CHAPTER 6

AMMUNITION AND GUNNERY

Despite the present-day emphasis on missiles, guns continue to be important offensive weapons.

As a Seaman, you may be required to man gun stations or serve as a member of a magazine crew, so it is necessary that you have a general knowledge of the ammunition and guns in service.

It is not our intent, nor is it necessary, to discuss all the different types of ammunition and guns used in the Navy today. This chapter does, however, contain much information on guns, ammunition, and gunnery in general; information that should be very helpful to you in meeting your early shipboard assignments.

Excluding small arms, Naval guns are classified according to size. Within this classification, they are grouped as major, intermediate, or minor calibers. Major caliber guns range from 8 inches up to 16 inches. Intermediate calibers are greater than 3 inches and less than 8 inches. Minor caliber guns are 3 inches and below.

AMMUNITION

LEARNING OBJECTIVE: Define ammunition. Differentiate between the types of ammunition used aboard naval ships. Define and explain the different types of projectiles and propelling charges used in the Navy. Explain the use of the magazine and magazine sprinkler system.

In a general sense, ammunition includes anything that is intended to be thrown at the enemy or put in his path to deter, injure, or kill personnel, or to destroy or damage materials. The term ammunition is used in a much narrower and more technical sense in this book. Ammunition includes any projectile or explosive weapon, as well as components or parts thereof, but not guns or weapon launchers and their parts.

Service ammunition is ammunition lit for service use and including all explosive and propellant components. Inert ammunition (that is, lacking explosive and propellant components) and partially inert ammunition of several types are used for test, training, and practice purposes. Dummy or drill ammunition (completely inert) resembling service ammunition in appearance, size, and weight, may include functioning components that contain no explosive or propellant. It is used for training and test purposes. Cutaway ammunition (completely inert) has a section cut away to show inner construction and components; it is used for training and display purposes. Plaster-loaded or sand-loaded ammunition lacks the explosive burster charge but is otherwise not inert; it is used for target practice and for testing of launchers, mounts, or projectors.

IDENTIFICATION

As a member of a gun-loading crew, you will be tasked with finding, identifying, and loading different types of ammunition. Each round fired must be identified and recorded in the ship's logs. Ammunition is identified by stenciled information printed on the round and by its color. Stenciled information consists mainly of the Navy Ammunition Logistics Code (NALC)/Department of Defense Identification Code (DODIC) and lot number.

A standard nomenclature and numbering system has been established by the Department of Defense (DOD). This system is a four-digit, alphabetic/numeric code which will be either a Department of Defense identification code (DODIC) assigned by Defense Logistics Services Center (DLSC) or a Navy ammunition logistics code (NALC) assigned by Ship's Parts Control Center (SPCC). Examples of DODIC/NALC nomenclature are as follows:

AMMUNITION TYPE	DODIC/NALC
5"/54 Illumination Projectile	D328
6"/50 BL&P Projectile	D873
12 GAUGE 00 BUCKSHOT	A011

COLOR CODES, MARKINGS, AND LETTERINGS

The system of identifying ammunition by the use of color codes, marking, and lettering is intended to be a

ready identification to determine the explosive loads and hazards presented by the identified items. A color coding system is employed to indicate the primary use of ammunition, the presence of a hazardous (explosive, flammable, irritant, or toxic) filler, and/or the color of tracers, dye loads, and signals. Information on color coding for ammunition 20-mm or larger is contained in MIL-STD-709, OP 2238 (latest revision), and WS 18782. The lettering, stenciled or stamped on ammunition, includes all the information necessary for complete identification and is marked in compliance with NATO standards and Department of Transportation (DOT) regulations. In addition to standard nomenclature and lot numbers, lettering may include such information as the mark and mod, the type of fuzes, and the weapon in which the item is fired. Table 6-1 gives the meaning of the different color codes.

CLASSIFICATION

Gun ammunition is most commonly classified by the size of the gun in which it is used. In addition to

Table 6-1.–Ammunition Color Coding

COLOR	INTERPRETATION
Yellow	1. Identifies high explosives
	2. Indicates the presence of explosive either
	a. sufficient to cause the ammunition to function as a high explosives or b. particularly hazardous to the user Brown
Brown	1. Identifies rocket motors 2. Indicates the presence of explosives either a. sufficient to cause the ammunition to funcuon as low explosive or b. particularly hazardous to the user
Gray	Identifies ammunition that contains irritant or toxic agents when used as an overall body color except for underwater ordnance
Gray with red band (s)	Indicates the ammunition contains an irritant (harassing) agent
Gray with dark green band (s)	Indicates the ammunition contains a toxic agent
Black	Identifies armor-defeating ammunition except on underwater ordnance
Silver/Aluminum	Identifies countermeasures ammunition
Light Green	Identifies smoke or marker ammunition
Light Red	Identifies incendiary ammunition or indicates the presence of highly flammable material
White	Identities illuminating ammunition or ammunition producing a colored light; exceptions are underwater ordnance, guided missiles, and rocket motors
Light Blue	Identifies ammunition used for training or firng practice
Orange	Identifies ammunition used for tracking or recovery
Bronze	Identifies Dummy/Drill/Inert ammunition used for handling and loading training
Nonsignificant Colors	
Olive Drab	All ammunition items
Black	For lettering
White	1. For lettering 2. For guided missiles and rocker motors

designations of bore diameter, such as 20-mm, 3-inch, or 5-inch, the length of the gun bore in calibers is also used as a means of classification. Thus a 3-inch, 50-caliber projectile is one used in a gun having a bore diameter of 3 inches and a bore length of 50 times 3 inches, or 150 inches. The three types of ammunition classified by assembly are shown in figure 6-1.

Fixed Ammunition

The Fixed class of ammunition applies to ammunition that has the cartridge case crimped around the base of the projectile. The primer is assembled in the cartridge case. The projectile and the cartridge case, containing the primer and propellant charge, form one unit as a fixed round of ammunition. Small-caliber guns and guns through 3-inch, 50-caliber use fixed ammunition.

Semi-fixed Ammunition

Semi-fixed, or separated ammunition, applies to ammunition that consists of two units: the projectile assembly and cartridge case assembly. The projectile assembly consists of the projectile body containing the load, the nose fuze, the base fuze, and the auxiliary detonating fuze, as applicable. The cartridge case assembly consists of the cartridge case, primer, propellant charge, wad, distance piece, and a plug to close the open end of the cartridge case. Semi-fixed ammunition is produced in gun sizes of 5-inch, 54-caliber through 8-inch, 55-caliber guns.

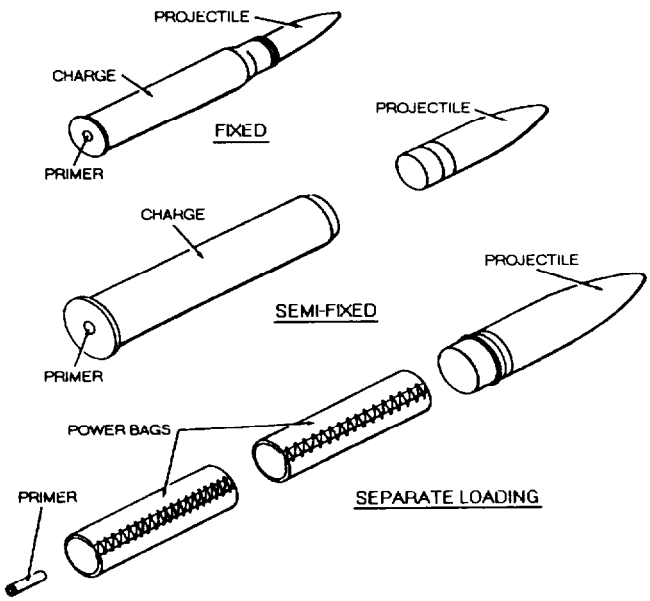


Figure 6-1.–Types of gun ammunition: fixed (top); semi-fixed (center); and separate-loading (bagged gun) (bottom).

PROJECTILES

The *projectile* is that component of ammunition that, when fired from a gun, carries out the tactical purpose of the weapon. While some types of projectiles are one piece, the majority of naval gun projectiles are assemblies of several components. All of the projectiles briefly discussed by classification in this chapter have several common features, as described in the following paragraphs and as illustrated in figure 6-2.

Ogive

The *ogive* is the curved forward portion of a projectile. The curve is determined by a complex formula designed to give maximum range and accuracy. The shape of the ogive is generally expressed by stating its radius in terms of calibers. It may be a combination of several arcs of different radii.

Bourrelet

The *bourrelet* is a smooth, machined area that acts as a bearing surface for the projectile during its travel through the bore of the gun. Some projectiles have only one bourrelet (forward); the rotating band serves as the bearing surface in the rear. Other projectiles have one bourrelet forward and one or two aft, the after one being located adjacent to and either forward or aft of the rotating band. Bourrelets are painted to prevent rusting.

Body

The *body* is the main part of the projectile and contains the greatest mass of metal. It is made slightly smaller in diameter than the bourrelet and is given only a machine finish.

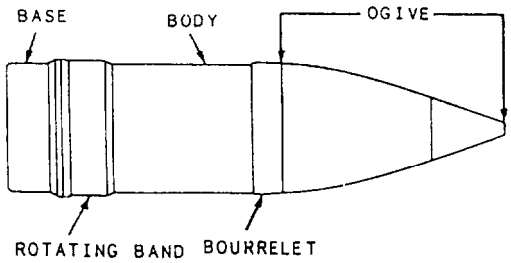


Figure 6-2.–Typical projectile, external view.

Rotating Band

The *rotating band* is circular and made of commercially pure copper, copper alloy, or plastic seated in a scored cut in the after portion of the projectile body. For all minor- and medium-caliber projectiles, rotating bands are made of commercially pure copper or gilding metal, which is 90-percent copper and 10-percent zinc. Major-caliber projectile bands are of cupro-nickel alloy, containing 2.5-percent nickel or nylon with a Micarta insert. As a projectile with a metallic band passes through the bore of the gun, a certain amount of copper will be wiped back on the rotating band and will form a skirt of copper on the after end of the band as the projectile leaves the muzzle of the gun. This is known as fringing and is prevented by cutting grooves, called cannelures, in the band or by undercutting the lip on the after end of the band. These cuts provide space for the copper to accumulate. The primary functions of a rotating band are (1) to seal the forward end of the gun chamber against the escape of the propellant gas around the projectile; (2) to engage the rifling in the gun bore and impart rotation to the projectile; and (3) to act as a rear bourrelet on those projectiles that do not have a rear bourrelet.

Base

The *base* is the after end of the projectile. A removable base plug is provided in projectiles that are loaded through this end. A fuze hole may be drilled and tapped in the center of the base plug. Projectiles with large openings in the nose for loading through that end require no base plug. In such cases, however, the solid base of the projectile may be drilled in the center to receive a base fuze or tracer if desired. The edge formed by the side walls and the base is usually broken slightly to give additional range. Some projectiles are tapered aft of the rotating band, a shape known as boat-tailed. Projectiles with plastic bands may have full caliber boat-tails for optimum aerodynamic shape.

Projectile Types

Projectiles are also classified by their tactical purpose. The following are descriptions of some of the common projectile types (fig. 6-3).

ANTIAIRCRAFT (AA).—Antiaircraft projectiles are designed for use against aircraft; they have no base fuzes. Otherwise, they are substantially the same as the high-capacity (HC) projectiles described below.

