

CHAPTER 2

AIRCRAFT ROCKETS AND ROCKET LAUNCHERS

The history of rockets covers a span of eight centuries, but their use in aircraft armament began during World War II. Rockets answered the need for a large weapon that could be fired without recoil from an aircraft.

Since the airborne rocket is usually launched at close range and measured in yards or meters, its accuracy as a propelled projectile is higher than a free-falling bomb dropped from high altitude.

AIRCRAFT ROCKETS

LEARNING OBJECTIVE: *State the principles of rocket propulsion. Identify rocket components to include motors, warheads, and fuzes. Identify the purpose and use of service rocket assemblies to include the 2.75-inch folding-fin aircraft rocket (FFAR), the low-spin folding-fin aircraft rocket (LSFFAR), and the 5.00-inch FFAR.*

There are two rockets currently used by the Navy. The first is the 2.75-inch, folding-fin aircraft rocket (FFAR) known as the Mighty Mouse. The second, a 5.0-inch, folding-fin rocket known as the Zuni. The Mighty Mouse and the Zuni are discussed in detail later in this chapter.

ROCKET AND ROCKET FUZE TERMINOLOGY

Some of the more common terms peculiar to rockets and rocket components used in this chapter are defined as follows:

Acceleration/deceleration. These terms apply to fuzes that use a gear-timing device in conjunction with the setback principle. Prolonged acceleration completes arming the fuze, and deceleration or proximity initiates detonation.

Igniter. The initiating device that ignites the propellant grain. It is usually an assembly consisting of an electric squib, match composition, black powder, and magnesium powder.

Hangfire. A misfire that later fires from delayed ignition.

Misfire. A rocket does not fire when the firing circuit is energized.

Motor. The propulsive component of a rocket. It consists of the propellant, the igniter, and the nozzle(s).

Propellant grain. The solid fuel used in a rocket motor, which, upon burning, generates a volume of hot gases that stream from the nozzle and propel the rocket (also known as the propellant or propellant powder grain).

Rocket. A weapon propelled by the sustained reaction of a discharging jet of gas against the container of gas.

Setback. This term is applied when internal parts react to the acceleration of the rocket. Setback is a safety feature designed into those fuzes that use a gear-timing device.

Thrust. The force exerted by the gases produced by the burning of the rocket motor propellant.

PRINCIPLES OF ROCKET PROPULSION

Rockets are propelled by the rearward expulsion of expanding gases from the nozzle of the motor. Burning a mass of propellant at high pressure inside the motor tube produces the necessary gas forces. Rockets function in an even vacuum. The propellant contains its own oxidizers to provide the necessary oxygen during burning.

As you read this section, refer to figure 2-1. To understand how a rocket operates, visualize a closed container that contains a gas under pressure. The pressure of the gas against all the interior surfaces is equal (view A). If the right end of the container is removed (view B), the pressure against the left end will cause the container to move to the left.

In the rocket motor, gases produced by the burning propellant are confined to permit a buildup of pressure to sustain a driving force. A Venturi-type nozzle (view C) restricts the size of the opening. The Venturi-type nozzle decreases the turbulence of escaping gases and increases the thrust. In this design, gas pressure inside the container provides about 70 percent of the force, and the escaping gases provide about 30 percent of the force necessary to move the container forward.

ROCKET COMPONENTS

A complete round of service rocket ammunition consists of three major components—the motor, the warhead, and a fuze. A general description of these components is given in the following paragraphs.

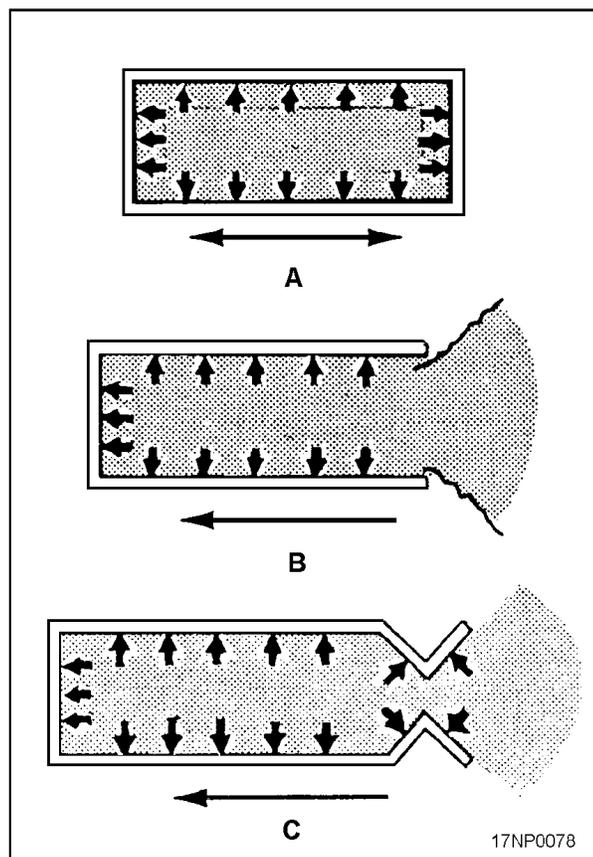


Figure 2-1.—Principles of rocket propulsion.

Motors

The rocket motor consists of components that propel and stabilize the rocket in flight. Not all rocket motors are identical, but they do have certain common components. These components are the motor tube, propellant, inhibitors, stabilizing rod, igniter, and nozzle and fin assembly. The rocket motors discussed in the following paragraphs are for the 2.75-inch Mk 66 Mods 2 and 4, and 5.0-inch Mk 71 Mod 0 and 1.

MOTOR TUBE.—The motor tube supports the other components of the rocket. Presently, all motor tubes are aluminum, threaded internally at the front end for warhead installation, and grooved or threaded internally at the aft end for nozzle and fin assembly installation.

The Mk 66 Mods rocket motor tube is an integral bulkhead type of motor tube and is impact-extruded from aluminum stock. The forward end contains the head closure and threaded portion for attachment of the warhead. The integral bulkhead closure does not rupture when accidentally fired without a warhead and becomes propulsive when ignited. The center portion of the motor tube contains the propellant. The nozzle and fin assembly attaches to the aft end by a lock wire in a groove inside the tube.

The Mk 71 Mods rocket motor tube is basically an aluminum tube with an integral bulkhead closure. The forward end contains the head closure, igniter contact band, igniter lead, RAD HAZ barrier, and a threaded portion for attachment of the warhead. The center section is the combustion chamber and contains the igniter, propellant grain, stabilizing rod, and associated hardware. The aft end of the motor tube is threaded internally to accept the nozzle and fin assembly.

PROPELLANTS.—The propellant grain contained in the Navy's 2.75-inch and the 5.0-inch rocket motors is an internal burning, star perforation, double-base solid propellant. The star perforation is designed to produce a nearly constant thrust level.

The Mk 66 rocket motor has the star points machined off (conned) to reduce erosive burning.

INHIBITORS.—Inhibitors restrict or control burning on the propellant surface. In the 2.75-inch and the 5.0-inch motors, the propellant grains are inhibited at the forward and aft ends, as well as the entire outer surface. The forward and aft end inhibitors are molded plastic (ethyl cellulose) components bonded to the propellant ends. The outer surface inhibitor is spirally

wrapped ethyl cellulose tape bonded to the propellant surface.

Inhibitors cause the propellant grain to burn from the center outward and from forward to aft uniformly. If inhibitors weren't used, the burning surface of the propellant grain would increase, and result in an increased burning rate. This could cause the motor tube to explode from excessive pressure. If a motor is accidentally dropped and the propellant grain is cracked, the crack in the grain increases the burning surface and an identical hazard exists.

STABILIZING ROD.—The stabilizing rod, located in the perforation of the motor propellant grain, is salt coated to prevent unstable burning of the propellant. It also reduces flash and after burning in the rocket motor, which could contribute to compressor stall and flameout of the aircraft jet engines. When the propellant ignites, the stabilizing rod ensures that the grain ignites simultaneously forward and aft.

IGNITER.—The igniter heats the propellant grain to ignition temperature. The igniter used in the 2.75-inch motor is a disc-shaped metal container that contains a black powder and magnesium charge, a squib, and electrical lead wires. It is located at the forward end of the motor. The igniter used in the

5.0-inch motor is a disc-shaped metal container that contains a powder or pellets charge, two squibs, and electrical lead wires. It is located at the forward end of the motor. A contact disc or a contact band transmits the firing impulses to the motor igniter.

The 2.75-inch motor has electrical leads that extend from the squib through the wall of the igniter. They are routed through the propellant perforation to the nozzle fin assembly. One of the wires is connected to the nozzle plate (ground), and the other passes through either one of the nozzles or the fin-actuating piston to the contact disc on the fin retainer. In the Mk 66 Mod 2, both lead wires are connected directly to the HERO filter wires, which extend out of the forward end of the stabilizing rod. When the rocket is placed in the launcher, the contact disc is automatically in contact with an electrical terminal that transmits the firing impulse to the rocket.

The igniter in the 5.0-inch motor (fig. 2-2) has an electrical lead wire post that protrudes through the forward bulkhead closure. The electrical lead connects the igniter to the contact band. When the rocket is placed in the launcher, the contact band is automatically in contact with an electrical terminal, which transmits the firing impulse to the rocket. Until actually loaded into a launcher, a metal shielding band

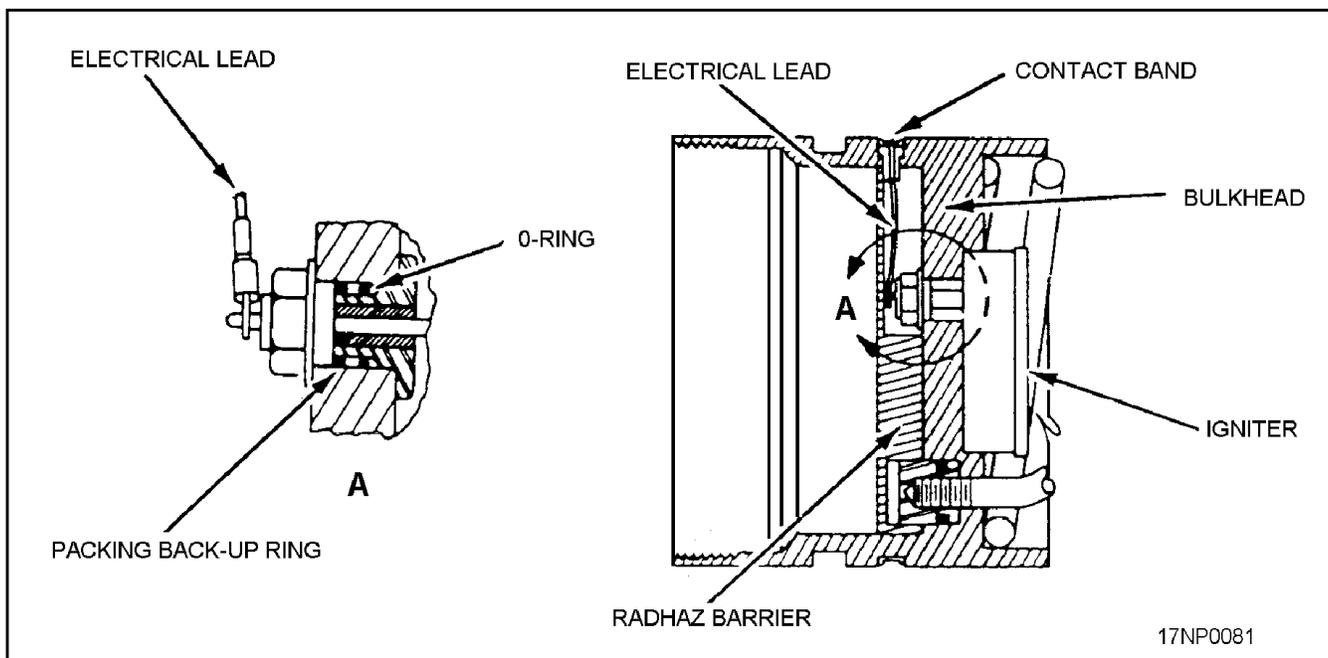


Figure 2-2.—Typical center electrical lead wire connection (5.0-inch motor).

