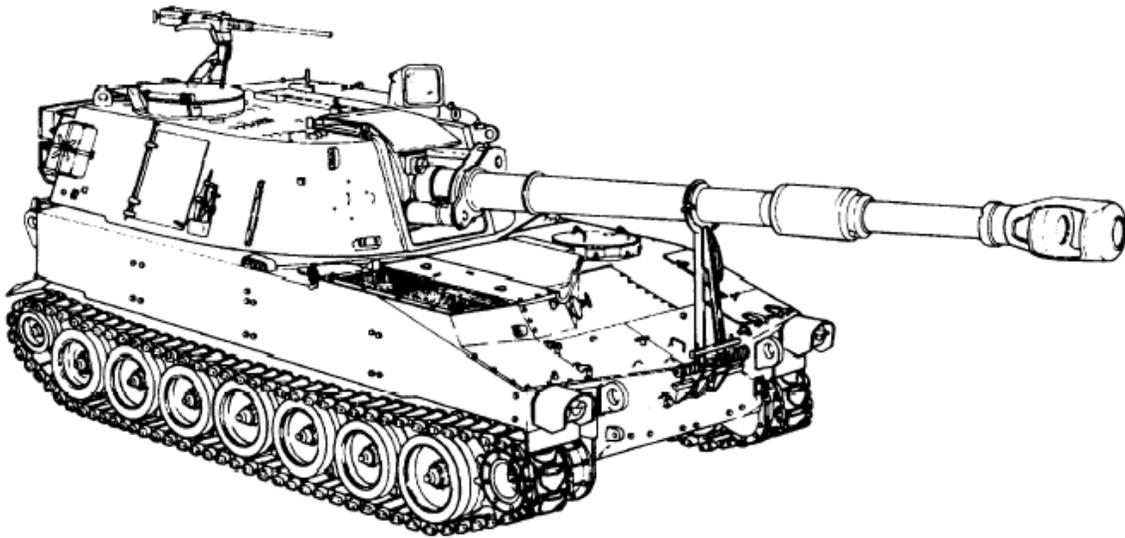


Figure 2-13. M109A5

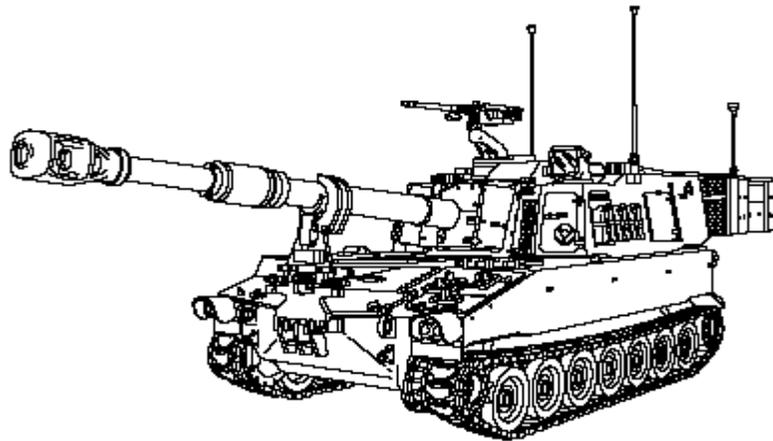
TABULATED DATA (155-MM M109A5 SELF-PROPELLED HOWITZER)	
Muzzle velocity -----	701 meters per second
Maximum ranges-----	18,000 meters (charge 7) 22,000 meters (charge 8) 30,000 meters (RAP)
Type breechblock-----	Threaded, interrupted screw
Type of firing mechanism-----	Continuous pull, M49
Maximum rate of fire-----	4 rounds per minute for 3 minutes
Sustained rate of fire-----	Charges 1-7, 1 round per minute Charge 8, 1 round per minute for 60 minutes, Then 1 round per 3 minutes thereafter

3. 155-MM M109A6 (Paladin) self-propelled (SP) howitzers.

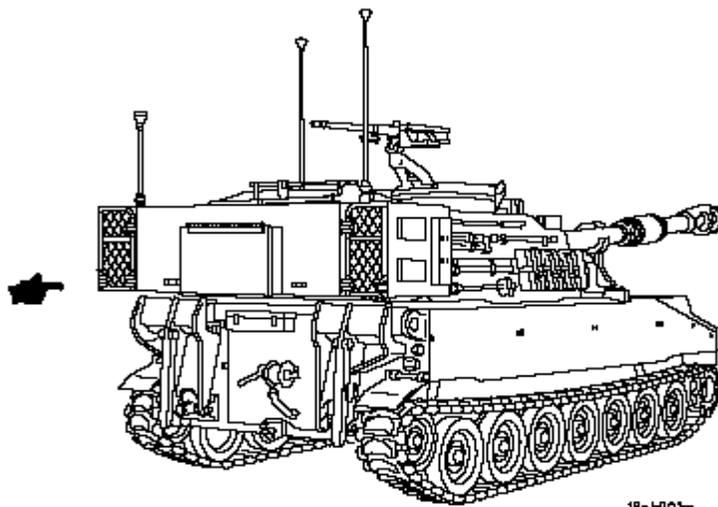
The M109A6 (Figure 2-13.5) is a highly mobile, armored, self-propelled, medium howitzer. It has a cruising range of 186 (aprox) miles at speeds up to 38 miles per hour. Combat loaded, the weapon weighs 63,615 pounds. The primary armament includes a 155-mm M284 cannon and M182A1 mount, with firing accomplished by an M49 firing mechanism which uses cartridge type primers. The vehicle carries a crew of four: chief of section, gunner, cannoneer, and driver. This Howitzer is an updated version of the M109A5 and carries an onboard computer system called the Automatic Fire Control System (AFCS) consists of the following major assemblies:

AFCS Computer Unit (ACU)
Display Unit (DU)
Power Conditioner Unit (PCU)
Backup Batteries (2 each)
Azimuth Tachometer (Az Tach)
Elevation Tachometer (EI Tach)
Hydraulic Components (manifolds, servo valves, solenoid valve, and pilot check valves).
AFCS Harness Assemblies
Vehicle Motion Sensor (VMS) Modems (1--hull/1--cab)
Tube Temperature Sensor (TTS)
Precision Lightweight GPS Receiver (PLGR)
Muzzle Velocity Sensor (MVS)

The AFCS receives target information, calculates weapons position and automatically lays gun tube. Calls for fire are accepted directly. Communication can be performed with any authorized source. Processing of input and output messages is handled by ACU. Weapon position is calculated and provided by Dynamic Reference Unit Hybrid (DRUH) to AFCS. Knowing weapon position, orientation and call-for-fire data, the Weapons Control (WC) calculates proper elevation and azimuth which is displayed on the DU. The lay switch causes the WC of ACU to drive the gun servos to lay the gun in elevation and azimuth. DRUH Nav Systems require periodic stops to align the AFCS. These stops are called Zero Velocity Updates (ZUPT). The DU panel alerts the operator when a ZUPT is required. The AFCS has built-in protection in case of a nuclear event. The detector will shut down the AFCS when it detects a nuclear event. The AFCS also has a Built-In Training Device (Embedded Trainer). This can be used as a tutorial device to train, maintain, improve and evaluate crew performance efficiency. This function allows for simulating Move and Fire Missions under a variety of battlefield scenarios. These include: Shoot Heavy, Move Heavy, Modified, Balanced, as well as Degraded conditions (for AFCS), all without need for radio communications. In addition, Embedded Trainer can be run from a Beginner's Tutorial option through a full-scale scenario. A TTS, powered by the AFCS, is provided to give the crew the temperature of the tube during firing. The PDIU is the central collection point for information concerning the condition of the M109A6 system. It gathers, stores, and communicates information concerning failures, or impending failures, to the crew. Based on that information, the crew can either proceed in a degraded mode or enter a maintenance mode and begin performing fault detection and fault isolation to an LRU or LRU's.



Left Front View



Right Rear View

18pl001m

Howitzer, Medium, Self-Propelled: 155MM, M109A6

Figure 2-13.5

TABULATED DATA (155-MM M109A6 SELF-PROPELLED HOWITZER)

Muzzle velocity -----	701 meters per second
Maximum ranges-----	18,000 meters (charge 7)
	22,000 meters (charge 8)
	30,000 meters (RAP)
Type breechblock-----	Threaded, interrupted screw
Type of firing mechanism-----	Continuous pull, M49
Maximum rate of fire-----	4 rounds per minute for 3 minutes
Sustained rate of fire-----	Charges 1-7, 1 round per minute
	Charge 8, 1 round per minute for 60 minutes,
	Then 1 round per 3 minutes thereafter

4. Ammunition/components for the 155-mm howitzer.

a. **Authorized rounds.** Separate-loading ammunition is used in 155-mm howitzer cannons. Loading each complete round into these howitzers requires three separate operations:

- Loading the fuzed projectile.
- Loading the propelling charge.
- Inserting the primer.

All four of these components (fuze, projectile, propelling charge, and primer) are shipped separately. This lesson will discuss many of the most common projectiles for the 155-mm howitzer. A complete summary of authorized projectiles and components are listed in tables in Appendix A for the M114A2, M198, and M109A2/A3 howitzers. Mnemonics for 155-mm projectiles as well as model, type and standard weight information is found in Appendix B.

b. **Projectile, 155-mm, HE, M107.** Used mainly for blast, fragmentation, and cratering, this normal or deep-cavity projectile consists of a steel case loaded with either TNT or composition B. Point detonating time, or VT fuzes may be used (Figure 2-14).

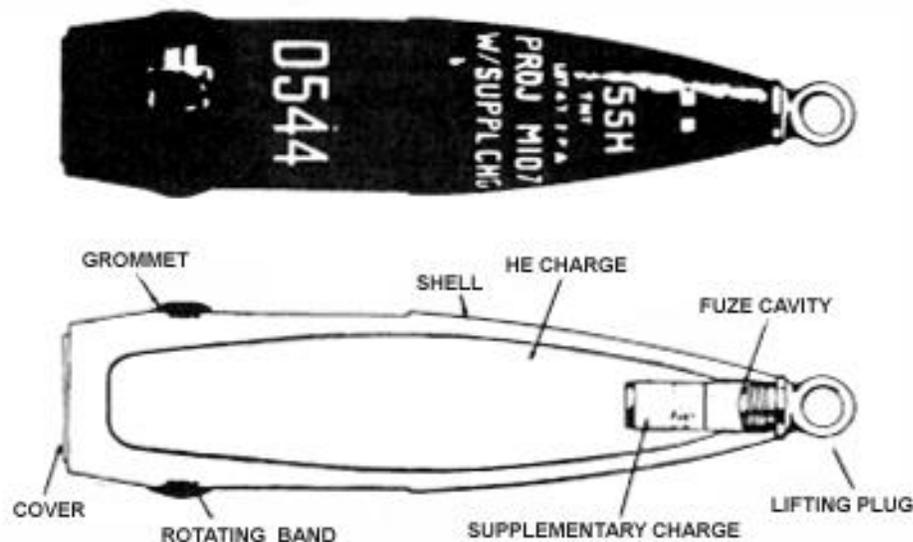


Figure 2-14. 155-mm HE, M107 round

c. **Projectile, 155-mm, gas, persistent, H or HD, M110.** The filler of this projectile produces a toxic effect on personnel and is also used to contaminate habitable areas. This projectile is filled with either H or HD (mustard) gas with a built-in burster charge.

d. **Projectile, 155-mm, gas, persistent, VX, M121A1.** This projectile contains VX (nerve) gas, which produces a toxic effect on personnel. A burster charge bursts the projectile.

e. **Projectile, 155-mm, smoke, WP, M110A1 (M110E2), and M110A2 (M110E3) WP.** The fillers of these smoke projectiles have a slight burning effect but are used mainly to produce screening smoke. The projectile is similar to the M110 gas projectile and has the same ballistic characteristics as the HE M107 projectile.

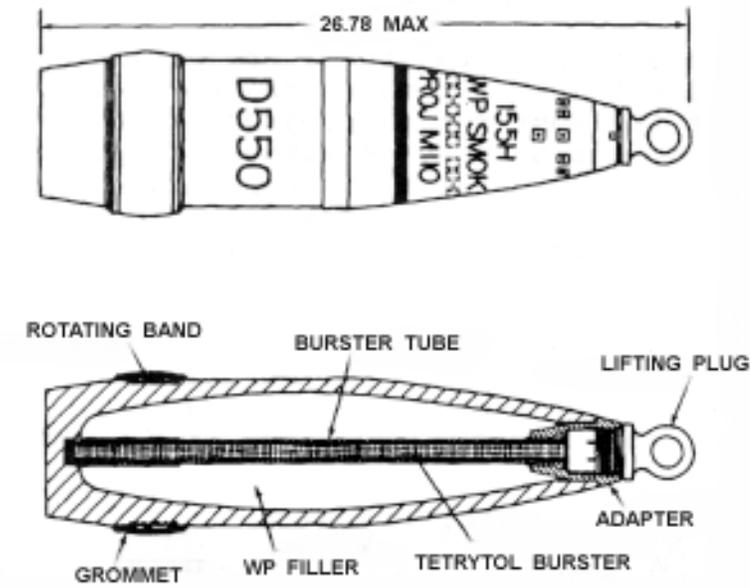


Figure 2-15. 155-mm Smoke, WP, M110A1 (M110E2) M110A2 (M110E3)

f. **Projectile, 155-mm, illuminating, M11SA2, M11SA2B, and M485.** These projectiles are used for battlefield illumination. The base-ejection type projectile consists of a hollow steel body containing an ejection charge and canister and parachute assembly.

g. **Projectile, 155-mm, improved conventional munitions (ICM), M449 series.** As you may recall from Lesson 1, these projectiles (Figure 2-16) are used mainly against personnel. They are base-ejecting projectiles that contain 60 M43-series grenade submissiles. The grenades are dispersed in the air when the time fuze (M565 MT or M577 MTSQ) functions. When the grenades impact, submunitions are ejected and explode 4 to 6 feet above the surface, producing fragmentation in a circular pattern.

i. **Projectile, 155-mm, HE, M692.** This projectile is known as the area denial artillery ammunition (ADAM). These projectiles carry mines as submunitions. These submunitions are antipersonnel mines that deny the enemy free use of certain areas for a period of time. After scattering over the target area, the mines can be detonated by being disturbed or they self destruct at a pre-set time to allow friendly troops to move through the area. The most significant markings are the row of yellow triangles with the letter L in them and the letters ADAM-L between the nose and bourrelet (Figure 2-18). The letter L indicates a long self-destruct time for the submunitions. This is a base-ejection type projectile and uses the M577 time fuze.

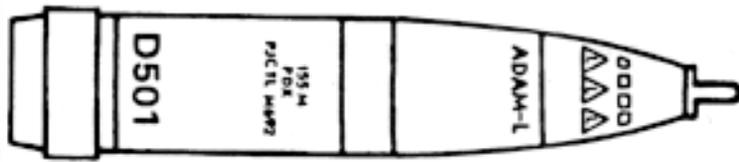


Figure 2-18. M692 (ADAM) projectile

j. **Projectile, 155-mm, HE, M731.** This projectile is also known as the ADAM projectile and is exactly like the M692 above except for the letter S painted in each yellow triangle and the letters ADAM-S, which indicate the shorter self-destruct time of the antipersonnel mine submunitions unit. This is a base-ejection type projectile and uses the M577 time fuze (Figure 2-19).

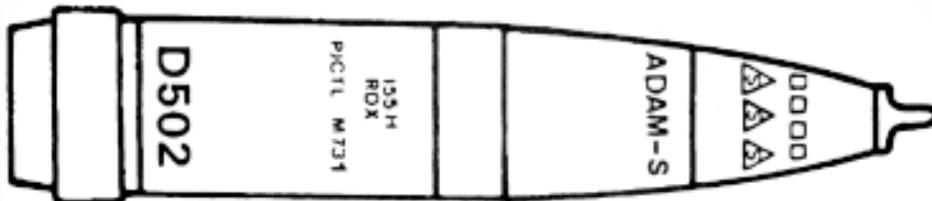


Figure 2-19. M731 projectile

k. **Projectile, 155-mm, HE, RAAMS M718.** This projectile is used to deliver high-explosive antitank mines in front of enemy armored forces to deny or delay access to a particular area for a specific time period. This projectile is from the family of scatterable mines and is known as the remote antiarmor mine system (RAAMS). It is painted olive drab with yellow markings. The most significant markings are the row of yellow triangles, which contain the letter L, between the nose and the bourrelet and RAAM-L on the ogive, which indicates the long self-destruct time for the submunition (Figure 2-21). This is a base-ejection type projectile and uses the M577 MTSQ fuze.

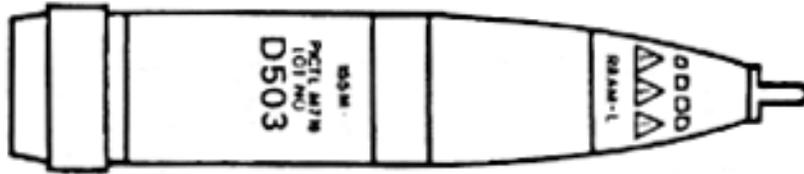


Figure 2-20. M718 projectile

1. Projectile, 155-mm, RAAMS, M741. This projectile is also known as a RAAMS projectile. It is exactly like the M718 above except the letter S painted in the yellow triangles and the RAAMS-S on the ogive are different to indicate a short selfdestruct time. This is a base-ejection type projectile and uses the M577 MTSQ fuze (Figure 2-21).

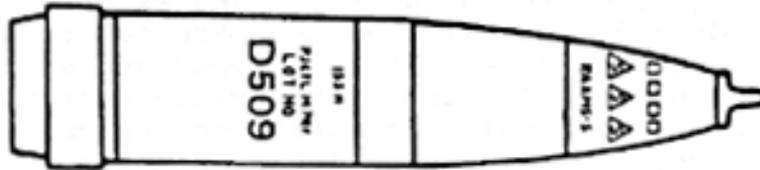


Figure 2-21. M741 (RAAMS) projectile

m. **Projectile, 155-mm, HEAT, M712 (Copperhead).** This projectile is a cannon-launched guided projectile (CLGP). It is a High Explosive Anti-Tank (HEAT) projectile loaded with 14.75 pounds (6.69 kilograms (kg)) of Composition B. It is guided to its target by a laser beam directed on the target from a laser designator. The projectile has five time and code switches set by the crew before firing. The warhead section of the projectile contains its own base-detonating fuze (M740). The projectile is 54 inches (137.16 centimeters (cm)) long and weighs 138 pounds (62.60 kg) (Figure 2-22).

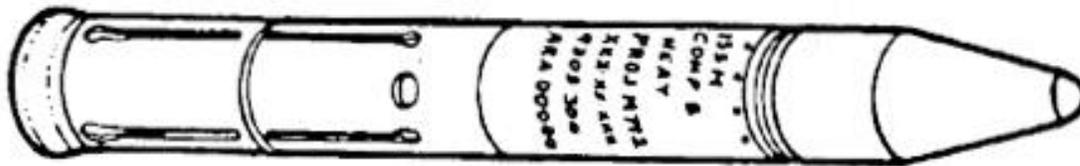


Figure 2-22. M712 (CLGP) projectile (fins and wings retracted)

n. **Projectile, 155-mm, training, M823.** This projectile is designed to train 155-mm howitzer weapon crews in the handling and setting of the M712 Copperhead projectile. It simulates the M712 in weight, center of gravity, and external appearance. It contains code and time switches that are set to simulate prefiring activity by the crew. It is shipped and stored in the same container as the M712, and is color-coded bronze for easy identification. Additional information on unpacking, repacking and extraction procedures can be found in Appendix C, Extract of TM 9-2350-311-10, at the back of this subcourse.

WARNING

THE M823 PROJECTILE MUST NOT BE FIRED. SUCH FIRING COULD BE A HAZARD TO PERSONNEL FORWARD OF THE WEAPON.

o. **Projectile, 1557mm, Smoke, WP, NS25.** The M825 is used to produce a ground screening smoke of 5-10 minutes duration. It consists of a modified M483AI ogive and expulsion charge in a modified M483A1 all steel body and a threaded steel ring base. It has a payload of 116 white-phosphorus-impregnated felt wedges contained in a hermetically sealed steel canister. A 1/4 inch diameter burster charge (approximately 21 grams of Composition A-5) runs the entire length of the canister (Figure 2-23).

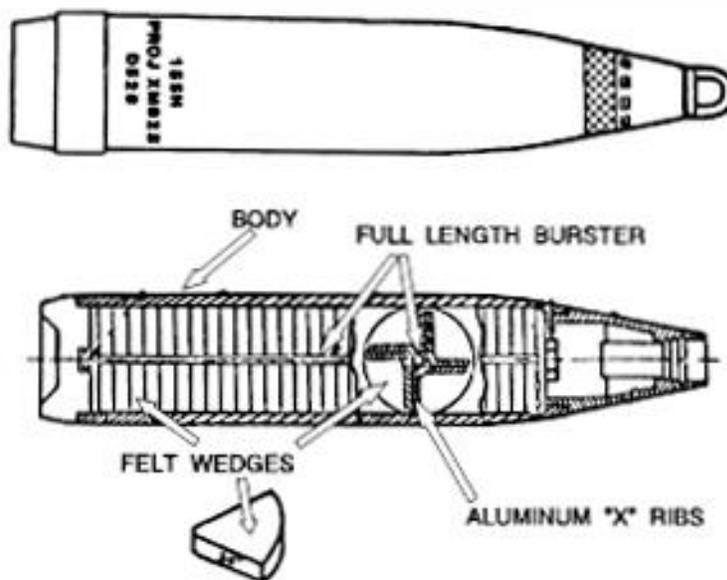


Figure 2-23. 155-mm Smoke, WP M825/825A1

5. Propelling charges.

The following are authorized propelling charges for the 155-mm howitzers. Refer to Table 1-2, and compare which weapon system can use the different series of propelling charges. For example, the M198, when firing the M107 HE, cannot use the M203 propelling charge.

a. **Propelling charge M3A1.** This is a green bag charge divided into a base and four increments for firing in zones 1 through 5. It has a flash reducer pad assembled forward of the base charge with similar 1-ounce pads assembled forward of increments 4 and 5. The increment bags are tied together by cloth tying straps. An igniter charge in a red cloth bag is sewn to the rear of the base section (Figure 2-24, page 2-22). The igniter pad consists of a red pancake-shaped bag of either black powder or clean-burning igniter (CBI).

