

DOC.
D 207.208/2:
Av5/13/990

Naval Education and
Training Command

NAVEDTRA 12308
June 1990
0502-LP-213-1800

DEPOSITORY

SEP 26 1990

UNIVERSITY OF ILLINOIS
AT URBANA-CHAMPAIGN

Training Manual
(TRAMAN)



Aviation Ordnanceman 3 & 2

DISTRIBUTION STATEMENT A: Approved for public release; distribution is unlimited.

Nonfederal government personnel wanting a copy of this document
must use the purchasing instructions on the inside cover.



S/N 0502-LP-213-1800

The terms training manual (TRAMAN) and nonresident training course (NRTC) are now the terms used to describe Navy nonresident training program materials. Specifically, a TRAMAN includes a rate training manual (RTM), officer text (OT), single subject training manual (SSTM), or modular single or multiple subject training manual (MODULE); and an NRTC includes nonresident career course (NRCC), officer correspondence course (OCC), enlisted correspondence course (ECC), or combination thereof.

Although the words "he," "him," and "his" are used sparingly in this manual to enhance communication, they are not intended to be gender driven nor to affront or discriminate against anyone reading this text.

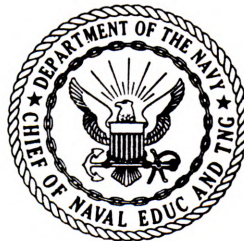
DISTRIBUTION STATEMENT A: Approved for public release; distribution is unlimited.

Nonfederal government personnel wanting a copy of this document must write to Superintendent of Documents, Government Printing Office, Washington, DC 20402 OR Commanding Officer, Naval Publications and Forms Center, 5801 Tabor Avenue, Philadelphia, PA 19120-5099, Attention: Cash Sales, for price and availability.

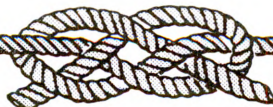


AVIATION ORDNANCEMAN 3 & 2

NAVEDTRA 12308



*1990 Edition Prepared by
AOCS Andrew W. Pitts, III*



Doc.
D207.208/2:
Av 5/13/990

PREFACE

This Training Manual (TRAMAN) and the Nonresident Training Course (NRTC) form a self-study package that will enable personnel in the Aviation Ordnanceman rating to fulfill certain requirements of their rating. Designed for individual study, this includes subject matter that relates directly to the occupational standards of the Aviation Ordnanceman rating at the second and third class levels. The NRTC includes learning objectives and supporting items designed to lead students through the TRAMAN. The occupational standards used as minimum guidelines in the preparation of this manual are found in the *Manual of Navy Enlisted Manpower and Personnel Classifications and Occupational Standards*, NAVPERS 18068-D.

The following definitions apply to the WARNINGS, CAUTIONS, and NOTES found throughout this Training Manual:

WARNING

Precedes a procedure or practice which, if not correctly followed, could result in personnel injury or loss of life.

CAUTION

Precedes a procedure or practice which, if not strictly observed, could result in damage to or destruction of equipment.

NOTE

Precedes or follows an operating procedure or condition which is essential to amplify.

The TRAMAN contains Review Subsets in each chapter. These consist of a group of questions designed to cover the learning objectives found in the chapter. Answering these questions is the way for you to learn material, which will help you successfully complete the NRTCs. The answers to each group of questions can be found by turning the page.

This Training Manual and the Nonresident Training Course were prepared by the Naval Education and Training Program Management Support Activity, Pensacola, Florida, for the Chief of Naval Education and Training.

1990 Edition

**Stock Ordering No.
0502-LP-213-1800**

Published by
NAVAL EDUCATION AND TRAINING
PROGRAM MANAGEMENT SUPPORT ACTIVITY

UNITED STATES
GOVERNMENT PRINTING OFFICE
WASHINGTON, D.C.: 1990

THE UNITED STATES NAVY

GUARDIAN OF OUR COUNTRY

The United States Navy is responsible for maintaining control of the sea and is a ready force on watch at home and overseas, capable of strong action to preserve the peace or of instant offensive action to win in war.

It is upon the maintenance of this control that our country's glorious future depends; the United States Navy exists to make it so.

WE SERVE WITH HONOR

Tradition, valor, and victory are the Navy's heritage from the past. To these may be added dedication, discipline, and vigilance as the watchwords of the present and the future.

At home or on distant stations we serve with pride, confident in the respect of our country, our shipmates, and our families.

Our responsibilities sober us; our adversities strengthen us.

Service to God and Country is our special privilege. We serve with honor.

THE FUTURE OF THE NAVY

The Navy will always employ new weapons, new techniques, and greater power to protect and defend the United States on the sea, under the sea, and in the air.

Now and in the future, control of the sea gives the United States her greatest advantage for the maintenance of peace and for victory in war.

Mobility, surprise, dispersal, and offensive power are the keynotes of the new Navy. The roots of the Navy lie in a strong belief in the future, in continued dedication to our tasks, and in reflection on our heritage from the past.

Never have our opportunities and our responsibilities been greater.

CONTENTS

CHAPTER	Page
1. Explosives and Ammunition	1-1
2. Aircraft Bomb Ammunition and Associated Components	2-1
3. Bomb Fuzes and Associated Components.....	3-1
4. Aircraft Rockets and Rocket Launchers	4-1
5. Air-Launched Guided Missiles, Guided Missile Launchers, and Guided Missile Handling	5-1
6. Pyrotechnics	6-1
7. Underwater Weapons	7-1
8. M61A1 Automatic Gun Installation and Loading Equipment.....	8-1
9. Aerial Targets and Associated Equipment	9-1
10. Ammunition Handling Equipment	10-1
11. Suspension, Arming, and Releasing Equipment.....	11-1
12. Ammunition Handling, Storage, and Assembly.....	12-1
13. Aircraft Loading/Unloading Procedures.....	13-1
14. Aircraft Weapons Systems	14-1
15. Aircraft Weapons Systems Test Equipment	15-1
APPENDIX	
I. Glossary.....	AI-1
II. References	AII-1
INDEX	INDEX-1

CHAPTER 1

EXPLOSIVES AND AMMUNITION

The composition and function of a complete round of ammunition determine its purpose. Each piece of ammunition has its own characteristics that determine its use as a military explosive. The demands for ammunition that fulfill Navy requirements make it necessary for explosives to perform in a specific manner.

EXPLOSIVES

Learning Objective: Recognize the various classifications of explosives to include their purpose and use. Identify the purpose and use of chemical agents to include military gases, screening smoke, incendiaries, and simulated military gases. Identify the types of explosives and recognize their applications.

An explosive must be insensitive enough for you to safely handle it using common handling equipment. It must be powerful enough to produce damage or activate another explosive. It must also remain stable over an extended period under varied conditions. The requirements of sensitivity, power, stability, handling, and availability are considered when manufacturing an explosive. However, manufacture must not be economically prohibitive.

EXPLOSIVE TERMINOLOGY

Common military explosive terminology and definitions are discussed in the following paragraphs.

Brisance. Brisance is the speed at which an explosive develops its maximum pressure. In a brisant explosive, the maximum pressure is attained so fast that it shatters any material in contact with it and all surrounding material.

Deflagration. Deflagration is the uncontrolled burning of explosives without detonation.

Explosion. An explosion is defined in a variety of ways. A simple definition that fits all types of explosives is a *loud noise and the sudden going away of things from the place where they have been.* Another definition states that *an explosion is a rapid and violent release of energy, not necessarily involving an explosive substance.* NAVSEA OP 4 defines an explosion as *a chemical decomposition or transformation with the evolution of heat and the formation of decomposition products, some of which are gaseous.*

Explosives. An explosive is a material (either a pure, single substance or a mixture of substances) capable of producing an explosion by its own energy.

High-order detonation. High-order detonation is the complete detonation of a mass of high explosives at maximum rate.

Hygroscopicity. Hygroscopicity is the tendency of a material to absorb moisture. Since moisture reduces the sensitivity of an explosive, explosives must be protected from moisture absorption to prevent deterioration.

Load density. Load density is the weight of the explosive per unit volume. A cast explosive has a high load density—more of it fits in a given space than if it were in powder form.

Low-order detonation. Low-order detonation is the incomplete detonation of a mass of high explosives. It progresses at a low rate of detonation. An explosion may be identified by the color of the smoke it produces. White or yellow smoke shows a low-order and black smoke shows a high-order detonation.

Rate of detonation. The rate of detonation of an explosive is defined as its burning speed. Some

explosives burn slowly while others burn very rapidly. Explosives that burn very rapidly *detonate* and are termed *high explosives*. Explosives that burn slowly are termed *low explosives*.

Although the word *burning* describes an explosion, the process is quite different from burning of the usual sort. Ordinary burning, such as the flame of a match, occurs in the presence of oxygen. Explosives and propellants are manufactured so the oxygen necessary for burning is contained in the explosive proper and in a concentrated form.

Sensitivity. Sensitivity is an important feature of military explosives. Sensitivity is the ease with which an explosive can be detonated. Explosives must be safe to handle. They must withstand severe shock before the start of the chemical reaction or detonation. The strength of the impulse required to explode or set off an explosive may vary considerably. Some explosives are exploded by the slightest touch. Others require a moderate blow or flame. Some other explosives require a violent blow and cannot be exploded in the open by a flame.

Shock. Shock is the values of pressure at the front of the shock wave. Different targets, both above and below the surface, respond mainly either to the shock front or to the whole shock wave.

Stability. Stability is the ability of the explosive to remain unaffected by storage conditions. Some explosives (like smokeless powder) decompose with age, even under the best conditions. They require frequent checking.

CLASSIFICATION OF EXPLOSIVES

Explosive substances are classified by their reaction, composition, or service use. Military explosives are divided into two general classes according to their rates of decomposition. These are high explosives and low explosives. They are further classified according to use.

Classification by Reaction

Explosives are classified as high explosive or low explosive. Both categories are discussed briefly.

HIGH EXPLOSIVE. A high explosive is characterized by the extreme speed at which it decomposes. This action is known as *detonation*. When initiated by a blow or shock, a high explosive decomposes almost instantaneously.

LOW EXPLOSIVE. Usually, a low explosive is a solid, combustible material that decomposes rapidly, but normally does not explode. This action is known as *deflagration*. Normally, low explosives do not start a detonation. However, under certain conditions, they react like high explosives, and they detonate.

Classification by Composition

Explosives are divided into explosive mixtures and explosive compounds according to their composition.

Explosive mixture. Explosive mixtures are composed of distinct substances. They are carefully prepared and mechanically mixed in varying proportions. Black powder is a typical example of an explosive mixture.

Explosive compound. Explosive compounds are homogeneous substances. Their molecules contain the oxygen, carbon, and hydrogen necessary for combustion.

Classification by Service Use

So far, you have learned that explosives are classified based on characteristics. From your standpoint, a more practical classification is their service use.

Propellants and impulse explosives. These explosives propel projectiles from guns, propel rockets and missiles, launch torpedoes, and launch depth charges from projectors. They are low explosives.

Disrupting or bursting explosives. These explosives damage the target under attack. They are high-explosive charges. They are used alone or as part of the explosive charge in mines, bombs, depth charges, missile and torpedo warheads, and in projectiles as a burster charge.

Initiating explosives. The initiation of an explosive reaction requires the application of

energy. Propellants are commonly ignited by the application of flame. Disrupting explosives are set off by a severe shock. The device used to initiate a propellant is known as a *primer*. The device used to initiate a disrupting explosive is known as a *detonator*.

Auxiliary explosives. These are large propellant charges and relatively insensitive disrupting explosives. They require an intermediate charge to increase the flame or shock of the initiating explosive for proper reaction of the main explosive charge. The intermediate or auxiliary explosive used with propellants is known as an *ignition charge*. It consists of a sufficient quantity of flame-producing material to engulf the propellant grains. The auxiliary explosive used with disrupting explosives is called a *booster*. It consists of a quantity of high explosives more sensitive than the burster charge.

Pyrotechnic substances. Military pyrotechnic substances are used to send visual signals, illuminate areas of interest, simulate other weapons or activities, and as ignition elements for certain types of weapons. Pyrotechnic compositions are low explosives because of their low rates of combustion.

The functional characteristics of pyrotechnic compositions are their luminous intensity (candlepower), burning rate, color, color value, and efficiency of light production. For military use, pyrotechnic compositions must have acceptable explosive as well as burning characteristics.

CHEMICAL AGENTS

A military chemical agent is a substance that produces a toxic (casualty) or an irritating (harassing) effect, a screening smoke, incendiary action, or a combination of effects. These agents include compounds and mixtures other than pyrotechnics. They are used as fillers in artillery shells, mortar shells, grenades, rockets, and bombs. They are classified according to tactical use, physiological effect, and purpose.

Military Gases

A military gas is any agent or combination of agents that produces a toxic or irritating physiological effect. Military gas is a solid, liquid, or gas, either before or after dispersion. The military gas is classified as **persistent** if it remains effective at its point of release for more than

10 minutes. If it becomes ineffective within 10 minutes, it is classified as nonpersistent. Military gases are further classified according to their toxic and irritating effects.

Screening Smoke

A screening smoke is a cloud that consists of small particles of solids, liquids, or both. It is dispersed and suspended in the air.

Incendiaries

An incendiary may be a solid, liquid, or a gelled semiplastic material. Its heat is intense. Its heat and flame can start fires and scorch combustible and noncombustible materials. It can injure and inactivate personnel.

Simulated Military Gases

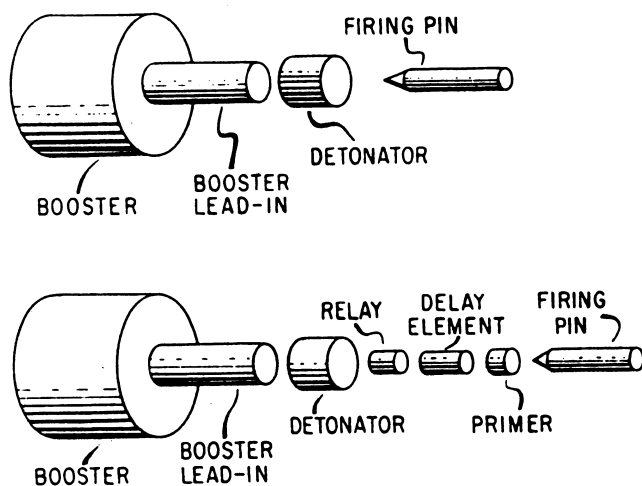
Simulated military gases are mild nontoxic harassing agents (substitutes for the real agent) designed specifically for training purposes.

TYPES AND APPLICATIONS OF EXPLOSIVES

High explosives are used for destruction, and they must meet two requirements. First, they must deliver the largest charge possible. Second, they must use the most effective explosive available.

- This first requirement governs the selection of the burster or main charge.
- The second requirement is to cause detonation of the burster with maximum effect by an acceptable safe means.

This will usually mean using the smallest possible amount of suitable primary explosives. In practice, maximum efficiency is often achieved by using a very small primary charge to explode a secondary or intermediate charge. The intermediate charge builds up the initiating shock to obtain full detonation of the burster charge. Such an intermediate charge is known as a *booster*. The combined system of the primary charge and booster charge forms an **explosive train**. The explosive train and the main charge (bursting charge) form the explosive system of the weapon.



53.153

Figure 1-1.—Typical high-explosive train.

The basic high-explosive train (fig. 1-1) consists of the detonator, booster, and bursting charge. High-explosive trains are modified by auxiliary boosters, time delays, and primers. An explosive train could consist of a primer delay element, detonator booster, and main charge.

High-explosive charges are loaded into their containers by one of three methods:

1. Cast-loading. The liquid substance is poured into a container and solidifies.
2. Press-loading. These explosives have no liquid and are pressed into their container.
3. Extrusion. Combining some explosives results in plastic mixtures. They are loaded by the extrusion method. A pressure system forces the plastic mixtures into the projectiles and bomb casings.

Service explosives used in the Navy are varied. They constantly undergo changes; however, some explosives are standard throughout the Navy. Some of these explosives are discussed in the following paragraphs.

Propellants

Propellants are classified as single base, double base, and composite. Single-base propellants include compositions that are principally gelatinized nitrocellulose. They do not contain high-explosive ingredients such as nitroglycerin. Double-base propellants are predominately nitrocellulose and nitroglycerin in composition. Composite propellants are compositions that

contain mixtures of fuel and inorganic oxidants. They do not contain a significant amount of nitrocellulose or nitroglycerin. There are also combinations of composite and double-base propellants.

In a digressive burning propellant, the surface area of the grains decreases as they burn. A neutral burning grain is a single perforated grain. As it burns, its inner surface increases, and its outer surface decreases. The result is that the total surface remains the same. In progressive burning (a multiperforated grain), the total burning area increases because it burns from the inside at the same time.

The Navy uses many different types of propellants. The more frequently used types are black powder and smokeless powder.

Black powder. Black powder is a low explosive. It is a mixture of potassium nitrate or sodium nitrate, charcoal, and sulfur. It is hygroscopic and deteriorates rapidly when exposed to moisture. It's a dangerous explosive to handle, because it's easily ignited by heat, friction, or sparks. Although black powder is no longer used as a propellant or a projectile bursting charge, it is used in ammunition and ammunition components.

Smokeless powder. Smokeless powder (fig. 1-2) is used as a propellant for gun and rocket ammunition. It is manufactured under uniform conditions. It is grained to a uniform size in the form of flakes, strips, sheets, balls, cords or perforated cylindrical grains. Figure 1-3 shows grain configurations of smokeless powder used in missiles and rockets. Some of the more frequently used types of smokeless powder are guncotton, ballistite, and Cordite N.

Guncotton is a nitrocellulose of high nitrogen content. It is used to manufacture single-base and double-base propellants. Guncotton is used in electric primers and in electrically initiated detonators. In most propellants, guncotton is blended with pyrocellulose where an increase in nitrogen content is needed. It is sometimes referred to by various names such as *pyropowder*, *pyrocellulose*, or *nitrocellulose*.

Ballistite is a double-base powder used as a rocket propellant. It is composed of two explosive substances, nitrocellulose and nitroglycerin, blended with diphenylamine, which acts as a stabilizer. It burns with a considerable

amount of flash and smoke, and it generates a great volume of gas. Ballistite burns progressively at a rate determined by the composition and physical characteristics of the powder grain, the temperature of the powder grain before ignition,

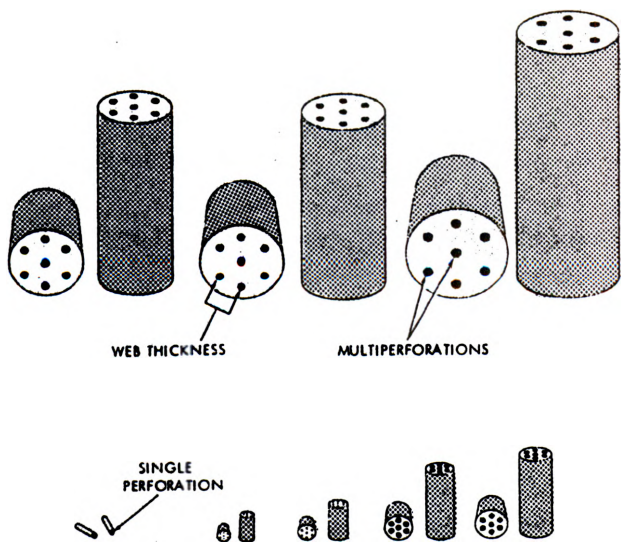
and the pressure during reaction. It is produced in various shapes to fit the rocket motor housing.

Solid propellant charges, such as ballistite, may be grouped under one of two types of charges—restricted burning and unrestricted burning.

A *restricted-burning charge* has some of its exposed surfaces covered with an inhibitor to control burning. Burning is restricted only on the desired surface or surfaces. Controlling the burning area lengthens burning time and determines the combustion chamber pressure for a given charge. A burning cigarette is a good example of restricted-burning; the paper-covered portion represents the inhibited area.

Unrestricted-burning charges burn on all surfaces simultaneously. The unrestricted grain delivers a large amount of thrust for a short period of time.

Cordite N is used as a propellant in aircraft gun ammunition. It contains three main explosive components—nitroguanidine, nitrocellulose, and nitroglycerin. Cordite N is cool burning, with little smoke and no flash. It has a higher velocity or burning rate than ballistite.

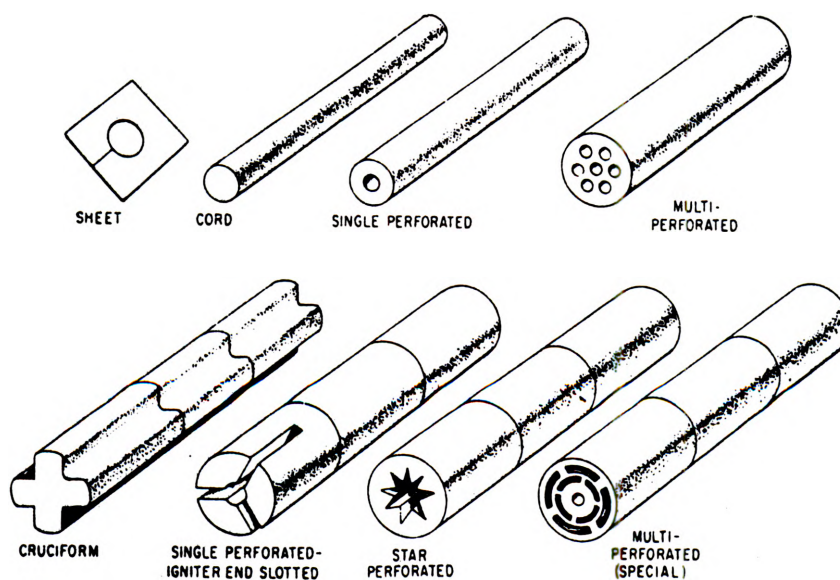


220.743

Figure 1-2.—Typical smokeless powder grains used in naval guns.

Initiating Explosives

Under normal conditions, initiating explosives don't burn, but they detonate if ignited. Their



53.144

Figure 1-3.—Shapes and forms of propellant grains used in missiles and rockets.

strength and brisance are inferior but sufficient to detonate high explosives. Because of their sensitivity, they are used in munitions for initiating and intensifying high-order explosions.

Mercury fulminate. Mercury fulminate is a heavy, nonhygroscopic, crystalline solid. When dry, it is sensitive to heat, friction, spark, flame, and shock. It is so sensitive that there are many accidents, especially during manufacturing. Do **not** let mercury fulminate contact materials such as aluminum, magnesium, zinc, brass, or bronze.

Lead azide. Lead azide has a high ignition temperature. It is less sensitive to shock and friction than mercury fulminate. It is also less brisant than mercury fulminate. Lead azide is the detonator of major-caliber base-detonating fuzes, point-detonating fuzes, and auxiliary detonating fuzes. It is also used in priming mixtures.

Lead styphnate. Lead styphnate is particularly sensitive to fire and static electricity discharge. When dry, it can be detonated by static discharges from the human body. Lead styphnate does **not** react with metals. Also, it is less sensitive to shock and friction than mercury fulminate or lead azide. It is used as a component in primer and detonator mixtures. It is stable in storage, even at elevated temperatures.

Tetracene. Tetracene is slightly hygroscopic. It explodes readily from flame, producing a large amount of black smoke. It is more sensitive to impact than mercury fulminate. Also, it is more brisant when initiated by tetryl or mercury fulminate than when self-initiated by fire.

Diazodinitrophenol (DDNP). Diazodinitrophenol is less sensitive to impact but more powerful than mercury fulminate and lead azide. The sensitivity of DDNP to friction is much less than mercury fulminate, but it is about the same as that of lead azide. DDNP is used with other materials to form priming mixtures, particularly where a high sensitivity to flame or heat is desired.

Auxiliary Explosives

Explosives used as auxiliary explosives are less sensitive than the primary high explosives used in initiators, primers, and detonators. However, they are more sensitive than high explosives used as filler charges or bursting explosives. As high explosives used for booster purposes, auxiliary explosives fall in the intermediate range of sensitivity. The explosives discussed in this section are tetrytol, tetryl, pentaerythritol tetranitrate (PETN), and granular TNT.

Tetrytol. Tetrytol is a cast mixture of tetryl and TNT. It is a tetryl mixture used in burster tubes for chemical bombs, in demolition blocks, and in cast-shaped charges.

Trinitrophenylmethylnitramine (TETRYL). Tetryl can be initiated from flame, friction, shock, or sparks. It burns readily and can detonate if burned in large quantities. Tetryl is the standard booster explosive. It is sufficiently insensitive when compressed to be used safely as a booster explosive.

Pentaerythrite tetranitrate (PETN). PETN is one of the strongest high explosives. It is more sensitive to shock or friction than TNT or tetryl, and it is **never** used alone as a booster. Its primary use is in booster and bursting charges of small caliber ammunition, in upper charges of detonators in some land mines and shells, and as the explosive core of primacord.

Trinitrotoluene (TNT). Trinitrotoluene is commonly known as *TNT*. It is found in many explosives, such as amatol, pentolite, tetrytol, torpex, tritonal, picratol, ednatol, and composition B. It was used under names such as Triton, Trotyl, Trilite, Trinol, and Tritolo.

In a refined form, TNT is a stable high explosive. You can store it for long periods of time. TNT is relatively insensitive to blows or friction. It is nonhygroscopic and does not form sensitive compounds with metals. However, it is acted on by alkalides to form unstable compounds that are very sensitive to heat and impact. TNT may exude an oily brown liquid. This exudate oozes out around the threads at the nose of the shell and may form a pool on the floor. The exudate is flammable and may contain particles of TNT. Carefully remove pools of exudate. TNT is used as a booster or as a bursting charge for high-explosive shells and bombs.

Bursting Explosives

The Navy uses several high explosives as burster charges (fillers) for bombs, torpedoes, mines, warheads, and shells. When combined in various percentages and combinations, these explosives produce high explosives with varying degrees of sensitivity, brisance, rate of detonation, and other characteristics. The principle bursting explosives, and some of the more common derivative explosives, are discussed in the following paragraphs.

Cyclotrimethylenetrinitramine (RDX). RDX is also known as *cyclonite*, or *hexogen*. It is a white, crystalline solid used in mixtures with other

explosives, oils, or waxes. It is rarely used alone. RDX has a high degree of stability in storage and is the most powerful and brisant of the military high explosives.

RDX compositions are mixtures of RDX, other explosive ingredients, and desensitizers or plasticizers. Mixed with other explosives or inert material at the manufacturing plants, RDX forms the base for the following common military explosives: composition A, composition B, composition C, HBX, H-6, and cyclotols.

Composition A is a wax-coated, granular explosive consisting of TDX and plasticizing wax. There are five varieties of composition A—composition A-1, A-2, A-3, A-4, and A-5. Compositions A-4 and A-5 are not widely used. Composition A is used as the bursting charge in Navy 3- and 5-inch projectiles.

Composition B consists of castable mixtures of RDX and TNT. In some instances, desensitizing agents are added to the mixture. Composition B is used as a burster in Army projectiles and in rockets and land mines.

Composition C is a plastic demolition explosive consisting of RDX, other explosives, and plasticizers. It can be molded by hand for use in demolition work and packed by hand into shaped-charge devices. Compositions C-3 and C-4 are the only plastic explosive presently being used, but C-1 and C-2 are still found.

HBX-1 and HBX-3 are binary explosives that are castable mixtures of RDX, TNT, powdered aluminum, and D-2 wax with calcium chloride. These explosives are used in missile warheads and underwater ordnance.

Cyclotol is manufactured in three formulations by varying mixture percentages of RDX and TNT. Cyclotols are used for loading shaped-charge bombs, special fragmentation projectiles, and grenades.

H-6 is a binary explosive that is a castable mixture of RDX, TNT, powdered aluminum, and D-2 wax with calcium chloride added. H-6 is used as the standard bursting charge for general-purpose bombs.

Minol 2. Minol 2 is a binary explosive that is a castable mixture of TNT, ammonium nitrate, and powdered aluminum. Minol 2 is used as a bursting charge when TNT is scarce. **NEVER** use Minol 2 aboard ship.

Ammonium picrate (explosive D). Ammonium picrate is the least sensitive to shock and friction

of all military explosives. It is well suited as a bursting charge in armor-piercing projectiles. Explosive D is used as a bursting charge for armor-piercing shells. It is used in other types of projectiles that must withstand severe shock and stress before detonating.

REVIEW NUMBER 1

Q1. When talking about explosives, what is meant by the term brisance?

Q2. An explosive is hygroscopic because _____.

Q3. The sensitivity of an explosive describes _____.

Q4. Explain the term "high explosive".

Q5. Explosives can be classified in many ways. List the classifications of explosives by service use.

Q6. List the uses for chemical agents.

Q7. How is an explosive train formed?

Q8. List the three classifications of propellants.

Q9. Describe the use of initiating explosives.

Q10. Tetrytol is an auxiliary explosive made up of _____.

AMMUNITION

Learning Objective: *Identify the various types of ammunition and recognize their purpose. Identify the purpose and use of CADS to include personnel escape devices; racks, launchers, and dispensers; and miscellaneous cartridges. Identify the service life requirements for CADS and identify appropriate aircraft logbook entries. Recognize 20-mm M50 aircraft gun ammunition configuration. Identify M50 20-mm gun cartridges and recognize their uses.*

Ammunition is an all-inclusive term for explosive combinations or devices that burn or detonate rapidly and violently. Gun ammunition includes everything needed to fire a shot. Ammunition also includes such weapons as hand grenades, rockets, bombs, and depth charges. The final definition must be broader: The term *ammunition* applies to the complete charge for any type of weapon involving explosives and to all the components of the charge.

TYPES OF AMMUNITION

As an AO, you don't know all the types of ammunition used by the Navy. However, you

REVIEW NUMBER 1 ANSWERS

- A1. *In explosives terminology, the term "brisance" defines the speed that an explosive develops maximum pressure.*
- A2. *A hygroscopic material tends to absorb moisture. Therefore, a hygroscopic explosive tends to absorb moisture, and it becomes less sensitive and deteriorates.*
- A3. *The term "sensitivity" describes the ease with which an explosive can be detonated. It is an important feature of military explosives because explosives must be handled without causing detonation.*
- A4. *An explosive can be classified by different means; one way is by reaction. Within this classification, explosives are termed either "high explosives" or "low explosives." A high explosive is an explosive that decomposes extremely fast. This action (decomposition) is known as "detonation".*
- A5. *Explosives classified by service use are propellants and impulse explosives, disrupting or bursting explosives, initiating explosives, auxiliary explosives, and pyrotechnic substances.*
- A6. *The military uses chemical agents for toxic and irritating effects, screening smoke, incendiary action, or combination of agents.*
- A7. *An explosive train is formed by the combined system of the primary charge and booster charge.*
- A8. *Propellants are classified as single-based (made up of gelatinized nitrocellulose), double-base (nitrocellulose and nitroglycerine), and composite (compositions that contain mixtures of fuel and inorganic oxidants).*
- A9. *Initiating explosives are used to initiate and intensify high-order explosions because they don't burn, but they do detonate if ignited.*
- A10. *Auxiliary explosives aren't as sensitive as primary high explosives used in initiators, primers, and detonators. They are more sensitive than high explosives used as filler charges or bursting explosives. One type of auxiliary explosive is tetrytol, which is a cast mixture of tetryl and TNT.*

should know the various types of ammunition used in naval aviation. In this chapter, you will learn about these types of ammunition.

Gun Ammunition

There are four types of gun ammunition—bag, semifixed, fixed, and small arms. The difference between the first three depends on how the charges are assembled. In bag ammunition, the primer, propelling charge, and projectile are separate units. In semifixed ammunition, the primer and propelling charge are contained in one unit, while the projectile is separate. In fixed ammunition, all three components are assembled as a complete unit.

Bomb Ammunition

Bomb ammunition is characterized by thin-walled containers loaded with relatively large bursting charges. This ammunition depends upon the destructive blast of the explosive for effect, not the penetrating qualities of the container. Bomb ammunition includes torpedo warheads, mines, depth charges, and aircraft bombs.

Rocket Ammunition

Rocket ammunition includes rocket motors, heads, and fuzes. The motor contains a propellant and igniter. The warhead may be a high explosive, chemical, or practice head. Normally, the fuze contains a detonator or booster. Different types of rocket ammunition may or may not be stowed together. Stowage depends on the types of ammunition involved and the safest stowage facility available.

Guided Missile Ammunition

Guided missile ammunition consists of a variety of ordnance materials such as rocket motors (solid or liquid propellant), igniters, fuzes, warheads, and possible boosters or auxiliary rockets. Normally, service guided missiles are received as all-up-rounds (AURs). Exercise, dummy drill, or practice missiles are received as unassembled units.

Pyrotechnic Ammunition

Pyrotechnic materials are mixtures of oxidizing agents and combustibles (powders such as magnesium and chlorate mixtures). Other

compounds may be added for particular purposes such as to color the flame or smoke. Pyrotechnic ammunition may be further divided into three classes according to their service use—signaling, illuminating, and marking.

Chemical Ammunition

Chemical ammunition includes all projectiles, bombs, grenades, candles, or other containers of compounds. Its purpose is to produce gas, smoke, or fire. Free fluids or gases released from aircraft tanks, projectors, or sprayers are also designated as chemical ammunition. Chemical ammunition is classified by type of filler or type of container and as a projectile, bomb, or grenade. The classification used for storage purposes is by type of chemical filler.

Demolition Ammunition

Demolition ammunition includes explosives used for blasting, eliminating hazards to navigation and obstacles to amphibious landing, destroying equipment to prevent capture by the enemy, and demolition of materials. Demolition charge blocks, consisting of either pressed TNT or cast TNT and tetryl, are issued to ships for general use. These charges are detonated by blasting caps set off by electric current.

AMMUNITION IDENTIFICATION

Ammunition identification is an important part of ordnance handling and administration. Ammunition identification tells you the service/nonservice type of ammunition, class of explosive contained in the round, Mark (Mk) and modification (Mod) numbers, lot numbers, and color codes representing the explosive hazards.

Service Ammunition

Ammunition intended for operational use is classified as service ammunition. The warhead contains explosives, pyrotechnics, or chemical agent filler. If required, the propellant is of service or reduced charge weight. Aircraft service ammunition is identified as either armament (kill stores) or ordnance (search stores).