ANTIAIRCRAFT COMMON (AAC).—Antiaircraft common projectiles are dual-purpose projectiles combining most of the qualities of the AA-type with the strength necessary to penetrate mild-steel plate (fig. 6-3, view A). However, AAC projectiles do not have the penetrating ability of common projectiles. The type of fuzing will depend on the use. Fuze threads are provided in the nose and in the base. AAC projectiles are normally equipped with a mechanical time fuze (MTF) and an auxiliary detonating fuze (ADF). Dual-purpose action is accomplished by a time setting for air burst or by setting MTFs on "safe" or for a time longer than flight-to-target to permit the base detonating fuze (BDF) (delay) to function for penetration. By substituting a point detonating fuze (PDF) for the MTF, you can convert these projectiles to high-capacity for surface burst.

CHEMICAL.—Chemical projectiles may be loaded with a toxic, harassing, or smoke-producing agent. Of the smoke agents, white phosphorous (WP) is the most frequently used. WP projectiles (fig. 6-3, view B) are designed to produce heavy smoke and, secondarily, an incendiary effect. The small WP containers are expelled and then scattered by a delayed action burster charge that is ignited by a black powder expelling charge. Other chemical loads are dispersed in a similar manner.

PUFF.—Puff projectiles (fig. 6-3, view C) are nonexplosive projectiles used as practice (spotting) rounds. They are designed to produce dense smoke clouds approximating those of high-explosive rounds.

DRILL.—Drill projectiles are used by gun crews for loading drills and for testing ammunition hoists and other ammunition-handling equipment. They are made of economical, but suitable metals, and are designed to simulate the loaded service projectile represented in size, form, and weight. They may be solid or hollow. If hollow, they may be filled with an inert material to bring them to the desired weight. This latter type is closed with a base or nose plug or both, as appropriate.

DUMMY.—Dummy projectiles are reproductions of projectiles that may be produced from a variety of materials for a number of purposes. Drill projectiles are dummy projectiles in that they are not to be fired from a gun; however, all dummy projectiles are not drill projectiles. Dummy projectiles may be made for display, instruction, or special tests.

HIGH CAPACITY (HC).—High-capacity projectiles are designed for use against unarmored surface targets, shore installations, or personnel. They have a medium wall thickness and large explosive cavities.

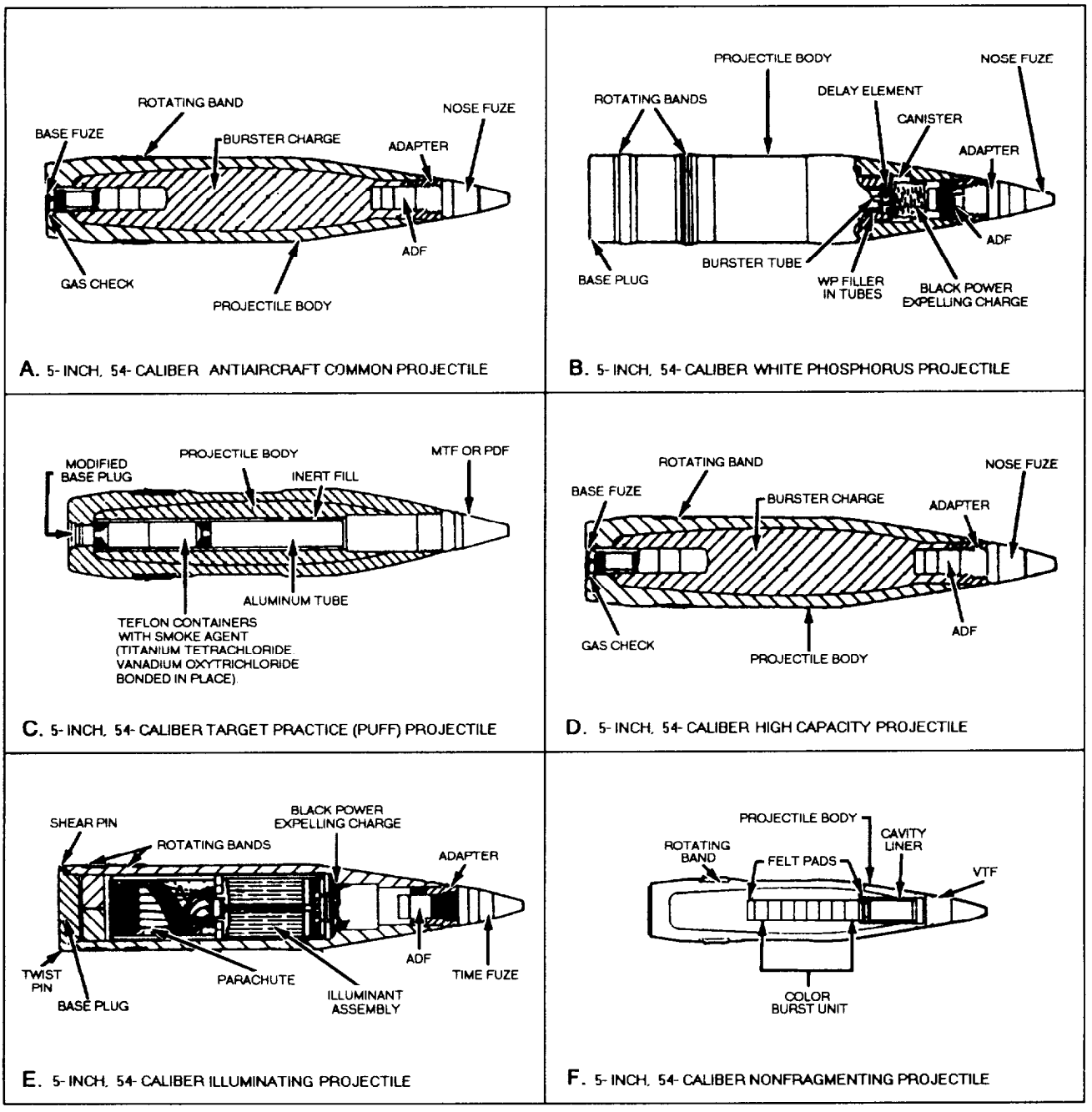


Figure 6-3.–Common projectile types.

Large HC projectiles (fig. 6-3, view D) are provided with an auxiliary booster to supplement the booster charge in the nose of the main charge. With threads in both the nose and base, HC projectiles may receive a variety of fuzes or plugs to accomplish different tactical purposes. An adapter ring (or rings) is provided on the nose end of most HC projectiles to allow installation of point detonating fuses (PDFs) or nose plug and auxiliary detonating fuses (ADFs) with different size threads. An adapter is removed for larger fuzes. HC projectiles are normally shipped with a PDF installed in the nose. The base fuzes that are shipped installed in the projectile may not be removed except at an ammunition depot.

ILLUMINATING (ILLUM).— Illuminating projectiles (fig. 6-3, view E) are made with thin walls. Each contains a time fuze, an ADF, a small black powder expelling charge behind the ADF, an assembly consisting of a pyrotechnic star or candle with a parachute, and a lightly held base plug. The time fuze serves to ignite the expelling charge. Explosion of the

expelling charge forces out the base and the illuminating assembly, and ignites the star or candle.

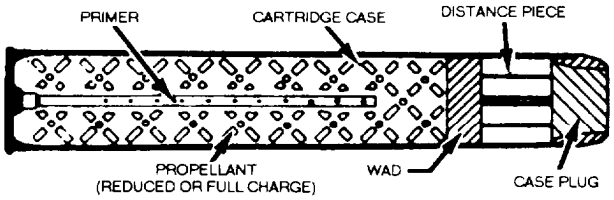
VARIABLE TIME NONFRAGMENTING (VT-NONFRAG).— VT-NONFRAG projectiles (fig. 6-3, view F) are loaded to avoid rupturing the body and spreading fragments when the fuze functions; however, sometimes the projectile ogive breaks up into low-velocity fragments. They are designed for use in antiaircraft target practice, particularly against expensive drone targets, for observing the results of firing without frequent loss of the drones. These projectiles have fillers of epsom salts or other inert material to give the projectile the desired weight. A color-burst unit, consisting of pellets of black powder and a pyrotechnic mixture, is placed in a cavity drilled in the center of the inert filler. The color burst is ignited through the action of the nose fuze and the black-powder pellets. The color-burst unit may be one of several colors that exits through the fuze cavity and ruptured projectile.

PROPELLING CHARGES

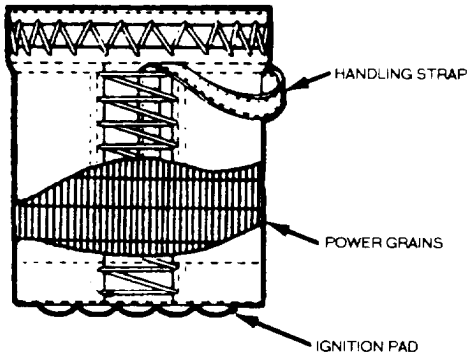
Propelling charges are mixtures of explosives designed to propel projectiles from the gun to the target. In fixed ammunition, the propelling charge and projectile are assembled together in a case and handled as one unit; the principal component parts are the brass or steel cartridge case, the primer, and a smokeless powder, the propelling charge. In the separated ammunition, the propelling charges and projectile are assembled separately; they are stored and handled as separate units until they are loaded into the gun. The propelling charge of the separated ammunition round consists of the propellant primer, details, and closure plug assembled into the metal case. The propelling charges of separate loading ammunition are made up in sections (bag charges) separate from the projectile and primer. Propelling charges for all calibers of ammunition have some common features. There are two basic categories into which these features can be grouped: case ammunition and bag charges. Saluting, reduced, and clearing charges have components that are the same as case ammunition, so they are included with case ammunition.

Case Ammunition

Propelling charges for small- and medium-caliber guns are assembled with primer and powder enclosed in a brass or steel container, called a cartridge case (fig. 6-4, view A). Assembly of the entire charge in a single, rigid, protective case increases the ease and



A. 5- INCH, 54- CALIBER PROPELLING CHARGE



B. BAG AMMUNITION FOR A 16- INCH GUN

Figure 6-4.–Propelling charges.

rapidity of loading and reduces the danger of flarebacks. Also, the case prevents the escape of gases toward the breech of the gun; it expands from the heat and pressure of the burning powder and forms a tight seal against the chamber.

Reduced Charge

A reduced charge is one in which less than the service load of powder is placed in the cartridge case. Reduced charges may be used in target practice, to decrease the wear on the gun.

Clearing Charge

When a round fails to seat fully upon being rammed into the gun chamber, thus preventing closure of the breech, or when the propelling charge fails to function, the projectile may be fired by extracting the full-sized case and loading a shorter clearing charge.

Saluting Charge

Saluting charges are charges used when firing a gun to render honors. Since no projectile is involved in such firing, the charge consists of a cartridge case containing a black powder load and a primer. The ships normally employ 40-mm or 3-inch guns for saluting. Saluting

charges for the 40-mm and the 3-inch guns are issued completely assembled, with no replacement components.

Bag Charge

In large guns (8-inch) using separate loading ammunition, the propellant charge is made up of sections of powder contained in cylindrical cloth bags that approximate the inside diameter of the gun chamber in which they are to be used. In most cases, more than one section (bag) is required. For example, the 8-inch, 55-caliber gun uses a propellant charge consisting of two sections; the 16-inch, 50-caliber gun uses a propellant charge of six sections (fig. 6-4, view B). In these guns the leaking of gases from the chamber is checked by the mushroom and pads on the breech plug. The breech plug also contains a lock, which receives the separately loaded primer.

Fuzes

Fuzes are the components that set off the projectile bursting charge. No matter how complicated or simple the construction or function of the fuzes, they always serve the same purpose.

All fuzes use the force of inertia for arming and, in most cases, operation. Each type of fuze has a different tactical use. The use and a detailed functional description will not be covered in this text. For more information on ammunition types and their fuzes, refer to *Navy Gun Ammunition*, SW030-AA-MMO-010.

Fuzes can be generally classified by function, as discussed in the following paragraphs.