Figure 2-24- M3A1 propelling charge

- b. **Propelling charge M3.** This is a green bag charge similar to propelling charge M3A1 (Figure 2-24), except it is not assembled with a flash reducer and black powder is used in the igniter pad.
- c. **Propelling charge M4A2.** This is a white bag charge (Figure 2-24) consisting of a base charge and four increments for firing in zones 3 through 7. The increments are tied together by cloth tying straps. An igniter charge in a red cloth bag is sewn to the rear of the base section. It has a flash reducer pad assembled forward of the base charge.

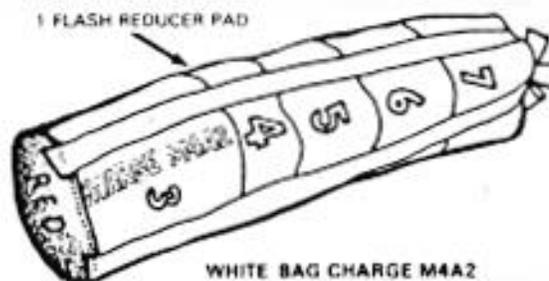


Figure 2-25. M4A2 propelling charge

- d. **Propelling charge M4A1.** Propelling charge M4A1 is identical to the M4A2, except that it does not contain a flash reducer and the base igniter contains black powder. The M2 flash reducer (Figure 2-29) may be used with this charge and is a separate item of issue.
- e. **Propelling charge M119.** This is a special single zone (8) charge developed to extend the range of the M109A5/A6 and M198 long tube. This white bag charge consists of only one increment with an igniter bag sewn on the base, and a flash reducer on the front of the charge (Figure 2-2C). This charge is only used with M109A5/A6 and M198 howitzers. Refer to Appendix B to determine which weapon system can use the various propelling charges.

2-22

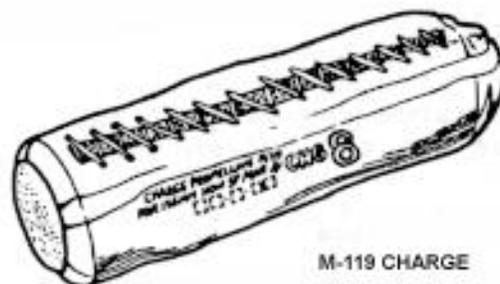


Figure 2-26. M119 propelling charge

f. **Propelling charge M119A1.** This charge is identical in appearance to the M119 charge. It contains some design improvements that include a modified flash reducer. The modified flash reducer allows firing of the charge with the M549/M549A1 projectile.

g. **Propelling charge M203.** The M203 propelling charge is a charge 8 (S) propelling charge developed for extended range in long-tube 155-mm howitzers. This red bag charge consists of one increment with an igniter bag sewn on its base, a central core igniter extending through the center of the charge, and a flash reducer in front of the charge. The entire length of the charge is encased in a tight-fitting, laced jacket for added strength and stability (Figure 2-2.7).

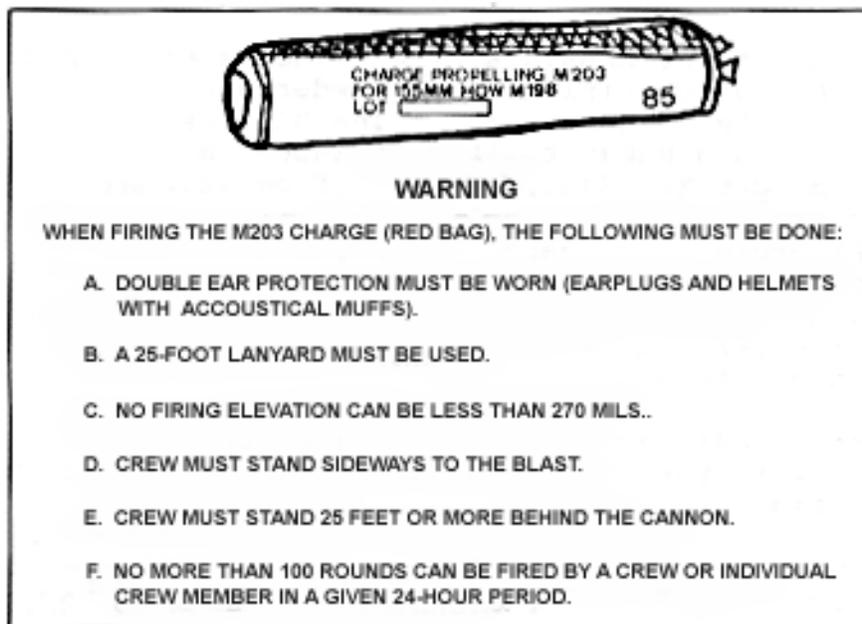


Figure 2-27. M203 propelling charge (red bag)

2-23

h. **Propelling Charge, M203A1.** The M203A1 propelling charge, (Figure 2-28) like the M203, is a charge a propelling charge developed for extended range in long-tube (M198) 155mm howitzers. This charge consists of one increment of stick propellant and a base igniter pad encased in a full length rigid combustible cartridge case. The charge also contains a wear reducing additive and a lead foil decoppering agent. The M203A1 charge 8 is ballistically equivalent to the M203 red bag charge 8.

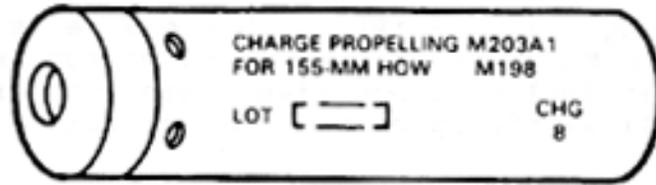


Figure 2-28. Propelling charge, M203A1

i. **Modular Charge Artillery System (MACS)**

The Army has begun fielding MACS—Soldiers no longer will waste unused powder. MACS consists of two propelling charges, the M231 and M232, and associated packaging. (See the figure below.) The system is compatible with all current and planned 155-mm weapons.



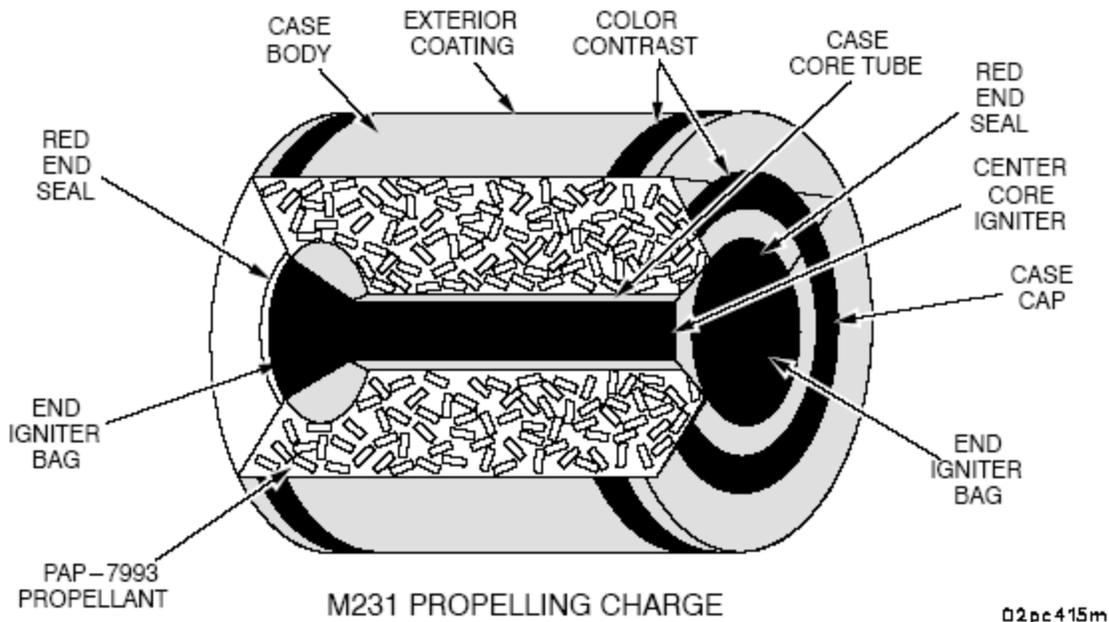
M231



M232

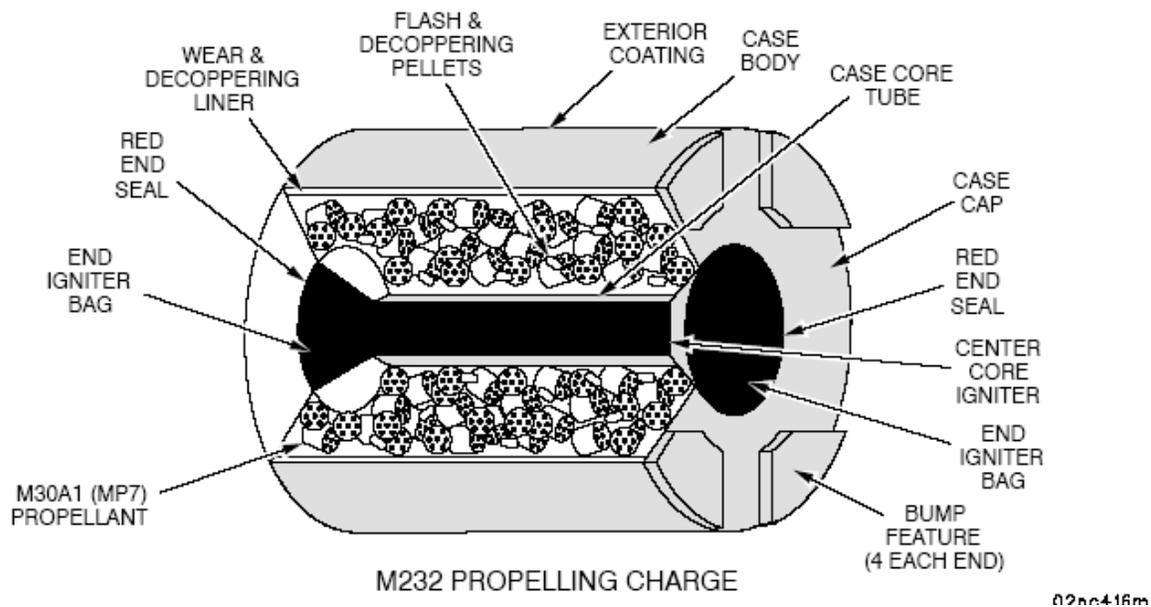
2-24

j. **Propelling Charge, M231.**



The M231 propelling charge is comprised of a green-colored, coated, nitrocellulose-based combustible case with black markings and black bands. This charge is bi-directional (can be loaded in either direction). The M231 is fired in increments of 1 or 2 for charges 1 and 2.

j. Propelling Charge, M232.



The M232 propelling charge is comprised of a tan-colored, coated, nitrocellulose--based combustible case with black markings. This charge is

bi-directional (can be loaded in either direction). Each end has four raised 1/8-inch bumps. The M232 is fired in increments of 3 through 5 for charges 3 through 5.

6. Flash reducer M2.

The M2 flash reducer consists of a 4-inch square, red cotton cloth bag containing black powder and potassium nitrate (Figure 2-29). The M2 flash reducer which is a separate item of issue, may be used with charges M4, M4A1, or M4A2 if additional Fig. 2-29 flash reduction is desired. In preparing a white bag M2 flash M4 and M4A1 propelling charge for firing, one flash reducer. reducer is added at the forward end of the base charge and at the forward end of each increment used. The flash reducer pads serve to limit muzzle flash and blast overpressure.

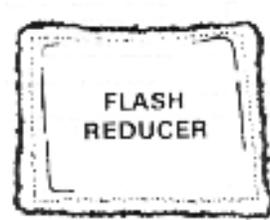


Fig 2-29
M2 flash reducer

7. Primers. There is one model of primer used with the 155-mm howitzer, the M82.

a. **Primer M82.** The M82 primer (Figure 2-30) is the only authorized primer to be used in the 155-mm, M198 towed, and the 155-mm M109A5/A6 self-propelled howitzers. The primers are ready for firing when unpacked and inspected.

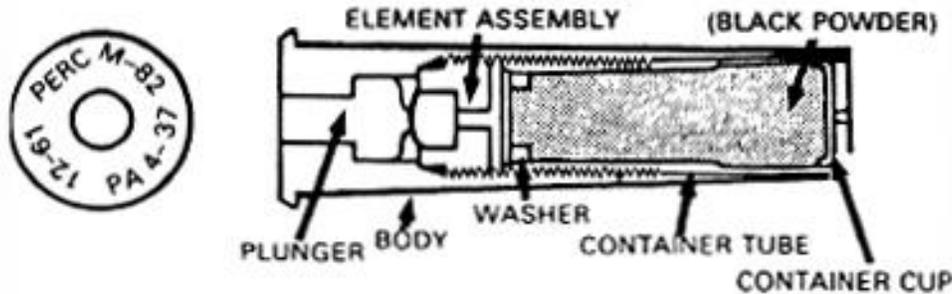


Figure 2-30. M82 primer

The 105-mm howitzer is a general-purpose, light, towed, field artillery weapon normally used in direct support of an airborne, air assault, or light infantry brigade.

Ammunition for the 105-mm howitzer is classified as semifixed. The cartridge case comes free fitted, rather than crimped, over the projectile base. Most cartridges for the 105-mm howitzer require preparation of the projectile, propelling charge, and fuze.

The 155-mm M198 towed howitzer is a medium artillery weapon designed to provide either general support or direct support. Ammunition for the 155-mm howitzer cannons is classified as separate-loading. That is, the loading of each complete round requires three separate operations. These operations are loading the fuzed projectile, then the propelling charge, and finally the primer.

There is only one model of primer used in the 155-mm howitzer, the M82.

The 155-mm M109A5/A6 Self Propelled (SP) howitzers is a medium artillery weapon designed to provide either general support or direct support. This weapon has a self-propelling carriage that was designed specifically for field artillery purposes. It is flexible, mobile, and stable to a degree never before attainable in medium SP field artillery weapons. Ammunition for the 155-mm howitzer is the separate-loading type.

PRACTICE EXERCISE

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

1. The sustained rate of fire for all 105-mm cannons is:
 - A. 10 rounds per minute.
 - B. 6 rounds per minute.
 - C. 3 rounds per minute.
 - D. 4 rounds per minute.

2. The M119A1, 105-mm howitzer fires a _____ -pound projectile of semifixed ammunition.
 - A. 35
 - B. 33
 - C. 31
 - D. 30

3. Ammunition for the 105-mm howitzer is classified as:
 - A. separate loading.
 - B. separately incremented.
 - C. semifixed.
 - D. free fitted.

4. Based on the text, which of the following are the authorized 105-mm weapon systems?
 - A. The M198 towed, M102 towed and M119 towed.
 - B. The M102 towed and M119 SP.
 - C. The M102 towed and M114 towed.
 - D. The M102 towed and M119 towed.

2-28

5. Select the sentence below that correctly describes the distribution of the M119 series, 105-mm howitzers.

- A. M119 howitzers are found only in active duty light infantry.
 - B. M119 howitzers are found in active duty Army and Army National Guard units.
 - C. M119 howitzers are only found in Army National Guard units.
 - D. M119 howitzers are found in some active duty Army Units.
6. Select the sentence below that correctly describes some characteristics of the M102, 105-mm howitzer.
- A. The M102 howitzer fires the same types of ammunition and has the same range as the M119 when it shoots charge 7.
 - B. The M102 howitzer fires the same ammunition as the M119 and fires 500 meters less than the M119 at charge 7.
 - C. The M102 cannot fire the aluminum bodied APERS round because the extreme chamber pressures distort these rounds.
 - D. The increased maximum rate of fire of the M102 requires a higher basic load of ammunition than for the M119.
7. Select the one statement below that is an accurate description of one of the characteristics of the 105-mm M1 HE round.
- A. Cast TNT is the only filler used in the M1.
 - B. Because of the higher fragmentation effect, only Composition B is used as a filler.
 - C. The cartridge case contains a percussion primer assembly and eight individually bagged and numbered propelling charge increments.
 - D. The cartridge case contains a percussion primer assembly and seven individually bagged and numbered propelling charge increments.
8. From the list below, select the one correct statement about the APERS-T M546 round.
- A. The M546 is designed for use against personnel in direct fire, muzzle action and in direct fire.
 - B. When set for delayed action, the M546 may be fired over the heads of exposed friendly troops.
 - C. The M546 is not effective against personnel in dense foliage.
 - D. The M546 consists of a two-piece light gauge brass body and fuze adapter, and a hollow steel base.
- 2-29
9. From the list below, select the one correct statement about field artillery illuminating rounds.

- A. Illuminating rounds are available in 105-mm, 155-mm and 203-mm weapons.
 - B. Illuminating rounds are not used for signaling, for illuminating a designated area or for marking an area.
 - C. The M314 illumination projectile is fitted with a mechanical time fuze.
10. From the list below, select the one correct statement about field artillery smoke rounds.
- A. Smoke rounds are available for 105-mm and 155-mm howitzers only.
 - B. 105-mm smoke rounds are manufactured with 4 smoke canisters.
 - C. The smoke canisters have a centrally located bursting tube and contain HC (white) smoke.
 - D. Smoke rounds emit smoke for a period of 90 to 120 seconds.
11. From the list below, select the one correct statement about field artillery improved conventional munitions (ICM) rounds.
- A. There are three types of ICM rounds for field artillery weapons.
 - B. There are no antipersonnel-antimateriel rounds for 105-mm howitzers.
 - C. There are no antipersonnel rounds for the 105-mm howitzer.
 - D. The ICM is designed to transport its internal payload of mines to the target.
12. From the list below, select the one correct statement about the M39 antipersonnel grenade.
- A. The M39 grenade contains a steel ball filled with explosive and steel fragments.
 - B. The 105-mm ICM contains 36 M39 grenades.
 - C. When the fuze in the projectile functions, it ignites the CBI expelling charge in the projectile.
 - D. The (explosive filled) steel ball is thrown into the air when the grenade striker plate impacts the ground and ignites the expelling charge in the grenade.
- 2-30
13. From the list below, select the one correct statement about the high-explosive rocket-assisted (HERA) M548 round.

- A. The 105-mm HERA round is used for fragmentation and blast effects in support of infantry and armored units.
 - B. The HERA warhead is filled with cast TNT.
 - C. The HERA cartridge case contains a primer and seven individually bagged and numbered propelling charge increments.
 - D. The rocket motor is inside the projectile body with the rocket delay housing assembly flush with the end of the boattail.
14. From the list below, select the one correct statement about 105-mm cartridge cases.
- A. M14 cartridge cases are made with either brass, steel, spiral wrapped steel and spiral wrapped aluminum.
 - B. Most 105-mm cartridges contain zoned charges (eight increments).
 - C. M14 series cartridges come with primers that are an integral part of the cartridge case.
 - D. 105-mm components are totally interchangeable so that projectiles, cartridge cases and propelling charges from different complete rounds may be interchanged in order to get the correct shell, fuze, propelling charge combination.
15. From the list below, identify the mnemonic that pertains to projectile M60 (White Phosphorous).
- A. GSB
 - B. GSD
 - C. SMA
 - D. SMB
16. Based on the text, which of the following are the authorized 155-mm weapon systems?
- A. M119, M198, and M109A5/A6.
 - B. M198, and M109A5/A6
 - C. M198, and M102.
 - D. M119, M198, and M109A5/A6

2-31

17. From the list below, select the one that correctly describes characteristics of 155-mm components.

- A. 155-mm components (fuze, projectile, propelling charge, and primer) come in the same container as a complete round.
 - B. Loading 155-mm ammunition requires four separate operations--loading projectile, loading propelling charge, ramming, and inserting the primer
 - C. Rounds for 155-mm howitzers are classified as separate component weapons.
 - D. The four 155-mm ammunition components are shipped separately.
18. From the list below, select the one statement that is correct about the M107, 155-mm projectile.
- A. It is used for blast, fragmentation and cratering.
 - B. It is loaded with Composition B or Composition A.
 - C. MTSQ or VT fuzes may be used with this projectile.
 - D. Newer models are available as a deep cavity projectile only.
19. Toxic chemical rounds M110 and M121A1 are similar in that:
- A. they both use an expelling charge.
 - B. they both use a burster charge.
 - C. they both have H or HD (mustard) as a filler.
 - D. they both have VX (nerve gas) as a filler.
20. The M449, 155-mm ICM projectile contains:
- A. 18, M39-series grenades.
 - B. 60, M39-series grenades.
 - C. 18, M43-series grenades.
 - D. 60, M43-series grenades.
21. Which statement, below, is correct concerning the M483A1 ICM projectile?
- A. The M483A1 ICM weighs approximately 120 pounds.
 - B. The M483A1 ICM carries 36 grenade submissiles.
 - C. The M483A1 ICM uses the M577 fuze only.
 - D. In the fire-for-effect mode, the projectile functions like an HE round.

2-32

22. The M692 and M731, 155-mm projectiles are similar because:
- A. they carry a distinctive triangle with the letter "L" inside.

- B. they carry a distinctive yellow triangle with the letter 'IS" inside.
 - C. their filler is cast Composition B.
 - D. they are both area denial artillery munitions.
23. The two remote antiarmor mine system (RAAMS) projectiles are the:
- A. M712 and M718.
 - B. M718 and M741.
 - C. M823 and M825.
 - D. M712 and M825.
24. What is the value of the M823 155-mm training round?
- A. It simulates the M712 copperhead round in weight, center of gravity and external appearance.
 - B. It has the same ballistic characteristics as service ammunition.
 - C. It is designed to train 155-mm howitzer crews in the handling of separate loading ammunition.
 - D. Unlike other training rounds it may be safely fired and, then recovered for re-use.
25. What is one difference between the M3 and M3A1 propelling charges?
- A. The M3's igniter pad contains either black powder or CBI while the M3A1 igniter pad contains only black powder.
 - B. The M3 igniter pad contains only black powder while the M3A1 igniter pad may contain either black powder or CBI.
 - C. The M3 is a green bag charge while the M3A1 is a white bag charge.
 - D. The M3A1 is a green bag charge while the M3A1 is a white bag charge.
26. What is one difference between the M4 series and M119 series propelling charges?
- A. The M4 series are green bag charges and the M119 series are white bag charges.
 - B. the M4 series are white bag charges and the M119 are red bag charges.
 - C. The M4 series have four increments while the M119 series are single zone charges.
 - D. The M4 series is a single zone charge while the M119 series has four increments.
- 2-33
27. From the following sentences, select the one correct statement about the M203 and M203A1 propelling charges.