Nonservice Ammunition

Ammunition used for training personnel is classified as nonservice ammunition. This

Table 1-1.—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 Bands(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) Indicates illuminating ammunition or ammunition producing a colored light; exceptions, 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.
<p>*NOTES: The following colors when applied as stated have NO identification color coding significance:</p> <ul style="list-style-type: none"> a. 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 rocket motors. b. The colors BLACK and WHITE when used for lettering. c. The color WHITE when used in diamond shaped figures on ammunition. 	

ammunition may be actual service (tactical) quality or may be specially modified or loaded practice ammunition, inert training, inert dummy/drill, or exercise/recoverable ammunition.

PRACTICE/TRAINING AMMUNITION.—

This ammunition is designed for training, practice, or systems testing purposes. It is actually launched, fired, or dropped. It may be a modification of service ammunition designed specifically for practice. Practice ammunition may or may not contain explosive or pyrotechnic materials. Practice ammunition may be either expendable or recoverable, depending upon the device involved.

DUMMY DRILL/INERT AMMUNITION.—

This ammunition is completely inert ammunition. It is used to represent the service ammunition for display purposes, testing weapons, and weapons handling operations. It is also used to develop assembly, testing, and handling proficiency of personnel without actually firing or launching the ammunition.

EXERCISE/RECOVERABLE AMMUNITION.—This is service ammunition that is functional in all respects **except** for the explosive payload. The payload furnishes operational data by the substitution of recoverable exercise components. Pyrotechnics, dye marker, or explosive fittings may be attached to or incorporated in the ammunition.

Painting

Painting (table 1-1) is the application of the final body coating to ammunition, ammunition components, or ammunition containers by authorized activities. Usually, paint color identifies the use or explosive hazards of the ammunition; however, sometimes it has no meaning.

Marking

Marking (table 1-2) is the application of colored spots, bands, or symbols on ammunition, ammunition components, or ammunition containers. Markings, by their color or shape, identify ammunition fillers or the presence of specific ammunition components.

Chemical filler ammunition, ammunition components, and ammunition containers are identified by bands that are color coded (table 1-1). Chemical fillers (table 1-3) are identified by

marking symbols placed on a line parallel to the colored bands.

Table 1-2.—Marking Symbols

SYMBOL	MEANING
CCC	Color burst of the same color as the marking symbol is loaded in the item.
DDD	Dye marker of the same color as the marking symbol is loaded in the item.
TTT	Tracer of the same color as the marking symbol is loaded in the item.
WP or PWP	Smoke/incendiary mix is loaded in the item; marking symbol is always light red.
◇◇◇◇	Flechette-loaded item; marking symbol is always white.

Table 1-3.—Chemical Filler Symbols and Band Colors

SYMBOL	CHEMICAL FILLER	BAND
Harassing Gases		
CN, CNB CNC, CNS	Chloracetophenone (Tear Gas)	Red
BBC	Bromobenzylcyanide (Tear Gas)	Red
BZ	Bromobenzyl	Red
CS	O-Chlorobenzal-malono- nitrile	Red
DM, DA, DC	Adamsite type	Red
Smoke		
WP	White phosphorus	Light Red
PWP	Plasticized white phosphorus	Light Red
FM	Titanium tetrachloride	Light Green
FS	Sulfur trioxide- chlorosulfonic acid	Light Green
HC	Hexachloroethane	Light Green
Incendiary		
TH3, TH4	Thermite/Thermate Thermate	Light Red
NP	Napalm	Light Red
IM	Incendiary oil	Light Red
PT1, PTV	Incendiary mixture	Light Red

Lettering

Lettering is the use of letters, words, abbreviations, or numerals on ammunition, ammunition components, or ammunition containers. Lettering is put on ammunition by die stamping, stenciling, decals, etching, or rubber stamping. Lettering identifies the type, mark and modification, ammunition lot number, and loading information of the ammunition item. Lettering applied in black or white has no color-code significance.

Mark and Modification Designation

Except for all-up, ship-launched, underwater rockets and guided missiles, Navy ammunition, ammunition components, or ammunition container are assigned a mark (Mk) number. The Mk number is an Arabic numeral and represents a basic design. It is followed by a modification (Mod) number to represent a less than major change in design. For example, the mark/modification number assigned to a general-purpose bomb without a change to the basic design is Mk 82 Mod O. If a minor change to the basic design is incorporated, it is designated as Mk 82 Mod 1. If further changes are incorporated, the modification designations are assigned in sequence, Mod 2, Mod 3, Mod 4, and so forth.

Some explosive devices and ordnance or armament (such as cluster weapons and bomblets used in cluster weapons) are designated by groups of letters and numbers. An example of this type designation is BLU-99-A-T-1B or BLU-7A/B (table 1-4). Other letter-type designators such as BRU, SUU, FAE, etc., are discussed in other chapters of this TRAMAN.

U.S. Army ammunition retains the Army identifier that uses a letter, numeral, and letter and numeral system. For example, the model is designated M23. The first modification of this model is designated M23A1, and subsequent modifications are designated by M23A2, M23A3, etc. If an item was jointly developed by the Navy and Army, the model identifying designation is preceded by the letters AN (Army/Navy). For example, a model is designated AN-M173. The first modification of this model is designated AN-M173A1. Later modifications are designated as AN-M173A2, AN-M173A3, etc.

Table 1-4.—Item Identification Designations for Cluster Munitions

Item Identification Unit	BL
Model Number	U
Modification	99
Trainer-Dummy	A
Installation	T-1
	B
Bomb or Mine	BLU
Seventh Model and First Modification	7A
Unit Must Be Expended on Mission	/B

Department of Defense Identification Code (DODIC) and Navy Ammunition Logistic Code (NALC)

The Department of Defense Information Code (DODIC) is a four-digit code assigned by the Defense Logistics Services Center (DLSC). It identifies ammunition and explosive items (non-nuclear) within the supply system applicable to all the armed forces. The Navy Ammunition Logistic Code (NALC) is a four-digit code assigned by Ships Parts Control Center (SPCC). It identifies Navy-unique items of ordnance.

The DODIC and NALC are interchangeable terms and are included as part of the letter identification contained on ammunition and ammunition components. These codes are used specifically for logistic control and ammunition administration.

If an ammunition item or ammunition component has been modified, a DODIC/NALC code is assigned to the modified item. For example, Mk 105 Mod O is assigned code A811 and Mk 105 Mod 1 is assigned code A894. A complete listing of DODICs/NALCs is contained in *Navy Ammunition Logistics Codes*, NAVAIR 11-1-116B/TW010-AA-ORD-030.

Ammunition Lot Number

An *ammunition lot* is a quantity of ammunition assembled from uniform components under similar conditions. A lot is expected to function in a uniform manner. Each ammunition lot is assigned a code number (ammunition lot number) that identifies **all** ammunition items assembled as part of that lot. For specific ammunition lot

numbers, you should refer to *Identification of Ammunition*, NAVSEA OP 2238/NAVAIR 11-1-117.

CARTRIDGES AND CARTRIDGE-ACTUATED DEVICES

High performance jet aircraft require the use of cartridge-actuated devices (CADs). Cartridge-actuated devices are highly reliable and easy to maintain. The cartridges undergo rigid quality control throughout their design and manufacture. However, their performance in cartridge-actuated devices is dependable **only** when they have been properly handled and installed.

All cartridges and cartridge-actuated devices now in use are not covered in this TRAMAN. However, the cartridges used in personnel escape devices; racks, launchers, dispensers; and miscellaneous cartridges are discussed in the following paragraphs.

Personnel Escape Devices

The design, special control features, and space limitations of many high-speed aircraft make it

necessary for the pilot and crew to carry out a sequence of emergency operations before they can escape. Cartridge-actuated devices perform several functions concurrently or in sequence to ensure pilot/crew escape. Some of the functions performed by these cartridges and CADs are canopy jettison, seat ejection, lap belt and parachute opening, and ejection seat drogue chute activation.

Normally, AOs are **not** responsible for the actual installation of cartridges and cartridge-actuated devices used in personnel escape systems. They **are** responsible for properly stowing, handling, and issuing these cartridges and devices.

Mark 37 Mod 0 impulse cartridge. The primary use of this impulse cartridge is to actuate a harness and foot retainer release actuator before the ejection seat has been catapulted from the aircraft. The cartridge (fig. 1-4, view A) consists of a cup-type case, a percussion primer, booster, and main charge. The open end is crimped over a closure disk.

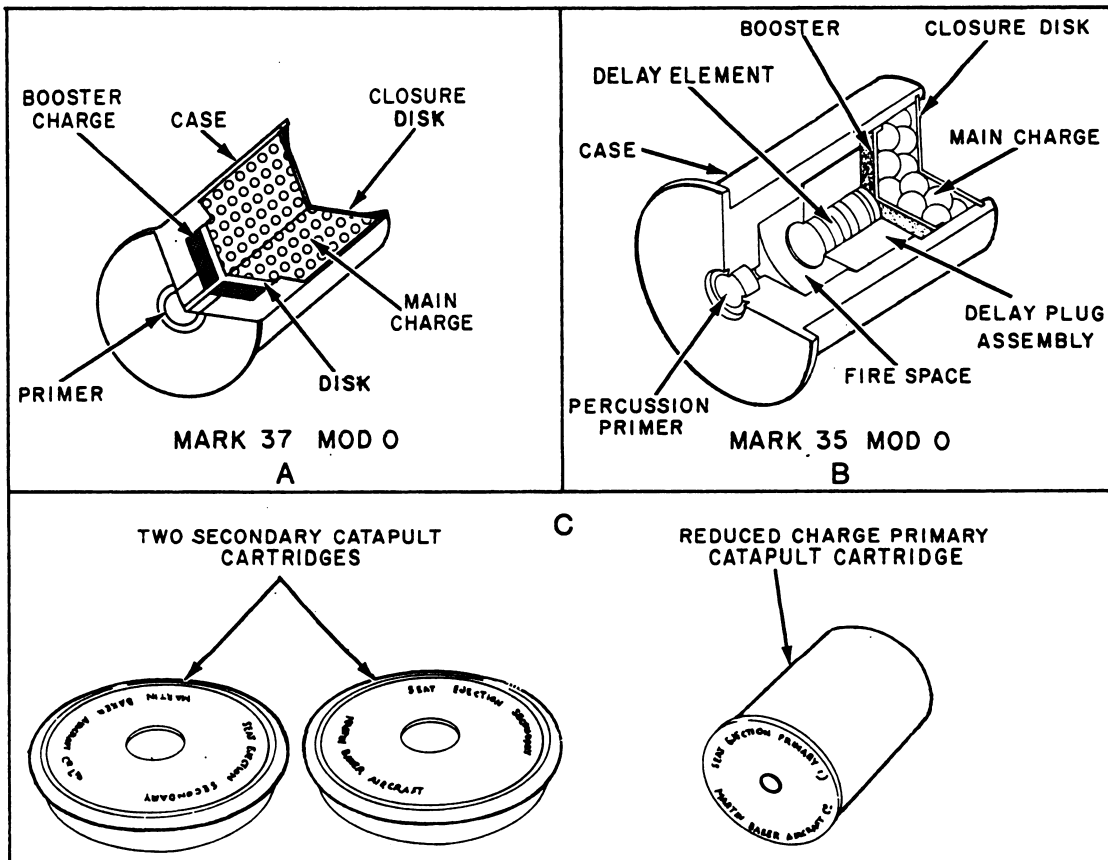


Figure 1-4.—Impulse cartridges used in personnel escape systems.

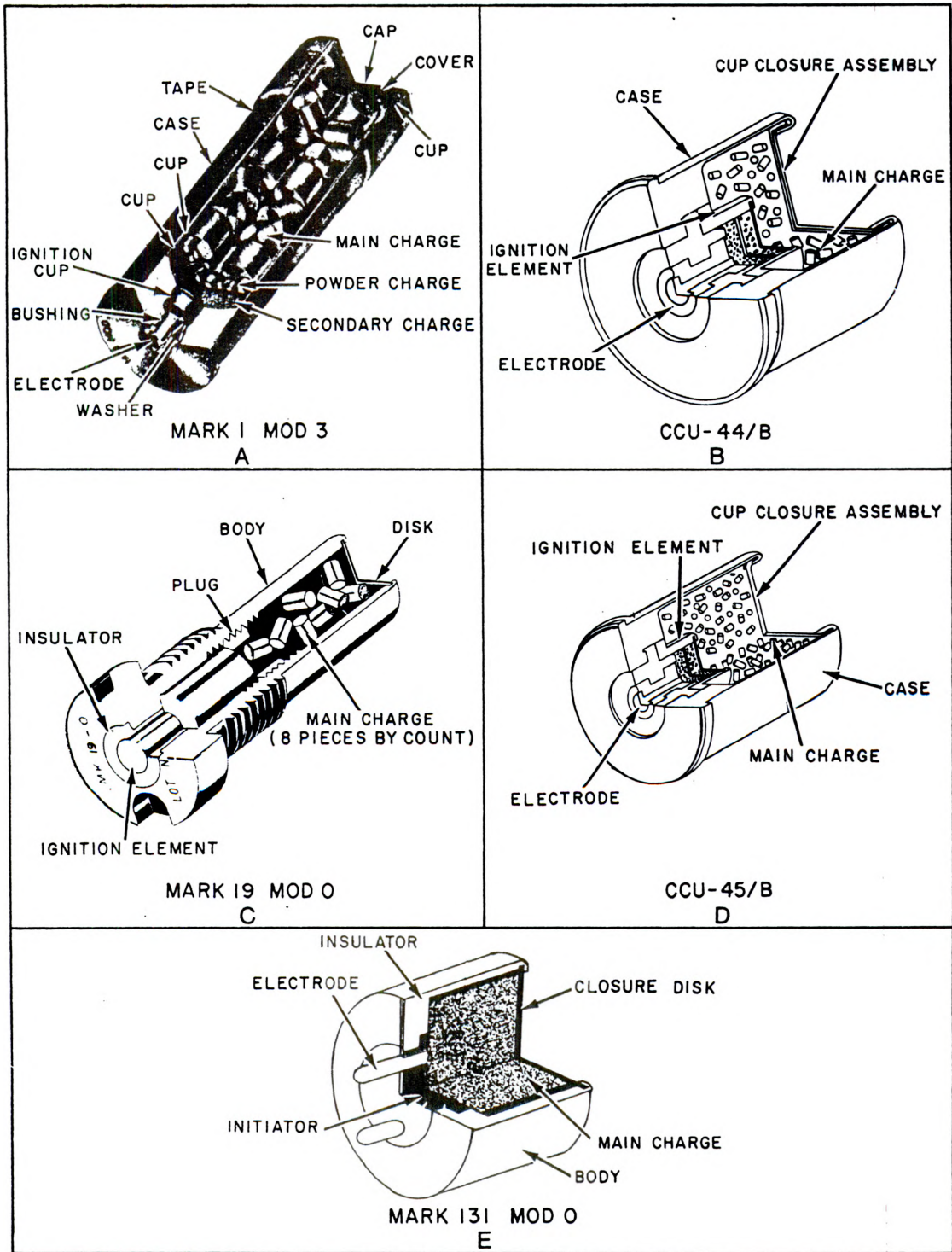


Figure 1-5.—Impulse cartridges used in racks, launchers, and dispensers.

220.745

Mark 35 Mod 0 delay cartridge. The delay cartridge is used to activate a harness-release actuator after the ejection seat has been catapulted from the aircraft. The cartridge (fig. 1-4, view B) consists of a case, a percussion primer, a delay train, booster, main charge, and closure disk. The cartridge is fired by a mechanically operated firing pin and has a nominal delay time.

M397 reduced charge primary ejection cartridge set. These ejection cartridges are packaged and issued in sets. They are identified by NAVAIR drawing numbers or by NALCs. The seat ejection reduced charge cartridge set is identified as NAVAIR Dwg 2519696 (fig. 1-4, view C). It includes a total of three cartridges—two secondary catapult cartridges (NAVAIR Dwg 2519696-1) and one reduced primary catapult cartridge (NAVAIR Dwg 2519696-2). These cartridges are used in the Martin-Baker Ejection Seat. When fired in sequence, they provide recoil forces and ballistic gases sufficient to eject the seat and its occupant from the aircraft.

Racks, Launchers, and Dispensers

Impulse cartridges are used as a power source, in the form of gas pressure, in stores release and ejection systems on aircraft. Detailed operation of racks, launchers, and dispensers is discussed later in this TRAMAN. Some of the more common impulse cartridges are discussed in the following paragraphs.

Mark 1 Mod 3 impulse cartridge. This impulse cartridge actuates a refueling hose guillotine in an emergency, operates the release ejector mechanism free or eject stores from an aircraft, or operates other cartridge-actuated devices. The cartridge (fig. 1-5, view A) is electrically initiated. It has an aluminum cup-type case, with an integral head and sides. The booster and main charge are separated by a celluloid cup. The charged end of the cartridge is closed with a paper cover sealed with varnish. A plastic shipping and handling cap is telescoped over the charged end of the case. This is removed before installing the cartridge in the breech of the ejector mechanism.

CCU-44/B impulse cartridge. This impulse cartridge releases and ejects stores from an

aircraft in flight. The cartridge (fig. 1-5, view B) is electrically initiated. It has an aluminum cup-type case with integral head and sides. The booster and main charge are separated by a celluloid cup. The charged end of the cartridge is closed with a paper cover sealed with varnish. A plastic shipping and handling cap is telescoped over the charged end of the case. It is removed before installing the cartridge in the breech of the mechanism. The CCU-44/B is a replacement for the Mk 2 Mod 1 and Mk 125 Mod O impulse cartridges.

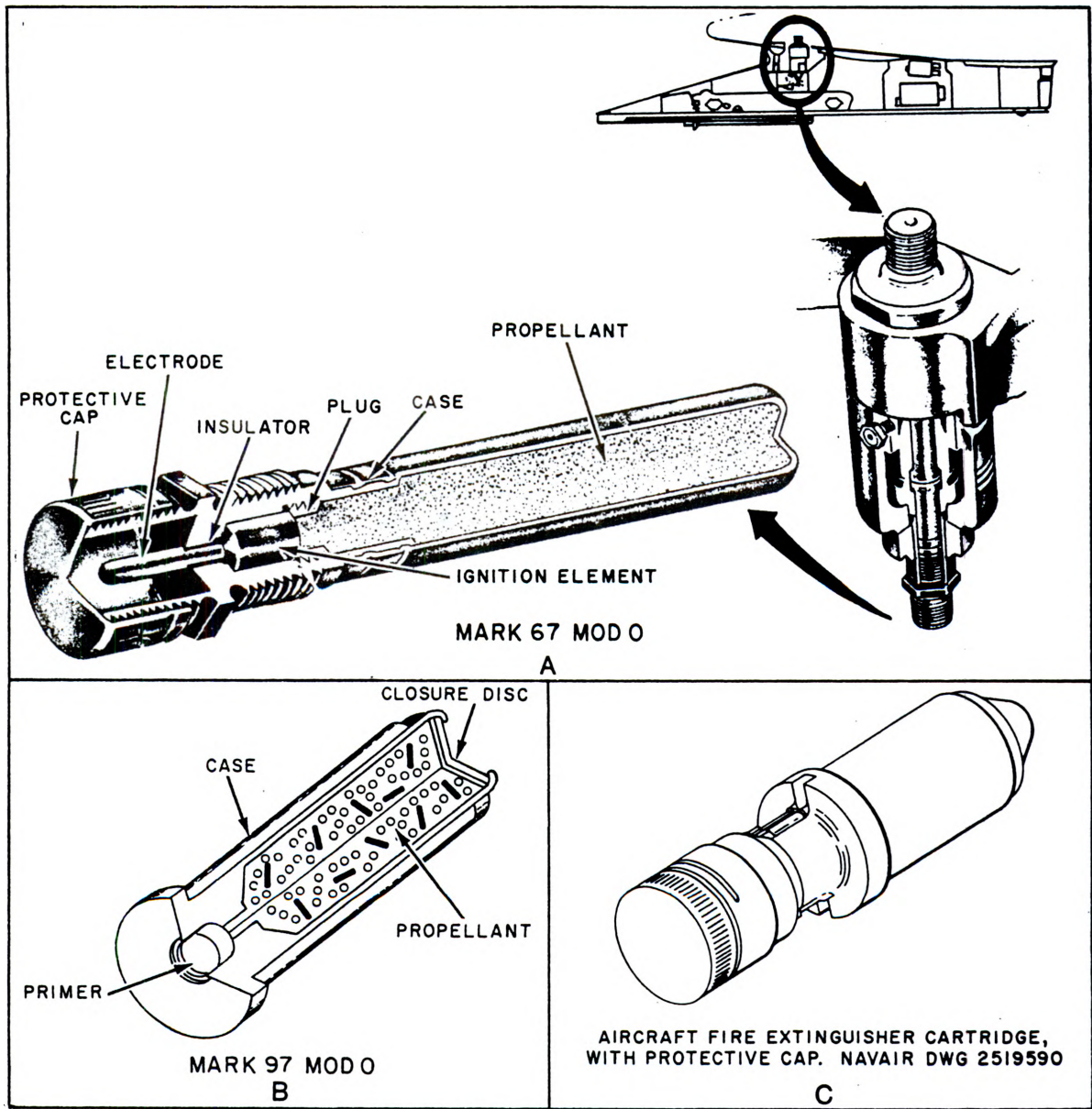
Mark 19 Mod 0 impulse cartridge. This impulse cartridge is normally used for the emergency jettison/release of stores loaded on aircraft during flight. The cartridge (fig. 1-5, view C) is an electrically initiated, case-grounded, screw-in cartridge. It consists of a body, ignition element, hollow metal plug, and main charge. The open end is crimped over a sealing disk. The electrode of the ignition element is separated from the body by an insulator. A hollow metal plug is threaded inside the body between the igniter assembly and the propellant charge.

CCU-45/B impulse cartridge. This impulse cartridge releases and ejects stores from aircraft in flight. The cartridge (fig. 1-5, view D) is electrically initiated and consists of a case, an ignition element assembly, and propellant. The cartridge case is crimped over a consumable closure assembly. The CCU-45/B is a replacement for the Mk 9 Mod O and Mk 124 Mod O impulse cartridges.

Mark 131 Mod 0 impulse cartridge. This impulse cartridge is installed in chaff dispensers. It is the power source for expelling chaff or decoy flares from the dispenser. The impulse cartridge (fig. 1-5, view E) consists of a two-pin, glass-to-metal seal assembly inside a cylindrical steel casing. It is crimped over a scored metal closure on the output end.

Miscellaneous Cartridges

Miscellaneous cartridges discussed in the following paragraphs include explosive bolt (Mk 57 Mod O), cable cutter, and fire-extinguisher cartridges.



220.452

Figure 1-6.—Miscellaneous cartridges.

Mark 67 Mod 0 impulse cartridge. This impulse cartridge (fig. 1-6, View A) is the power source to eject missile launcher pylons from aircraft. It is an electrically initiated, case-grounded, screw-in cartridge. It consists of a steel body, ignition element, hollow aluminum case, and main charge. One end is threaded for connection to the terminal of the electrical fitting cable. Between the threaded ends, the body has a 3/4-inch hex head. The electrode of the ignition element is

separated from the body by an insulator. A hollow metal plug is threaded inside the body between the ignition assembly and the main charge.

Mark 97 Mod 0 cartridge. This impulse cartridge is used as a power source to actuate a helicopter cable cutter to cut a chain/cable in an emergency. The cartridge (fig. 1-6, view B) is a percussion-ignited cartridge consisting of a case, primer, propellant, and closure disk.

Aircraft fire extinguisher cartridge. The aircraft fire-extinguisher cartridge, NAVAIR Dwg 2519590, releases fire extinguishing agents into the area surrounding an aircraft engine fire. The cartridge (fig. 1-6, view C) consists of an aluminum casing, with a threaded end, enclosing electrically fired dual squibs. The output end of the cartridge is crimped over a brass slug.

Service Life

Cartridges used in cartridge-actuated personnel escape devices installed in aircraft **must** function perfectly the first time. If the device malfunctions or fails to fire when needed, severe injury to or death of aircrew members could result. Also, the aircraft could be damaged or destroyed.

If a cartridge installed in miscellaneous cartridge-actuated device, store suspension, or a release/ejection rack and launcher malfunctions, material damage or loss of equipment could result. Also, possible serious injury or death of personnel may occur.

Cartridges are carefully designed and manufactured. However, their performance in cartridge-actuated devices is dependable only when they have been properly handled and installed. Since individual cartridges cannot be tested, the responsibility for proper functioning is in the hands of ordnance personnel.

The service life of a cartridge or cartridge-actuated device is defined as *the specified periods of time during which a CAD is allowed to be used*. Periods of time are affected by the environment, which result in assigned time limits designated as *shelf life* and *installed life*. To determine service life expiration dates, both the shelf life and installed life must be computed.

SHELF LIFE.—CADs are issued to the Fleet in hermetically sealed containers. To compute the shelf life expiration date, the hermetic seal on the CAD container **must** not be broken. If the container is opened or the seal broken, the start or *installed life expiration date* has begun. When you open a hermetically sealed container, use indelible ink and mark the date you opened the container on the outside of the container. Also mark the date on each CAD inside the container.

You can compute the shelf life expiration date of a CAD by using its lot number (table 1-5). There are two methods used to compute lot

Table 1-5.—Derivation of Lot Number

KEY	DEFINITION
a	Lot sequence number
b	Manufacturer's identification symbol
c	Month of production (two digit)
d	Year of production (two digit)
e	Month of production (single alpha)
	JAN —A MAY—E SEP —J FEB —B JUN —F OCT—K MAR—C JUL —G NOV—L APR —D AUG—H DEC—M
f	Interfix number
g	Lot suffix (alpha)
<p>Example:</p> <p>Lot Number, Method 1: 11 ABC 0588 Key: (a) (b) (c) (d)</p> <p>(Note that (c) and (d) will be used to compute service life.)</p> <p>Example:</p> <p>Lot Number, Method 2: XYE 88 E 001-011A Key: (b) (d) (e) (f) (a) (g)</p> <p>(Note that (d) and (e) will be used to compute service life.)</p>	

numbers. Use the following steps to compute the shelf life expiration date.

1. Refer to the lot number stamped on the outside of the container or on the cartridge casing.

NOTE: In method 1, lot number 11 ABC 0588 is used. In method 2, lot number XYE 88 E 001-011A is used.

2. Get the shelf life (number of months and years) for the individual CAD from the CADs descriptive data text in *Cartridges and Cartridge-Actuated Devices for Aircraft and Associated Equipment*, NAVAIR 11-100-1.2.

NOTE: In this particular case, the shelf life is 5 years.

3. Add this figure (shelf life) to the month and year of manufacture determined from the CAD lot number.

NOTE: The month and year of manufacture for method 1 is determined by key (c) 05. This represents the fifth month of the year. Key (d) 88 represents the year 1988. The resulting sum (date) is the shelf life expiration date of the CAD in question. The date of manufacture = 0588 + 5 years shelf life = 0593, the shelf life expiration date.

NOTE: To compute the shelf life expiration date of the lot number shown in method 2, use key (d) 88. It represents the year 1988. Key (e) E represents the month of May. Then compute the expiration date using the same procedures as above.

INSTALLED LIFE.—You compute the installed life expiration date using the following steps:

NOTE: Remember, the installed life *start date* begins the date the hermetically sealed container is opened.

1. Determine the CADs installed life by referring to the CAD's descriptive data text in

NAVAIR 11-100-1.2. Get the installed life figure (number of months or years). In this particular case, the installed life figure is 30 months.

2. The installed life expiration date is then computed by adding 30 months to the date the hermetically sealed container was opened. For example, the container was opened on 0588 (MAY 88) + 30 months installed life = 1190 (NOV 90) installed life expiration date).

When you find the shelf life expiration date and the installed life expiration, compare the two dates. The date that expires first determines the CAD's service life expiration date. In this particular case, you found the shelf life expiration date as 0593 (MAY 1993) and the installed life expiration date as 1190 (NOV 1990). Therefore, the service life expiration date would be 1190 (NOV 1990).

Aircraft Logbook Entries

Only stores release CADs are exempt from aircraft logbook entry requirements. Before each CAD is installed in the stores release mechanism, check the CAD to make sure the service life expiration date has not been exceeded.

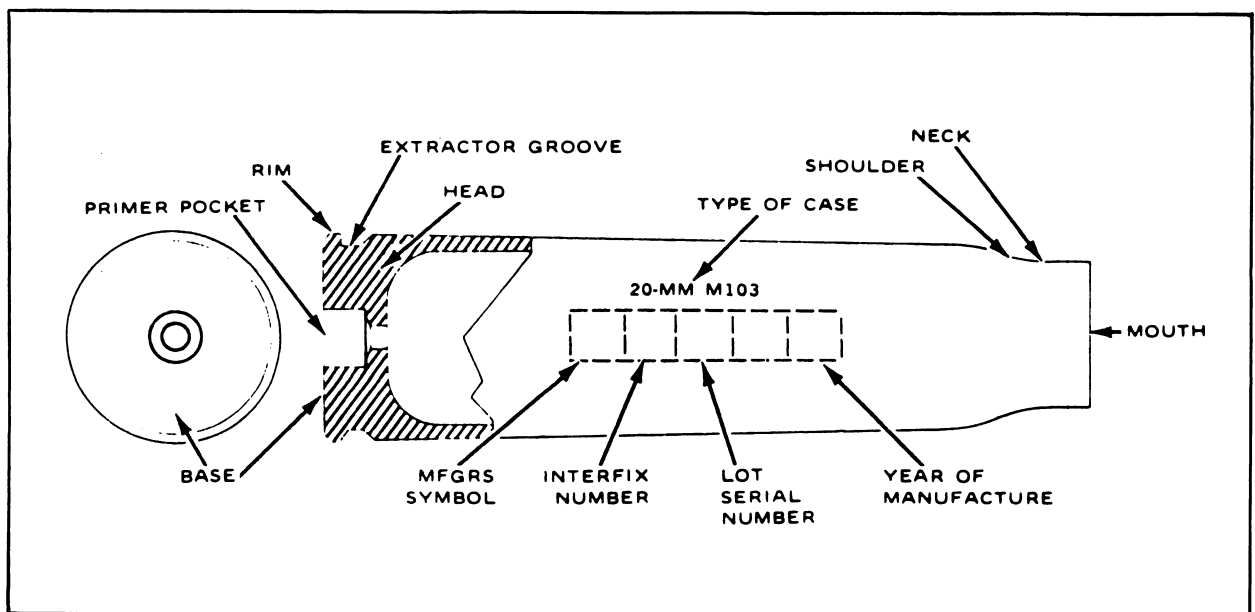


Figure 1-7.—M103 (brass) and M103B1 (steel) cartridge cases.

220.746

When a CAD is installed in an aircraft system, a log entry is made in the aircraft logbook, identifying the item installed by DODIC/NALC, lot number, serial number (if applicable), and computed service life, (for example, M688/70-IHM-5078 393/0980 or M688/ABC78E001-011A/0980).

For detailed information concerning CADs, you should refer to NAVAIR 11-100-1.2. This manual gives the function, description and location, operation, identification and handling, service life, and CAD safety.

CRAFT GUN AMMUNITION 20-MM M50 CONFIGURATION

M50 configuration ammunition for the M61A1 Navy aircraft gun is issued in the form of cartridges (rounds). A complete service cartridge assembly consists of a cartridge case, electric primer, propellant, projectile, and fuze. All service cartridges have matched ballistics and are electrically primed.

Classification

The M50 configuration ammunition currently issued is classified as follows:

1. Dummy Cartridge M51A1B1, M51A2 (steel), or M254 (plastic)
2. High-Pressure Test Cartridge, M54A1 (HPT)
3. Target Practice Cartridge, M55A2 (TP)
4. High-Explosive Incendiary Cartridge, M56A3 (HEI)
5. Target Practice-Tracer Cartridge, M220 (TP-T)
6. High-Explosive Incendiary-Tracer Cartridge, M242 (HEI-T)

Cartridge Components, General Description

The cartridge components for M50-configured ammunition as used in a complete round are discussed in the following paragraphs.

CARTRIDGE CASE.—The M103 (brass) and the M103B1 (steel) cartridge cases (fig. 1-7) are marked longitudinally. The caliber/case

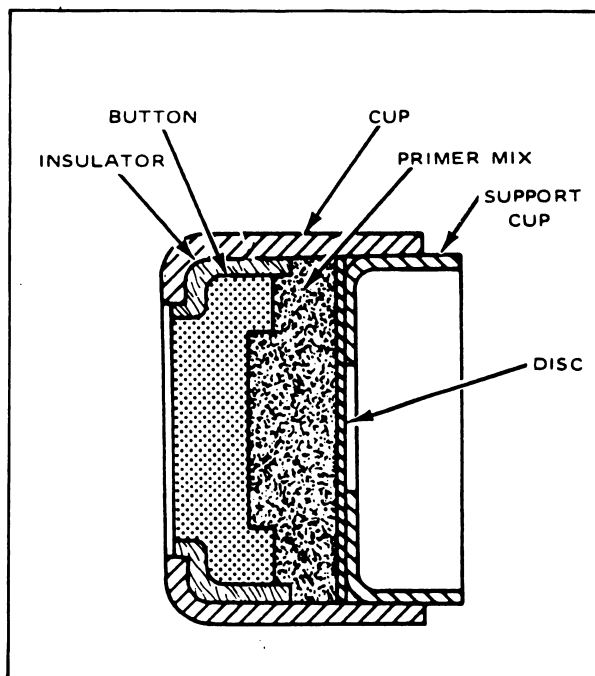
designation is on the first line. The manufacture symbol, interfix number, lot serial number, and year of manufacture is on the second line. The M103 case is loaded for use with all service ammunition, and the M103B1 is used with the M51A1B1/M51A2 dummy cartridges.

PROPELLANT.—All M50-configured cartridges are loaded with (double-base) ball spherical propellant.

M52A3B1 ELECTRIC PRIMER.—The electric primer (fig. 1-8) is used in all current M50 configurations. It consists of an open-ended brass cup that contains a brass button insulated from the cup by a plastic liner. The firing pin of the gun contacts this button. The ignition charge (a conductive explosive mixture) is in contact with the other side of the button. This is retained by a paper disk and a metal support cup. The electrically initiated primer ignites the propellant charge.

NOTE: The primer explosive element is sensitive to electromagnetic and electrostatic energy.

PROJECTILES.—All projectiles, except the HPT, have essentially the same external



220.747

Figure 1-8.—M52A3B1 electric primer.