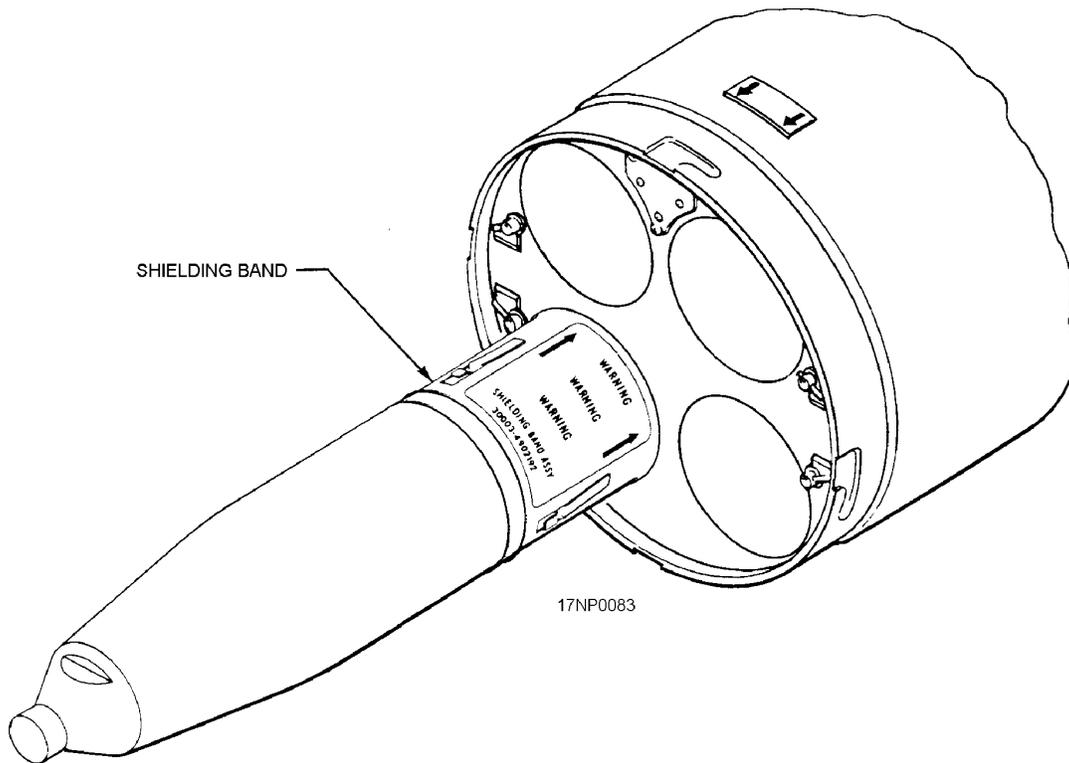


Figure 2-3.—Shielding band for 5.0-inch FFAR.

(fig. 2-3) is always in place over the ignition contact band.

NOZZLE AND FIN ASSEMBLIES.—The nozzle assembly for the Mk 66 consists of the nozzle

body, carbon insert, fins, contact band assembly, and weather seal.

Pivot pins attach the fins to lugs machined on the aft part of the nozzle plate. When folded, the fins lie within

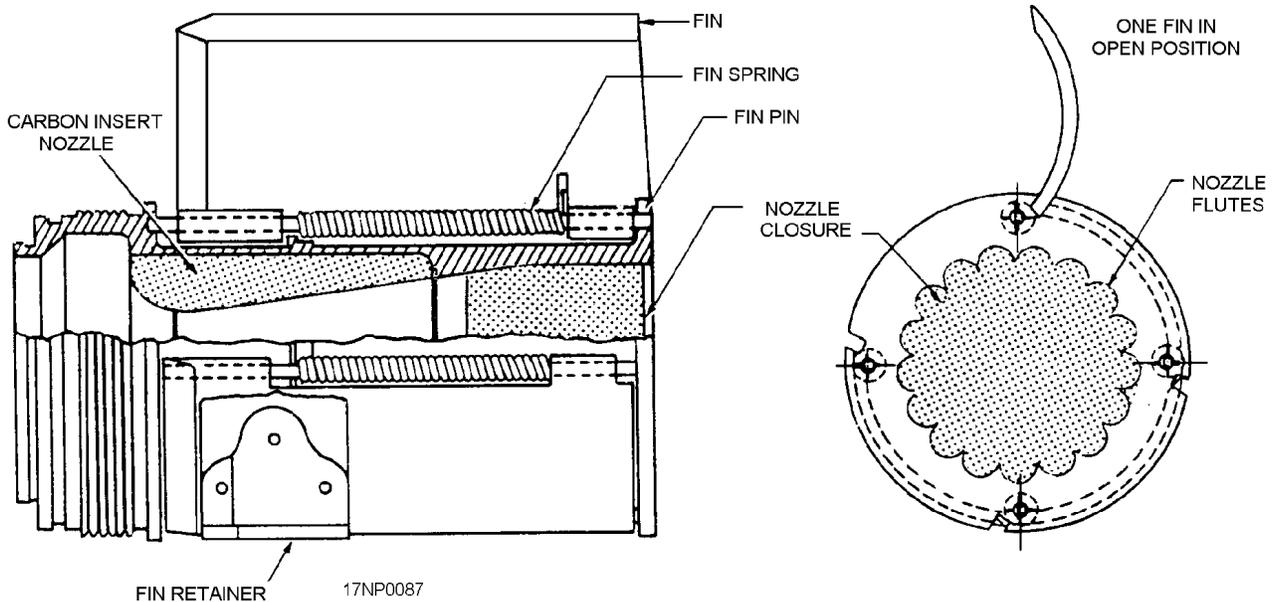


Figure 2-4.—Mk 71 Mods motor, nozzle, and fin assembly.

the 2.75-inch diameter of the rocket. The fins are notched at the tips to allow attachment of a fin retainer.

The fin-actuating mechanism is a steel cylinder and a piston with a crosshead attached to its aft end. When the rocket is fired, gas pressure from the motor operates the piston, cylinder, and crosshead. The crosshead is pushed against the heels of the fins, causing the fins to rotate on the fin pivot pins to the open position after the rocket leaves the launcher. After the fins have opened to the final flight position, the crosshead prevents the fins from closing.

There are four nozzle inserts and the detent groove in the aft end of the nozzle plate. They hold the rocket in position after it is loaded in the launcher.

The Mk 71 Mods motor has a modified igniter and a modified nozzle and fin assembly. The nozzle and fin assembly (fig. 2-4) contains four, spring-loaded, wraparound fins inside the motor diameter. The steel nozzle expansion cone has flutes that cause the rocket to spin during free flight. This permits the rocket to be launched from high-speed aircraft, helicopters, and low-speed aircraft.

The Mk 71 Mods spring-loaded fins (fig. 2-5) deploy after emerging from the rocket launcher tube. They lock in place (open) by sliding into a locking slot in the flange at the aft end of the fin nozzle assembly. When not actually installed in the launcher, the fins are held in the closed position by a fin retainer band, which must be removed when the rocket is installed into the launcher tube. The fin retainer band is not interchangeable with the shielding band.

REVIEW NUMBER 1

- Q1. List the two rockets currently used by the Navy.
- Q2. If a rocket does not fire when the firing circuit is energized, it is known as a _____.
- Q3. What is meant by the rockets thrust?
- Q4. In rocket propulsion, the Venturi nozzle decreases turbulence of escaping gases and increases thrust. Gas pressure inside the container provides about _____, and the escaping gases provide about _____ to move the container forward.
- Q5. List the three components of a rocket.
- Q6. List the components of rocket motors.
- Q7. What is the purpose of the inhibitor?

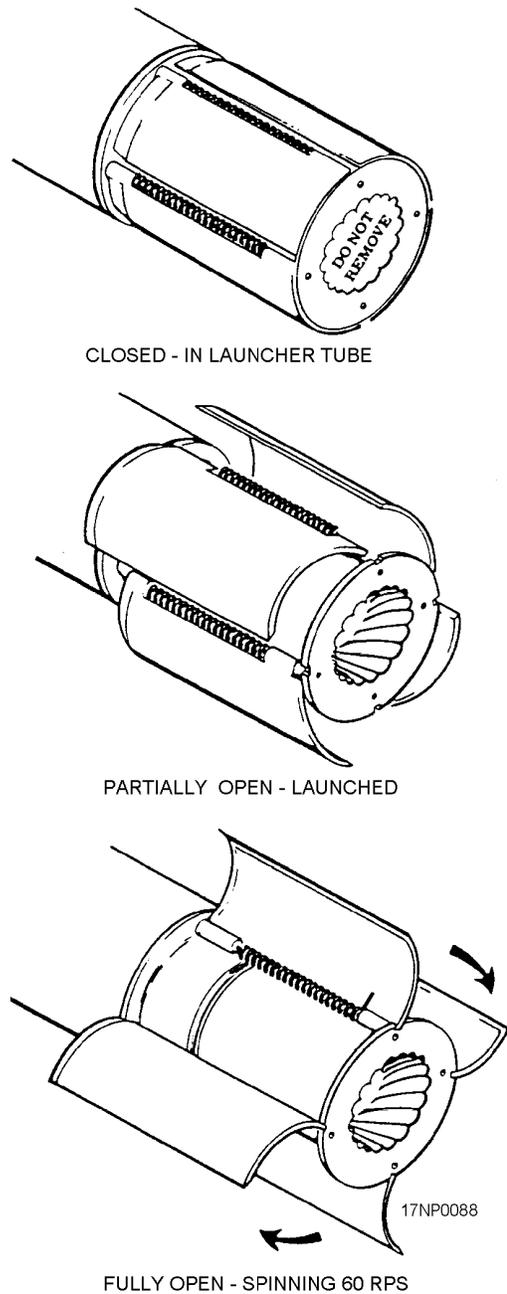


Figure 2-5.—Mk 71 Mods motor, nozzle, and fin assembly.