- A. Both are charge 8 propelling charges but the M203 is a cloth bag while the M203A1 components are encased in a rigid combustible cartridge case.
 - B. Both are charge 8 propelling charges divided into 4 increments for firing in zones 3 through 7.
 - C. The M203 is identical in appearance to the M119 charge with the addition of a modified flash reducer.
 - D. The M203A1 is identical in appearance to the M119 charge with the addition of a modified flash reducer.
28. From the following sentences, select the one correct statement about the M2 flash reducer.
- A. It consists of a 4-inch square, white cloth bag containing black powder and potassium nitrate.
 - B. It consists of a 4-inch square, red cloth bag containing CBI and potassium nitrate.
 - C. It may be used with charges M4, M4A1, or M4A2 if additional flash reduction is desired.
 - D. It may be used with charges M4A1, M4A2 and M119 if additional flash reduction is desired.
29. Which one of the following statements about primers is correct?
- A. The M82 is the only primer authorized for firing in M198 howitzers.
 - B. The MK24A4 is the only primer authorized for firing in M198 howitzers.
 - C. The use of the M82 primer in M109 series howitzers is not recommended.
 - D. The M82 requires removal of the cork plug and inspection of the container cup prior to use.
30. The only authorized towed 155-mm howitzer in service is the:
- A. M109A6
 - B. M198
 - C. M119
 - D. M102

2-34

31. From the sentences below, select the one correct statement about the M231 propelling charge.?

- A. The M231 propelling charge is comprised of a tan-colored, coated, nitrocellulose-based combustible case with black markings.
 - B. The M231 propelling charge is comprised of a green-colored, coated, nitrocellulose-based combustible case with black markings and black bands.
 - C. The M231 propelling charge is comprised of a green-colored, coated, nitrocellulose-based combustible case with black markings and red bands.
 - D. The M231 propelling charge is comprised of a tan-colored, coated, nitrocellulose-based combustible case with black markings and blue bands.
32. From the sentences below, select the one correct statement about the M231 propelling charge.
- A. It is a green bag charge divided into a base and five increments.
 - B. It is a white bag charge divided into a base and four increments.
 - C. It is used for firing in zones 1 through 5.
 - D. It is used for firing in zones 1 and 2.
33. From the statements below, choose the correct statement that describes a difference between the M231 and M232 propelling charge.
- A. The M231 is divided into a base charge and two increments while the M232 is a three-increment charge.
 - B. The M231 is a white bag charge and the M232 is a green bag charge.
 - C. The M231 has 2 increments for charges 1 and 2, the M232 is fired in increments of 3 through 5 for charges 3 through 5.
 - D. The M231, and the M232 is bi-directional (can be loaded in either direction).

2-35
LESSON 2

PRACTICE EXERCISE

ANSWER KEY AND FEEDBACK

Item Correct Answer and Feedback

1. C. 3 rounds per minute

After maximum rate of fire has been achieved, all 105-mm howitzers may fire a sustained rate of 3 rounds per minute. The M119 can sustain this rate for 30 minutes. (pages 2-2, 2-3, and 2-4, TABULATED DATA boxes).

2. B. 33

The M101A1, 105-mm howitzer fires a 33-pound projectile of semifixed ammunition to a maximum range of 11,000 meters. (page 2-1, para 1).

2. C. semi fixed.

Ammunition for the 105-mm howitzers (M101, M101A1, M102 and M119) is classified as semifixed. (page 2-5, para 4).

4. D. The M101 towed, M101A1 towed, M102 towed and M119 towed.

Lesson 2 provides a brief description of the M101 series, M102 and M119 as the only authorized 105-mm weapons systems. (pages 2-1, 2-2, 2-3 and 2-4).

5. B. M119 howitzers are found in active duty Army and Army National Guard units.

2. A. The M102 howitzer fires the same types of ammunition and has the same range as the M119 when it shoots charge 7.

The M102 howitzer fires the same types of ammunition as the M119 howitzer with charge 7 they reach the same range, but the M119 can shoot farther away with charge 8 RAP to range up to 19,000 meters. The M102 is only used by the National Guard now.

2-36

7. D. The cartridge case contains a percussion primer assembly and seven individually bagged and numbered propelling charge increments.

The cartridge case contains a percussion primer assembly and seven individually bagged and numbered propelling charge increments. (page 2-5, para 4a).

8. A. The M546 is designed for use against personnel indirect fire, muzzle action and in direct fire.

The 105-mm APERS-T M546 (flechette) round, commonly referred to as the Beehive round (Figure 2-5), is designed for use against personnel in direct fire, muzzle action and in direct fire with a time setting other than muzzle action. It is effective against personnel in the open or in dense foliage. (page 2-6, para 4b).

9. C. The M314 illumination projectile is fitted with a mechanical time fuze.

The (M314 illuminating) projectile is fitted with a mechanical time fuze. (page 2-6, para 4c).

10. A. Smoke rounds are available for 105-mm and 155-mm howitzers only.

Smoke rounds are available for 105-mm and 155-mm howitzers only, and are used for spotting, screening, and signaling purposes. (page 2-7, para 4d).

11. B. There are no antipersonnel-ant materiel rounds for 105-mm howitzers.

There are two types of ICM rounds available for field artillery howitzers: the old single-purpose antipersonnel round for the 105-mm, 155-mm, and 203-mm howitzers and the new dual-purpose, antipersonnel-antimateriel round (dual purpose ICM or DPICM) for the 155-mm and 203-mm howitzers. There are no antipersonnel-antimateriel rounds for the 105-mm howitzer. (page 2-8, para 4e).

12. D. The (explosive filled) steel ball is thrown into the air when the grenade strike plate impacts the ground and ignites the expelling charge in the grenade.

After the grenades are expelled from the projectile, small vanes on each grenade flip upward and arm the grenade. The vanes keep the armed grenade in a vertical position as it falls through the air so that **the striker plate at the base of the grenade strikes the ground. This action causes the expelling charge in the grenade to hurl the steel ball 4 to 6 feet in the air.** High explosive shatters the metal ball and scatters metal fragments over the target area. (page 2-9, para 4f).

2-37

13. A. The 105-mm HERA round is used for fragmentation and blast effects in support of infantry and armored units.

The M548 is a high explosive, rocket-assisted round with extended range capability. It is used for fragmentation, and blast effects in support of infantry and armored units.(page 2-9, para 4g).

14. C. M14 series cartridges come with primers that are an integral part of the cartridge case.

M14 series cartridges do not require preparation of -the primer. Percussion primers are used with these cartridges and come as an integral part of the cartridge case. (page 2-10, para 6b).

15. C. SMA

Appendix B provides you with the mnemonics for 105-mm, 155-mm and 203-mm projectiles and fuzes. While it is important for you to know what these mnemonics look like, there are numerous references at the unit level to assist automated fire direction system users in inputting the correct mnemonics into these system. These references include battalion and battery SOP'S, technical manuals, and job aids. (page 2-11, para 7 and page B-4).

16. B. M114A2, M198, and M109A2/A3/A4.

The text provides descriptions of the above authorized weapons systems on the pages that follow in parentheses. (page 2-12, 2-13, and 2-14).

17. D. The four 155-mm ammunition components are shipped separately.

Separate-loading ammunition is used in 155-mm howitzer cannons. Loading each complete round into these howitzers requires three separate operations: loading the fuzed projectile; loading the propelling charge; and inserting the primer. All four of these components (fuze, projectile, propelling charge, and primer) are shipped separately. (page 2-15, para 4a).

18. A. It is used for blast, fragmentation and cratering.

Projectile, 155-mm, HE, M107 is used mainly for blast, fragmentation, and cratering. This normal or deep-cavity projectile consists of a steel case loaded with either TNT or composition B. (page 2-15, para 4b).

2-38

19. B. They both use a burster charge.

Burster charges are used in both the M110 and M121AI in order burst the projectiles and spread the HD (mustard) or VX (nerve) gases over the target area (pages 2-15 and 2-16, para 4c and 4d).

20. D. 60, M43-series grenades.

M449 series projectiles are used mainly against personnel. They are base-ejecting projectiles that contain 60 M43-series grenade submissiles. (page 2-16, para 4g).

21. C. The M483AI ICM uses the M577 fuze only.

The M483AI ICM projectile weighs 102 pounds and uses only the M577 fuze. (page 2-17, para 4h).

22. D. they are both area denial artillery munitions.

Both these ADAM projectiles carry mines as submunitions. These submunitions are antipersonnel mines that deny the enemy free use of certain areas for a period of time. After scattering over the target area, the mines can be detonated by being disturbed or they self destruct at a pre-set time. (page 2-18, para 4i and 4j).

23. B. M718 and M741.

The two referenced paragraphs describe these projectiles as remote antiarmor missile systems (RAAMS). (page 2-19, para 4k and 4l).

24. A. It simulates the M712 copperhead round in weight, center of gravity and external appearance.

Projectile, 155-mm, training, M823 is designed to train 155-mm howitzer weapon crews in the handling and setting of the M712 Copperhead projectile. It simulates the M712 in weight, center of gravity, and external appearance. It contains code and time switches that are set to simulate pre-firing activity by the crew. (page 2-20, para 4m and 4n).

2-39

25. B. The M3 igniter pad contains only black powder while the M3AI igniter pad may contain either black powder or CBI.

The M3A1 propelling charge has an igniter charge in a red cloth bag sewn to the rear of the base section. The igniter pad consists of a red pancake-shaped bag of either black powder or clean-burning igniter (CBI). The M3 is a green bag charge similar to propelling charge M3A1, except it is not assembled with a flash reducer and black powder is used in the igniter pad. (page 2-21 and 2-22, para 5a and 5b).

26. C. The M4 series have four increments while the M119 series are single zone charges.

The M4A2 is a white bag charge consisting of a base charge and four increments for firing in zones 3 through 7. The M119 is a special single zone (8) charge developed to extend the range of the M109A1 and A3 long tube. This white bag charge consists of only one increment. (page 2-22, para 5c and 5e).

27. A. Both are charge 8 propelling charges but the M203 is a cloth bag while the M203A1 components are encased in a rigid combustible cartridge case.

The M203 propelling charge is a charge 8(S) propelling charge. This red bag charge consists of one increment with an igniter bag sewn on its base. The entire length of the charge is encased in a tight-fitting, laced jacket for added strength and stability. The M203A1 propelling charge, like the M203, is a charge 8 propelling charge. This charge consists of one increment of stick propellant and a base igniter pad encased in a full length rigid combustible cartridge case. (pages 2-23 and 2-24, para 5g and 5h).

28. C. It may be used with charges M4, M4A1, or M4A2 if additional flash reduction is desired.

The M2 flash reducer which is a separate item of issue, may be used with charges M4, M4A1, or M4A2 if additional flash reduction is desired. (page 2-24, para 6).

29. A. The M82 is the only primer authorized for firing in M198 howitzers.

The M82 primer is the only authorized primer to be used in the 155-mm, M198 towed, and the 155-mm M109A1/A2/A3/A4 self-propelled howitzers. (page 2-25, para 7a and 7b).

2-40

30. B. M198

The only 155-mm towed weapon currently in service in the U.S. is the M198.

31. B. The M231 propelling charge is comprised of a green-colored, coated, nitrocellulose-based combustible case with black markings and black bands.
32. D. It is used for firing in zones 1 and 2.
33. C. The M231 has 2 increments for charges 1 and 2, the M232 is fired in increments of 3 through 5 for charges 3 through 5.

2-41

LESSON 3

FUZES, FUZE WRENCHES, FUZE SETTERS, AND BOOSTERS

OVERVIEW

LESSON DESCRIPTION

Upon completion of this lesson, you will be able to identify the different types of fuzes, fuze setters, and boosters. You will also recognize the steps in the functioning of representative fuzes and boosters used by the field artillery.

TERMINAL LEARNING OBJECTIVE:

- ACTION:** Identify fuzes and associated fuzing equipment and identify proper procedures for setting fuzes.
- CONDITION:** Given the material found in this lesson.
- STANDARD:** Correctly answer all questions in the practice exercise at the end of this lesson.
- REFERENCES:** This lesson is based on TM 43-0001-28, FM 6-50 other materials approved for US Army field artillery instruction; however, development and progress render the text continually subject to change. Therefore, base your examination answers on material presented in this text rather than on individual or unit experience.

PART A - FUZE ARMING AND FUZE CLASSIFICATION

An important duty in preparing a complete round of cannon ammunition for firing is the selection and preparation of the correct fuze. When a round is fired with the correct fuze and with the proper setting on the fuze, the projectile explosive train will achieve the desired results. Firing a round of ammunition without a fuze or with an unauthorized fuze could cause a premature burst, or could injure personnel and damage equipment.

1. Arming of fuzes.

A fuze is armed when it is ready to detonate the projectile; that is, when all parts are in or are free to move to their proper positions so the fuze operates as intended. Fuzes are armed principally by inertia and centrifugal force. In some fuzes, both of these forces are used to actuate the safety devices. In others, only one force is used. Inertia

3-1

is the property by which any physical body persists in its state of rest or uniform motion until acted upon by some external force. In a fuze, inertia is used in several ways.

a. Setback occurs when the projectile accelerates on firing and components inside are forced toward, the base. Setback may be used to lock or unlock safety devices.

b. Creep occurs as the projectile decelerates in flight. This is the same force a person feels when standing inside a bus or train as the vehicle slows to a stop. As deceleration occurs, fuze components tend to move toward the fuze end of the projectile. Creep is taken into consideration in designing the fuze.

c. Set forward occurs at impact or on sudden deceleration. This effect may be used to drive firing pins into primers or to drive primers against stationary firing pins.

d. Centrifugal force results from rotation of the projectile and fuze during flight. All objects within the fuze that are free will move away from the axis of rotation toward the outside of the fuze.

2. Classification of fuzes.

An artillery fuze is classified according to its position on the projectile as either Base-Detonating (BD) or Point-Detonating (PD). Field artillery fuzes are also classified according to method of functioning as impact, Mechanical Time (MT), Variable Time (VT), or a combination of these. Combination fuzes, such as Superquick, are further classified as selective fuzes, i.e., the fuze may be set for either of two available actions. A selective fuze set for primary action should function on the alternate action if the primary arming element fails. This alternate functioning prevents duds. It also provides a self-destruction capability that prevents recovery of rounds by enemy personnel. Setting a selective fuze for alternate functioning (e.g., setting a Superquick and delay fuze for delay action or a mechanical time and Superquick fuze for Superquick action) eliminates-the alternate function, and reduces the fuze to a single-action fuze. This will result in a dud or a low-order burst if the alternate arming element (which is now the primary arming element) fails. Certain models of proximity (VT) fuze incorporate a Superquick element expressly for self-destruction purposes, whereas others are the selective type. Impact fuzes are further classified according to action initiated by force of impact as:

3-2

- superquick
- Delay

- Non-delay
- Point-Initiating, Base-Detonating (PIBD)

a. **Selective fuzes.**

(1) The M557 fuze (Figure 3-2) is classified as a selective fuze because it offers a choice of superquick or delay action. This fuze has a black powder pellet that gives a delay of 0.05 seconds and is used with all HE projectiles. The M557 fuze is set by means of a slotted screwhead (selector sleeve) on the side of the fuze body. Turning the slot to the vertical position (SQ) gives superquick action. Turning it to the horizontal position (DELAY) gives a delay action. The position of this slot determines the action of the interrupter. If the selector is set for DELAY, the interrupter is locked into the flash channel and the superquick element cannot be armed. If the selector is set for SQ, the interrupter is moved out of the flash channel by centrifugal force. Therefore, the flash from the superquick detonator travels directly to the booster, and superquick action results. If, for any reason, the superquick components fail to function, the delay plunger will move forward and cause the projectile to explode with delay action. The M557 fuze consists of:

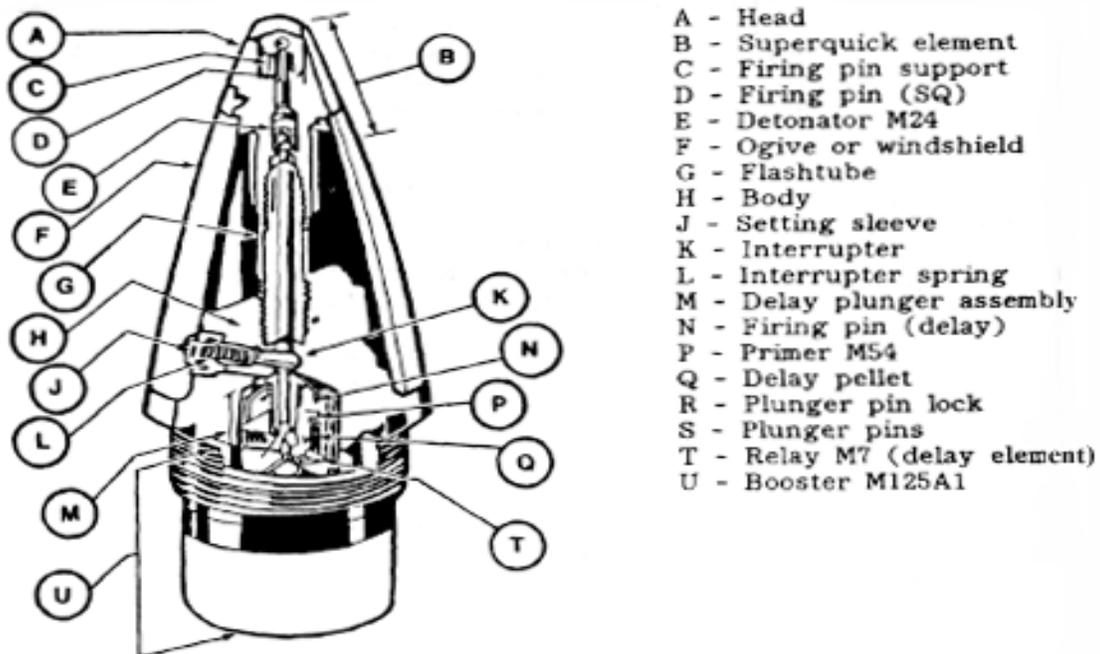


Figure 3-2. Impact fuze M557

3-3

- **A superquick firing pin in the nose.**
- **A superquick detonator.**

- A flash channel, extending from the superquick detonator to the booster.
- An interrupter in the flash channel, coupled with a selector sleeve.
- A delay action plunger in the base of the fuze, consisting of a fixed firing pin, a sliding detonator, and a black powder pellet.
- A booster (MI25AI).

(2) Other

selective fuzes include the M572 selective fuze and the M739 selective fuze. The M572 is essentially the same as the M557 fuze, except the nose of the M572 has been filled with epoxy. The M739 (Figure 3-3) is so the latest improved version of the impact fuze. This new fuze has an aluminum-

filled body. In addition, this fuze has a rain insensitivity

modification of the firing pin head. It is recessed 3/4-inch into a 1/2-inch diameter sleeve, with four small crossbars installed at different depths and orientations inside this sleeve cavity. These crossbars cause raindrops that enter this sleeve to be atomized into small droplets. These droplets are thrown out of the cavity by centrifugal force and air pressure through four 1/8-inch-diameter radial holes located at the bottom of the sleeve. This action makes the fuze less sensitive to rain so it can be fired through heavy rainstorms without premature functioning. It will eventually replace both of the older rain-sensitive M557 and M572 fuzes.

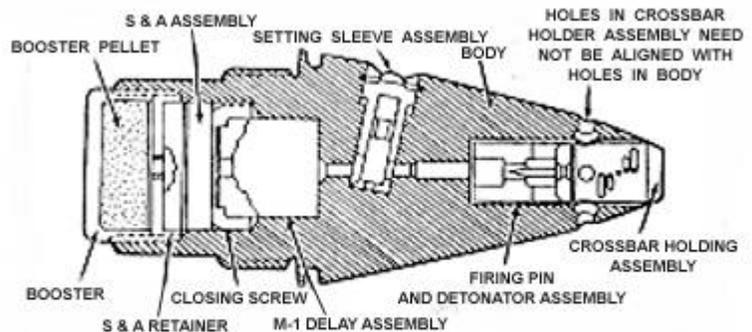


Figure 3-3. Fuze M739

- b. **Non-delay fuzes.** There are two types of nondelay fuzes: base-detonating and point-detonating. The base-detonating fuzes are used when the location of the fuze on the point of the projectile would be impractical, as in the high-explosive plastic round. The non-delay point-detonating fuze is steel hardened to permit penetration of concrete emplacements without damage to the firing pin and booster assembly. The firing pin and detonator assembly of all nondelay fuzes are located within the fuze body and thus are protected from possible damage upon impact. Nondelay fuze action is slightly slower than superquick, but much faster than delay action. (The delay fuze incorporates a black powder pellet to control the duration of the delay). There are two non-delay single-action fuzes

(1) **M78 concrete-piercing, point-detonating.** The concrete-piercing (CP), M78 fuze is an impact, point-detonating, steel-hardened fuze. It has a white tip painted on the nose to distinguish it from the CP M78 delay fuze (para d., below). This nondelay fuze enables adjustment of fire on a fortification without the requirement for a fuze of different ballistic characteristics. A box of CP M78s contains 4 nondelay and 16 delay fuzes. The nondelay has the same elements as the delay fuze (para d., below), except it has no black powder delay pellet.

The nondelay fuze is used in final adjustments during missions requiring concrete-piercing or rubble-clearing action. The M25 booster is used with the CP M78 fuze to ensure complete detonation of the bursting charge. Currently, the M78 is not being issued because of functioning problems.

(2) **M91 base-detonating nondelay fuze.** The BD M91 is a single-action fuze with an integral booster charge and a tracer element. It is used and issued with the 105-mm HEP-T projectile. The tracer element is located in the conical base of the fuze and has a burning time of 7.5 seconds.

c. **Delay fuzes.** A delay fuze is designed to allow the fuze and projectile to penetrate the target prior to the complete detonation of the bursting charge. This action requires a steel-hardened fuze to withstand this penetration. CP M78 delay PD is a single-action impact fuze that requires no setting and is only capable of delay action. An M25 booster is used with the CP M78 fuze to ensure complete detonation of the bursting charge. The black powder element gives a delay of 0.025 seconds. The fuze and booster (used to convert a high-explosive round to a concrete-piercing round) are installed by the cannoneer with a special fuze wrench. The M16 fuze wrench (Figure 3-4) is designed for tightening the M25 booster and the M78 concrete-piercing fuze in the standard HE projectile. The T-end of the wrench is used to seat and tighten the M25 booster. The curved end of the wrench with the short, round projection is used to seat and tighten the M78 fuze.