TIME FUZES.—Mechanical time fuzes (MTFs) function a predetermined length of time after the projectile is fired. The exact time is set before the projectile is loaded into the chamber, by a mechanical fuze setter on the mount, or you can set the fuze with a special fuze wrench. The interval between the instant the fuze is set and the instant the projectile is fired is dead time. No matter when, how, or by what it is set, the timing mechanism of a time fuze will not function until the projectile is fired.

PROXIMITY FUZES.—Proximity (variable time (VT)) fuzes are energized after the projectile is fired and function when the projectile nears the target.

PERCUSSION FUZES.—Percussion (impact) fuzes function as the projectile strikes the target or (especially an armor-piercing projectile) after the projectile penetrates. Some fuzes (nondelay type) function immediately on contact with any thin material (for example, the thin sheet metal skin of an aircraft). Fuzes for armor-piercing projectiles, however, always incorporate a slight delay to keep the burster from going off until after penetration. These percussion fuzes can be located either on the nose (PDF) or on the base (BDF) of the projectile.

COMBINATION FUZES.—Combination fuzes incorporate both time and percussion features; that is, the fuzes may go off either on impact or after the time set, whichever occurs first.

AUXILIARY DETONATING FUZES.—Auxiliary detonating fuzes (ADF), as the name implies, operate only with other fuzes. In gun projectiles, they form part of the explosive train and pass on the explosion initiated by another fuze (located in the projectile nose) to the main bursting charge.

MAGAZINES

The term *magazine* applies to any compartment, space, or locker that is used or is intended to be used for the stowage of explosives or ammunition of any kind.

The term *magazine area* includes the compartment, spaces, or passages on board ship that contain magazine entrances and that are intended to be used for the handling and passing of ammunition. The term is also used to denote areas adjacent to, or surrounding, explosive stowages, including loaded ammunition lighters, trucks, and railroad cars, where applicable safety measures are required.

Magazines are arranged with regard to ease of supply, the best obtainable protection, and the most favorable stowage conditions.

Magazine Types

Many different types of magazines are provided on ships. Each magazine is designed specifically for the type of ammunition it is to contain. For our purpose, however, we will be concerned with only three types: primary magazine, ready-service magazine, and ready-service stowage.

PRIMARY MAGAZINES.—Primary magazines are designed as ammunition stowage spaces generally located below the main deck and, if possible, below the waterline. They are adequately equipped with insulation, ventilation, and sprinkler systems. These spaces must be provided with fittings so that they may be securely locked. Primary magazines accommodate a

vessel's complete allowance of ammunition for peacetime operation.

READY-SERVICE MAGAZINES.—Ready-service magazines are spaces physically convenient to the weapons they serve. They provide permanent stowage for part of the ammunition allowance. They are normally equipped with insulation, ventilation, and ammunition sprinkler systems, and should be secured by locking. The combined capacities of primary and ready-service magazines are normally sufficient to stow properly the allowance for war and emergencies.

READY-SERVICE STOWAGE.—Ready-service stowages are those ammunition stowage facilities in the immediate vicinity of the weapon served. They include weather deck lockers, bulwark (gun shield) racks, and 5-inch upper handling rooms. This stowage normally is filled only when the weapon is to be fired. There is little security for ammunition in such stowage, and it provides the least favorable protection from the elements.

Magazine Sprinkler Systems

As a member of a magazine crew, you may be trained to operate the magazine sprinkler systems protecting your magazine. You must be PQS qualified to operate any sprinkler system. Do not tamper with any sprinkler system controls unless you have been thoroughly trained, certified, and instructed to do so by competent authority according to your ship's instructions.

Sprinkler systems are used for emergency cooling of, and firefighting in, magazines, ready-service rooms, ammunition, and missile-handling areas. A magazine sprinkler system consists of a network of pipes secured to the overhead and connected by a sprinkler system control valve to the ship's saltwater firemain. The pipes are fitted with spray heads or sprinkler head valves that are arranged so that the water forced through them showers all parts of the magazine or ammunition and missile handling areas. A modern sprinkler system can wet down all exposed bulkheads at the rate of 2 gallons per minute per square foot and can sprinkle the deck area at the rate of 4 gallons per minute per square foot. Magazine sprinkler systems are designed so that they are capable of completely flooding their designated spaces within an hour. To prevent unnecessary flooding of adjacent areas, all compartments equipped with sprinkler systems are watertight. Upper deck handling and ready-service rooms are equipped with drains that limit the maximum water level to a few inches. Magazines are completely enclosed; if flooded, they would be exposed to the full firemain pressure. The firemain pressure on most ships is considerably higher than the pressure that magazine bulkheads could withstand; therefore, magazines are equipped with exhaust ventilators, which are located in the bulkhead near the overhead. An *exhaust ventilator* is a pipe with a check valve that permits pressure release (usually to the topside). Since the diameter of the pipe is large enough to allow water to flow out as fast as it flows in, no excess pressure can build up in the magazine compartment.

Magazines are also equipped with small, capped drainpipes located in the bulkhead near the deck The caps may be removed in the adjacent compartment to drain flooded magazines.

The sprinkler system control valve and associated components vary in complexity with the type of ship, type of stowage, and type of ammunition or missile stowed in the magazine.

PYROTECHNICS

LEARNING OBJECTIVE: Define pyrotechnic. List and explain the different types of pyrotechnics pistols and pyrotechnics used aboard ship. Explain the storage and handling procedures for pyrotechnics.

Pyrotechnic is the Greek word for fireworks. The Navy uses fireworks not for celebration but for illumination, marking, and signaling. An example is the illuminating projectile, or star shell, used to illuminate targets for gunfire. A star shell actually is a pyrotechnic device, although it is encased in a projectile body of standard external shape and is fired from a standard rifled gun.

In the following sections, we discuss the common pyrotechnic devices currently in use on modern Navy surface ships. For further information on these and other pyrotechnic devices used by the Navy, refer to *Pyrotechnic, Screening, Marking, and Countermeasure Devices,* NAVSEA SW050-AB-MMA-010. All the pyrotechnics we study here are intended for signaling and marking. We discuss the following:

- Marine location markers
- Marine illumination signals and the pyrotechnic pistols and projectiles used in firing them

Also, at the end of this section on pyrotechnics, we provide some basic information on the proper handling and storage of these devices.

MARINE LOCATION MARKERS

Marine location markers are used as night or day long-burning reference markings on the ocean's surface. They are dropped over the side from surface ships for man-overboard marking, navigation drills, and other similar operations. These markers may also be dropped from aircraft for search and rescue operations. The two marine location markers currently in use are the Mk 58 and the Mk 6.

Mk 58 Marine Location Marker

The Mk 58 marine location marker is the primary marine location marker found aboard surface vessels. It is approximately 21 1/2 inches long and weighs about 12 3/4 pounds. It contains a battery squib, some starter mix, two pyrotechnic candles, and a transfer fuse between the two candles. Before launching, the tear tape over the water port must be removed so that seawater can enter to activate the battery. Battery current energizes the electric squib, which ignites the starter mix, which, in turn, lights the pyrotechnic candle. When the first candle has burned out (in 20 to 30 minutes), the second candle is started by the transfer fuse, for a total burning time of approximately 40 to 60 minutes. The Mk 58 currently is available in two versions: the Mod 0 and the Mod 1. The Mod 0 is a hermetically sealed can, which is opened with a twist key. Figure 6-5 illustrates this marker. The Mod 1 (fig. 6-6) is capped with a replaceable polyethylene cover.

MK 6 Marine Location Marker

The Mk 6 aircraft smoke and illumination signal (fig. 6-7) is a pyrotechnic device that is launched from surface craft only to produce a day or night floating reference point. One of its principal uses is as a man-overboard marker. It was previously approved for launching from low-performance aircraft as a long-burning marker but has been replaced for this purpose by the Mk 58 marine location marker.

The Mk 6 signal consists of a wooden body with a flat, die-cast metal plate affixed to one end to protect it from water impact damage and to maintain it in the correct floating attitude. There are four flame and smoke emission holes in the opposite end, each capped and

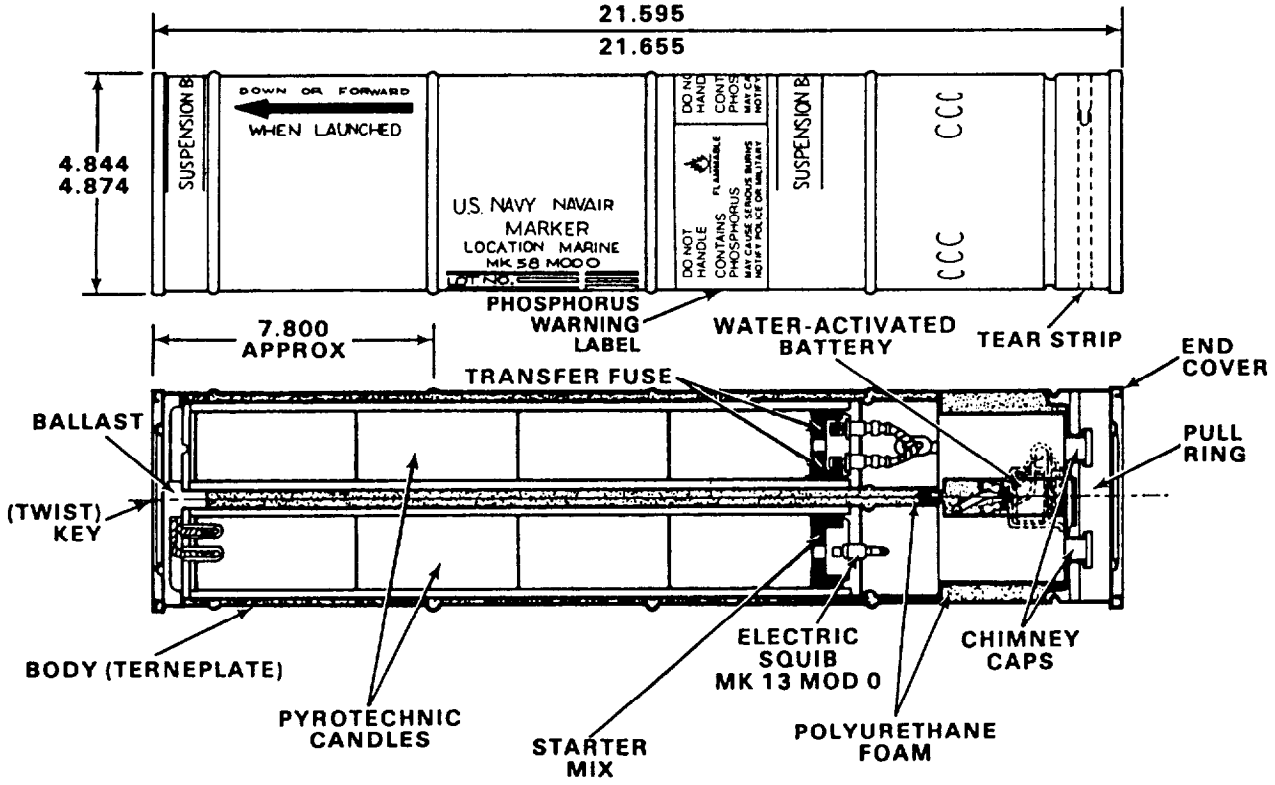


Figure 6-5.–The Mk 58 Mod 0 marine location marker.