- Q8. What rocket component is salt coated to prevent unstable burning of the rocket propellant?
- Q9. When should you remove the fin retainer band on a Mk 71 rocket motor?

Warheads

Different tactical requirements demand different types of rocket warheads be used with airborne rockets.

Warheads are classified as either 2.75 inch or 5.0 inch warheads. They may be further classified as high explosive, flechette, smoke, flare, or practice. Warheads for 2.75-inch rockets are normally received with the fuzes installed.

There are many different warheads, fuzes, and motor combinations available. Therefore, the following discussion is general. For specific component information, you should refer to *Aircraft Rocket Systems 2.75-inch and 5.0-inch NAVAIR 11-75A-92*.

High-explosive warheads contain high-explosive material (generally comp-B) surrounded by a metal case. An internally threaded nose fuze cavity permits the installation of a nose fuze or an inert nose plug, depending on tactical requirements. Some warhead configurations require the use of a base fuze. Base fuzes are installed at the factory and should never be removed. High-explosive warheads are painted olive drab and may have a narrow yellow band around the nose.

There are several types of high-explosive warheads, and each is designed for a specific type of target.

HE-FRAG WARHEADS.—High-explosive fragmentation (HE-FRAG) warheads (fig. 2-6) are used against personnel and light material targets, such as trucks and parked aircraft. Upon detonation, a large quantity of metal fragments accelerates to a high

velocity. This action damages the target. The types of HE-FRAG warheads currently in use are listed in table 2-1.

REVIEW NUMBER 1 ANSWERS

- A1. *The two rockets currently used by the Navy are the 2.75-inch Mighty Mouse and the 5.0-inch Zuni.*
- A2. *If a rocket does not fire when the firing circuit is energized, it is known as a misfire.*
- A3. *Thrust is the force exerted by the gases produced by the burning of the rocket motor propellant.*
- A4. *In rocket propulsion, the Venturi nozzle decreases turbulence of escaping gases and increases thrust. Gas pressure inside the container provides about 70% of the force, and the escaping gases provide about 30% of the force to move the container forward.*
- A5. *The three components of a rocket are the motor, warhead, and fuze.*
- A6. *The components of rocket motors include the motor tube, propellant, inhibitors, stabilizing rod, igniter, and nozzle and fin assembly.*
- A7. *The inhibitor restricts or controls burning on the propellant.*

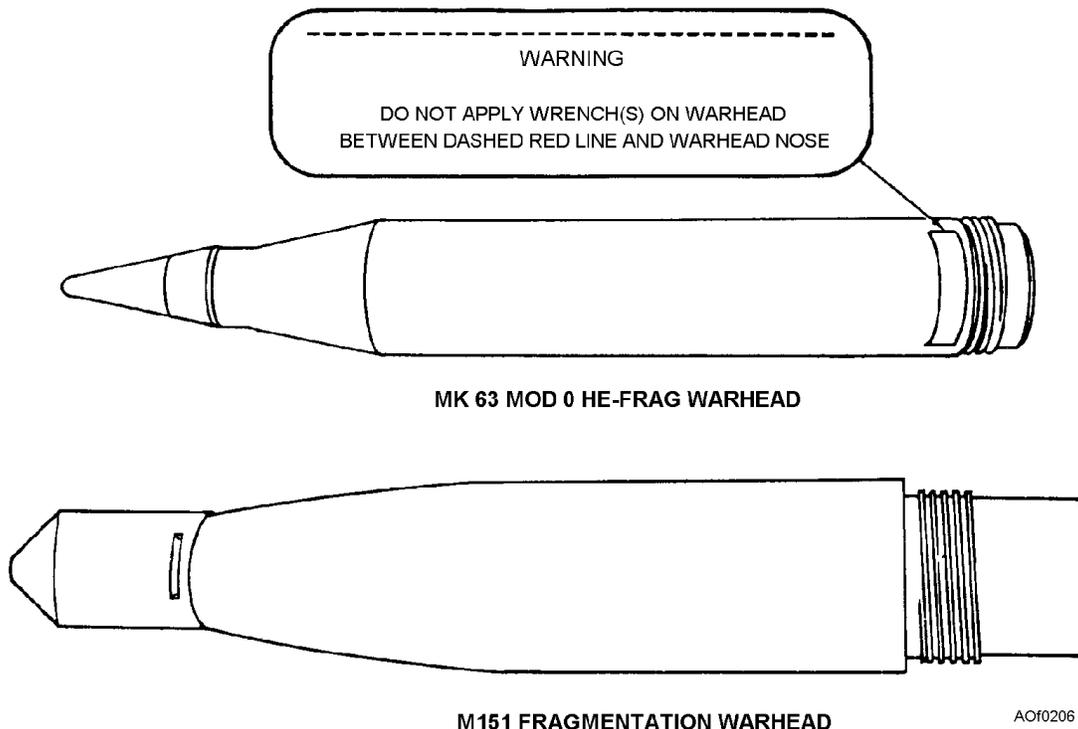


Figure 2-6.—High-explosive fragmentation (HE-FRAG) warheads.

Table 2-1.—Service Warheads

| TYPE | 2.75-INCH | 5.0-INCH |
|-----------|-------------|--------------------|
| HE-FRAG | M151 | Mk 63 Mod 0 |
| AT/APERS | ----- | Mk 32 Mod 0 |
| GP | ----- | Mk 24 Mod 0 |
| FLECHETTE | WDU-4A/A | ----- |
| SMOKE | M156 | Mk 34 Mods 0 and 1 |
| | Mk 67 Mod 0 | |
| FLARE | M257 | Mk 33 Mod 1 |
| | M278 IR | |

A8. *The stabilizing rod is salt coated to prevent unstable burning of the rocket propellant.*

A9. *You should remove the fin retainer band on the Mk 71 rocket motor when the rocket is installed into the launcher tube.*

AT/APERS WARHEAD.—The high-explosive antitank/antipersonnel (AT/APERS) warhead (fig. 2-7) combines the effectiveness of the HE-FRAG and HEAT warheads. The explosive shaped-charge in the AT/APERS warhead detonates at the aft end, producing the jet from the cone at the forward end. The booster in the aft end detonates the warhead by transmitting an explosive impulse along a length of detonating cord. It connects the booster charge to the initiating charge, which is next to the nose fuze. The combination of an

instantaneous-acting nose fuze and rapid-burning detonating cord permits detonation of the explosive load in time for the shaped-charge to produce its explosive jet before being disintegrated upon target impact. The only AT/APERS warhead currently in use is the Mk 32 Mod 0.

GP WARHEAD.—The high-explosive, general-purpose (GP) warhead (fig. 2-8) is a compromise between the armor-piercing and the fragmentation designs. The walls and nose section are not as strong as those of an armor-piercing warhead, yet they are stronger than those of a fragmentation warhead. The explosive charge is greater than that in the armor-piercing warhead, but less than that in the fragmentation warhead.

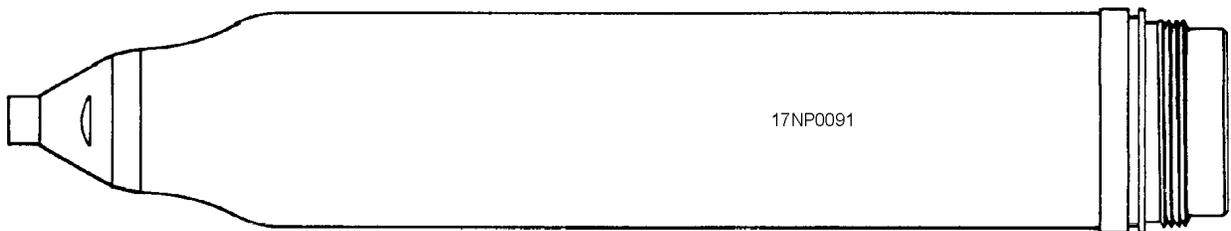


Figure 2-7.—Mk 32 Mod 0 AT/APERS warhead.

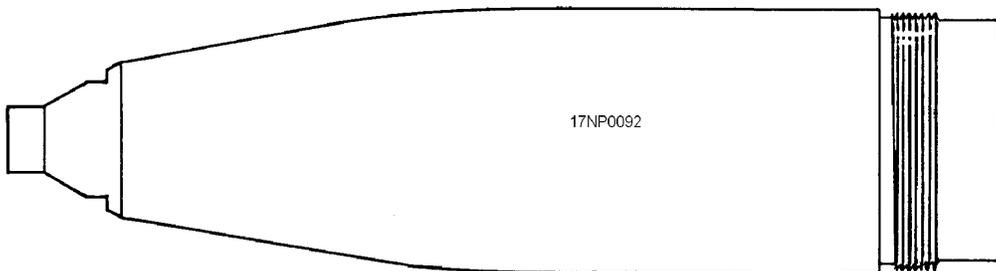


Figure 2-8.—Mk 24 Mod 0 high-explosive, general-purpose (GP) warhead.

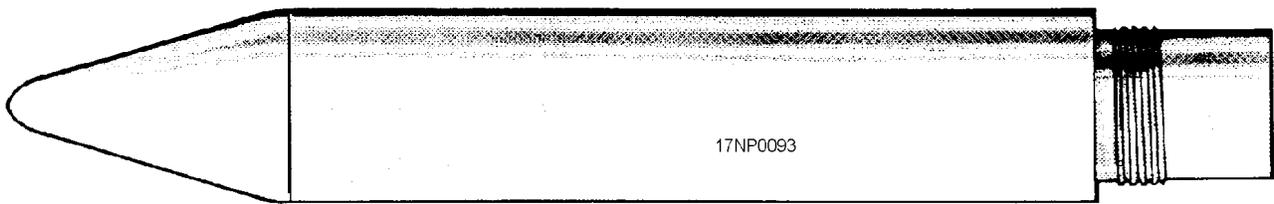
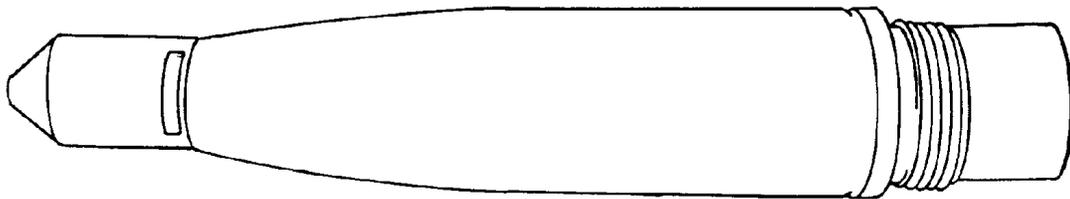


Figure 2-9.—WDU-4A/A flechette warhead.