Figure 3-4. Fuze wrench M16

3-5

PART B - SETTING FUZES

1. Mechanical Time/Superquick fuzes.

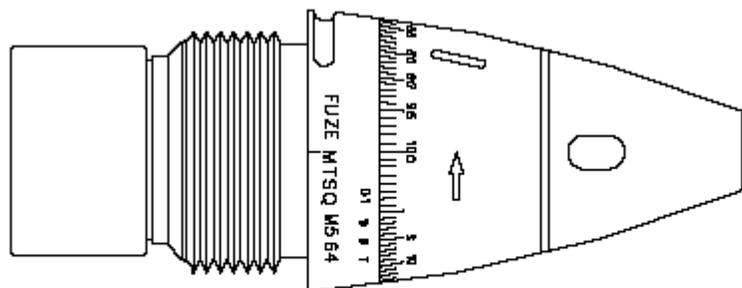
Mechanical Time (MT) fuzes cause the projectile explosive train to function at the right time or place. This paragraph contains information on the Mechanical Time (MT) and the Mechanical Time/Superquick (MTSQ) fuzes used in the field artillery. It also discusses the fuze wrench used in installing each fuze, the fuze setter to be used in setting each type of fuze, the direction in which the time ring must be turned, and the number of times each fuze can be reset.

WARNING

DO NOT FIRE AN ARTILLERY ROUND OF ANY CALIBER WITHOUT USING THE FUZE AUTHORIZED FOR THAT PARTICULAR ROUND. FIRING A ROUND WITHOUT A FUZE OR WITH A FUZE NOT AUTHORIZED FOR THAT TYPE OF ROUND MAY RESULT IN AN IN-BORE BURST OR OTHER HAZARD THAT COULD INJURE PERSONNEL AND DAMAGE EQUIPMENT.

a. Mechanical Time/Superquick M564.

This fuze is an improvement over the older MTSQ fuzes, in that it provides a longer timing mechanism (100 seconds) for functioning at longer ranges. The date of manufacture is stamped on the fuze body before the lot number. Fuzes manufactured through 1969 must be set on 90 seconds if superquick (impact) action is desired. Setting of these fuzes between S and 2 seconds may result in functioning after approximately 2 seconds. Fuzes manufactured from 1970 on may be set as shipped on S for superquick (impact) functioning. However, current doctrine dictates that all M564 fuzes, regardless of manufacture date, must be set on 90 seconds if superquick (impact) action is desired. Premature functioning of the fuze may occur downrange if the fuze is fired in heavy precipitation (rain, snow, sleet, hail).



SUPERQUICK M564 FUZE

b. Installing the M564 fuze.

Install the M564 fuze in projectile by removing the closing plug (or eyebolt lifting plug) from the projectile. Inspect the fuze well, then place the fuze in the fuze well, and tighten the fuze by hand. Next, place the M18 fuze wrench (Figure 3-5) on the fuze, and turn the wrench (M18) counterclockwise about one-quarter turn to loosen the fuze.

With your hand on the handle of the wrench, turn the wrench sharply and firmly clockwise to tighten the fuze to the projectile. Do not use an extension on the fuze wrench. Be sure there are no threads showing, and that the fuze fits snugly against the nose of the projectile.

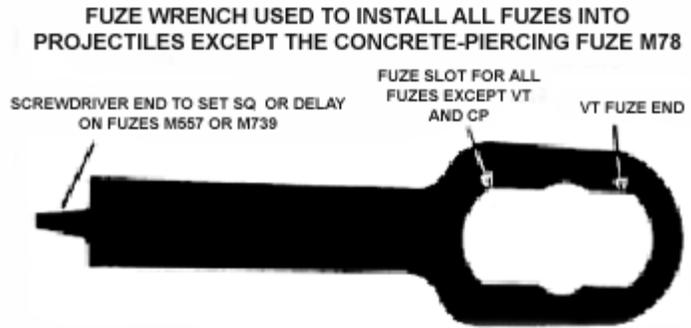


Figure 3-5. Fuze

c. Fuze wrench M18. The M18 fuze wrench (Figure 3-5) is designed for tightening current models of point-detonating fuzes, including Impact, Mechanical time, and Variable time fuzes. The screwdriver end of the M18 fuze wrench is designed to adjust the sleeve of a selective impact fuze, such as the M557; but it also can be used to set the M577 and M582 MTSQ when an M35 setter is not available. The modified rectangular opening at the end farthest from the handle is stamped VT END ONLY, and should be used accordingly.

d. M27 fuze setter.

Fuze setter M27 (Figure 3-7) is a flat-handled wrench-type instrument. It has a cone-shaped portion, which consists of a bronze casting with a steel catch dovetailed and pinned to the casting on the center of the T-handle. The fuze setter has no scale.

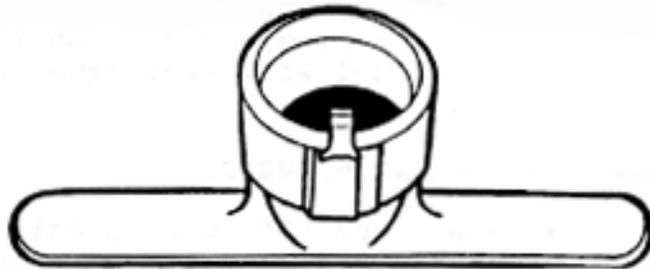


Figure 3-7. Fuze setter M27

2. Mechanical time fuzes.

The M563, M564, and M565 mechanical time fuzes (Figures 3-8, 3-9, and 3-10) have 100-second time mechanisms and vernier scales, which are used in setting the fuzes to the closest 0.1 second. These fuzes have standard size bodies and will replace the M501 and M520 MTSQS.

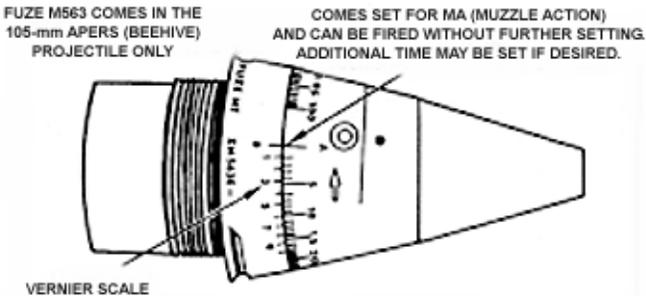


Figure 3-8. Fuze M563 Mechanical time

(paragraph b., below) and is set for time in the same manner (paragraph e., below).

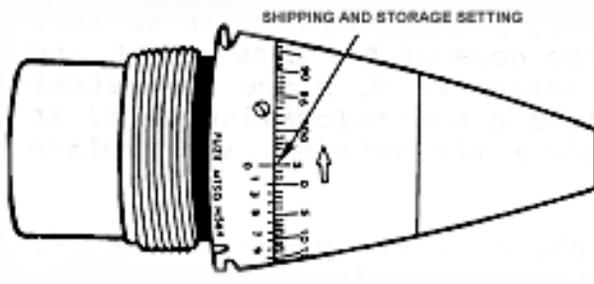


Figure 3-9. Fuze M564 MTSQ

booster assembly prevents this fuze from arming for either action until the round has traveled a minimum distance of 200 feet from the weapon muzzle.

a. **The M563 mechanical time fuze.**

(Figure 3-8) is a single- action fuze that comes set for muzzle action. The fuze can be set for any time of flight up to 100 seconds. The M563 mechanical time fuze was specifically developed for use with the 105-mm antipersonnel (Beehive) round. It is not used with any other projectile. It incorporates a time vernier scale similar to the M564 MTSQ fuze

b. **M564 mechanical time-superquick fuze.**

The M564 mechanical time superquick fuze (Figure 3-9) is used with spin-stabilized burster projectiles in which mechanical time settings (from 2 to 100 seconds) or impact superquick functioning is desired. The M564 MTSQ fuze is designed to function either at a set time or upon impact, whichever occurs first after arming. However, the

c. **M565 mechanical time fuze.**

The M565 mechanical time fuze (Figure 3-10) is similar to the M564 but does not contain a booster or a superquick element. This fuze is set for mechanical time action just like the M564, and must always be set for time. **SETTING THE M565 FUZE FOR IMPACT ACTION WILL**

RESULT IN A DUD! Remember, use the M565 in the new base-ejection rounds with the larger fuze well. Use the M564 in high explosive and burster-type projectiles.

THIS FUZE HAS NO BOOSTER, AND IT IS USED IN BASE-EJECTION PROJECTION ONLY

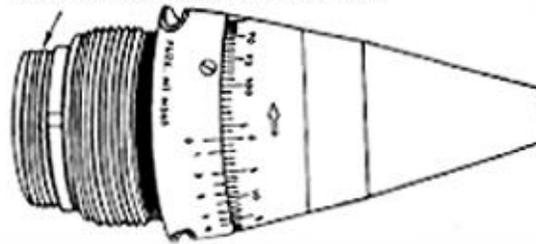


Figure 3-10. Fuze M565 mechanical time

WARNING

BECAUSE OF THE STANDARDIZATION OF THE FUZE WELL OPENINGS AND FUZE BODIES, IT IS POSSIBLE TO PUT EITHER THE M564 OR THE M565 IN ANY OF THE NEW PROJECTILES. MALFUNCTIONS CAN OCCUR IF THESE FUZES ARE USED INCORRECTLY. KNOW WHICH FUZE GOES IN WHICH PROJECTILE!

d. **Installing the M564 or M565 fuze.** The M564 or M565s are installed with the M18 fuze wrench. Remove the closing plug (on 105-mm projectiles) or the eyebolt lifting plug (on separate-loading projectiles), inspect the well, and then hand-tighten the M564 or M565 in the appropriate projectile. Place the M18 fuze wrench on the fuze so you can turn the wrench counterclockwise about one-quarter turn and slightly loosen the fuze. With your hand on the handle, turn the wrench clockwise sharply and firmly to tighten the fuze to the projectile. There should be no threads showing, and the fuze should fit snugly against the nose of the projectile.

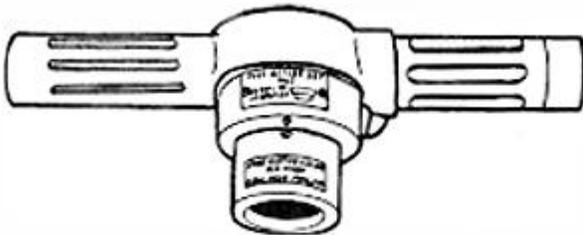


Figure 3-11. M63 fuze setter

(Figure 3-13) that allows accurate 0.1-second settings to be made. The M563 fuze comes assembled with the 105-mm Beehive round and set for muzzle action; however, it can be set for additional time, depending upon the distance to the target. The M565

e. **Setting the M563, M564, or M565 fuze.** The M563, M564, M565 fuzes do not require a precision fuze-setting instrument such as the M26 fuze setter. The time ring on each of these fuzes is set with a fuze setter and socket such as the M63 (Figure 3-11) or a simple spanner fuze setter, open-wrench type, M34 (Figure 3-12). Each fuze has a vernier scale

fuze is used only with base-ejection rounds and has no booster. The procedures for setting fuzes M563, M564, and M565 with fuze setter M63 and M34 are explained below.

CAUTION

THE M563 AND M565 FUZES CANNOT BE SET FOR IMPACT ACTION. THEY CANNOT BE USED WITH BURSTER-TYPE HIGH-EXPLOSIVE PROJECTILES. THE M564 FUZE IS USED WITH BURSTER-TYPE HIGH-EXPLOSIVE PROJECTILES AND CAN BE FIRED FOR IMPACT SUPERQUICK OR TIME ACTION.



Figure 3-12. M34 fuze setter

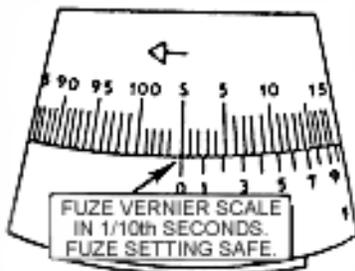


Figure 3-13

tenths of a second), turn the upper scale clockwise in the direction of the arrow (Figure 3-13). Turn until the graduation for the desired whole second on the upper scale is aligned with the 0 graduation on the vernier scale (Figure 3-14). Observe on the upper scale the graduation for the desired tenth of a second on the vernier scale. Continue to turn the lower cap until the observed graduation on the upper scale is aligned with the graduation for the desired tenth of a second on the vernier scale (Figure 3-15). For example, if the desired time setting is 5.5 seconds, turn the lower cap until the 5 graduation on the upper scale is aligned with the 0 graduation on the vernier scale (Figure 3-14). Observe that the 15 graduation on the upper scale is immediately above

f. **M63 fuze setter.** Whole-second settings are made with the M63 by placing it over the fuze so the socket engages the two lugs on the cap. The upper scale is the only moveable part of the fuze and rotates over the vernier scale on the fuze body. Turn the upper scale clockwise until the mark representing the desired time, setting is aligned with the 0 mark on the vernier scale (Figure 3-14).

(1) Fractional second settings. Safe setting for fractional second settings (in

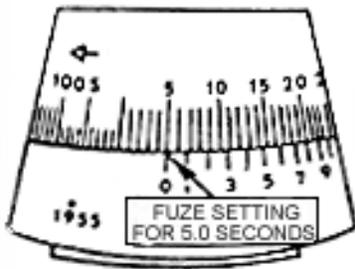


Figure 3-14 Whole

and to the right of the 5 graduation on the vernier scale. Continue to turn second setting. the upper scale until the 15 graduation on the upper scale is aligned with the 5 graduation on the vernier scale. The desired time of 5.5 seconds is now set on the fuze (Figure 3-15). Note in Figure 3-15; the only place the upper scale and the vernier scale align is at 15 on the upper scale and at 5 on the vernier scale. Now, look at Figure 3-16 and the setting for 4.9 seconds. Again, notice 9 on the vernier scale and 22 on the upper scale are the only places the two scales align.

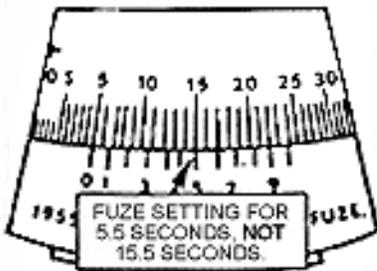


Figure 3-15. 1/10 second settings

(2) Setting the fuze to safe. If the fuzed projectile is prepared for firing but is not fired, place the M63 fuze setter back on the fuze. Realign the S mark on Figure 3-16. the upper scale (MA on the M563 fuze) with the 0 mark on the vernier scale

by turning the fuze setter clockwise until the S mark (MA on 563) is aligned over the 0. There is no safety wire to add (as on the M501) because the holddown time lug is engaged inside the fuze automatically as the lower cap is turned to the S setting.

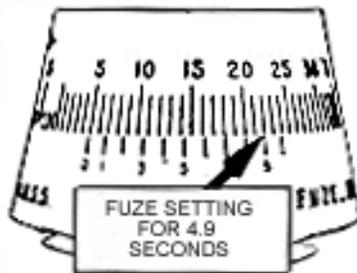


Figure 3-16. 4.9 second setting

NOTE: Never fire an M565 fuze without putting some time on the fuze so the hold down time lug will be unlocked. Always turn the M63 fuze setter clockwise.

g. **M34 fuze setter.** The M34 fuze setter (Figures 3-12 and 3-17) is a simple spanner wrench-type setter with two small projections on the inside of the circle that fit into the lugs of the M563, M564, and M565 fuzes. To set any of these fuzes, turn the M34 fuze setter in the direction of the arrow on the fuze (clockwise). The time or safe setting is made on the vernier scale with this fuze setter in the same manner as with the M63 fuze setter (para f above). However, if you miss the time setting, you can back up this fuze setter 1 or 2 seconds, then reset the fuze for the desired time. Be sure the vernier scale is set to the correct tenth of a second.

h. **Resetting fuzes.** The M563, M564, or M565 fuze can be set as many times as necessary, each of these fuzes has a wavered washer between the lower cap and the time ring that keeps the cap tight regardless of how many times it is turned. Always turn the M34 or M63 clockwise, in the direction of increasing time, as shown by the arrow on each of these fuzes. Remember the M563 fuze is issued on the 105-mm Beehive projectile only, and that it is already set for muzzle action (MA). This fuzed round, when fired on muzzle action, causes the flechettes to be expelled within 3 meters of the howitzer muzzle. Also, time can be set on the fuze, depending on the distance to the enemy.

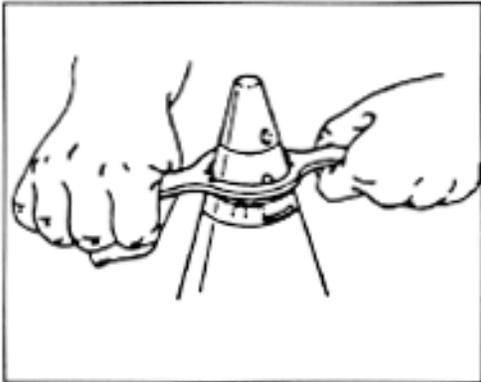


Figure 3-17. Use of M34

superquick action when it hits the target. If the M564 is fired only for impact superquick action, then check the date of manufacture stamped on the fuze body, and follow the proper paragraph below.

i. **Setting the M564 fuze.** All settings on the M564 are clockwise. This fuze has two firing pins, one at the nose for impact action and one inside for mechanical time action. The time action cannot take place until you turn the time ring. This unlocks the safety lug and allows the clock mechanism to function after the round is fired. Accomplishing these functions allows the projectile to detonate along its trajectory. If the fuze does not function on the time setting, it will function on impact

(1) **M564 fuze made before 1970.** Fuzes made before 1970 must never be fired without a time setting on the vernier scale, either for time or superquick action. The impact superquick setting for these early M564 fuzes is 90.0 seconds.

NOTE: Do not fire these early fuzes on the S setting. Premature bursts can occur!

(2) **M564 fuze made after 1970.** A correction was made to M564 fuzes manufactured in late 1969 so the later fuzes can be fired as they come out of the can (set on S) for superquick action. The date on these fuzes should read 1970 or later.

NOTE: These later fuzes do not have to be set on 90.0 seconds for impact superquick action.

j. **Setting the M565 fuze.** All settings on the M565 fuze are clockwise. This fuze has only one firing pin inside for mechanical time action. It cannot be set for impact action. In fact, a projectile fuzed with the M565 will be a dud if it hits the ground before the time on the vernier scale expires. It will also be a dud if the round does not go off on the time action. REMEMBER: this fuze is used with the newer (larger well opening) base-ejection rounds only. It is never fired in any burster-type high-explosive projectile.

3. Improved Mechanic Time/Superquick fuzes.

The M577 and M582 Mechanical Time/Superquick fuzes (Figure 3-18) have 200-second time mechanisms, used in setting the fuzes to the closest 0.1 second. These newer fuzes will eventually replace the M564 and M565 mechanical time fuzes. The newer fuzes do not have vernier scales. Instead, each has three movable digital dials (similar in design and functioning to an odometer in a car) that can be viewed through a window on the body. The desired setting is placed under the hairline in the window. These fuzes may be set for three distinct functions:

- Shipping and storage.
- Superquick impact.
- Time function.

The fuze is armed by the simultaneous exposure to projectile spin and setback upon firing the weapon. When set for time function, the timing mechanism starts to operate (arming cycle) approximately 3 seconds prior to the set time. It is important to

recognize and understand the meaning of the black triangle symbol ,(▲) in the dial window when it is visible and when it is not visible.



Figure 3-18 M577 and M582 MTSQ fuzes

- A nontime setting is indicated when the symbol is visible under the hairline in the window.
 - • The symbol, together with a black triangle reading of 93.0 to 95.5, indicates a nontime setting required during shipping and storage.
 - • The symbol, together with a black triangle reading of 98.0, indicates superquick function is set.
 - • Time settings are set on the fuze when the black triangle is not showing in the window. Authorized time settings cannot exceed 199.9 seconds, even though the maximum is indicated as 200 seconds. The minimum time setting is governed by safety but cannot be less than 0.1 second.

(See paragraph d., page 3-19, for fuze setting procedures).

a. **M577 MTSQ fuze.** The M577 MTSQ fuze is used with a base-ejection projectile to expel the payload over the target area by mechanical time action. This fuze, however, can be fitted with a special shaped-charge booster (Figure 3-19). It can then be used with the newer antipersonnel and antimaterial (ICM) projectiles, M483 and M509, to make them function like conventional high-explosive rounds. For conventional high-explosive functioning, remove the expelling charge (Figure 3-19) from the projectile before inserting the shaped charge booster and fuze.



Figure 3-19. M577 fuze and booster charge

b. **M582 MTSQ fuze.** The M582 MTSQ fuze is intended for use with spin-stabilized burster-type high-explosive projectiles, when mechanical time settings up to 200 seconds, or impact superquick functioning are desired. This fuze will be shipped with its own booster assembled and should not be used in a base-ejection round. This fuze must never be fired without a setting for impact action or time action.

c. **Installing the M577 or M582 fuze.** Install the M577 or M582 in the fuze well of the appropriate projectile by using the M18 fuze wrench. Remove the closing or the eyebolt lifting plug (as appropriate), inspect the fuze well, and then screw the M577 or M582 into the projectile until it is handtight. Place the M18 fuze wrench (Figure 3-20) on the fuze and turn the wrench counterclockwise about one-quarter turn. Tighten the fuze to the projectile with a sharp clockwise snap of the wrench. There should be no threads showing, and the fuze should be seated firmly against the nose of the projectile. When the M577 fuze is to be fired with the 155-mm (M483) antipersonnel-antimateriel ICM round, special preparation of the fuze is required before it is installed. These special preparations are as follows:

(1) **Special assembly, registration mode.** A special shaped-charge booster (Figure 3-19) is available for use with the M577 fuze. It must be attached to the fuze for registering with shaped-charge booster when installed in the projectile. This shaped-charge booster causes the ICM round to function as a standard high-explosive round.

