The Interactive features of this manual are currently disabled.

Many graphics will not appear correctly unless these features are turned on. You should either see a popup window, or a yellow banner at the top of the application. To enable the Interactive features of this manual follow the steps illustrated below:

If you see a popup window do the following:

![Manage Trust for Multimedia Content dialog box]

Click Here

Then Click Here

If you see a yellow banner, do the following:

![Options to trust the document]

Click Here

Then Click Here

Once you have completed either of the above procedures the features will be enabled for this document, and this warning won't appear again after you leave this page.
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.

On ships and shore stations, the handling of ammunition and explosives - such as, assembly/disassembly, and loading/unloading - requires certain restrictions, environmental conditions, and designated areas where the operation is to be performed. As an aviation ordnanceman, it is important to be knowledgeable of the hazards of electromagnetic radiation to ordnance (HERO) which affects the handling of rocket motors.

Radiation hazard (RADHAZ) is radio-frequency electromagnetic fields of sufficient intensity to produce harmful biological effects in humans, cause spark ignition of volatile combustibles, or actuate electroexplosive devices. During rocket motor handling or assembly operations, proper RADHAZ must be controlled. For the safety of personnel and to maintain reliability of aviation ordnance, all necessary precautions must be taken to ensure the prevention and accidental ignition of electrically initiated devices (EIDs) due to radio frequency (RF) electromagnetic fields.

To better understand, EIDs perform a variety of functions, such as initiating rocket motors, arming and detonating warheads, and ejecting chaff and flares. The need for HERO control arises so that these functions do not occur unintentionally or prematurely because of exposure to electromagnetic energy.

HERO is discussed in the following chapters of this manual. For more information on HERO you should refer to Electromagnetic Radiation Hazards to Ordnance, NAVSEA OP 3565/NAVAIR 16-1-529.

LEARNING OBJECTIVES

When you have completed this chapter, you will be able to do the following:

1. State the principles of rocket propulsion.
2. Identify rocket components to include motors, warheads, and fuzes.
3. Identify the purpose and use of service rocket assemblies to include the 2.75-Wrap-Around Folding Fin Aircraft Rocket (WAFFAR) and the 5.0-inch spring-actuated, wrap-around fin rocket.
4. Recognize the shipping configuration for aircraft rocket launchers and identify common aircraft rocket launcher components.
5. Recognize the safety precautions to follow when working with aircraft rockets and rocket launchers.
AIRCRAFT ROCKETS

There are two rockets currently used by the Navy. The first is the 2.75-inch, Wrap-Around Folding Fin Aircraft Rocket (WAFFAR) known as the Mighty Mouse (Figure 2-1). The second is the 5.0-inch, spring-actuated, wrap-around fin rocket known as the Zuni (Figure 2-2). 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.** Terms applied 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.** The result when 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.** The term 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 even in a vacuum. The propellant contains its own oxidizers to provide the necessary oxygen during burning.

To understand how a rocket operates, it will help to refer to Figure 2-3 and 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 the design shown, 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.

**Motor**

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 Mods 1 and 2.

**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 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 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, radiation hazard (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.

**PROPELLANT** - 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 uniformly from the center outward and from forward to aft. If inhibitors aren'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 would increase the burning surface and an identical hazard would exist.

**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 and 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 Hazards of Electromagnetic Radiation to Ordnance (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 (Figure 2-4) 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 automatically comes 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 2-5) is always in place over the ignition contact band.

Figure 2-4 — Typical center electrical lead wire connection (5.0-inch motor).
Figure 2-5 — Shielding band for 5.0-inch FFAR.

**NOZZLE AND FIN ASSEMBLY** - 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 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 a detent groove in the aft end of the nozzle plate to hold the rocket in position after it is loaded in the launcher. The Mk 71 Mods rocket motor has a modified igniter and a modified nozzle and fin assembly. The nozzle and fin assembly (*Figure 2-6*) 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 (Figure 2-7) 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.

Warhead

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.