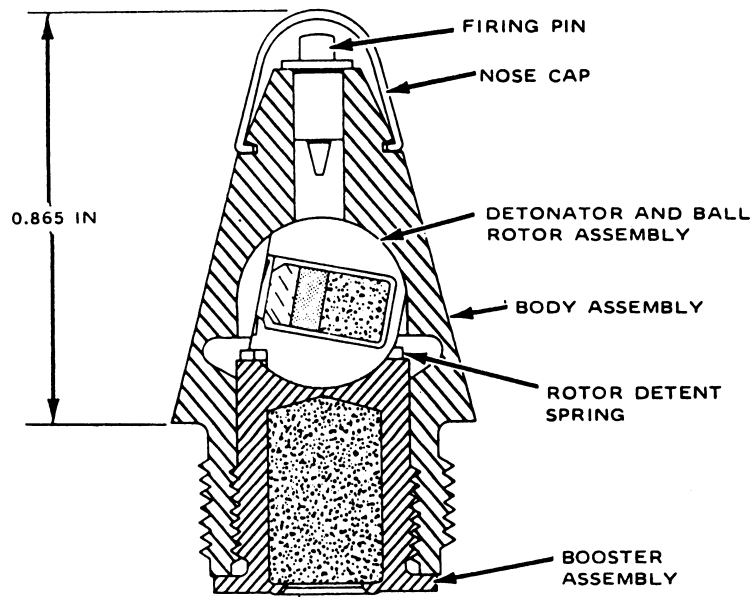


Figure 1-9.—M505A3 point-detonating fuze (unarmed).

220.748

configuration. The rotating band is a copper alloy swaged into a circumferential groove near the aft end of the steel body.

FUZE M505A3 POINT-DETONATING (PD).—The PD fuze (fig. 1-9) consists of a body assembly, a rotor assembly, and a booster assembly. The fuze has a delayed arming distance of 20 to 35 feet after it leaves the muzzle of the gun. Before firing the HEI projectile, the rotor and the firing pin are locked in position by the rotor safety spring. (The rotor contains the detonator, which is out-of-line with the firing pin.) Centrifugal force causes the spring to open, allowing the rotor to move in-line with the firing pin. The fuze functions when the nose of the fuze is crushed against the target, forcing the firing pin against the detonator. The detonator, in turn, initiates the booster. The booster detonates and initiates the projectile's explosive charge.

TRACER.—A tracer mix is direct-loaded into a cavity machined in the base of the TP-T and HEI-T projectiles. It is used in assembling the M220 and M242 cartridges, respectively. The tracer is ignited by the heat and pressure of the propelling charge. The tracer is visible for about 1,280 yards of projectile flight.

M51A1B1/M51A2 Dummy Cartridges

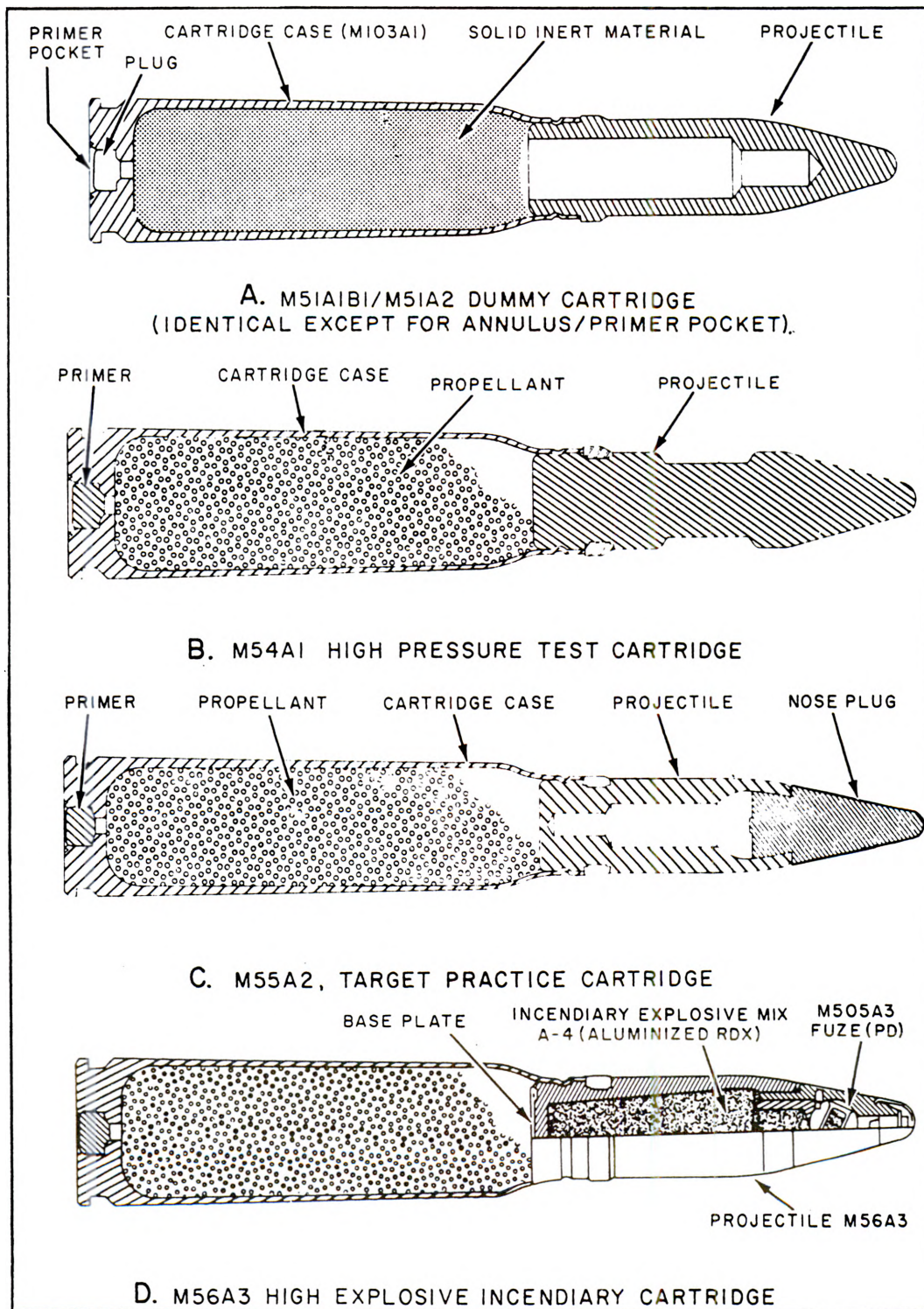
Dummy cartridges (fig. 1-10, view A) are completely inert assemblies. They are used for drill and testing the feeder assembly of a weapon. The dummy cartridge is assembled with the M51A1B1/M51A2 projectile and M103B1 cartridge case to simulate the service cartridge. The two cartridges are the same **except** for a change to the annulus/primer pocket. The cartridge contains approximately 635 grains of inert material. This material produces an average overall weight equal to that of the other M50-configured ammunition.

M54A1 High-Pressure Test Cartridge

The M544A1 cartridge (fig. 1-10, view B) is used only for proof firing of the gun at the place of manufacture. The projectile is made from a solid steel bar. It has a standard rotating band. The M103 or M103B1 cartridge case is used with the M52A3B1 electric primer.

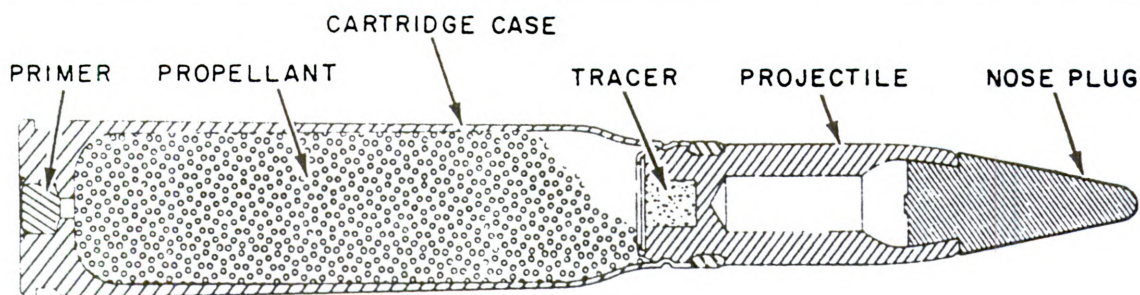
M55A2 Target Practice Cartridge

The M55A2 cartridge (fig. 1-10, view C) has no explosive filler in the projectile. The solid nose is made of aluminum alloy. The projectile shape and ballistic properties are similar to those of the other M50-configured ammunition. The cartridge

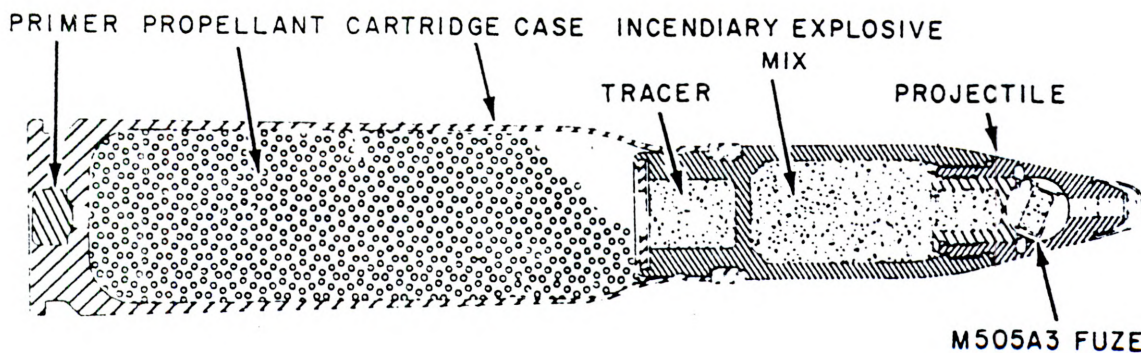


220.749A

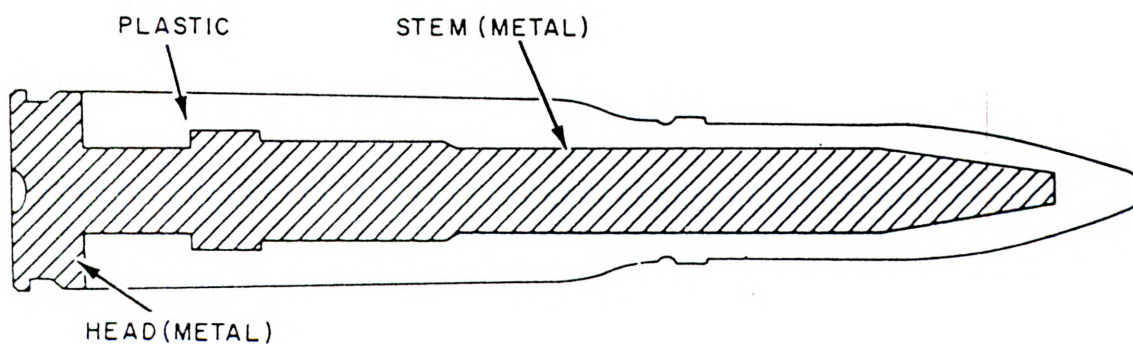
Figure 1-10.—M50 cartridge assemblies.



E. M220 TARGET PRACTICE-TRACER CARTRIDGE



F. M242 HIGH EXPLOSIVE-TRACER CARTRIDGE



G. M254 PLASTIC DUMMY CARTRIDGE

220.749B

Figure 1-10.—M50 cartridge assemblies—Continued.

is used for practice firing, boresighting weapons, and testing new guns. The M103 cartridge case and M52A3B1 electric primer make up this cartridge.

M56A3 High-Explosive Incendiary Cartridge

The M56A3 or M56E5 projectile is used in the M56A3 cartridge (fig. 1-10, view D). The projectile is loaded with an incendiary and explosive composition, giving the combined effect of the blast of a high-explosive charge plus a fire-starting ability.

Both the M56A3 and M56E5 are loaded with aluminized composition A-4. The major difference between the projectiles is their construction. The M56A3 has a base plate to prevent ignition of the HEI charge by the propellant. The M56E5 does not have the base plate and has approximately 10 more grains of A-4. Both cartridges use the M103 case, M52A3B1 electric primer, and the M505A3 PD fuze.

M220 Target Practice-Tracer Cartridge

The M221 projectile is used with the M220 cartridge (fig. 1-10, view E). The M221 projectile is similar to the M55A2 projectile, except

it incorporates a tracer in the base of the projectile.

M242 High-Explosive Incendiary-Tracer Cartridge

The M242 projectile is used with the M242 cartridge (fig. 1-10, view F). The projectile has a tracer in the base and aluminized composition A-4 in the forward section. It has a combined effect of a high-explosive charge plus a fire-starting ability. The projectile is assembled with the M505A3 PD fuze, the M103 case, and the M52A3B1 electric primer.

M254 Dummy Cartridge

The M254 cartridge (fig. 1-10, view G) is made of plastic. It is an alternate to the M51A1B1/M51A2 steel dummy cartridge. You can tell the difference between the M254 and live ammunition by its appearance and by the feel of its nylon composition. M50 configuration characteristics are shown in table 1-6.

Identification

Ammunition is identified by the color the projectile is painted and by the lettering on the body of the projectile.

Table 1-6.—M50 Configuration Ammunition Characteristics

Cartridge		Approximate Unit Weight (grains)				Total wt. (grains) (approx.)	Remarks
Designation	Type	M103 case	M52A3B1 Electric primer	Propellant	Projectile		
M51A1B1/M51A2	Dummy	1,775	None	635 (inert)	1,520	3,850 (min)	M103A1 Steel case
M54A1	HPT	1,855	22	590	1,965	4,392	M505A3 fuze required
M55A2	TP	1,855	22	590	1,521	3,935	
M56A3	HEI	1,855	22	590	1,565	3,965	
M220	TP-T	1,855	22	590	1,470	3,935	M505A3 fuze required
M242	HEI-T	1,855	22	590	1,535	3,865	
M254	Dummy	n/a	None	None	n/a	4,005	Plastic

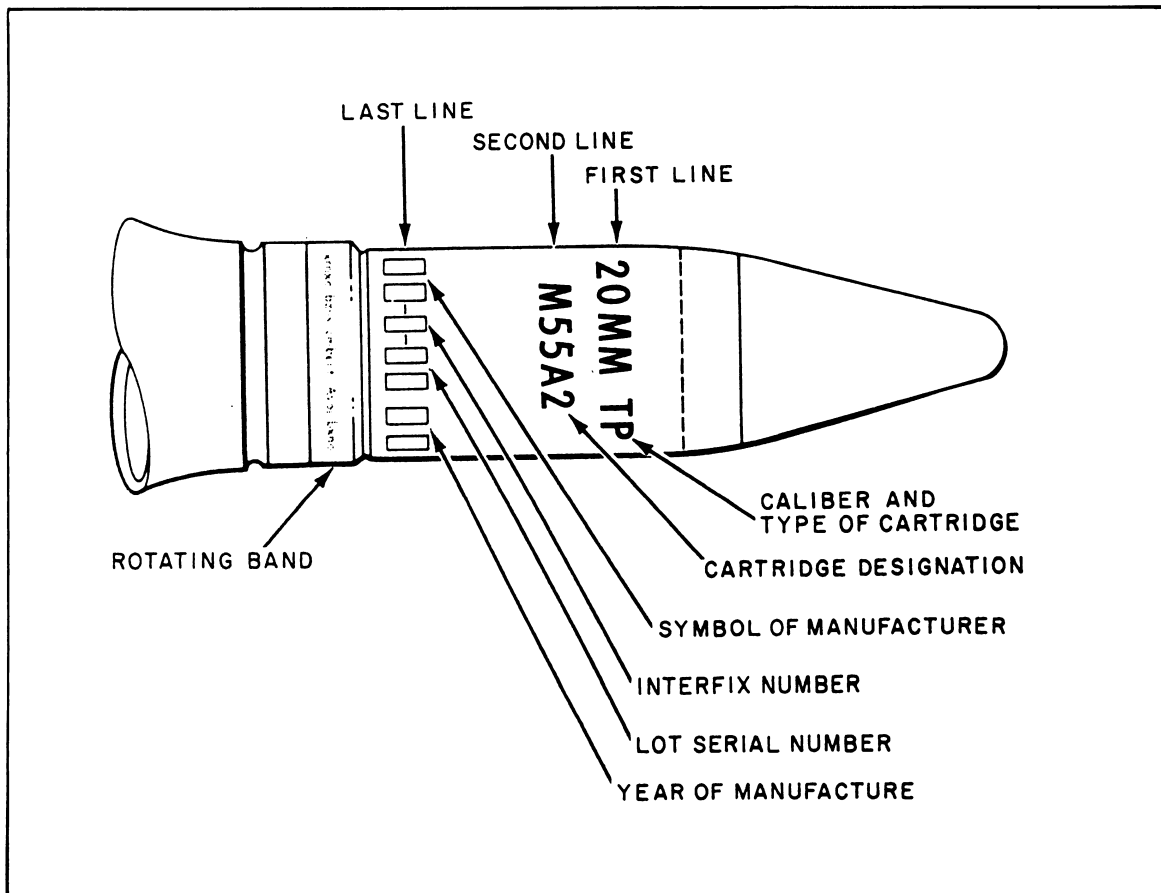


Figure 1-11.—Example of color coding and marking for M50 configuration ammunition.

220.750

LETTERING.—The lettering (fig. 1-11) is stenciled in waterproof marking ink around the body of the projectile. The first line of lettering identifies the caliber and type of cartridge; for example, 20MM HEI, 20MM TP, or 20MM HEI-T. The second line gives the cartridge designation; for example, M254, M55A2, or M220. The last line consists of a code number that identifies the manufacturer, interfix number, lot serial number, and year of manufacture. The color of the letters has no meaning.

COLOR CODING.—The color codes for the M50-configured 20-mm ammunition are listed in figure 1-12. You can see exactly where colors are located on the projectile. The projectile (fig. 1-12) is divided into sections marked A, B, C, and D.

The sections on the projectile match the color code to columns in the figure.

By looking at figure 1-12, you can identify high-explosive incendiary-tracer round M242. First, find the projectile and its color code in column A. Then, look at section A of the projectile. This section of the projectile isn't painted; therefore, section A of the projectile remains the natural color of the metal (copper). Look at column B and find the color for section B. Refer to section B of the projectile. This area is painted yellow (high explosives), and section B1 is painted red (incendiary). Use the same procedures for sections C and D. Also note the red T markings in the section B area just outside of the B1 section. The red T, and in some cases orange T, shows the presence of an incendiary explosive (tracer).

Projectile Type	Color of Painting				Color of Lettering
	A	B	C	D	
Dummy M51A1B1/M51A2	Chromate finish	Chromate finish	Chromate finish	Chromate finish	Black
High Pressure Test M54A1 (HPT)	No paint (copper)	Purple	Purple	Purple	Black
Target Practice (TP) M55A2/M55A2B1 M55A3/M55A3B1	No paint (copper)	Blue	Blue	Blue	White
High Explosive Incendiary (HEI) M56A3/M56A4	No paint (copper)	Yellow Red band in B ₁ area	No paint (chromate)	No paint (chromate)	Black
Target Practice Tracer (TP-T) M221 (M220 cartridge)	No paint (copper)	Blue	Blue	Blue	White with Orange T's (at location B ₁)
High Explosive Incendiary-Tracer (HEI-T) M242	No paint (copper)	Yellow Red band in B ₁ area	No paint (chromate)	No paint (chromate)	Black with Red T's (below B ₁)
Plastic Dummy Cartridge M254	No paint (white plastic)	No paint (white plastic)	No paint (white plastic)	No paint (white plastic)	Black

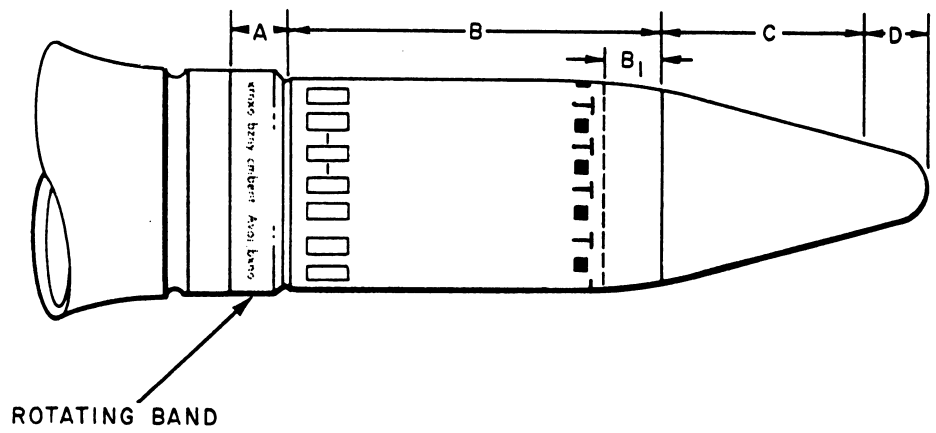
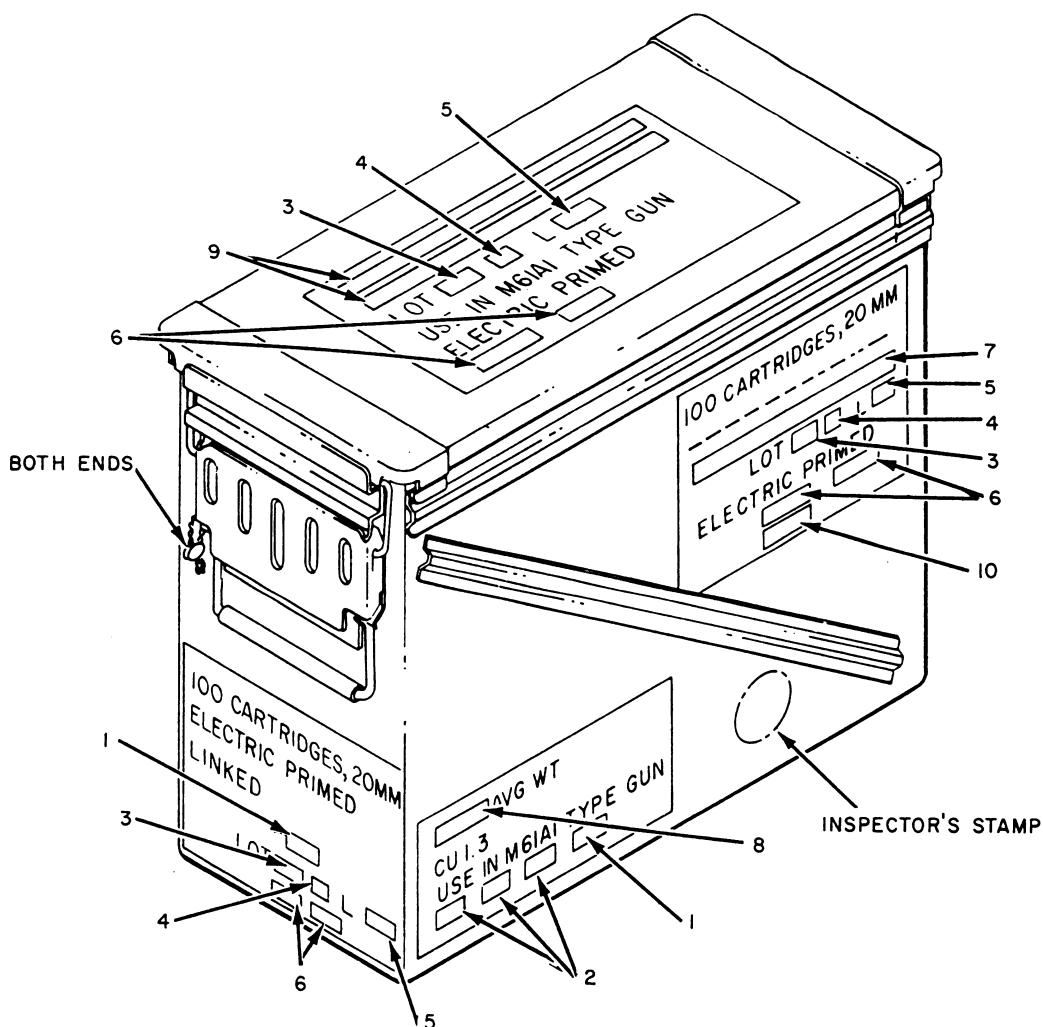


Figure 1-12.—Color coding, marking, and sectionalized projectile of M50 configuration ammunition.

220.751



- | | |
|---|--|
| <ol style="list-style-type: none"> 1. DOD CARTRIDGE IDENTIFICATION CODE 2. FEDERAL STOCK NUMBER OF CARTRIDGE 3. SYMBOL OF CARTRIDGE MANUFACTURER 4. "S" IF STEEL CARTRIDGE CASE 5. LOT NUMBER OF CARTRIDGE | <ol style="list-style-type: none"> 6. MONTH AND YEAR OF CARTRIDGE MANUFACTURE 7. TYPE AND MODEL OF CARTRIDGE 8. AVERAGE WEIGHT OF PACKED CONTAINER 9. TYPE OF PROJECTILE 10. COAST GUARD CLASSIFICATION |
|---|--|

220.752

Figure 1-13.—Ammunition container M548 (typical).

Ammunition Container M548

The M548 container (fig. 1-13) is made of metal. The lid is attached by quick-release latches at both ends. Required information about the ammunition contained inside is listed on the outside of the container. Do **not** break the moisture-resistant seal between the lid and the container until the ammunition is to be used.

NOTE: M50 series ammunition is normally packed in the M548 container as

loose rounds (not prebelted). The Linkless Ammunition Loading System (LALS) eliminated the requirement for prebelted ammunition.

The rounds are packed in the container in layers. There are cardboard partitions between each layer and between the rounds on all sides of the container. Each round has a tubular-shaped cardboard protector around the projectile. Use these cardboard partitions and tubular protectors when repacking the ammunition in the containers.

For additional information concerning M50-configured ammunition, refer to *Ammunition for Navy 20-mm Aircraft Guns*, NAVAIR 11-1-119.

REVIEW NUMBER 2

- Q1. List the types of ammunition.
- Q2. Describe the purpose of ammunition identification.
- Q3. Explain the difference between service and nonservice ammunition.
- Q4. The DODIC and the NALC are used to _____.
- Q5. When installed in chaff dispensers, what cartridge expels chaff from the dispenser?
- Q6. Define the following terms: service life, shelf life, and installed life.
- Q7. What CADS are exempt from aircraft logbook entry requirements?
- Q8. Match the term with its definition.

<u>TERM</u>	<u>DEFINITION</u>
M55A2 cartridge	Used to proof-fire guns when manufactured
M54A1	Used for drill and testing feed assemblies in weapons
M51A1B1/M51A2	Used for practice firing, boresighting weapons, and testing new guns

HAZARDS OF ELECTROMAGNETIC RADIATION TO ORDNANCE (HERO)

Learning Objective: *Recognize HERO classification standards. Identify HERO hazards. Identify the uses of the EMCON bill.*

The functional characteristics of electrically initiated ordnance cause hazards of electromagnetic radiation to ordnance (HERO). Ordnance that presents a HERO problem include cartridges, cartridge-actuated devices, and 20-mm ammunition. The ordnance electroexplosive devices (EEDs) may be accidentally initiated or their performance degraded by exposure to radio frequency (RF) environments. Ordnance is more susceptible to RF environments during assembly, disassembly, handling, loading, and unloading operations.

The term RADHAZ (radiation hazards) applies to radio frequency (RF) electromagnetic fields of sufficient intensity to—

- produce harmful biological effects in humans, and/or
- cause spark ignition of volatile combustibles or actuate electroexplosive devices.

Although the effects of RADHAZ are important, this chapter limits discussion to HERO hazards.

HERO ORDNANCE CLASSIFICATIONS

The susceptibility of ordnance to RF environments is determined by a testing program sponsored by the Naval Sea Systems Command (NAVSEASYS COM). Tests are conducted in the maximum RF environment the ammunition or ordnance systems may be subjected to in its stockpile-to-launch sequence. This data is the basis for the three HERO classifications assigned to ordnance—HERO safe ordnance, HERO susceptible ordnance, and HERO unsafe ordnance.

HERO Safe Ordnance

An ordnance item is classified as **HERO safe** if it meets the following criteria:

- Percussion initiated
- Sufficiently shield protected so all EEDs contained by the item are immune to adverse

effects (safe and/or reliable) when the item is used in its expected RF environments

- General HERO requirements are observed

HERO Susceptible Ordnance

An ordnance item is classified as **HERO susceptible** if proved (by tests) to contain EEDs. HERO susceptible ordnance can be adversely

affected by RF energy. The safety and/or reliability of the system is in jeopardy when the system is used in its expected RF environments.

HERO Unsafe Ordnance

An ordnance item is classified as **HERO unsafe** if it meets the following criteria:

- Its internal wiring is physically exposed.

REVIEW NUMBER 2 ANSWERS

- A1. *The types of ammunition include gun ammunition, bomb ammunition, rocket ammunition, guided missile ammunition, pyrotechnic ammunition, chemical ammunition, and demolition ammunition.*
- A2. *Ammunition identification allows you to find the sertype of ammunition (service/nonservice), class of explosive contained in the round, Mk and Mod number, lot number and color codes to identify explosive hazards.*
- A3. *Service ammunition is operational ammunition while nonservice ammunition is used for training personnel.*
- A4. *The DODIC identifies all ammunition and nonnuclear items in the supply system, and it applies to all the armed forces. The NALC is assigned by the Ships Parts Control Center (SPCC) and identifies Navy-unique ordnance items.*
- A5. *When installed in chaff dispensers, the Mk 131 Mod 0 impulse cartridge expels chaff from the dispenser.*
- A6. *The service life of a cartridge is the specified period of time during which a CAD can be used. The shelf life of a cartridge is the period of time that a cartridge can remain in the inventory with the hermetically sealed container unopened. The installed life of a cartridge begins on the date its hermetically sealed container is opened.*
- A7. *Stores release CADS are exempt from aircraft logbook entry requirements.*
- A8. *The M55A2 target practice cartridge is used for practice firing, boresighting weapons, and testing new guns.*

The M54A1 high-pressure test cartridge is used to proof-fire guns when manufactured.

The M51A1B1/M51A2 dummy cartridge is used for drill and testing feed assemblies in weapons.

- Tests are being conducted on the item that result in additional electrical connections to the item.

- EEDs having exposed wire leads are handled or loaded.

- The item is being assembled or disassembled.

- It is disassembled.

HERO EMISSION CONTROL (EMCON) BILL

Ordnance items classified as **HERO unsafe** are protected from electromagnetic radiation by putting them in a completely enclosed all-metal container. (NOTE: Ordnance in a wooden or plastic container or on a metal pallet is as exposed as if the container or pallet were not there).

HERO unsafe ordnance should NEVER be exposed to an RF environment. However, the requirement for assembly, disassembly, handling, loading, and unloading exposes ordnance to some degree. If exposure cannot be avoided, ordnance should be exposed only in essentially RF-free designated regions, such as below deck or in RF-shielded buildings.

The commanding officer is responsible for making sure that **HERO unsafe** ordnance is not handled in RF environments. Sometimes operational commitments require **HERO unsafe** ordnance to be exposed to RF environments such as the flight deck, hangar deck, or weather decks. A degree of relief from HERO RF restrictions is obtained by following the command HERO EMCON bill.

The HERO EMCON bill depends upon two factors—(1) the amount and type of ordnance that is involved, and (2) a knowledge of the RF environment at locations where presence, handling, and loading occur.

The HERO EMCON bill contains a list of all **HERO susceptible** and **HERO unsafe** ordnance items on board and their allowable RF environmental levels. It also includes a list of all transmitter-antenna combinations on board and their output power. By reducing or securing certain transmitter-antenna combinations, allowable RF environmental levels can be maintained.

Normally, to ensure that proper conditions are met in a given ordnance-handling situation, two actions are taken:

1. All on-board transmitters are listed.
2. The action each operator is to take when a given HERO EMCON condition is set.

For example, in HERO condition 1, a transmitter operator may switch the transmitter to STANDBY. In HERO condition 2, the same operator may restrict transmission to 100 watts, or perhaps there is no transmission restriction at all.

The AO is the most important factor in avoiding a **HERO unsafe** situation. You determine if an ordnance item is **HERO safe**, **HERO susceptible**, or **HERO unsafe**. Before moving a **HERO unsafe** item from an RF-free environment, you must request, through strike operations or ordnance control, the proper HERO condition. You make sure that the ordnance item remains in an RF-free environment until the word has been passed that the proper HERO condition has been set.

For detailed information concerning all aspects of electromagnetic radiation hazards, refer to *Electromagnetic Radiation Hazards*, NAVSEA OP 3565/NAVAIR 16-1-529, volumes I and II.

REVIEW NUMBER 3

- Q1. List the three HERO ordnance classifications.*
- Q2. Ordnance is HERO safe if it meets what criteria?*
- Q3. Name the environment to which HERO susceptible and HERO unsafe ordnance should not be exposed.*
- Q4. What is the HERO EMCON bill?*
- Q5. What information can you find in the local HERO EMCON bill?*

SAFETY PRECAUTIONS

Learning Objective: *Recognize the importance of safety precautions when working with ordnance.*

Accidents caused by explosives are prevented by preplanning, ordnance training,

and carefully handling ordnance. The phrase "The life you save may be your own" is a good one, especially when you handle ordnance. It is your responsibility to make sure that safe, approved practices and procedures are used when you handle ordnance.

REVIEW NUMBER 3 ANSWERS

- A1. The three HERO ordnance classifications are HERO safe, HERO susceptible, and HERO unsafe.*
- A2. HERO safe ordnance must be percussion initiated and shielded enough so that EDDs are safe when used in RF environments.*
- A3. HERO susceptible and HERO unsafe ordnance should not be exposed to RF environments.*
- A4. The HERO EMCON Bill contains a degree of relief from HERO RF restrictions.*
- A5. The HERO EMCON Bill contains a list of all HERO susceptible and HERO unsafe ordnance items on board the command.*

CHAPTER 2

AIRCRAFT BOMB AMMUNITION AND ASSOCIATED COMPONENTS

Aircraft bomb ammunition is released over enemy targets to reduce and neutralize the enemy's war potential. This is done by destructive explosion, fire, nuclear reaction, and war gases. Aircraft bomb ammunition is used strategically to destroy installations, armament, and personnel; and tactically in direct support of our land, sea, and air forces engaged in offensive or defensive operations.

For safety reasons, some bomb ammunition is shipped and stowed without the fuzes or arming assemblies and associated components installed. This ammunition must be assembled before use. Other types, such as cluster bomb units (CBUs), are shipped and stowed as complete assemblies, with fuzes or arming assemblies and associated components installed.