(2) **Special assembly, fire for effect (FFE) mode, 155-mm projectile M483.**

To prepare this round for firing, remove the eyebolt lifting plug, inspect the well, screw in M577 with the M18 wrench, and set the correct time with the M35 (Figure 3-21 and 2-22) fuze setter. The 155-mm projectile M483 is then ready to be loaded and fired for effect.



Figure 3-20. Using the M18 fuze wrench

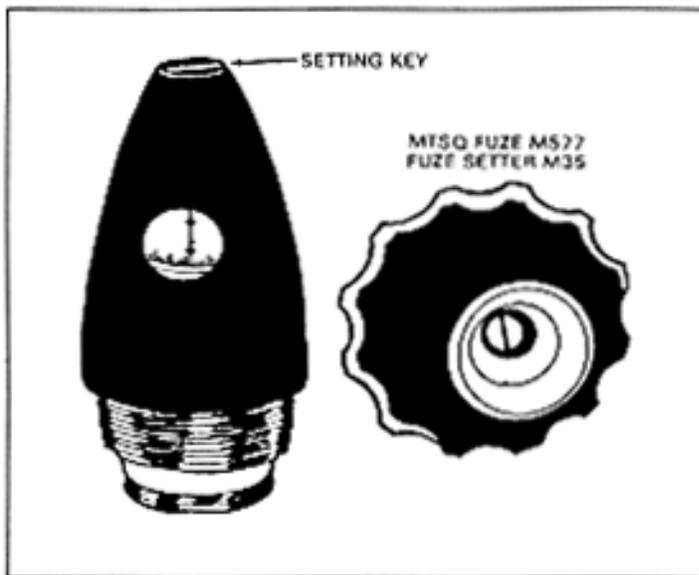


Figure 3-21. Fuze M577 and Fuze setter M35

(3) **Special instructions for installing the M582 fuze.** Never use the M582 fuze in any base-ejection round. Do not remove the booster that comes with the fuze. Always install the fuze and booster together every time you use the M582 fuze in burster-type projectiles such as high-explosive, white phosphorus, and certain chemical projectiles.

d. **Setting the M577 or M582 fuze.** The fuze setting key located on the nose (which looks like a slotted screwhead) controls the three dials in the fuze. This key is used for setting either the M577 or the M582 after it has been screwed into the projectile. Place the M35 fuze setter over the nose of the fuze. With the palm of your hand pressing the top of the fuze setter (Figure 3-22), rotate it counter-clockwise so the screwdriver-like blade in the cone of the setter engages the slot in the top of the fuze.

When the M35 fuze setter is not available, the screwdriver end of the M18 fuze wrench may be used to adjust the selector sleeve of the M577 or M582 MTSQ fuzes. Set the appropriate numbers under the hairline that is visible through the window on the nose of the fuze. When the M35 fuze setter is not available, the screwdriver end of the M18 fuze wrench may be used to adjust the selector sleeve of the M577 or M582 MTSQ fuzes.

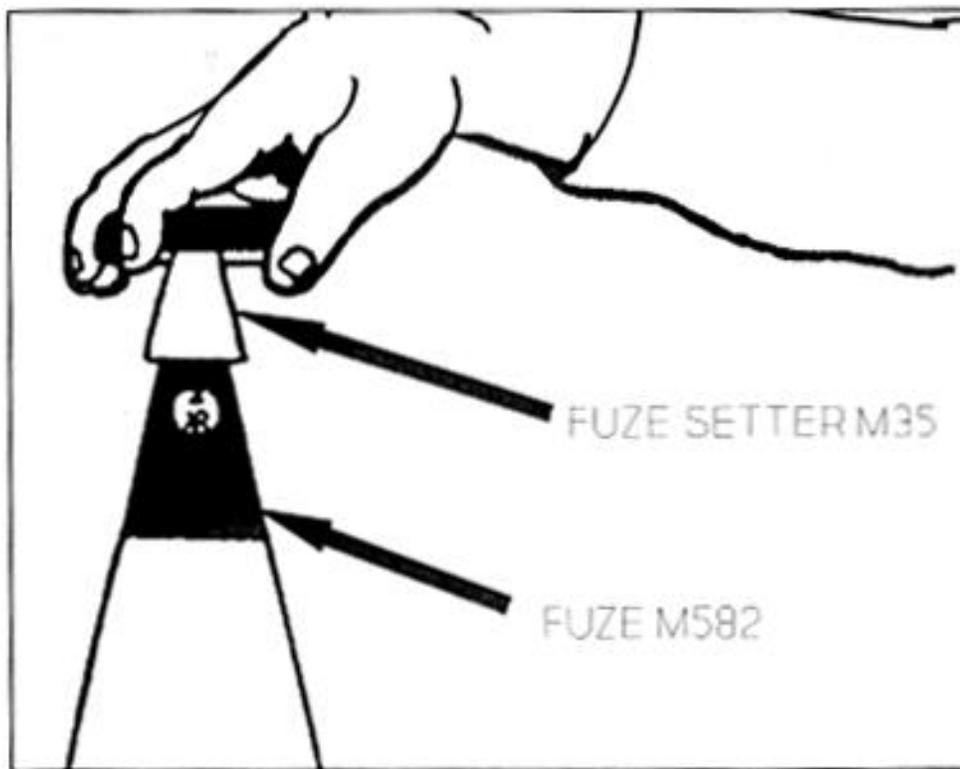


Figure 3-22. Fuze setter M35 on fuze M582

(1) **Setting for impact action.** Rotate the fuze setter approximately one-quarter turn counterclockwise to change from the shipping and storage setting of 95.0 (Figure 3-23) to a setting of 98 (figure 3-24). At this fuze setting (98) either fuze M577 or M582 will operate as a superquick point-detonating (PD) impact fuze.



Figure 3-23. Shipping & storage for fuze M577 or M582



Figure 3-24. SQ/PD setting of fuze M577 or M582

(2) **Setting for time airburst up to 200 seconds.** Rotate the M35 fuze setter counterclockwise approximately one-half turn to remove the shipping/storage and impact settings, as well as the black triangle. The black triangle indicates a nontime setting. Continue rotating counterclockwise past the zero (000) until the desired time setting is reached. Each complete turn of the fuze setter moves the dials 10 seconds. Turning the fuze setter 20 complete turns moves the dials from 000 to 200 (Figure 3-25). The dials cannot go beyond the 200 setting. To set the fuze back to a lower time, for impact, or to the shipping setting, you must turn the fuze setter clockwise. **DO NOT TRY TO TURN THE FUZE SETTER BEYOND THE MECHANICAL STOPS AFTER 200 APPEARS ON THE DIALS IN THE WINDOW OR SET THE FUZE BELOW THE SHIPPING SETTING OF 95.5 TO 93.0 (e., below).** While reading the setting, apply slight torque to remove backlash.

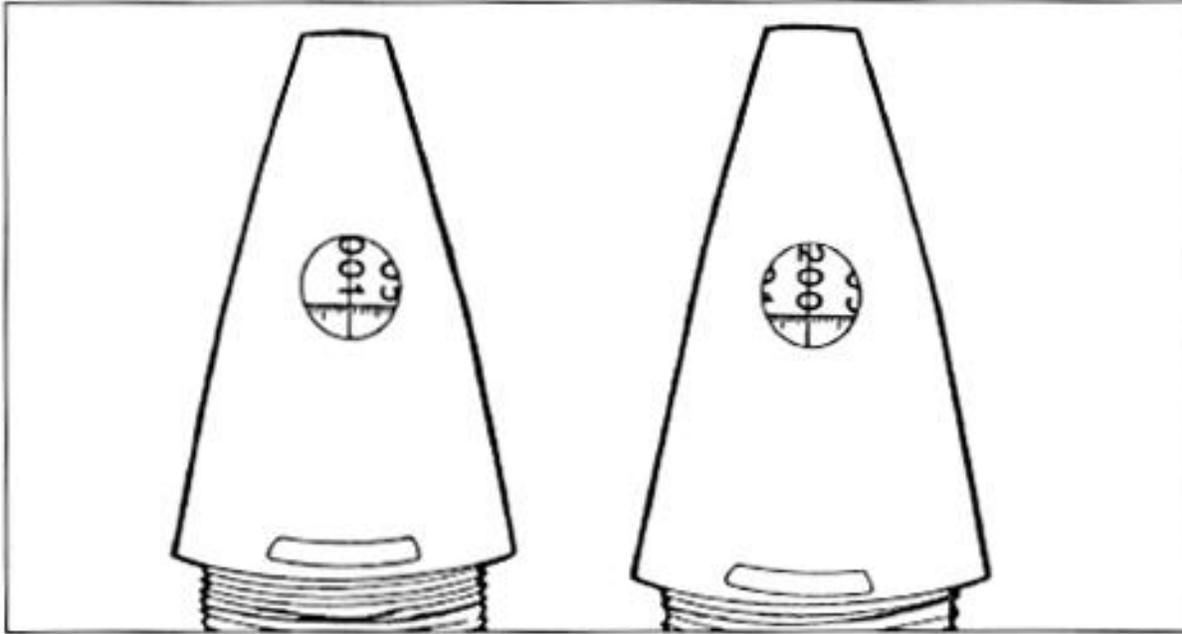


Figure 3-25. Start time setting and maximum time setting of fuze M577 or M582

(3) **Reducing setting for time airburst.** To reset either the M577 or the M582 fuze for a time interval less than the original turn the fuze setter clockwise to at least 1 or 2 seconds less than the required setting. Turn the fuze setter counter-clockwise and set the fuze to the required time by lining up the appropriate number under the hairline.

e. **Direction of setting the M577 or M582 fuze.** You can change either the M577 or M582 fuze from the shipping and storage mode to the desired setting (PD or Time) by rotating the M35 fuze setter counterclockwise. However, these fuzes cannot be set to the desired setting and then to shipping and storage by continuous rotation of the fuze setter counterclockwise. To change a time setting to an impact or a shipping and storage setting, you must rotate the fuze setter clockwise.

CAUTION

DO NOT ATTEMPT TO SET THESE FUZES BELOW 93.0 (NONTIME) WHEN TURNING CLOCKWISE, OR ABOVE 200 SECONDS WHEN TURNING COUNTERCLOCKWISE. THE SETTINGS OF 000 AND 200 ARE NOT AUTHORIZED SERVICE SETTINGS.

f. **Resetting.** The M577 and M582 fuzes can be set as many times as necessary. If you miss the setting the first time, back the dials up 1 or 2 full seconds and reapproach from a counterclockwise direction.

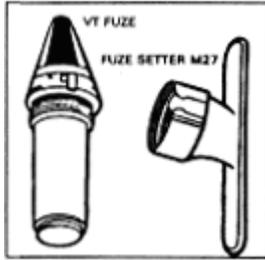


Figure 3-26. VT fuze and M27 fuze setter

4. **Proximity (VT) fuzes.**

Each proximity (VT) fuze (Figure 3-26) has a clocklike mechanism set to control the activation of the radio transmitter and receiver in the fuze. These fuzes may be set as many times as necessary. The proximity (VT) fuze is essentially a combination radio transmitter and receiver. At a set time (from 5 to 100 seconds) after the projectile leaves the muzzle of the weapon, the radio is activated and begins sending out

continuous waves toward the target. As the projectile approaches an object, the waves are reflected back to the fuze and are picked up by the receiving unit. When the incoming waves reach a predetermined intensity, an electronic switch is thrown. This action starts the projectile explosive train. Impact superquick action can be expected if the proximity (VT) element fails to function.

a. **M513 and M514 variable time (VT) fuzes.** The M513 and M514 VT fuzes are basically the same except that the sensitivity switch in the M513-series fuze is set for a lower height of burst. It is used only with the 105-mm projectiles. The M514-series fuze is used with the 155-mm and 203-mm projectiles; however, the M514 series is being phased out and replaced by the M728 and M732 VT fuzes.

NOTE: *The impact elements of VT fuzes M513, M513BI, M514, and M514BI are not operable unless armed for proximity action. If the fuzed projectile hits the target before the time set on the fuze expires, the result will be a dud. Later series of these fuzes, such as the M513AI, M513A2, and M514AI, have been improved with an impact superquick arming device which arms 2 to 3 seconds outside the muzzle of the cannon. See Table 2-1 for VT fuze restrictions to the proximity mode and the impact mode.*

(1) **M513 and M513B1.** The M513 and M513B1 VT fuzes, used only with 105-mm projectiles, must always be set for proximity action. The impact electronic switch cannot be engaged until the proximity action is activated. If, after activation, the fuze does not produce an airburst, then it should function on impact because the superquick element is armed when the proximity element begins broadcasting signals. These fuzes cannot be set for only impact action. They must be set for proximity action.

(2) M513A1 and M513A2. The M513A1 and M513A2 VT fuzes are an improvement over the early M513 and M513BI VT fuzes. One of the improvements is that the impact element arms 2 to 3 seconds outside the muzzle, regardless of the time set for proximity action. Thus, if the fuzed projectile strikes the target before the time expires on the time mechanism, the result will be impact superquick action. If impact action only is desired, set these fuzes for 90 seconds (see Table 3-1, page 3-24).

(4) Desensitizing cap M5 for M513-series fuzes. The desensitizing cap M5 (Figure 3-27) lowers the burst height of the HE 105-mm projectile fired with the M513-series proximity fuze when rounds are fired over water and the burst heights exceed 20 meters. The effectiveness of the HE 105-mm projectile decreases significantly when bursts higher than 20 meters occur. The M5 cap applied to the M513-series fuze will reduce the burst height by a factor of about 4; for example, a burst height of 80 meters will be reduced to about 20 meters on the next round. Thus, much better results are obtained with subsequent firing when the M5 cap is used.



Figure 3-27. Capping device, M513 VT fuze, M5 desensitizing cap

CAUTION

DO NOT USE THIS CAP WITH ANY PROXIMITY FUZES EXCEPT THE M513 SERIES.

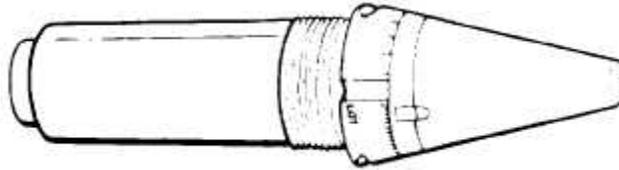


Figure 3-27.5

(4) **and M514B1.** The M514 and M514BI (Figure 3-27.5) fuzes are similar to fuzes discussed in paragraph (1) above and cannot be fired in an "impact action" only mode. They must always be used for proximity action. These fuzes are used with some separate-loading 155-mm projectiles. They are not used with 105-mm howitzer projectiles.

(5) **M514A1.** The M514A1 fuze is similar to proximity fuzes discussed in paragraph (2) above. It also has the impact element armed 2 to 3 seconds outside the muzzle, regardless of the time set for proximity action. These fuzes are used with 155-mm.

b. **M728 (formerly M514A3 or M514A1E1) VT fuze.** The M728 (Figure 3-27.5) proximity fuze can be used with all calibers of field artillery projectiles and weapons. However, it must not be fired with Charge 7 on the 105-mm projectile, except in a combat emergency.

c. **M732 VT fuze.** The M732 VT fuze (Figure 3-28) is the latest development in the proximity fuze family. It is a short intrusion model of the same overall length as the standard impact or mechanical time fuze. The removal of the supplementary charge (Figure 3-29) is not required. In fact, the charge must be left in the fuze well for proper functioning of the fuze. Because of this new development, the production of projectiles with deep cavities and supplementary charges will be discontinued soon. This proximity fuze has a time ring that can be set from 5.0 to 150 seconds. The M732 fuze will be used when stockpiles of the M513, M514, and M728 series are exhausted.

d. **Installing the VT fuzes.** To accommodate the longer fuze bodies, all VT fuzes except the M732 (para c above) require a deeper fuze well cavity in the projectile than do the impact or MTSQ fuzes. Therefore, a part of each bursting charge has been placed in a small package that can either be left in the fuze well or removed to make room for the longer proximity fuzes. This small high-explosive package is called the supplementary charge. Always remove the supplementary charge when firing any M513, M514, or M728-series proximity fuzes.

BE SURE THE SUPPLEMENTARY CHARGE IS LEFT OR REPLACED IN THE FUZE WELL, IF THE FUZE IS CHANGED FROM VT TO IMPACT OR MTSQ or when the short- intrusion M732 VT fuze is used. To prepare a projectile

for a long-intrusion VT fuze, first remove the eyebolt lifting plug (on separate-loading projectiles) or the closing plug (on 105-mm projectiles). Remove the supplementary charge (Figure 3-29) by its lifting loop, and inspect the fuze well cavity. Next, place the proximity fuze (M513 series for the 105-mm caliber projectiles, M514 series for all other caliber projectiles, or M728 series on any caliber projectile) into the fuze well, and screw it down hand tight. Place the M18 fuze wrench so the VT portion of the fuze slot (the outer fitting on the wrench) is in the two grooves on the fuze. Turn the M18 fuze wrench counterclockwise about one-quarter turn (to loosen the fuze) and then, with your hand on the handle, turn the wrench sharply and firmly clockwise to tighten the



Figure 3-28. M732 VT fuze

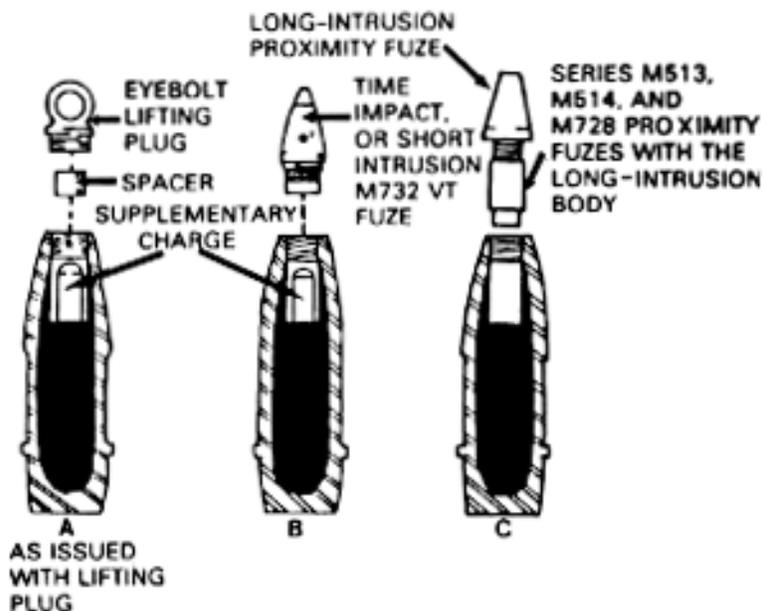


Figure 3-29. Deep cavity projectile with supplementary charge

NOTE: The supplementary charge must be left in the projectile when firing a short-intrusion fuze such as mechanical time, VT M732, or impact fuze (b., above). The supplementary charge must be removed when firing a long-intrusion proximity VT fuze (c., above).

fuze to the projectile. There must be no threads showing, and the fuze must fit snugly against the nose of the projectile. Because of the longer body of the long-intrusion proximity fuze, it is sometimes impossible to tighten so it is snug to the nose of the projectile (Figure 3-30). **DO NOT FIRE THE FUZED PROJECTILE IN THIS CONDITION! REPLACE THE FUZE OR THE PROJECTILE, PUT THE SUPPLEMENTARY CHARGE BACK IN THE ORIGINAL PROJECTILE, AND FIRE IT WITH AN IMPACT, MTSQ, OR SHORT-INTRUSION M732 VT FUZE.**

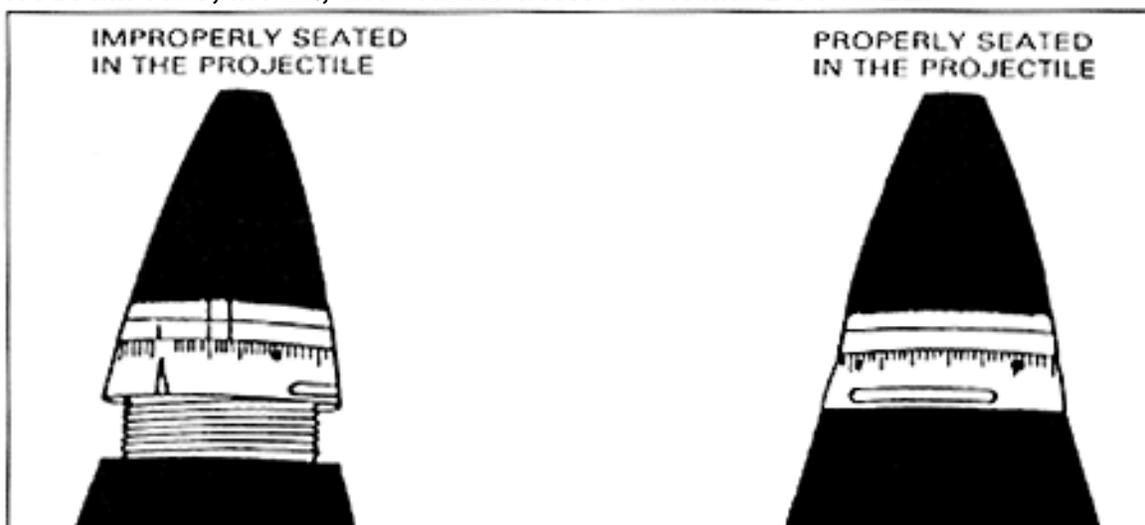


Figure 3-30. Left, improperly installed VT fuze; right, properly installed VT fuze

e. **Setting the VT fuze.** Unlike the MTSQ fuzes, which must be set to the closest 1.0 second for correct time action, VT fuzes are set to the closest 1.0 second. The clock mechanism time ring on these fuzes merely delays the activation of the radio transmitter-receiver until the projectile gets close to the target. The receiver is activated 2 seconds later and starts picking up the reflected signal. As the projectile approaches the target, the signal becomes stronger until it causes the VT fuze to activate the explosive train and detonate the projectile near the target. The early series VT fuzes (M513, M513B1, M514, and M514B1) were designed so if the radio was not activated, the electronic impact switch was not thrown. If a round then hit the target before the time set on the time ring had expired, the result was always a dud. To prevent a round from becoming a dud with a VT fuze on it, later M513 and M514 series fuzes (with numbers ending in A1, A2, or A3) and M728 and M732 VT fuzes were designed so the impact action on the VT-fuze projectile would always be armed 2 to 3 seconds outside the muzzle of weapon. Because of this change, these fuzes will function on either impact or time, whichever occurs first.