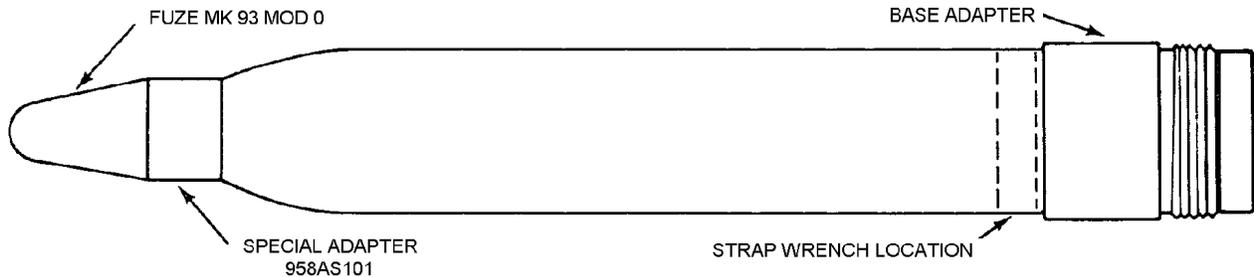
The GP warhead is used against a variety of targets. Maximum penetration is obtained by using a solid nose plug and the delayed-action base fuze. Its maximum blast effect is obtained by using an instantaneous-acting

nose fuze. The only GP warhead currently in use is the Mk 24 Mod 0.

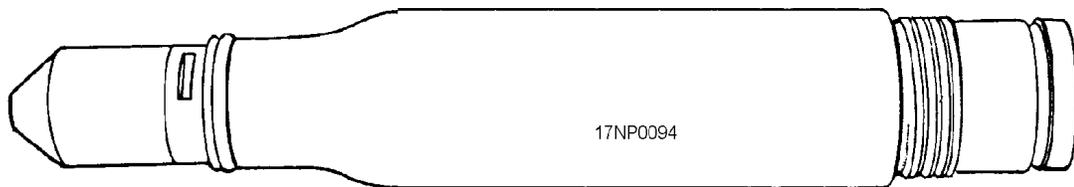
FLECHETTE WARHEADS.—Flechette warheads (fig. 2-9) are used against personnel and light



M156 SMOKE WARHEAD



MK 34 MOD 0 WARHEAD



MK 67 MOD 0 SMOKE WARHEAD

Figure 2-10.—Smoke warheads.

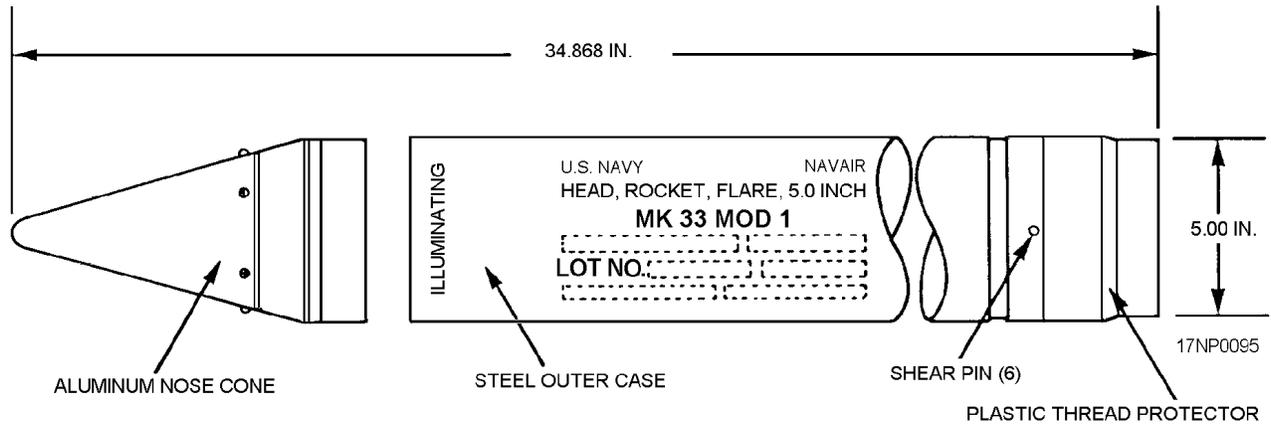


Figure 2-11.—Mk 33 Mod 1 flare warhead.

armored targets. These warheads contain a large number of small arrow-shaped projectiles. A small explosive charge in the base fuze of the warhead dispenses the flechettes through the nose of the warhead after rocket motor burnout. Target damage is caused by impact of the high-velocity flechettes.

SMOKE WARHEADS.—Smoke warheads (fig. 2-10) are used to produce a volume of heavy smoke for target marking. The warhead contains a burster tube of explosives, usually comp-B, which bursts the walls of the warhead, dispersing the smoke. These warheads are designated SMOKE, followed by the abbreviation for the smoke producing agent it contains. For example, WP for white phosphorus, or PWP for plasticized white phosphorus. The types of smoke warheads currently in use are listed in table 2-1.

FLARE WARHEADS.—Flare warheads (fig. 2-11) are used to illuminate tactical operations. They consist of a delay-action fuze, an illuminating candle, and a parachute assembly. The fuze ignites the expelling charge, which separates the case from the candle and parachute assembly. The wind stream forces the parachute open, suspending the burning candle. The only flare warhead currently in use is the Mk 33 Mod 1.

PRACTICE WARHEADS.—Practice warheads are either dummy configurations or inert-loaded service warheads. In the inert-loaded service warheads, the weight and placement of the filler gives the practice warhead the same ballistic characteristics as the explosive-loaded service warhead. A steel nose plug is assembled in the practice heads in place of the nose fuze. The entire surface, except for the stenciled marking, is painted blue. The practice warheads currently in use are listed in table 2-2.

Table 2-2.—Practice Warheads

| 2.75-INCH | 5.0-INCH |
|-----------|-------------|
| WTU1/B | Mk 6 Mod 7 |
| M230 | Mk 32 Mod 1 |
| | Mk 24 Mod 0 |
| | WTU-11/B |

REVIEW NUMBER 2

- Q1. What color are high-explosive rocket warheads?
- Q2. What type of targets are HE-FRAG warheads used against?
- Q3. The AT/APERS warhead is an effective combination of what other warheads?
- Q4. What warhead contains a large number of small, arrow-shaped projectiles?
- Q5. Smoke warheads produce a volume of heavy smoke for _____.
- Q6. What warhead is used to illuminate tactical operations?

Fuzes

Rocket fuzes are primarily classified by their location in the warhead; for example, nose fuze or base fuze. They are further classified by mode of operation, such as impact-firing, mechanical-time, acceleration and deceleration, or proximity. All fuzes contain safety/arming devices to prevent detonation during normal transporting, handling, and launching of the complete rocket.

A representative fuze from each class is discussed in the following paragraphs. The fuzes currently in use and their primary application are listed in table 2-3. For more detailed information on fuzes, refer to *Aircraft Rocket Systems 2.75-inch and 5.0-inch NAV-AIR 11-75A-92*.

REVIEW NUMBER 2 ANSWERS

- A1. *High-explosive rocket warheads are painted olive drab and may have a narrow yellow band around the nose.*
- A2. *HE-FRAG warheads are used against personnel and light material targets, such as trucks and parked aircraft.*
- A3. *The AT/APERS warhead is an effective combination of the HE-FRAG and HEAT warheads.*
- A4. *The flechette warhead contains a large number of small, arrow-shaped projectiles.*
- A5. *Smoke warheads produce a volume of heavy smoke for target marking.*
- A6. *The flare warhead is used to illuminate tactical operations.*

IMPACT FIRING FUZES.—Impact firing fuzes (fig. 2-12) function when the rocket strikes a target that offers sufficient resistance to cause crushing or other disarrangement of actuating parts.

All current impact firing rocket fuzes have the same type of safety/arming mechanism. This mechanism consists of an unbalanced rotor, which, under setback forces, drives a gear-train timing system. A given minimum acceleration over a given length of time is required to complete the arming cycle. If rocket acceleration is too low or extends over too short a period of time, the arming mechanism returns to the unarmed condition. The timing mechanism provides a safe separation distance from the launcher before arming.

When located in the nose of the warhead, impact firing fuzes are known as point-detonating (PD) fuzes. If they are located in the base of the warhead, they are known as base-detonating (BD) fuzes. Nose and base fuzes function either instantaneously or after a short delay that gives the warhead time to penetrate the target before functioning.

MECHANICAL TIME FUZES.—Mechanical time fuzes (fig. 2-13) function by the action of a mechanical timer. These fuzes contain a safety/arming device and a clock mechanism. The arming mechanism is similar to those in impact detonating fuzes and requires a minimum acceleration over a given time to complete the arming cycle. Upon arming, the mechanical timer is started, and after a set elapsed time, the fuze initiates the firing train.

The Mk 193 Mod 0 is the only mechanical time rocket fuze currently in use. It is permanently installed in the nose of the Mk 33 Mod 1 flare warhead.

