CHAPTER 8

AIRCRAFT ORDNANCE

INTRODUCTION

As an Airman, you might be assigned to the armament branch of an aircraft squadron, the weapons department of a naval air station, or an aircraft carrier. Regardless of where you are assigned, you will work around aircraft armament systems and various associated weapons.

Aviation Ordnancemen (AOs) handle aircraft ordnance. They work with aircraft guns and pyrotechnics. They also maintain bombs, rockets, missiles, mines and torpedoes. They maintain the aircraft weapons releasing and launching equipment necessary for disbursing such items. AOs are familiar with the safety precautions for working with such material. Personnel directly involved in ordnance handling must be qualified and/or certified according to the Navy's current qualification/certification program.

You may not be assigned in an area that requires direct contact with ordnance. You must still be familiar with the basic characteristics of ordnance and hazards peculiar to aircraft ordnance.

GENERAL TERMINOLOGY AND DEFINITIONS

LEARNING OBJECTIVE: Recognize common terms and definitions associated with aircraft ordnance.

AOs use special terminology on the job. To understand this chapter, you should know these terms. A few of the more common terms and definitions are as follows:

Ordnance. Military material (such as combat weapons of all kinds) with ammunition and equipment required for its use. Ordnance includes everything that makes up a ships or aircraft's armament. This includes guns, ammunition, and all equipment needed to control, operate, and support the weapons.

Propellant. The material that provides the energy for propelling a projectile. Specifically an explosive charge for propelling a bullet, shell, or the like. It may also be a fuel, either solid or liquid, for propelling a rocket or missile.

Pyrotechnics. Ammunition containing compositions that produce illumination. Examples are colored lights or smoke for marking or signaling, or incendiary effects of smoke screens.

Ammunition. A device charged with explosives, propellants, pyrotechnics, initiating composition, or chemical material.

Bomb-type ammunition. Bomb-type ammunition is characterized by a large high-explosive charge-to-weight ratio. Examples are aircraft bombs, mines, and warheads used in guided missiles and rockets. This ammunition has destructive blast effect at or near the target.

Cartridge-activated device (CAD). Explosive-loaded devices designed to provide the means of releasing or harnessing potential cartridge energy to initiate a function or a special-purpose action. Aircraft equipment, such as ejection seats, canopy ejection systems, aircraft bomb racks, and launchers, use CADs.

Chemical ammunition. Chemical ammunition consists of a variety of items that depend upon a chemical filling for its effect rather than upon explosives or shrapnel. An explosive or ignition element must activate this ammunition.

Inert ordnance. Actual size ammunition items with working mechanisms used for training exercises but having no explosive materials.

Guided missile. An unmanned vehicle designed as a weapon that travels above the surface of the earth. This vehicle follows a course or trajectory that is guided by an automatic or remotely controlled mechanism within the vehicle.

Incendiary. A chemical used to ignite combustible substances.

Practice/training ammunition. An ammunition item that looks and acts just like the service item. It may be a modification of a service (tactical) item or something designed specifically for practice. Used in training associated with all types of ordnance. Practice ammunition may either be expendable or recoverable, depending upon the device involved.

Service ammunition. Ammunition for combat use. This ammunition is approved for service use. It contains explosives, pyrotechnics, or chemical agent filler. The propellant, if required, is of service or reduced charge weight. Service ammunition is also called *tactical ammunition*.

Warhead. The part of ammunition containing the materials intended to inflict damage. The explosives in warheads are called the *payload*.

Airborne stores. Items that are NOT normally separated from the aircraft in flight. A partial list of these items includes tanks, pods, and non-expendable training weapons. Targets, racks, launchers, adapters, and detachable pylons are also included.

Q8-1. What aircraft equipment uses cartridge-active devices (CADs)?

Q8-2. Define the term incendiary.

Q8-3. What are airborne stores?

THE FUNDAMENTALS OF EXPLOSIVES

LEARNING OBJECTIVE: Recognize the fundamental concepts of explosives, the potential hazards associated with weapons, and the identification and marking of ammunition.

You should know the difference between an explosive and an explosion. An explosive is a material that is capable of producing an explosion by its own energy.

There are many definitions of an explosion. Dr. Tenney L. Davis gave us the only simple definition: an explosion is "a loud noise and the sudden going away of things from the place where they have been." Another definition states "an explosion is a rapid and violent release of energy, not necessarily involving an explosive substance." For example, in the explosion of a boiler, the water is not an explosive substance.

In this chapter, an explosion is defined as "a chemical decomposition or transformation, with the growth of heat and the formation of decomposition products, sometimes producing gas." All explosives in military use produce gas, so this definition is correct, though a chemist might not agree.

If ammunition is to function at the time and place desired, you must use the right type of explosives. Each has a role, either as a propellant or as a bursting charge. Explosives suitable for one purpose may be entirely unsatisfactory for another. For example, the explosive used to burst forged steel projectiles is unsuitable for ejecting and propelling the projectile. Normally, the more sensitive the explosive, the smaller the amount used. Similarly, the explosives used in initiators, such as primers and fuzes, are so sensitive to shock that only a small quantity can be used safely.

HIGH AND LOW EXPLOSIVES

There are two general classes of military explosives—high explosives and low explosives. Each is classified according to its rate of decomposition. High and low explosives may be further classified by their reaction, composition, or service use. However, only the two general classes, high and low, are covered in this chapter.

High Explosives

High explosives are usually nitration products of organic substances. They may contain nitrogen and inorganic substances or mixtures of both. A high explosive may be a pure compound or a mixture of several compounds. Additives, such as powdered metals, plasticizing oils, or waxes, provide desired stability and performance characteristics.

A high explosive is characterized by extremely fast decomposition called detonation. A high explosive detonates almost instantaneously. The detonation is similar to a very rapid combustion or a rupture and rearrangement of the molecules themselves. In either case, gaseous and solid products are produced. The disruptive effect of the reaction makes some explosives valuable as a bursting charge. This bursting effect prevents its use in ammunition and gun systems because the gas pressures formed could burst the barrel of a weapon.

Low explosives

Low explosives are mostly solid combustible materials that decompose rapidly but do not normally explode. This action is called *deflagration*. Upon ignition and decomposition, gas pressures develop to propel something in a definite direction. Ammunition, gun systems, and some missiles use this type of explosive. The rate of burning is an important characteristic, which depends on such factors as combustion gas pressure, grain size and form, and composition. Under certain conditions, low explosives may react in the same manner as high explosives and explode.

ORDNANCE IDENTIFICATION AND MARKING

Identification of ammunition is extremely important when handling ordnance. Identification provides working/safety information, such as service (live)/nonservice (training) ammunition, class of explosives, and color codes representing the explosive hazards. Identification also provides administrative information, such as mark, modification, and lot numbers.

Color codes contain the most important information of the identification system! Color codes identify the explosive hazards contained within the ordnance. Regardless of your rating, you will work around ordnance-handling crews. Therefore, you should be familiar with the color code identification of ordnance.

Table 8-1 gives the color codes used to identify the hazards contained in ordnance. It also gives the meaning for each color code. These colors are normally painted on the ordnance during manufacturing. The colors may be stripes painted around the body or down the side of the item.

You can use the color codes shown in table 8-1 to identify ordnance explosive hazards. For example, you are approaching an aircraft and there is a bomb loaded on a wing station. The bomb is painted an olive drab (overall) color and has a yellow band painted around the nose. The olive drab color has no identification color-coding significance; but, the yellow band means that the bomb contains high explosives. Another example is a missile. A missile is painted white with a yellow band around the warhead section and a brown band around the rocket motor section. The white color on a missile has no identification color-coding significance. The yellow band means that the warhead contains high explosives. The brown band means that the rocket motor contains low explosives.

Knowing the color codes and the type of ordnance loaded on the aircraft give you vital information in an emergency such as a fire. For example, an aircraft loaded with ordnance is engulfed in a fire. All the ordnance on the aircraft is a light blue color with no other identification color codes visible. From this visual information, you can determine that none of the ordnance contains explosives. Thus, the fire can be fought much closer to the aircraft than if the ordnance contained high explosives.

Q8-4. What is the difference between an explosive and an explosion?

Q8-5. What are the two general classes of military explosives?

Q8-6. High explosives are not used in ammunition and gun systems for what reason?

Q8-7. Define low explosives.

Q8-8. What type of information is provided by ordnance identification?

Q8-9. In the ordnance identification system, the color codes provide what information?

AIRCRAFT WEAPONS AND AMMUNITION

LEARNING OBJECTIVE: Identify the types, uses, and basic characteristics of aircraft weapons and ammunition.

Aircraft weapons and ammunition are designed to reduce and/or neutralize an enemy's war potential. Several different types are discussed in the following text.

AIRCRAFT BOMB-TYPE AMMUNITION

Bomb-type ammunition is carried either in the bomb bay of an aircraft or externally on the wing or fuselage stations. Because of safety requirements, some bomb-type ammunition is shipped and stowed without the fuzes or arming assemblies. Ordnancemen must assemble these types of ammunition before they are used. Other types, such as cluster bomb units (CBUs), are shipped and stowed as complete assemblies.

Only the general characteristics and basic principles of operation for bomb-type ammunition and associated components are discussed in this chapter.

Table 8-1.—Ammunition Color Codes

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

*__NOTES__: The following colors, when applied as stated, have **no** identification color coding significance:

1. The colors **gray**, **orange**, **black**, **white**, **brick red**, or **green** on underwater ordnance, such as mines and torpedoes, and the color white on guided missiles or rockets.
2. The colors **black** and **white**, when used for lettering.
3. The color **white** when used in diamond-shaped figures on ammunition.

MK 80 (SERIES) GENERAL-PURPOSE BOMBS

The Mk 80 (series) low-drag, general-purpose (LDGP) bomb (fig. 8-1) is used in aircraft bombing operations. The case (bomb body) is aerodynamically designed and relatively light. Only 45 percent of the bomb's total weight consists of explosives.

The basic difference between the bombs shown in figure 8-1 is their size and weight. Unless otherwise indicated, the following details of the Mk 80 (series) LDGP bomb will be applicable to all the bombs listed in figure 8-1.

A complete bomb consists of all the components and accessories necessary for the bomb to function in the manner intended. Sensitive or fragile components, such as fuzes and adapter boosters, are packed separately and assembled to the bomb before it is used. The components of a typical LDGP bomb are as follows:

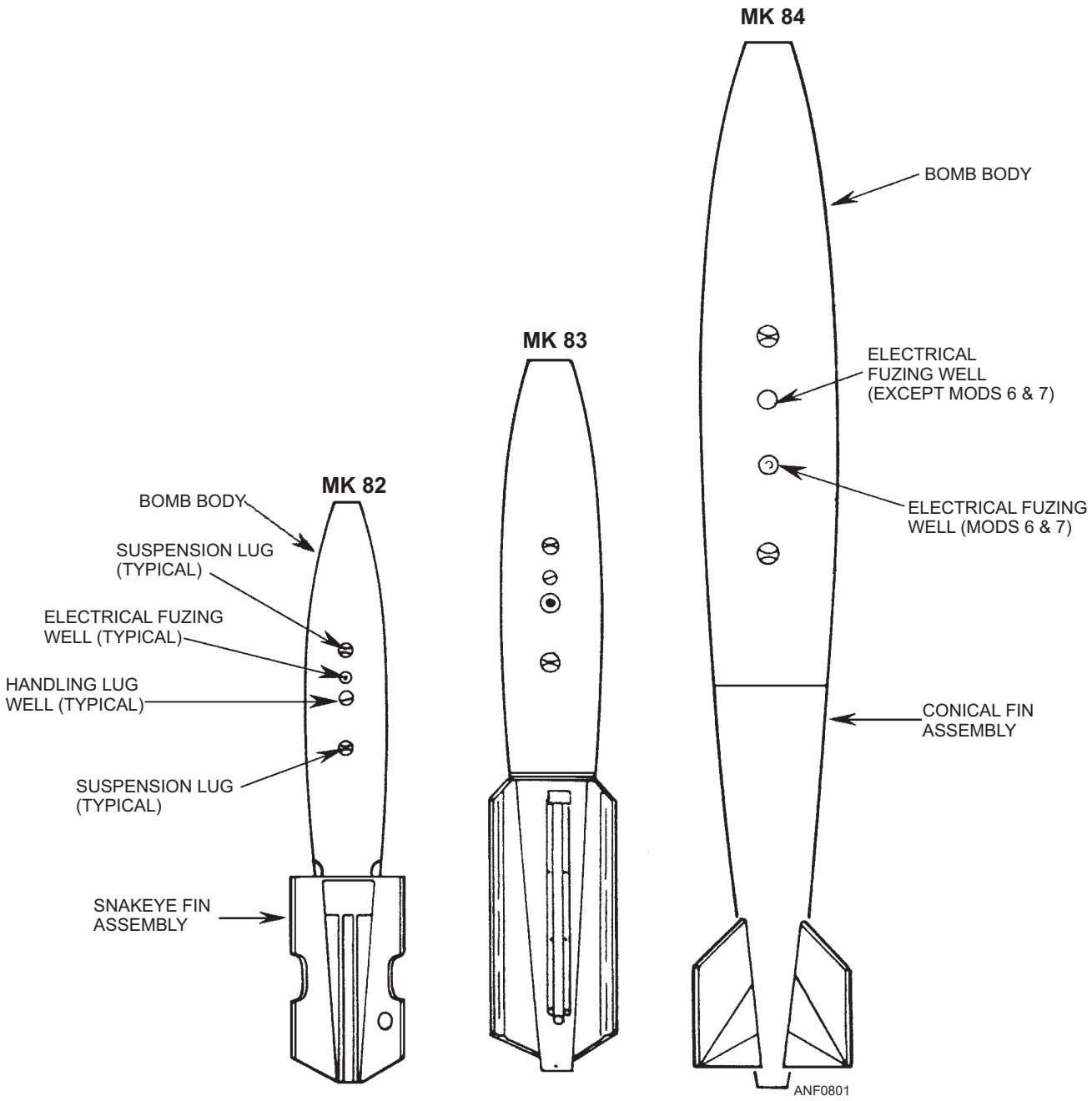


Figure 8-1.—Mk 80/BLU series bombs.

- Bomb body
- Suspending lugs
- Fuzing
- Fin assemblies

Bomb Body

The bomb body (fig. 8-1) is a metal container that contains the high explosive charge. There is a threaded cavity in both the nose and tail of the bomb body that allows the various fuzing applications. The bomb body also has threaded cavities for the installation of suspension and/or hoisting lugs. The rear charging tube, forward charging tube, charging receptacle, and charging receptacle plug are installed in the bomb body during the manufacturing process. These are used with various fuzing operations.

Suspending Lugs

Suspension lugs (fig. 8-1) are used for attaching the assembled bomb to the aircraft's suspension and releasing equipment. The lugs screw into the bomb body in pairs. They are spaced either 14 or 30 inches apart, depending on the size of bomb. During loading, the lugs engage the bomb rack suspension hooks, securing the bomb to the aircraft.

Fuzing

There are various fuzing combinations for the bomb body, depending on tactical requirements. Fuzes are divided into two broad categories—mechanical and electrical. Mechanical and electrical fuzes can be installed in either the nose and/or tail of the bomb body. These fuzes are maintained in a safe condition by the insertion of a safety cotter pin or arming wire through the arming vane and the fuze body. Mechanical fuzes are activated by means of an arming wire or lanyard, or by electrical energy transferred from the aircraft-carried equipment to the fuze as the weapon is released from the aircraft. When the mechanically fuzed weapon is released and falls away from the aircraft, the arming wire is pulled from the arming vane. This allows the arming vane to rotate in the airstream, arming the fuze. For emergency or other tactical reasons, the pilot has the option of permitting the arming wire to fall with the weapon. When the pilot uses this option, the arming vane can't rotate. Therefore, the weapon remains in an unarmed condition. When an electrically fuzed weapon is released from the aircraft, it receives the necessary electrical voltage signal from the aircraft firing circuits to arm the fuze.

Fin Assemblies

Fin assemblies provide bomb stability and cause it to fall in a smooth, definite curve to the target.

The conical fin (fig. 8-1) is used for the unretarded mode of delivery. The Snakeye fin assembly is used for either the low drag, unretarded (fig. 8-2, view A) or high drag retarded (fig. 8-2, view B) mode of delivery. Low-level bombing requires the retarded mode of delivery. The aircraft and the weapon are traveling at the same speed at the time of weapon release. This means the weapon and the aircraft will arrive at the target together, which could result in explosion damage to the aircraft. Therefore, use of the retarded mode of delivery retards (slows down) the weapon so the weapon gets to the target after the aircraft has passes. The explosion occurs after the aircraft passes the target.

Mk 80 series LDGP bombs are painted an olive drab color overall. A single or double yellow band painted around the nose of the bomb body identifies a high-explosive hazard. The double yellow bands indicate that the bomb body is thermally protected. This protection increases the weapon's *cook off* time if the weapon is engulfed by fire.

PRACTICE BOMBS

Practice bombs display the same ballistic properties as service-type bombs; however, they contain no explosive filler. Therefore, practice bombs are safer to use when training new or inexperienced pilots and ground handling crews. Practice bombs are inexpensive and can be used in more target locations.

There are two types of practice bombs—full-scale and subcaliber. **Full-scale** practice bombs are about the same size and weight as service bombs. **Subcaliber** practice bombs are much smaller than the service bombs they simulate.

Full-Scale Practice Bombs

The full-scale practice bombs are the Mk 82, 83, and 84 series LDGP inert bombs. Each bomb can be configured with the same components, such as fuzes, fins, and suspension lugs that are used with service bombs. The Mk 80 series practice bombs have an overall blue exterior or an olive drab exterior. Mk 80 series bombs also have a blue band around their nose and the word INERT in 1-inch letters on the exterior bomb body.

Subcaliber Practice Bombs

There are two types of subcaliber practice bombs—the Mk 76 Mod 5 and the BDU-48/B.