(2) Fuze setter M27. Fuze setter M27 can be used with the M732 VT fuze. It can also be used to set any of the time rings on VT fuzes in either direction. This is done by turning the time rings clockwise as you approach the desired second setting on the scale. You may turn these time rings as many times as necessary.

f. Direction of setting VT fuzes. Rotate the M27 fuze setter in either direction. It is recommended that VT fuzes always be set clockwise. If you miss the setting with the 27 fuze setter, back it up 1 or 2 seconds and approach from lower to higher numbers.

5. Boosters.

A separate charge of greater sensitivity is provided to detonate the high-explosive filler of an artillery projectile. Because its function is to increase, or boost, the effectiveness of the explosive train, this charge is known as a booster. This high explosive is usually tetryl. The function of a booster is twofold. It ensures the proper detonation of the bursting charge and gives a high-order detonation. It also provides mechanical bore safety, which is accomplished by a booster rotor. In most fuzes equipped with a superquick element, a flash channel extends from the superquick detonator to the booster charge. Inserting a rotor above the bursting charge and offsetting that portion of the flash channel prevents the flash from the superquick detonator from reaching the booster. If the rotor is eccentrically weighted and pivoted near its center, centrifugal force causes the rotor to turn. When the rotor has turned so that the heaviest portion is toward the outside of the fuze, the portion of the flash channel in the rotor aligns with the remainder of the flash channel. By the time this alignment occurs, the projectile is well clear of the tube.

a. **M125-series boosters.** The M125-series boosters are received already assembled to those fuzes used in burster-type and high-explosive projectiles, with the exception of the M78 series concrete-piercing fuzes. The fuze booster assembly is removed from the container, inspected, and seated in the fuze well of the projectile in one operation. Bore safety of the complete projectile and fuze is provided by the booster rotor, which holds the explosive train out of alignment with the firing pin until the round has been fired through the cannon tube. The setback force of the firing of the round and the rapid acceleration and centrifugal force applied to the round cause the rotor to unlock and move the explosive train into alignment with the firing pin. The earlier booster of this series reaches the armed position after the projectile has traveled 150 to 300 feet from the muzzle, depending on the velocity and spin rate of the projectile. The later booster of this series, the M125AI, requires a minimum of 200 feet of projectile travel from the tube before reaching the armed position.

b. **M25 booster.** The M25 booster functions in the same manner as the M125 series; however, the M25 is used only with the M78-series CP fuzes. It must always be assembled in the fuze well of the high-explosive projectile instead of on the fuze. It cannot be assembled to the fuze because it does not fit. The primary difference between the M25 and the M125 booster series is the M25 only has three external threads, whereas the M125 has nine. A cotter pin on the M25 holds the rotor assembly in place during shipping and handling. This cotter pin must be removed by the cannoneer before the booster is installed in the fuze well of the high-explosive round. After the booster has been installed, the CP fuze M78 is screwed tightly into the fuze well of the projectile on top of the booster. The M16 fuze wrench is used to assemble the booster and CP fuze M78 in the fuze well of the HE projectile.

c. **Projectile spotting charge.** A special projectile spotting charge, which looks like a shaped-charge booster, is screwed onto the MTSQ fuze M577 when the ICM projectile M483 is being prepared for firing in the registration mode. This projectile spotting charge is drawn from the ammunition supply point as a separate item when firing either of these projectiles. This charge is not used with any other fuze or projectile.

SUMMARY

A field artillery fuze is classified according to its position on the projectile as base-detonating or point-detonating. It is also classified according to its method of functioning as impact, mechanical time, electrical time, variable time, or a combination of these. Impact fuzes are further classified as superquick, nondelay, or delay.

Some mechanical time fuzes have an impact superquick action, and some do not. The newest mechanical time fuze has three digital dials that permit a 200-second time setting. Variable time fuzes do not necessarily function at the time set but anytime after the projectile reaches the optimum distance from the target.

All fuzes contain some safety device to prevent functioning until the round clears the muzzle. Arming fuzes is accomplished by inertia and centrifugal force.

The primary function of a booster is to ensure the proper detonation of the projectile bursting charge. The three types of fuze setters are the precision instrument, the hand wrench and the screwdriver blade.

WARNING

DO NOT FIRE AN ARTILLERY ROUND OF ANY CALIBER WITHOUT USING THE FUZE AUTHORIZED FOR THAT PARTICULAR TYPE OF ROUND. THE FIRING OF A ROUND WITHOUT A FUZE, OR WITH A FUZE THAT IS NOT AUTHORIZED, COULD RESULT IN AN IN-BORE BURST OR INJURY TO PERSONNEL OR DAMAGE TO EQUIPMENT.

NOTE: The M762 and the M767 Electronic Time (ET) fuze will replace the M577, M565, M548, and M724 fuzes within the next five years.

LESSON 3

PRACTICE EXERCISE

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

1. Fuzes are armed principally by inertia and
 - A. setback.
 - B. centrifugal force.
 - C. creep.
 - D. set forward.

2. Setback occurs when the projectile
 - A. impacts on the target.
 - B. rotates during flight.
 - C. decelerates on being fired.
 - D. accelerates on being fired.

3. An artillery fuze is classified according to its position on the projectile as either
 - A. base-detonating or point-detonating.
 - B. point initiating or base-detonating.
 - C. delay or non-delay.
 - D. mechanical time or variable time.

4. Superquick action is designed to cause the projectile to
 - A. delay the burst upon impact with a solid object.
 - B. permit penetration of concreteemplacements.
 - C. burst at the instant of impact with a solid object.
 - D. burst at a preset altitude over the target.

5. The M563, M564, and M565 mechanical time fuzes have second time mechanisms and vernier scales, which set the fuzes to the closest 0.1 second.
 - A. 50
 - B. 100
 - C. 150
 - D. 200

6. The M563 mechanical time fuze is a single-action fuze that comes set for
- A. impact action.
 - B. superquick action.
 - C. delay action.
 - D. muzzle action.
7. Do not use the M565 mechanical time (MT) fuze for
- A. point-detonating action.
 - B. delay action.
 - C. impact action.
 - D. nondelay action.
8. The M563 fuze comes assembled to the 105-mm projectile, set for muzzle action.
- A. illumination
 - B. Beehive
 - C. high-explosive
 - D. white phosphorus
- E. The fuze which must have a time set on it before firing is the
- A. M501.
 - B. M520.
 - C. M563.
 - D. M565.
10. In which direction is the M34 fuze setters turned to increase the time setting on fuzes?
- A. Clockwise.
 - B. Counterclockwise.
 - C. You can't set a time with the M34 or M63 fuze setter.
 - D. It does not matter which way you turn the M34 or M63.
11. The impact superquick setting for the M564 fuze before 1970 is set for _____ seconds.
- A. 79.0
 - B. 80.0
 - C. 90.0
 - D. 99.0

12. The M577 and M582 MTSQ fuzes have a _____ -second time mechanism, which is used in setting the fuzes to the closest _____ second.
- A. 200, 1.0
 - B. 100, 1.0
 - C. 200, 0.1
 - D. 100, 0.1
13. When the black triangle mark is in the window of an M577 fuze, this indicates a _____ setting.
- A. delay action
 - B. minimum time
 - C. maximum time
 - D. nontime
14. The timing mechanism starts to operate on the M577 fuze upon simultaneous exposure to projectile spin and _____
- A. set forward.
 - B. setback.
 - C. creep.
 - D. centrifugal force.
15. The M577 MTSQ fuze is intended for use with a _____ projectile; whereas, the M582 MTSQ fuze is intended for use with spin-stabilized _____ high-explosive projectiles.
- A. base ejection, burster-type
 - B. base ejection, expelling-type
 - C. base detonating, burster type
 - D. base detonating, concrete piercing
16. Never use the _____ fuze in any base-ejection round.
- A. M577
 - B. M564
 - C. M565
 - D. M582

17. When setting the M577 or M582 fuze for impact action, rotate the fuze setter - _____ turn in (a) _____ direction to change it from the storage and shipping setting.
- A. 1, either
 - B. either
 - C. counterclockwise
 - D. clockwise
18. Each complete turn of the fuze setter M35 moves the dials _____ seconds.
- A. 10
 - B. 15
 - C. 20
 - D. 30

LESSON 3
PRACTICE EXERCISE
ANSWER KEY AND FEEDBACK

Item Correct Answer and Feedback

1. B. centrifugal force.

Fuzes are armed principally by inertia and centrifugal force. (page 3-1, para 1).

2. D. accelerates on being fired.

Setback occurs when the projectile accelerates on firing and components inside are forced toward the base. (page 3-2, para 1a)

3. A. base-detonating or point-detonating.

An artillery fuze is classified according to its position on the projectile as either Base-Detonating (BD) or Point-Detonating (PD). (page 3-2, para 2).

4. C. burst at the instant of impact with a solid object.

superquick action is designed to cause the projectile to burst at the instant of impact with a solid object. (page 3-3, para 2a).

5. B. 100

The M563, M564, and M565 mechanical time fuzes have 100-second time mechanisms and vernier scales, which are used in setting the fuzes to the closest 0.1 second. (page 3-10, para 2).

6. D. muzzle action.

The M563 mechanical time fuze is a single-action fuze that comes set for muzzle action. (page 3-10, para 2a).

7. C. Impact action.

This fuze is set for mechanical time action just like the M564 and must always be set for time. Setting the M565 fuze for impact action will result in a dud. (page 3-10 and 3-11, para 2c).

8. B. Beehive

The M563 fuze comes assembled with the 105-mm Beehive round and is set for muzzle action (MA). (page 3-12, para 2e).

9. D. M565

Never fire an M565 fuze without putting some time on the fuze so the holddown time lug will be unlocked. (page 314, NOTE).

10. A. Clockwise.

The M63 and M34 fuze setters are turned in the direction of the arrows on the fuze (clockwise). (page 3-13 para 2f and 3-14, para 2g).

3. C. 90. 0

The impact superquick setting for these early M564 fuzes is 90.0 seconds. [page 3-15, para 2i(l)].

12. C. 200, 0.1

The M577 and M582 Mechanical Time/Superquick fuzes have 200-second time mechanisms, used in setting the fuzes to the closest 0.1 second. These newer fuzes do not have vernier scales. Instead, each has three movable digital dials that can be viewed through a window on the body. (page 3-16, para 3).

13. D. Nontime

A nontime setting is indicated when the symbol is visible under the hairline in the window. [page 3-16, para 3 and page 3-20, para 3d(2)].

14. B. Setback.

The fuze is armed by the simultaneous exposure to projectile spin and setback upon firing the weapon. (page 3-15, para 3).

15. A. base-ejection, burster-type

The M582 MTSQ fuze is intended for use with spin-stabilized burster-type high-explosive projectiles, when mechanical time settings up to 200 seconds, or impact superquick functioning are desired. (page 3-17, para 3a and 3b).

16. D. M582

Never use the M582 fuze in any base-ejection round. (page 3-17, para 3b).

17. C. 1/4, counterclockwise

Rotate the fuze setter approximately one-quarter turn counterclockwise to change from the shipping and storage setting of 95.0 to a setting of 98. (page 3-20, para 3d(l)).

18. A. 10

Each complete turn of the fuze setter moves the dials 10 seconds. [page 3-20, para 3d(2)).

LEGEND FOR ABBREVIATIONS IN TABLES 10-2 THROUGH 10-7

ADAM	= area denial artillery munitions	ICM	= improved conventional munitions
APERS	= antipersonnel	illum	= illumination
BB	= basebleed	IOC	= initial operational capability
BD	= base detonating (fuze)	L	= long (duration) suffix with ADAM or RAAMS
BE	= base ejection (fuze)	MA	= muzzle action
CP	= concrete piercing (fuze)	MAMT	= muzzle action, mechanical time (fuze)
CS	= riot control agent	mod	= modified
D	= delay (fuze)	MT	= mechanical tone
DODAC	= Department of Defense ammunition code	MTSQ	= mechanical time superquick (fuze)
DODIC	= Department of Defense identification code	ND	= nondelay (fuze)
DPICM	= dual-purpose improve conventional munitions	PD	= point detonating (fuze)
ET	= electronic time (fuze)	prox	= proximity
FASCAM	= family of scatterable mines	RAAMS	= remote antiarmor mine system
GB	= a nonpersistent nerve (casualty) agent	RAP	= rocket-assisted projectile
H	= blister agent (mustard)	S	= short (duration) (suffix with ADAM) or (RAAMS)
HC	= hexachloropethane (smoke)	sec	= second
HD	= blister agent (distilled mustard)	SQ	= superquick
HE	= high-explosive	TBD	= to be determined
HEAT	= high-explosive antitank	VT	= variable time (fuze)
HEP	= high-explosive plastic	VX	= nerve agent (persistent)
HEP-T	= high-explosive plastic-tracer	WP	= white phosphorous
HERA	= high-explosive rocket-assisted		

PROJECTILES	DODOC	MAXIMUM RANGES			FUZE ACTIONS
		M101A	M102	M119	
M546 APERS-T	1315-C513	11,600	12,400	12,400	Comes set for MA. Can be set to 100 sec.
M360 gas, GB	1315-C441	11,000	11,500	11,500	PD
M60 gas, H, HD	1315-C442	11,000	11,500	11,500	PD
M629 gas, tactical CS	1315-C468	11,000	11,500	11,500	MT
M1 HE (deep cavity)	1315-C445	11,000	11,500	11,500	CP, PD, MTSQ, VT
M444 ICM, HE	1315-C462	11,000	11,500	11,500	MT modified
M548 RAP, HE	1315-C463	14,500	15,100	15,100	PD, VT
M327 HEP-T	1315-C448	Direct fire			BD
M314A3 Illumination	1315-C449	11,000	11,500	11,500	MT
M84 HC, smoke, BE	1315-C452	11,000	11,500	11,500	MT
M60 WP, smoke	1315-C454	11,000	11,500	11,500	PD
M760 HE	1315-C743	No	No	14,000	PD
<p>*Most 105-mm rounds come complete with primer, propellant, projectile, and fuze. The exceptions are the HE, HERA M548, and some lots of WP M60 that come without fuzes. CP, PD, MTSQ, or VT fuzes, as appropriate, must be drawn as separate items for these rounds. See KEY TO FUZES block below for fuze DODACs.</p>					
KEY TO FUZES DODAC = 1390 PLUS DODIC NUMBER AS SHOWN					
TYPE	CURRENT	DODIC	REPLACEMENT	DODIC	FUTURE
CP delay or nondelay	M78A1 M78A1	N330 N331	None None	-- --	None None
PD SQ/D SQ/D	M557 M572	N335 N311	M739 M739	N340 N340	None None
MAMT	M563	NA	None	--	None
MT	M565 ¹	N248	M577 ²	N285	ET XM762
MTSQ	M564	N278	M582 ²	N286	ET XM767
VT	M513 M514	N412 N411	M728 M728	N463 N463	M732 DODIC N464
<p>¹M548 MTSQ fuze is being issued and used instead of M565 until stocks are exhausted. See TM 43-0001-28 for additional details. ²M577 and M582 can be set for either MT or SQ. If the fuze is set for MT, SQ action may occur.</p>					

PROJECTILES	DODOC	PROPELLING CHARGES		MAXIMUM RANGE	FUZE ACTIONS
		M3 SERIES	M4 SERIES		
M107 HE	1320-D544	Yes	Yes	14,600	CP, PD, MTSQ VT
M449A1 ICM	1320-D562	Yes	Yes	14,600	MT
M485 Illum	1320-D505	Yes	Yes	13,600	MT
M454 nuclear	Controlled distribution	Uses special propelling charges M197 and M206		14,900	Airburst
		Yes	Yes		
M1164A1 HC	1320-D506	Yes	Yes	14,600	MT
M110A1 WP	1320-D550	Yes	Yes	14,600	PD, MTSQ
M110 H/HD	1320-D543	Yes	Yes	14,600	PD, MTSQ
M121 chemical	1320-D568	Yes	Yes	14,600	PD, VT
M712 Copperhead	1320-D510	No requirement for zones 1 through 3		TDB	BD (comes al - ready installed)
<p>Note. The family of M483 long-type projectiles (M549 RAP, M483 DPICM, M864 BB DPICM, M795 HE, M825 WP Smoke, M693/M731 RAAMS) are not compatible with the M114/M114A1 howitzer tubes. See Table 10-4 for compatibility with howitzers of the M114A2 tubes.</p>					
KEY TO FUZES 155-MM PROPELLING CHARGE DODAC = 1320 PLUS DODIC NUMBER AS SHOWN					
155-MM PROPELLING CHARGE					DODIC
M3 series, green bag, with zone 1 through 5					D540
M4 series, white bag, with zones 3 through 7					D541
M119/M119A1, white bag, with zone 8 only					D533
M119A2, red bag, with zone 7 only, but muzzle velocity approximately the same as M119/M119A1					D533
M203, red bag, with zone 8 super, used onloly in the M198 towed howtizer at this time					D532

M483A1 DPICM	1320-D563	Yes	Yes	14,500	MT
MM864 BB DPICM	1320-D864	Yes	Yes	TBD	MTSQ M577
M692 ADAM-I	1320-D501	Yes	Yes	14,300	MT
M731 ADAM-S	1320-D502	Yes	Yes	14,300	MT
M454 nuclear	Controlled distribution	Uses special propelling charges M197 and M206		14,900	Airburst
M116A1 HC	1320-D506	Yes	Yes	14,600	MT (M732 only)
M1101A1 WP	1320-D550	Yes	Yes	14,600	PD, MTSQ
M110 H/HD	1320-D543	Yes	Yes	14,600	PD, MTSQ
M687 binary ¹	1320-D594	Yes	Yes	TBD	PD, MTSQ
M121 chemical	1320-D568	Yes	Yes	14,600	PD, VT
M795 HE ¹	1320-D529	Yes	Yes	TBD	CP, PD, MTSQ VT (M732 only)
M825 smoke	1320-D528	Yes	Yes	TBD	MT
M718 RAAMS-L	1320-D503	Yes	Yes	14,300	MT
M741 RAAMS-S	1320-D509	Yes	Yes	14,300	MT
M712 Copperhead	1320-D510	No requirement for zones 1 through 3		TBD	BD (comes already installed)
M804 practice	1320-D513	Yes	Yes	14,600	PD, MTSQ, (M732 only)
¹ Type classified but not in production					
KEY TO FUZES 155-MM PROPELLING CHARGE DODAC = 1320 PLUS DODIC NUMBER AS SHOWN					
M3 series green base with zones 1 through 5					DODIC
M4 series white base with zones 3 through 7					D540
M119/M119A1 white base with zone 8 only					D541
M119A2 red base with zone 7 only but muzzle velocity approximately the same as M119/M119A1					D533
M203 red base with zone 8 super used only in the M198 towed howitzer at this time					D532

		M113 SERIES	M4 SERIES	M119 SERIES	M203	MAXIMUM RANGE	FUZE ACTION
M107 HE	1320-D544	Yes, but not zone 1	Yes	Yes	No		
M549A1 RAP	1320-D579	No	Yes, but zone 7 only	Yes, but not M119	No	23,500	PD

M549A1 ICM	1320-D562	Yes, but not zone 1	Yes	Yes	No	18,100	MT
M485 illum	1320-D505	Yes, but not Zone 1	Yes	Yes, but degraded reliability	No	17,500	MT
M483A1 DPICM	1320-D563	Yes, but not zone 1 or 2	Yes	Yes	No	17,500	MT
M854 BB DPICM	1320-D854	No	Yes	Yes	No	22,000	MTSQ M577
M692 ADAM-L	1320-D501	Yes, but not zone 1 or 2	Yes	Yes	No	17,740	MT
M731 ADAM-S	1320-D502	Yes, but not zone 1 or 2	Yes	Yes	No	17,740	MT
M454 nuclear	Controlled Distribution	Yes, but not zone 1 or 2	Uses special propelling charges M197 and M206			14,800	Airburst
M116A1 HC	1320-D506	Yes, but not zone 1	Yes	Yes	No	18,100	MT
M110A1 WP	1320-D550	Yes, but not zone 1	Yes	Yes	No	18,100	PD, MTSQ
M110 H/HD	1320-D543	Yes, but not zone 1	Yes	Yes	No	18,100	PD, MTSQ
M687 binary ¹	1320-D594	Yes, but not zone 1 or 2	Yes	Yes	No	TBD	PD, MTSQ
M121 chemical	1320-D568	Yes, but not zone 1	Yes	Yes	No	18,100	PD, VT
M795 HE ¹	1320-D529	Yes, but not zone 1 or 2	Yes	Yes	No	TBD	CP, PD, MTSQ VT, (M732 only)
M825 smoke	1320-D528	Yes, but not zone 1 or 2	Yes	Yes	No	17,500	MT
M718 RAAMS-L	1320-D503	Yes, but not zone 1 or 2	Yes	Yes	No	17,740	MT
M741 RAAM-S	1320-D509	Yes, but not zone 1 or 2	Yes	Yes	No	17,740	MT
M712 Copperhead	1320-D510	Yes, but no requirement for zones 1 or through 3	Yes	Yes	No	16,400	BD (comes already installed)
M804 practice	1320-D513	Yes, but not zone 1	Yes	Yes	No	18,100	PD, MTSQ, VT (M732 only)

¹ Type classified, but not in production.