**HIGH-EXPLOSIVE FRAGMENTATION (HE-FRAG) WARHEADS** - HE-FRAG warheads (*Figure 2-8 and Figure 2-9*) 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.*

---

*Figure 2-8 — High-explosive fragmentation (HE-FRAG) 2.75-inch warheads.*

*Figure 2-9 — High-explosive fragmentation (HE-FRAG) 5.0-inch warheads.*
Table 2-1 Service Warheads

<table>
<thead>
<tr>
<th>TYPE</th>
<th>2.75-INCH</th>
<th>5.0-INCH</th>
</tr>
</thead>
<tbody>
<tr>
<td>HE-FRAG</td>
<td>M151</td>
<td>Mk 63 Mod 0</td>
</tr>
<tr>
<td></td>
<td>Mk 146 Mod 0</td>
<td></td>
</tr>
<tr>
<td>AT/APERS</td>
<td></td>
<td>Mk 32 Mod 0</td>
</tr>
<tr>
<td>GP</td>
<td></td>
<td>Mk 24 Mod 0 and 1</td>
</tr>
<tr>
<td>FLECHETTE</td>
<td>WDU-4A/A</td>
<td></td>
</tr>
<tr>
<td>SMOKE</td>
<td>M156 (WP)</td>
<td>Mk 34 Mod 0</td>
</tr>
<tr>
<td></td>
<td>Mk 67 Mod 1 (RP)</td>
<td>Mk 34 Mod 2</td>
</tr>
<tr>
<td>ILLUMINATION/IR FLARE</td>
<td>M257</td>
<td></td>
</tr>
<tr>
<td></td>
<td>M278 IR</td>
<td></td>
</tr>
</tbody>
</table>

**ANTITANK/ANTIPERSONNEL (AT/APERS) WARHEAD** - The high-explosive AT/APERS warhead (Figure 2-10) combines the effectiveness of the HE-FRAG and high-explosive antitank (HEAT) warheads.

![Mk 32 MOD 0 AT/APERS Warhead Configuration](image)

**Figure 2-10** —Mk 32 Mod 0 AT/APERS warhead.

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.
General Purpose (GP) WARHEAD - The high-explosive, GP warhead (Figure 2-11) 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.

FLECHETTE WARHEAD – The Flechette warhead (Figure 2-12) is used against personnel and light 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 WARHEAD – The smoke warhead (Figure 2-13) is 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. This warhead is designated SMOKE, followed by the abbreviation for the smoke producing agent it contains. For example, the abbreviation for white phosphorus is (WP); for plasticized white phosphorus is (PWP); and for red phosphorus is (RP). The types of smoke warheads currently in use are listed in Table 2-1.

![Figure 2-13 —Smoke warheads.](image)

FLARE WARHEAD – A flare warhead (Figure 2-14) is used to illuminate tactical operations. It consists 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.
PRACTICE WARHEAD - Practice warheads are either dummy configurations or inert-loaded service warheads. In the inert-loaded service warhead, 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>
<thead>
<tr>
<th>Table 2-2 — Practice Warheads</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.75-INCH</td>
</tr>
<tr>
<td>WTU-1/B</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>