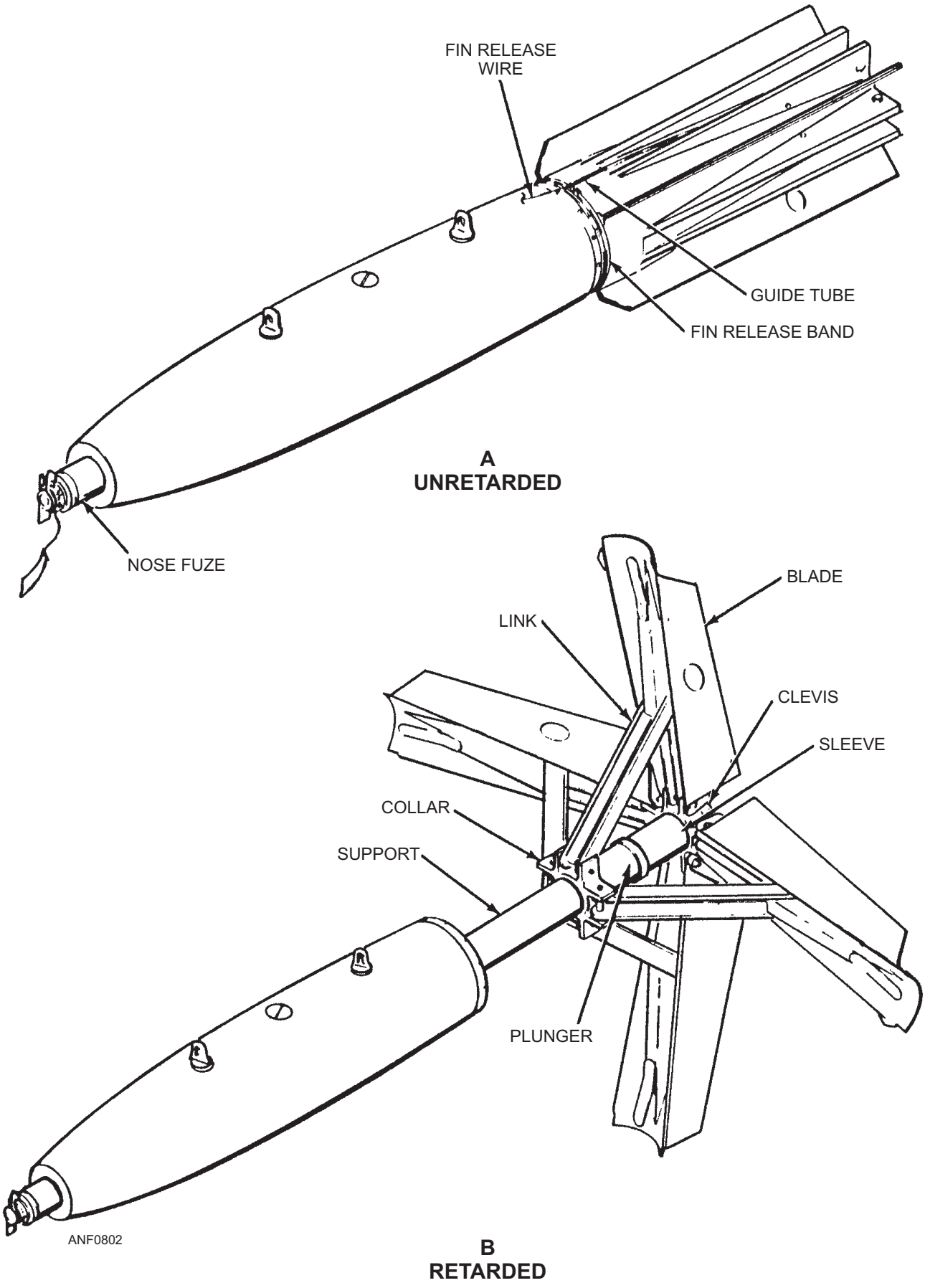


Figure 8-2.—Mk 82 LDGP bomb configured with a Snakeye fin assembly.

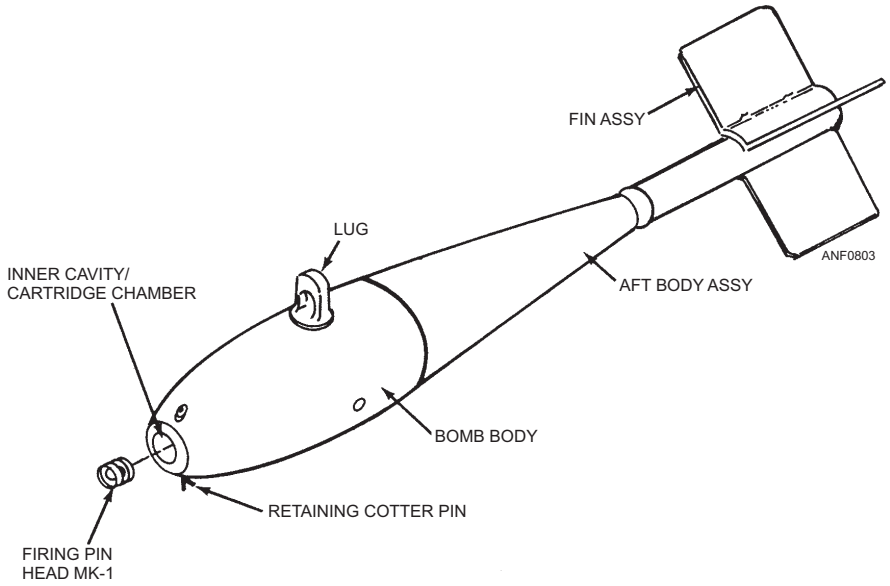


Figure 8-3.—Mk 76 Mod 5 practice bomb.

Although both are used for practice, each is quite different in design and appearance.

MK 76 MOD 5.—The 25-pound, solid metal-cast, Mk 76 Mod 5 practice bomb (fig. 8-3) has a teardrop-shaped body. It is centrally bored to permit the insertion of a practice bomb signal cartridge. The after body, covering the tail tube, is crimped to the bomb body and has welded-on conical tail fins. The bomb has single-lug suspension and is painted blue with identification nomenclature s stenciled in white letters on the body. The Mk 76 Mod 5 subcaliber practice bomb is specifically designed to simulate unretarded weapon delivery.

BDU-48/B.—The 10-pound BDU-48/B practice bomb (fig. 8-4) is a thin-cased cylindrical bomb used to simulate retarded weapon delivery. The bomb is composed of the bomb body with a bore tube for the installation of a single cartridge, a spring-loaded retractable suspension lug, firing device, and box-type fin assembly. The bomb is painted blue with identification nomenclature stenciled in white letters on the body.

CLUSTER BOMB UNITS (CBUs)

Cluster bomb units (CBUs) are weapons that carry and dispense small bomblets over a large target area. These weapons are designed to destroy material and

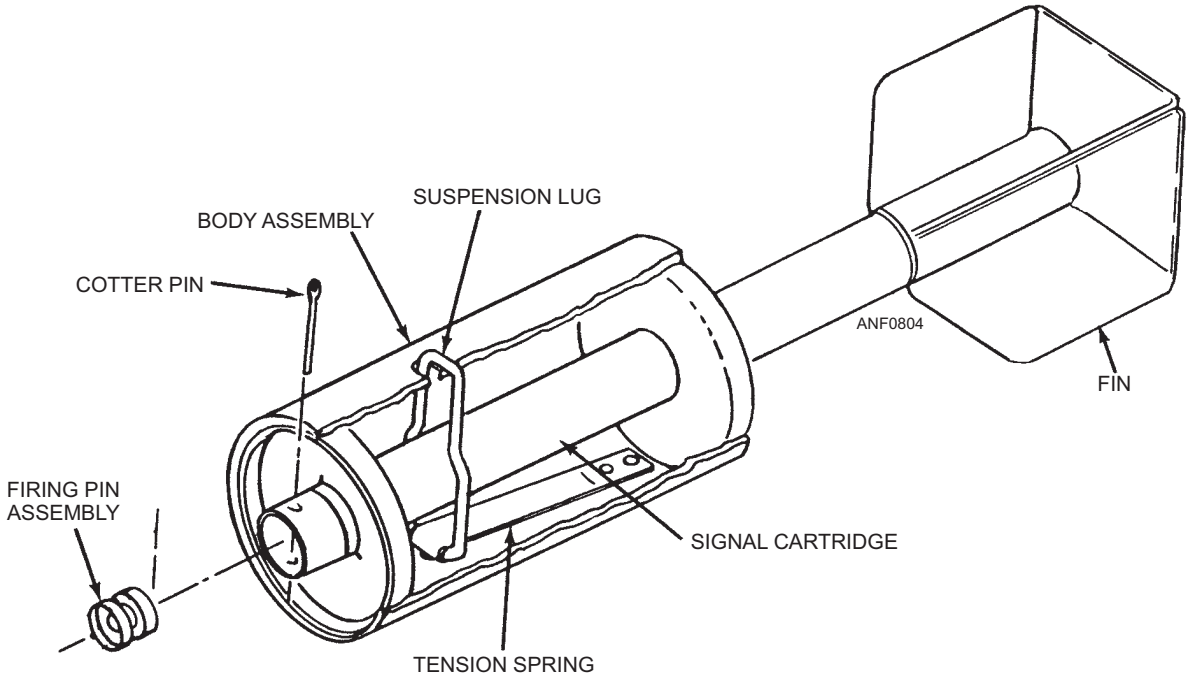


Figure 8-4.—BDU-48/B practice bomb.

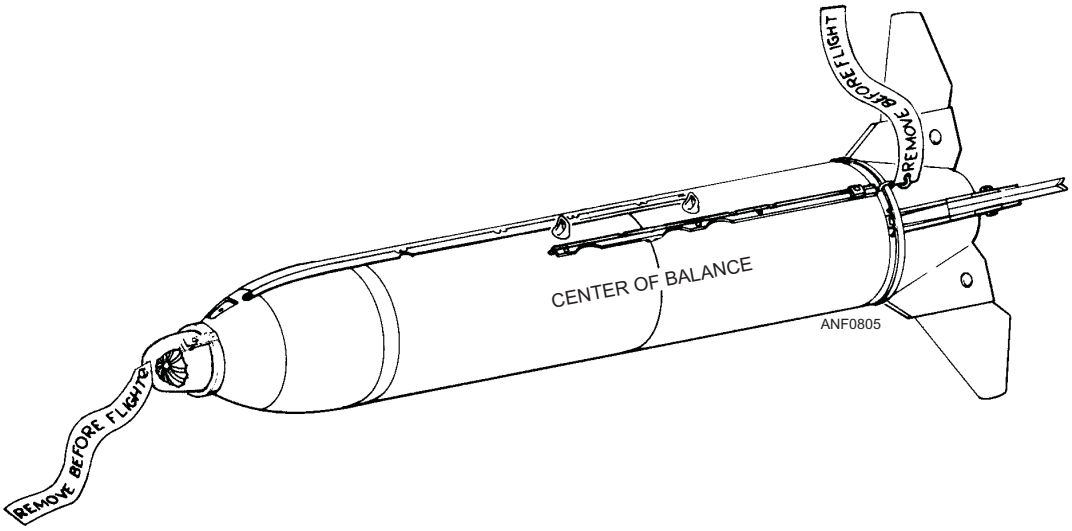


Figure 8-5.—Mk 20 Mods antitank bomb cluster and CBU-59/B antipersonnel/antimaterial bomb cluster.

personnel targets. The most commonly used types are discussed in this section.

Antitank Bomb Cluster and Antipersonnel/ Antimaterial Bomb Cluster

The antitank bomb cluster Mk 20 Mods and the antipersonnel/antimaterial bomb cluster CBU-59/B (fig. 8-5) are air-launched, conventional free-fall weapons. The Mk 20 Mods are used against armored vehicles. The CBU-59/B is used against light material and personnel targets.

The Mk 20 Mods and CBU-59/B CBUs are delivered to the fleet completely assembled. Fuzes, suspension lugs, arming wires, wire extractors, and all other necessary components have been installed.

The only difference between the Mk 20 Mods and the CBU-59/B CBUs is the type of bomb/bomblets contained inside the dispenser. The Mk 20 CBU weighs 490 pounds and contains 247 Mk 118 antitank bombs. The CBU-59/B weighs 750 pounds and contains 717 BLU-77/B target discriminating shape-charge airburst bomblets.

When either the Mk 20 Mods or the CBU-59/B CBU is released from the aircraft, the fuze arming wire and the fin release wire is withdrawn from the fuze, allowing the fuze to function after the preset delay. Functioning of the fuze initiates a linear-shaped charge in the dispenser. This, in turn, cuts the dispenser case in half, dispersing the bombs/bomblets in the air.

Both CBUs are painted white with a yellow band on the dispenser body, indicating a high-explosive hazard.

Guided Bombs Unit (GBU)

GBU-12, GBU-16, and GBU-10 are Mk 82, Mk 83, and Mk 84 bombs that are actually low-drag, general-purpose (LDGP) bombs modified to detect a target illuminated by a laser beam (fig. 8-6). LDGP

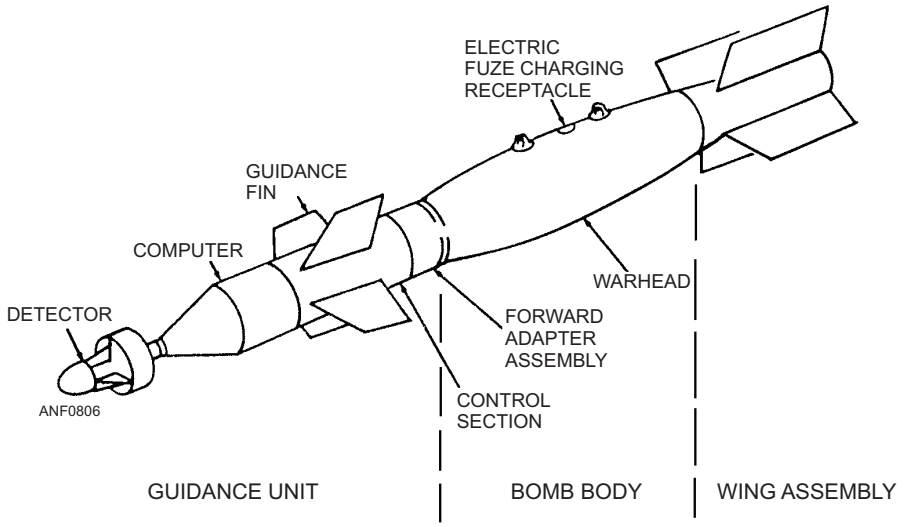


Figure 8-6.—Typical guided bomb unit.

bombs are converted into GBUs by the attachment of a guided bomb unit kit. Each guided bomb unit kit contains a computer-control group (CCG) and an airfoil group (wing assembly and guidance fins).

The CCG mounts on the nose of the bomb body. This precludes the use of nose fuzing. The CCG detects and guides on a laser-illuminated target. It provides weapon guidance signals to the movable guidance fins to guide the weapon to the target. An electrical fuze installed in the tail of the bomb detonates the bomb at the proper time.

Except for the glass nose of the CCG, all components are painted olive drab. The bomb body has standard LDGP markings. A single or double yellow band around the nose of the bomb body indicates a high-explosive hazard.

Mines

The Mk 62, Mk 63, and Mk 64 mines are all modular, influence-actuated bottom mines. They are used against submarines and surface targets. The mines are upgraded by installation of the Mk 130 conversion kit and Mk 130 battery and flight gear.

The Mk 65 Quickstrike mine (fig. 8-7) is a 2,000-pound, air-laid, all modular, influence-actuated, bottom mine. The Mk 65 is used against submarines and surface targets. The Mk 65 consists of a mine case, a Mk 45 safety device arming group with a Mk 2 arming device, a Mk 57 target detecting device, and a Mk 7 tail assembly.

Q8-10. What are the four components of the Mk 80 series bombs?

Q8-11. What are the two types of practice bombs used to train new or inexperienced pilots and ground crew?

Q8-12. What are two types of cluster bombs used by the Navy?

AIR-LAUNCHED WEAPONS

LEARNING OBJECTIVE: Identify the types, uses, and basic characteristics of air-launched weapons.

Air-launched weapons are designed to be either rail or ejection launched. In the case of airborne rockets, they are fired from launchers suspended on the parent rack of Navy aircraft. Underwater weapons, such as air-laid mines and torpedoes, are suspended from the parent rack and bomb bays of aircraft, and are designed to destroy enemy submarines and surface ships.

Air-launched weapons provide a defensive or offensive capability against enemy aircraft, combatant ships, ground radar installations, armored vehicles, and cruise missiles. Some of the various types of airborne

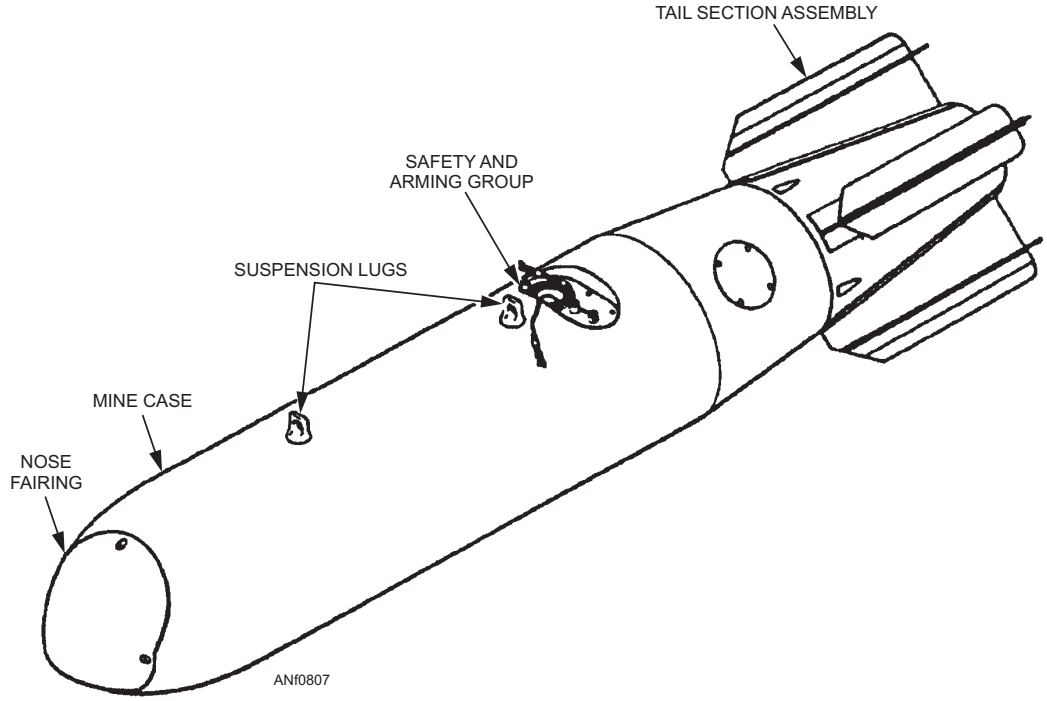


Figure 8-7.—Mk 65 Quickstrike mine.

rockets, guided missiles, and underwater weapons used by the Navy are discussed in the following text.