PROJECTILES	DODAC	M113 SERIES	M4 SERIES	M119	M203	MAXIMUM RANGE	FUSE ACTION
		zone 1		Yes	No		
M107 HE	1320-D544			Yes	No		
M549A1 RAP	1320-D579	No	Yes, but zone 7 only	Yes, but not M119	No	23,500	PD

M549A1 ICM	1320-D562	Yes, but not zone 1	Yes	Yes	No	18,100	MT
M485 illum	1320-D505	Yes, but not Zone 1	Yes	Yes, but degraded reliability	No	17,500	MT
M483A1 DPICM	1320-D563	Yes, but not zone 1 or 2	Yes	Yes	No	17,500	MT
M854 BB DPICM	1320-D854	No	Yes	Yes	No	22,000	MTSQ M577
M692 ADAM-L	1320-D501	Yes, but not zone 1 or 2	Yes	Yes	No	17,740	MT
M731 ADAM-S	1320-D502	Yes, but not zone 1 or 2	Yes	Yes	No	17,740	MT
M454 nuclear	Controlled Distribution	Yes, but not zone 1 or 2	Uses special propelling charges M197 and M206			14,800	Airburst
M116A1 HC	1320-D506	Yes, but not zone 1	Yes	Yes	No	18,100	MT
M110A1 WP	1320-D550	Yes, but not zone 1	Yes	Yes	No	18,100	PD, MTSQ
M110 H/HD	1320-D543	Yes, but not zone 1	Yes	Yes	No	18,100	PD, MTSQ
M687 binary ¹	1320-D594	Yes, but not zone 1 or 2	Yes	Yes	No	TBD	PD, MTSQ
M121 chemical	1320-D568	Yes, but not zone 1	Yes	Yes	No	18,100	PD, VT
M795 HE ¹	1320-D529	Yes, but not zone 1 or 2	Yes	Yes	No	TBD	CP, PD, MTSQ VT, (M732 only)
M825 smoke	1320-D528	Yes, but not zone 1 or 2	Yes	Yes	No	17,500	MT
M718 RAAMS-L	1320-D503	Yes, but not zone 1 or 2	Yes	Yes	No	17,740	MT
M741 RAAM-S	1320-D509	Yes, but not zone 1 or 2	Yes	Yes	No	17,740	MT
M712 Copperhead	1320-D510	Yes, but no requirement for zones 1 or through 3	Yes	Yes	No	16,400	BD (comes already installed)
M804 practice	1320-D513	Yes, but not zone 1	Yes	Yes	No	18,100	PD, MTSQ, VT (M732 only)

¹ Type classified, but not in production.

PROJECTILES	DODAC	PROPELLING CHARGES				MAXIMUM RANGE	FUZE ACTIONS
		M1	M2	M188	M188A1		
M107 HE	1320-D680	Yes	Yes	Yes	Yes (Charge 8 only)	22,900	PD, MTSQ VT
M404 ICM	1320-D584	Yes	Yes	No	No	17,200	MT
M422A1 nuclear	Controlled distribution	Uses special propelling charges		Yes	Yes ¹	18,100	MT
M426 chemical VX	1320-D695	Yes	Yes	Yes	Yes ¹	18,100	PD
M426 chemical GB	1320-D696	Yes	Yes	Yes	Yes	22,900	MT
M509A1 DPICM	1320-D651	Yes	Yes	Yes	Yes	22,900	MT
M753 nuclear	Controlled Distribution	Yes	Yes	Yes	No	22,900	MT
M650 RAP rocket on	1320-D624	Yes	Yes	Yes	Yes	30,000	Airburst
M650 RAP rocket on	1320-D624	Yes	Yes	Yes	Yes	24,400	PD MTSQ, VT (M732)
¹ Zone 9 is not authorized for either the M422A1 or the M424A1 projectiles. During peacetime, the M424A1 projectile may be fired with either M80 or zone 8 of the M188 or M188A1 propelling charges in a new cannon tube. A new cannon tube is defined as one that has at least one-half of the tube life remaining.							

Ammunition	Painting and Marking of Ammo of Earlier Manufacture	Painting and Marking of Ammo of Recent Manufacture
HE HEAT HEP (over 40-mm)	Olive drab w/yellow marking Olive drab w/yellow marking Olive drab w/yellow marking	Olive drab w/yellow marking Black w/yellow marking Olive drab w/black band and yellow marking
Smoke (except WP or PWP)	Gray w/one yellow band and yellow marking	Light green w/black marking
Smoke (WP or PWP)	Gray w/one yellow band and yellow marking	
Illuminating (semifixed)	Gray w/one white band and white marking	Light green w/yellow band and light red marking
Illuminating (separate-loading)	Gray w/one white band and white marking	White w/black marking
Practice wo/explosive filler	Blue or black w/white marking	Olive drab w/white band and white marking
Practice w/high-explosive filler	Blue or black w/white marking	Blue w/white marking
Practice w/low-explosive filler	Blue or black w/white marking	Blue w/yellow band and white marking
Chemical:	Gray w/two green bands and green marking	Blue w/brown band and white marking
Persistent toxic agent	Grayw/one green band and green marking	Gray w/two green bands and green marking (one yellow band w/explosive burster)
Nonpersistent toxic agent	Gray w/two red bands and red marking	Gray w/one green band and green marking (one yellow band w/explosive burster)
Persistent irritant agent	Gray w/one red band and red marking	Gray w/two red band and red marking (one yellow band w/explosive burster)
Nonpersistent irritant agent	Gray w/one green bank for G series, two green bands for V series, and green marking	Gray w/three green bands and green marking (one yellow band w/explosive burster)
G and V series agents		Gray w/three green bands and green marking (one yellow band w/explosive burster)
AP and APDS wo/filler	Black w/white marking	Black w/white marking
AP w/high-explosive filler	Black w/yellow marking	Black w/yellow marking
APERS w/fletchettes	Black w/white marking	Olive drab w/yellow band, white Marking and white diamonds
Canister w/slugs	Black w/white marking	Olive drab w/white marking
Canister w/fletchettes	Black w/white marking	Olive drab w/white marking and White diamonds
Dummy	Black or blue w/white marking	Bronze w/white marking

TABLES B-1. FUZE TYPES AND MODELS

<u>FUZE TYPE (MNEMONIC)</u>	<u>FUZE MODELS</u>
PDA	557, M572, M739 with superquick option
PDAD	M557, M572, M739 with Delay option
PDC	M78, M78A1
TIA	M564
TIB	M577
TIC	M548
TID	M582
TIE	M587
TIF	M565
TIN	M542, M543, M543A1
VTAD	M513, M513A1, M513A2, M513B1
VTB	M732
VTC	M514, M514A1, M514B1
VTN	M727
VTX	M735

TABLE B-2. PROPELLANT TYPES AND CHARGES

<u>105 MM</u>	<u>155 MM</u>
M67 (CHG 1-7)	M3A1 (CHG 2-5) Green Bag
M167	M4A2 (CHG 3-7) White Bag
	M119A1 (CHG 8) White Bag
	M231 (CHG 1-2) MACS
	M232 (CHG 3-5) MACS
	M203 (CHG 9(8s)) for M198 8 Super only
	M119A2 (CHG 7) Red Bag

TABLE B-3 - PROJECTILE TYPES, MODELS, MNEMONICS AND STANDARD WEIGHTS

105 MM

PROJECTILE TYPE	DESCRIPTION (MNEMONIC)	PROJECTILE MODEL	STANDARD WT (POUNDS)	STANDARD WT. (SQUARES)
HEA	High Explosive	ML (Deep Cavity)	33.0	2
HEB	High Explosive	ML (Normal Cavity)	33.0	2
NEC	APICM	M444	33.0	2
HEO	RAP (Rocket Off)	M548	28.5	2
HER	RAP (Rocket On)	M548	28.5	2
GSB	Chemical, GB	M360	35.4	6
GSD	Chemical, and HD	M60 (H and HD)	33.0	2
SMA	White Phosphorous	M60 (WP)	34.8	5
SMB	Smoke, HC and Colored	M84, M84AL, M84BL	32.9	NA ²
ILA	Illumination	M314A3	32.7	NA ³

Notes.

1. Projectile weight is determined by applying 0.6 pound to standard weight for each square variation from the standard square weight.

2. Not weight zoned. Colored smokeweight depends on filler:

Filler	Weight (Pounds)
Yellow	30.3
Red	30.7
Violet	30.5
Green	30.5

3. Not weight zoned.

TABLE B-3. CONTINUED
155 MM

PROJECTILE TYPE	DESCRIPTION (MNEMONIC)	PROJECTILE MODEL	STANDARD WT (POUNDS)	STANDARD WT (SQUARES)
HEA	High Explosive	M107 (Deep Cavity)	95.0	4
HEB	High Explosive	M107 (Normal Cavity)	95.0	4
HEC	APICM	M449	95.0	4
HEE	APICM	M449AI	95.0	4
HEF	DPICM	M483AI	103.5	4
HER	RAP (Rocket On)	M549, M549AI	96.0	4
APL	Antipersonnel Mine (Long Delay)	M692	103.5	4
APS	Antipersonnel Mine (Short Delay)	M731	103.5	4
AML	Antimaterial Mine (Long Delay)	M718	103.5	4
AMS	Antimaterial Mine (Short Delay)	M741	103.5	4
NUA	Nuclear	M454	120.45	4
GSB	Chemical, GB	M121A1 (GB)	99.4	8
GSD	Chemical, H and HD	M110H	95.0	4
GSX	Chemical, VX	M121A1 (VX)	99.4	8
SMA	White Phosphorus	Milo	97.2	6
SMB	Smoke, Colored and HC	M116A1, M116B1	95.0	42

TABLE B-3. CONTINUED

155 MM

<u>PROJECTILE TYPE</u>	<u>DESCRIPTION (MNEMONIC)</u>	<u>PROJECTILE MODEL</u>	<u>STANDARD WT (POUNDS)</u>	<u>STANDARD WT (SQUARES)</u>
SNC	Smoke, WP	N825	103.5	4
ILA	Illumination	M48SA1I, M48SA2	91.5	NA ³

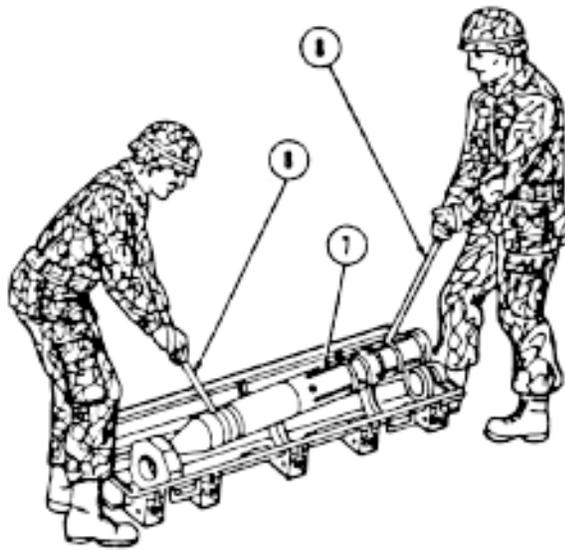
Notes.

1. Projectile weight is determined by applying 1.1 pounds to the standard weight for each square variation from the standard weight.
2. Colored smoke weighs 86.4 pounds.
3. Not weight zoned.

TABLE B-4. PROJECTILE FAMILIES (MNEMONIC REFERENCES)

<u>105-MM PROJECTILE FAMILIES</u>	<u>MEMBER PROJECTILE TYPES</u>
HEA	HEA, HEB, GSD, GSB, SMA, SMB, ILA, HEC
HER	HER, HEO
<u>155-MM PROJECTILE FAMILIES</u>	<u>MEMBER PROJECTILE TYPES</u>
HEA	HEA, HEB, SMA, SMB, ILA, GSB, GSD, GSX, HEC, HEE
HEF	HEF, APL, APS, AML, AMS, SMC
CPH	CPH
NUA	NUA

APPENDIX – C
EXTRACT OF TM 9-2350-311-10
(UNPACKING, REPACKING AND EXTRACTION OF THE
M712 COPPERHEAD)

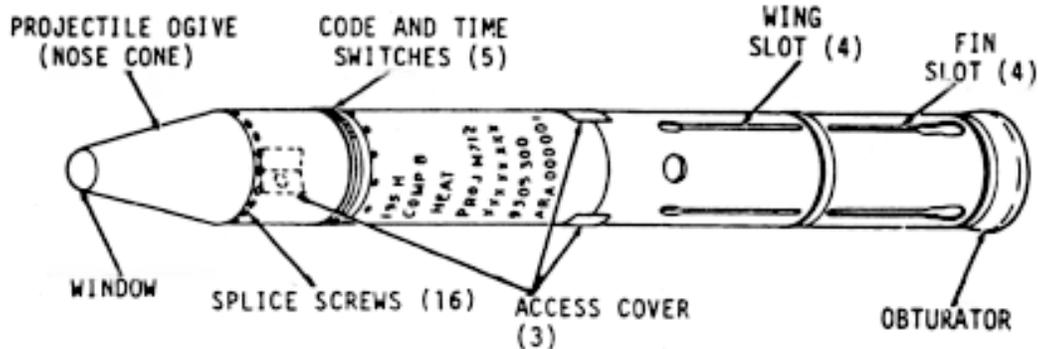


C-1

Section IV. CANNON-LAUNCHED GUIDED M712 PROJECTILE HEAT COPPERHEAD) AND M823 PROJECTILE (TRAINING)

4-27. DESCRIPTION.

a. Cannon-launched, guided M712 projectile is a terminally guided system launched from the M109A2/A3 howitzer into a ballistic trajectory. During flight, the target illuminated by a laser beam from a laser designator. An onboard computer continuously refines the terminal trajectory and provides guidance to the control surfaces, causing the round to home in on stationary or moving hard-point targets. The M712 projectile is fired in the same manner as conventional projectiles.



WARNING

The M823 training projectile must not be fired. Such firing could be a hazard to personnel forward of the weapon.

b. The training round for M712 projectile is the M823 projectile. The M823 training projectile is designed to train 155MK howitzer weapon crews in the handling and setting of the M712 projectile. It simulates the M712 in weight, center of gravity, and external appearance. It contains code and time switches which are set to simulate prefiring activity by the crew; however, it does not have the wings or fins. It is shipped and stored in the same type of container as the M712 and is color coded bronze for easy identification.

4-28. UNPACKAGING AND INSPECTION.

WARNING

If exuded composition B is observed on the projectile or in the container during the unpackaging and inspection operations, move the projectile to a safe area and notify EOD for disposal.

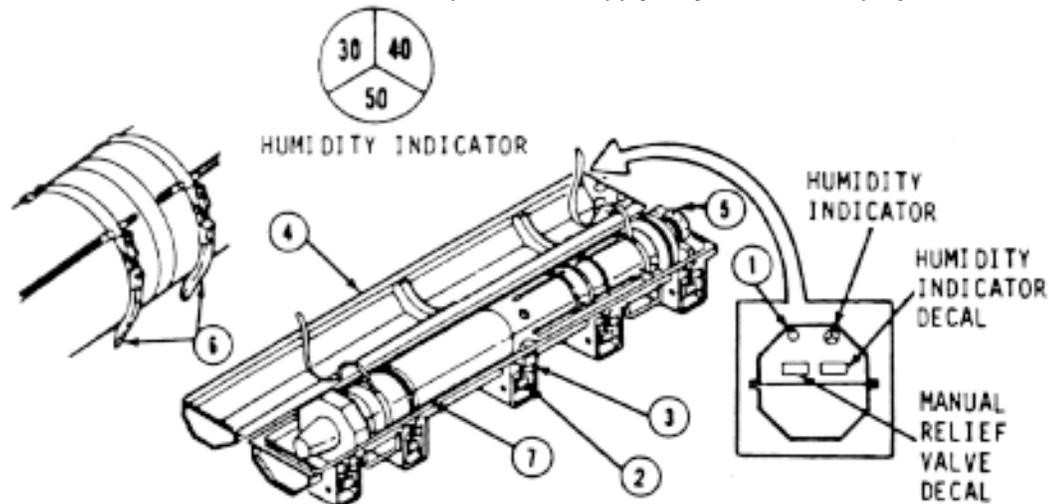
NOTE

Container with repackaged projectiles should be tagged to indicate-time of exposure.

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4-28. UNPACKAGING AND INSPECTION.-Continued

a. Unpackaging. A humidity Indicator is located in aft end of the container. This indicator is the pie-sector type. The M823 training round has an indicator card that resembles the card for the M712, but says "DUMMY CARD" on its face. These procedures apply only to the M712 projectile.



CAUTION

Before removing the round from container, make a quick visual inspection of the projectile for obvious damage or other condition that would prevent use. If projectile appears not usable, replace lid and return to battalion maintenance.

Open only those containers whose humidity indicator card shows under 40 percent relative humidity (40 percent spot must be colored blue, 30 percent spot may be blue or pink), and only when a fire mission is planned or anticipated. If the 40 percent humidity spot turns pink, turn complete item in to battalion ammunition section. Keep all packaging materials in the container. A protective bag is provided inside each container. When mission requirements dictate a need, the M712 projectile may be removed from the shipping and storage container and placed in the protective bag. The protective bag will protect the round against direct effects of water, sunlight, dirt, and debris. However, it will not protect the round from the elements for more than 72 hours at a time. Repackage unfired projectiles within 72 hours and turn in to battalion ammunition section. Projectiles must be repackaged for vehicular transportation. Cannoneers no. 2 and 3 will unpackage the M712 projectile from its container as follows:

(1) Break metallic seal wire (if still present) located on center latch assembly, using screwdriver or equivalent tool. (One wire on center latch assembly of each side of the container.)

(2) Depress manual relief valve (1).

4-28. UNPACKAGING AND-INSPECTION.

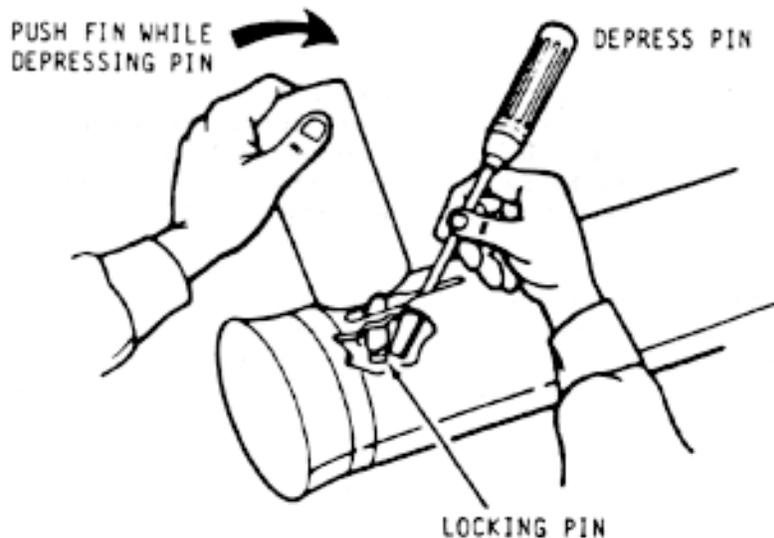
(3) Release all ten latches (2). Start at one and open corresponding left and right side latches. Pull latch all the way up to release T-bolts (3). Then push latch with T-bolts all the way down.

(4) Separate cover from container body and place upside down on ground, alongside the body.

(5) Partially pull torquing rod (5) from rear and of tension mechanism.

(6) Use rod to release the tension by turning counterclockwise, then spin tension mechanism by hand until it stops.

(7) Open stainless steel fin and wing preload bands (6). (Omit this step if projectile (7) is to be stored inside the howitzer.) Remove and place in container cover.



(8) Cannoneers no. 2 and 3 should carefully remove projectile (7) from container by lifting it up and to the rear using lifting straps (8) provided on the projectile.

(9) Place the projectile on a clean surface free of dirt or water. Projectile may be placed on a tarpaulin or may be put down across the top of the open container. The projectile should be shielded from direct sunlight, rain, dirt, and other debris.

(10) Remove lifting straps (8) and place them in the container.

(11) Keep the container and all packing materials for reuse or return complete container to battalion ammunition section. Covers and bodies of containers form a set. Do not separate or mix covers and bodies.

4-28. UNPACKING AND INSPECTION.-Continued

a. Unpacking.

CAUTION

Do not let the projectile touch the ground or lay in water. Water, dirt, or other materials entering projectile through wing/fin slots may cause projectile to fail during flight. Do not touch or grasp ogive when handling and loading projectile.

b. Inspection (M712 projectile). Cannoneers no. 2 and no. 3 perform the following inspections immediately after the projectile is unpackaged from its container. If a projectile is found to be unserviceable as a result of damage or other defects as described below, repackage the projectile in its original container and return to battalion ammunition section. Attach a tag describing the defects.

(1) Inspect the window area of the nose cone to make sure that it is clean and that there are no cracks, fogging, indications of moisture on the inside of the window, or other damage. Clean a dirty window using a clean, soft cloth (item 58, app D) or tissue. Reject a projectile as unserviceable for any of the following reasons:

- (a) Window cannot be properly cleaned.
- (b) Window shows signs of fogging or has moisture on the inside.
- (c) Window is cracked, broken, or badly gouged.

(2) Inspect code and time switches for dirt. Numbers and index marks must be legible. Remove dirt using a clean cloth (item 58, app D). Reject a projectile as unserviceable for any of the following reasons:

- (a) Missing or broken switch dials.
- (b) Switch dials cannot be properly cleaned to make numbers and index marks legible.
- (c) Switches cannot be rotated freely when the firing codes are being set into the projectile.

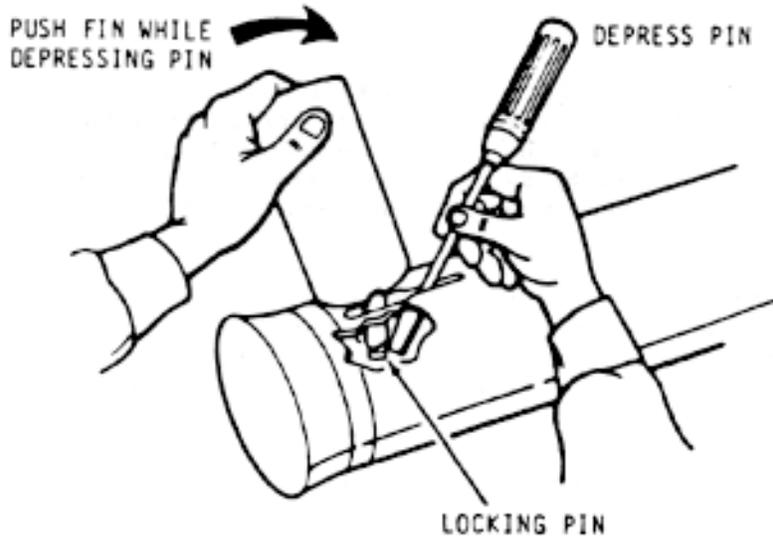
(3) Reject a projectile as unserviceable-if the obturator has a crack or large gouge.

(4) Inspect wing and fin slots to make sure there is no dirt, debris, or other foreign matter in the slots. If debris is found, attempt to clean out the slots. Reject as unserviceable if foreign material cannot be removed.

(5) Inspect fins to make sure that they are cot in extended position. If they are, perform either (a) or (b) below to relatch fins. Reject projectile as unserviceable if fins cannot be relatched.

(a) If fin is only part way out, gently push fin back into its slot until it locks in place.

(b) If fin is locked in extended position, insert a small screwdriver, knife blade, or similar tool into fin slot as shown below. Depress locking pin with the tool and push fin forward at the same time to lock fin in retracted position.