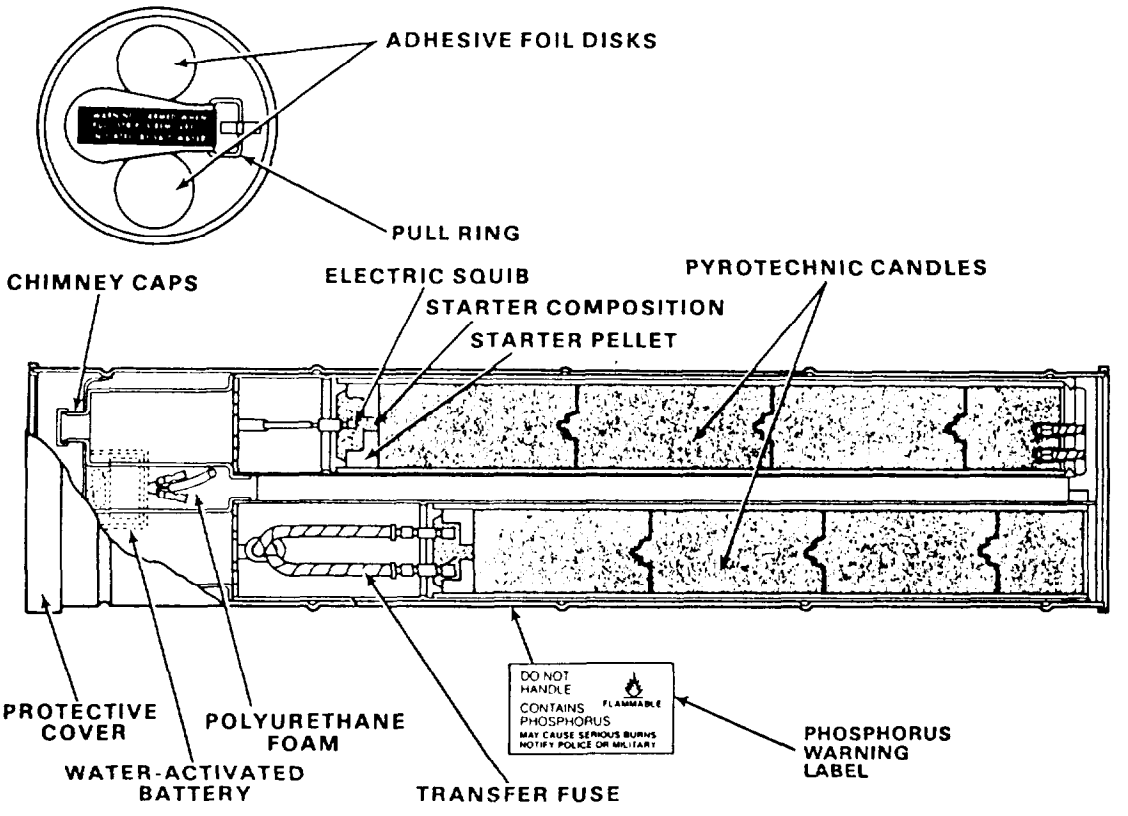


Figure 6-6.–The Mk 58 Mod 1 marine location marker.

sealed with tape. The pull-wire ring, also at the emission end, is also covered with tape.

The Mk 6 signal has a direct-firing ignition system. Ignition results from pulling the pull ring. The pull ring is pulled by hand, and the device is thrown into the water immediately. The pull wire ignites a 90-second delay fuse that ignites the quick match at the top of the first of four candles. The quick match ignites the first candle starting mix, which, in turn, initiates burning of that candle. Expanding gases of combustion force the cap and tape from the emission hole, allowing smoke and flame to be emitted. When the first candle is nearly burned out, a transfer fuse carries the ignition to the quick match of the next candle in series. This process continues until all four candles have burned. The yellow flame and gray-white smoke are produced for at least 40 minutes.

After the tear-strip on the shipping container has been removed, the following rules apply:

1. The tape over the pull ring should not be disturbed until immediately before hand-launching the signal. This tape not only prevents an accidental pull on the pull ring but also protects the igniter assembly from moisture, which might render the signal useless.

WARNING

This signal is initiated by the physical movement of a friction wire through ignition compound. Extreme care must be taken to prevent tension of the pull ring during all handling operations.

2. If this device is prepared for launching and is not launched, the pull ring should be securely retaped into position at the top of the signal without exerting any pulling force on the pull-wire igniter.

3. Under no circumstances should these signals be stowed or restowed with their pull rings exposed or with any wires, strings, or other material of any kind joined to their pull rings.

All safety precautions pertaining to this signal must be observed. In addition, the following specific rules apply:

- Do not remove the tape over the pull ring until immediately before launching.

- The Mk 6 signal should be thrown over the side immediately after pulling the pull ring. This device

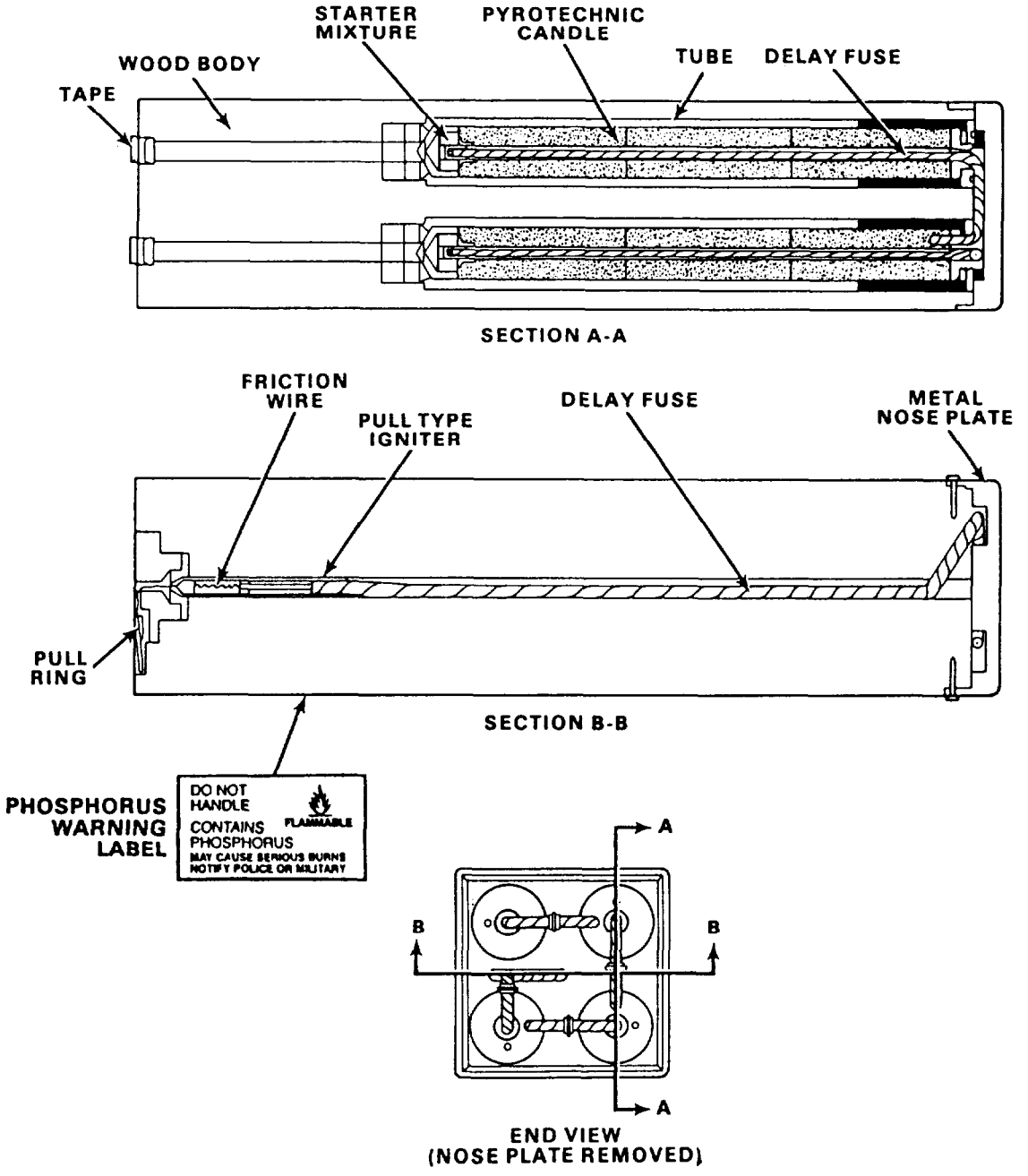


Figure 6-7.–The Mk 6 Mod 3 marine location marker.

contains a maximum 90-second delay element between initiation and candle ignition.

- In all handling, extreme care should be taken to avoid pulling on the pull ring. The slightest movement of the friction igniter may start the ignition train.

The Mk 6 Marine Location Marker is being replaced by the Mk 58. There are, however, remaining serviceable stocks of the Mk 6 available. If you have any of these markers in your inventory, they should be used first. Man-overboard and navigation drills are good instances where these stocks can be efficiently expended.

MARINE ILLUMINATION AND SMOKE SIGNALS AND PYROTECHNIC PISTOLS

Marine illumination signals are similar in appearance to a standard shotgun cartridge. When fired from the proper pistol or projector, a burning star (somewhat like a star from a roman candle) shoots high into the air. In this section, we describe the marine illumination and

smoke signals and pyrotechnic pistols currently in use. These include the

Mk 2 marine illumination signal,

Mk 5 pyrotechnic pistol,

AN-M37A2 through AN-M39A2 series, double-star illumination signal,

Mk 1 marine illumination signal, and

the AN-M8 pyrotechnic pistol.

MK 2 Marine Illumination Signals

The Mk 2 marine illumination signal is available in three colors: red, green, and white. Each cartridge has a percussion primer and a propelling or expelling charge of 10 grains of black powder, which projects the burning star to a height of about 200 feet. The star charge is a tightly packed cylinder wrapped with a quick match (a fast-burning fuse), which ignites it when fired. The star charge is separated from the expelling charge by a shock-absorbing wad of hard felt. The cartridge is closed by a wad that is so marked that the color of the star can be determined at night by feeling the wad, as shown in figure 6-8.

The red star may be identified by its corrugated closing wad; the green star has a smooth closing wad; and the white has a small conical boss on its closing wad. Each of the three colors may also be identified by the corresponding color of the paper on the cartridge.

The burning time for each of the stars is approximately 6 seconds.

The illumination signals are available in 10-round metal or cardboard containers. The containers are packaged in wooden boxes that hold 40, 45, or 100 containers.

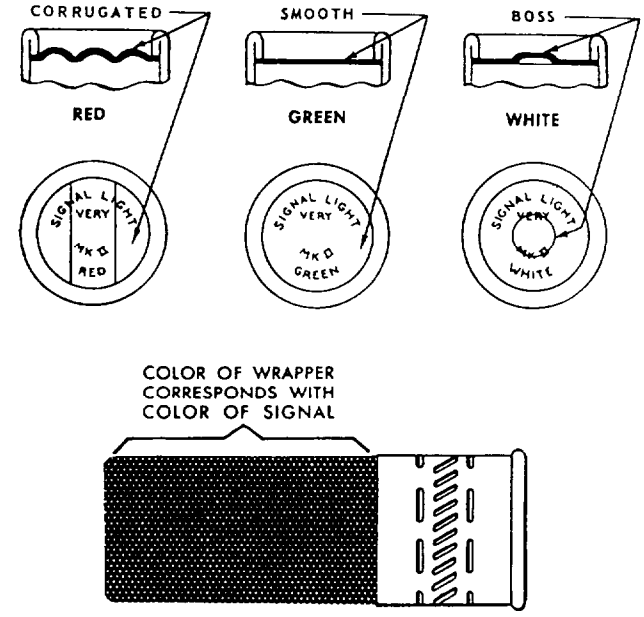


Figure 6-8.–The Mk 2 marine illumination signal.