AIRBORNE ROCKETS

The Navy uses two types of rockets—the 2.75-inch Mighty Mouse and the 5.0-inch Zuni. The 2.75 standard folding-fin aircraft rocket (FFAR) motor (fig. 8-8, view A) uses a standard nozzle insert. The low-speed FFAR rocket motor (fig. 8-8, view B) uses a scarfed nozzle insert. When the low-speed rocket is fired, the scarfed nozzle insert causes the rocket to spin during flight. This spin enables the rocket to be fired from a slow-flying aircraft, such as a helicopter, and still maintain trajectory to the target.

In early development, both the Mighty Mouse and the Zuni were used against both air and ground targets. However, with the introduction of modern missile technology, rockets are now used primarily against ground targets. The Mighty Mouse is fired in large numbers. It is carried in rocket launchers with a capacity of 7 or 19 rockets. The Zuni, which carries a much larger explosive payload than the Mighty Mouse, is carried in rocket launchers with a capacity of four rockets. Both the Mighty Mouse and the Zuni are fired either singularly, in pairs, or in ripple salvo.

AIR-LAUNCHED GUIDED MISSILES

A guided missile is defined as "a self-propelled object that automatically alters its direction of flight in response to signals received from outside sources." Guided missiles are equipped for, and usually carry, high-explosive charges. They have the means to explode on contact or in near proximity of a target. The majority of guided missiles used in the Navy are essentially rockets that can maneuver while in flight and make course corrections to intercept the target.

Guided missiles are classified according to their range, speed, and launch environment, mission, and vehicle type. Long-range guided missiles can usually travel at least 100 miles. Short-range guided missiles usually do not exceed the range capabilities of long-range guns. Between these extremes the Navy has an arsenal of medium or extended-range guided missiles.

Guided missile speed is expressed in Mach numbers. The Mach number *"is the ratio of the speed of an object to the speed of sound in the medium through which the object is moving."* Therefore, an object moving at sonic speed is traveling at Mach 1. In air under standard atmospheric conditions, sonic speed is 766 miles per hour. Guided missiles are classified according to speed as follows:

1. Subsonic—up to Mach 0.8,
2. Transonic—Mach 0.8 to Mach 1.2,
3. Supersonic—Mach 1.2 to Mach 5.0, and
4. Hypersonic—above Mach 5.0.

The speed of the launching aircraft is added to the speed of the missile. Therefore, if a missile's speed is Mach 2.5 and the aircraft's speed, at the time of missile launch, is Mach 2.0, the missile would be traveling at Mach 4.5.

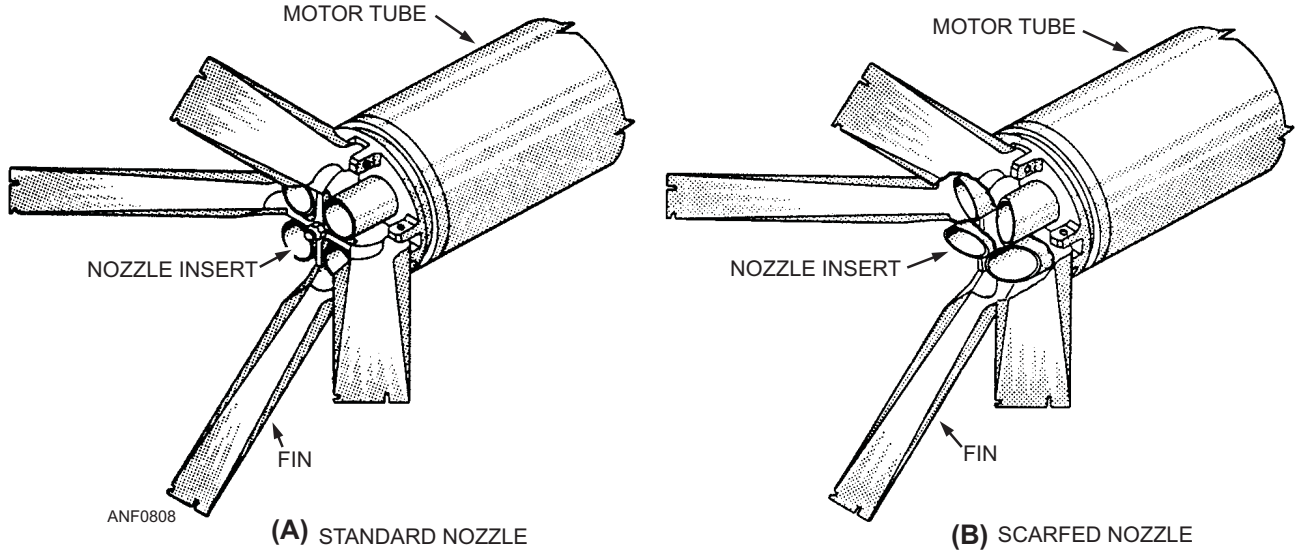


Figure 8-8.—Nozzle and fin assemblies. (A) standard nozzle; (B) scarfed nozzle.

The Department of Defense has established a missile and rocket designation system. The designation of every guided missile includes letters that show the following information:

1. The environment from which the missile is launched
2. The primary mission of the missile
3. The type of missile

The letters of the basic designator and their meaning are listed in table 8-2.

Examples of common guided missile designators are as follows:

Table 8-2.—Guided Missile and Rocket Designations

FIRST LETTER DESIGNATING LAUNCH ENVIRONMENT	**DESCRIPTION**
A Air	Air launched
B Multiple	Capable of being launched from more than one environment
C Coffin	Stored horizontally or at least less than 45° angle in a protective enclosure and launched from the ground
F Individual	Carried and launched by one man
M Mobile	Launched from a ground vehicle or movable platforms
P Soft pad	Partially or non-protected in storage and launched from the ground
U Underwater	Launched from a submarine or other underwater device
R Ship	Launched from surface vessel, such as a ship or barge
SECOND LETTER DESIGNATING MISSION SYMBOL	**DESCRIPTION**
D Decoy	Vehicles designed or modified to confuse, deceive, or divert enemy defenses by simulating an attack vehicle
E Special electronic	Vehicles designed or modified with electronics equipment or communications, countermeasures, electronic relay missions
G Surface attack	Vehicles designed to destroy enemy land or sea targets
I Intercept aerial	Vehicles designed to intercept aerial targets in defensive roles
Q Drone	Vehicles designed for reconnaissance or surveillance
T Training	Vehicles designed or permanently modified for training purposes
U Underwater attack	Vehicles designed to destroy enemy submarines or other underwater targets or to detonate underwater
W Weather	Vehicles designed to observe, record, or relay data pertaining to meteorological phenomena
THIRD LETTER DESIGNATING VEHICLE TYPE SYMBOL	**DESCRIPTION**
M Guided missile	An unmanned, self-propelled vehicle with remote or internal trajectory guidance
R Rocket	A self-propelled vehicle whose flight trajectory cannot be altered after launch
N Probe	A non-orbital instrumented vehicle to monitor and transmit environmental information
NOTE: The designation listed in the table covers all the guided missiles and rockets used within the Department of Defense. Therefore, all designations listed might not be used by the Navy.	

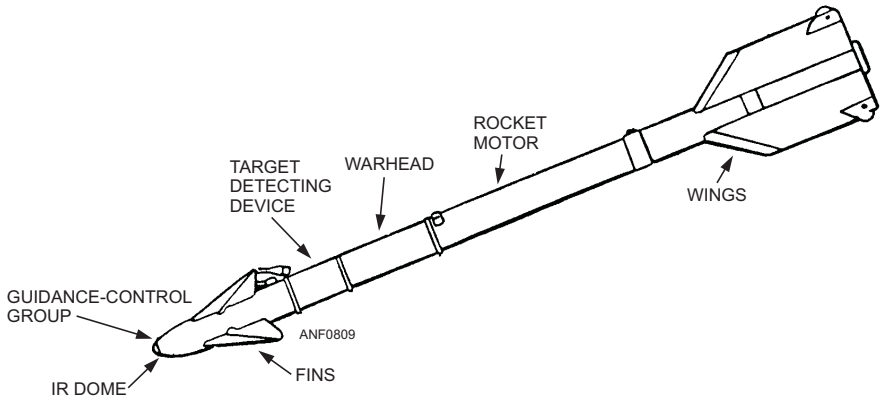


Figure 8-9.—Typical air-to-air guided missile.

BASIC DESIGNATION	MEANING
AGM	Air-launched, surface-attack guided missile
AIM	Air-launched, intercept-aerial guided missile
ATM	Air-launched, training guided missile
RIM	Ship-launched, intercept-aerial guided missile

The basic designators are followed by a design number; this may be followed by a modification symbol of consecutive letters. A designation of AGM-45C is identified as follows:

A—Air-launched

G—Surface-attack

M—Guided missile

45—Forty-fifth missile design

C—Third revision of the forty-fifth design

Most guided missiles are given popular names, such as Sparrow, Sidewinder, Harpoon, and HARM. These names are kept regardless of later modifications to the original missile.

The external surfaces of all Navy guided missiles (except radomes and antenna items) are painted white. The color white has no identification color-coding significance when used on guided missiles. There are three significant color codes used on guided missiles—yellow, brown, and blue. These color codes indicate the explosive hazard contained within the missile component.

Guided missiles are made up of a series of subassemblies (fig. 8-9 and fig. 8-10). The subassemblies, related by function, form a major section of the overall missile. These sections operate a system such as guidance, control, armament (warhead and fuzing), or propulsion. The major sections are carefully connected to form the complete missile assembly. The arrangement of major sections in the missile assembly varies in missiles, depending on missile type.

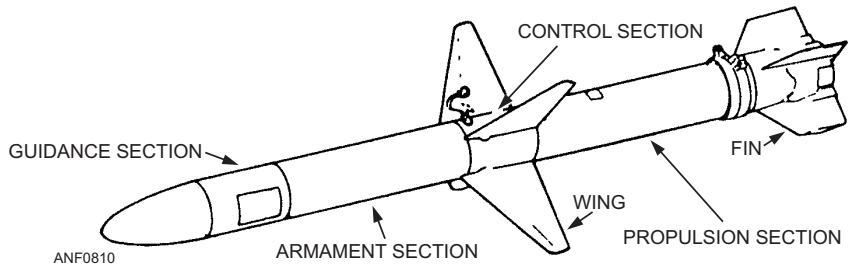


Figure 8-10.—Typical air-to-surface guided missile.

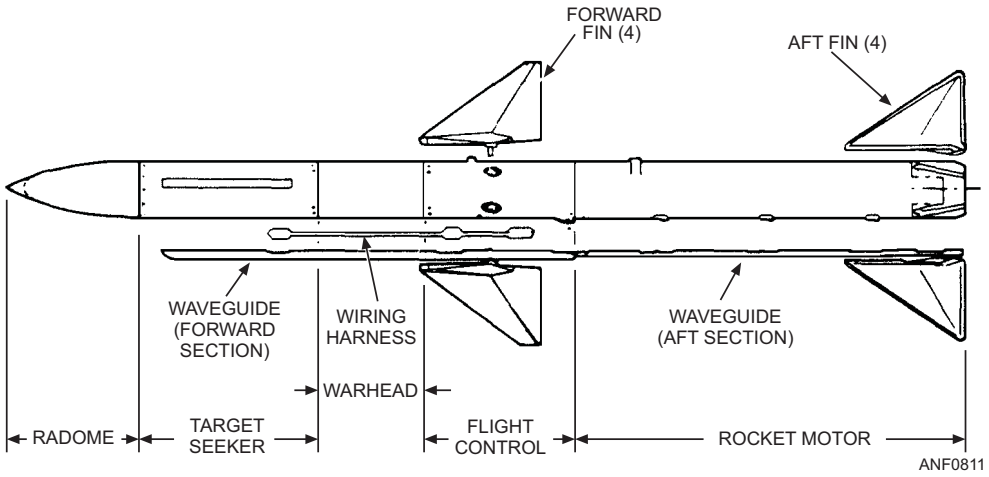


Figure 8-11.—AIM-7F Sparrow III guided missile.

Several of the guided missiles now in use by the Navy are discussed briefly in the following paragraphs.

Sparrow III

The AIM-7F Sparrow III guided missile (fig. 8-11) is a medium-range, all weather, supersonic, air-to-air missile. It is designed to be rail or ejection launched from an interceptor aircraft. The tactical mission of the missile is to intercept and destroy enemy aircraft in all weather environments. It is launched from the F-14 *Tomcat* and F/A-18 *Hornet* aircraft. Excluding the radome, the missile body is made of four sectional tubular shells that house the four major functional components. The four major functional components are the target seeker, flight control, warhead, and rocket motor. The missile is 12 feet (142 inches) long, 8 inches in diameter, and weighs 510 pounds.

Harpoon

The AGM-84A-1 Harpoon surface-attack guided missile (fig. 8-12) is an all-weather, air-launch, antiship attack weapon. It is launched from the P-3 *Orion* and S-3 *Viking* aircraft. The missile consists of the guidance section, warhead section, sustainer section, and boat-tail section. It also contains wings and control fins.

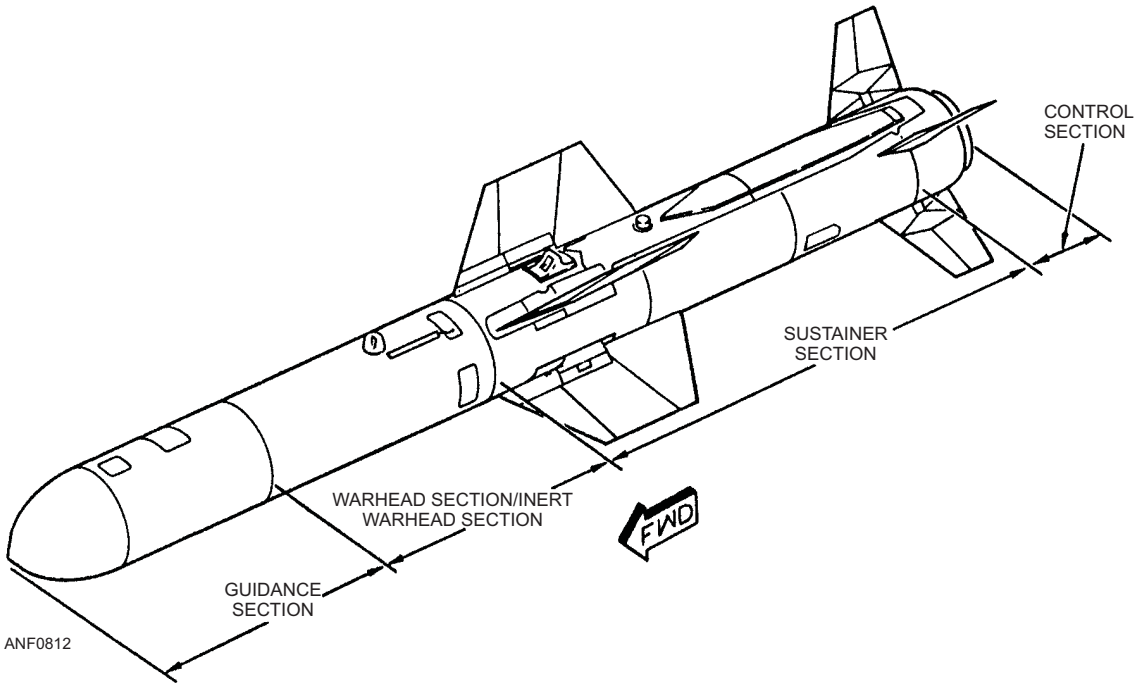


Figure 8-12.—AGM-84A-1 Harpoon guided missile.

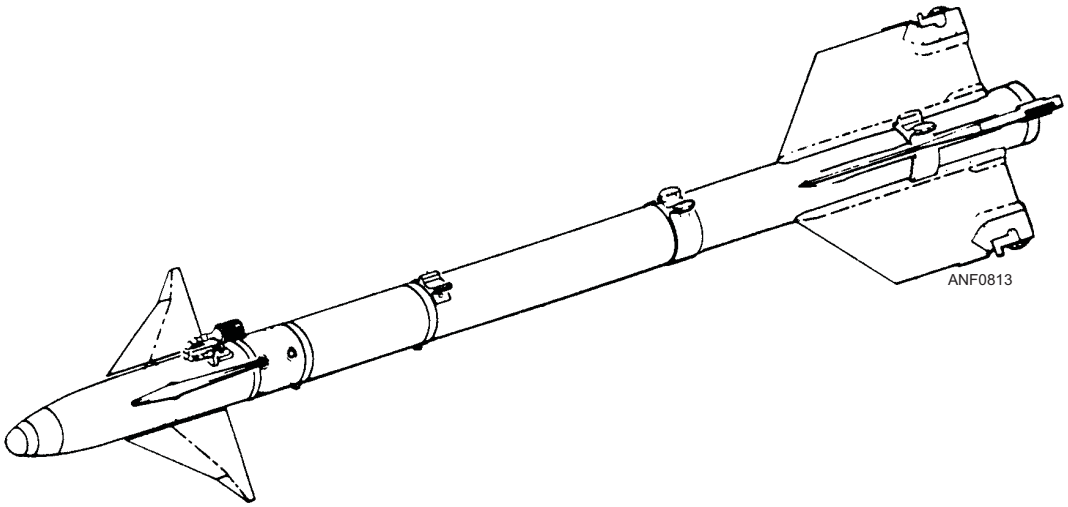


Figure 8-13.—AIM-9M Sidewinder guided missile.