LOCKING PIN

(6) Inspect the overall projectile to make sure that there is no caked on dirt, excessive corrosion, loose or missing items such as screws or access covers or other damage. Remove dirt, minor corrosion, and foreign matter using a clean, soft cloth (Item 17, App. D) or tissue. Inspect for loose or missing screws (see illustration in paragraph 4-27. a., page 4-61). If any splice screw or access cover screw is loose, attempt to make it finger tight, turning by hand. Reject a projectile as unserviceable if there is excessive corrosion or screw missing on access cover. Minor corrosion, minor gouges, burrs on metal projectile body, and/or missing splice screw(s) are acceptable. Screws slightly above flush are acceptable after tightening.

c. Inspection (M823 projectile). Since the M823 projectile will be reused many times, it will be rejected only for the following reasons:

- (1) Nose cone is cracked or broken.
- (2) One or more switches cannot be rotated or will not stay act to a number.
- (3) Severe damage to projectile body which could prevent it from being rammed or extracted, and cause damage to the interior of the tube.
- (4) Badly damaged or worn obturator which results in fallback.
- (5) Damaged base which prevents proper extraction.

4-29. PREPARATION FOR FIRING.

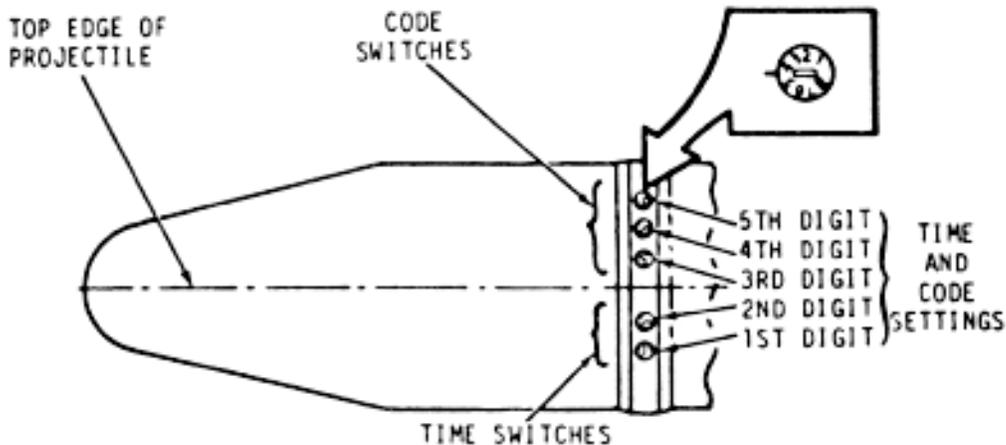
WARNING

- Forcing cone in the tube must be free of oil and grease before ramming. Oil or grease may permit projectile fallback.
- After extracting an M712 projectile from a hot tube, clean the forcing cone of melted plastic. Failure to do so may result in projectile fallback. Cleaning may be accomplished by firing another type projectile, if mission requirements permit, or firing a propelling charge alone.

NOTE

For training purposes, the M823 training projectile will be used instead of the M712 projectile. All operational procedures which apply to the M712 also apply to the M823 projectile. However, no live propelling charges are to be used with the M823 training projectile.

- Unpackage and inspect M712 projectile or M823 projectile, page 4-57.
- The chief-of-section makes sure that the extractor is set up and ready for use as described on page 4-64.
- After unpackaging the projectile, cannoneer no. 2 will set the time and code switches using a screwdriver or the tang end of the M18 fuze-setter wrench. The fire direction center will announce this setting in the fire command in the same place as they usually send 'time' for time or VT fuzes. This switch setting will always have five numbers. Switches will be set from left to right as seen when facing the nose of the projectile from the base of the round. Switches are circular dials that can be rotated clockwise or counterclockwise as many times as required without damaging the switches. The appropriate number on the switch must be aligned with the scribe line.



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TM 9-2350-311-10 4-4-29. PREPARATION FOR FIRING.

- c. The assistant gunner sets the elevation of the tube to approximately 300 miles. Cannoneer no. 1 places loading tray in loading position.
- e. Cannoneers no. 2 and 3 will pass the projectile through the rear of the howitzer to the chief of section and cannoneer no. 1.
- f. The chief of section and cannoneer no. 1 place the projectile on the loading tray with the nose cone window approximately 3 in. (7.62 cm) from the breech ring. Cannoneer no. 1 supports the rear end of the projectile at all times until it is loaded into the tube. The chief of section rechecks the nose cone window and obturator for cleanliness. If necessary, they are wiped clean using a clean, soft cloth (Item 15, App. D) or tissue.
- g. The chief of section and cannoneer no. 1 rotate the projectile until code and time switches are up and then push projectile forward until switches are directly under overhead light (approximately 10 in. (25-40 cm) from breech ring).
- h. The chief of section rechecks code and time switches. If switches have not been set or are set incorrectly, he sets them. The chief of section will also verify that the steel fin and wing retainer clamps have been removed. If the clamps have not been removed, he will have them removed before permitting the round to be rammed.
- i. The projectile is now ready to load for firing. Loading, ramming, and firing the M712 projectile is the same as for all other ammunition in this manual.

4-30. MISFIRE AND CHECKFIRE PROCEDURES.

The precautions and actions associated with misfire and checkfire are the same for the M712 projectile as for other projectiles in this manual. Refer to page 2-195.

4-31. OPERATION OF EXTRACTOR ASSEMBLY.

a. General. The extractor assembly is used to remove the M712 and M823 projectile from the weapon breech. The following procedures include setting up the extractor in preparation for use, and the breakdown procedures for stowage by cannoneer no. 1.

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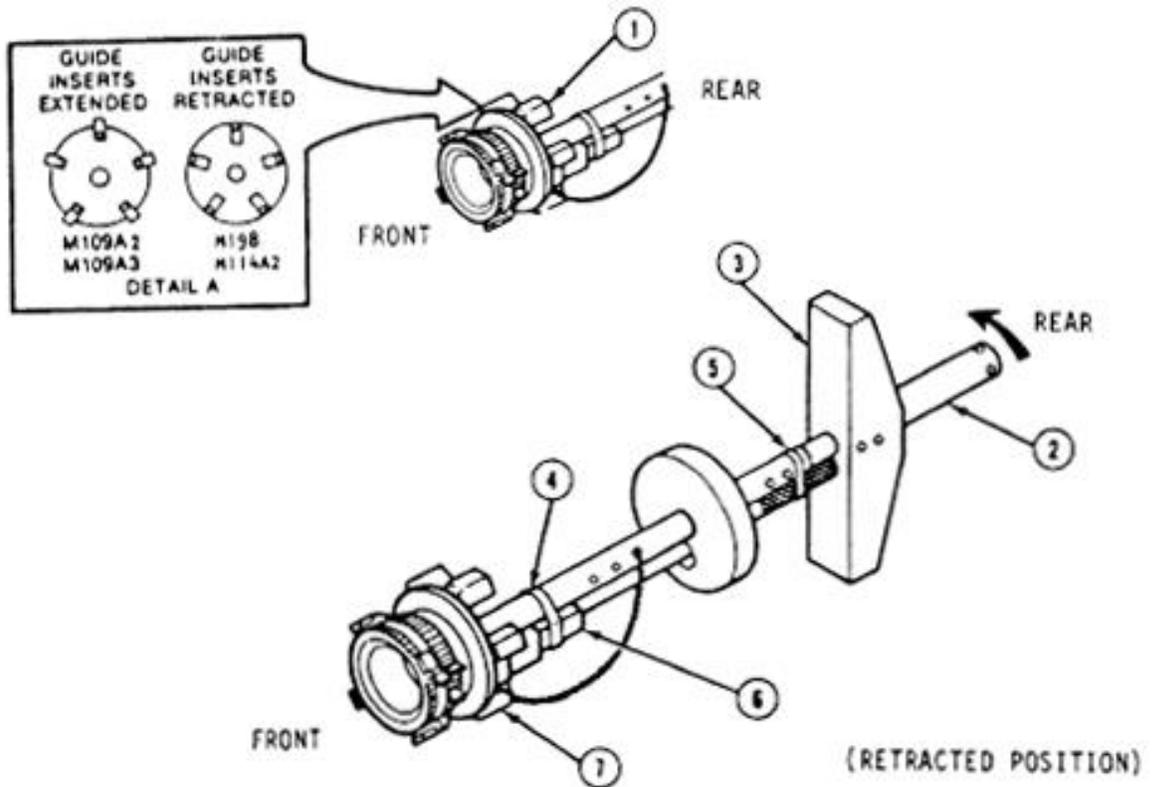
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4-31. OPERATION OF EXTRACTOR ASSEMBLY-Continued

b. Setup For Use.

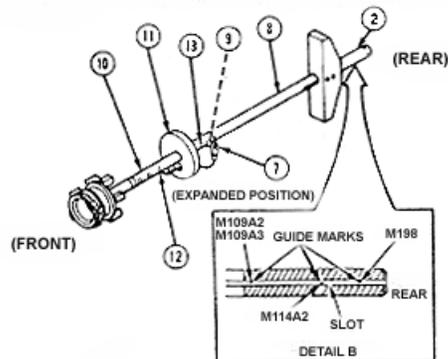
- (1) Get extractor assembly from stowage brackets on right wall of the crew compartment
- (2) Inspect to make sure that the five guide inserts (1) on the extractor assembly are extended.

See DETAIL A.



(3) While standing at the rear, loosen drive nut (2) (clockwise) to farthest white marks (forward mark).

- (4) Move brace (3) back.
- (5) Loosen two straps (4 and 5).
- (6) Remove ratchet (6).
- (7) Disengage locking pin (7).



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4-64

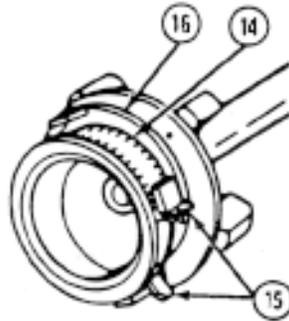
TM 9-2350-311-10
4-31. OPERATION OF EXTRACTOR ASSEMBLY-

(8) Extend telescoping shafts until hole in solid shaft (8) aligns with the nearest hole (9) in the hollow shaft (10).

(9) Move alignment support (11) forward midway between locking pin chain screw (12) and the two holes (9 and 13) at end of the hollow shaft (10).

(10) Guide the locking pin (7) through the slot in alignment support (11).

(11) Insert locking pin (7) completely into both shafts (8 and 10) into hole (9).



(12) Turn drive nut (2) counterclockwise until forward edge of drive nut aligns* with guide mark (white) on solid shaft (8) of extractor. Use front mark for M109A,2/M109A3 howitzers. See DETAIL B.

(13) Cock extractor as follows:

(a) Compress expansion ring (14) by squeezing tabs (15) together.

(b) Align cutout in retaining ring (16) with tabs (15) on expansion ring (14) and slide retaining ring (16) forward over expansion ring (14).

c. Set Up for Use Under Conditions of Poor Visibility. If the extractor is being expanded under conditions of poor visibility, the alignment hole and shaft detent may be used as described below.

(1) Disengage locking pin (7) and pull solid shaft (8) from hollow shaft (10).

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4-31. OPERATION OF EXTRACTOR ASSEMBLY-Continued

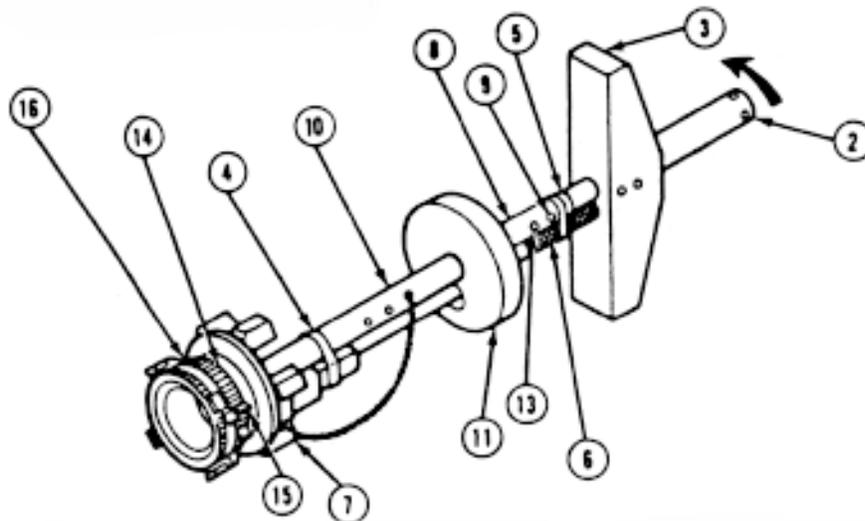
c. Set Up for Use Under Conditions of Poor Visibility.

- (2) Move alignment support (11) forward to the two holes (9 and 13) in hollow shaft (10).
- (3) Guide locking pin (7) through the slot in the alignment support (11).
- (4) Insert locking pin (7) in the alignment hole (13) (second hole from end of hollow shaft (10)).
- (5) Insert solid shaft (8) in hollow shaft (10) and rotate until alignment detent in end of solid shaft (8) rests against locking pin (7).
- (6) While holding both shafts, to prevent them from turning or sliding, remove locking pin (7) from alignment hole (13) and insert pin completely through farthest hole (9) to lock both shafts in extended position.
- (7) Turn drive nut (2) counterclockwise until forward edge of drive nut & lines with guide mark (white) on solid shaft (8) of extractor. Use front mark for M109A2/A3 howitzer (rear mark is for M198 howitzer only, middle mark is for M114A2 howitzer only). See DETAIL B.

(8) Cock extractor as follows:

- (a) Compress expansion ring (14) by squeezing tabs (15) together.
- (b) Align cutout in retaining ring (16) with tabs (15) on expansion ring (14) and slide retaining ring (16) forward over expansion ring (14).

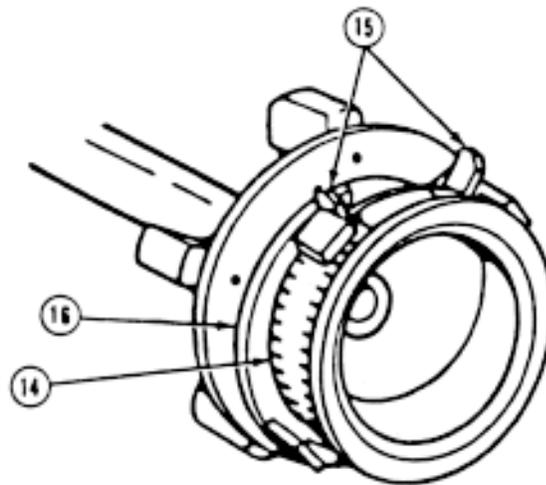
d. Breakdown for Stowage.



- (1) Disengage locking pin (7) and compress telescoping shafts to retracted position.
- (2) Guide locking pin (7) through slot in alignment support (11).

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- (3) Insert locking pin (7) completely through solid shaft (8) and hollow shaft (10).
- (4) Remove ratchet (6) and guide ratchet handle through the slot in alignment support (11).
- (5) Strap ratchet (6) to hollow shaft (10), using the straps (4 and 5) provided.
- (6) Slide brace (3) forward until it touches end of ratchet handle. Turn drive nut (2) counterclockwise until brace (3) is held firmly against ratchet handle.
- (7) Check to see if extractor is cocked. If it is not cocked, perform the following:
 - (a) Compress expansion ring (14) by squeezing tabs (15) together.
 - (b) Aline cutout in retaining ring (16) with tabs (15) on expansion ring (14) and slide retaining ring (16) forward over expansion ring (14).
- (8) Stow extractor in stowage brackets on right sponson



4-32. UNLOADING AN M712 PROJECTILE.

CAUTION

Do not use bell rammer to unload the M712 projectile.

a. Removal of Primer and Propelling Charge.

(1) Cannoneer no. 1 removes primer and propelling charge as performed for other ammunition in this manual.

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4-32. UNLOADING AN M712 PROJECTILE-Continued

a. Removal of Primer and Propelling Charge.

- (2) Assistant gunner elevates/depresses tube to approximately 300 ails.
- (3) Cannoneer no.1 positions loading tray in loading position.

b. Unloading Projectile M712. Cannoneer no. 1 unloads the M712 projectile following the steps listed below.

- (1) Obtain extractor.
- (2) Check to see if extractor is cocked. If ring is cocked, proceed to (3) below; otherwise, cock extractor as follows:
 - (a) Compress expansion ring by squeezing tabs together.
 - (b) Aline cutout in ring retainer with tabs on expansion ring and slide ring retainer forward over expansion ring.
- (3) Insert extractor through breech ring until forward end makes contact with base of projectile. Push extractor firmly against projectile until expansion ring is seated in the base of the projectile. Pull on extractor to make sure that it is engaged with projectile. If extractor did not engage, remove it from tube and repeat step (2)(a) and (b) and this step.
- (4) Turn extractor drive nut counterclockwise by hand until brace touches and is centered across face of breech ring.
- (5) Connect ratchet to end of extractor drive nut. Set ratchet to OFF and turn ratchet counterclockwise until projectile is pulled free of forcing cone. Remove ratchet from drive nut.
- (6) Let the projectile and extractor slide slowly out of tube until base of projectile has passed through breech ring. Projectile will have to be raised a little to pass obturator over Swiss groove.
- (7) Release extractor by squeezing tabs on expansion ring.
- (8) Cannoneer no. 1 and the assistant gunner pass the projectile out of the howitzer to cannoneers no. 2 and no. 3. Cannoneers no. 2 and no. 3 repackage the projectile. If the projectile is loaded in a hot tube, follow the procedures on page 2-195.

4-33. M712 AMMUNITION PREPARED FOR FIRING BUT NOT FIRED.

a. General. M712 projectiles that have been unpackaged but not fired will be repackaged within 72 hours and returned to battalion ammunition section for further disposition. Long exposure of the projectile to sunlight and other elements may cause it to fail. Code and time switch settings made during preparation need not be reset. A projectile that has been unloaded from a weapon an result of a misfire or checkfire will be repackaged as described below.

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4-33. M712 AMMUNITION PREPARED FOR FIRING BUT NOT FIRED.

NOTE

An M712 projectile which has been rammed and extracted from a cold tube may be reused.

b. Repackage projectile. Cannoneers no. 2 and no. 3 -will repackage the M712 projectile as follows:

(1) Wipe all loose dirt and moisture from projectile.

(2) Locate original container. If container has become Unserviceable, replace container. If original container cannot be found or has been replaced for unserviceability, make sure that markings on replacement container match markings on projectile. If markings do not match, return to battalion ammunition section for remarking.

(3) Install projectile Into container as follows:

(a) Check red decals at nose end of container halves to assure cover body match. Switch container halves, if required.

(b) Open container. Remove lifting straps. Also remove fin and wind preload bands.

(c) Install fin and wing preload bands on projectile.

CAUTION

Make sure that all four fin/wing retainer blocks securely engage fins/wings.

(d) Install lifting straps on projectile.

(e) Lift projectile and position over opened container.

(f) Carefully lower projectile, guiding nose cone into retainer ring in the container.

(g) Using torquing rod, turn tension mechanism clockwise, as far as possible, to snug projectile into the retainer ring. Position torquing rod in holes to that rod is horizontal (or as close to it as possible). This is required to avoid interference with the cover stops Inside the cover.

(h) Be sure that desiccant and protective bags are placed inside container.

(h) Place container cover on lower container half in a manner that align the inside cradles and places both the relief valve and humidity indicator to the rear of the container.

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4-33. M712 AMMUNITION PREPARED FOR FIRING BUT NOT FIRED-Continue

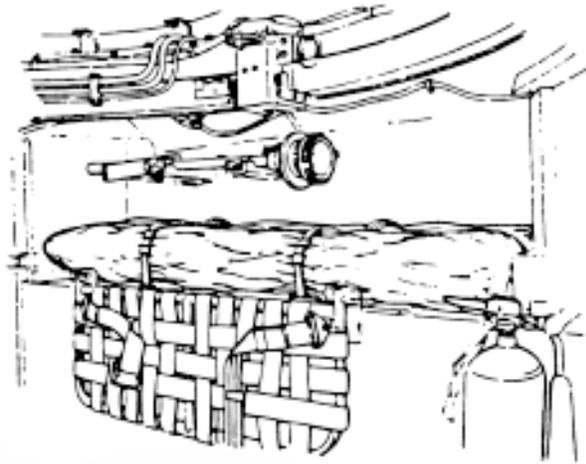
b. Repackage projectile.

- (1) Starting on the end opposite the humidity indicator, straddle container, place T-bolts in cover recesses and close corresponding left and right side latches at the same time in pairs.

4-34. STOWAGE OF M712 PROJECTILES IN M109A2/MI09A3 HOWITZERS.

a. General. Stowage facilities are provided for two M712 projectiles in the crew compartment of the M109A2/A3 howitzer. Use of these projectiles is reserved for the time when the howitzer is operating in a buttoned-up mode or when M712 projectiles are not available from the external ammunition carrier.

b. Stowage. The chief-of-section assisted by cannoneer no.1 will place two uncontainerized projectiles on the right-side sponson as shown in illustration below, with nose cone facing forward. Install protective bag as follows:



- (1) Obtain protective bag from container and remove tie-wraps.
- (2) Remove lifting straps from projectile and place straps in container. Raise front of projectile. Second man, slide protective bag over projectile as far as possible.
- (3) Lower projectile into cradle.
- (4) Raise base of projectile and slide bag over remainder of projectile.
- (5) Lower projectile into cradle.
- (6) Secure open end of protective bag with tie-wrap provided.
- (7) Securely fasten projectile to sponson with two straps provided on sponson, tightening ratchets on straps.
- (8) Repeat steps (1) through (7) for second projectile.

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4-36. STOWAGE OF EXTRACTOR ASSEMBLY IN M109A2/MI09A3 HOWITZERS.

Stow the extractor in the holding brackets provided as shown in illustration on page 4-70. Due to space limitations, the extractor must be stowed in the retracted position. See pages 4-66 and 4-67 on how to break extractor down for stowage.

4-36. M712 PROJECTILE MAINTENANCE.

Humidity indicators on containerized M712 projectiles must be monitored for humidity every 90 days, as a minimum. If relative humidity in the container is 40 percent or greater, (40 percent section of humidity indicator card to not blue), turn containerized projectile in to battalion ammunition section.

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