Fuzes

Rocket fuzes are primarily classified by their location in the warhead; for example, a 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, NAVAIR 11-75A-92.
<table>
<thead>
<tr>
<th>FUZE</th>
<th>CLASSIFICATION</th>
<th>APPLICATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mk 352 Mod 2</td>
<td>Nose impact (PD)</td>
<td>2.75-inch and 5.0-inch (Note 1)</td>
</tr>
<tr>
<td>M423</td>
<td>Nose impact (PD)</td>
<td>2.75-inch (Note 2)</td>
</tr>
<tr>
<td>M427</td>
<td>Nose impact (PD)</td>
<td>2.75-inch</td>
</tr>
<tr>
<td>Mk 436 Mod 0</td>
<td>Nose impact (PD)</td>
<td>2.75-inch</td>
</tr>
<tr>
<td>Model 113A</td>
<td>Acceleration-deceleration</td>
<td>2.75-inch</td>
</tr>
<tr>
<td>M442</td>
<td>Acceleration-deceleration</td>
<td>2.75-inch</td>
</tr>
<tr>
<td>FMU-90/B</td>
<td>Nose impact (PD)</td>
<td>5.0-inch (Note 1)</td>
</tr>
<tr>
<td>Mk 188 Mod 0</td>
<td>Nose impact (PD)</td>
<td>5.0-inch</td>
</tr>
<tr>
<td>Mk 191</td>
<td>Base detonating impact (BD)</td>
<td>5.0-inch</td>
</tr>
<tr>
<td>Mk 193 Mod 0</td>
<td>Mechanical time</td>
<td>5.0-inch</td>
</tr>
<tr>
<td>Mk 93 Mod 0/M414A1</td>
<td>Proximity</td>
<td>5.0-inch</td>
</tr>
</tbody>
</table>

Note 1: Designed to be used with 2.75-inch but can also be used with 5.0-inch when the BBU-15/B adapter is installed.

Note 2: Designed for use with 2.75-inch only.
PACT FIRING FUZES - Impact firing fuzes (Figure 2-15) function when the rocket strikes a target that offers sufficient resistance to cause crushing, distortion of the fuze structure, or deceleration to occur during impact (inertial).

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 unarm 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 (Figure 2-16) 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.
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 currently in use by the Navy. It is a base-mounted fuze that is permanently installed in the WDU-4A/A flechette warhead.

PROXIMITY FUZES - Proximity fuzes, sometimes referred to as VT fuzes (Figure 2-17), 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 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 (Figure 2-18).
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.

Figure 2-17 — Proximity fuze.

Figure 2-18 — Adapter booster BBU-15/B.
The 2.75-inch airborne rocket is an effective air-to-ground weapon against most targets. The Wrap-Around Folding Fin Aircraft Rocket (WAFFAR) is fired in large numbers to produce a shotgun pattern and are carried and launched from 7- or 19-round tube launcher packages. These packages are described later in this chapter.

The 2.75-inch WAFFAR is accurately and safely launched from low-speed aircraft and helicopters.

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

1. Complete rounds in 7 or 19 round 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 ordnance personnel 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. Additional information can be found in specific aircraft loading and tactical manuals.

Like the 2.75-inch rocket, the 5.0-inch rocket 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 and used with all configurations.

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
2. Separate components in separate shipping containers

NOTE
The Mk 191 and Model 113A fuzes are permanently installed in the warheads.
AIRCRAFT ROCKET LAUNCHERS

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-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 is shown in Figure 2-19 is typical of all launcher-shipping configurations, except for the radio frequency (RF) barriers.
Figure 2-19 — Typical launcher shipping and storage configuration.

Center Section

The launcher tubes of both types of launchers are constructed of thin-walled, high-strength aluminum alloy and are secured together with metal ribs. The entire package is covered with an aluminum skin. The launchers have a thermal protective coating on the exterior surface and an RF/Thermal barrier that fit on the forward and aft end of the launcher. The center section houses or supports all other components of the launcher.
RF/Thermal Barriers shall be used for all shipboard operations.

<table>
<thead>
<tr>
<th>LAUNCHER TYPE</th>
<th>NO. OF TUBES</th>
<th>TUBE MATERIAL</th>
<th>REUSABLE</th>
<th>METHOD OF FIRING</th>
</tr>
</thead>
<tbody>
<tr>
<td>LAU-61C/A</td>
<td>19</td>
<td>Alum.</td>
<td>Yes</td>
<td>Ripple or Single</td>
</tr>
<tr>
<td>LAU-68D/A</td>
<td>7</td>
<td>Alum.</td>
<td>Yes</td>
<td>Ripple or Single</td>
</tr>
</tbody>
</table>

Table 2-4 — 2.75-Inch Rocket Launchers

<table>
<thead>
<tr>
<th>LAUNCHER TYPE</th>
<th>NO. OF TUBES</th>
<th>TUBE MATERIAL</th>
<th>REUSABLE</th>
<th>METHOD OF FIRING</th>
</tr>
</thead>
<tbody>
<tr>
<td>LAU-10C/A</td>
<td>4</td>
<td>Alum.</td>
<td>Yes</td>
<td>Ripple or Single</td>
</tr>
<tr>
<td>LAU-10D/A</td>
<td>4</td>
<td>Alum.</td>
<td>Yes</td>
<td>Ripple or Single</td>
</tr>
</tbody>
</table>

Table 2-5 — 5.0-Inch Rocket Launchers

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.