The missile has a low-level cruise trajectory with over-the-horizon range, making it less susceptible to radar detection. It uses active guidance and has counter-countermeasure capability. The missile is 12 1/2 feet (151 inches) long and weighs 1,144 pounds.

Sidewinder

The AIM-9M Sidewinder guided missile (fig. 8-13) is a short-range, supersonic, air-to-air weapon. It has passive infrared target detection, proportional navigation guidance, and a torque-balance control system. The Sidewinder is comprised of five major components. These are the guidance and control section, the target detector section, the safety-arming device, the warhead section, and the rocket motor section. The missile is capable of being launched from the F-14 *Tomcat* and F/A-18 *Hornet* aircraft. The only assembly required at fleet level is the installation of the wings and control fins. The Sidewinder is 9 1/2 feet (113 inches) long, 5 inches in diameter, and weighs 190 pounds.

Phoenix

The AIM-54C/D Phoenix (fig. 8-14) is an air-to-air guided missile. It employs active, semi-active, and passive homing capabilities. The Phoenix is a long-range air intercept missile launched from the F-14 *Tomcat* aircraft. The missile may be launched in multiple missile attacks against groups of aircraft or a single aircraft. A maximum of six AIM-54C/D missiles can be launched from a single aircraft with simultaneous guidance against widely separated targets. In addition, the missile has dogfight, electronic counter-countermeasures, and anti-cruise missile capabilities.

The Phoenix consists of the guidance section, the armament section, the propulsion section, and the control section. The only assembly required at fleet level is the installation of wing and fin assemblies. The missile is 13 feet (156 inches) long, 15 inches in diameter, and weighs 1,020 pounds.

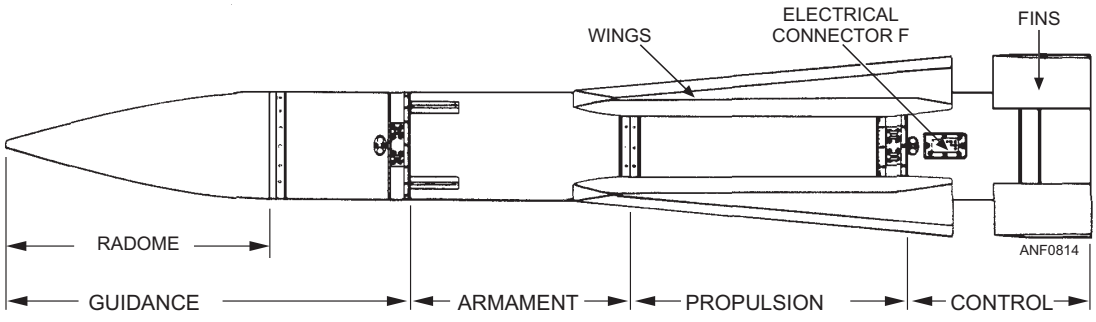


Figure 8-14.—AIM-54C/D Phoenix guided missile.

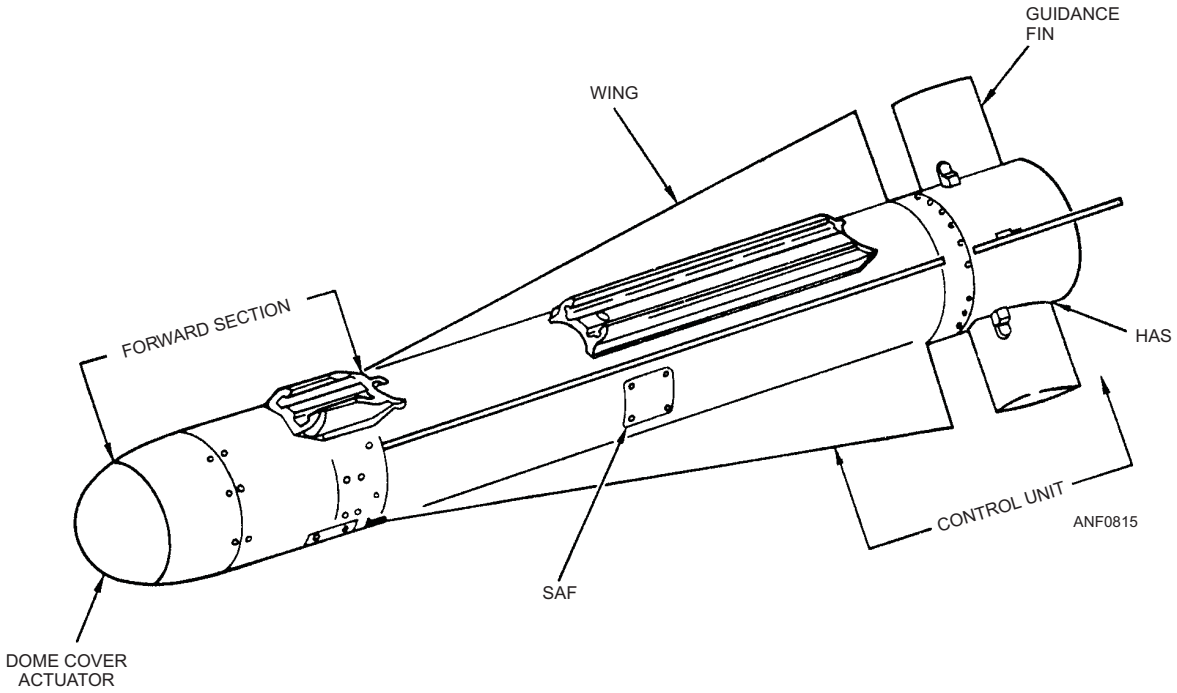


Figure 8-15.—AGM-65E/F Maverick guided missile.

Maverick

The AGM-65E (laser) and AGM-65F (infrared) (fig. 8-15) are guided, rocket-propelled, air-to-ground missiles that are designed for use against fortified ground installations, armored vehicles, and surface combatants. The Maverick consists of two major sections—the guidance and control section and the center/aft section. The Maverick is compatible with the AV-8 *Harrier* and F/A-18 *Hornet* aircraft. The only assembly required at fleet level is the installation of the fins.

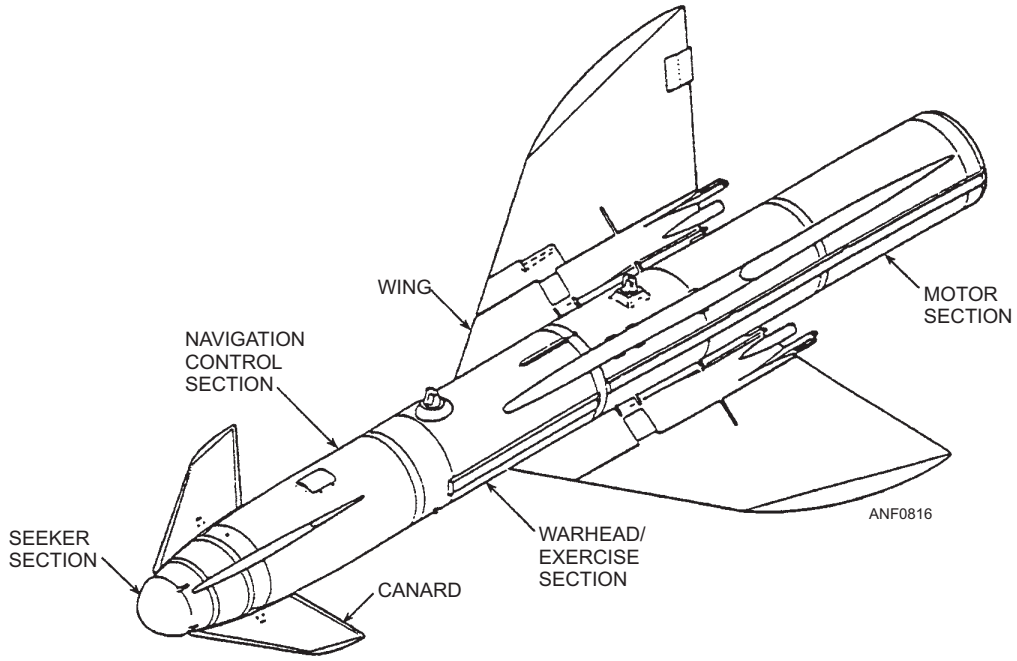


Figure 8-16.—AGM-119B Penguin guided missile.

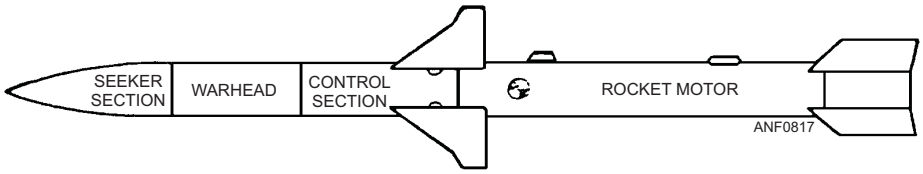


Figure 8-17.—AGM-88A HARM guided missile.

Penguin

The AGM-119B Penguin (fig. 8-16) is a short-to-medium range, inertialy guided, infrared terminal homing, air-to-surface missile. It is used against ships and surfaced submarines. The Penguin consists of the following components—a seeker, navigation and control section, warhead, rocket motor, four folding wings, and four canards. The missile is designed to be launched from helicopters at low speeds and low altitudes.

High-Speed Antiradiation Missile (HARM)

The AGM-88A HARM (fig. 8-17) is a supersonic, terminal homing, air-to-ground missile. It is used primarily against ground radar installations, and it has the capability of selecting a single target from a number of targets in the environment. The missile has four major sections—guidance, control, warhead, and rocket motor. It is capable of being launched from the F/A-18 *Hornet* aircraft.

Advanced Medium Range Air-to-Air Missile (AMRAAM)

The AIM-120 (AMRAAM) missile is an advanced missile system (fig. 8-18) that provides significant performance and reliability improvements over the existing Sparrow missile. The AMRAAM is an all-weather, radar-guided missile. It provides fighter aircraft with precision medium-range attack against airborne targets. The missile is divided into four major sections: guidance, warhead, propulsion, and control. The missile can be launched from the F-14 and F/A-18 aircraft.

Walleye Guided Weapon

The Walleye guided weapon does not contain a propulsion system as do other guided missiles. It is classified as a missile because it has a guidance system, a control system, and externally mounted control surfaces.

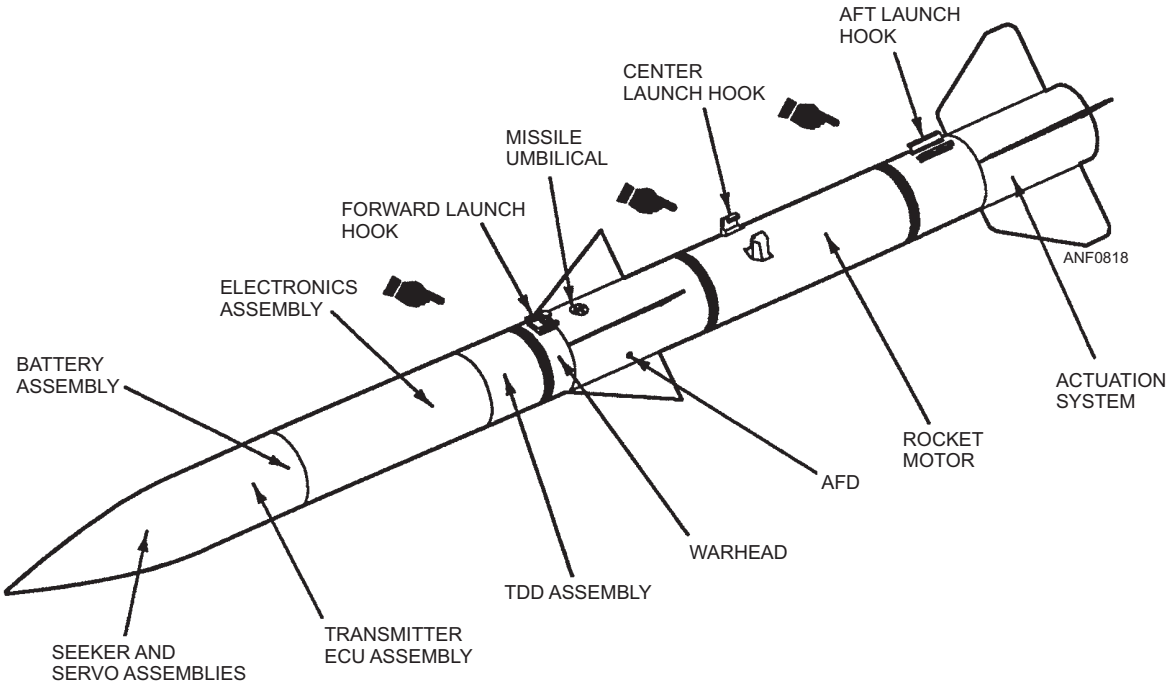


Figure 8-18.—AIM-120 (AMRAAM) guided missile.

The Walleye (fig. 8-19) is a self-contained, self-guided, high explosive weapon. It is grouped into three basic series of weapons—Walleye I (small-scale, 1,000 pounds), Walleye II (large-scale, 2,000 pounds), and Walleye II Extended Range Data Link (ERDL).

UNDERWATER WEAPONS

Since World War II, the Navy has placed major emphasis on the development of air-launched torpedoes and air-laid mines. These weapons incorporate components so sensitive that their operation is protected as classified information. Therefore, the unclassified information we can provide on these weapons is limited.

Torpedoes

The Mk 46 torpedo is the primary weapon used in antisubmarine warfare (ASW). It is designed to search for, detect, attack, and destroy submarines. The torpedo can be assembled into exercise configurations, and it can be used for training.

The tactical torpedo consists of a nose section, warhead, control group, long fuel tank, and after-body. The physical characteristics (such as weight, length, and other features) vary with the configuration and the launch accessories attached. The Mk 46 torpedo can be configured with aircraft launch accessories for either helicopter or fixed-wing aircraft launching.

Aircraft-Laid Mines

Naval mines may be used in either offensive or defensive mining operations. In either case, the primary objective is to defend or control straits, port approaches, convoy anchorage, and seaward coastal barriers.

Aircraft mine delivery has been the principal method for large-scale mining attacks into enemy coastal and port areas. Mines that are delivered by aircraft are usually carried and dropped in much the same manner as bombs. Mines have different ballistic flight paths than bombs. Air-laid mines usually require parachutes.

Q8-13. What are the two types of rockets used by the Navy?

Q8-14. Long-range guided missiles can usually travel at least what distance?

Q8-15. Define the term Mach number.

Q8-16. Guided missiles are classified according to speed. What are the four classifications?

Q8-17. What are the three significant color codes used on guided missiles?

Q8-18. Walleye guided weapons differ from other guided missiles in what way?

Q8-19. What are the basic underwater weapons used by the Navy?

20-MM AUTOMATIC AIRCRAFT GUNS

LEARNING OBJECTIVE: Identify the basic operation, characteristics, and components of the 20-mm automatic aircraft gun.

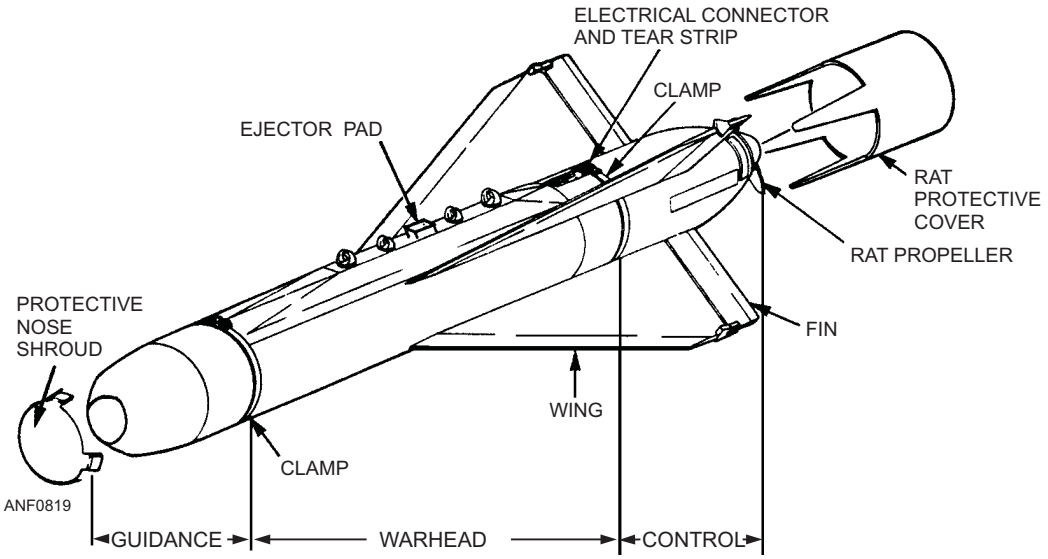


Figure 8-19.—Typical Walleye guided weapon.

Aircraft gun systems have changed significantly over the years. The Navy's high-speed, computer-controlled gun systems are almost futuristic when compared to the mounted machine guns used on the biplanes of the early 1900's. The old Mk 12, 20-mm aircraft gun installed in the A-4 aircraft and operated by a gas-blowback system is primitive by today's standards. Today's gun systems must meet demanding performance requirements and provide the firepower needed to penetrate and destroy advanced enemy targets. The M61A1, 20-mm automatic gun system is the most widely used gun system in Navy aircraft.