Table 2-3.—Rocket Fuzes

| FUZE | CLASSIFICATION | APPLICATION |
|---|-----------------------------|---------------------------------|
| Mk 188 Mod 0 | Nose impact (PD) | 5.0-inch |
| Mk 352 Mod 2 | Nose impact (PD) | 2.75-inch and 5.0-inch (Note 1) |
| FMU-90/B | Nose impact (PD) | 5.0-inch (Note 1) |
| M423 | Nose impact (PD) | 2.75-inch (Note 2) |
| M427 | Nose impact (PD) | 2.75-inch |
| Mk 191 | Base detonating impact (BD) | 5.0-inch |
| Mk 193 Mod 0 | Mechanical time | 5.0-inch |
| Model 113A | Acceleration-deceleration | 2.75-inch |
| Mk 93 Mod 0/M414A1 | Proximity | 5.0-inch |
| Note 1: Requires use of BBU-15/B adapter booster for 5.0-inch configurations. | | |
| Note 2: Designed for use with 2.75-inch LSFFARs only. | | |

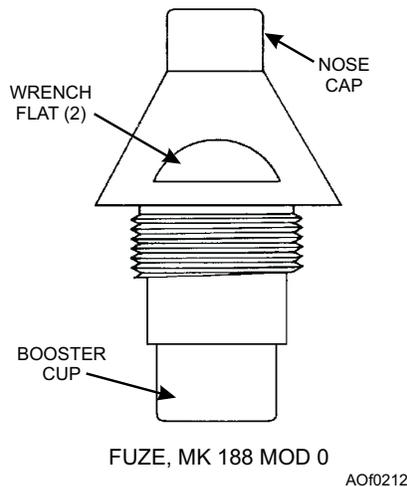
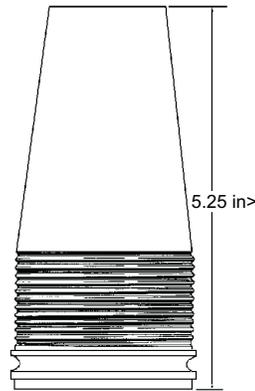
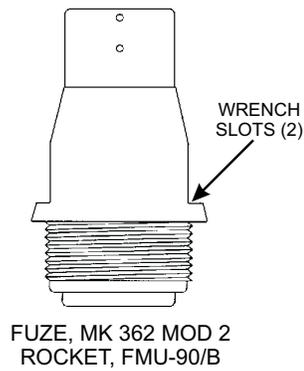


Figure 2-12.—Impact firing fuzes.

ACCELERATION-DECELERATION FUZES.—

Acceleration-deceleration fuzes are similar to impact and time fuzes because they require acceleration for a given time to complete the arming cycle. After the arming cycle is completed and the rocket velocity begins to drop, deceleration causes the fuze to function.

The Model 113A is the only acceleration-deceleration fuze in use by the Navy at this time. It is a base-mounted fuze that is permanently installed in the WDU-4A/A flechette warhead.

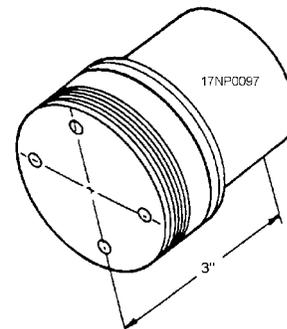


Figure 2-13.—Mk 193 Mod 0 mechanical time fuze.

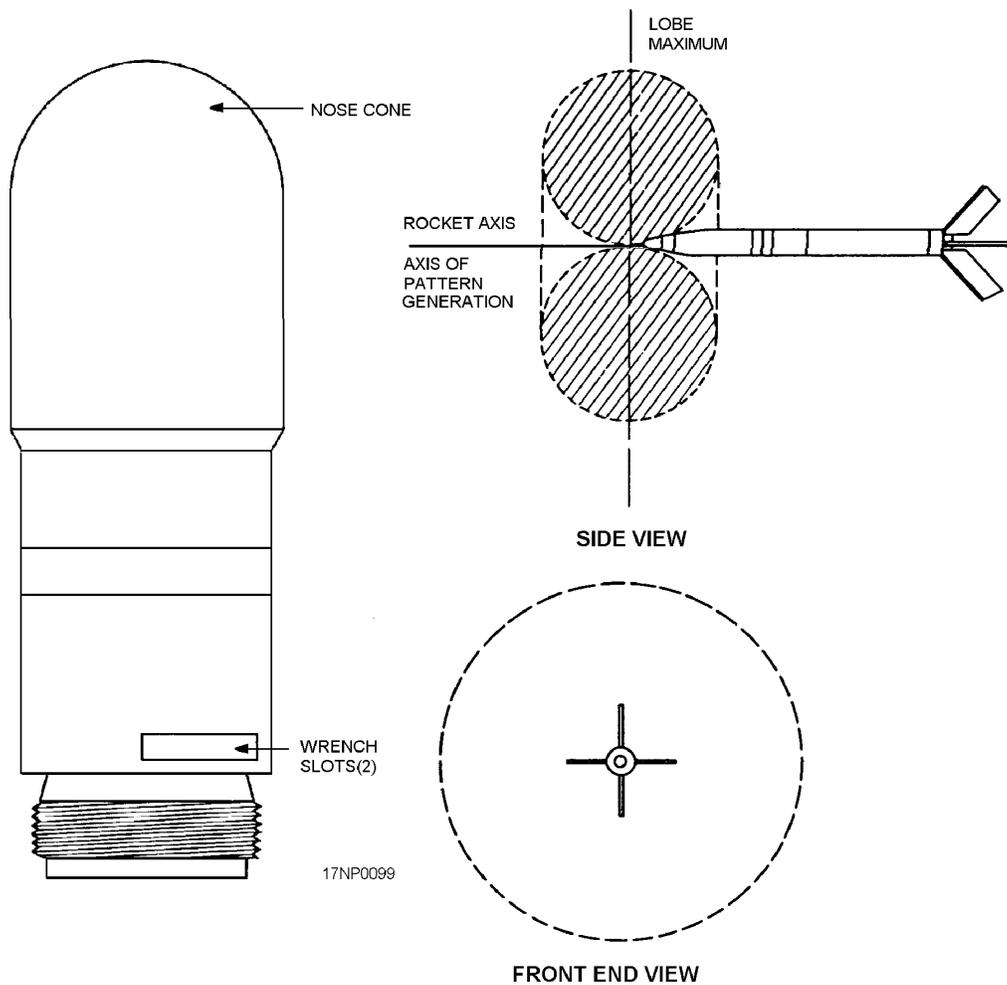


Figure 2-14.—Proximity fuze.

PROXIMITY FUZES.—Proximity fuzes, sometimes referred to as VT fuzes (fig. 2-14), initiate by "sensing," usually by electronic means, the presence and distance of a target. Proximity fuzes are primarily used in air-to-ground operations where air bursts above the target are desired. They are not suitable for use against targets that require penetration and detonation within the target for effective destruction.

In general, proximity fuzes consist of an electronics package in the forward end, a thermal battery, a safety/arming device, and an explosive booster in the base. The arming mechanism is similar to those in impact detonating fuzes, and it requires a minimum acceleration over a given time to complete the arming cycle.

NOTE: Some rocket fuzes designed for use with 2.75-inch warheads can be used with the 5.0-inch warhead by using the BBU-15/B adapter booster (fig. 2-15).

REVIEW NUMBER 3

Q1. When classified by their mode of operation, fuzes are classified as _____.

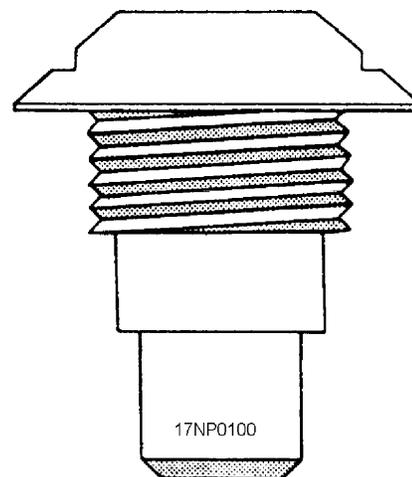


Figure 2-15.—Adapter booster BBU-15/B.

- Q2. *At what point does the impact-firing fuze function?*
- Q3. *List the two types of impact firing fuzes.*
- Q4. *At what point does the mechanical time fuze initiate the firing train?*
- Q5. *In acceleration-deceleration fuzes, what force causes the fuze to function?*
- Q6. *Name the fuze that senses, usually by electronic means, the presence and distance of a target.*

SERVICE ROCKET ASSEMBLIES

Airborne rockets, consisting of fuzes, warheads, and motors, are combined and assembled in various configurations to meet specific tactical requirements. For example, a rocket assembly that consists of a fragmentation warhead armed with a proximity fuze is entirely unsuitable for use against an armored tank or bunker. Likewise, the GP warhead fuzed only with the Mk 191 base fuze is relatively ineffective against personnel or unarmored targets. With each specific type of target, the right combination of warhead, fuze, and motor is assembled from the wide variety of components available.

2.75-Inch FFAR and LSFFAR

The 2.75-inch airborne rocket is an effective air-to-ground weapon against most targets. The FFAR is an air-to-air weapon. Fired in large numbers to produce a shotgun pattern, FFARs are carried and launched from 7- or 19-round launcher packages. These packages are described later in this chapter.

The LSFFAR is accurately and safely launched from low-speed aircraft and helicopters. Because of their spin feature, they cannot be ripple fired. LSFFARs are fired singly from 7- or 19-round launchers that have single-fire capability.

The 2.75-inch rockets are received through the supply system in three configurations as follows:

1. Complete rounds in 7- or 19-tube launchers, or in wooden boxes
2. Rocket motors in 7-tube launchers, and the fuze-warhead combination in separate shipping containers
3. Separate components in authorized shipping containers

Squadron ordnancemen based ashore order and may assemble components for current operations. Aboard ship, weapons department ordnancemen assemble the components according to the ship's air and load plan. They deliver these assemblies to squadron ordnancemen for loading onto aircraft.

For detailed information, such as authorized assemblies, safety precautions, and restrictions, you should refer to *Aircraft Rocket Systems 2.75-inch and 5.0-inch NAVAIR 11-75A-92*. You can find additional information in specific aircraft loading and tactical manuals.

5.0-Inch FFAR

Like the 2.75-inch rocket, the 5.0-inch FFAR can be assembled in various warhead and fuze combinations. The Mk 71 motor gives the additional advantage of one motor for all launch-speed applications.

The 5.0-inch rocket is carried and launched from multiple-round launchers. Because of their large size and weight, the number of rounds per launcher is reduced to four. The 5.0-inch rockets are received through the supply system in the following two configurations:

1. Rocket motors in a 4-round launcher and fuzes and warheads in separate shipping containers

NOTE: The Mk 191, Mk 193, and Model 113A fuzes are permanently installed in the warheads.

2. Separate components in separate shipping containers

REVIEW NUMBER 4

- Q1. *What is the usual configuration of the 2.75-inch airborne rocket?*
- Q2. *Aboard ship, who assembles rocket components for current operations?*

REVIEW NUMBER 3 ANSWERS

- A1. *When classified by their mode of operation, fuzes are classified as impact firing, mechanical time, acceleration-deceleration, or proximity.*
- A2. *Impact-firing fuzes function when the rocket strikes the target that offers enough resistance to cause actuation of the parts.*

Table 2-4.—2.75-Inch Rocket Launchers

| LAUNCHER TYPE | NO. OF TUBES | TUBE MATERIAL | REUSABLE | METHOD OF FIRING |
|---------------|--------------|---------------|----------|------------------|
| LAU-61C/A | 19 | Alum. | Yes | Ripple or Single |
| LAU-68D/A | 7 | Alum. | Yes | Ripple or Single |

- A3. *The two types of impact firing fuzes are the point detonating and base detonating types.*
- A4. *Upon arming, the mechanical timer starts, and after a set time, the mechanical time fuze initiates the firing train.*
- A5. *In acceleration-deceleration fuzes, deceleration causes the fuze to function.*
- A6. *Proximity fuzes sense, usually by electronic means, the presence and distance of a target.*

AIRCRAFT ROCKET LAUNCHERS

LEARNING OBJECTIVE: *Recognize the shipping configuration for aircraft rocket launchers and identify common aircraft rocket launcher components.*

Aircraft rocket launchers (pods) carry and provide a platform to fire rockets. Launcher design permits multiple loading and launching of 2.75-inch and 5.0-inch rockets. Rocket pods let rocket motors (and, in some cases, completely assembled rounds) stay in the same container from their manufacture, through stowage, to their final firing.