Radio Frequency (RF)/Thermal Barriers

The RF/Thermal barriers for the LAU-61C/A and LAU-68D/A launchers consist of molded-alumina silica fiber material covered with aluminum foil and afford both thermal and RF protection. These barriers may vary slightly in color, thickness, or weight.

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.

To reduce exposure of the rockets to fire or cook-off during weather deck handling, the forward and aft Thermal Electromagnetic Shield Barrier Assemblies and the Forward LAU-61/68 Fairing Assembly shall be installed in the assembly area and shall remain in place until just prior to commencing aircraft loading.

Use of the forward barrier is not required if the rocket warheads protrude beyond the forward edge of the launcher. Barriers shall be reinstalled immediately following download of the all-up-round (AUR) rockets from aircraft.

The barriers remain installed for flight and are removed by impact or blast when the rocket is fired.

NOTE

RF/Thermal Barriers shall be used for all shipboard operations.
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.

Fairings

Frangible fairings (Figure 2-20) 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) (Figure 2-20, 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 (Figure 2-20, 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 (Figure 2-19).

Figure 2-20 — Frangible fairings rocket launcher airborne configurations.
Fairings are not used in all applications. For any restrictions in the use of fairings, the specific tactical manual should be reviewed.

**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 will not fire. The detent pin has a REMOVE BEFORE FLIGHT red streamer attached. The pin should be pulled immediately before the aircraft takes off and installed immediately after the aircraft lands.

The detent pin must be installed in the breaker switch before the launcher is loaded with rocket motors. The detent pin should remain installed—except during actual flight—until the launcher is downloaded and verified 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) pods. 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-round tube launcher pod is in the SINGLE fire position, the intervalometer fires rockets in pairs. If the mode selector switch is 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 2-21).

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 (Figure 2-21) 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. The current then travels 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 (Figure 2-22). During loading, the rocket motor depresses the detent until the detent snaps into the detent groove located on the aft end of the motor. To remove rocket motors, a rocket loading and release tool is used to depress the detent.

![Figure 2-22 — Rocket launcher detent (2.75-inch).](image)

A spring-loaded firing contact (Figure 2-23) 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.

![Figure 2-23 — Launcher firing contact assembly (2.75-inch launcher).](image)
MK III ROCKET LAUNCHER TESTER

The self-test of the Mk III Rocket Launcher Tester (fig. 2-24) should be performed prior to loading launchers in accordance with *Intermediate Maintenance and Illustrated Parts Breakdown MK III Rocket Launcher Test Set*, NAVAIR 17-15MDA-40.

ROCKET SAFETY PRECAUTIONS

The aircraft rocket is no more dangerous than any other explosive weapon. However, 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. A fire hazard exists since ballistite or cordite ignites easily and burns readily. High-explosive heads, either fuzed or unfuzed, present the same risk as gun projectiles under the same conditions. Whether completely assembled or disassembled, rockets should be handled 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, all safety practices that apply to airborne armament and weapons should be followed. 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 and matches and open flames should NEVER be allowed in the stowage area. Smoking is NOT permitted in the loading area within 200 feet of ammunition. Rocket motors must NEVER be stowed in the same compartments with or near radio apparatus or antenna leads. Induced currents might ignite the motor. Rocket motors should NEVER be fired 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 any distance, it should NOT be used. Cracks or breaks in the grain increase the carefully calculated burning area and will cause excessive internal pressure buildup, which can cause the motor to blow up after ignition.