The M61A1 20-mm automatic aircraft gun (fig. 8-20) is a six-barrel rotary-action mechanism based on the early Gattling gun. It is a revolving cluster of barrels fired once per each revolution. The gun is hydraulically driven and electrically controlled by the aircraft's weapons control systems. The gun is capable of firing 4,000 to 7,200 rounds of M50 (series) ammunition per minute. As installed in Navy aircraft, the gun has two pilot-selectable firing rates of 4,000 (gun low) or 6,000 (gun high) rounds per minute.

Ammunition is supplied to the gun by the ammunition handling and storage system. The system is an endless conveyor belt (closed loop). Ammunition is transported from the ammunition drum to the gun, and expended casings and unfired rounds are returned to the drum. Although the component's physical location may vary between gun installations, the function and operation of the system are basically the same.

Q8-20. What is the most widely used gun system in Navy aircraft?

SIGNALING, MARKING, AND ILLUMINATION DEVICES

LEARNING OBJECTIVE: Identify the types, uses, and basic characteristics of signaling, marking, and illumination devices.

Signaling, marking, and illumination devices are used by the Navy for various purposes. Some are used as signals by downed aircraft, while others are launched by aircraft.

PYROTECHNICS

Pyrotechnics are "fireworks adapted to military use." The word *pyrotechny* means "the art of fire." Pyrotechnics are items that produce their effect by burning and are consumed in the process. As used in the military, pyrotechnics are burning items that produce a bright light for illumination. They also produce colored lights or signaling smoke. All of the pyrotechnic devices described here contain combustible chemicals, which when ignited produce a flame, flash, smoke, or a combination of these effects. Because of the many pyrotechnics available, only those items that an Airman may see on a routine basis are covered.

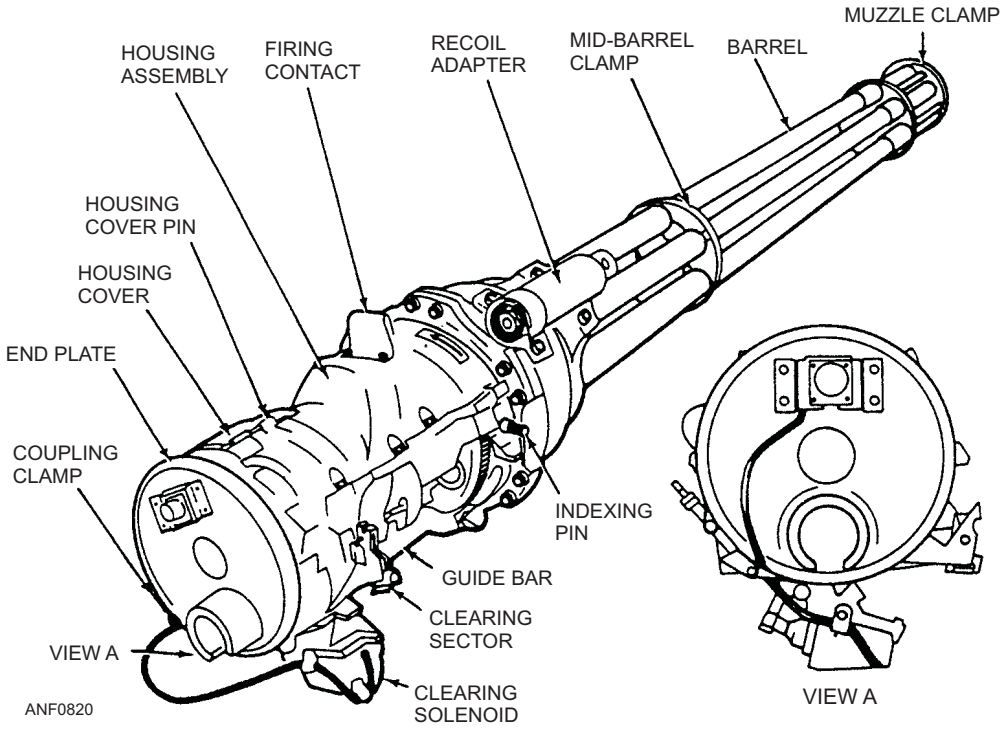


Figure 8-20.—M61A1 20-mm automatic aircraft gun.

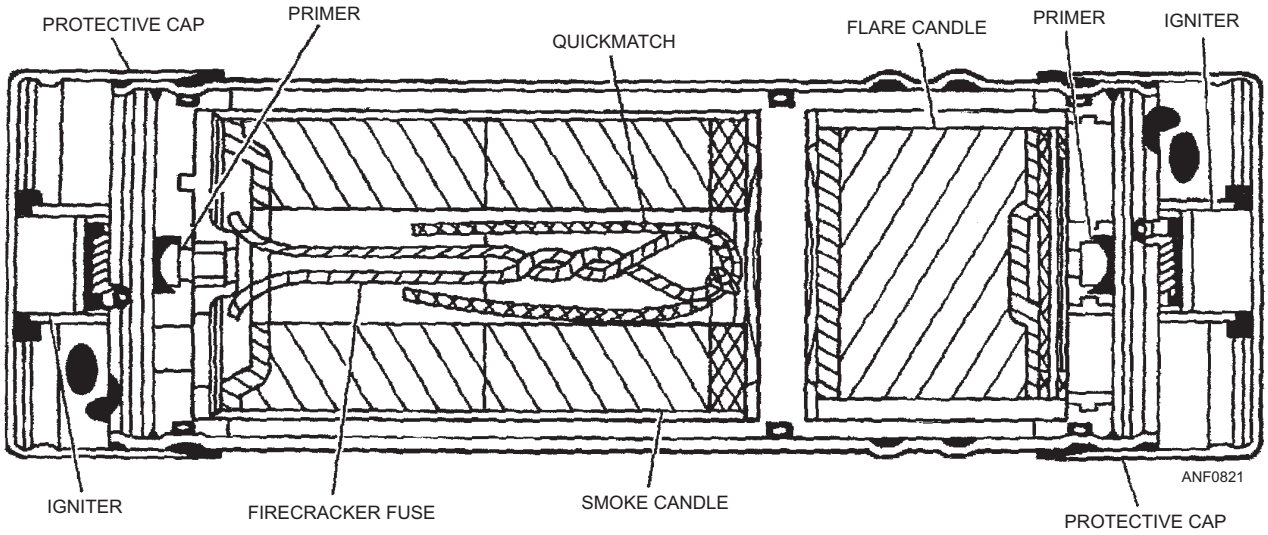


Figure 8-21.—Mk 124 Mod 0 marine smoke and illumination signal.

HAND-HELD SIGNALING DEVICES

Hand-held signaling devices are used for signaling or for reference point marking for downed aircrew and personnel in distress over land or at sea.

Mk 124 Mod 0 Marine Smoke and Illumination Signal

The Mk 124 Mod 0 marine smoke and illumination signal (fig. 8-21) is used for either day or night

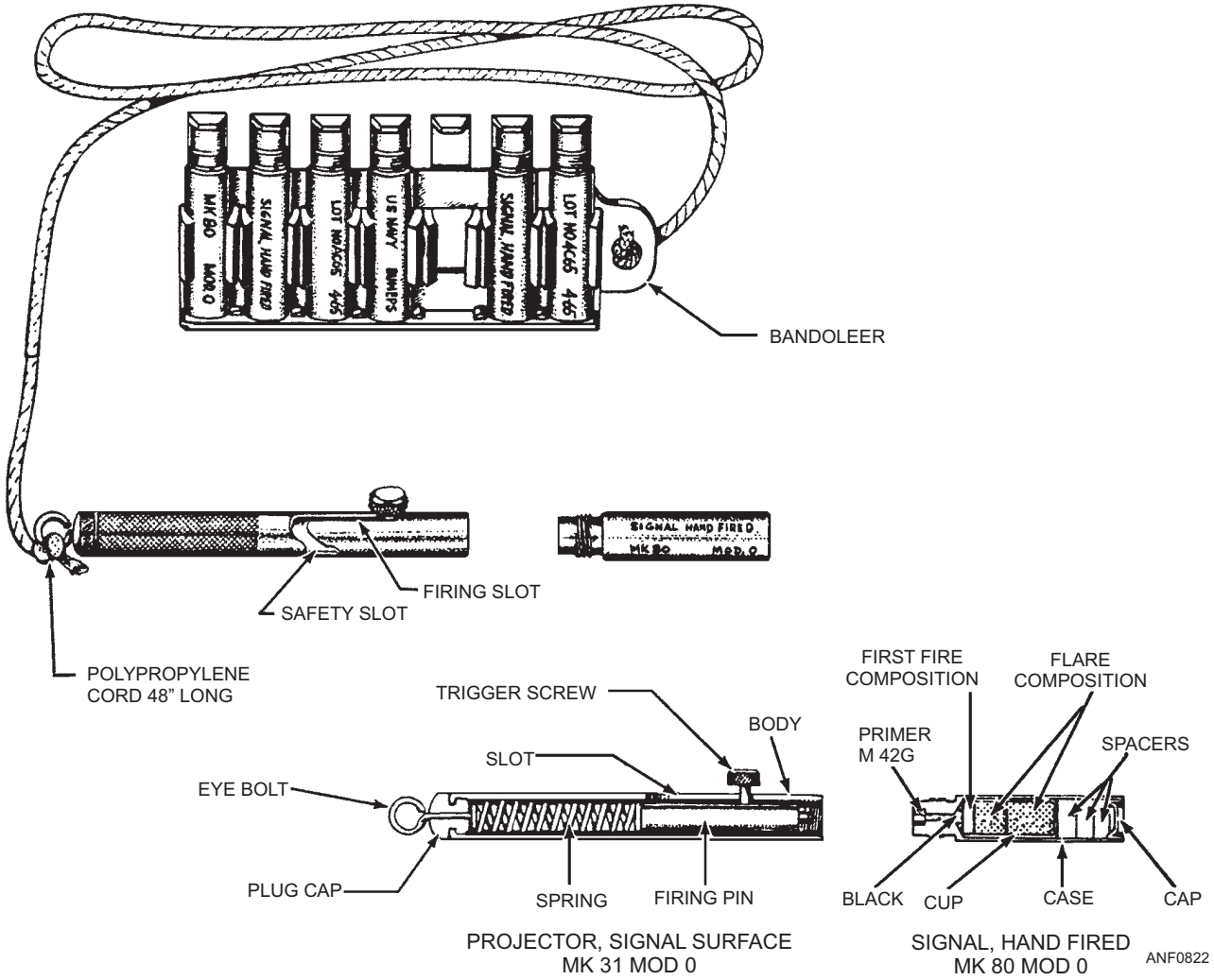


Figure 8-22.—Mk 79 Mod 0 illumination signal kit.

signaling by personnel on land or sea. It is a one hand operable device that emits orange smoke for daytime use and red flare for nighttime use. Burning time for each end is about 20 seconds. Each end has protective plastic caps. The night end has two prominent raised bead circles on the casing that positively identify this end, by the sense of touch, for nighttime use. A label on the outer surface around the whole body of the signal further identifies the smoke (day) and flare (night) ends. The label also gives detailed instructions on how to use the signal.

Mk 79 Mod 0 Illumination Signal Kit

The Mk 79 Mod 0 illumination signal kit (fig. 8-22) contains a Mk 31 Mod 0 signal projector, a plastic bandoleer that holds seven Mk 80 Mod 0 signals, and an instruction sheet. The kit is designed for use as a distress signaling device. It is small and lightweight for carrying in flight suit pockets or life rafts. The projector aims and fires the signals. Each signal contains a single red star. On activation, this star is propelled upward to a height of 250 to 650 feet. The star burns for at least 4 1/2 seconds.

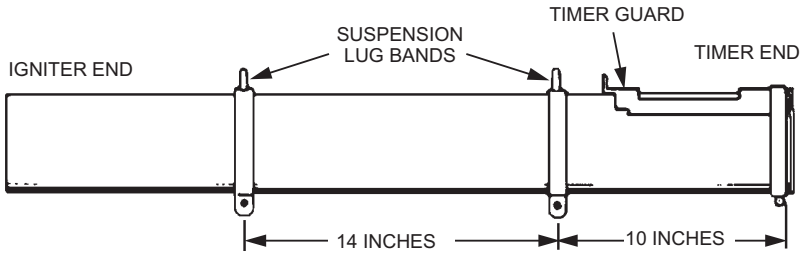
AIRCRAFT-LAUNCHED ILLUMINATION DEVICES

The devices discussed in this section are designed to be launched or dropped from aircraft.

LUU-2 Aircraft Parachute Flare

The LUU-2 aircraft parachute flare (fig. 8-23) is used for nighttime illumination of surface areas in search and attack operations. The flare consists of a candle, parachute assembly, and fuze, which are all encased in a cylindrical aluminum container.

The LUU-2 flare is launched from an external launching system, such as a bomb rack or by hand, from an aircraft. The method most often used is the dispenser-launch method. Regardless of the method of launching, exerting pull on the fuze lanyard starts flare operation. After a predetermined delay, a small explosive charge detonates, expelling the candle and parachute from the container. On opening, the main parachute exerts pull on the cables of the suspension/ignition system, igniting the candle. The candle produces about 2 million candlepower.



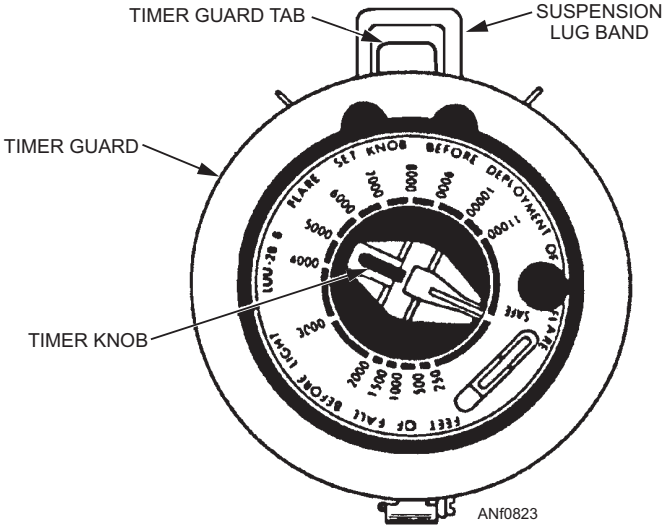


Figure 8-23.—LUU-2 aircraft parachute flare with drogue tray.

Mk 25 Marine Location Marker

The Mk 25 marine location marker (fig. 8-24) is launched from aircraft or surface craft. It is primarily launched from aircraft to provide day or night reference points in marking the course of enemy submarines. It is suitable for any type of sea-surface reference-point marking that calls for both smoke and flame for 10 to 20 minutes.

Mk 58 Mod 1 Marine Location Marker

The Mk 58 Mod 1 marine location marker (fig. 8-25) is used for long burning, smoke and flame reference-point marking on the ocean's surface. In addition to being used for antisubmarine warfare, it is also used for search and rescue operations. It is also used for man-overboard markings and to provide a target for practice bombing at sea. This marker produces a yellow flame and white smoke for 40 to 60 minutes. The marker is visible from an aircraft for at least 3 miles under normal operating conditions.

Q8-21. Define pyrotechnics as used in the military.

Q8-22. What are the two hand-held signaling devices used by downed aircrew and personnel in distress over land or at sea?

Q8-23. The Mk 25 Mod 0 aircraft parachute flare is used for what purpose?

Q8-24. The Mk 58 Mod 1 Marine location marker is used for what purpose?

CARTRIDGES AND CARTRIDGE-ACTUATED DEVICES (CADs)

LEARNING OBJECTIVE: Identify the types, uses, and basic characteristics of cartridges and cartridge-activated devices.

With the advent of the high-performance jet aircraft, aviation relies more and more on CADs. CADs are small explosive-filled cartridges used to fire other explosives or release mechanisms. CADs provide high reliability and easy maintenance. The cartridges undergo rigid quality control throughout design and manufacture. **Their actual performance is dependable only when they have been properly handled and installed**. In a personnel escape system, the CAD must work perfectly the first time. Malfunction of a device or failure to fire when needed usually results in injury or death to the pilot and/or crew members. Escape operations performed by cartridges and CADs are canopy removal, seat ejection, streaming of ejection seat drogue chutes, and parachute opening.

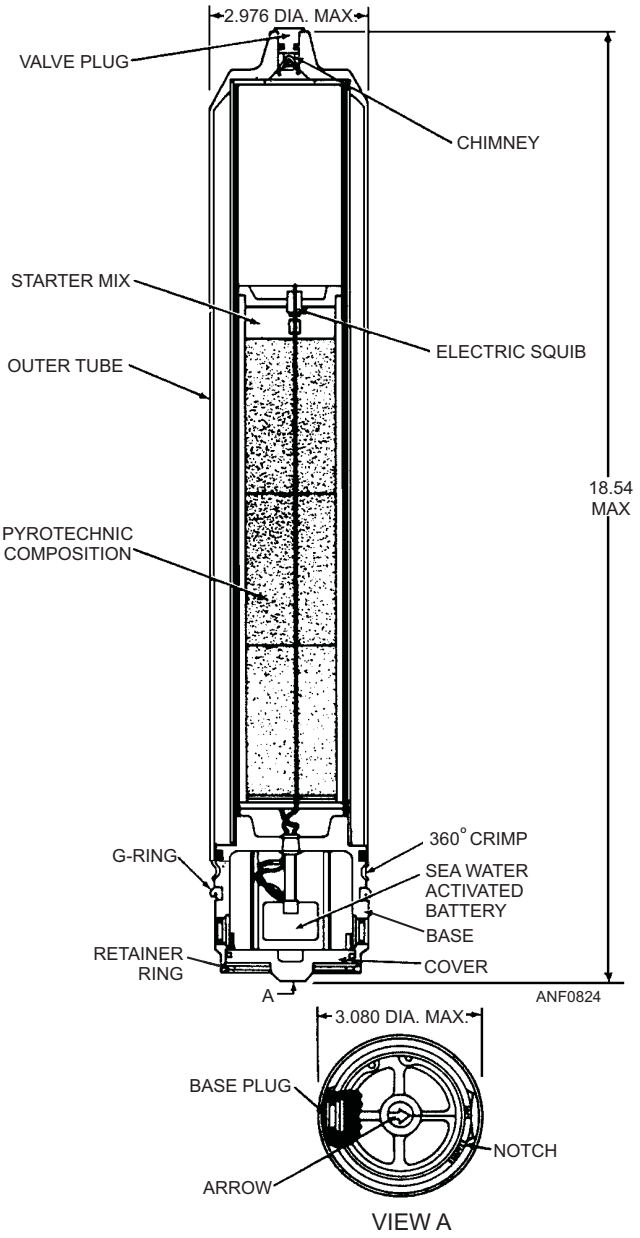


Figure 8-24.—Mk 25 marine location marker.