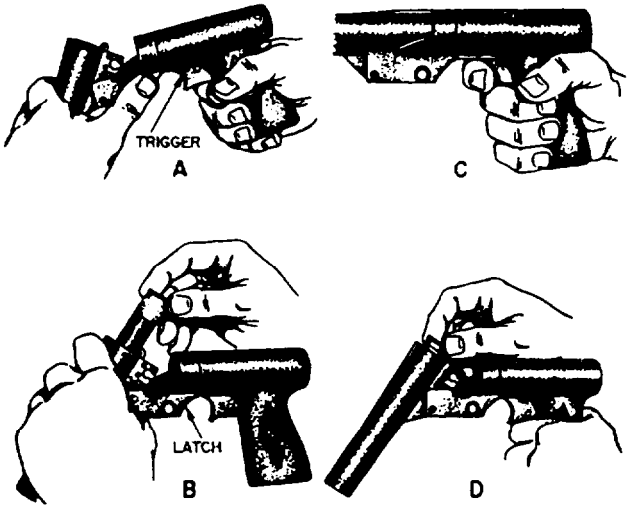


Figure 6-9.–Operation of the Mk 5 pyrotechnic pistol.

Mk 5 Pyrotechnic Pistol

Marine illumination signals are fired from the Mk 5 pyrotechnic pistol. This pistol is a breech-loaded, double-action, single-shot device, 11 inches long. Metal parts are mounted on a plastic frame. The operating instructions for the Mk 5 pistol are as follows:

1. To load the pistol, depress the latch button below the barrel. At the same time, pull the barrel downward, as in view A of figure 6-9. Insert the signal shell (view B). Push the barrel upward until it latches closed. The pistol is now ready to fire.

2. To fire the pistol, aim it upward at the desired angle, normally 60 degrees, but clear of other ships or personnel. Bull the trigger, as shown in figure 6-9, view C. Keep your elbow slightly bent when firing, to absorb the shock of recoil and to prevent the pistol from knocking itself out of your hand.

3. To extract the expended shell, break the pistol open again (view A), and pull the shell out of the chamber (view D).

WARNING

The pyrotechnic pistol is cocked at all times when the breech is closed; it has no positive safety mechanism. Illumination signals must NOT BE LOADED in the pistol until just before use. Unfired signals must NOT be left in the pistol.

The Mk 5 pistol must be kept in serviceable condition at all times. Clean it thoroughly after each use in accordance with the procedure prescribed on the appropriate 3-M System maintenance requirement card (MRC).

When loading or firing a pyrotechnic pistol, NEVER point it in the direction of other personnel or vessels.

NEVER use the Mk 5 pistol with ammunition other than that authorized for use with it. Conversely, illumination signals should never be fired from shotguns or from projectors other than those authorized.

PYROTECHNIC SAFETY HANDLING AND STORAGE

The following general information is taken directly from *Pyrotechnic, Screening, Marking, and Countermeasure Devices,* NAVSEA SW050-AB-MMA-010, chapter 1.

Pyrotechnic Safety

"All pyrotechnic and screening devices, while designed and tested to be safe under normal conditions, can be subject to accidental ignition because of a wide variety of circumstances. The general rule to follow is: Be constantly aware that pyrotechnics contain chemical components that are intended to burn with intense heat, and act accordingly."

Pyrotechnic Handling and Storage

All pyrotechnics and smoke-screening devices are designed to withstand normal handling. They should, however, be handled as little as possible to lessen the chances of damage, which might cause accidental ignition or leakage. Many devices contain materials of a dangerous nature and are therefore designed with safety features, which should be maintained in good operating condition. Dents, deformations, or cracks in the outer body may interfere with the proper functioning of these safety features or might cause ignition during handling or storage. It is therefore imperative that extreme care be taken to prevent damage to containers of pyrotechnics and screening devices, and to the devices themselves.

Effect of Moisture on Pyrotechnics

The proper functioning of pyrotechnic, dye-marking, and screening devices is frequently affected by moisture. Some compositions may become more sensitive and dangerous when exposed to moisture, while others tend to become difficult to ignite and less dependable in operation. Care should be exercised to prevent damage that would interfere with seals because some screening devices produce their smoke by reaction of their chemical contents with moisture in the air. Also, bear in mind that some marine location markers, such as the Mk 58, are saltwater-activated, and should be stored with that in mind. That fact should also be considered in emergency situations where the markers could be inadvertently exposed to fire-fighting water or runoff.

Effect of Temperature on Pyrotechnics

Pyrotechnics and some screening devices may become adversely affected by excessively high or variable temperatures. These devices should never be stored where direct rays of the sun could generate excessively high temperature. Storage should be in dry, well-ventilated places that provide the greatest possible protection from such conditions. All Navy pyrotechnics have been designed to withstand temperatures from -65°F to 160°F and, therefore, will probably be safe from deterioration or damage within that range. However, it is recommended that every reasonable effort be made to maintain storage temperature at not more than 100°F. (Specific ammunition storage temperature requirements are addressed in chapter 2 of this manual.)

Toxic Hazards of Pyrotechnics

Many chemicals used in pyrotechnics, screening equipment, and dye-marking devices are poisonous if taken internally. This also applies to the residue of burned pyrotechnics. From the inhalation standpoint, the products of pyrotechnic devices and smoke generators often present a serious problem. Many of the smokes and fumes given off by pyrotechnics and screening devices are considered non-toxic and only mildly irritating to the eyes and nasal passages when encountered in relatively light concentrations out of

doors. Heavy concentrations in closely confined spaces, however, are dangerous and may be lethal because they reduce the amount of oxygen in the air. Anything more than a brief exposure to the gases of combustion, or to screening smokes, should be avoided or should be protected against through the use of an appropriate breathing apparatus.

ORDNANCE HANDLING SAFETY

LEARNING OBJECTIVES: Recognize safety precautions, practices, and principles applicable for the handling of ordnance. List general ammunition safety precautions. List and define standard commands for gun crews.

The utmost care and prudence must be exercised in supervising the handling, inspecting, preparing, assembling, and transporting of all types of ammunition. People tend to become careless and indifferent when continually engaged in work with explosives and, as long as nothing occurs, are inclined to drift gradually into neglecting the necessary precautions. Nothing but constant vigilance on the part of the all concerned will ensure the steadfast observance of the rules and regulations that experience has taught are necessary.

Safety is everyone's responsibility. Awareness of danger, knowledge of how danger can be avoided, and constant vigilance are the three basic requirements to prevent accidents when working with explosives. If a thorough understanding of the basic ideas behind the precautions is developed, unsafe conditions can be recognized and corrected and further suitable action taken instinctively when the unexpected occurs. Safety precautions pertaining to the handling of and working with explosives may be found in OP 4, *Ammunition Afloat;* OP 1014, *Ordnance Safety Precautions, Their Origin and Necessity;* and OP 3347, *United States Ordnance Safety Precautions.*

Safety precautions, rules, and regulations for handling explosives should be made the subject of frequent review, and the necessity for strict compliance with these precautions should be firmly fixed in the minds and habits of all hands involved in handling explosives so that they will react in an emergency to the instruction previously received.

Note that in the early stages of the use of explosives, experience was gamed at a great price–not only in dollars, but in human lives. No relaxation should be tolerated, since this tends to create the impression that the rules are arbitrary.

All personnel assigned to handle ammunition or gunnery equipment should receive a thorough indoctrination from a qualified chief petty officer or petty officer regarding the general safety precautions and procedures to be followed in the course of their duties. This indoctrination is MANDATORY before ANY weapons-handling/firing evolution.

Periodic drills should be conducted to provide realistic training and to identify and/or eliminate any unsafe practices. Inexperienced personnel will constantly be under the direct supervision of skilled and experienced personnel until adequate experience is acquired.

Because of the nature of gunnery and ammunition, safety precautions should be of extreme importance to every Seaman. Compliance with all safety procedures will ensure a safe ammunition transfer.

The following general safety precautions concerning gunnery and ammunition should be of extreme importance to every Seaman:

Ammunition should ALWAYS be handled carefully and ONLY when necessary.

The proper way to handle ammunition is to hold the base of the projectile downward with one hand covering the base, while supporting the top of the round up at a 45° angle and cradling the top, like a baby, in the elbow.

Smoking is prohibited in magazines and any area containing explosives or ammunition, as well as in the vicinity of handling or loading operations involving ammunition.

Naked lights, matches, lighters or other spark-, flame-, or heat-producing devices should NEVER be taken or stowed near magazines or any other area where explosives are present.

Unauthorized personnel should not be permitted in magazines or in the vicinity of handling operations involving explosives or ammunition.

Personnel assigned to gunnery stations during general quarters should ALWAYS know the type of ammunition being handled.

Ammunition handlers should wear appropriate clothing and safety shoes. Ammunition handlers should never wear keys, gloves, rings, watches, or headgear when handling ammunition. Belt buckles should be turned inside or be removed to avoid the possibility of striking a primer on a projectile.

Fire hoses should be laid out and charged before handling weapons as well as gunnery exercises, and repair lockers should be manned and ready as appropriate.

When guns are trained or elevated, an audible warning alarm is sounded from within the gun enclosure. All hands should stand outside the train warning circle.

No ammunition or explosive assembly may be used in any gun system for which it is not designed.

Powder cans and bags must always be in perfect condition.

Care must be taken to avoid obliterating identification marks on ammunition or putting it into incorrectly marked containers.

Smokeless powder must never be exposed to the direct rays of the sun. Powder in bulk, tanks, cartridge cases, ammunition boxes, and other containers must be protected against high temperature.

Smokeless powder, when wet, must be regarded as dangerous for dry storage and must be kept immersed completely in freshwater. It must be turned in at an ammunition depot at the first chance or dumped overboard.

Before any work that may cause either an abnormally high temperature or an intense local heat in a magazine is started, all explosives must be removed to safe storage until normal conditions are restored.

Pyrotechnic material must always be kept by itself in regular pyrotechnic lockers or storage spaces.

Black powder, which is most dangerous, must always be kept by itself. Containers of black powder must never be opened in a magazine or adjacent to other explosives.

Projectiles must not be altered, nor may fuzes or other parts be removed from them on board ship without instructions from higher authority.

A fuzed projectile or a cartridge case, whether in a container or not, if dropped from a height exceeding 5 feet, must be set aside and turned in at an ammunition depot as soon as possible. Such ammunition must be handled with the greatest care.

Service ammunition is never used for drill; only drill ammunition may be used.

Certain fuzes armed by setback may explode accidentally by tapping or jarring. Extreme care must be taken to avoid dropping them.

Care must be taken that nose fuzes are not struck (as by the gun in recoil).

Time fuzes that have been set must be reset on SAFE before storing below.

GUN MOUNTS

LEARNING OBJECTIVES: Define gun mount. Identify the different components of a gun mount.

A gun mount is the supporting structure assembly and operating device for one or several guns. The mounts may be open, or enclosed in a shield. Each mount is assembled as a unit by the manufacturer, then hoisted on board ship and bolted in place.

Modern gun mounts have been effectively developed to meet the threat of all types of targets. They comprise an entire system of gun-supporting parts that enable them to rapidly load, position, and fire their projectiles with such speed and accuracy that they have become the backbone of the U.S. Navy's support forces.

Every gun system includes equipment used for gun positioning, loading, and firing. Loading equipment varies greatly in design from gun to gun, but its purpose remains the same–to load a complete round in the gun chamber for firing. We will describe the various loading systems later in this chapter. The greatest similarities from one gun to the next are found in the positioning and firing components, which we will now describe.

POSITIONING EQUIPMENT

Positioning equipment includes all the machinery used to support and move the gun tube to the desired train (horizontal) and elevation (vertical) angle. Positioning equipment includes the stand, base ring, trunnions, carriage, and slide, (fig. 6-10).