Bomb ammunition is designed to be carried either in the bomb bay of aircraft or externally under the wings or fuselage. The general characteristics and basic principles of operation of bomb ammunition and its associated components are described in this chapter. Bomb ammunition

assembly procedures are discussed in chapter 15 of this manual.

GENERAL-PURPOSE BOMBS AND FIN ASSEMBLIES

Learning Objective: Identify the purpose and use of general-purpose bombs to include shipping configuration, fuze wells and charging circuits, suspension lugs, arming wire assemblies, and fin assemblies.

Low-drag, general-purpose (LDGP) bombs are used in most bombing operations. Their cases (bomb body) are aerodynamically designed, relatively light, and approximately 45 percent of their weight is made of explosives. General-purpose bombs may use both nose and tail mechanical or electric fuzes and conical or Snakeye fins.

The general-purpose bombs currently in use are the LDGP Mk 80 (series). The specifications for the individual bombs are listed in table 2-1.

Table 2-1.—Specifications for General-Purpose Bombs

	Mk 82	Mk 83	Mk 84
Weight class (pounds)	500	1,000	2,000
(kilograms)	226.8	453.5	907.0
Assembled weight (pounds)	531	985	1,970
(kilograms)	240.8	446.7	893.4
Filler weight (pounds)	192	445	945
(kilograms)	80.1	201.8	428.6
Assembled length (inches)	86.9	118.4	151.5
(centimeters)	220.7	300.7	384.8
Diameter (inches)	10.75	14	18
(centimeters)	27.3	35.6	45.7
Suspension (inches)	14	14	30
(centimeters)	35.6	35.6	76.2

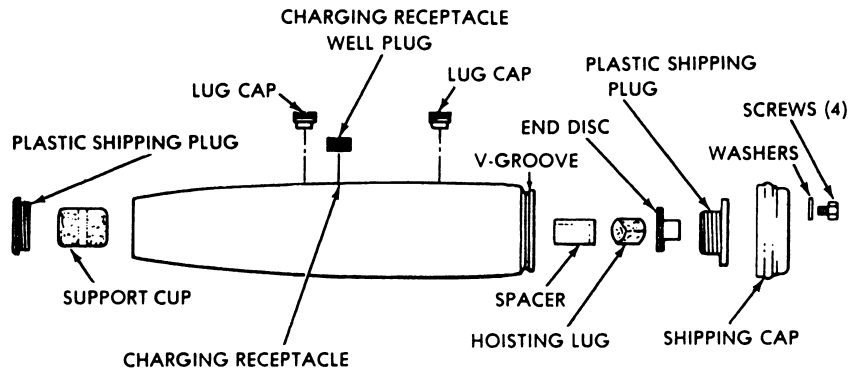
The basic difference between the bombs listed in table 2-1 is their size and weight. The following description of the Mk 80 (series) bomb is applicable to all bombs within the Mk 80 (series) unless otherwise noted.

SHIPPING CONFIGURATION

The bomb body (fig. 2-1) is shipped with a plastic plug installed in the nose and tail fuze well

to prevent damage to the internal threads and to keep out moisture. The aft end of the bomb body has a metal shipping cap installed. Plastic lug caps are installed in the suspension lug wells, and a plastic plug is installed in the fuze charging receptacle well. Some bombs contain a hoisting lug packaged in the tail fuze well.

Bombs are shipped on metal pallets. The number of bombs loaded on each pallet depends on the bomb size. For example, six Mk 82 bombs



220.753

Figure 2-1.—LDGP bomb Mk 80 (series)—exploded view (shipping configuration).

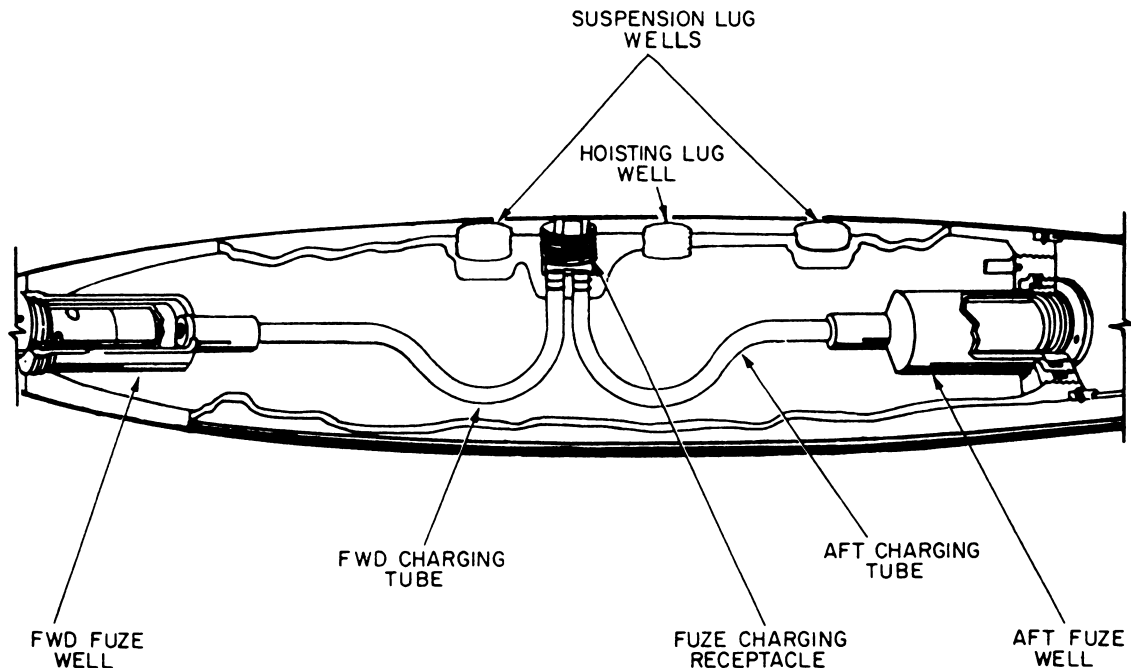


Figure 2-2.—Sectional view of typical LDGP bomb Mk 80 (series).

can be shipped on a pallet, three Mk 83 bombs can be shipped on a pallet, and two Mk 84 bombs can be shipped on a pallet.

FUZE WELLS

The bomb body (fig. 2-2) is designed with a nose and tail fuze well. These wells are internally threaded to receive either mechanical or electric fuzes.

FUZE CHARGING CIRCUIT

The forward and aft charging tubes (fig. 2-2) are installed at the factory and contain the electric fuze wire harness. When electric fuzing is used, the wire harness provides a path for the charging current from the fuze charging receptacle to the forward and aft fuze wells.

SUSPENSION LUGS

There are two suspension lug wells (fig. 2-2) for the installation of suspension lugs. The suspension lugs are spaced 14 or 30 inches apart, depending upon the size of the bomb. Suspension lugs are used to attach the weapon to the aircraft bomb racks. An internally threaded well for the installation of a hoisting lug is located between the suspension lugs, at the center-of-gravity (CG) position on the bomb. The hoisting lug is used for handling purposes only.

IDENTIFICATION

The high-explosive filler of the bomb (Tritonal 80-20 or H-6) is identified by the yellow stenciled nomenclature on the bomb body and yellow band(s) around the nose. The lot number is stenciled in white ink on the forward end of the bomb. All Mk 80 (series) general-purpose bombs currently being used aboard ships are required to be thermally protected. Thermally protected Mk 80 series bombs can be identified by the words THERMALLY PROTECTED in the identification legend, a bumpy exterior surface, and two yellow bands around the nose.

ARMING WIRE ASSEMBLIES

Arming wire assemblies (fig. 2-3) are used for arming procedures during ordnance evolutions. The primary function of arming wire assemblies is to maintain ordnance components in a safe condition until actual release of the bomb from the aircraft.

Normally, the wires consist of one or two brass or steel metal strands attached to a swivel loop. Safety Fahnstock clips (fig. 2-3) or safety clips MAU 166/182 are attached to the ends of the arming wires after installation. They prevent premature or accidental withdrawal of the arming wires from the component.

NOTE: Safety clips are used vice Fahnstock clips unless otherwise specified.

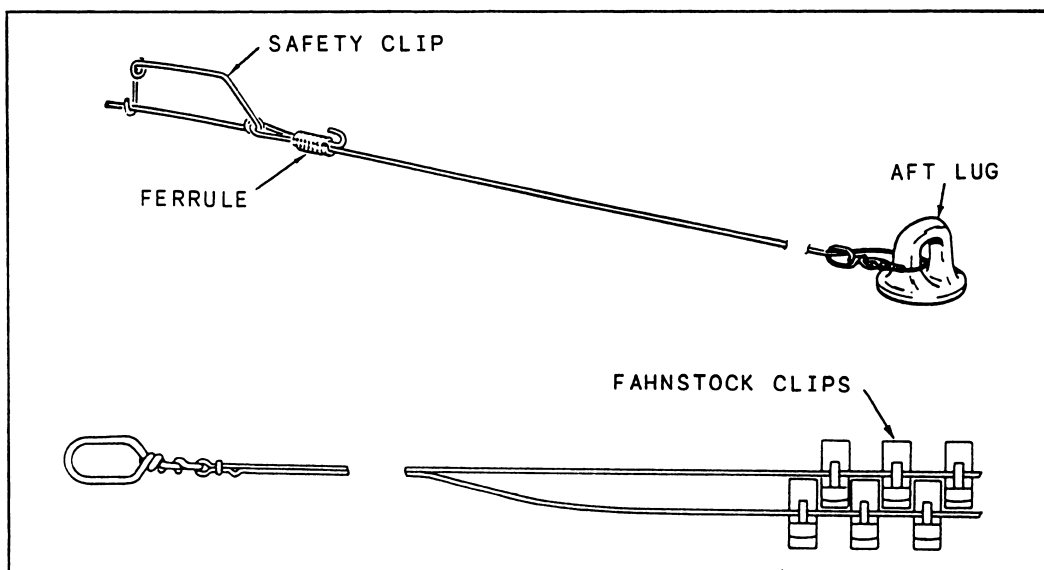


Figure 2-3.—Arming wire assemblies.

220.181

Table 2-2.—Arming Wire Data

Arming Wires/ Hardware	Type	Material	Dia. (in.)	Leg Lengths (in.)
MK 1 Mod 0	Single	Brass	0.064	57.0
MK 2 Mod 0	Double	Brass	0.064	57.0
MK 3 Mod 0	Single	Steel	0.032	57.0
MK 4 Mod 0	Double	Brass	0.064	96.0
MK 9 Mod 0	Single	Brass	0.064	90.0
MAU-182/A Swivel & Loop Assembly Ferrule Safety Clip	Arming Wire Accessory Kit			
MAU-166 Swivel & Loop Assy only				
Arming Adapter Self Adjusting				

Normally, arming wire assemblies are shipped in spiral-wound fiber tubes, overpacked in a wooden box. Generally, the safety Fahnstock clips are packed in the tubes with the arming wires. The most commonly used arming wire assemblies are listed in table 2-2.

Arming wire installation procedures are discussed in the TRAMAN where the use of arming wire assemblies is required.

FIN ASSEMBLIES

Fin assemblies, used with the Mk 80 (series) LDGP bombs, provide stability to the bomb. They cause the bomb to fall in a smooth, definite curve to the target, instead of tumbling through the air.

The fin assemblies, except the MAU-91A/B, are shipped on metal pallets. Each individual fin is crated in a lightweight, disposable metal crate (fig. 2-4). Some fin assemblies are shipped with bomb lugs attached to the shipping crate, depending upon the particular NALC.

Two types of fins are described in this part of the TRAMAN—conical and Snakeye. The

conical fin is used for the unretarded mode of delivery, and the Snakeye fin assembly can be used for either the unretarded or retarded mode of delivery.

Conical Fin

The conical fin assembly (fig. 2-5) is steel, conical in shape, and has four fins to provide stability. Access covers, attached by quick release screws, are located on the sides of the fin body, providing access for dearming and inspections. There is a drilled or punched hole at the top and bottom of the forward end of the fin body. This hole is used to install an arming wire when the bomb is being configured for electric tail fuzing. The fin is attached to the aft end of the bomb, and is secured in place by tightening the fin setscrews into the V-groove of the bomb.

The conical fin may be used with all Mk 80 (series) bombs. The basic difference between types of conical fins is their physical size; the larger the bomb, the larger the fin.

Snakeye Fin Assemblies

Snakeye fin assemblies are used with the Mk 82 and Mk 83 LDGP bombs. They are capable

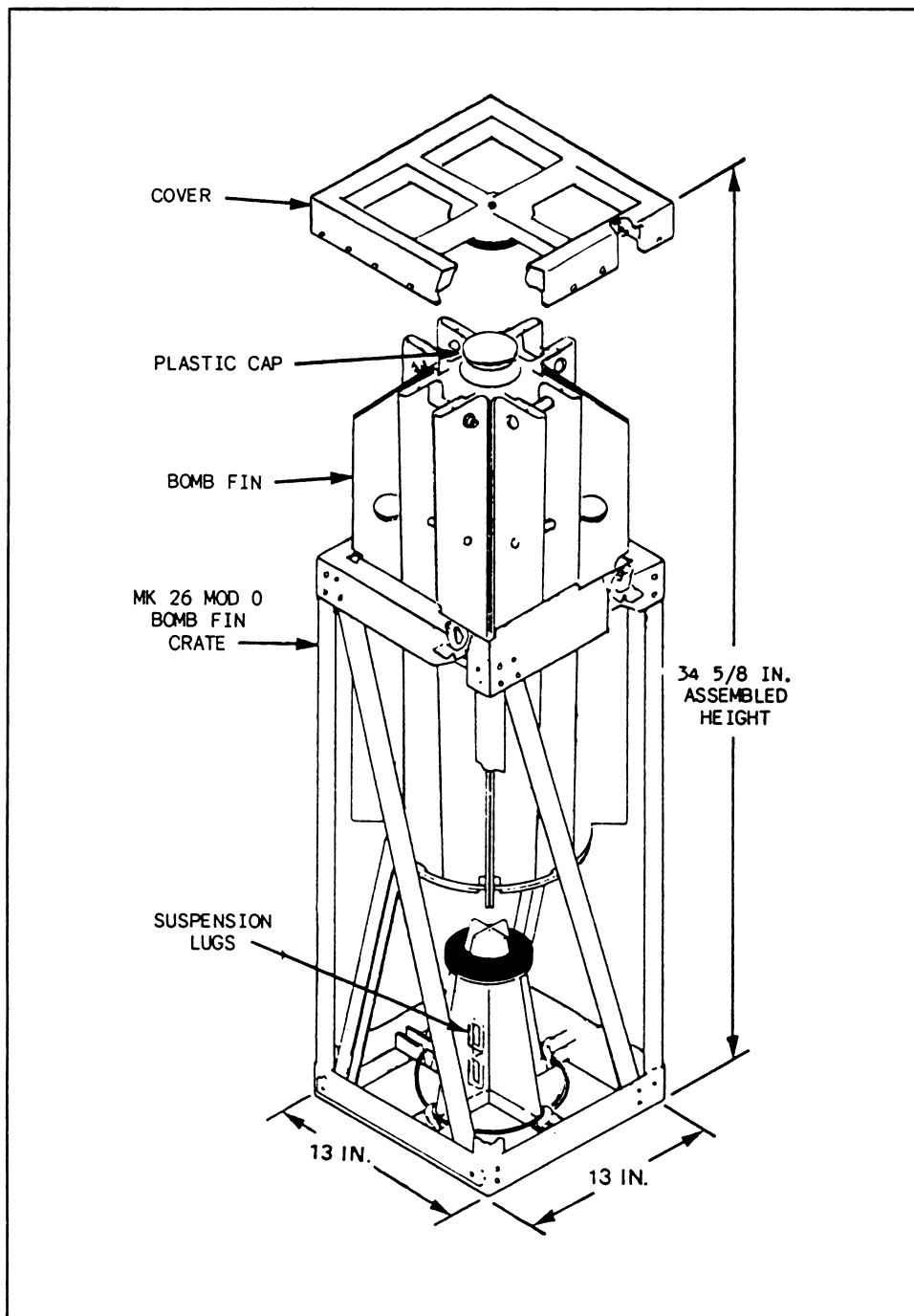


Figure 2-4.—Fin crate Mk 26 Mod 0 for Mk 15 fin.

of delivering bombs at high speed and low altitude without the danger of damaging the aircraft from ricocheting bombs or fragments. A physical description of both fin assemblies and the principles of operation are discussed in the following paragraphs.

MK 15 AND MODS SNAKEYE FIN ASSEMBLY.—The Mk 15 and Mods bomb fin

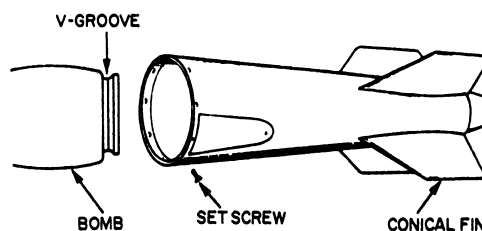


Figure 2-5.—Conical fin.

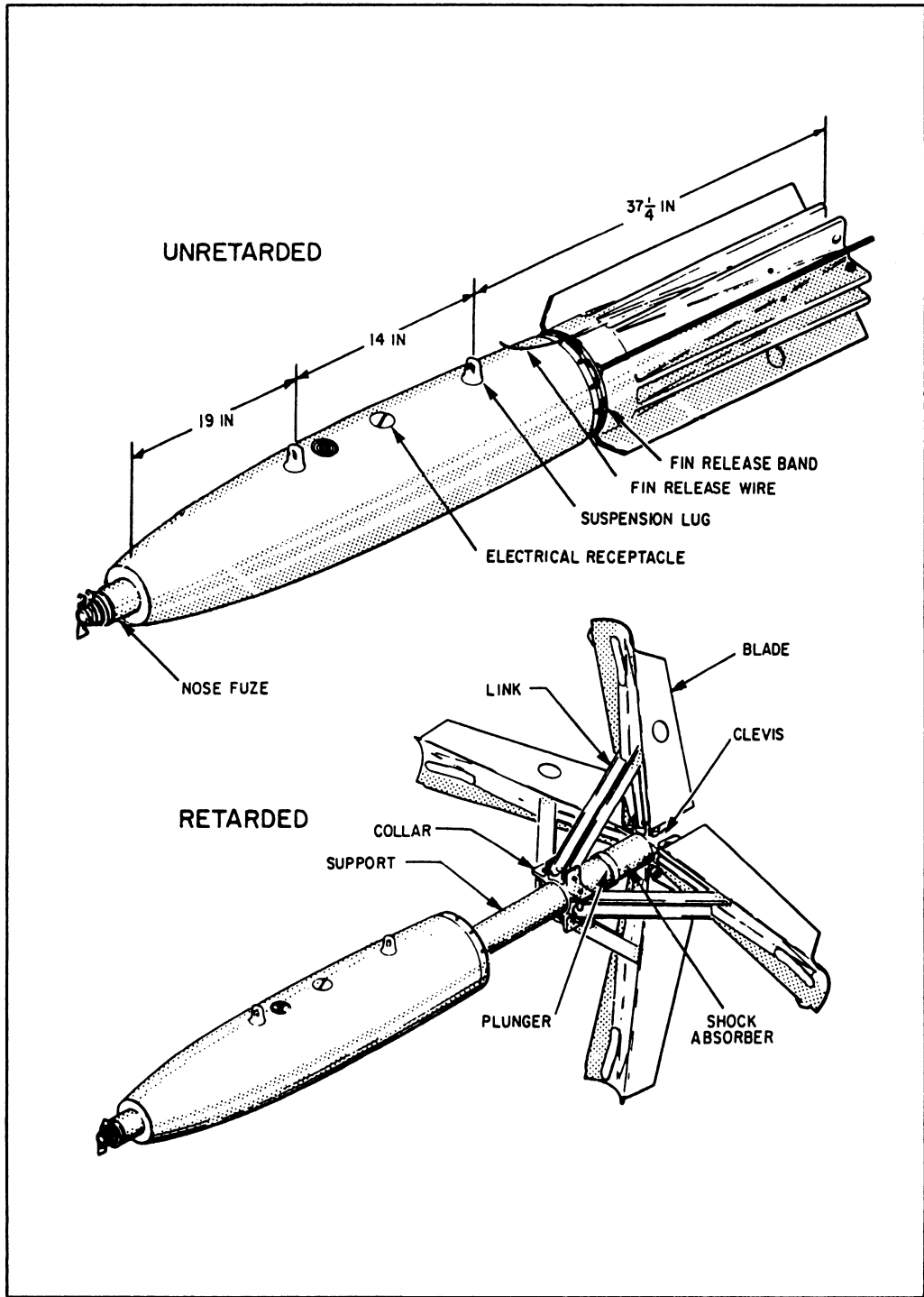


Figure 2-6.—Mk 15 fin with Mk 82 bomb body.

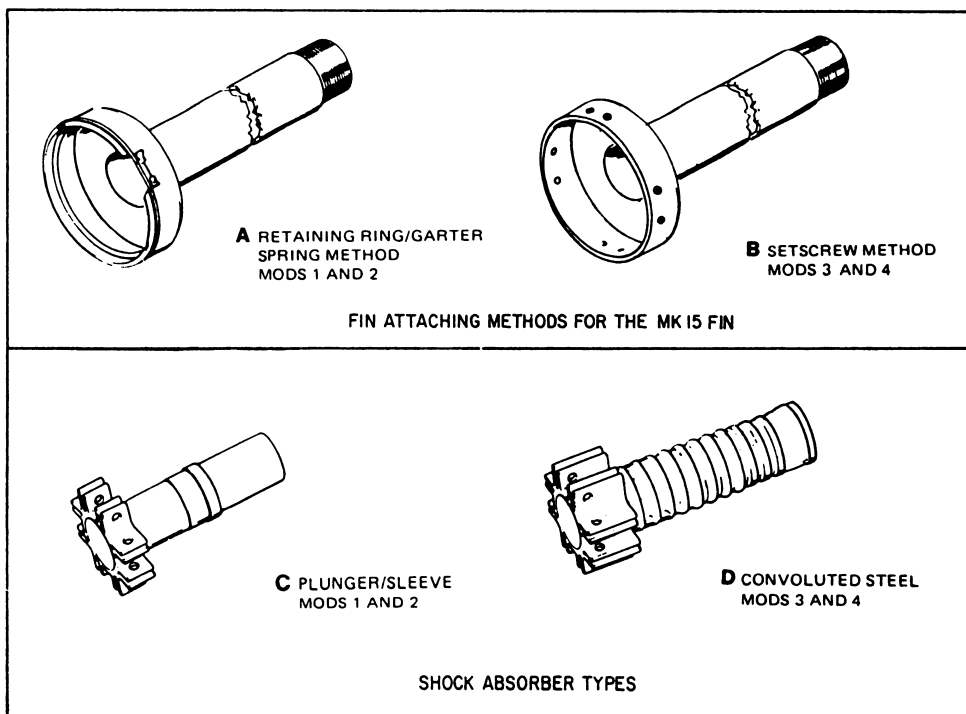


Figure 2-7.—Fin support tubes.

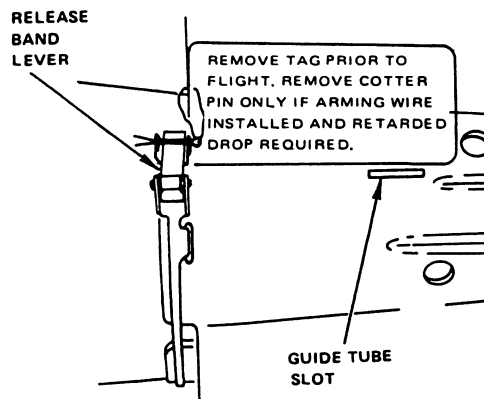
assembly (fig. 2-6) is a retarding fin. It is used with the 500-pound LDGP, Mk 82 and Mods bomb. The fin assembly presents a low-drag configuration when dropped in the unretarded position and a high-drag configuration when in the retarded position.

The fin support tube is the main structure of the fin. It provides a means of attaching the fin assembly to the bomb. On the Mod 1 and Mod 2 fins, the fin support tube (fig. 2-7, view A) is attached to the bomb by a retaining ring in the V-groove of the bomb. The retaining ring expands in a semicircular groove in the flange of the fin support tube. On Mod 3 and Mod 4 fins, the fin is attached by eight setscrews (fig. 2-7, view B).

On the Mod 1 and Mod 2 fins, the shock of fin opening is absorbed by a plunger that expands a sleeve (fig. 2-7, view C). On the Mod 3 and Mod 4 fins, the shock is absorbed by the crushing of a convoluted steel tube (fig. 2-7, view D). The fin support tube has a fuze mounting ring for attaching the tail drive of a mechanical tail fuze.

The fins are spring-loaded and secured in the closed position by a spring-loaded release band. The release band lever (fig. 2-8) is prevented from opening by a cotter pin, which stays installed until an arming wire is installed. A guide tube that

reduces arming wire breakage comes with each Mod 1, and it must be installed externally on the fin assembly. On the Mods 2, 3, and 4 fins, the guide tube is an integral part of the fin. The fin assemblies have drilled holes at the top and bottom of the forward end for installation of arming wires when the weapon is being configured for electric tail fuzeing.



220.758
Figure 2-8.—Fin release band for Mk 15 fin.

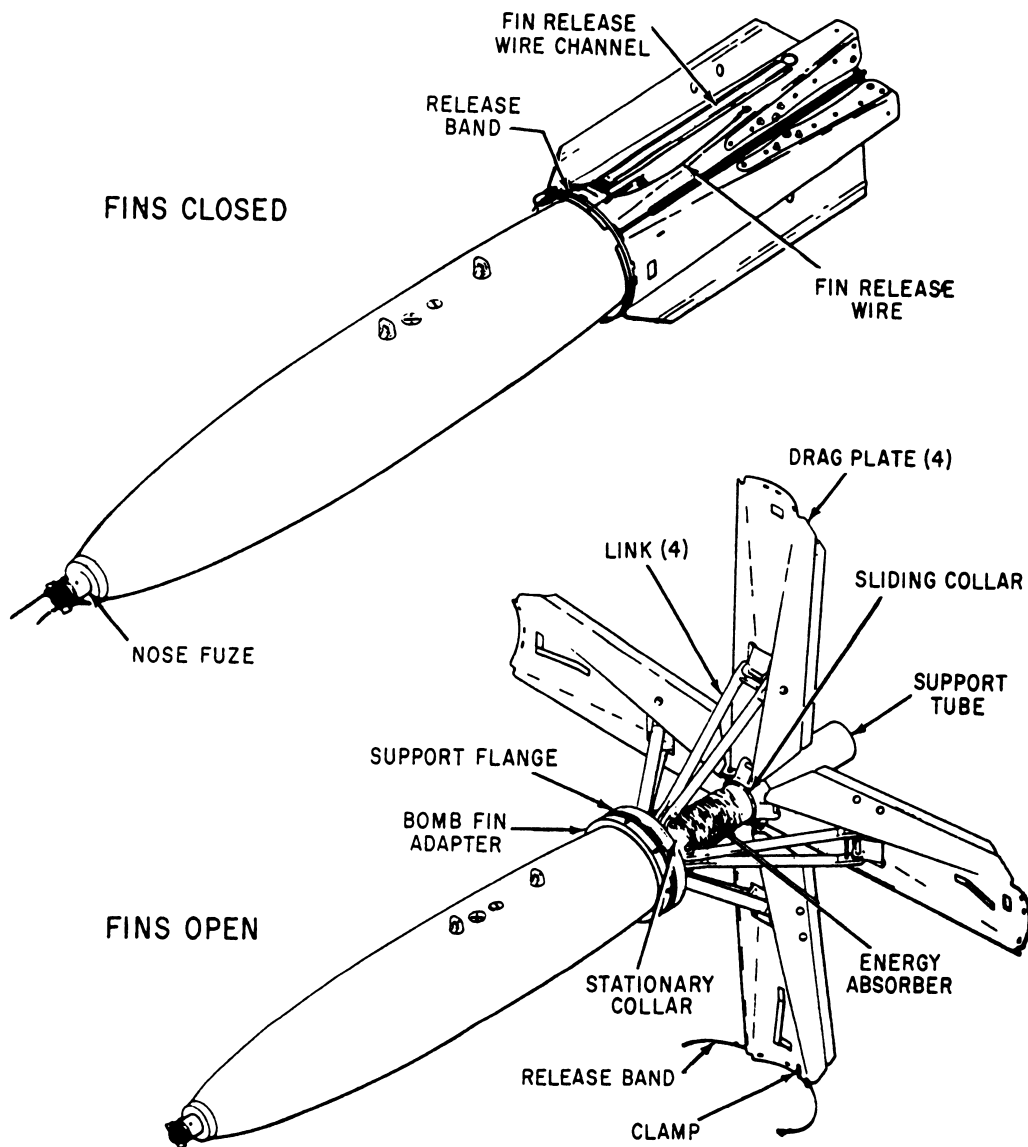


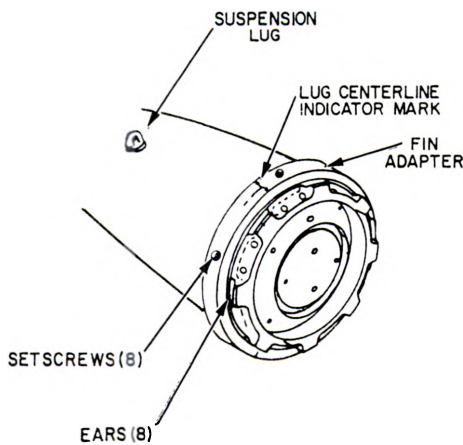
Figure 2-9.—MAU-91A/B and B/B fins with ADU-320/B adapter on bomb body Mk 83.

MAU-91A/B AND B/B SNAKEYE FIN ASSEMBLY.—The MAU-91A/B and B/B fin assembly (fig. 2-9) are retarded tail fins used with the 1,000-pound LDGP bomb Mk 83 and Mods. This fin assembly can be dropped in either the retarded or unretarded position.

The MAU-91 fin consists of four folding drag plates with links, a support flange, and a support tube. An energy absorber, made of aluminum honeycomb tubing, is located on the support tube between the stationary collar and the sliding collar. The sliding collar is driven against the energy absorber, causing it to compress and deform. A channel located on the top drag plate

holds the fin release wire until it is pulled out at bomb release. The drag plates are held in the closed position by a release band secured by a fin release wire pin located in the latch of the release band. The band tabs fit into slots located near the end of each drag plate. The band is securely attached to the bottom drag plate by a stainless steel clamp, which prevents damage from the band striking the aircraft after release.

The MAU-91 fin is attached to the Mk 83 bomb by fin adapter ADU-320/B (fig. 2-10). The adapter is secured to the aft end of the bomb by eight setscrews. The fin support flange has eight teeth that mate to ears on the fin adapter. A garter



220.759

Figure 2-10.—Fin adapter ADU-320/B for MAU-91A/B and B/B fins.

spring is forced into the gap between the flange teeth and the adapter, making sure that the teeth fit tightly against the ears. Two locking pins, which fit through matching holes in the flange and adapter, prevent rotation of the fin.

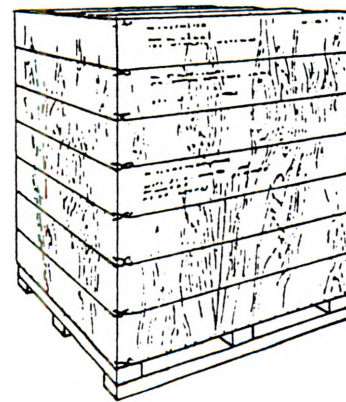
The MAU-91 fin assembly is shipped in a wooden shipping and storage container (fig. 2-11). Included in the container are eight suspension lugs, one spare garter spring, and a spare locking pin.

Principles of Operation

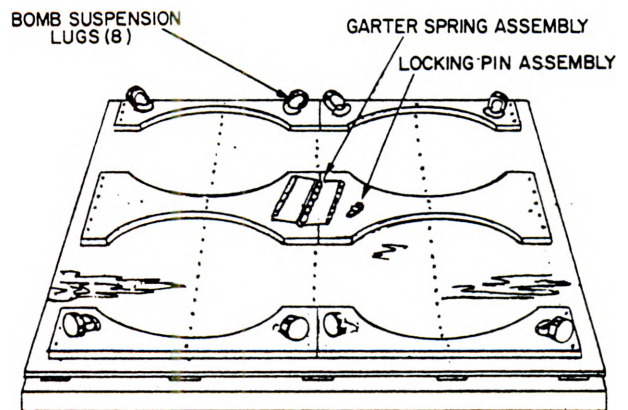
There are three modes of delivery available for the Snakeye fin assembly. They are retarded, unretarded, and in-flight selection (pilot option) of either mode.

RETARDED MODE.—In the retarded mode of delivery, the fins open to retard or slowdown the weapon. Since the aircraft and the weapon are traveling at the same speed when the weapon is released, the weapon and the aircraft arrive at the target at the same time. During low-level bombing, the aircraft could be damaged; therefore, the retarded mode of delivery is used during low-level bombing.

The fin assembly is positively armed in the retarded configuration. In this configuration, the fin release arming wire is looped over a permanent structure on the bomb rack. As the weapon is released from the aircraft, the arming wire is pulled from the fin release band, and the spring-loaded fins pop open. The fins are forced



CONTAINER



COMPONENTS STAPLED TO BASE OF CONTAINER

220.760

Figure 2-11.—Fin shipping and storage container for MAU-91A/B and B/B fins.

to the full-open position by the airstream, which causes the weapon to rapidly decelerate and allows the releasing aircraft sufficient time to safely clear the target area.

UNRETARDED MODE.—In the unretarded mode of delivery, the weapon is released from the aircraft, and the fins remain in the closed position. The weapon free falls to the target. In the unretarded mode of delivery (without pilot option), the cotter/safety pin installed in the fin release band is not removed or replaced with an arming wire. However, the safety tag reading REMOVE BEFORE FLIGHT is removed.