Explosive heads and fuzes (except fuzes that are permanently installed in the head) should be stowed 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 Ammunition Afloat, NAVSEA OP 4 and Ammunition and Explosives Ashore, NAVSEA OP 5.

A fuze is relatively sensitive and must be handled with care to avoid extreme shock that might cause damage. Fuzing, unfuzing, assembly, or disassembly operations of all types of ammunition should be conducted 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, there is a chance a fuze might be armed, the fuze should be treated as an armed and sensitive fuze. The fuze should NEVER be removed 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.

Personnel should NOT tamper with (or attempt to repair) any parts of the round. If the round is damaged or defective, the head should be removed from the motor and the defective part marked 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, the launcher should NOT be used 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, airborne rockets or loaded launchers should NOT be exposed 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. All 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 certain electrical checks are being made, or when the aircraft is ready for flight. Under NO circumstances should an electrical test be performed with rockets in the launcher.
End of Chapter 2

Aircraft Rockets and Rocket Launchers

Review Questions

2-1. The history of rockets covers a span of how many centuries?

A. Three  
B. Five  
C. Seven  
D. Eight

2-2. What initiating device ignites the propellant grain of a rocket?

A. Motor  
B. Igniter  
C. Stabilizing rod  
D. Venturi-type nozzle

2-3. What component of a rocket contains the propellant, igniter, and nozzle?

A. Crosshead  
B. Nozzle insert  
C. Contact disc  
D. Motor

2-4. The gases produced when rocket motor propellant burns create what type of force?

A. Thrust  
B. Lift  
C. Thermal  
D. Molecular

2-5. Rockets are propelled by what means?

A. The expulsion of gases  
B. An electrical discharge  
C. A jet engine  
D. A turbo fan engine

2-6. Which of the following rocket components is/are a part of the motor?

A. Fuze  
B. Propellant only  
C. Nozzle and fin assembly only  
D. Propellant and nozzle and fin assembly
2-7. What type of HE-FRAG warhead is used with a 5.0-inch rocket?

A. Mk 1 Mod 0  
B. Mk 32 Mod 0  
C. Mk 63 Mod 0  
D. Mk 64 Mod 0

2-8. What type of warhead combines the effectiveness of HE-FRAG and HEAT warheads?

A. GP  
B. AT/APERS  
C. Flare  
D. Flechette

2-9. What type of warhead is a compromise between the armor-piercing and fragmentation designs?

A. HE-FRAG  
B. HEAT  
C. AT/APERS  
D. GP

2-10. A 2.75-inch rocket assembly can be carried and launched from which of the following launcher packages?

A. 4-round packages  
B. 7-round packages only  
C. 19-round packages only  
D. 7- or 19-round packages

2-11. All 2.75-inch rockets may be shipped in which of the following configurations?

A. Complete rounds in 7- or 19-tube launchers or in wooden boxes  
B. Rocket motors in 7-tube launchers and fuze-warhead combinations in separate shipping containers  
C. Separate components in authorized shipping containers  
D. All the answers are correct

2-12. Which NAVAIR publication provides authorized assemblies, safety precautions, and restrictions for airborne rockets?

A. 01-700  
B. 11-75A-92  
C. 11-5D-20  
D. 11-5A-17
2-13. All 5.0-inch rockets should be received through the supply system in which of the following configurations?

A. Rocket motors in a 4-round launcher  
B. Separate components in separate shipping containers  
C. Fuzes and warheads in separate shipping containers  
D. All the answers are correct

2-14. A rocket motor should NOT be used if it has been dropped more than what prescribed number of feet?

A. 2 feet  
B. 4 feet  
C. 8 feet  
D. A rocket motor should NEVER be used if dropped

2-15. When, if ever, should you attempt to remove the base fuze from a rocket warhead?

A. After the warhead has been dropped more than 4 feet  
B. After external evidence of arming is evident  
C. After receiving orders from your supervisor  
D. You should never attempt to remove the base fuze