Stand

The stand is a steel ring bolted to the deck; it serves as a foundation and rotating surface for movement in train. The stand contains both the train beatings and the training circle. The training circle is a stationary internal gear that the train drive pinion walks around to move the gun in train.

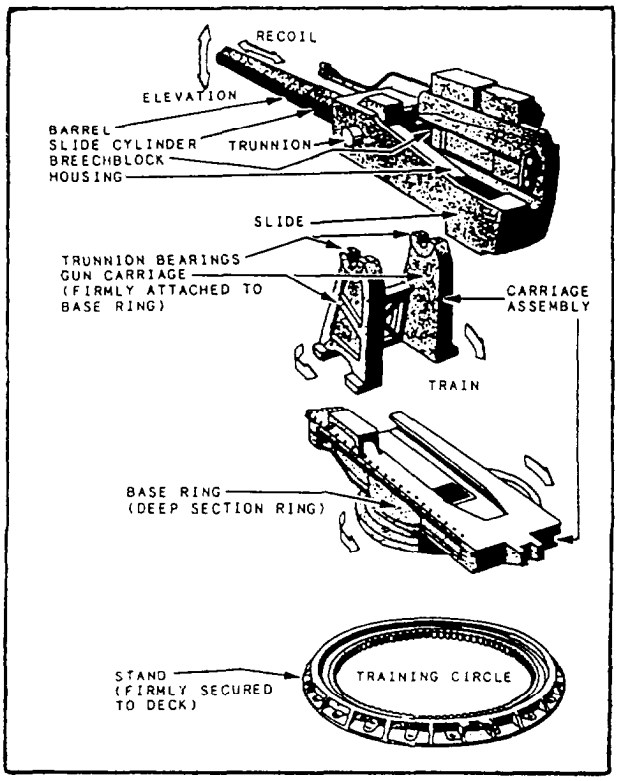


Figure 6-10.–Gun-positioning equipment.

Base Ring

The base ring is also called the lower carriage. It is the rotating platform, supported by the stand, and supports the upper carriage.

Gun Carriage and Trunnion Bearing

The gun carriage is also called the upper carriage. It is a massive pair of brackets that holds the trunnion bearings. The trunnion bearings support the trunnions, which are part of the slide; together they form the elevation pivot point.

Slide

The slide is a rectangular weldment that supports all of the elevating parts of the gun.

FIRING EQUIPMENT

Firing equipment includes all the components necessary to allow the gun to safely fire, absorb the shock of recoil, and reposition for further firing. This includes the housing, breechblock, recoil, counter-recoil systems, firing circuits, and firing cutouts.

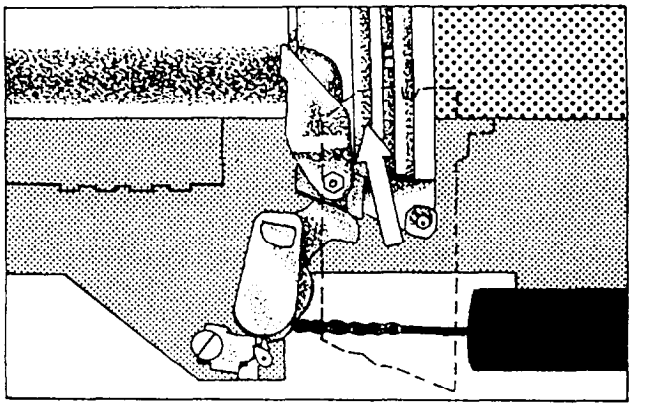


Figure 6-11.–The sliding-wedge breechblock.

Housing

The housing is a large steel casement in which the barrel and breechblock are fitted. The housing moves in recoil inside the slide.

Breechblock

The breechblock seals the breech end of the barrel. The sliding-wedge-type breechblock (fig. 6-11) consists of a machined steel plug that slides in a grooved way in the housing to cover the breech opening. The grooves are slanted so that the breechblock moves forward as it covers the back of the casing, edging it in place. All guns currently use the sliding-wedge-type breechblock.

Recoil System

Normally, a recoil system (fig. 6-12) consists of two stationary pistons attached to the slide, set in a liquid-filled cylinder in the housing. As the housing moves rearward in recoil, the trapped liquid is forced around the piston head through metered orifices, slowing the movement of the housing.

Counterrecoil System

A counterrecoil system consists of a piston (or pistons) set in a pressurized cylinder. As the gun recoils, the piston protrudes further into the cylinder. After the force of recoil is spent, the air pressure, acting against the piston, pushes the housing back into the battery (the full forward position). The piston may be attached to the slide, allowing the cylinder (which is machined into the housing) to slide over it during recoil (fig. 6-13). Later guns use two free-floating pistons set in an air chamber mounted to the inside of the slide (fig. 6-14). Air pressure

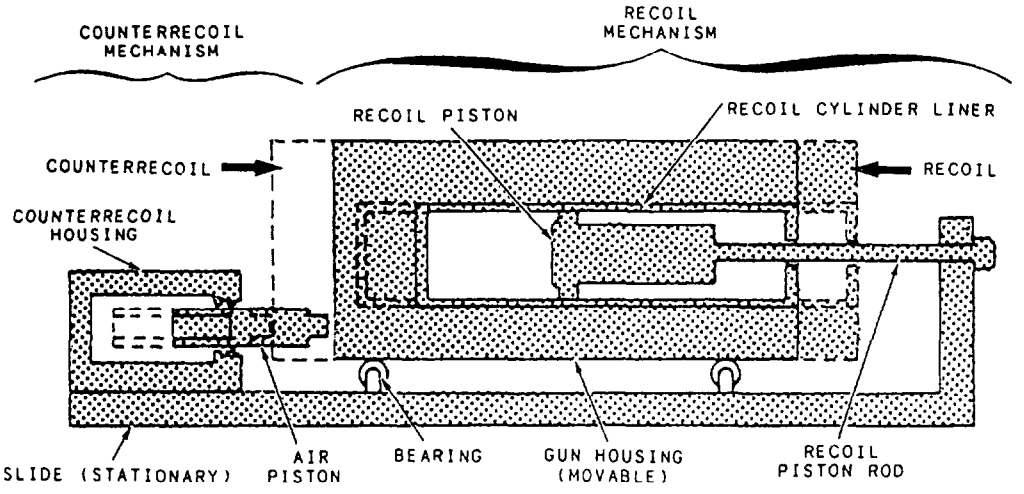


Figure 6-12.–Recoil and counterrecoil system.

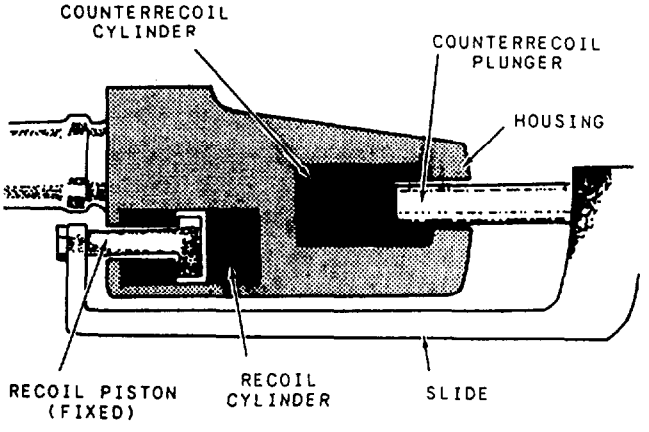


Figure 6-13.–A basic recoil and counterrecoil system.

holds the pistons against the back of the housing, and forces them into the stationary chamber during recoil.

Since the air pressure in the counterrecoil system is the only thing holding the gun in battery, all guns are equipped with a safety link. The safety link physically attaches the housing to the slide to prevent it from moving if system pressure is lost. The safety link is disconnected prior to firing.

Firing Circuits

Basically, a firing circuit supplies firing voltage to the propelling charge primer. This sounds simple, but the application can be quite complicated. For a safe

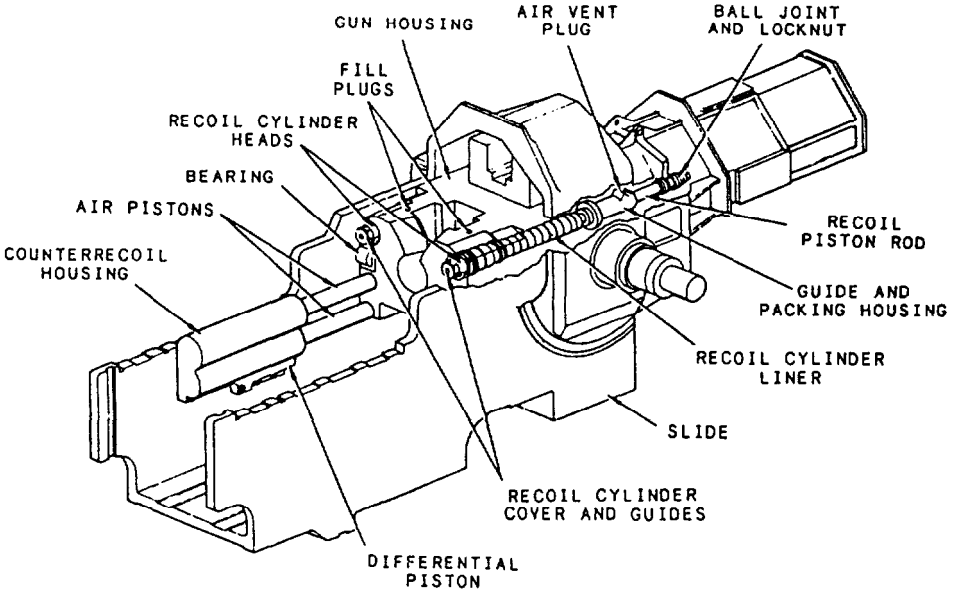


Figure 6-14.–5"/54 Mk 42 recoil and counterrecoil system.

evolution, certain conditions must exist prior to firing. Making sure that the gun is pointed in a safe direction, that all the loading equipment is in the fire position (out of the way of recoiling parts), and that the breechblock is all the way closed are just a few of the obvious things that must be correct before firing. A typical electronic firing circuit includes inputs that monitor these and many other conditions, allowing firing voltage to pass only after all safety conditions have been satisfied.

Firing Cutouts

A firing cutout mechanism interrupts firing when the gun is pointed at or near the ship's permanent structure. A firing cutout is a mechanical device that monitors gun position.

The components we have just described are common to all guns. We will now discuss the individual gun systems in the fleet today, paying particular attention to the loading system in each one.

GUN SYSTEMS

LEARNING OBJECTIVES: List and explain the different gun mounts used aboard ship. Explain crew position and responsibilities and loading sequence when operating gun mounts.

As you read this section and study the illustrations, note the different configurations of machinery designed to accomplish the same task from one gun to the next. When we are speaking of gun equipment, all directional nomenclature (left, right, front, back) is relative to the muzzle of the gun (the end of the barrel from which the projectile exits when fired); the muzzle is to the front as you stand inside the gunhouse.

5"/54 MK 42 GUN

In the 1950s as potential targets became faster and more sophisticated, a gun with more range and a faster rate of fire was needed. The 5"/54 Mk 42 was developed to effectively engage these targets as well as shore targets. Several versions of the Mk 42 gun have seen service since then. In the fleet today, you will find only the Mod 9 and the Mod 10; all others have been retired. The two versions are identical in many respects. The differences will be pointed out at the end of this section.

The 5"/54 Mk 42 is an automatic, dual-purpose gun mount. It can be controlled either remotely from a fire control system, usually the Mk 68 GFCS, or locally from the mount at the One Man Control (OMC) station. The normal mode of operation is the remote mode. The mount fires an average 70-pound projectile up to 26,000 yards with a 48,000-foot ceiling. The gun, with its automatic loading system, has a rate of fire of 34 rounds per minute.