Aircraft rocket launchers are classified as either 2.75-inch or 5.0-inch. They may be further classified as either reusable or nonreusable. Launcher tubes that are constructed of metal are considered reusable and are

usually returned for reloading. Under certain conditions, they may be jettisoned at the pilot's discretion.

The 2.75-inch rocket launchers currently in use are the LAU-61C/A and LAU-68D/A. Characteristics and specifications for these launchers are listed in table 2-4. For detailed information about the LAU-61 and LAU-68 series launchers, refer to *Aircraft Rocket Systems 2.75-inch and 5.0-inch NAVAIR 11-75A-92*.

The 5.0-inch rocket launchers are the LAU-10B/A, LAU-10C/A, and the LAU-10D/A. Characteristics and specifications for these launchers are listed in table 2-5. For detailed information on the LAU-10 series launchers, you should refer to *Aircraft Rocket Systems 2.75-inch and 5.0-inch NAVAIR 11-75A-92*.

SHIPPING CONFIGURATION

The rocket launcher-shipping configuration shown in figure 2-16 is typical of all launcher-shipping configurations, except for the RF barriers.

Center Section

The launcher center section is a cylindrical construction of 4, 7, or 19 tubes held together by a supporting framework, and it is covered with an aluminum skin. The center section houses or supports all other components of the launcher.

Table 2-5.—5.0-Inch Rocket Launchers

| LAUNCHER TYPE | NO. OF TUBES | TUBE MATERIAL | REUSABLE | METHOD OF FIRING |
|---------------|--------------|---------------|----------|------------------|
| LAU-10B/A | 4 | Alum. | Yes | Ripple or Single |
| LAU-10C/A | 4 | Alum. | Yes | Ripple or Single |
| LAU-10D/A | 4 | Alum. | Yes | Ripple or Single |

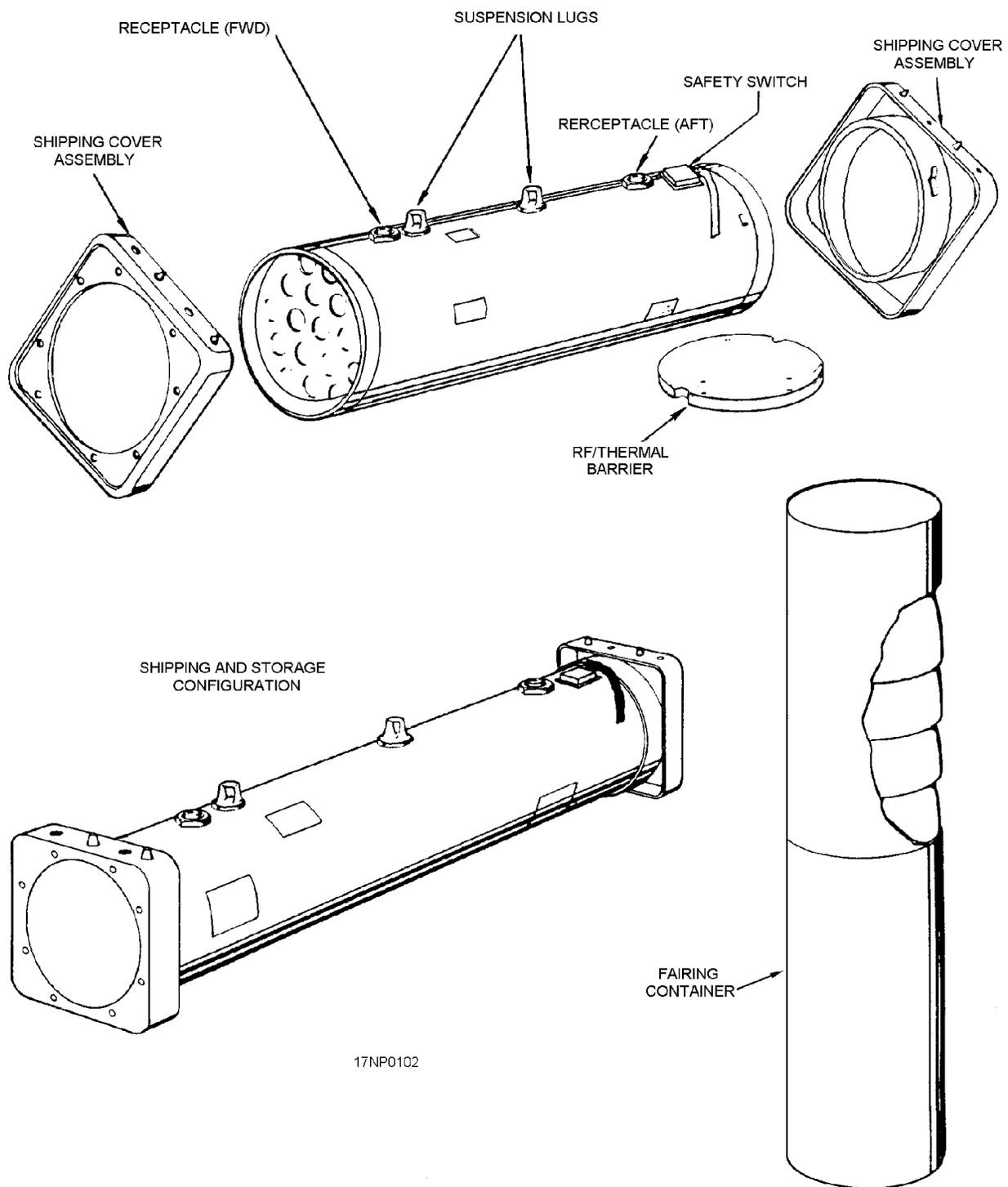


Figure 2-16.—Typical launcher shipping and storage configuration.

The center section for the LAU-10 (series) allows either 14-inch or 30-inch suspension. The center section for the LAU-61 and LAU-68 (series) provides for 14-inch suspension only.

Shipping Ends

The shipping ends are a multipurpose arrangement that consists of a shockpan assembly, a shockpan cover

assembly, and/or locking ring assembly. An alternate hole and pin arrangement on the top and bottom is arranged so that the shockpans interlock when the launchers are stacked. The cover is equipped with a rubber seal ring that, when compressed by the locking ring assembly, forms a watertight closure over the end of the launcher.

RF/Thermal Barriers

RF/Thermal barriers consist of a molded, expanded, polystyrene bead base with an aluminum foil coating cemented to the outer surface. RF/Thermal barriers are used on 2.75-inch pods to prevent the entry of electromagnetic radiation into the rocket igniter circuit. Equally important is the barrier on the aft end of the pod. It prevents exposure of the igniter lead contact. The LAU-61 and LAU-68 use the aft barrier only. The barriers remain installed for flight and are removed by impact or blast when the rocket is fired.

COMMON COMPONENTS

Rocket launcher packages have several components that are common to all or most launcher packages. Any notable differences are pointed out in the following discussion.

REVIEW NUMBER 4 ANSWERS

- A1. *The 2.75-inch airborne rocket is used as an air-to-ground weapon against most targets.*
- A2. *Aboard ship, weapons department ordnancemen assemble rocket components according to ships and load plans, and deliver them to the squadron ordnancemen who load them onto the aircraft.*

Fairings

Frangible fairings (fig. 2-17) are made of an impregnated molded fiber designed with a waffle- or grenade-type structure that shatters readily upon rocket impact or from a blast. The fairings fit flush with the outside surface of the center section and form an aerodynamically smooth joint. The forward fairing consists of a one-piece molded section that disintegrates on rocket impact. The tail fairing for the LAU-10 (series) (fig. 2-17, view A) is molded in two sections (nose and base). The rocket blast shatters the nose portion. The base section remains on the launcher and acts as a choke or funnel to direct debris away from the aircraft. The tail fairings for the LAU-61 and

LAU-68 (series) are distinctively different in appearance (fig. 2-17, view B). They are made of aluminum and are open on both ends. They function in the same manner as the base section of the tail fairing for the LAU-10 (series).

Fairings are not shipped with the rocket launcher packages. They must be ordered separately and are received in sets packaged in cylindrical-shaped cardboard fairing containers (fig. 2-16).

Fairings are not used in all applications. You should review the specific aircraft tactical manual for any restrictions in their use.

Breaker Switch

A breaker switch is used on all rocket launchers. The breaker switch is a safe-arm device that prevents loaded rockets from firing. It is usually located on the top of the center section of the launcher between the aft end and the aft electrical receptacle.

With the detent pin installed in the breaker switch, the electrical system is grounded in the safe position and the rockets won't fire. The detent pin has a REMOVE BEFORE FLIGHT red streamer attached. Pull the pin immediately before the aircraft takes off and install it immediately after the aircraft lands.

Install the detent pin in the breaker switch before loading the launcher with rocket motors. Keep detent pin installed, except during actual flight, until the launcher is downloaded and/or verified as being empty.

Mode Selector Switch

The mode selector switch is used on all launchers. The switch is located in the aft bulkhead of the launcher. The switch permits preflight selection of either ripple or single firing of the rockets by controlling the functioning of the pod intervalometer.

Intervalometer

The intervalometer for the LAU-10 (series) pods is located in the forward bulkhead of the center section and in the aft bulkhead for the LAU-61 and LAU-68 (series). Intervalometers, whether installed in 5.0-inch or 2.75-inch launchers, perform the same function.