IN-FLIGHT SELECTION.—The most frequently used mode for delivery is the in-flight selection (pilot option) mode. The pilot can drop

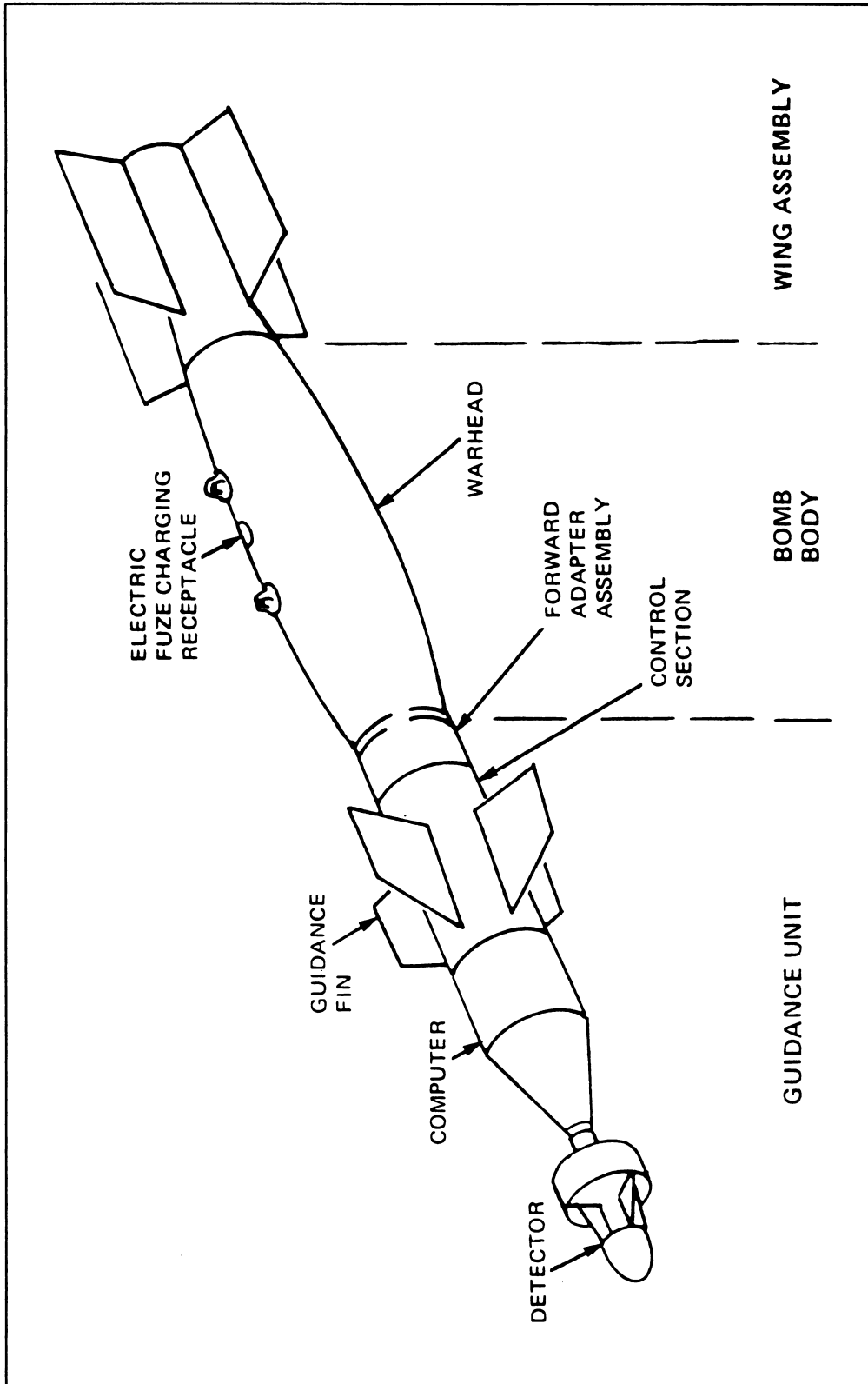


Figure 2-12.—Typical laser-guided bomb.

220.594

the weapon in the retarded or unretarded mode. This is possible by connecting the swivel loop of the fin release arming wire to the tail arming solenoid of the bomb rack. If the pilot energizes the arming solenoid upon weapon release, the arming wire remains connected to the arming solenoid and is pulled from the fin release band at weapon release, which allows the fins to pop open and results in a retarded delivery. If the pilot does not energize the arming solenoid upon weapon release, the arming wire is pulled free of the arming solenoid. This allows it to remain in the fin release band, preventing the fins from opening, which results in an unretarded delivery.

REVIEW NUMBER 1

- Q1. *What type of bomb is used in most bombing operations?*
- Q2. *Name the type of pallets on which bombs are shipped.*
- Q3. *Bombs are shipped on metal pallets because _____.*
- Q4. *List the two types of bomb fins.*
- Q5. *The Mk 15 fin is used with the _____ LDGP bomb.*
- Q6. *What adapter is used to mate the MAU-91A/B fin to the Mk 83 bomb?*
- Q7. *List the three modes of delivery used with Snakeye fins.*

LASER GUIDED BOMBS

Learning Objective: Identify the purpose, use, and operation of laser-guided bombs.

The Mk 82, Mk 83, and Mk 84 laser-guided bombs (LGBs) (fig. 2-12) are Mk 82, Mk 83, and Mk 84 LDGP bombs modified to detect a target illuminated by a laser beam. The Mk 82, Mk 83, and Mk 84 LDGP bombs are converted into laser-guided bombs by using laser guidance kits KMU-388/B, KMU-431/B, and KMU-351A/B, respectively. Each laser guidance kit contains a computer-control group (CCG) and an air-foil group (wing assembly and guidance fins).

The CCG mounts on the nose of the bomb body. (Note: This precludes the use of nose fuzing.) The CCG detects a laser-illuminated target and provides weapon guidance signals to the moveable guidance fins.

The guidance fins (canards) attach to the CCG and the forward adapter assembly. The canards react to the signals received from the CCG to direct the weapon to the target. The canards are issued with fin extenders, which may be snapped off if wing extenders are not required.

The wing assembly is mounted on the aft end of the bomb body. It adds necessary aerodynamic stability and lift for in-flight maneuvering. An electric tail fuze is installed in the tail of the bomb.

Except for the glass nose of the CCG, all components are painted olive drab, and the bomb body has standard LDGP markings.

REVIEW NUMBER 2

- Q1. *How do laser-guided bombs detect a target?*
- Q2. *What type of tail fuze is used with laser-guided bombs?*
- Q3. *Describe the location of the wing assembly used with laser-guided bombs.*

DESTRUCTORS

Learning Objective: *Identify the purpose, use, and operation of destructors.*

The destructor mine consists of an LDGP aircraft bomb and a Mk 75 modification kit. The Mk 75 modification kit (fig. 2-13) contains the Mk 32 arming device, Mk 59 booster, Mk 42 firing mechanism, and all necessary hardware (less battery and fin assembly) to convert an LDGP bomb to an air-laid mine. The firing mechanism of the Mk 42 arming device requires the use of

a Mk 95 battery, which must be installed during assembly procedures.

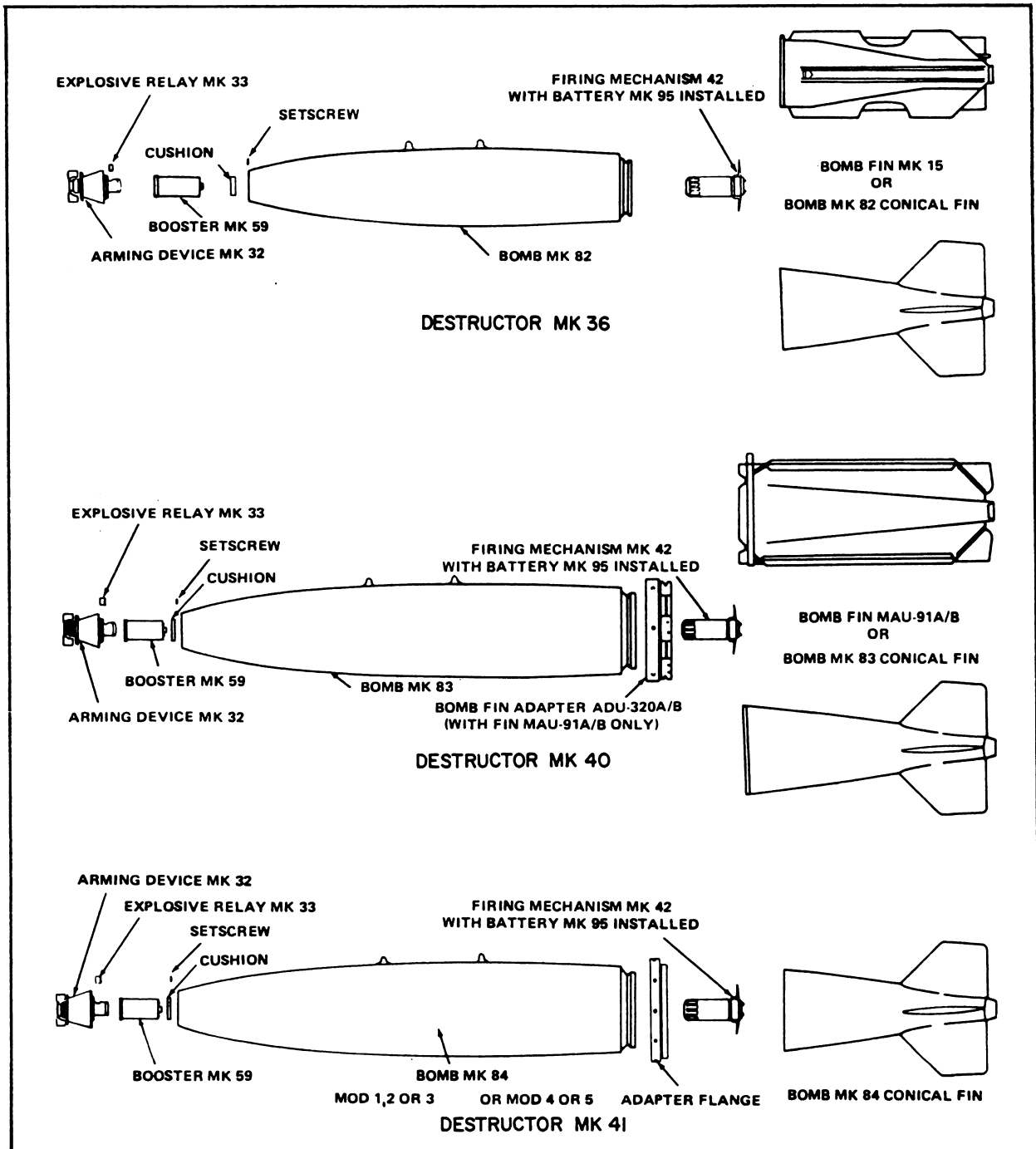
With the Mk 75 kit installed, a Mk 82 LDGP bomb (500 pounds) becomes a Mk 36 DST, a Mk 83 LDGP bomb (1,000 pounds) becomes a Mk 40 DST, and a Mk 84 LDGP bomb (2,000 pounds) becomes a Mk 41 DST. The Mk 36 and Mk 40 DST can be dropped in the retarded or nonretarded mode of delivery. The installation of a conical fin provides nonretarded (free-fall) delivery only. The installation of a Snakeye fin assembly provides the pilot with the in-flight option of releasing the DST in the retarded or nonretarded mode. The Mk 41 DST is configured

REVIEW NUMBER 1 ANSWERS

- A1. *Normally, low-drag general-purpose (LDGP) bombs are used in bombing operations. Currently, Mk 80 (series) LDGP bombs are used.*
- A2. *Bombs are shipped on metal pallets because of their increased capacity and for grounding purposes over wooden pallets.*
- A3. *Suspension lugs are used to fasten the weapons to the aircraft bomb racks.*
- A4. *The two types of bomb fins are the conical and Snakeye fins.*
- A5. *The Mk 15 fin is used with the Mk 82 bomb in either a low-drag or high-drag configuration.*
- A6. *The ADU-320/B adapter is used to mate the MAU-91A/B fin to the Mk 83 bomb.*
- A7. *The three modes of delivery used with Snakeye fins are the retarded mode, used during low-level bombing; nonretarded mode, in which the weapon free falls to the target; and the jin-flight selected moded (pilot option), where the pilot selects either the retarded or nonretarded mode of delivery.*

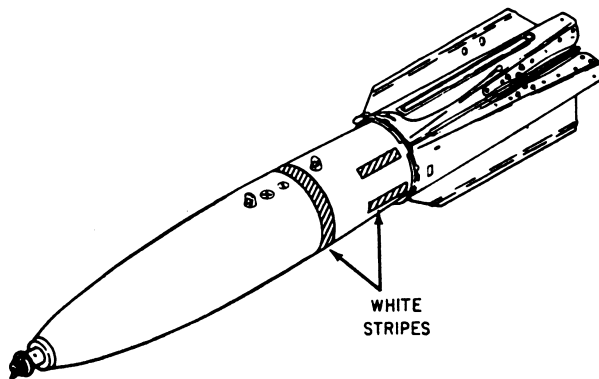
REVIEW NUMBER 2 ANSWERS

- A1. *Laser-guided bombs detect a target illuminated by a laser beam.*
- A2. *Electrical tail fuzes are used in laser-guided bombs.*
- A3. *The wing assembly is mounted on the aft end of the bomb body to add aerodynamic stability and lift for in-flight maneuvering.*



220.761

Figure 2-13.—Typical destructor configurations.



220.595

Figure 2-14.—DST identification markings.

with a conical fin for nonretarded delivery only. DSTs are identified by the standard LDGP bomb markings plus white stripes (fig. 2-14).

Additional information on DSTs may be found in *Destructor Mk 36, 40, and 41, all Mods, NAVSEA OP 3529.*

REVIEW NUMBER 3

- Q1. *What modification kit is used to make LDGP bombs into destructor (DST) mines?*
- Q2. *Name the bomb used to make the Mk 40 destructor.*
- Q3. *Name the DST that can only be dropped in the nonretarded mode.*

FIRE BOMBS

Learning Objective: *Identify the components of the Mk 77 Mod 4, CBU-55A/B, and CBU-72/B fire bombs. Describe the function of the Mk 77 Mod 4, CBU-55A/B, and CBU-72/B fire bombs.*

A fire bomb is a thin-skinned container of fuel gel designed for use against dug-in troops, supply

installations, wooden structures, and land convoys. Fire bombs rupture upon impact and spread burning fuel gel on surrounding objects. One or more igniters and fuzes are used to ignite the fuel gel mixture upon impact. Fire bombs are used primarily for low-level attacks.

Currently, the Navy has three fire bombs available for use. They are the Mk 77 Mods 2 and 4, and the fuel-air explosive (FAE) bomb clusters CBU-55A/B and CBU-72/B.

MK 77 MOD 4 FIRE BOMB

The Mk 77 Mod 4 fire bomb (fig. 2-15) holds approximately 75 gallons of fuel gel mixture and weighs approximately 500 pounds when filled.

NOTE: The Mod 4 differs from the Mod 2 because the igniter adapters have been removed, and the filler holes are 31° down instead of in line with the suspension lugs.

The Mk 77 Mod 4 container is cigar-shaped, nonstabilized (will tumble end over end when released from the aircraft), lightweight, and made of aluminum. It has a 14-inch suspension between the lugs and has two filler holes that are 31 degrees down from the top of the container. The filler holes are covered by filler caps secured by retainer rings. The filler caps prevent foreign objects from getting inside the container during shipping and storage. They provide a sealed closure after the container is filled with fuel gel before fuzing. The filler holes also provide for the installation of the primary fuzes. During fuzing procedures, the filler caps are removed and replaced by igniters, which seals the closure.

The primary fuzing system (fig. 2-15) consists of the igniter Mk 273 Mod 0 with the M918 fuze or the initiator Mk 13 (igniter Mk 273 Mod 1 with the Mk 343 fuze). The Mk 77 Mod 4 also has provisions in the nose and tail for an alternate fuzing system (fig. 2-15) using the AN-M173A1 fuze and the AN-M23A1 igniter.

Functional Description

When the fire bomb is released from the aircraft, the arming wires are pulled from the fuzes. The fuzes become armed. When the bomb impacts the target or the ground, the container ruptures, spreading the fuel gel mixture over the area. The fuzes detonate, rupturing the igniters, which, in turn, ignite the gel mixture.

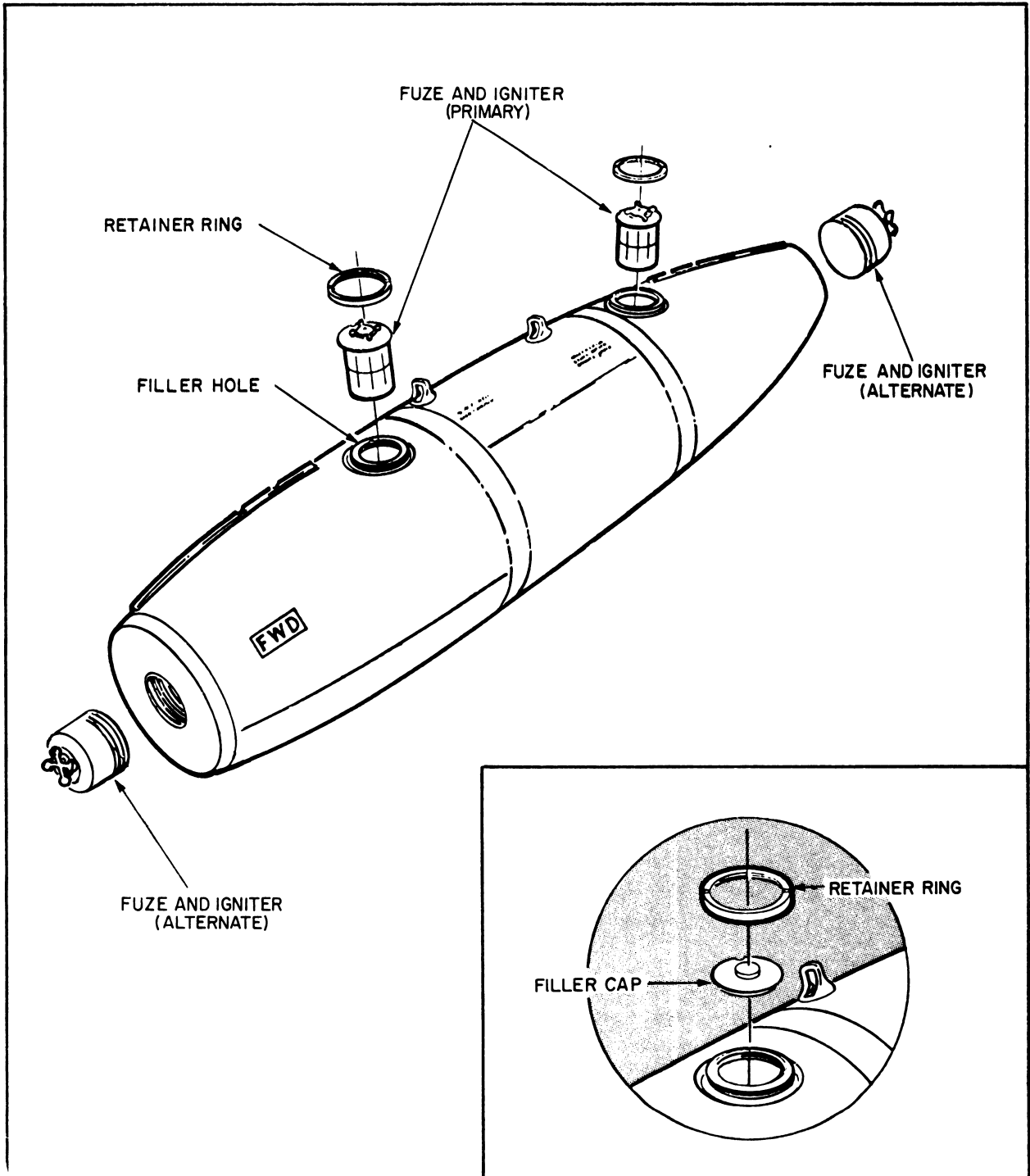


Figure 2-15.—500-pound fire bomb Mk 77 Mod 4 (exploded view).

Fuel Gel Mixture

Fire bomb fuel gel mixture (formerly known as napalm) is a mixture of fuel and a gelling solution that produces a thickened mixture. A

good gel mixture appears like the one shown in figure 2-16. The gel should be stringy, sticky, and adhere to most surfaces. The fuel gelling system consists of a fuel gelling unit, drums of gelling solution, aviation gas, mogas, JP-4, or JP-5 fuels.

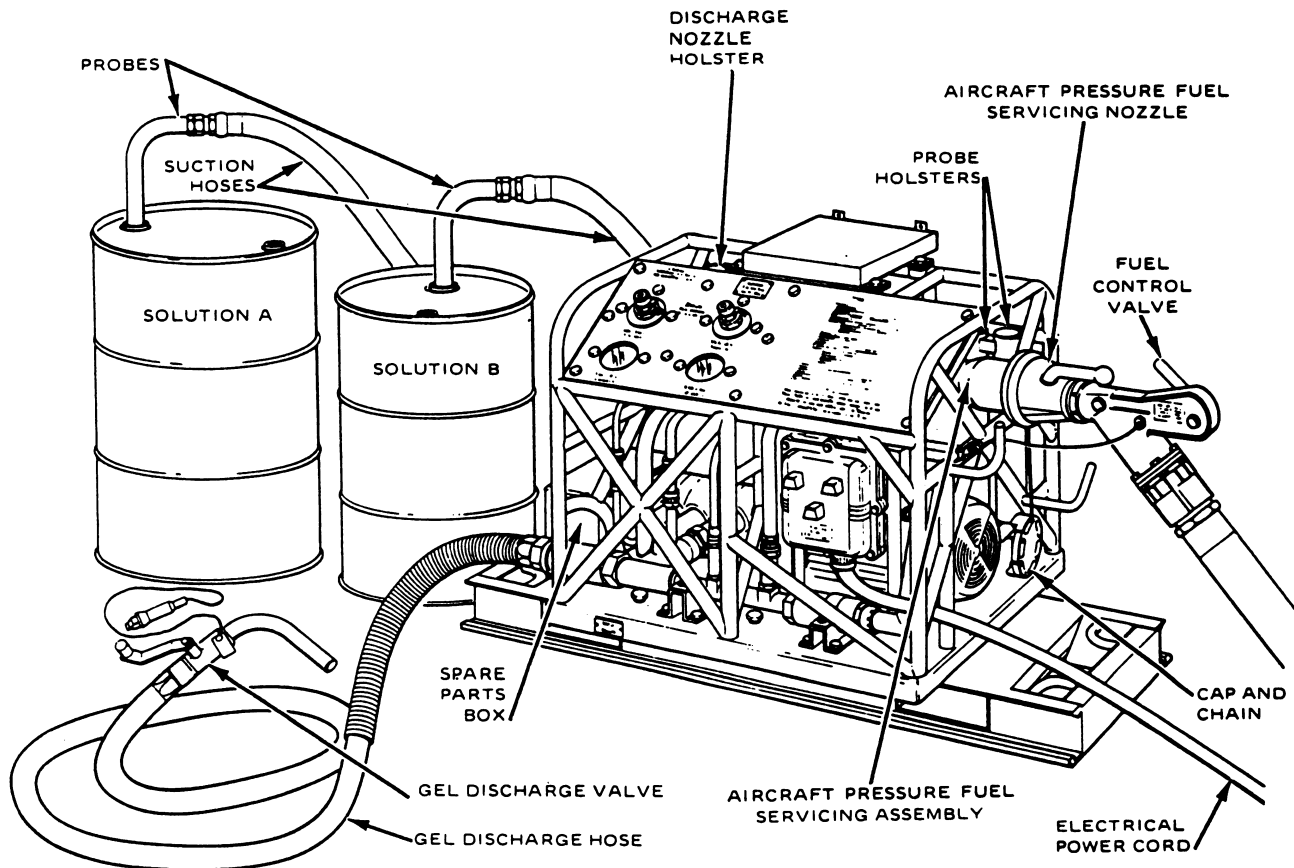


Figure 2-16.—Appearance of typical gel.

220.762

REVIEW NUMBER 3 ANSWERS

- A1. The Mk 75 modification kit is used to make destructor mines.*
- A2. When the Mk 75 modification kit is installed, the Mk 83 LDGP bomb becomes the Mk 41 DST.*
- A3. The Mk 41 DST can only be delivered in the nonretarded mode.*



220.763

Figure 2-17.—Fuel gelling unit Mk 1 Mod 0 (typical setup).

Mark 1 Mod 0 Fuel Gelling Unit

The Mk 1 Mod 0 fuel gelling unit (fig. 2-17) is a 220- or 440-volt ac, electrically driven unit, designed for use by shore-based or shipboard squadrons. This unit replaces all other incendiary mixers. The gelled fuel flow rate of the unit is approximately 48 gallons per minute.

SOLUTIONS.—Solution A is a crystallized, distilled cottonseed, unsaturated fatty acid with an additive containing a mine and esopropanol. Solution B is a mixture of concentrated caustic soda and caustic potash. These solutions must be used in sets of two (a 55-gallon drum of solution A and a 30-gallon drum of solution B). This mixture combination produces approximately 900 gallons of gel, or enough gel to fill 12 to 14 fire bomb casings.

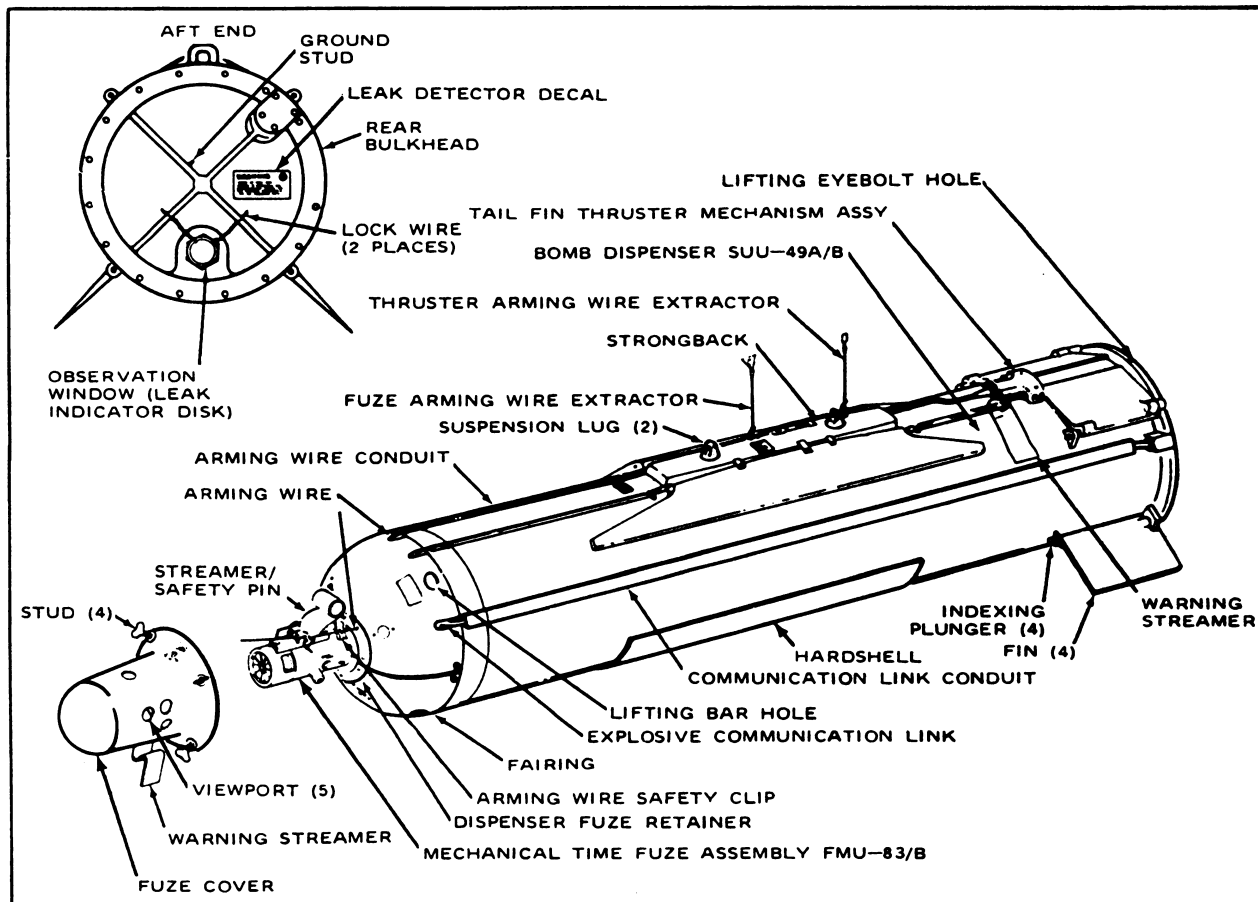
FUEL.—The fuels that can be used in the Mk 1 Mod 1 fuel gelling unit are aviation gasoline

80/87, 100/130, and 115/145 octanes, combat automotive gasoline (mogas), or aviation turbine fuel, JP-4 or JP-5.

FILLING.—A typical fuel gelling system setup is shown in fig. 2-17. The mixing unit draws gelling solutions A and B from the drums through suction hoses and fuel through an aircraft pressure fuel supply hose/nozzle and puts it directly into the unit where it is mixed with the solutions and gelled. The gelled fuel is then pumped through a gel discharge hose to fill the fire bomb cases.

The fire bomb cases are filled to within 1 1/2 inches of the bottom of the filler holes, with the filler holes at the 12-o'clock position. This space gives a minimum airspace of three percent in the bomb to prevent rupture because of expansion of the fuel gel mixture.

For detailed information concerning the fuel gelling unit Mk 1 Mod 0 and mixing instructions, refer to NAVAIR 19-1-112.



220.764

Figure 2-18.—Fuel-air explosive bomb cluster CBU-55A/B.

FUEL-AIR EXPLOSIVE BOMB CLUSTER CBU-55A/B AND CBU-72/B

The CBU-55A/B (fig. 2-18) and CBU-72/B (fig. 2-19) are fuel-air explosive (FAE) bomb clusters. They are air-to-surface, free-fall, unguided weapons delivered from low-speed or high-speed fixed-wing aircraft. The CBU-55A/B bomb cluster may also be delivered from rotary-wing aircraft. The weapons are effective against personnel in defensive positions, light material targets, booby traps, foliage, and in clearing helicopter landing zones.

Components

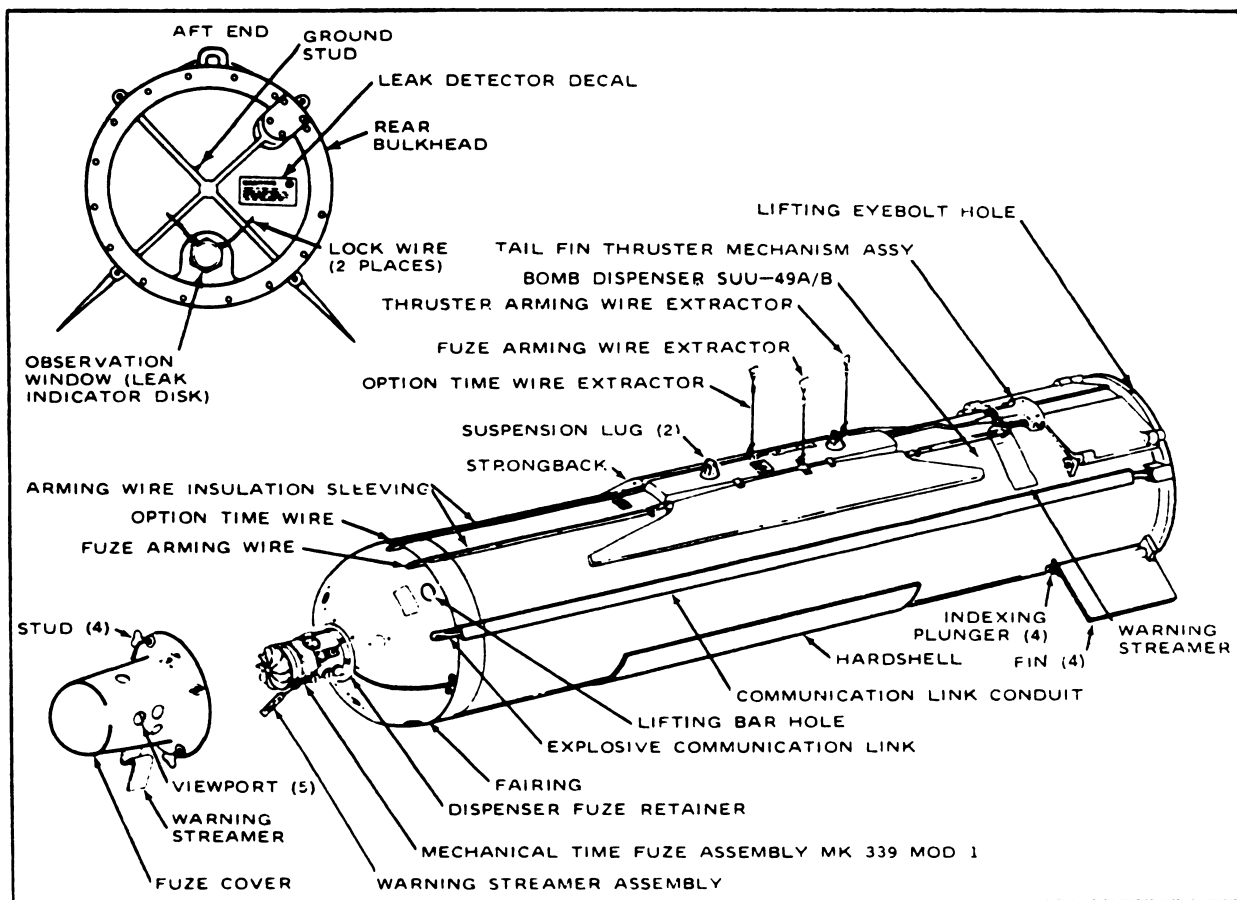
The SUU-49A/B bomb dispenser is used with both the CBU-55A/B and CBU-72/B bomb clusters. The dispenser contains three BLU-73A/B

fuel-air explosive bombs and contains both high explosives and ethylene oxide fuel. Ethylene oxide fuel is a clear, colorless, flammable, toxic liquid having a characteristic ether-like odor.

Both bomb clusters have mechanical time fuzes installed in the nose of the bomb dispenser. The FMU-83/B fuze is used with the CBU-55A/B, and the Mk 339 Mod 1 is used with the CBU-72/B. Fuzing is the only difference between the two weapons. The bomb clusters weigh approximately 520 pounds and are delivered to the fleet completely assembled as all-up-rounds (AURs).

SUU-49A/B BOMB DISPENSER.—The SUU-49A/B bomb dispenser (fig. 2-18 and fig. 2-19) is an aluminum cylinder equipped with the following:

- Nose fairings



220.765

Figure 2-19.—Fuel-air explosive bomb cluster CBU-72B.