As you will see, the loading system is actually two almost separate systems, left and right. The ammunition carrier and the hydraulic power drive units are the only components shared by both sides. The advantage of having separate systems is readily apparent. In the event of a casualty, you can isolate the affected side and continue to fire at 17 rounds per minute from the other side.

We will now describe the major components of the mount as we walk through a loading cycle.

Figure 6-15 illustrates the major components of the 5"/54 Mk 42 gun. The gun is operated by the mount captain from the EP2 panel. Electrical power is supplied to the gun through the EP1 panel. Both the EP1 and EP2 panels are located in the compartment directly under the mount, along with the lower hoist power drive, ammunition carrier, and upper hoists. This compartment is commonly called the carrier room. Inside the gun mount, there are two manned positions: the gun captain and the OMC operator. The gun captain has the responsibility of monitoring the operation of the gun and relaying bore reports (whether or not the gun bore is clear) after each round or salvo is fired. The OMC operator functions as a check sight observer during normal firing. As check sight observer, he uses the telescopic sight to ensure that the gun is trained on the intended target. He then reports *CHECK SIGHT ON TARGET*. The loader drums, located in the projectile magazine, are served by the magazine crew. The magazine crew is made up of Seamen from various divisions of the ship. You may be assigned to this station. Here, you will remove propelling charges and projectiles from their storage bins and load them into the loader drums at the command of the mount captain. Some individuals from the magazine crew also serve as members of the *hot gun* clearing team. The responsibilities of this team will be described later in this chapter.

When a remote order is received, the mount captain gives control of gun train, elevation, and firing circuit to the fire control system. When ordered to fire, the mount captain initiates the loading cycle by pressing the RAM ONCE or the RAM CONTINUOUS button on the EP2 panel. RAM ONCE allows one round to be loaded and fired. RAM CONTINUOUS allows the gun to continue firing until it is empty or ordered to stop by

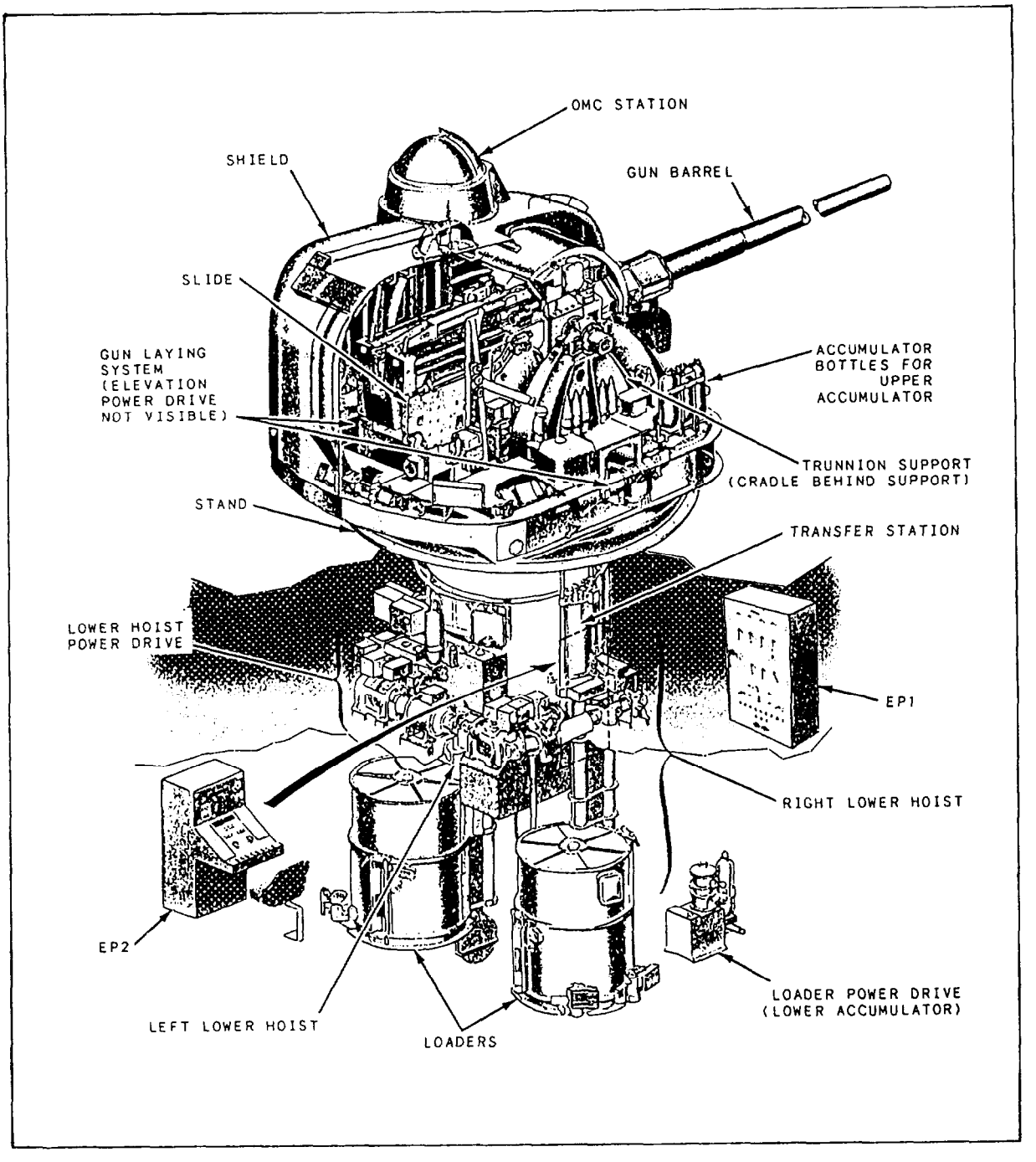


Figure 6-15.–Major components of the 5"/54 Mk 42 (Mod 10 shown).

the mount captain, who presses the OFF button. In both instances, the rounds are fired using firing voltage supplied from the fire control system. When firing is controlled from the OMC station, the operator supplies all the inputs normally received from the fire control system. The operator positions the mount with the OMC unit, while aiming with the telescopic sight, then fires the gun using his/her own firing key. Note that the mount captain has to physically give control of the mount to the intended operator.

5"/54 MK 45 GUN

The 5"/54 Mk 45 gun, developed in the early 1970s, is the newest of the 5" guns in the fleet today. It is found aboard the DD-963, DDG-51, LHA-1, and CG-47 class

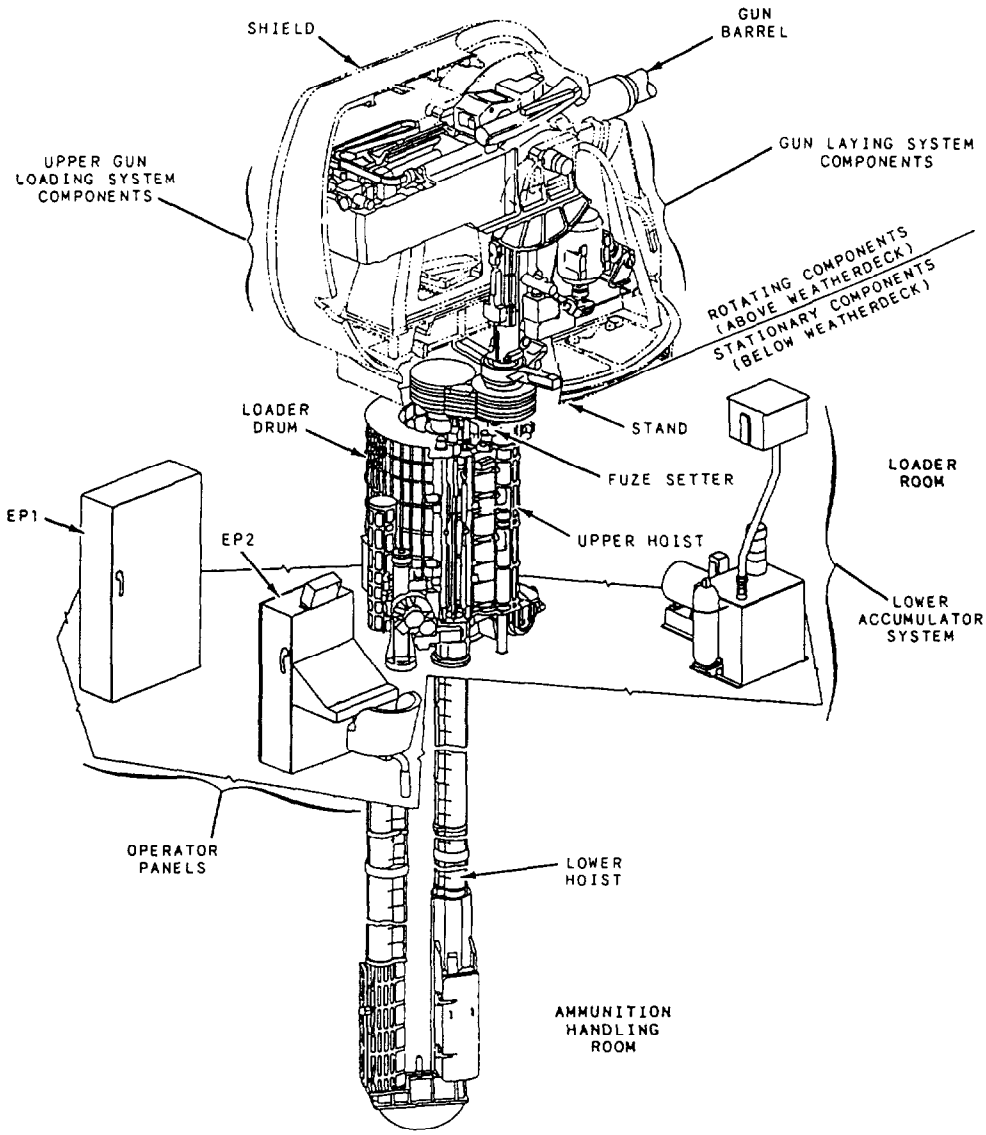


Figure 6-16.–The 5"/54 Mk 45 Mod 0, general arrangement.

ships. The Mk 45 (fig. 6-16) is a fully automatic, dual-purpose, lightweight gun mount capable of firing the full range of 5"/54 projectiles, including rocket-assisted projectiles (RAPs), at a rate of 17 to 20 rounds per minute. During normal operation the loading system (fig. 6-17), like the Mk 42, is operated locally by the mount captain; the gun laying, fuze setting, and firing orders are generated by the FCS. The gun may be positioned locally from the EP2 panel for maintenance only.

The only manned positions on the Mk 45 gun during normal operations are the mount captain, who operates the gun from the EP2 panel, and the loader room crew. The gun mount itself, unlike the Mk 42, is unmanned. There is no local firing position, as with the Mk 42 OMC. The mount power distribution panel, EP1, is also the mount captain's responsibility.