It is not possible to discuss all the cartridges and CADs in this TRAMAN. Therefore, a few representative cartridge systems are briefly discussed.

PERSONNEL ESCAPE DEVICE CARTRIDGES

High-speed aircraft have many designs, special control features, and space limitations. As a result, a sequence of emergency operations must be carried out before it is possible for pilot and/or crew members to escape. CADs allow several operations to be performed concurrently (at the same time), or in rapid sequence, to

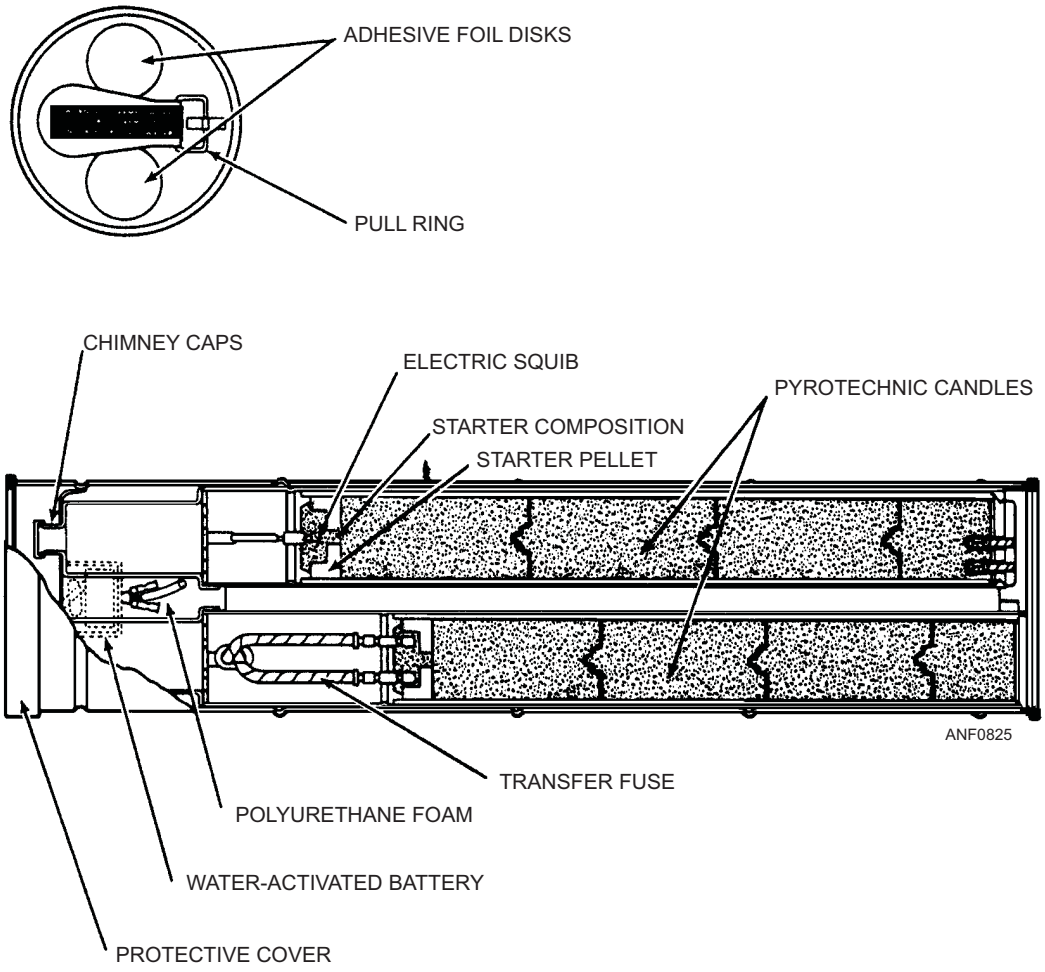


Figure 8-25.—Mk 58 Mod 1 marine location marker.

ensure personnel escape. Personnel in the AME rating usually install cartridges and CADs used in personnel escape systems.

IMPULSE AND DELAY CARTRIDGES

Impulse cartridges are used as power sources in aircraft stores release and ejection systems. The cartridges provide a force to free or eject a store away from the aircraft or to operate other devices.

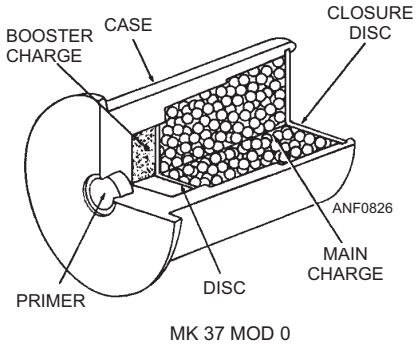


Figure 8-26.—Typical impulse cartridge used in personnel escape systems.

The impulse cartridge (fig. 8-26) contains an electric primer, a booster, and a main charge. When the cartridge is fired, gas pressure moves a piston and unlocking linkage, freeing and/or ejecting the store from the rack.

CCU-45/B Impulse Cartridge

The CCU-45/B impulse cartridge (fig. 8-27) is used primarily for release and ejection of stores from an aircraft in flight.

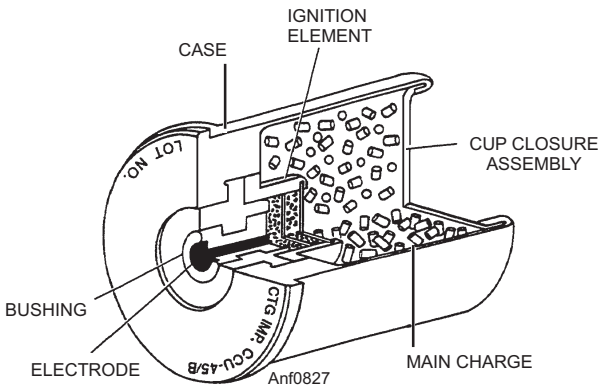


Figure 8-27.—Impulse cartridge CCU-45/B (sectioned).

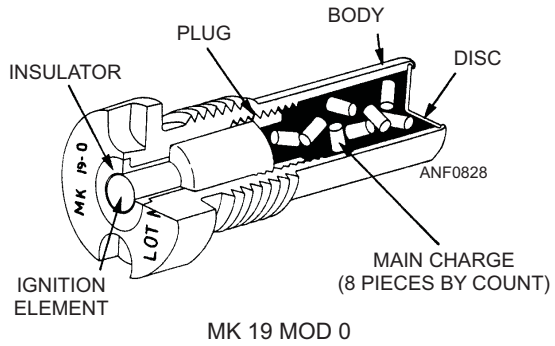


Figure 8-28.—Typical impulse cartridge used in bomb racks, launchers, and dispensers.

Mk 19 Mod 0 Impulse Cartridge

The Mk 19 Mod 0 impulse cartridge (fig. 8-28) is a backup cartridge. It is normally used for the emergency jettison/release of stores loaded on an aircraft during flight. This cartridge is fired after an attempt has been made to fire the primary cartridges.

MISCELLANEOUS CARTRIDGES

Miscellaneous cartridges include cable cutters, explosive bolts, and fire extinguishers.

Mk 97 Mod 0 Impulse Cartridge

The Mk 97 Mod 0 impulse cartridge (fig. 8-29) is used as a power source to actuate a helicopter cable cutter to cut a chain/cable in an emergency.

Mk 1 Mod 3 Impulse Cartridge

The Mk 1 Mod 3 impulse cartridge (fig. 8-30) is used primarily to actuate a refueling hose guillotine in an emergency.

Aircraft Fire-Extinguisher Cartridge

In the event of fire, the aircraft fire extinguisher cartridges start the release of fire-extinguishing agents into the area surrounding an aircraft engine.

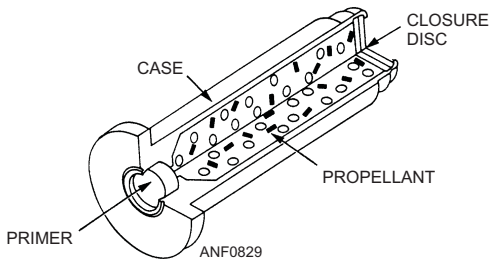


Figure 8-29.—Mk 97 Mod 0 impulse cartridge.

Q8-25. What are some of the escape operations performed by cartridges and CADs?

Q8-26. Personnel in what rating usually install cartridges and CADs used in personnel escape systems?

Q8-27. Cartridges that are used for cable cutters, explosive bolts, and fire extinguishers are known as what type of cartridges?

AIRCRAFT WEAPONS SUSPENSION AND RELEASING EQUIPMENT

LEARNING OBJECTIVE: Identify the types, uses, and basic characteristics of aircraft weapons suspension and releasing equipment.

Naval combat aircraft and weapons use highly complex suspension, arming, and releasing devices. The majority of these devices are electronically operated and are part of the aircraft's electrical circuits. The devices are activated by a hand switch or automatically through a circuit-closing device in the system. Manual operation is possible, if needed.

Current suspension, arming, and releasing devices for aircraft require the use of associated electrical gear. This gear times the release of stores and rack selectors

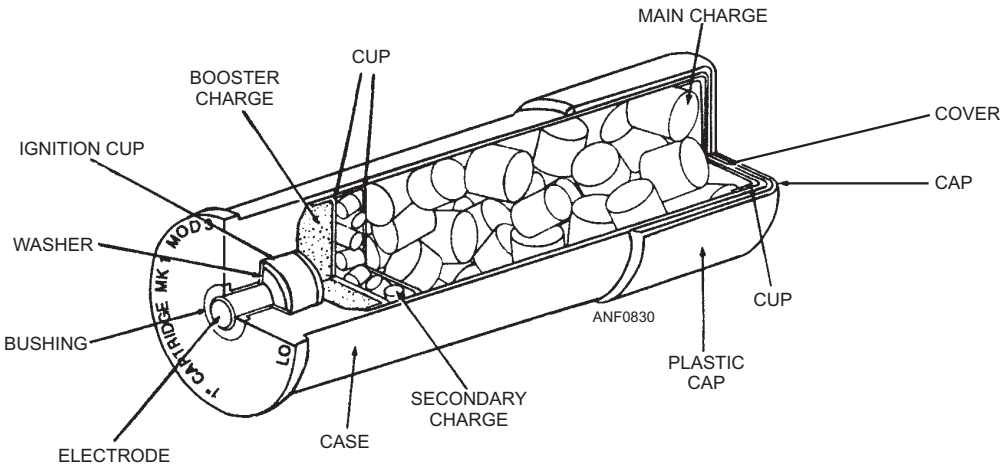


Figure 8-30.—Mk 1 Mod 3 impulse cartridge (sectioned).

to control the pattern of store releases. Other units preselect the desired arming of bomb fuzes. Each serves a definite purpose in accurately delivering weapons against the enemy.

The Navy uses a wide variety of suspension equipment. Suspension equipment is designed to accommodate a certain maximum weight. The structural strength of the aircraft determines the maximum weight that may be suspended. The aircraft weight capacity per rack is usually less than rack design capability.

Several representative types of suspension and releasing equipment are discussed briefly in the following text.

BOMB RACKS

Aircraft bombs, torpedoes, mines, and other stores are suspended either internally or externally by bomb racks. Bomb racks carry, arm, and release these stores.

The BRU-14 (series) bomb rack (fig. 8-31) suspends and releases conventional and nuclear weapons/stores weighing up to 2,200 pounds with a 14-inch suspension. In certain applications, adapter assemblies are added to increase the suspension capacity to 30 inches.

When a weapon/store is loaded onto the bomb rack, the suspension lugs on the weapon/store engage the heel of the bomb rack suspension hooks. This causes the hooks to pivot up and engage the suspension lugs. The hooks are held in the closed position by sears. When the pilot initiates bomb release, an electrical signal is routed through the weapon system circuits to the bomb rack. This signal activates a solenoid that activates the release linkage in the bomb rack. This causes the suspension hooks to open, letting the weapon/store fall away from the aircraft. The BRU-14 has a CAD backup release method if the primary method fails. When the CAD is fired, the release linkage frees the weapon/store.

BOMB EJECTOR RACKS

Bomb ejector racks differ from standard bomb racks. Ejection racks use electrically fired impulse cartridges to open the suspension hook linkage and eject the weapon/store. When in flight, a vacuum can be created under the fuselage and wings of the aircraft. In some cases, this vacuum will prevent the released weapon/store from entering the airstream and falling to the target. Physical contact between the weapon/store and the aircraft structure may result. This could cause damage to or loss of the aircraft. Bomb ejector racks eject the weapon/store from the bomb rack with sufficient force to overcome this vacuum and ensure a safe release.

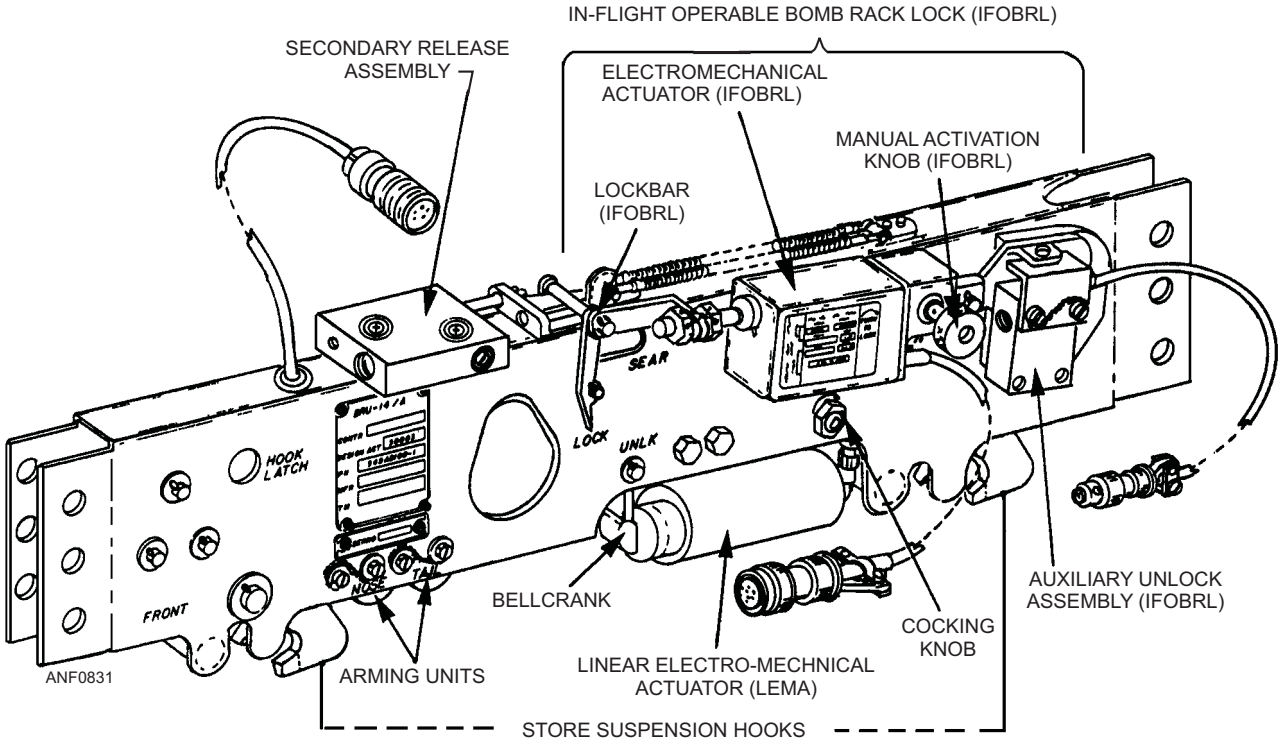


Figure 8-31.—BRU-14 (series) aircraft bomb rack.

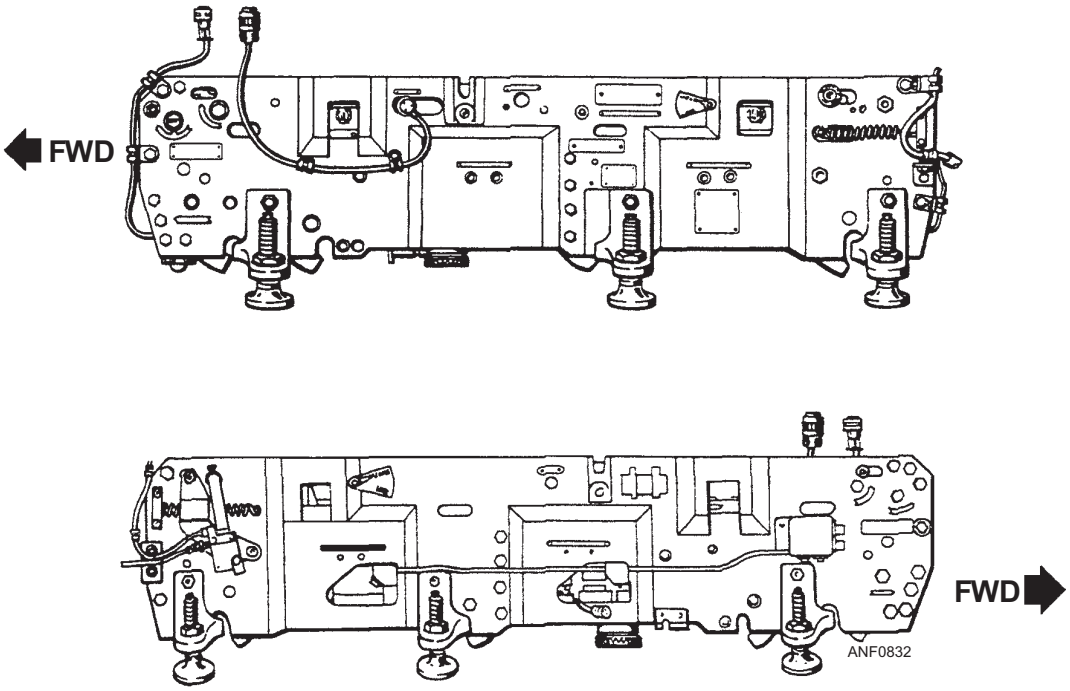


Figure 8-32.—BRU-11A/B bomb ejector rack.