- A strongback and hard-shell area for handling/chocking purposes
- Arming wires
- Extractors
- Thruster mechanism
- Four fins that are folded for shipping, storage, and handling

The lower and upper dispenser fins are unfolded manually. The upper fins are unfolded manually before flight or by the thruster mechanism upon release from an aircraft. The upper nose fairing contains holes for inserting a lifting bar for handling. An observation window assembly (fig. 2-18 and fig. 2-19) is mounted

on the rear bulkhead for detection of leaking fuel. There is a leak detector decal next to the observation window assembly. The leak detector disk can be seen through this window. If you find the leak indicator disk white or red as the color on the leak indicator decal, the bomb cluster is hazardous. Handle it according to current disposition instructions. A leak indicator disk may turn orange, pink, or brown from environmental exposure, but it will still turn red if a leak occurs. The fuze covers (fig. 2-18 and fig. 2-19) are used to protect the installed fuzes during ground handling only, and they are removed before flight.

FMU-83/B AND MK 339 MOD 1 MECHANICAL TIME FUZE.—The purpose of the mechanical time fuzes used with the FAE weapons is to initiate the communication link assembly, resulting in removal of the rear bulkhead.

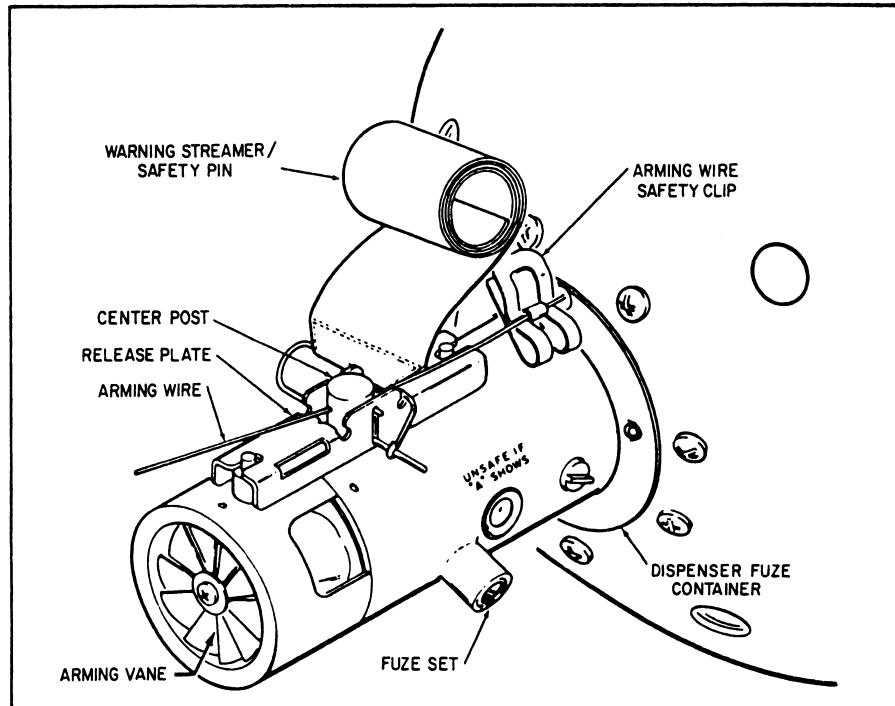


Figure 2-20.—Mechanical time fuze assembly FMU-83/B.

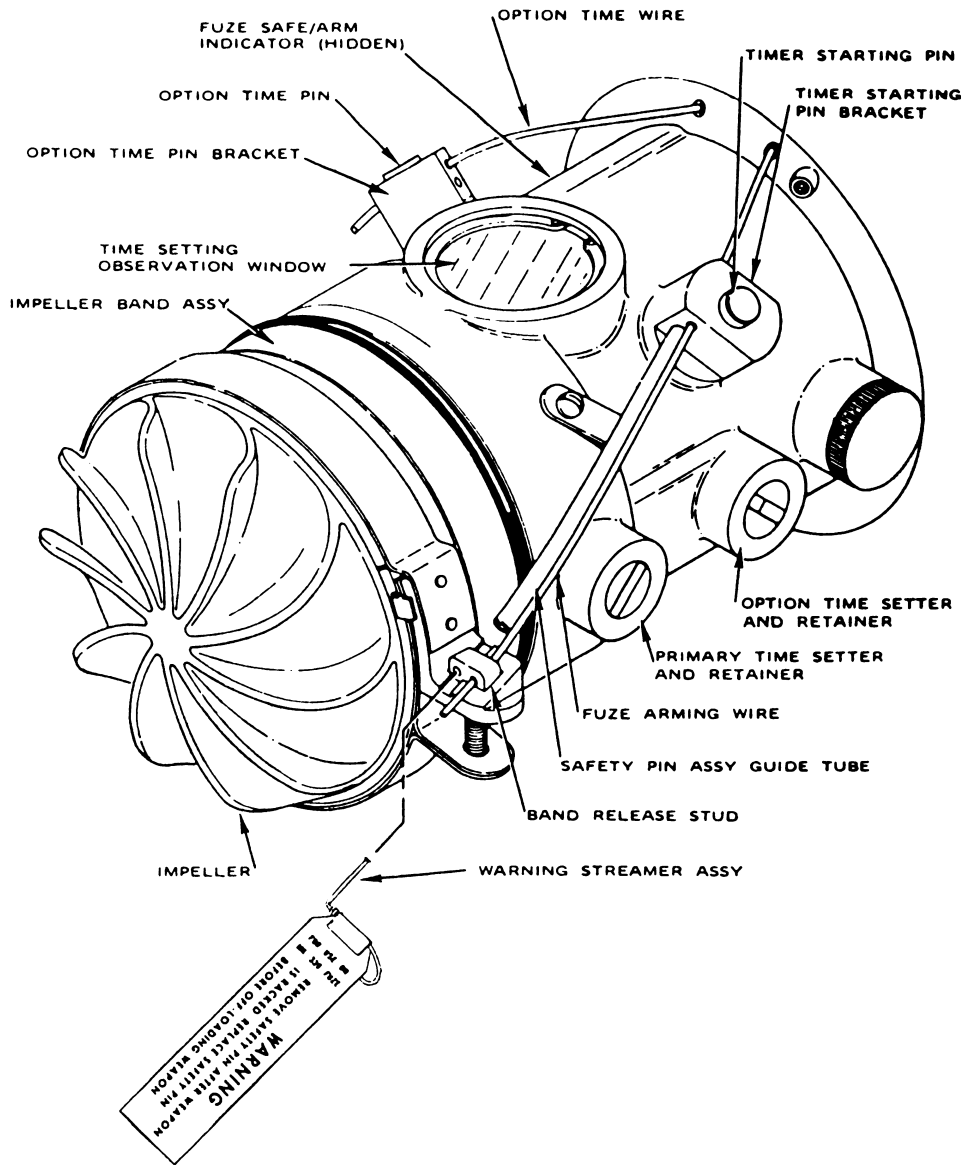
220.766

FMU-83/B Mechanical Time Fuze.—The FMU-83/B fuze (fig. 2-20) is installed in the nose of the CBU-55A/B bomb cluster. It is an air-armed, air-discriminating, mechanical time fuze. The air-discriminating feature means the fuze must be subjected to a minimum of 50 knots velocity before it can arm. A safe/arm indicator, located on the left side of the fuze, indicates the safe/arm and time setting conditions of the fuze. A tubular projection that contains the function-time setting device is located near the safe/arm indicator. A fuze function-time setting from 1.0 to 9.7 seconds must be set before flight. The fuze will fail if set at less than 1.0 second or more than 9.7 seconds. An arming wire and warning streamer/safety pin are installed through the center post at the top of the fuze; it must be removed before flight.

Mk 339 Mod 1 Mechanical Time Fuze.—The Mk 339 Mod 1 fuze (fig. 2-21) is installed in the nose of the CBU-72/B bomb cluster. It is an air-armed, air-discriminating mechanical time fuze. The air-discriminating feature means the fuze must be subjected to a minimum of 225 knots

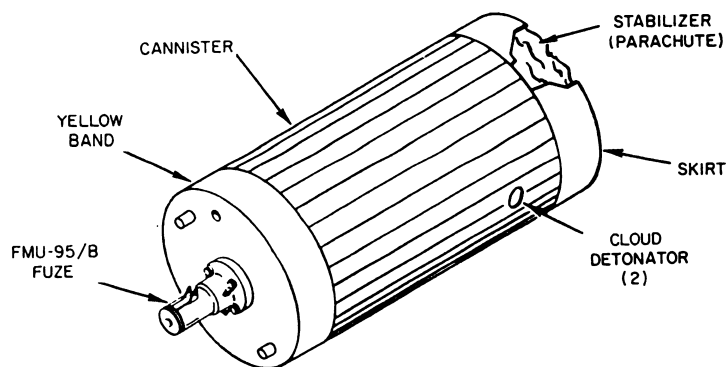
velocity before it can arm. Fuze functioning time is preset with 1.2- and 4.0-second time delay options.

BLU-73A/B FUEL-AIR EXPLOSIVE BOMB.—Three BLU-73A/B bombs (fig. 2-22) are packed in the SUU-49A/B bomb dispenser, which is an aluminum cylinder containing ethylene oxide. An FMU-95/B fuze is mounted at the forward end and a stabilizer (parachute) with skirt is attached to the aft end of each bomb. A burster charge extends through the center of the bomb, and two cloud detonators are installed in the side of the bomb opposite each other. Each bomb weighs 132 pounds. The FMU-95/B bomb fuze consists of an extendable probe with a piezoelectric crystal mounted in the tip, a backup inertial firing pin, a detonator, and a pyrotechnic delay element. When extended, the probe is approximately 4 feet in length. A self-destruct device (pyrotechnic delay) provides for positive detonation of the burster charge if the fuze is armed and fails in its primary or backup firing mode. The cloud detonators contain a firing pin, delay element, out-of-line safety device, and detonator pellet.



220.767

Figure 2-21.—Mechanical time fuze assembly Mk 339 Mod 1.



220.768

Figure 2-22.—Fuel air explosive bomb BLU-73A/B.

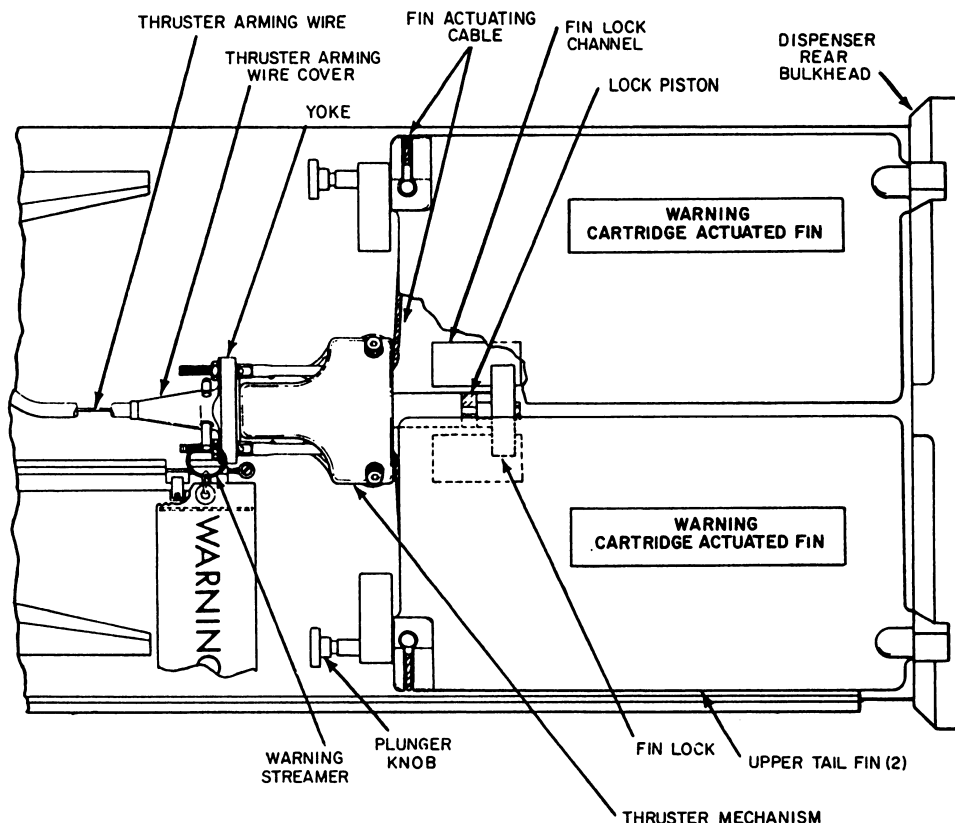


Figure 2-23.—Tail fin thruster mechanism.

220.769

THRUSTER MECHANISM.—The thruster mechanism (fig. 2-23) holds the two upper fin assemblies in the folded position and unfolds the fin assemblies when the bomb cluster is released from the aircraft. An extractor is attached to the aircraft and thruster arming wire, and upon release, the thruster arming wire pulls the firing pin pull rod, which fires the impulse cartridge. Gases drive the fin lock aft and release the fin assemblies from the folded position. The expanding gases then drive the yoke forward, pulling the fins into the open position by means of fin-actuating cables. The upper fins may also be opened manually before flight.

Functional Description

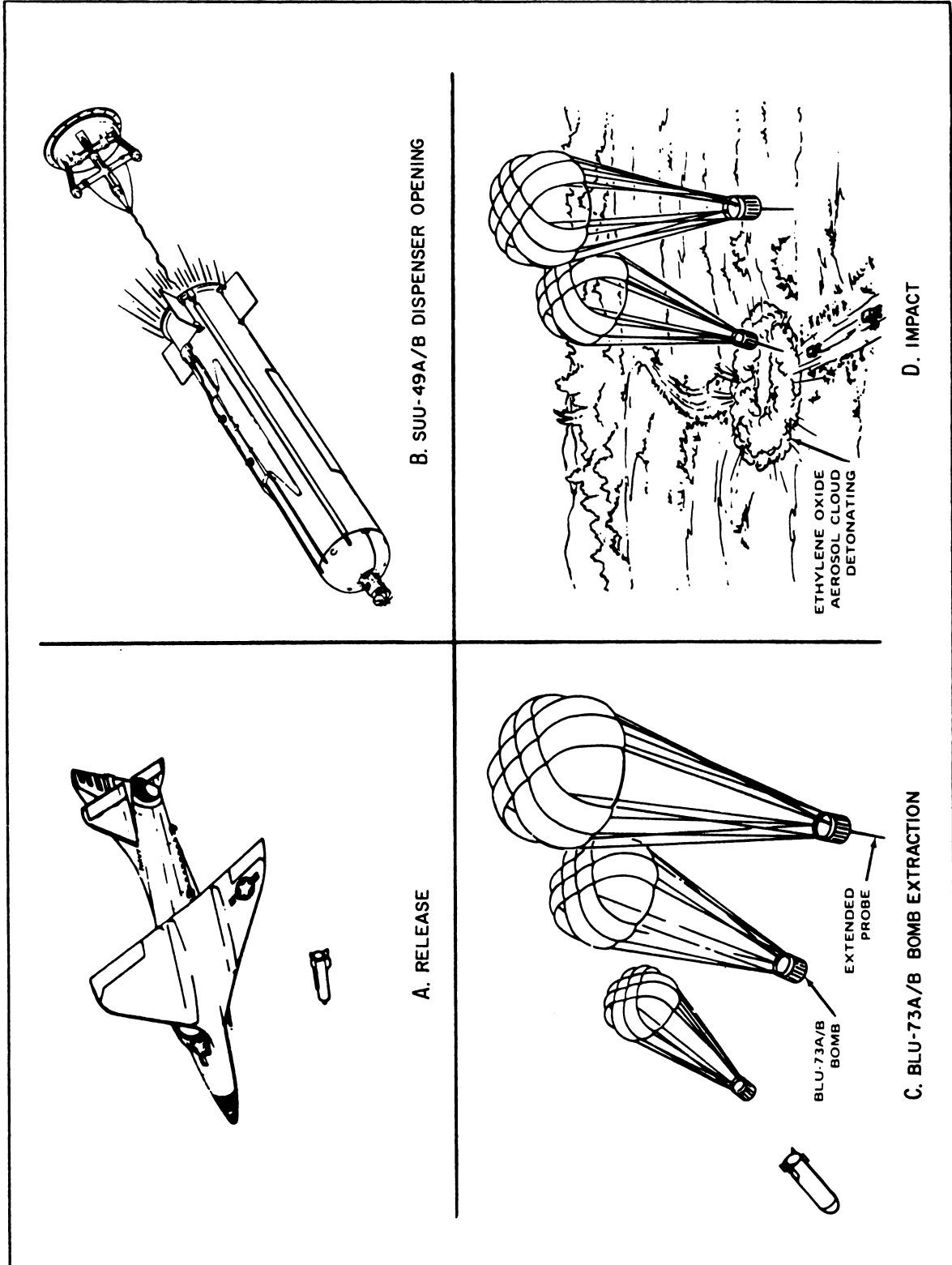
As you read this section, look at figure 2-24. When a bomb cluster is released from the aircraft (view A), the arming wire is withdrawn from the mechanical time fuze, starting the arming cycle, and, if applicable, from the thruster mechanism to extend the two upper fin assemblies. If the

option time wire is withdrawn on the CBU-72/B bomb cluster, the fuze will function at the option time set in the fuze.

After preset time delay has elapsed, the fuze fires, initiating the explosive communication link and the mild detonating charge that removes the rear bulkhead assembly. Removal of the rear bulkhead (view B) causes extraction and deployment of the stabilizer (parachute) attached to the aft BLU-73A/B bomb. Drag forces produced by the stabilizer (parachute) extract the aft bomb from the dispenser (view C); this, in turn, extracts and deploys the center bomb stabilizer (parachute).

Extraction of the forward bomb is a similar process to that of the aft bomb. After 2.2 to 2.3 seconds have elapsed, the fuze probe extends from the FMU-95/B fuze (view C), completing the arming cycle.

Upon ground impact (view D), the probe or inertial firing device detonates the fuze and the bomb burster charge. The burster charge ruptures



220.770

Figure 2-24.—Bomb cluster release to impact sequence.

the bomb, dispersing fuel into an aerosol cloud, and, at the same time, propelling the cloud detonators into the cloud. After a preset delay, the cloud detonators fire and initiate the cloud. If the probe or inertial devices fail to initiate the burster charge, a self-destruct device (pyrotechnic

delay) detonates the charge 2 minutes after fuze function begins.

Handling and Shipping

Both the CBU-55A/B and CBU-72/B bomb clusters are shipped and stored in either the

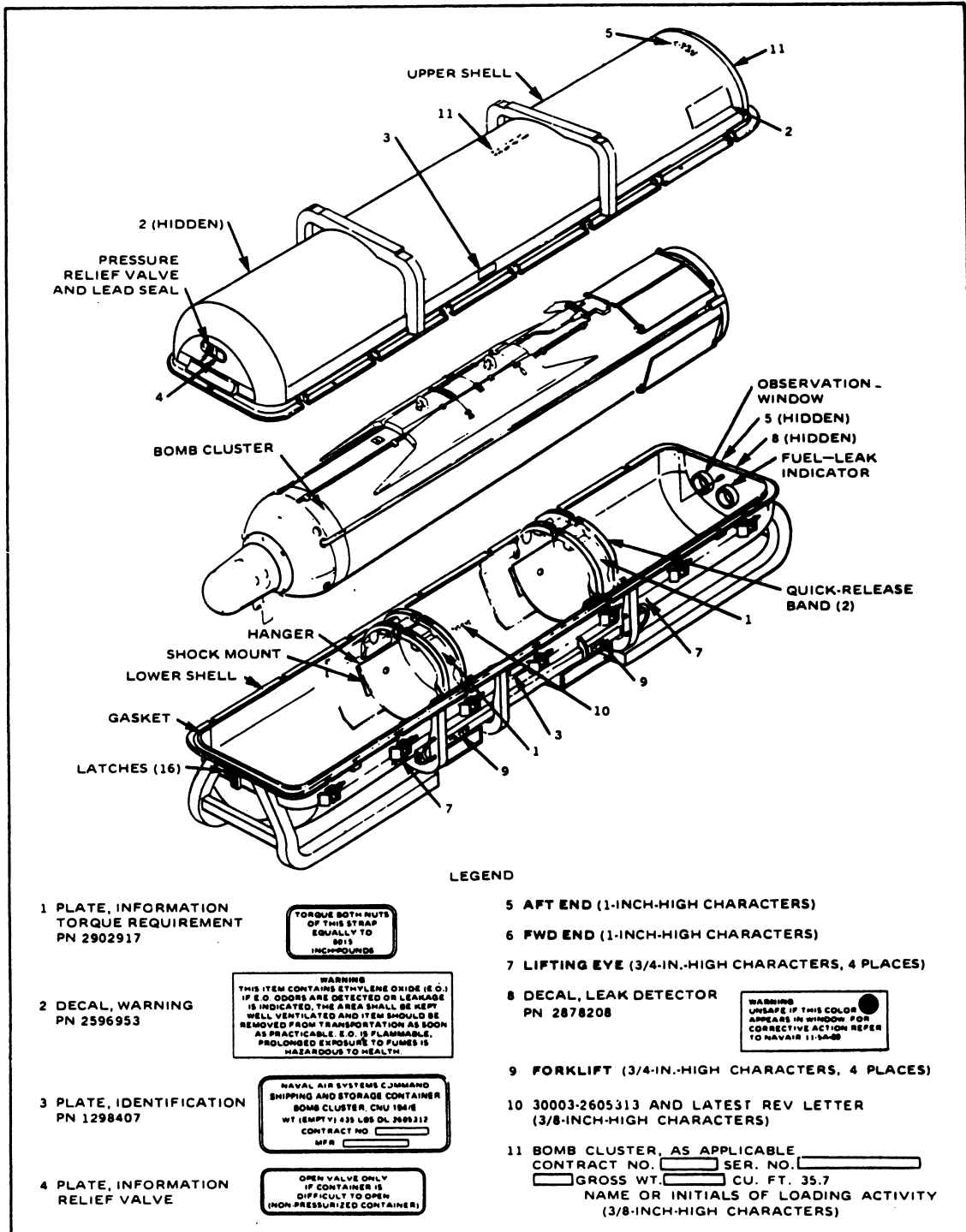


Figure 2-25.—Bomb cluster shipping and storage container CNU-194/E.

CNU-194/E (fig. 2-25) or CNU-208/E (fig. 2-26) reusable shipping and storage containers. The CNU-194/E container holds one fully assembled bomb cluster, and the CNU-208/E holds two fully assembled bomb clusters. The containers consist

of metal upper and lower shell assemblies. The bomb clusters are secured to the lower shell by the shock-dissipation cradles. When the upper and lower shell assemblies are mated and latched, a rubber gasket provides an environmental seal. Do

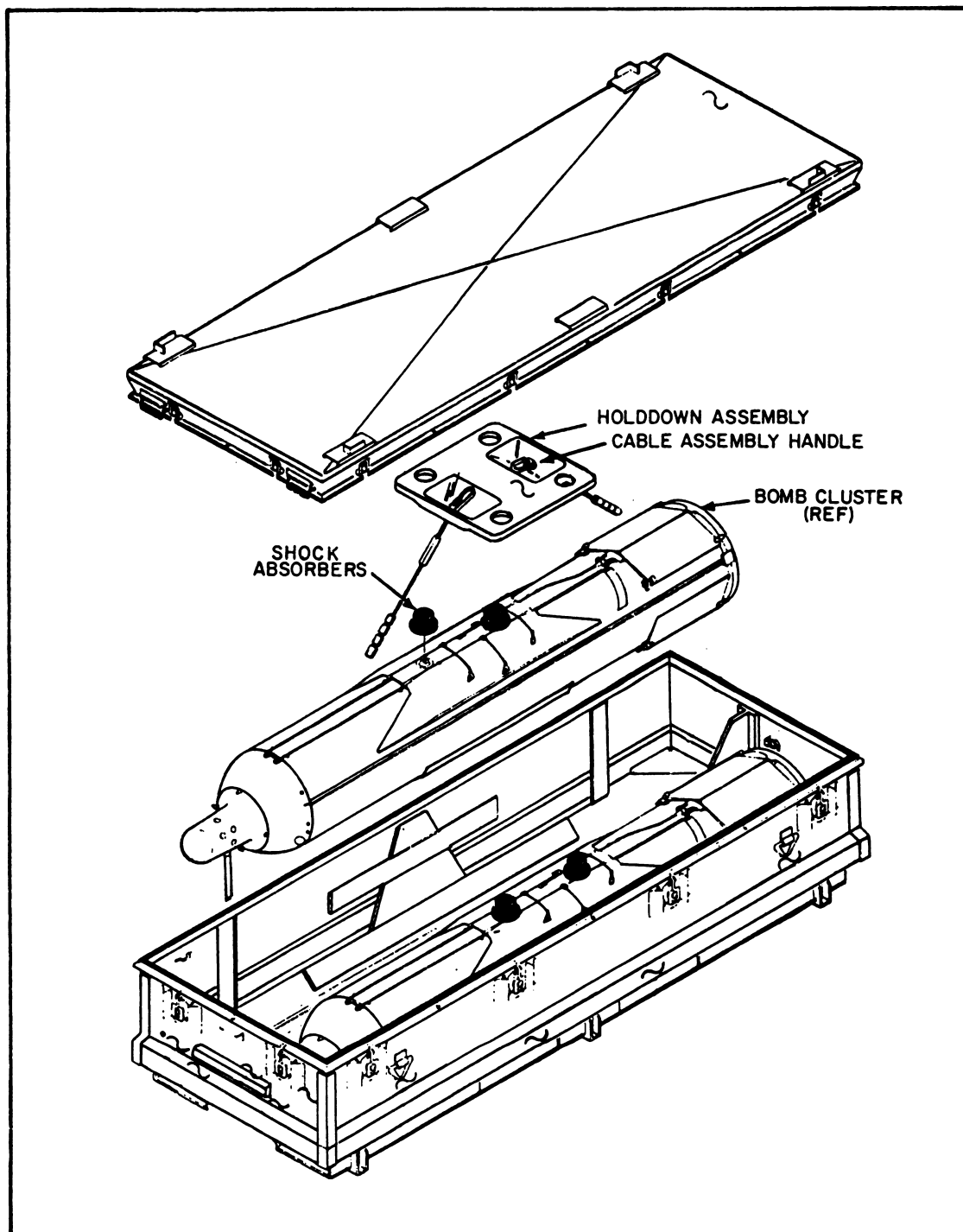


Figure 2-26.—Multipurpose shipping and storage container CNU-208/E.

not open them until the weapons are actually ready for use.

The CNU-194/E container has two view ports on the aft end of the lower shell assembly; one is an observation window with a leak indicator disk for the container, and the other is an observation window giving visual access to the bomb cluster's leak indicator disk. The CNU-208/E container has three view ports—one for observation of a leak indicator disk for the container, and two for the observation of each bomb cluster.

REVIEW NUMBER 4

Q1. List the three fire bombs that the Navy uses.

Q2. The Mk 77 and Mods fire bomb will hold _____ and, when filled, weighs _____.

Q3. Fire bomb cases are filled to within 1 1/2 inches of the filler holes in the Mk 1 Mod 0 fuel gelling unit. What is the reason for this action?

Q4. What type of delivery is used with CBU-55A/B and CBU-72/B fuel-air explosive (FAE) bomb clusters?

Q5. Name the bomb dispenser used with both types of bomb clusters.

Q6. If you handle the SUU-49A/B bomb dispenser, how can you check for a fuel leak?

Q7. Before the Mk 339 Mod 1 can arm, it has to attain what velocity?

Q8. The fuze function time on the FMU-83/B can be set from 1.0 to 9.7 seconds. What happens if the function time is set below 1.0 or above 9.7 seconds?

Q9. What fuze is used with the CBU-72/B FAE?

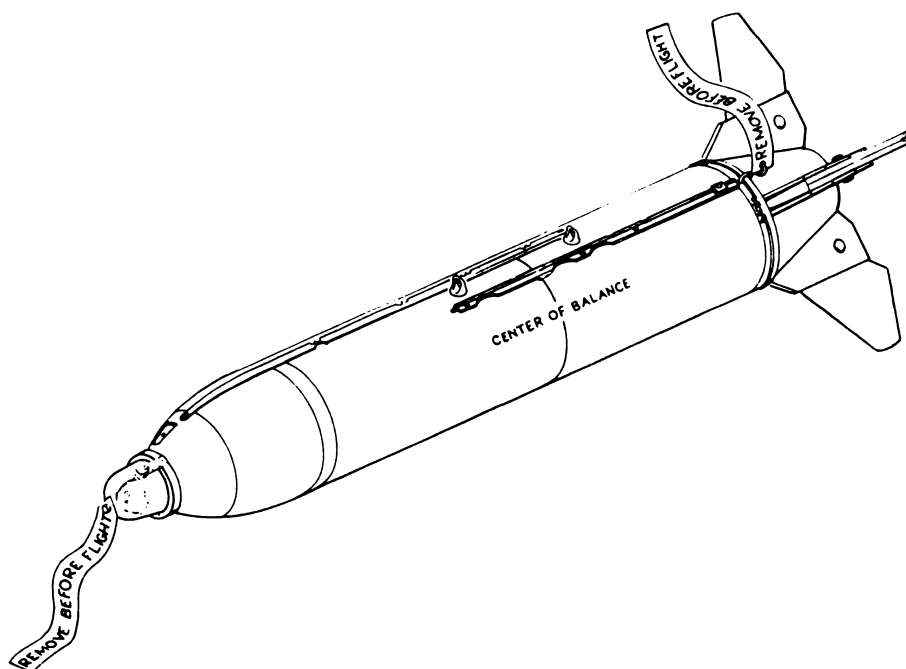


Figure 2-27.—Antitank bomb cluster Mk 20 Mods 2, 3, 4, and 6, and antipersonnel/antimaterial bomb cluster CBU-59/B.

Q10. List the shipping containers used to ship CBU-55A/B and CBU-72/B bomb clusters.

**ANTITANK BOMB CLUSTER
MK 20 MODS AND ANTI-
PERSONNEL/ANTIMATERIAL
BOMB CLUSTER CBU-59/B**

Learning Objective: *Identify the purpose and use of the various configurations of the Mk 20 and Mods antitank bomb cluster and the CBU-59/B antipersonnel/antimaterial bomb cluster. Describe the function of the Mk 118 Mods 0 and 1 antitank bomb and the BLU-77/B bomblet.*

The antitank bomb cluster Mk 20 Mods 2, 3, 4, and 6 and the antipersonnel/antimaterial bomb cluster CBU-59/B (fig. 2-27) are air-launched, conventional free-fall weapons. The Mk 20 and Mods are used against armored vehicles, and the CBU-59/B is used against light material and personnel targets. Both weapons are commonly referred to as CBUs (cluster bomb units).

The Mk 20 Mods and CBU-59/B bomb clusters are delivered to the fleet as completely assembled all-up-rounds (AURs). Fuzes, suspension lugs, arming wires, wire extractors, and all other necessary components are installed.

The difference between the Mk 20 Mods and the CBU-59/B is the type of bomb/bomblets found in the dispenser. The Mk 20 bomb cluster 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. The information on configuration, functional description, and shipping and storage containers of the Mk 7 bomb dispenser and its associated components is applicable to both cluster weapons.

**MK 20 MODS 2, 3, 4, AND 6
BOMB CLUSTER AND CBU-59/B
CONFIGURATIONS**

The configurations of the Mk 20 Mods and the CBU-59/B bomb clusters (table 2-3) consist of a Mk 7 Mod 2, 3, 4, or 6 bomb dispenser, a Mk 339 Mod 0 or Mod 1 mechanical time fuze, the Mk 118 Mod 0 or Mod 1 antitank bombs, or the BLU-77 antipersonnel/antimaterial bomblets.

Table 2-3.—Bomb Cluster Mk 20 Mods and CBU-59/B Configurations

BOMB CLUSTER	BOMB DISPENSER	FUZE	EXPLOSIVE PAYLOAD
Mk 20 Mod 2	Mk 7 Mod 2	Mk 339 Mod 0 Mechanical Time Fuze	247 Mk 118 Mod 0 antitank bombs with Mk 1 Mod 0 fuzing system
Mk 20 Mod 3	Mk 7 Mod 3	Mk 339 Mod 0/1 Mechanical Time Fuze	247 Mk 118 Mod 0 antitank bombs with Mk 1 Mod 0 fuzing system
Mk 20 Mod 4	Mk 7 Mod 4	Mk 339 Mod 0/1 Mechanical Time Fuze	247 Mk 118 Mod 1 antitank bombs with Mk 1 Mod 1 fuzing system
Mk 20 Mod 6	Mk 7 Mod 6	Mk 339 Mod 1 Mechanical Time Fuze	247 Mk 118 Mod 1 antitank bombs with Mk 1 Mod 1 fuzing system
CBU-59/B	Mk 7 Mod 4	Mk 339 Mod 0/1 Mechanical Time Fuze	717 BLU-77/B bomblets with FMU-88/B fuze
MJU-5/B	Mk 7 Mod 3	Mk 339 Mod 0/1 Mechanical Time Fuze	Chaff

Mk 7 and Mods Bomb Dispenser

The cargo section of the Mk 7 Mod 2 bomb dispenser (fig. 2-28) is the main structure of the weapon and contains the bombs/bomblets. A nose fairing is attached to the forward end of the cargo section for aerodynamics and fuze installation. It has an observation window for viewing the safe/arm indicator on the installed fuze. The mechanical time fuze Mk 339 Mod 0 is installed in the nose fairing and is protected during ground handling by the fuze cover assembly. The dispenser has two linear-shaped charges secured longitudinally inside the walls. When initiated, these shaped charges cut the dispenser in half, from front to

rear, and the bombs/bomblets spread in free-fall trajectories.

To stabilize the weapon after release from the aircraft, a tail cone assembly is attached to the aft end of the cargo section. The tail cone assembly houses four, spring-actuated folding fins. The fins are spring-loaded to the open position and secured in the closed position during ground handling by a fin release-band assembly. The fin release band is secured in the closed position by a safety cotter pin and by the fin release wire.

The explosive content of the weapon is indicated by a yellow band around the forward end of the cargo section.