The loader drum holds a total of 20 complete rounds of ammunition. Before an operation, the loader crew will load the drum, through the lower hoist, with 20 rounds of one type of ammunition. If during the operation another type of round is desired, the mount captain, using local controls, can allow the system to operate under alternate loading. This mode allows the loaders to hand-feed the different types of ammunition into the loading system, which automatically transfers only these rounds to the breech for firing. Depending upon the tactical situation, the loader crew may be required to load several different types of ammunition in a short time. The loader crew must, therefore, be able

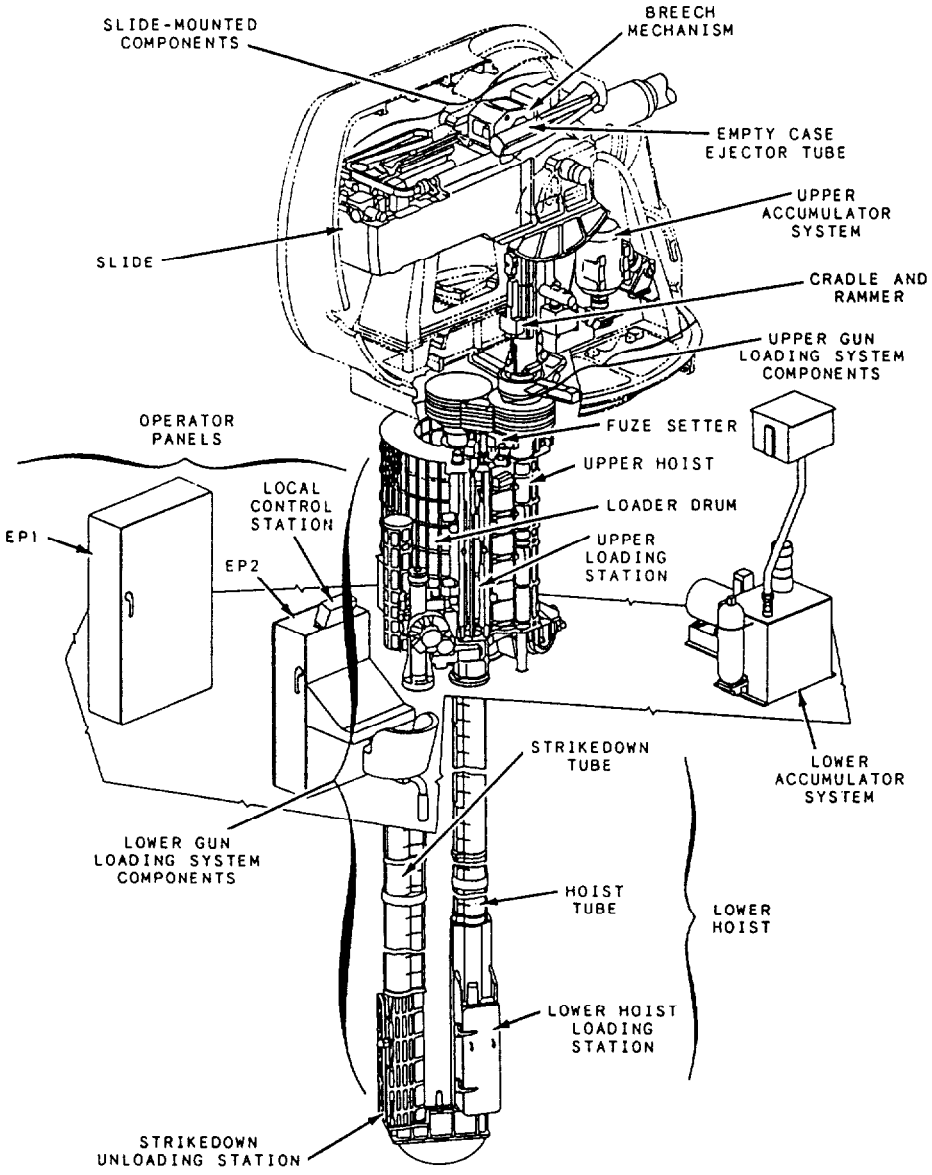


Figure 6-17.–The 5"/54 Mk 45 gun loading system, major components.

to quickly and accurately identify the various ammunition types.

76-MM MK 75 GUN

The Mk 75 gun (fig. 6-18) is a fully automated, remotely controlled gun mount that stows, aims, and fires 76-mm 62-caliber ammunition. The 76-mm system, along with the Mk 92 GFCS, is currently aboard FFG-7- and PHM-class ships. The design of the gun mount makes extensive use of lightweight corrosion-resistant alloys and modern engineering techniques. The result is a lightweight, compact, fast-firing, versatile weapon. It is primarily a defensive weapon, used to destroy antiship cruise missiles. However, it can also be used effectively against surface and shore targets. The gun has a variable rate of fire of up to 80 rounds per minute with a range of up to 16,459 meters and a maximum altitude of 11,519 meters. The most notable innovation featured on this system is the automatic barrel cooling system. This cooling system allows sustained operation at high rates of fire without excessive barrel wear or the danger of a cookoff if a misfire occurs.

The Mk 75 gun fires a somewhat limited variety of ammunition types. The types of ammunition currently available include point detonating (PD), infrared (IR), radio frequency (RF), and blind-loaded and plugged (BL&P).

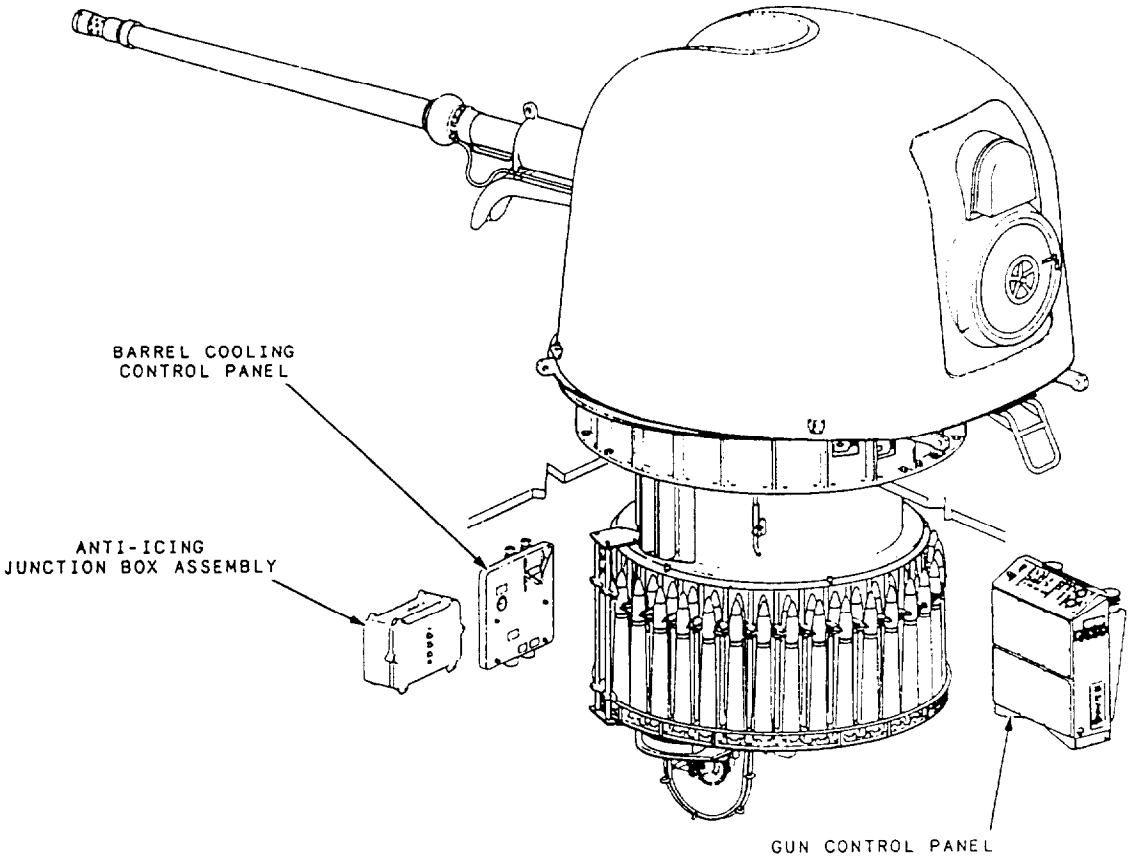


Figure 6-18.–The Mk 75 gun system, general configuration.

The gun mount crew consists of the mount captain, two loaders, and the safety observer.

The mount captain is stationed in the ammunition-handling room at the gun control panel (GCP). It is the mount captain's responsibility to set the gun up for the desired mode of operation, then monitor it, in case of a malfunction. In case of a malfunction or misfire, the mount captain supervises and directs the corrective action.

The two loaders are stationed in the ammunition-handling room during loading and unloading operations. Their primary duties are to load and unload the gun, clear misfires, and assist in corrective maintenance. Although the actual loaders may be Gunner's Mates (GMGs), you may be stationed in the handling room to assist in breaking out the ammunition for loading.

The safety observer is stationed topside, near the gun. It is the responsibility of the safety observer to monitor the gun and the area around the gun for any unsafe condition. The safety observer is in direct contact with the mount captain.

HOT-GUN CREW

LEARNING OBJECTIVE: Define the duties of a hot-gun crew.

As is true of all mechanical devices, guns, too, are susceptible to malfunctions. In the case of a gun system, however, you are also dealing with large quantities of propellant and high explosives. When a gun misfires, either the casualty must be corrected quickly or the round removed from the gun chamber and disposed of over the side. A *hot gun* is a gun that has fired a sufficient number of rounds in a defined period of time and reaches a temperature that could *cook off* the round in the chamber. And should the gun misfire while in the hot-gun condition, clearing the gun quickly becomes a very high priority. An inbore explosion is a catastrophic event and should be avoided at all cost.

As a member of the hot-gun clearing crew, you will assist the Gunner's Mates in clearing the misfired round from the gun. They will actually remove the round from

the chamber and pass it out to a member of the team for disposal over the side. While this is occurring, team members may be called upon to set up fire hoses with special attachments for internal and external gun cooling. External cooling will normally begin immediately after a misfire. Internal cooling can only be started after the propelling charge has been removed. These procedures are directed by the mount captain.

External cooling directs cooling water to the outside of the gun barrel through a standard fire nozzle configured to be attached to the barrel. Internal cooling uses a special applicator, which is inserted into the gun barrel, to directly cool the inside of the barrel and projectile.

Another similar task for magazine crew members is to assist in the disposal of leaking white phosphorous projectiles. Both tasks require regular training and practice. Since the procedure for the disposal of leaking white phosphorous projectiles is subjected to regular revision, this procedure will not be discussed here.

All hands aboard ship should become familiar with certain standard gunnery commands. All gun and magazine crew members, however, need to become especially familiar with these commands. Like the gun crew, the magazine crew must operate as a smooth, safe machine.

NOW MAN ALL GUNNERY STATIONS is the command used to direct gun and magazine crew personnel to "Lay to assigned stations; get in battle dress; and make preparations to service gun(s) for action."

Other standard gunnery commands, along with the proper interpretation, are as follows:

LOAD—Ammunition handlers in magazine crews fill projectile hoists or mechanisms with prescribed ammunition.

COMMENCE FIRING—This is a command from gunfire control indicating that firing of designated gun(s) is authorized.

CHECK FIRE—A gong or siren is sounded and all guns immediately stop firing.

RESUME FIRING—Gunfire control orders firing to start again. This command is given AFTER a CHECK FIRE.

CEASE FIRE—All guns stop firing immediately upon receipt of this command. A gong or siren is sounded. Gun captains automatically report to gunfire control on the condition of the gun bore, the number of rounds fired and the number of casualties, if any. An example would be "Mount 51 bore clear, 10 rounds expended, no apparent casualties."

SILENCE—Any member of the gun crew or magazine crew who observes a serious casualty or dangerous condition requiring immediate attention for safety reasons will sound off "SILENCE."

All personnel hearing this command freeze in position until further orders or CARRY ON is heard. The senior person at the scene will take charge and remedy the unsafe condition.

SUMMARY

In this chapter, we discussed today's naval gun systems and the type of ammunition used by each. This basic knowledge should enable you to perform as an integral member of a gun or magazine crew. This manual should help you in your at-sea experiences and, together with practical experience gained over a period of time, provide the necessary guidance you will need to become a top-notch Seaman. Your time at sea should be both challenging and rewarding.