The BRU-11A/B bomb ejector rack (fig. 8-32) has four suspension hooks. Two of these hooks are spaced 14 inches apart and two are spaced 30 inches apart. These hooks carry weapons/stores weighing up to 4,000 pounds. The rack has electrical connections, mechanical and electrical arming units, ejection components, and mechanical linkage for safely suspending and ejecting weapons/stores.

When the pilot fires the impulse cartridges, the resulting gas pressure unlocks the suspension hooks. The gas pressure simultaneously causes the ejection piston and ejector foot to **kick** the weapon/store away from the aircraft. The BRU-11A/B has a secondary weapons/stores jettison release if the primary system fails. The secondary release also uses an impulse cartridge to unlock the suspension hooks, but it does not eject the weapon/store.

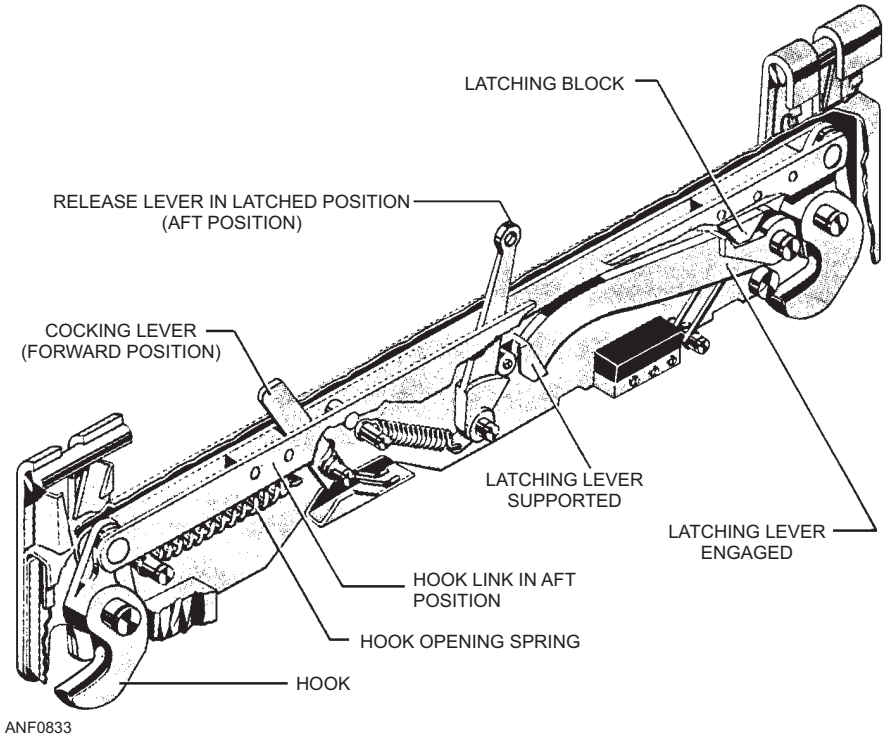


Figure 8-33.—Mk 8 Mod 5 bomb shackle.

BOMB SHACKLES

The Mk 8 Mod 5 bomb shackle (fig. 8-33) is the only bomb shackle now in use. It is used on helicopters. The shackle is used to suspend and release mines or torpedoes that weigh from 100 to a maximum of 1,500 pounds. The shackle has suspension hooks spaced 14 inches apart, center to center. It has no integral provision for electrical release, electrical arming, or mechanical arming. Electrical release of the shackle is possible by attaching an electrical release unit to the shackle structure. Weapons may be mechanically armed by attaching arming solenoids to the shackle or to the aircraft structure.

DISPENSERS AND EJECTORS

Dispensers and ejectors are used during tactical situations to give an aircraft added offensive and defensive capabilities. These units are usually detachable and suspended from other installed suspension equipment, or they are mounted directly to the aircraft. They are used to suspend and release ordnance, such as aircraft parachute flares, chaff, and decoy flares.

SUU-25F/A Flare Dispenser

The SUU-25F/A flare dispenser (fig. 8-34) is capable of suspending and launching eight LUU-2B/B

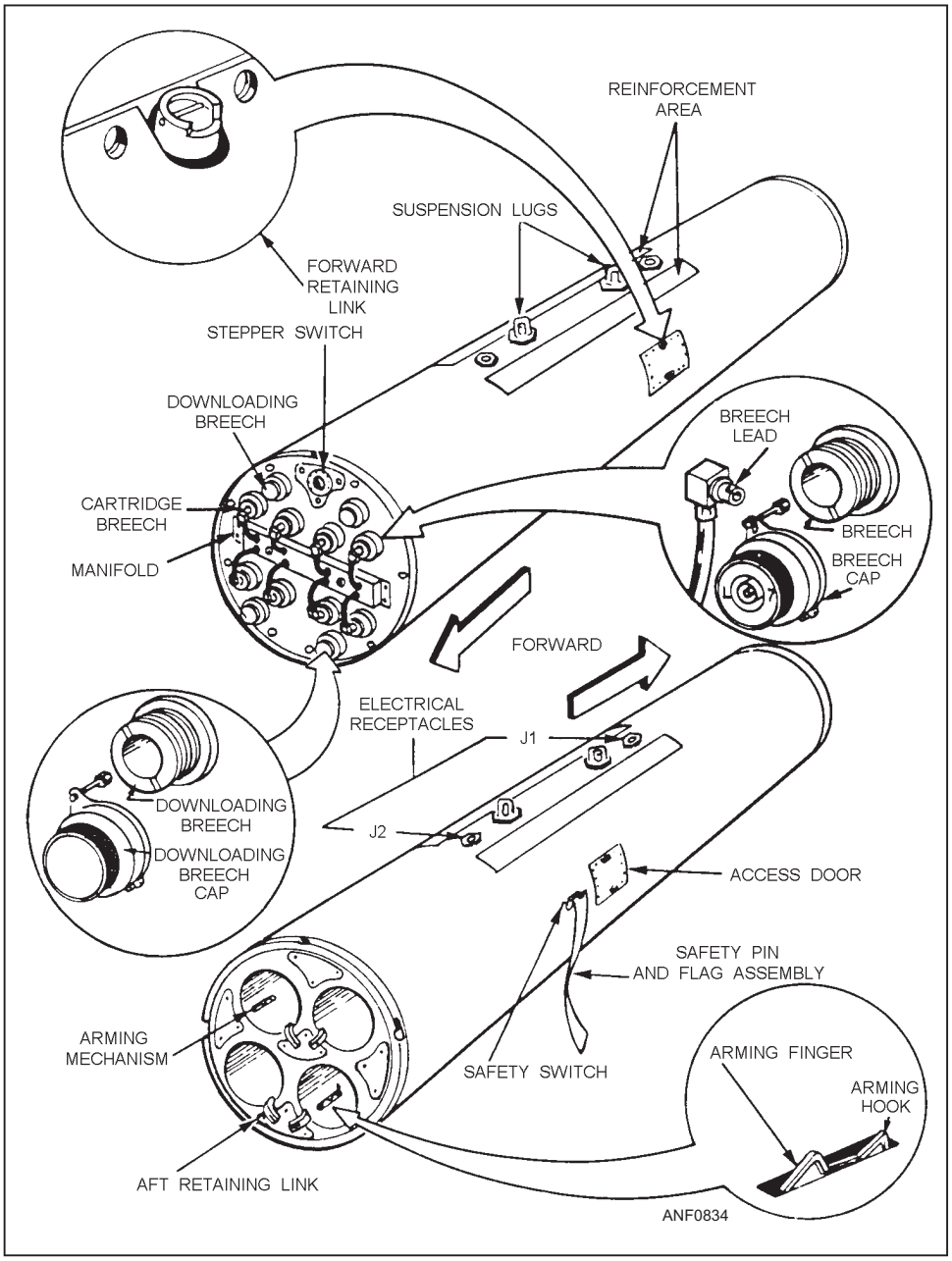


Figure 8-34.—SUU-25F/A flare dispenser.

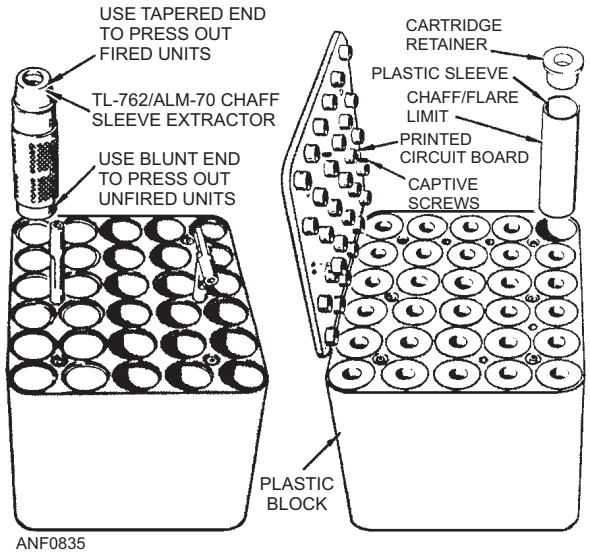


Figure 8-35.—AN/ALE-29A countermeasures chaff dispensing set.

aircraft parachute flares. The SUU-25F/A dispenser is made up of four aluminum tubes housed in a supporting frame and covered with aluminum skin. Each tube is loaded with a pair of flares configured with a flare adapter kit. The dispenser allows the flares to be ejected one at a time, thereby doubling the mission capability over previous models. Each tube has two flares. The forward bulkhead (A) of the dispenser has breech assemblies for eight impulse cartridges (one for each flare). Four aft retaining links (B) attached to the rear bulkhead keeps the aft flares in the dispenser tubes until they are ejected.

When initiated by the pilot, the impulse cartridge in the number 1 breech will be fired. The resulting gas pressure is routed into the launcher tube. Gas pressure buildup will be sufficient enough to force the flare aft and shear the aft retaining lock shear pin, allowing a single flare to be ejected from the launcher tube. A stepper switch automatically steps the firing circuit in the dispenser to the next tube. Each subsequent activation of the firing circuit steps the stepper switch and repeats the process for the remaining tubes.

AN/ALE-29A Countermeasures Chaff Dispensing Set

The AN/ALE-29A countermeasures chaff dispensing set (chaff dispenser) (fig. 8-35) is an electronic device installed in most Navy combat aircraft. The chaff dispenser ejects cartridge-loaded configurations of Mk 46 or MJU-8/B decoy flares and RR-129 or RR-144 chaff.

Decoy flares are used during evasive maneuvers against heat-seeking missiles. Chaff rounds consist of extremely fine shredded metal strips in a cylindrical metal container. When ejected, the metal strips cause a jamming effect against ground-controlled radar installations or radar-controlled missiles.

GUIDED MISSILE LAUNCHERS

A guided missile launcher provides mechanical and electrical means of suspending and air launching a guided missile from an aircraft. The launcher either ejects the missile or the missile leaves the launcher rails under its own power. Each of these type launchers is discussed briefly in the following text.

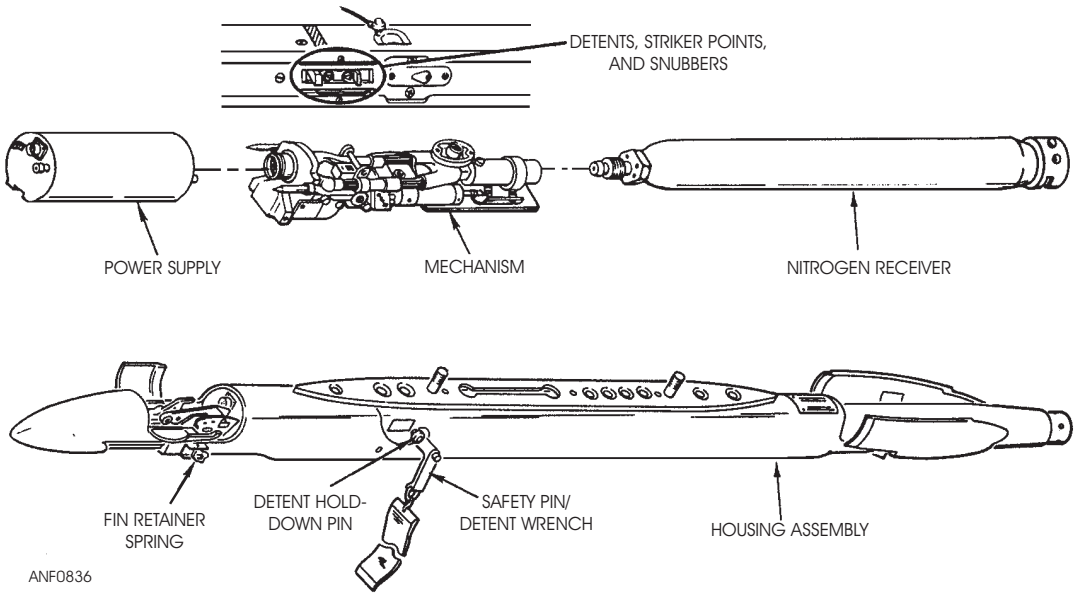


Figure 8-36.—LAU-7/A (series) guided missile launcher.

LAU-7/A Guided Missile Launcher

The LAU-7/A (series) guided missile launcher (fig. 8-36) is a reusable launcher system for use with AIM-9 Sidewinder missiles. The launcher has four major assemblies—the housing assembly, the nitrogen receiver assembly, the mechanism assembly, and the power supply.

LAU-92/A Guided Missile Launcher

The LAU-92/A guided missile launcher (fig. 8-37) is a self-contained, gas operating mechanism. It carries, retains, and ejection-launches the Sparrow III missile.

Launcher unlocking and ejection force is supplied by two Mk 124 Mod 0 impulse cartridges installed in the breeches. The cartridges are ignited by an electrical impulse from the aircraft firing circuits.

AIRCRAFT ROCKET LAUNCHERS

Aircraft rocket launchers (rocket pods) are a platform from which airborne rockets can be fired. Rocket pods contain rocket motors and, in some cases, completely assembled rounds. Each may use the same container from manufacture, through stowage, to final firing.

Aircraft rocket launchers are classified as either 2.75-inch (fig. 8-38, view A) or 5.0-inch (fig. 8-38, view B) and either reusable or non-reusable. Metal launcher tubes are reusable. Paper launcher tubes are designed for onetime use only, and are jettisoned by the pilot after use.

The 2.75-inch rocket launchers now in use are the LAU-61/A (19 shot), LAU-68/A (7 shot), and the LAU-69/A (19 shot). The 5.0-inch rocket launchers are the LAU-10 series (4 shot).

Q8-28. What is the purpose of ordnance suspension and releasing equipment?

Q8-29. What is the purpose of bomb racks?

Q8-30. The Mk 8 Mod 5 bomb shackle is used on what type of aircraft?

Q8-31. What is the purpose of dispenser and ejector equipment?

Q8-32. What guided missile launcher is used with the AIM-9 Sidewinder missile?

SUMMARY

In this chapter, you have identified the different types of ammunition, materials, operation, and hazards associated with aircraft ordnance. You have also become familiar with some of the responsibilities of the Aviation Ordnanceman.