REVIEW NUMBER 4 ANSWERS

- A1. The Navy uses the Mk 77 Mods 2 and 4 fire bombs and CBU-55A/B and CBU-72/B fuel-air explosive (FAE) bomb clusters.*
- A2. The Mk 77 and Mods fire bomb holds 75 gallons of fuel gel mix and weighs about 500 pounds when filled.*
- A3. In the Mk 1 Mod 0 fuel gelling unit, the fire bomb cases are filled to within 1 1/2 inches of the filler holes so a minimum 3-percent airspace exists to prevent bomb rupture because of expansion.*
- A4. CBU-55A/B and CBU-72/B bomb clusters are delivered as air-to-surface, free-fall unguided weapons from high- or low-speed fixed-wing aircraft.*
- A5. The SUU-49A/B bomb dispenser is used with both types of bomb clusters.*
- A6. There is an observation window assembly on the rear bulkhead of the dispenser, and a decal is next to the window. If the indicator disk is white or red as the color on the decal, the bomb cluster is hazardous.*
- A7. The Mk 339 Mod 1 must attain 225 knots velocity before it can arm.*
- A8. If the fuze function time is set below 1.0 second or above 9.7 seconds, the fuze will fail.*
- A9. The Mk 339 Mod 1 mechanical time fuze is used in the CBU-72/B FAE. It is installed in the nose of the bomb.*
- A10. The CBU-55A/B and CBU-72/B bomb clusters are shipped in the CNU-194/E or CNU-208/E shipping containers.*

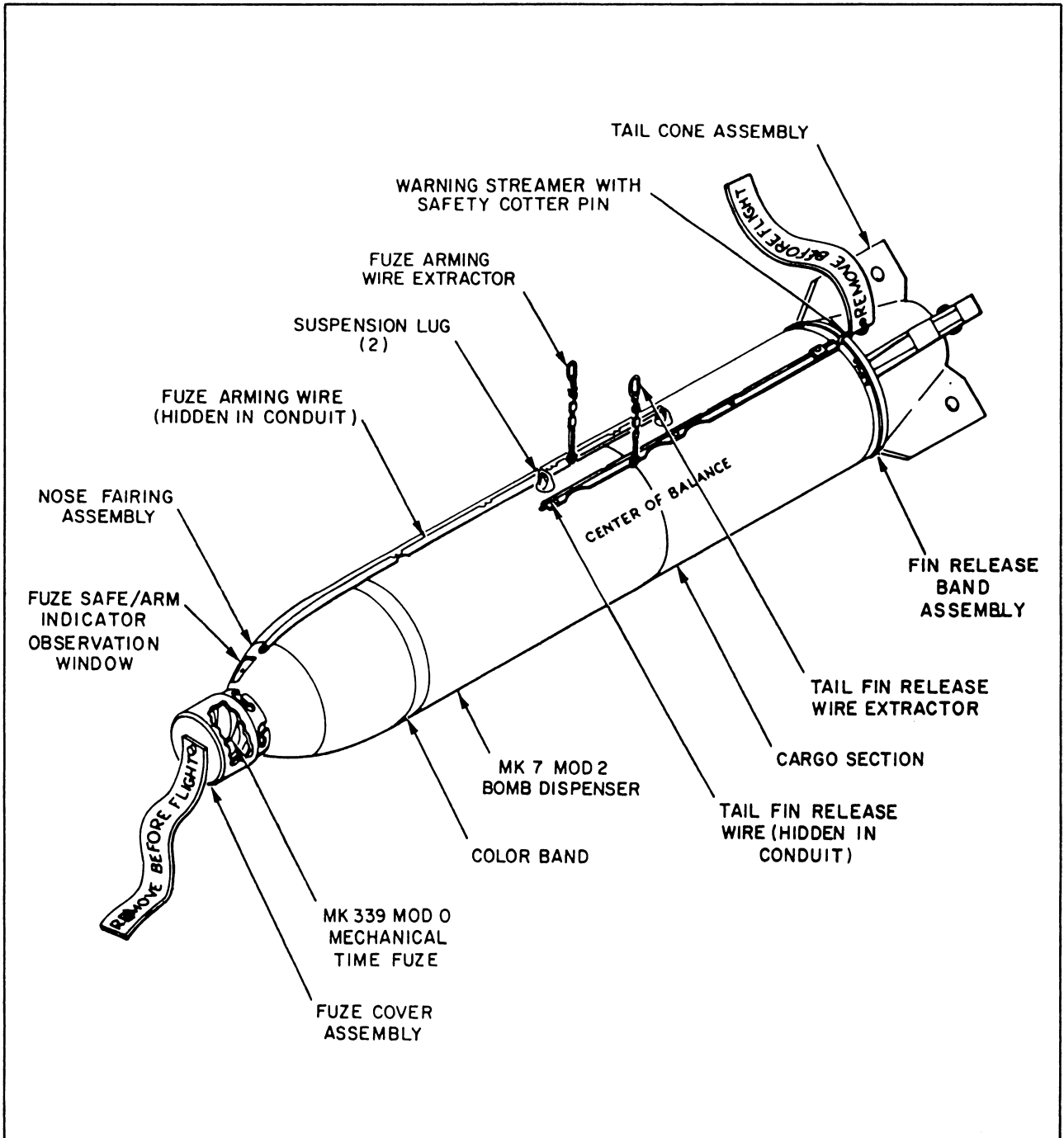
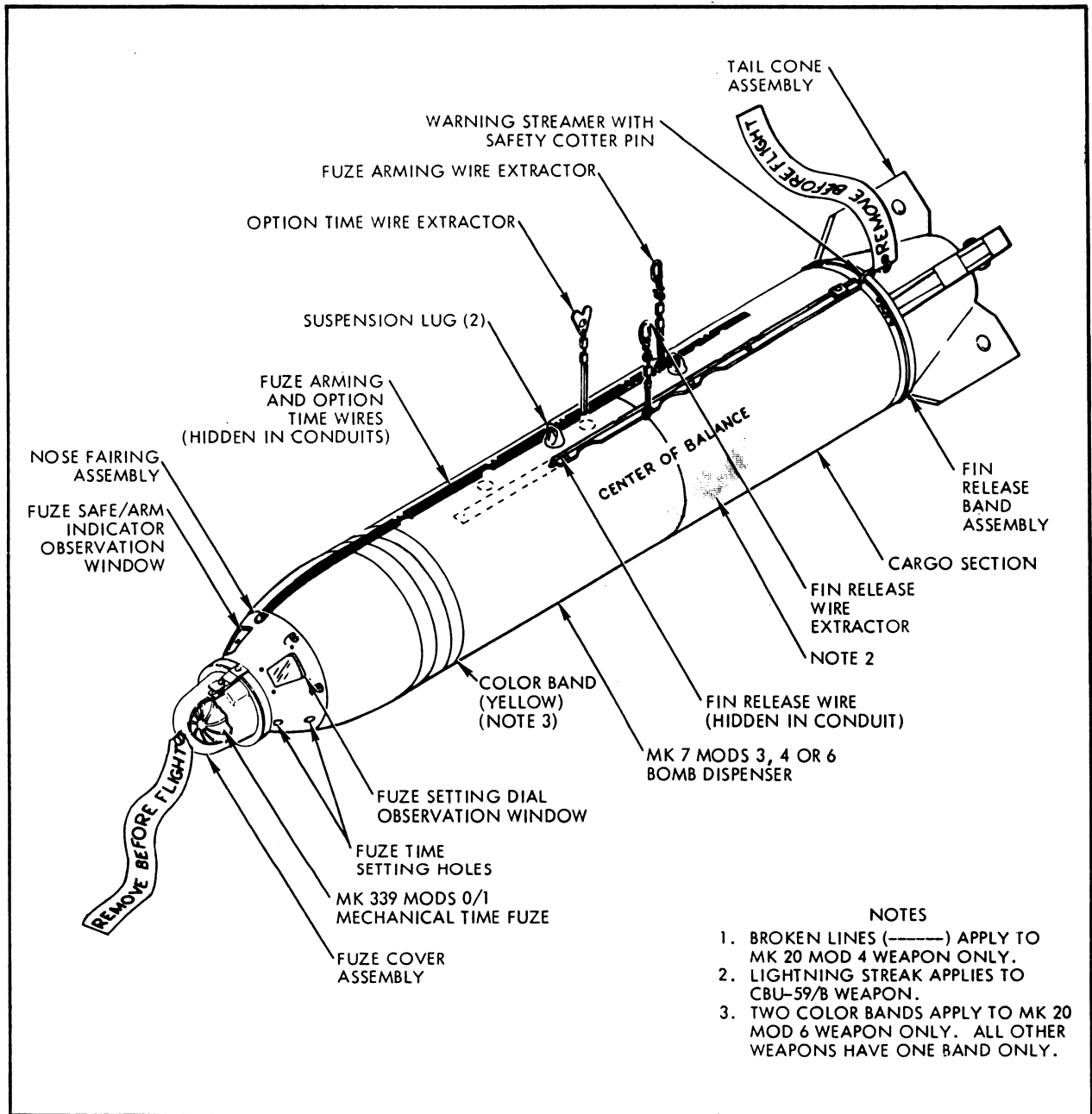


Figure 2-28.—Bomb cluster Mk 20 Mod 2 configuration.

220.590



220.590.3

Figure 2-29.—Bomb cluster Mk 20 Mods 3, 4, 6, and CBU-59/B configuration.

The Mk 7 Mods 3, 4, and 6 bomb dispensers (fig. 2-29) differ from the Mk 7 Mod 2, but the physical appearance of the dispenser remains basically the same. The most significant change incorporated on Mod 3 and later Mods is the Mk 339 Mod 1 fuze, which provides the pilot with in-flight selection of the fuze function time.

The Mk 7 Mod 4 bomb dispenser differs from the Mk 7 Mod 3 by modifying the dispenser giving interface capabilities with a wider range of military aircraft. The Mk 7 Mod 6 bomb dispenser is the same as the Mk 7 Mod 3 except that the outside of the Mod 6 cargo section is coated with a thermal protective coating and has an additional yellow band around the forward end of the cargo

section. The addition of the thermal coating increases the overall weight of the Mod 6 to 505 pounds.

Mk 339 Mods 0 and 1 Mechanical Time Fuze

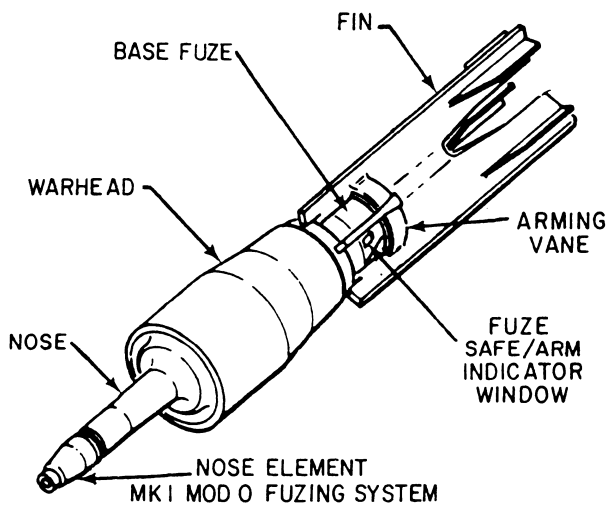
The purpose of the Mk 339 Mods 0 and 1 mechanical time fuze is to initiate the linear-shaped charges located in the cargo section walls.

Mk 118 Mod 0 and Mod 1 Antitank Bomb

The antitank bomb Mk 118 Mod 0 (fig. 2-30) consists of a Mk 1 Mod 0 fuzing system, a shaped-charge warhead, and fixed stabilizing fins. It is loaded in the Mk 20 Mods 2 and 3 bomb clusters only. In the antitank bomb Mk 118 Mod 1, the fuzing system is a Mk 1 Mod 1, and the bombs are loaded in the Mk 20 Mods 4 and 6 bomb clusters only.

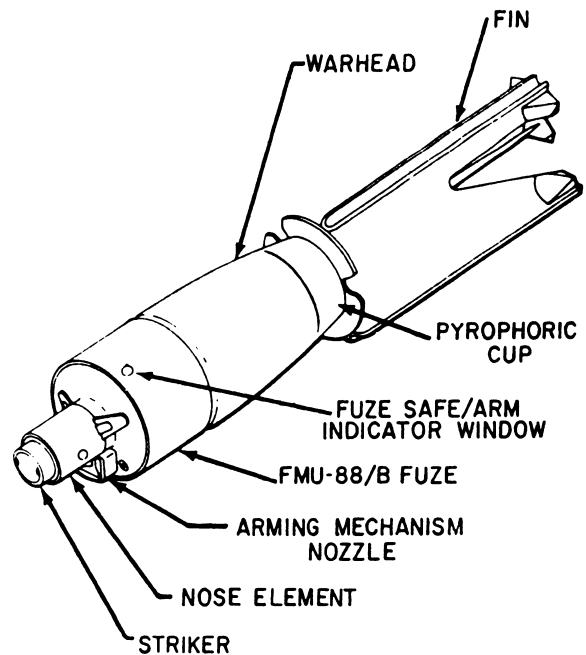
BLU-77/B Target Discriminating Shaped-Charge Airburst Bomblet

The BLU-77/B bomblet (fig. 2-31) consists of a shaped-charge, fragmenting warhead, stabilizing fins, nose element, and a FMU-88/B fuze. The BLU-77/B bomblets are loaded in the CBU-59/B bomb clusters only (Mk 7 Mod 4 dispenser).



220.591

Figure 2-30.—Antitank bomb Mk 118 Mod 0 and Mod 1.



220.592

Figure 2-31.—Target discriminating shaped-charge airburst bomblet BLU-77/B.

FUNCTIONAL DESCRIPTION

When either the Mk 20 or CBU-59/B bomb cluster is released from the aircraft, the arming wires (primary and/or optional arming) are pulled sufficiently to arm the Mk 339 fuze and release the fins. The positive armed fin release arming wire frees the fin release arming band, and the movable fins snaps open by spring-force.

When the primary fuze arming wire is withdrawn from the Mk 339 Mod 0 fuze, the fuze will function after a 1.2-second (primary) or 4.0-second (option) delay, depending upon which setting was set in the fuze during weapon preparation. Functioning of the fuze initiates the linear-shaped charges in the dispenser; they cut the dispenser case in half, and disperse the bombs/bomblets. If the MK 339 Mod 1 fuze is used and only the primary fuze arming wire is pulled, the fuze will function 1.2 seconds after the arming wire has been extracted. If the pilot selects the option time (4.0 seconds), both the primary and option arming wires must be pulled. If the pilot selects the option time and the primary arming wire is **not** pulled, the fuze will be a dud.

Mk 118 Mods 0 and 1 Antitank Bomb

When the Mk 118 bomb separates from the dispenser case, the base fuze arming vane rotates and the fuze is armed. If the bomb strikes a hard target, such as concrete or armor, the electric detonator ignites the shaped-charge warhead immediately. If the bomb strikes a soft target, such as earth or sandbag, the bomb penetrates the targets until deceleration lets the inertia firing pin strike and initiate the stab detonator, causing warhead denotation.

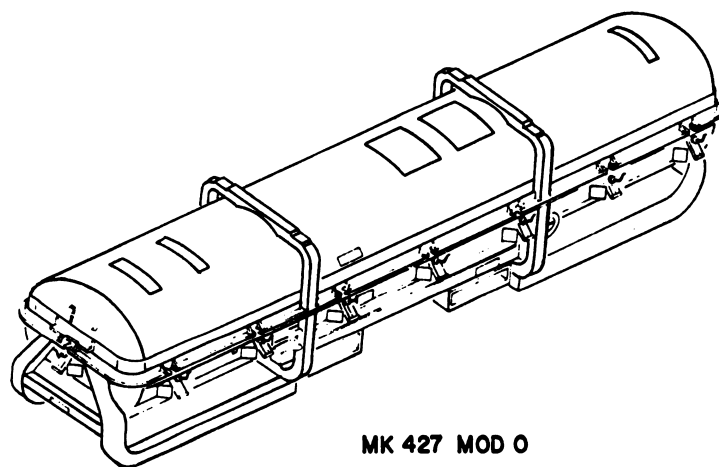
BLU-77/B Bomblet

When the BLU-77/B bomblet separates from the dispenser case, the bomblet fuze is armed by ram air entering the arming mechanism nozzle. If the bomblet contacts a hard target, the striker

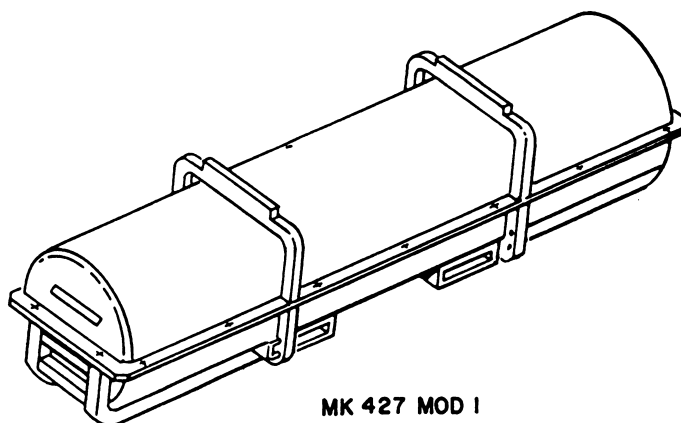
initiates the stab detonator, igniting an explosive transfer assembly, which detonates the warhead. If the bomblet strikes a soft target, the bomblet penetrates the target until deceleration activates the delay firing train. The delay firing train functions when the inertia firing pin detonates the stab primer, which ignites a delay element and impulse cartridge. The cartridge gases propel the warhead into the air (pop-out). At a predetermined time, the delay element ignites the stab detonator and explosive transfer assembly, which detonates the warhead.

SHIPPING AND STORAGE CONTAINERS

The Mk 427 Mod 0 and Mod 1 shipping and storage containers (fig. 2-32) encase one fully assembled Mk 20 or CBU-59/B bomb cluster. The



MK 427 MOD 0



MK 427 MOD 1

Figure 2-32.—Shipping and storage containers for Mk 20 and CBU-59/B bomb clusters.

220.773

reusable containers consist of metal upper and lower shell assemblies that are secured with either 16 quick release latches (Mod 0) or 18 "T" latches (Mod 1). A rubber gasket provides an environmental seal when the upper and lower shells are mated. External frame members are welded to each half of the container so the containers can be stacked six high and provide the necessary fittings for ground-handling equipment.

The reusable weapon cradle Mk 18 Mod 0 (fig. 2-33) is used to ship and store two fully assembled Mk 20 bomb clusters. The cradle consists of plastic upper and lower shell assemblies, shock-mounted on a metal cradle assembly. The weapon cradle has forklift guides, lifting eyes, handtruck brackets, and lift devices to permit the use of handling equipment. Four supports are provided on each cradle to aid in stacking the cradle assemblies.

REVIEW NUMBER 5

Q1. Name the cluster bomb used against armored vehicles and the one used against light material and personnel targets.

Q2. Name the main structure of the Mk 7 Mod 2 bomb dispenser.

Q3. The Mk 20 bomb cluster weighs _____ and contains _____ bombs, while the CBU-59/B weighs _____ and contains _____ target discriminating, shape-charge, airburst bomblets.

Q4. Name the component used to stabilize the bomb after release from the aircraft.

Q5. Describe the purpose of the Mk 339 Mod 0 and Mod 1 mechanical time fuzes.

Q6. List the components of the Mk 118 Mod 0 and Mod 1 antitank bomb.

Q7. List the components of the BLU-77/B target discriminating, shaped-charge airburst bomblet.

Q8. What shipping container is used to ship and store the Mk 20 or CBU-59/B bomb cluster?

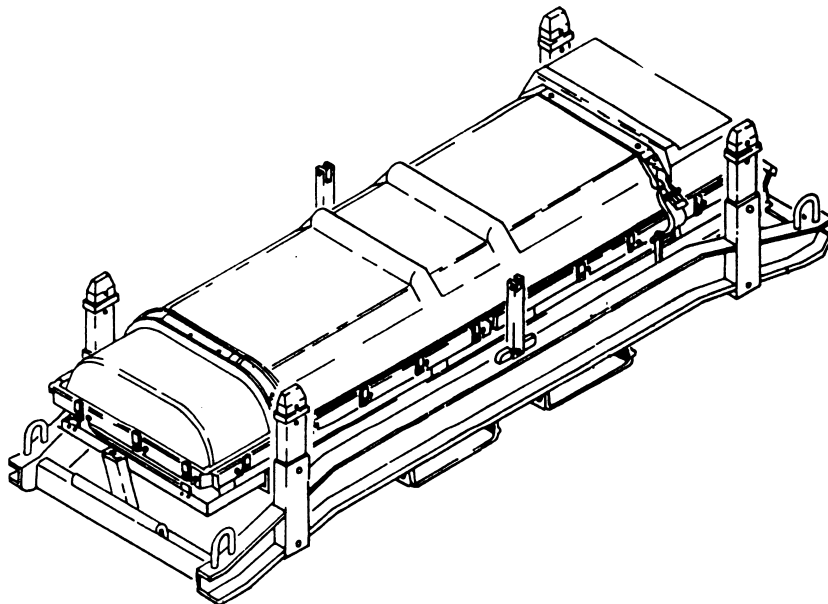


Figure 2-33.—Weapon cradle Mk 18 Mod 0 for two Mk 20 bomb clusters.

220.774

HELICOPTER TRAP WEAPON (HTW) MK 115 MOD 0

Learning Objective: *Identify the purpose and use of the Mk 115 Mod 0 (HTW).*

The Mk 115 Mod 0 helicopter trap weapon (HTW) (fig. 2-34) is a retarded bomb used for

clearing prospective helicopter landing sites. The weapon consists of a high-explosive bomb, Mk 115 Mod 0, and bomb fuze Mk 374 Mods 0 and 1.

When the bomb is released from the aircraft, the parachute assembly is deployed to stabilize, retard, and orient the bomb vertically. At the same time, the arming wire is withdrawn from the

REVIEW NUMBER 5 ANSWERS

- A1. The Mk 20 Mods 2, 3, 4, and 6 cluster bomb is used against armored vehicles. The CBU-59/B cluster bomb is used against light material and personnel targets.
- A2. The cargo section is the main structure of the Mk 7 Mod 2 bomb dispenser.
- A3. The Mk 20 bomb cluster weighs 490 pounds and holds 247 Mk 118 antitank bombs. The CBU-59/B weighs 750 pounds and holds 717 BLU/77Bs.
- A4. The tail cone assembly, attached to the aft end of the cargo section, stabilizes the bomb after it is released from the aircraft.
- A5. The Mk 339 Mod 0 and Mod 0 mechanical time fuze is used to initiate the linear-shaped charges in the cargo section wall.
- A6. The Mk 118 Mod 0 and Mod 1 antitank bombs contain the following:
- Mk 1 Mod 0 fuzing system
 - Shaped-charge warhead
 - Fixed stabilizing fins
- A7. The BLU-77/B target discriminating shaped-charge airburst bomblet contains the following:
- Shaped-charge, fragmenting warhead
 - Stabilizing fins
 - Nose element
 - FMU-88/B fuze
- A8. The Mk 427 Mod 0 and Mod 1 shipping containers are used to ship and store Mk 20 and CBU-59/B bomb clusters.

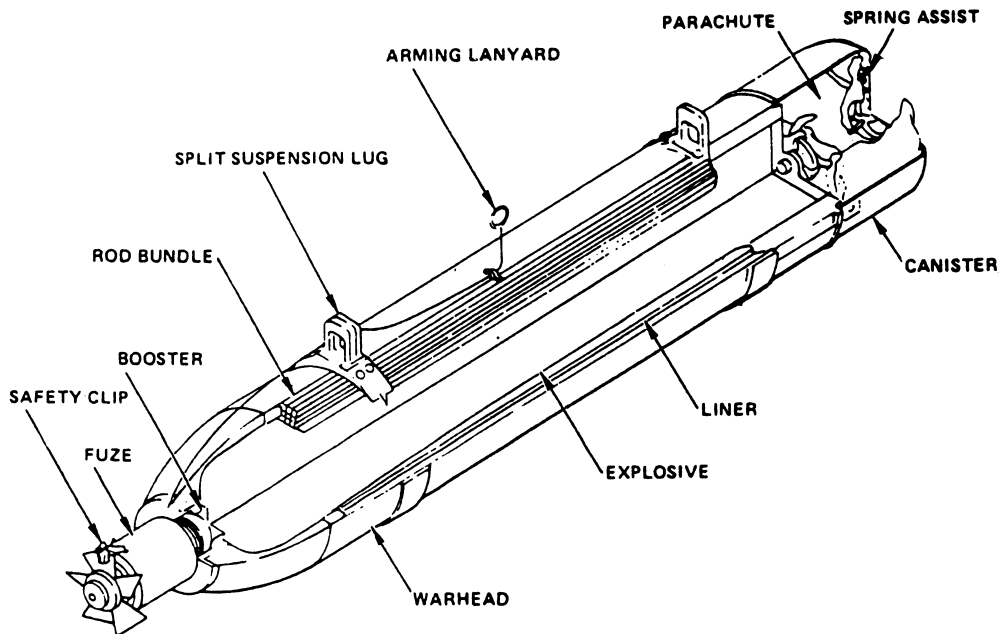


Figure 2-34.—Mk 15 Mod 0 helicopter trap weapon.

220.596

Mk 374 nose fuze, and the fuze arms. The fuze detonates the warhead instantaneously upon impact.

Detailed information on the Mk 115 Mod 0 is contained in the *High Explosive Bomb, Mk 115 Mod 0 (HTW)*, NAVAIR 11-5A-25.

PRACTICE BOMBS

Learning Objective: Identify the purpose and use of practice bombs to include subcaliber and full-scale practice bombs.

Practice bombs are used to simulate the same ballistic properties of service bombs. Practice bombs are manufactured as either solid, cast-metal bodies or thin, sheet-metal containers. They can be filled with wet sand to obtain the necessary weight. Since practice bombs contain no explosive filler, a practice bomb signal cartridge (smoke) can be used for visual observation of weapon-target impact.

The primary purpose of practice bombs is safety when training new or inexperienced pilots

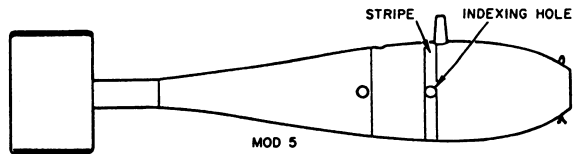
and ground-handling crews. Other advantages of practice bombs include their low cost and an increase in available target locations.

Although not classified as practice bombs, the Mk 80 (series), inert filled, LDGP bombs are used for full-scale practice bombing. These bombs are physically the same as the Mk 80 (series) LDGP service bombs, but they do not contain explosive filler and are painted blue. These bombs provide full-scale training for assembly and loading crews and pilots.

The general types of practice bombs are subcaliber or full-scale practice bombs. Subcaliber means that the practice bomb is much smaller in size and weight than the service bomb it simulates. Full-scale practice bombs are representative of service bombs in their size and weight.

SUBCALIBER PRACTICE BOMBS

There are two types of subcaliber practice bombs—the Mk 76 Mod 5 and Mk 106 Mod 4. The two types are used for practice and are quite different in design and appearance from each



220.198

Figure 2-35.—Mk 76 Mod 5 practice bomb.

other. Each type is discussed in the following paragraphs.

Mk 76 Mod 5

The Mk 76 Mod 5 is a 25-pound, solid, metal-cast, practice bomb (fig. 2-35). Its body is teardrop shaped and centrally bored to permit the insertion of a practice bomb signal cartridge. The after body, which covers the tail tube, is crimped to the bomb body and has welded-on conical tail fins. The bomb is designed with single lug suspension, using the Mk 14 suspension lug.

The Mk 76 Mod 5 practice bomb is designed for impact firing only. It uses the Mk 1 firing pin assembly to initiate the practice bomb signal cartridge. The bomb signal and the firing pin assembly are held in the bomb by means of a cotter pin.

The bomb is painted blue. The identification nomenclature is stenciled in white letters on the bomb body.

Mk 106 Mod 4

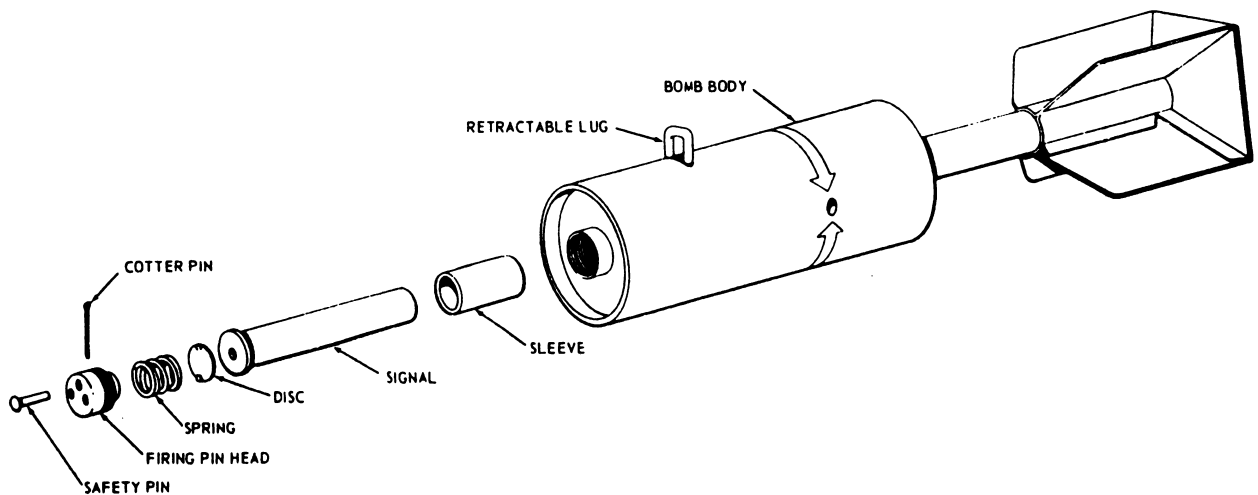
The Mk 106 Mod 4 is a 5-pound practice bomb (fig. 2-36). It is a thin-cased cylindrical bomb used to simulate retarded weapon delivery. The bomb is composed of the bomb body, a retractable suspension lug, a firing device, and box-type conical fins.

The firing device (fig. 2-36) consists of a safety pin, a firing pin head, a cotter pin, a spring, and a disc. The firing pin head is the main body of the device and is threaded so it can be screwed into the forward end of the bomb body. The spring and disc prevent the practice bomb signal cartridge from striking the firing pin, located on the face of the firing pin head, until it meets sufficient resistance to force the cartridge into the firing pin. This resistance is normally met when the weapon impacts the target. For added safety during ground handling, install the safety pin into the firing pin head and secure it by a cotter pin. The safety pin and cotter pin are removed before flight.

The Mk 106 Mod 4 is painted blue. Identification nomenclature is stenciled in white letters on the bomb body.

FULL-SCALE PRACTICE BOMBS

Full-scale practice bombs have the same dimensions, weight factor, and configuration abilities as the service bombs they simulate. The bombs are filled with inert material to obtain the proper weight.



220.200

Figure 2-36.—Mk 106 Mod 4 practice bomb.

The full-scale practice bombs currently in use are in the Mk 80 (series). They include the Mk 82, Mk 83, and Mk 84 LDGP bombs. These bombs are assigned a different NALC than their service counterpart to differentiate between inert and service bombs when requisitioning them through the supply system. They can be configured with the same bomb components (fuzes, fins, lugs, and so forth) that are used to configure service bombs. However, if the use of fuzes is not desired, a Mk 89 Mod 0 bomb spotting charge adapter can be installed in the tail fuze well of the practice bomb to provide visual observation of weapon/target impact.

The Mk 80 (series) inert LDGP bombs are painted blue. The new Mk 80 (series) inert LDGP bombs have an olive-drab colored exterior and are thermally protected, but they can be distinguished from service bombs by a blue band around the nose and by the 1-inch letters INERT stenciled on the outside of the bomb body.

The Mk 89 Mod 0 bomb spotting charge adapter (fig. 2-37) is designed for use in the tail fuze well of the Mk 80 (series) LDGP inert bombs. A practice bomb signal cartridge is installed in the Mk 89 Mod 0, which provides visual observation (smoke) of weapon-target impact.

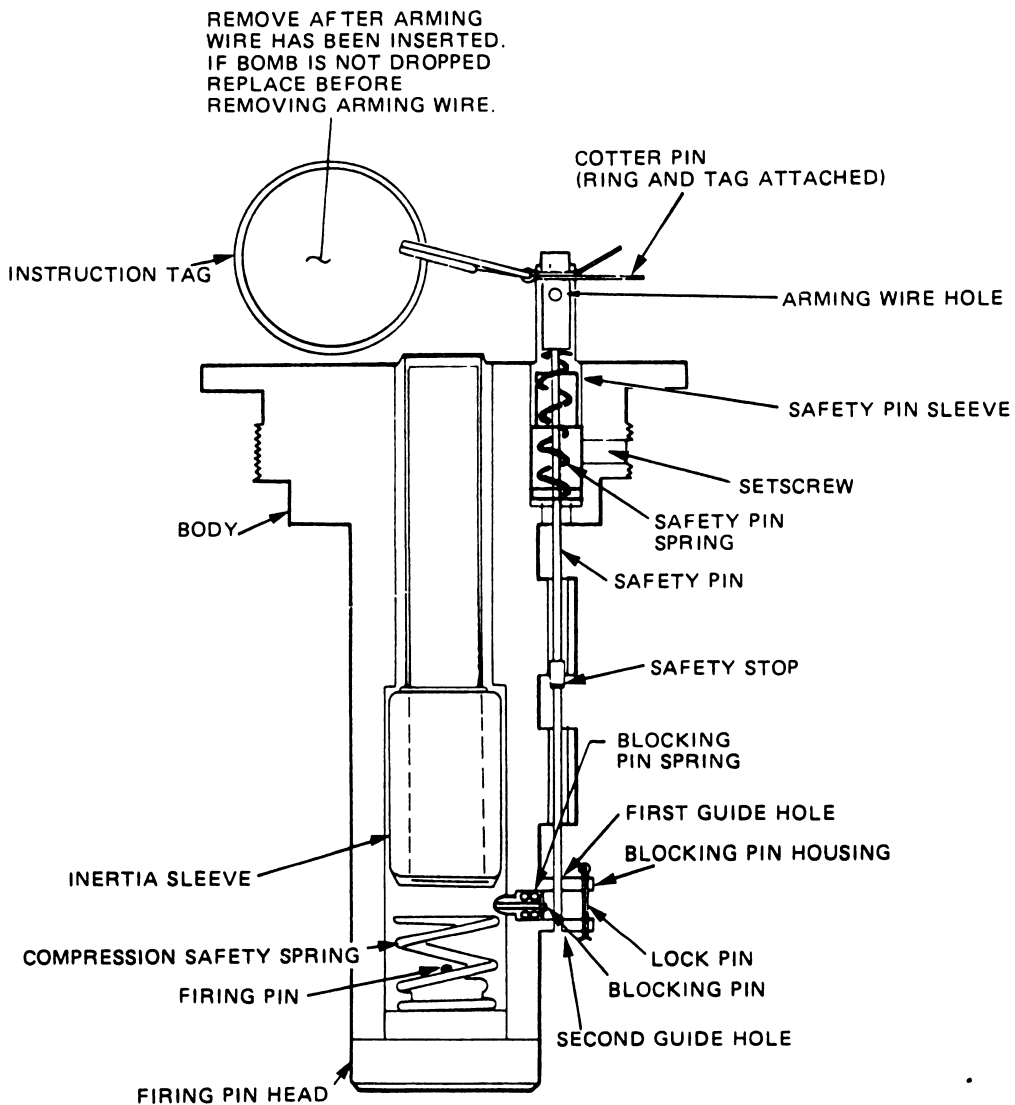


Figure 2-37.—Mk 89 Mod 0 bomb spotting charge adapter.