If the mode selector switch is in the SINGLE fire position, the intervalometer fires one rocket on each firing pulse. If the mode selector switch in the 19-shot pod is in the SINGLE fire position, the intervalometer fires the rockets in pairs. If the mode selector switch is

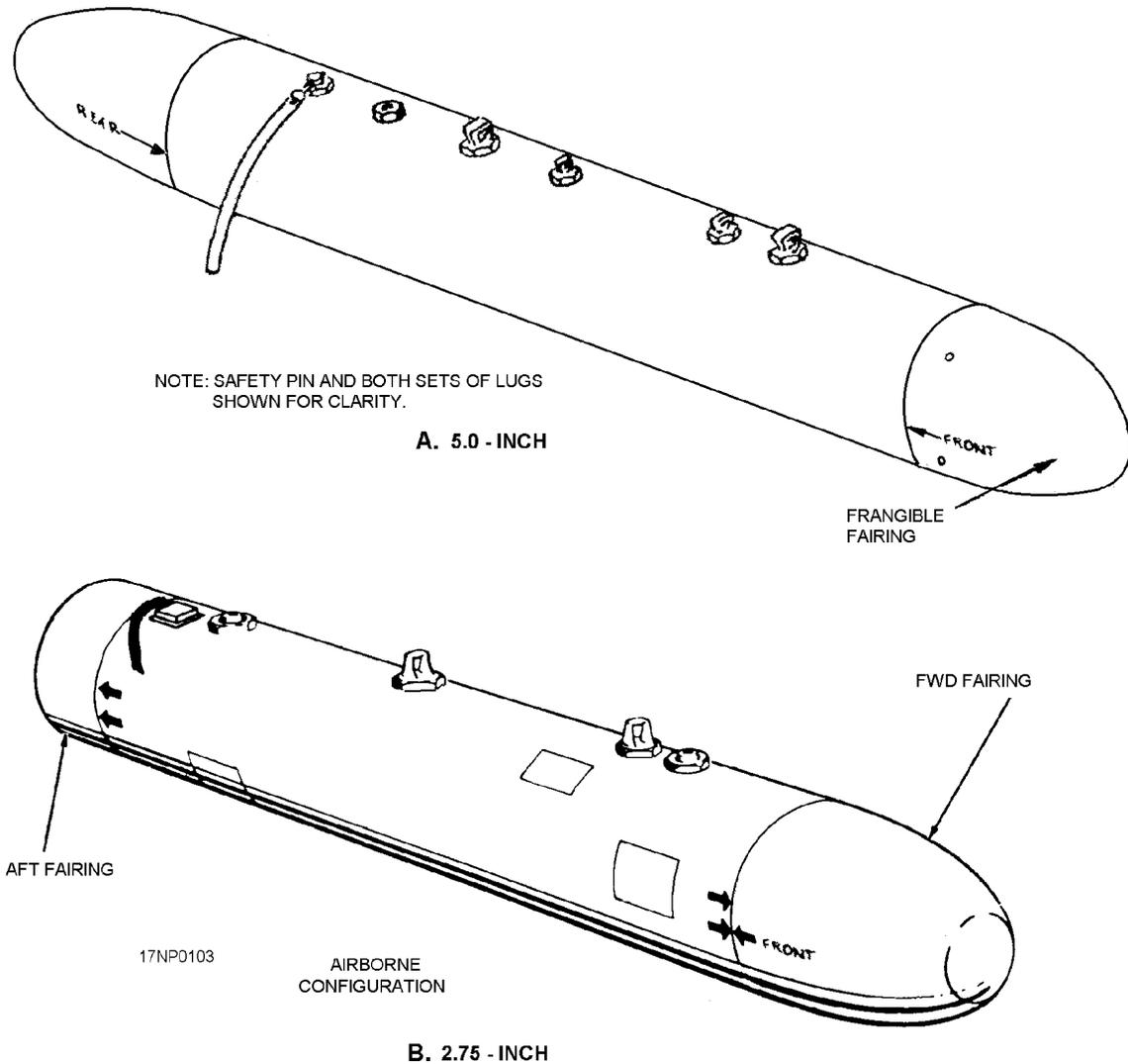


Figure 2-17.—Rocket launcher airborne configurations.

in the RIPPLE fire position, the intervalometer converts the firing pulse into a ripple pulse and successively fires all rockets at 95-millisecond intervals. Ripple firing operates the same on all pods.

The intervalometer used with the 2.75-inch pod has a shaft that extends through the aft bulkhead of the launcher and a knurled knob with a reference (index) mark mounted on the shaft. Intervalometer switch positions are marked on the aft bulkhead of the center section. **The intervalometer should NOT be manually rotated through the numbered positions except when checking an empty pod.**

Intervalometers used in the LAU-10 (series) pods cannot be manually rotated. When the intervalometer has made a complete four-round firing cycle, it

automatically homes in on the original starting point (zero) and does not recycle without first de-energizing the circuit, and then re-energizing it.

5.0-INCH (SERIES) LAUNCHERS

The LAU-10 (series) launchers are reusable launchers intended for shipping (without warheads), stowing, and firing four 5.0-inch rockets. When loaded with four completely assembled rounds, the total weight varies with rocket configuration from 500 to 550 pounds.

The rockets are retained in the launcher tubes during shipping, handling, and flight by engagement of a spring-loaded detent pawl in the rocket detent groove

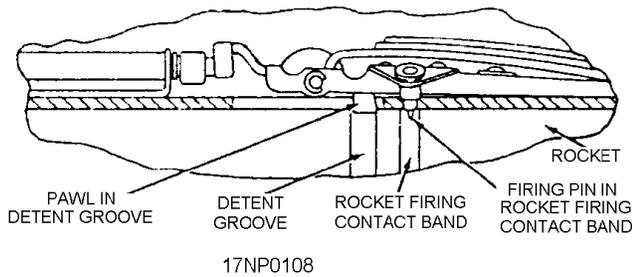


Figure 2-18.—LAU-10 (series) detent pin and firing pin assembly.

(fig. 2-18). When the rocket is loaded and unloaded, a detent lift tool is used to raise and lower the detent pawl by rotating the detent lift handle, which is located at the forward end of the launcher. The detent also supports the firing pin. Each firing pin (fig. 2-18) is part of the detent assembly and is raised and lowered concurrent with the pawl. The firing pin extends into the tube and contacts the rocket firing contact band, which is located aft of the rocket detent groove.

When the switch in the aircraft firing circuit is closed, electrical current flows from the aircraft firing circuit through the electrical receptacle, safety switch, mode selector switch, intervalometer, and the firing pin in the launcher to the contact band in the forward end of the motor, and through the lead wire to the squib in the igniter. The current entering the rocket squib heats the

squib primer mixture, which, in turn, ignites the igniter charge.

Pressure within the igniter unseats a blowout plug, permitting the burning charge to ignite the propellant grain. The whole process of ignition requires about 0.005 second. Pressure of the hot propellant gases from the burning grain bursts the nozzle seal and provides the thrust to propel the rocket. Thrust overrides the detent spring, releasing the pawl from the rocket detent groove. The thrust then pushes the rocket out the forward end of the tube. The impact from the first rocket out shatters the forward fairing and the blast removes the tail fairing.

2.75-INCH (SERIES) LAUNCHERS

The 2.75-inch (series) launchers are intended for shipping (in some cases, with warheads installed) stowing, and firing the 2.75-inch rockets. The weight of loaded launchers varies, depending upon the number of rockets installed and rocket configuration.

The rockets are retained in the launcher tubes during shipping, handling, and flight by engagement of a leaf-spring type of detent with integral blast paddles (fig. 2-19). During loading, the rocket motor depresses the detent until the detent snaps into the detent grooves located on the aft end of the motor. To remove rocket motors, use a rocket loading and release tool to depress

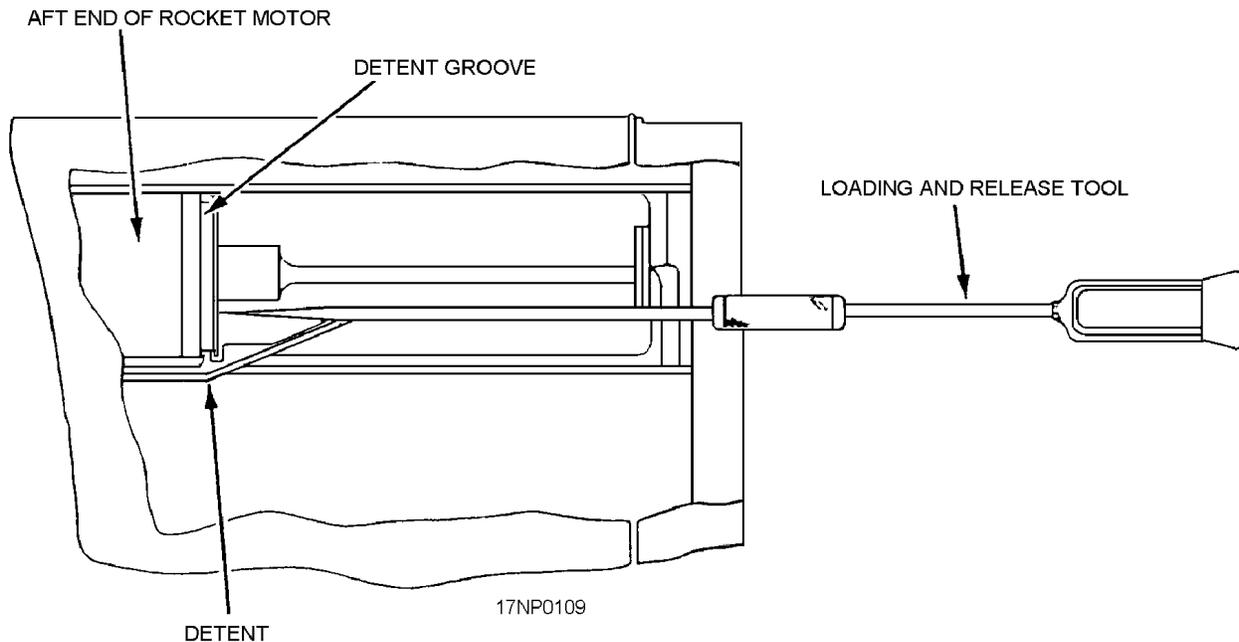


Figure 2-19.—Rocket launcher detent (2.75-inch).

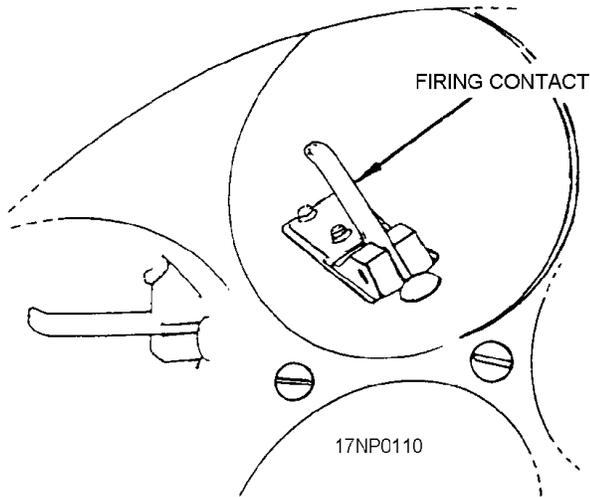


Figure 2-20.—Launcher firing contact assembly (2.75-inch launcher).

the detent. A spring-loaded firing contact (fig. 2-20) is located in the end of each tube.