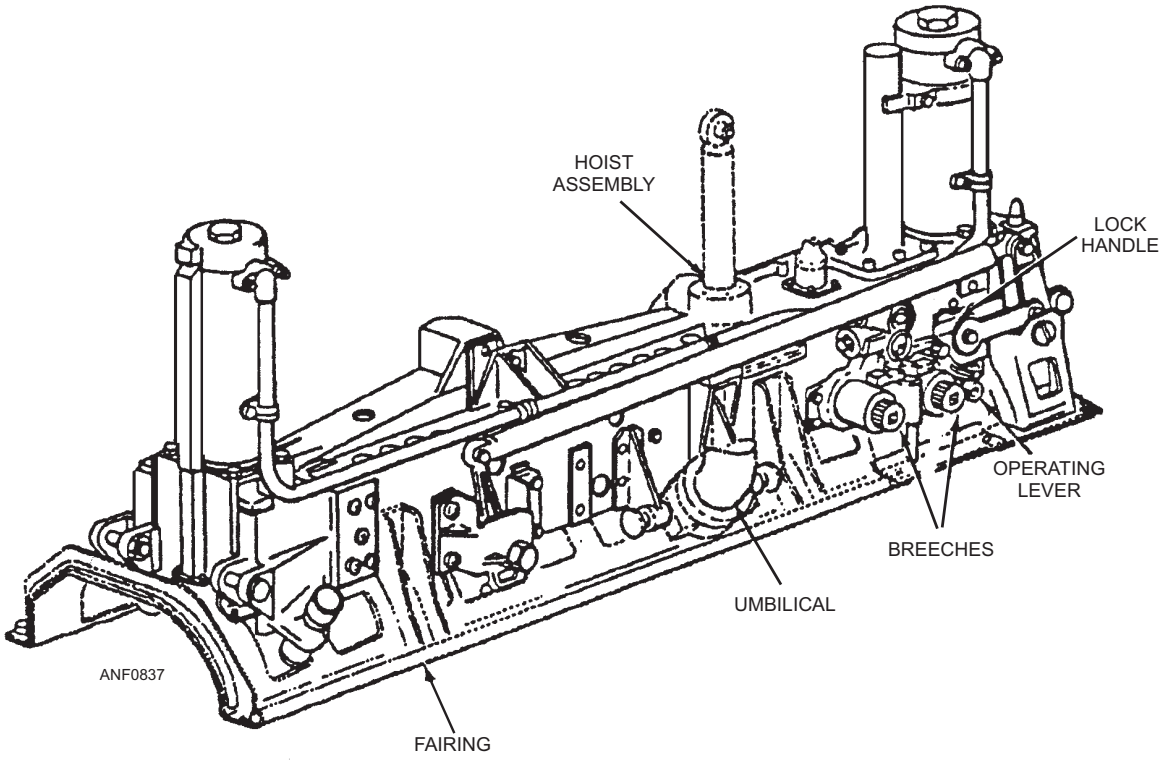
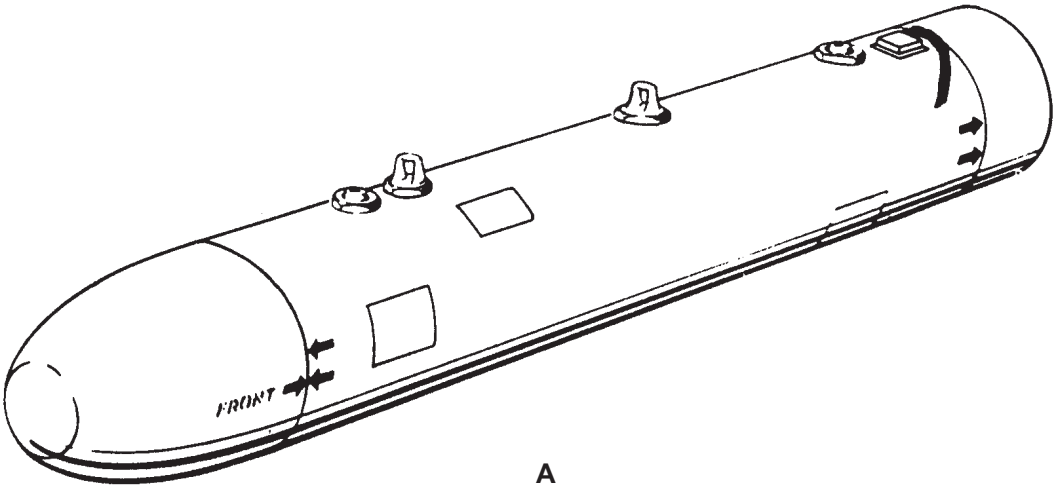
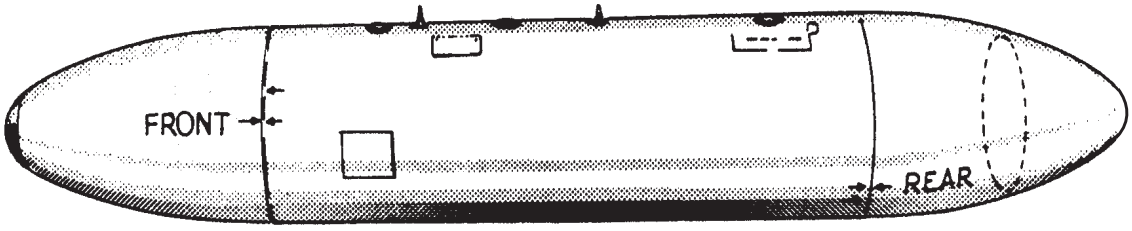


Figure 8-37.—LAU-92/A guided missile launcher.



A

2.75-INCH



ANF0838

B

5.0-INCH

Figure 8-38.—Typical airborne rocket launcher configurations.

ASSIGNMENT 8

Textbook Assignment: "Aircraft Ordnance," chapter 8, pages 8-1 through 8-30.

8-1. Which of the following types of ammunition is used to produce illumination?

1. Propellant
2. Incendiary
3. Pyrotechnics
4. Illumination

8-2. What type of ammunition is characterized by a large high-explosive charge-to-weight ratio?

1. Cartridge-actuated device
2. Incendiary
3. Bomb-type ammunition
4. Inert ordnance

8-3. Which of the following devices is an explosive-loaded device designed to provide the means of releasing potential energy to initiate a function or a special-purpose action?

1. Cartridge-actuated device
2. Incendiary
3. Bomb-type ammunition
4. Inert ordnance

8-4. What actual size ammunition items with working mechanisms are used for training exercises but have no explosive materials?

1. Cartridge-actuated device
2. Incendiary
3. Bomb-type ammunition
4. Inert ordnance

8-5. What type of ammunition uses a chemical primarily for igniting combustible substances?

1. Cartridge-actuated device
2. Incendiary
3. Bomb-type ammunition
4. Inert ordnance

8-6. Ammunition intended for combat rather than for training has what classification?

1. Airborne stores
2. Propellants
3. Incendiaries
4. Service ammunition

8-7. The *Warhead* is the part of the ammunition containing the materials intended to inflict damage. What are the explosives in the warhead called?

1. Stores
2. Payload
3. Expendables
4. Components

8-8. An explosive is a material that is capable of producing an explosion by its own energy.

1. True
2. False

8-9. What are the two general classes of military explosives?

1. Explosive and nonexplosive
2. High and low explosives
3. Incendiary and burster explosives
4. Chemical and detonating explosives

8-10. Which of the following additives may be added to high explosives to provide desired stability and performance characteristics?

1. Powdered metals
2. Oils
3. Waxes
4. All the above

8-11. Which of the following explosives is characterized by the extremely fast decomposition called "detonation"?

1. High explosive
2. Low explosive
3. Initiating explosive
4. Auxiliary explosive

8-12. The decomposition of low explosives is known as what type of decomposition?

1. Detonation
2. Explosion
3. Deflagration
4. Combustion

8-13. Proper identification of ammunition provides which of the following types of information?

1. Service (live) ammunition
2. Nonservice (training) ammunition
3. Class of explosives
4. Each of the above

8-14. What is the most important means of identifying explosive hazards contained within ordnance?

1. Safety information sheets
2. Color codes
3. Manufacturer’s assembly card
4. Ordnance manual

IN ANSWERING QUESTIONS 8-15 THROUGH 8-18, REFER TO TABLE 8-1 IN YOUR TRAINING MANUAL.

8-15. Which of the following color codes identifies high explosives and indicates the presence of explosives either sufficient to cause the ammunition to function as a high explosive or particularly hazardous to the user?

1. Yellow
2. Brown
3. Red
4. Silver

8-16. Which of the following color codes identifies armor-defeating ammunition except on underwater ordnance?

1. Yellow
2. Brown
3. Red
4. Black

8-17. Which of the following color codes identifies incendiary ammunition or indicates the presence of highly flammable material?

1. Light blue
2. Light red
3. Light green
4. Light orange

8-18. Which of the following color codes identifies ammunition used for training or firing practice?

1. Light green
2. White
3. Light blue
4. Gray

8-19. Some bomb-type ammunition is shipped and stowed without the fuzes or arming assemblies and associated components installed for which of the following reasons?

1. Physical size of the weapon
2. To meet safety requirements
3. To simplify handling requirements
4. To provide required training

8-20. Approximately what percent of a Mk 80 general-purpose bomb's total weight is made of explosives?

1. 25%
2. 35%
3. 45%
4. 55%

8-21. By what means is the spacing of the suspension lugs used with general-purpose bombs determined?

1. The configuration of the aircraft's bomb rack
2. The size of the bomb
3. The assembly supervisor
4. The weapons handling officer

8-22. Bomb fuzes are divided into what two categories?

1. Explosion and detonation
2. Deflagration and combustion
3. Mechanical and electrical
4. Initiating and auxiliary

8-23. What part of the bomb causes a general-purpose bomb to fall in a smooth, stable, and definite curve to the target?

1. Stabilizer
2. Target detector
3. Fin assembly
4. Bomb casing

8-24. What is the preferred mode of delivery for low-level bombing to prevent damage to the aircraft?

1. Retarded
2. Unretarded
3. Mechanical
4. Restricted

8-25. What is the primary purpose of practice bombs?

1. To simulate different ballistic properties as those of service-type bombs
2. To provide optimum safety during the training of new or inexperienced pilots and ground handling crews
3. To provide low cost training and to provide an increase in available target locations
4. To provide for the training of experienced pilots and ground handling crews

8-26. A Mk 80 series bomb with a blue band around the nose is classified as what type of bomb?

1. Full-scale practice
2. Subcaliber practice
3. Service
4. Nonrestricted use

8-27. Which of the following types of bombs is/are classified as subcaliber practice bombs?

1. Mk 82 Mod 3
2. BDU-48/B
3. Mk 76 Mod 5
4. Both 2 and 3 above

8-28. What type of weapons carry and dispense small bomblets over a target area?

1. Laser guided bombs
2. General purpose bombs
3. Cluster bomb units
4. Full-scale bombs

8-29. The CBU-59/B contains bomblets of (a) what quantity and (b) what type?

1. (a) 717 (b) BLU-77/B
2. (a) 717 (b) Mk 118
3. (a) 247 (b) BLU-77/B
4. (a) 247 (b) Mk 110

8-30. Laser-guided bombs are modified from what types of general-purpose bombs?

1. Mk 82
2. Mk 83
3. Mk 84
4. All of the above

8-31. Where is the computer-control group mounted on a converted low-drag general-purpose bomb?

1. Conical fin assembly
2. Nose of the bomb body
3. Inside the bomb casing
4. Exterior mounting stanchion

8-32. How many assemblies make up the Mk 65 Quickstrike mine?

1. One
2. Two
3. Three
4. Four

8-33. Which of the following components enables a rocket to spin when fired from a slow-flying aircraft?

1. Nozzle
2. Folding fins
3. Scarfed nozzle insert
4. Stabilizer rod

8-34. What is the rocket launcher capacity for the Mighty Mouse weapons system?

1. 7 or 19 rockets
2. 4 or 12 rockets
3. 6 or 18 rockets
4. 5 or 16 rockets

8-35. Guided missiles are classified according to what characteristics?

1. Speed, launch environment, mission, vehicle type, and weight
2. Speed, launch environment, mission, range, and vehicle type
3. Speed, launch environment, mission, range, and weight
4. Speed, mission, range, vehicle type, and weight

8-36. At what speed is an object traveling in air at 766 miles per hour (Mach 1) under standard atmospheric conditions?

1. Subsonic
2. Transonic
3. Supersonic
4. Hypersonic

8-37. When a guided missile with a speed of Mach 2.5 is launched from an aircraft traveling at a speed of Mach 2.0, the missile will reach what speed?

1. Mach 0.5
2. Mach 2.5
3. Mach 4.5
4. Mach 5.5

IN ANSWERING QUESTIONS 8-38 AND 8-39, REFER TO TABLE 8-2 IN YOUR TEXT.

8-38. In the first letter designation for launching guided missiles and rockets, what letter signifies multiple launch environments?

1. A
2. B
3. C
4. D

8-39. In the second letter designation for the mission of guided missiles and rockets, what does the letter E signify?

1. Surface attack
2. Intercept aerial
3. Decoy
4. Special electronic

8-40. In the basic missile designation of the AGM-65E, what does the number signify?

1. Missile design
2. Mach speed
3. Modification
4. Model

8-41. What are the three significant color codes used on guided missiles?

1. White, brown, and blue
2. White, brown, and yellow
3. Red, brown, and blue
4. Yellow, brown, and blue

8-42. What is the tactical mission of the AIM-7F Sparrow III guided missile?

1. To destroy enemy ships
2. To destroy enemy ground radar installations
3. To intercept and destroy enemy aircraft
4. To destroy enemy fortified installations

8-43. The AGM-84A-1 Harpoon guided missile is an all-weather, air-launch, antiship attack weapon and is launched from which of the following aircraft?

1. F-15 and F-16
2. F-14 and AV-8
3. F/A-18 and EA-6
4. S-3 and P-3

8-44. The AIM-9L Sidewinder guided missile is comprised of what total number of major sections?

1. Five
2. Two
3. Three
4. Four

8-45. What maximum number of Phoenix missiles may be launched from a single aircraft with simultaneous guidance against widely separated targets?

1. Eight
2. Two
3. Six
4. Four

8-46. The AGM-65E Maverick guided missile uses what type of guidance?

1. Infrared
2. Laser
3. Homing
4. Heat-seeking

8-47. The AGM-65E/F guided missile is employed against what type of targets?

1. Microwave electromagnetic energy
2. Armored vehicles and fortified bunkers
3. Fortified ground installations, armored vehicles, and surface combatants
4. Ground personnel, bunkers, tanks, and artillery positions

8-48. What short-to-medium range guided missile is designed to be launched from helicopters at low air speeds and altitudes?

1. AGM-119B Penguin
2. AGM-88A HARM
3. AGM-65E/F Maverick
4. AGM-78E Standard

8-49. The AIM-120 AMRAAM is an advanced missile system and offers performance improvements over which of the following missiles?

1. Shrike
2. Sidewinder
3. Maverick
4. Sparrow

8-50. The Walleye guided weapon employs which, if any, of the following propulsion systems?

1. Double-base solid propellant
2. Liquid rocket motor
3. Single-base gas propellant
4. None of the above

8-51. What are the primary weapons used in antisubmarine warfare (ASW)?

1. Aircraft laid mines
2. Mk 54 depth bombs
3. Mk 46 torpedoes
4. Subsurface guided missiles

8-52. Where are naval mines used?

1. In enemy harbors and ports
2. In offensive mining operations only
3. In defensive mining operations only
4. In offensive and defensive mining operations

8-53. How is the M61A1 20-mm automatic aircraft gun (a) driven and (b) controlled?

1. (a) Gas blowback (b) Fire
2. (a) Hydraulically (b) Electrically
3. (a) Pneumatically (b) Manually
4. (a) Gas blowback (b) Hydraulically

8-54. What is the firing rate of the M61A1 20-mm gun as installed in Navy aircraft?

1. 4,000 (gun low) and 6,000 (gun high) rounds per minute
2. 2,000 (gun low) and 4,000 (gun high) rounds per minute
3. 5,000 rounds per minute
4. 7,200 rounds per minute

8-55. By what means is the night end of the Mk 124 Mod 0 marine smoke and illumination signal identified?

1. By color
2. By the raised beads on the casing
3. By the D-ring located on the ignition lanyard
4. By the larger sized end ring

8-56. What number of signal flares is contained in the Mk 79 Mod 0 illumination signal kit?

1. 4
2. 5
3. 6
4. 7

8-57. By which of the following methods can the LUU-2 aircraft parachute flare be launched?

1. By hand
2. From a bomb rack
3. Dispenser-launched
4. Each of the above

8-58. What is the primary purpose of the Mk 25 marine location marker?

1. As a distress signal for downed aircrew personnel
2. Antisubmarine warfare operations
3. To illuminate target areas
4. As a channel marker

8-59. The Mk 58 Mod 1 marine location marker produces yellow flame and white smoke for (a) a minimum of and (b) a maximum of how many minutes?

1. (a) 15 (b) 30
2. (a) 30 (b) 45
3. (a) 40 (b) 60
4. (a) 45 (b) 80

8-60. Which of the following functions is performed by cartridges and CADs in personnel escape devices?

1. Removal of cockpit canopies
2. Ejection of seats
3. Streaming of ejection seat drogue chutes
4. Each of the above

8-61. Which of the following ratings is normally responsible for the installation of cartridges and CADs as used in personnel escape systems?

1. AO
2. AME
3. AT
4. AD

8-62. What is the primary use of the CCU-45/B impulse cartridge?

1. To remove cockpit canopies
2. To eject seats
3. To release and eject stores from an aircraft in flight
4. To eject and deploy seat drogue chutes

8-63. Which of the following impulse cartridges is/are classified as miscellaneous cartridges?

1. Mk 19 Mod 0
2. Mk 97 Mod 0
3. Mk 1 Mod 3
4. Both 2 and 3 above

8-64. Aircraft weapons suspension and releasing equipment is generally operated by what means?

1. Hydraulic and pneumatic
2. Electronic and manual
3. Hydraulic and electrical
4. Hydraulic and mechanical

8-65. What is the function of bomb racks?

1. To carry stores
2. To arm stores
3. To release stores
4. Each of the above

8-66. How do bomb ejector racks differ from bomb racks?

1. Bomb ejector racks are designed to carry more weight
2. Bomb ejector racks are designed to carry less weight
3. Bomb ejector racks use electrically fired impulse cartridges
4. Bomb racks use electrically fired impulse cartridges

8-67. The BRU-11A/B bomb ejector rack provides (a) how many suspension hooks and (b) are spaced how far apart?

1. (a) Four
   (b) two 14 inches apart and two 30 inches apart
2. (a) Two
   (b) 30 inches
3. (a) Two
   (b) 14 inches
4. (a) Four
   (b) two 14 inches apart and two 28 inches apart

8-68. The Mk 8 Mod 5 bomb shackle is used on which of the following types of aircraft?

1. Fighter
2. Attack
3. Helicopter
4. Patrol

8-69. The SUU-25F/A flare dispenser provides the capability for suspending and launching what total number of LUU-2B/B aircraft parachute flares?

1. Eight
2. Two
3. Six
4. Four

8-70. The AN/ALE-29A countermeasures chaff dispensing set is capable of cartridge ejecting which of the following load configurations?

1. Mk 46 or MJU-8/B decoy flares
2. RR-129 or RR-144 chaff
3. Both 1 and 2 above
4. Mk 50 decoy flares or RR-142 chaff

8-71. What is the primary purpose of decoy flares?

1. Used during evasive maneuvers against heat-seeking missiles
2. Causes a jamming effect against ground-controlled radar installations
3. Interrupts enemy aircraft radar tracking systems
4. Used for training purposes only

8-72. The LAU-7/A guided missile launcher provides a complete launching system for which of the following guided missiles?

1. Sidewinder
2. Harpoon
3. Sparrow III
4. Phoenix

8-73. The LAU-92/A guided missile launcher is capable of carrying, retaining, and ejection-launching which of the following missiles?

1. Harpoon
2. Sparrow III
3. Maverick
4. Shrike

8-74. Which of the following designations is a classification of rocket launchers?

1. 2.75-inch or 5.0-inch
2. Reusable
3. Nonreusable
4. Each of the above

8-75. How many shots does the LAU-10 series rocket launcher provide?

1. 4
2. 7
3. 19
4. 21