The principles of operation for the 2.75-inch launcher are basically the same as the 5.0-inch launcher. The 2.75-inch launcher can be loaded with less than 7 or 19 rockets when tactical requirements exist. However, you should refer to the specific tactical manual and aircraft-loading manual. Also, since the rockets are fired in a definite sequence, the rockets must be loaded into the launcher tubes in the proper sequence. Airborne rocket loading procedures, including electrical test procedures, are covered later in this manual.

MK III ROCKET LAUNCHER TESTER

Perform the self-test of the Mk III Rocket Launcher Tester (fig. 2-21) prior to loading launchers in accordance with NAVAIR 17-15MDA-40.

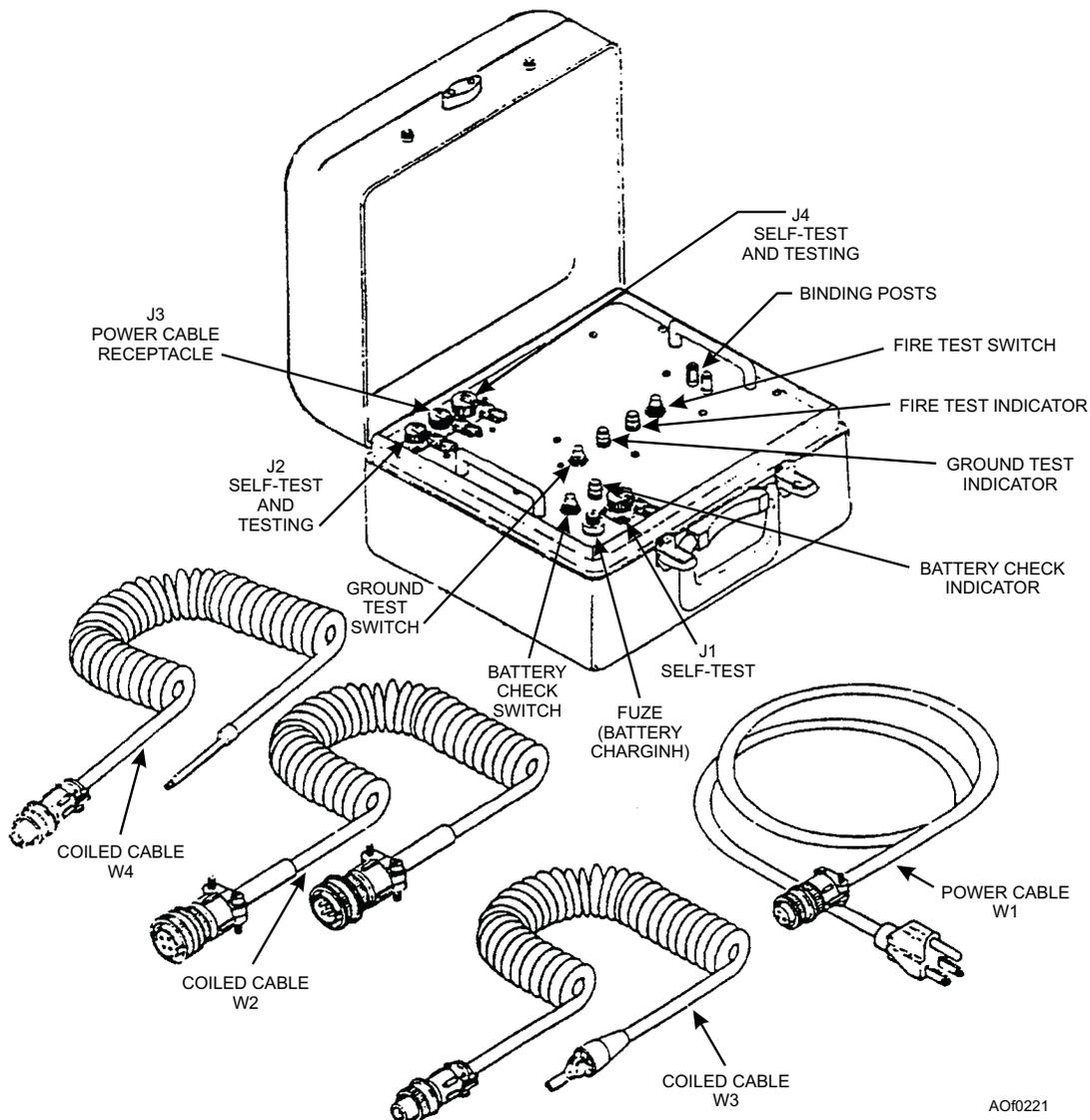


Figure 2-21.—Mk III Rocket Launcher Tester with cables.

REVIEW NUMBER 5

- Q1. Name the section of the launcher that houses or supports all other components of the launcher.
- Q2. RF barriers are used on 2.75-inch rocket pods to _____.
- Q3. List the components that are common to rocket launcher packages.
- Q4. What device, found on all rocket launchers, prevents loaded rockets from firing?
- Q5. When is the detent pin in the rocket launcher safe/arm device removed?
- Q6. What is the weight, depending on configuration, of a fully loaded LAU-10 rocket launcher?

ROCKET SAFETY PRECAUTIONS

LEARNING OBJECTIVE: *Recognize the safety precautions to follow when working with aircraft rockets and rocket launchers.*

The aircraft rocket is no more dangerous than any other explosive weapon. It does have certain peculiar hazards. A completely assembled rocket, if accidentally fired, takes off under its own power in the direction it is pointed, and threatens everything in its path. When fired, an assembled rocket expels a blast of burning gas capable of injuring or killing anyone it strikes. Generally, rocket motors without a head attached won't explode. It is a fire hazard since ballistite or cordite N (SPCG) ignites easily and burns readily. High-explosive heads, either fuzed or unfuzed, present the same risk as gun projectiles under the same conditions. Handle rockets, whether completely assembled or disassembled, with extreme care to avoid damage to parts.

Only personnel who are certified to handle rockets should be in the vicinity of assembly operations. When handling airborne rockets, rocket components, and launchers, follow all safety practices that apply to airborne armament and weapons. If practicable, all work should be performed from the side of the rocket launcher.

Rocket motors should be stowed in the same manner as smokeless powder. **Never allow matches and open flames in the stowage area. Smoking is NOT permitted in the loading area within 200 feet of ammunition.** Do not stow rocket motors in the same

compartments with or near radio apparatus or antenna leads. Induced currents might ignite the motor. Do NOT fire rocket motors when the propellant temperature is outside the safe-firing temperature limits specified on the motor tube.

If a rocket motor is dropped and any portion impacts on a hard surface after falling 2 feet or more, do NOT use it. Cracks or breaks in the grain increase the carefully calculated burning area and cause excessive internal pressure buildup, which can cause the motor to blow up after ignition.

Stow high explosive heads and fuzes (except fuzes that are permanently installed in the head) separately in the same manner as high-explosive projectiles. Ready-service stowage of assembled rockets is authorized for the 2.75-inch and 5.0-inch aircraft rockets according to NAVSEA OP 4 and NAVSEA OP 5.

A fuze is relatively sensitive and must be handled with care to avoid extreme shock that might cause damage. Conduct fuzing, unfuzing, assembly, or disassembly operations of all types of ammunition away from other explosives and vital installations. Only the minimum number of persons and rounds required should be in the vicinity. The ideal situation is to permit work on only one round at a time. This work should be done on a deck or at some other location remote from all magazines, ready stowage, explosive supplies, or vital installations.

Examination of the exterior of some fuzes will not show if they are armed. If, for any reason, you think a fuze might be armed, the fuze should be treated as an armed and sensitive fuze. You must NOT attempt to remove it from the rocket head. The complete fuzed round should be disposed of according to current directives. When available, explosive-ordnance-disposal (EOD) personnel should dispose of such rounds.

CAUTION

NEVER attempt to remove a base fuze from a rocket head.

You should NOT tamper with (or attempt to repair) any parts of the round. If the round is damaged or defective, remove the head from the motor and mark the defective part for return to the issuing agency. Disassembly or alteration of rocket components is NOT authorized except under specific instructions from Naval Air Systems Command.

Fuzes and/or warheads dropped 5 feet or more onto a hard surface and rockets that have been accidentally released from aircraft launchers upon aircraft landing must be disposed of according to current directives. If a loaded launcher is dropped, you should NOT use it until the launcher tubes, latching mechanisms, and rockets are inspected for damage.

Rocket launchers should NOT be suspended from a bomb rack that does not have independent ignition and jettisoning circuits. To prevent possible explosion, do NOT expose airborne rockets or loaded launchers to the exhaust from jet engine starter pods or gas turbine compressors. A minimum distance, as indicated on the unit, must be maintained between the gas turbine exhaust path and rocket assemblies upon which the exhaust impinges. In the absence of specific information on the unit, a minimum distance of 10 feet must be maintained.

Rockets should NOT be loaded or unloaded from launchers while on the flight deck. RF barriers should remain in place on the launcher while on the flight deck.

The detent pin must be in the breaker switch at all times. The only exceptions are when you are making certain electrical checks, or when the aircraft is ready for flight. Do NOT, under any circumstances, perform an electrical test with rockets in the launcher.

REVIEW NUMBER 6

- Q1. *If you are working around rockets or loaded pods, the preferred position is _____.*
- Q2. *Smoking is not permitted within what minimum range of rocket ammunition?*
- Q3. *What is the maximum distance that a rocket motor can be dropped and still be used as a serviceable motor?*

- Q4. *What minimum distance must be maintained between gas turbine exhaust paths and rockets?*

REVIEW NUMBER 5 ANSWERS

- A1. *The center section of the launcher that houses or supports all other components of the launcher.*
- A2. *RF barriers are used on 2.75-inch rocket pods to prevent entry of electromagnetic radiation into the igniter circuit.*
- A3. *The components that are common to rocket launcher packages are as follows: fairings, breaker switch, mode selector switch, and intervalometer.*
- A4. *The breaker switch, found on all rocket launchers, prevents loaded rockets from firing.*
- A5. *The detent pin in the rocket launcher safe/arm device is removed immediately before takeoff.*
- A6. *The weight, depending on configuration, of a fully loaded LAU-10 rocket launcher is approximately 500 to 550 pounds.*

REVIEW NUMBER 6 ANSWERS

- A1. *If you are working around rockets or loaded pods, the preferred position is at the sides of the rocket or pod. Never work in front or behind them.*
- A2. *Smoking is not permitted within 200 feet of rocket ammunition.*
- A3. *A rocket motor can be dropped 2 feet and still be used as a serviceable motor.*
- A4. *A minimum of 10 feet must be maintained between gas turbine exhaust paths and rockets.*