220.775

The bomb spotting charge adapter is kept in a safe condition during ground handling by the installation of a safety cotter pin in the safety pin sleeve. Once the arming wire has been installed through the arming wire hole in the safety pin sleeve, the safety cotter pin must be removed.

REVIEW NUMBER 6

- Q1. Describe the purpose of the Mk 115 Mod 0 helicopter trap weapon (HTW).*
- Q2. List the components of the Mk 115 Mod 0 (HTW).*
- Q3. Describe the primary purpose of practice bombs.*
- Q4. List the two general types of practice bombs.*
- Q5. List the types of subcaliber practice bombs.*
- Q6. What color are Mk 80 (series) inert LDGP bombs painted?*

BOMB DUMMY UNITS

Learning Objective: Identify the purpose and use of bomb dummy units.

Bomb dummy units (BDUs) are used as expendable or nonexpendable nuclear weapon simulators for handling and aircrew training. The more common BDUs are discussed in the following paragraphs.

NOTE: Information on BDUs is limited in this manual because of their security classification.

BDU-8A/B

The BDU-8A/B dummy unit (fig. 2-38) is a training counterpart for the B43 special weapon. The BDU simulates the B43 AMAC (aircraft monitor and control) warning light circuits and aerodynamic characteristics. The BDU consists of a nose section, center section, and aft section. The nose section contains ballast and is usually damaged beyond repair after drop. The center section is filled with concrete and contains two suspension lugs 30 inches apart, two handling fittings, a pullout cup, and all electrical receptacles. The aft section houses a parachute for use during retarded drops.

BDU-24/C

The BDU-24/C dummy unit is a practice bomb that serves as an aircraft handling, loading, and delivery training device for loading crews and pilots. It simulates the B43 bomb physically, aerodynamically, and ballistically. It gives AMAC SAFE and ARM lamp indications for both free-fall and retarded options. The BDU-24/C has a recording system that monitors certain cable connections, switch positions in the BDU, the position of nuclear GRD-AIR (ground-air) selector switch, and provides a permanent record of the information when the unit is released from the aircraft.

BDU-11A/E

The BDU-11A/E dummy unit is a practice bomb that serves as an aircraft loading and handling training device for the B57 special weapon. It is used to train personnel in the use of the aircraft monitor and control system and aircraft response when handling and loading the weapon.

BDU-12A/B

The BDU-12A/B dummy unit (fig. 2-39) is a training device for the B57 special weapon. The BDU simulates the B57 AMAC warning light circuitry and aerodynamic characteristics. This BDU is usually reused after retarded drops with minor refurbishing. The BDU consists of a nose section, center section, and aft section. It has 30-inch suspension provisions, with the forward suspension lug on the nose section and the aft suspension lug on the center section. The center section contains the electrical receptacle, an

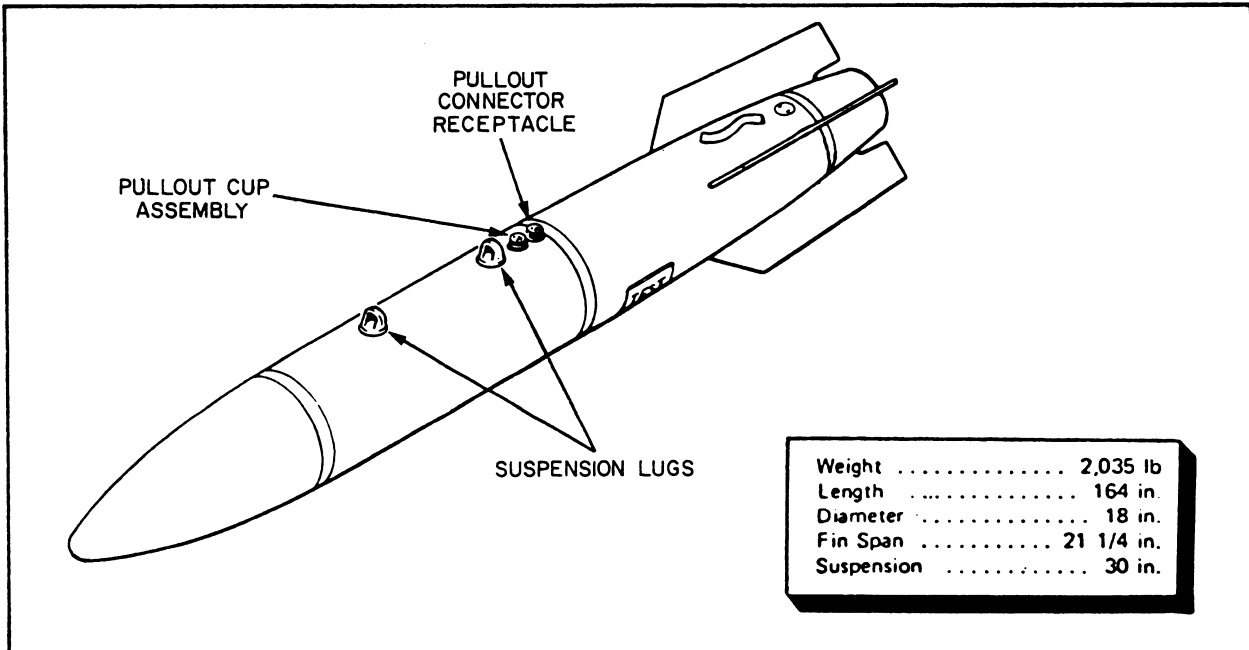


Figure 2-38.—BDU-8A/B.

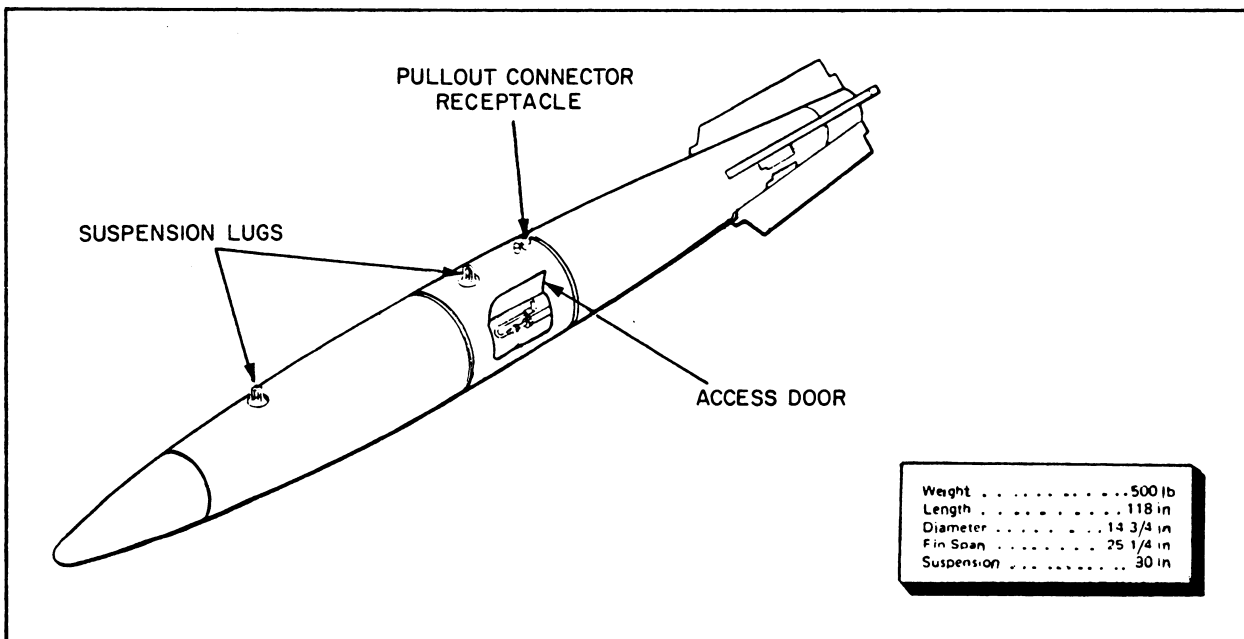


Figure 2-39.—BDU-12A/B.

access door, and an initiator assembly (when installed). The aft section contains a gas generator (when installed), tail fins, and a parachute for use during retarded drops.

BDU-20/C

The BDU-20/C dummy unit is a training device for the B57 special weapon. It is used for handling, loading, and delivery training of loading crews and pilots. Usually it is reused after retarded drops with minor refurbishing. The BDU-20/C simulates the B57 weapon relative to cockpit indications received in flight, as well as the physical and aerodynamic characteristics of the weapon.

BDU-36/C

The BDU-36C dummy unit is a training device for the B61 special weapon. It is used for handling, loading, and delivery training of loading crews and pilots. It is designed to be reused with minimum refurbishing after retarded drops. The BDU-36/C simulates the B61 weapon relative to cockpit indications received in flight, as well as the physical and aerodynamic characteristics of the weapon.

REVIEW NUMBER 7

- Q1. What bomb does the BDU-24/C practice bomb simulate?*
- Q2. Name the training counterpart to the B57 weapon.*
- Q3. Name the BDU that serves as a training device for the B61 special weapon.*

SAFETY PRECAUTIONS

Learning Objective: Recognize the safety precautions to follow when working with aircraft bomb ammunition and associated equipment.

The hazards of bomb ammunition will vary depending on the type and quantities of explosives involved. Regardless of the particular weapons being handled, potential hazards are always

REVIEW NUMBER 6 ANSWERS

- A1. The Mk 115 Mod 0 HTW is used to clear helicopter landing sites.*
- A2. The Mk 115 Mod 0 HTW contains the following:*
- *Mk 115 Mod 0, high explosive bomb*
 - *Mk 374 Mods 0 and 1 bomb fuze*
- A3. Practice bombs are primarily used for safety, when training new or inexperienced pilots and ground-handling crews.*
- A4. The two general types of practice bombs are the subcaliber and the full-scale bombs.*
- A5. The Mk 76 Mod 5 subcaliber practice bomb is used for impact firing only.*
- The Mk 106 Mod 4 subcaliber practice bomb is used to simulate retarded weapons delivery.*
- A6. Mk 80 (series) inert LDGP bombs are painted blue.*

present. Explosive bomb ammunition is hazardous because of its tendency, when detonated, to set off all explosive material that is near it.

Although bomb ammunition containing high explosives causes greater injury to personnel and loss of equipment, the improper handling of practice bombs causes more frequent injury to personnel. When handling practice bombs, the weight factor alone can cause severe injury or even loss of limb. Dropping a practice bomb, even a short distance, with a practice bomb signal cartridge installed can cause the cartridge to detonate, resulting in severe and permanent injury to personnel.

Accidents are prevented through good design, testing, and careful handling of ordnance. Safety precautions must be followed. All personnel involved in weapons handling must be briefed on particular safety precautions before actually handling weapons. All personnel who

handle ordnance must be qualified and certified. Newly assigned personnel, still under training, are assigned as crew members and **never** permitted to work alone until they are fully qualified and certified.

Specific safety precautions for bomb ammunition are outlined in the publications for the specific ammunition and the aircraft loading manuals.

REVIEW NUMBER 8

Q1. Why is explosive bomb ammunition hazardous?

Q2. Handling _____ causes more injuries than handling _____.

REVIEW NUMBER 7 ANSWERS

- A1. The BDU-24/C practice bomb is used to simulated the B43 special weapon.*
- A2. The counterpart to the B57 weapon is the BDU-20/C.*
- A3. The BDU-36/C serves as a training device for the B61 special weapon.*

REVIEW NUMBER 8 ANSWERS

- A1. Explosive bomb ammunition is hazardous because of its tendency to set off all explosive material near it if it is detonated.*
- A2. Handling practice bombs causes more injuries than handling bomb ammunition containing high explosives.*

CHAPTER 3

BOMB FUZES AND ASSOCIATED COMPONENTS

In chapter 2, you learned that bombs must be manufactured to withstand reasonable heat and be insensitive to the shock of ordinary handling. They must also be capable of being dropped from an aircraft in a safe condition when in-flight emergencies occur.

Bomb detonation is controlled by the action of a fuze. *A fuze is a device that causes the detonation of an explosive charge at the proper time after certain conditions are met.* A bomb fuze is a mechanical or an electrical device. It has the sensitive explosive elements (the primer and detonator) and the necessary mechanical/electrical action to detonate the main burster charge. The primer is fired by a mechanical action or an electrical impulse, causing the detonator to explode. The primer-detonator explosion is relayed to the main charge by a booster charge. This completes the explosive train.

FUZE TERMINOLOGY AND BASIC FUZE THEORY

Learning Objective: Describe the operation of mechanical and electrical fuzes. Identify special safety features that are inherent in bomb fuzes.

FUZE TERMINOLOGY

Some of the most common fuze terms that you should know are defined in this section.

Arming time. The amount of time or vane revolutions needed for the firing train to be aligned after the bomb is released, or from time of release until the bomb is fully armed. It is also known as *safe separation time (SST)*.

Delay. When the functioning time of a fuze is longer than 0.0005 second.

External evidence of arming (EEA). A means by which a fuze is physically determined to be in a safe or armed condition.

Functioning time. The time required for a fuze to detonate after impact or a preset time.

Instantaneous. When the functioning time of a fuze is 0.0003 second or less.

Nondelay. When the functioning time of a fuze is 0.0003 to 0.0005 second.

Proximity (VT). The action that causes a fuze to detonate before impact when any substantial object is detected at a predetermined distance from the fuze.

Safe air travel (SAT). The distance along the trajectory that a bomb travels from the releasing aircraft in an unarmed condition.

BASIC FUZE THEORY

Fuzes are normally divided into two general classes—mechanical and electrical. These classes only refer to the primary operating principles. They may be subdivided by their method of functioning or by the action that initiates the explosive train—impact, mechanical time, proximity, hydrostatic, or long delay. Another classification is their position in the bomb—nose, tail, side, or multipositioned. In this TRAMAN, mechanical and electrical fuzes are discussed.

Mechanical Fuzes

In its simplest form, a mechanical fuze is like the hammer and primer used to fire a rifle or pistol. A mechanical force (in this case, the bomb impacting the target) drives a striker into a sensitive detonator. The detonator ignites a train of explosives, eventually firing the main or filler charge. A mechanical bomb fuze is more

complicated than the simple hammer and primer. For safe, effective operation, any fuze (mechanical or electrical) has the following features:

- It must remain safe in stowage, while it is handled in normal movement, and during loading and down-loading evolutions.
- It must remain safe while being carried aboard the aircraft.
- It must remain safe until the bomb is released and is well clear of the delivery aircraft (arming delay or safe separation period).
- Depending upon the type of target, the fuze may be required to delay the detonation of the bomb after impact for a preset time (functioning delay). Functioning delay may vary from a few milliseconds to many hours.
- It should not detonate the bomb if the bomb is accidentally released or if the bomb is jettisoned in a safe condition from the aircraft.

To provide these qualities, a number of design features are used. Most features are common to all types of fuzes.

Electrical Fuzes

Electrical fuzes have many characteristics of mechanical fuzes. They differ in fuze initiation. An electrical impulse is used to initiate the electrical fuze rather than the mechanical action of arming vane rotation.

An electrical pulse from the delivery aircraft charges capacitors in the fuze as the bomb is released from the aircraft. Arming and functioning delays are produced by a series of resistor/capacitor networks in the fuze. The functioning delay is electromechanically initiated, with the necessary circuits closed by means of shock-sensitive switches.

The electric bomb fuze remains safe until it is energized by the electrical charging system carried in the aircraft. Because of the interlocks provided in the release equipment, electrical charging can occur only after the bomb is released from the rack or shackle and has begun its separation from the aircraft; however, it is still connected electrically to the aircraft's bomb

arming unit. At this time, the fuze receives an energizing charge required for selection of the desired arming and impact times.

SPECIAL SAFETY FEATURES

Some fuzes incorporate special safety features. The most important safety features are detonator safe, shear safe, and delay arming.

Detonator safe fuzes do not have the elements of their firing train in the proper position for firing until the fuze is fully armed. The elements remain firmly fixed and out of alignment in the fuze body while the fuze is unarmed. This increases safety during shipping, stowing, and handling of the fuze. The arming action of the fuze aligns the firing train.

A shear-safe fuze does not become armed if its arming mechanism is damaged or completely severed from the fuze body. The arming mechanism of the fuze protrudes from the bomb, and it might be severed from the fuze body if the bomb is accidentally dropped. Shear-safe fuzes give additional security for carrier operations and for externally mounted bombs.

Delay arming mechanically or electrically slows the arming of the fuze. It keeps a fuze in the safe condition until the bomb falls far enough away from or long enough from the aircraft to minimize the effects of a premature explosion. Delay arming helps to make carrier operations safe because a bomb accidentally released during landing or takeoff ordinarily will not have sufficient air travel, velocity, or time to fully arm the fuze.

REVIEW NUMBER 1

- Q1. Name the device that controls bomb detonation.*
- Q2. The time or number of vane revolutions needed for the firing train to align after a bomb is released is the _____.*
- Q3. Describe the functioning time of a fuze.*

Q4. The distance along the trajectory that a bomb travels from the releasing aircraft in an unarmed condition is the _____.

Q5. List the two basic classes of fuzes.

Q6. Describe the basic principle of the mechanical fuze.

Q7. What means is used to initiate an electrical fuze?

Q8. List the three special safety features incorporated into fuzes.

MECHANICAL FUZES

Learning Objective: *Identify the various types of mechanical fuzes to include their physical description and functional operation.*

There are many fuzes in use by the Navy today. Some of the commonly used fuzes are discussed in this TRAMAN. To keep up with current fuzes, you should refer to *Aircraft Bombs, Fuzes and Associated Components*, NAVAIR 11-5A-17, and *Airborne Bomb and Rocket Fuze Manual*, NAVAIR 11-1F-2.

M904E2/E3/E4 MECHANICAL IMPACT NOSE FUZE

The M904 (series) fuze (fig. 3-1) is a mechanical impact nose fuze used in the Mk 80

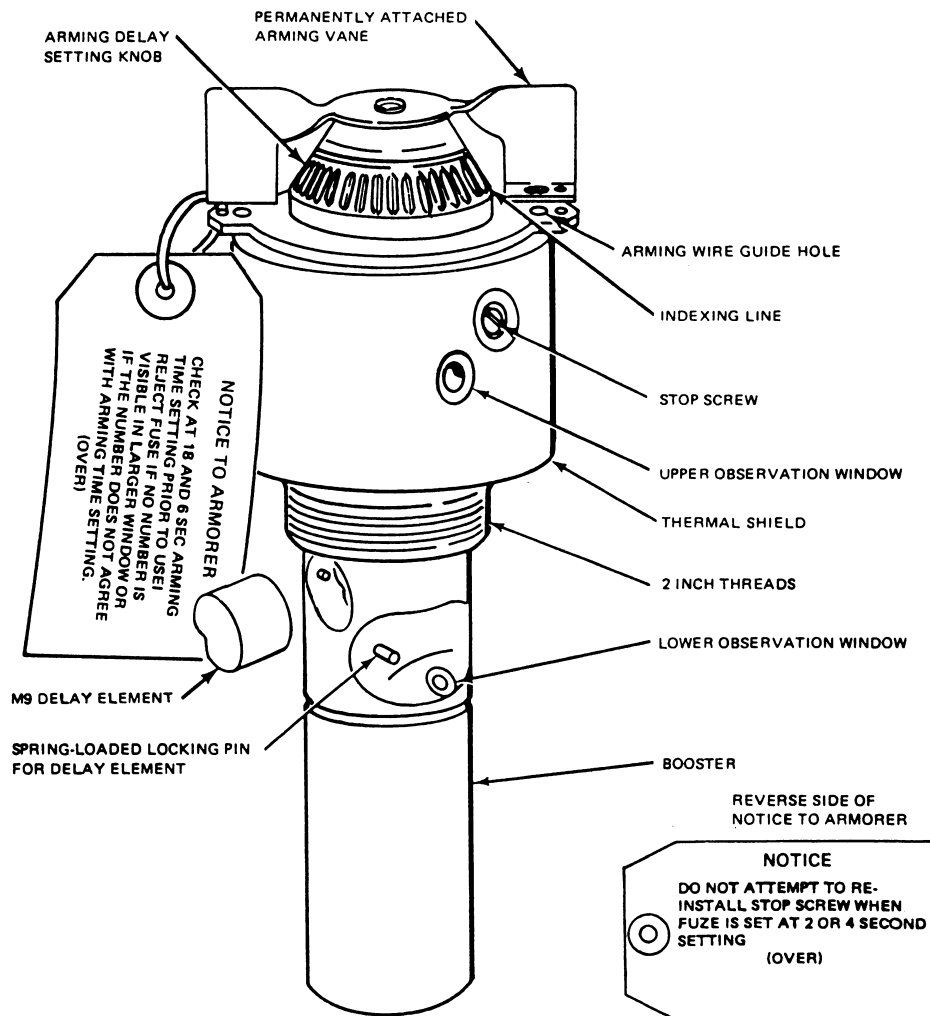


Figure 3-1.—Mechanical impact nose fuze M904 (series).

(series) LDGP bombs. The M904 (series) fuze is installed in the nose fuze well of the bomb and requires the use of an adapter booster. The fuze is detonator-safe and contains two observation windows through which you can determine the safe/arm condition of the fuze. There is no special locking feature designed into the fuze for shear safety if the bomb is accidentally dropped. However, detonation is unlikely if the collar (forward end of the fuze) is sheared off by the accidental drop before arming is complete.

The fuze may be configured for a number of preselected arming and functioning delays needed by a mission. There are nine arming delays from 2 to 18 seconds in 2-second increments, and any combination of six functioning delays from instantaneous to 250 milliseconds (0.250 seconds) may be selected. An internal

governor driven by the permanently mounted arming vane allows relatively constant arming times at release speeds ranging from 170 to over 525 knots.

Functioning times are determined by the installation of a M9 delay element. Any one of six delay elements may be installed. Each delay element is identified by the functioning delay time stamped on the element body—NONDELAY (instantaneous), 0.01, 0.025, 0.05, 0.01, or 0.25 second.

Physical Description

The M904 (series) fuze contains approximately 1 1/2 ounces of tetryl in the booster located at the base of the fuze body. The entire fuze weighs about 2 1/3 pounds and is 9 1/4 inches long.

REVIEW NUMBER 1 ANSWERS

- A1. A fuze controls bomb detonation.
- A2. The time or number of vane revolutions needed for the firing train to align after a bomb is released is the arming time.
- A3. The time required for a fuze to detonate after impact or a preset time is known as the functioning time.
- A4. The distance along the trajectory that a bomb travels from the releasing aircraft in an unarmed condition is known as the safe air travel (SAF).
- A5. The two basic classes of fuzes are electrical and mechanical.
- A6. The force used to initiate the mechanical fuze is like the hammer and primer used to fire a rifle. A mechanical force drives a striker into a sensitive detonator.
- A7. An electrical impulse initiates an electrical fuze.
- A8. The three special safety features incorporated into fuzes are detonator safe, shear safe, and delay arming features.

The M904E4 is a thermally protected fuze. It is especially designed for use with the thermally protected Mk 80 (series) general-purpose bombs and the thermally protected M148E1 adapter booster. This significantly increases the *cook-off* time of the bombs subjected to intense heat or flame.

ARMING DELAY TIMES.—Arming delay times are inscribed into the face of the forward nose retaining ring. A white indexing line is scribed on the knurled delay setting knob below the arming vane. The white indexing line must be matched to one of the indicated arming times to select the desired arming delay. To select the required arming delay time, depress the setting index locking pin and rotate the knurled arming delay setting knob until the white indexing line is aligned with the desired arming delay time

stamped on the nose retaining ring. The 2- and 4-second arming times are for use with retarded weapons, and are only set by removing the stop screw located next to the setting index locking pin. **Never try to reinstall the stop screw when either of these two settings are used.** The stop screw may be reinstalled at any delay setting of 6 seconds or more.

IDENTIFICATION OF ARMED FUZES.—There are three conditions of the M904 fuze—safe, partially armed, and fully armed. You can verify the fuze conditions by looking through the two observation windows in the fuze body (fig. 3-1). To check the fuze condition, hold the fuze vertically and look through the windows perpendicular to the fuze body. Look at table 3-1. It tells you what you'd see through the observation windows of the M904E2 fuze at various

Table 3-1.—Indications for Determining Conditions of M904E2 Noze Fuze

Condition	Time Setting	Upper Window	Lower Window
Safe	18 and 6 Seconds	**White stripe visible at both settings.	Vacant or dark in color.
Partially Armed	18 and 6 Seconds	White stripe not visible at either setting. (If white stripe is visible at any setting other than 18 or 6 secs., fuze is partially armed.)	Vacant or dark in color.
Armed	Any setting. (Time setting cannot be changed.)	*Full red.	*Red. Some fuzes have black letter "A" on red background.

*The fuze is dangerous to handle if either or both windows indicate the armed condition.

**On some M904 fuzes, a thin red line may be visible even though the fuze is safe.

Table 3-2.—Indications for Determining Conditions of M904E3/4 Nose Fuzes

Condition	Time Setting	Upper Window	Lower Window
Safe	18 Seconds	White number "18" on green background.	Vacant or dark in color.
	6 Seconds	White number "6" on green background.	
Partially Armed	18 and 6 Seconds	Green background with no numbers visible. (If numbers appear at other than "18" or "6" second setting or if numbers do not match settings, fuze is partially armed.)	Vacant or dark in color.
Armed	Any setting. (Time setting cannot be changed.)	*Red with black letter "A's." (Some green may show at top of window.)	*Red with black Letter "A."

*The fuze is dangerous to handle if either or both windows indicate the armed condition.

time settings and fuze conditions. Table 3-2 gives the same information for the M904E3 and E4 fuzes.

Also, check the M904E4 to make sure the thermal sleeve is firmly bonded to the fuze collar and is not cracked.

NOTE: If the safe condition of any fuze is in doubt, explosive ordnance disposal (EOD) personnel should be notified immediately.

Functional Description

The M904 fuze arms and functions by the rotation of the arming vane and alignment of its internal components. When the fuze is released from the aircraft, the fuze arming wire is withdrawn from the fuze arming vane, and the arming vane is rotated by the airstream. Arming vane rotation is controlled by the constant arming action of the governor in the fuze. The arming vane continues to rotate until the pre-selected arming delay period (2 to 18 seconds) elapses (ends). Once the arming delay period elapses, the firing train is in full alignment and ready to function.

At impact, the forward part of the fuze body drives the striker body and firing pin down into the M9 delay element. After the proper delay, the

M9 delay ignites the relay, detonator, lead, and booster, which sets off the main charge.

REVIEW NUMBER 2

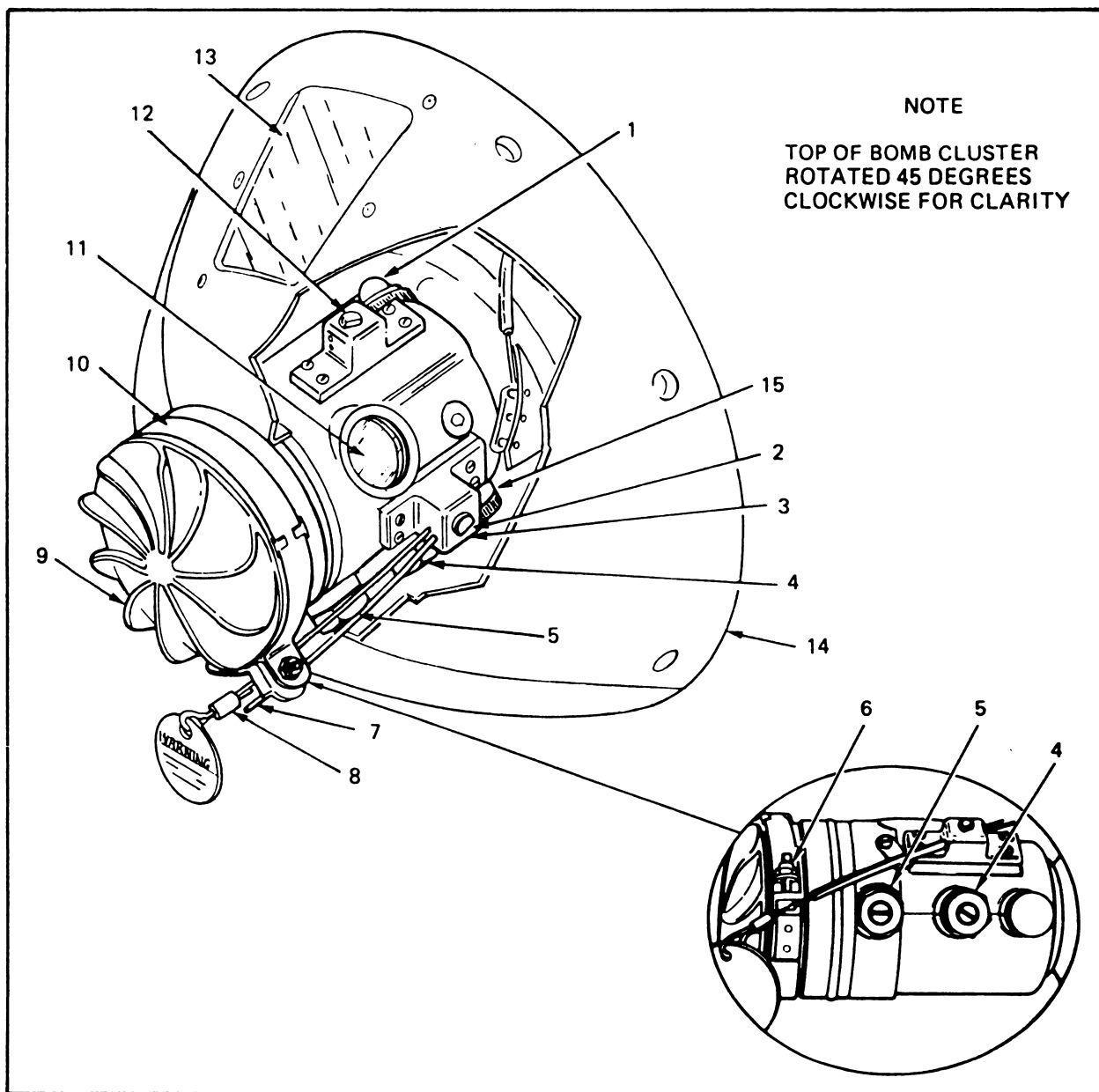
- Q1. *What kind of fuze is the M904?*
- Q2. *What bomb series is the M904 fuze used with?*
- Q3. *The M904 fuze has _____ arming delays, which you can set for 2 to 18 seconds in _____ increments; there are any combination of _____ functioning delays from instantaneous to 250 milliseconds.*
- Q4. *The M904 is thermally protected. Why is this important?*
- Q5. *Describe the means you use to check the condition of the M904 fuze.*

Q6. If you can't tell if a fuze is "safe," you should notify _____.

MK 339 MOD 0 AND MOD 1 MECHANICAL TIME FUZE

Q7. The M904 arms and functions by _____.

The Mk 339 Mod 0 mechanical time fuze (fig. 3-2, without the option time wire), Mod 0



1. FUZE SAFE/ARM INDICATOR
2. TIMER STARTING PIN
3. TIMER STARTING PIN BRACKET
4. OPTION TIME SETTING ADJUSTMENT
5. PRIMARY TIME SETTING ADJUSTMENT
6. BAND RELEASE STUD AND NUT
7. FUZE ARMING WIRE
8. SAFETY PIN ASSEMBLY

9. IMPELLER
10. IMPELLER BAND ASSEMBLY
11. TIME SETTING OBSERVATION WINDOW
12. OPTION TIME PIN
13. INDICATOR OBSERVATION WINDOW
14. NOSE FAIRING
15. SLIDER RETAINER

220.805

Figure 3-2.—Installed mechanical time fuze Mk 339 Mod 0 (without option time bomb cluster Mk 20 Mod 2 only).

(fig. 3-3, with the option time wire), and Mod 1 (fig. 3-4) are used with dispenser weapons and have the following characteristics:

- Nose-mounted
- Air-enabling
- Detonator-safe

The Mod 0 and Mod 1 fuzes are installed in the Mk 20 Mods 2, 3, 4, and 6 bomb clusters and the CBU-59/B bomb cluster. The Mod 0 fuze without the option time wire configuration is only used in the Mk 20 Mod 2 bomb cluster. The Mk 339 Mod 0 and Mod 1 fuzes are installed in the bomb clusters during assembly by the manufacturer; therefore, the following information on these fuzes is limited.

Physical Description

The Mk 339 Mod 1 fuze is similar to the Mod 0 fuze. Several improvements are discussed in the following paragraphs.

The primary and option functioning delays are preset during assembly at the factory for both the

Mod 0 and Mod 1 fuzes. The fuzes are preset at 1.2 seconds for primary delay, and the option delay is preset at 4.0 seconds. The Mod 0 fuze (without the option time wire) is preset at 4.0 seconds on the option delay. The primary delay is **not** used on this fuze. The primary delay is set at zero time.

You already know the primary and option delays for the Mod 0 and Mod 1 fuzes are preset at the factory. These time delays can be reset during weapon preparation to meet various tactical requirements. The primary and option time delays for the Mod 0 fuze can be adjusted from 1.2 to 50.0 seconds by adjusting the primary time setting dial (fig. 3-3, callout 5) and the option time setting dial (fig. 3-3, callout 6), respectively. The functional delays for both the primary and option modes of the Mod 1 fuze can be adjusted from 1.2 to 100 seconds in the same manner.

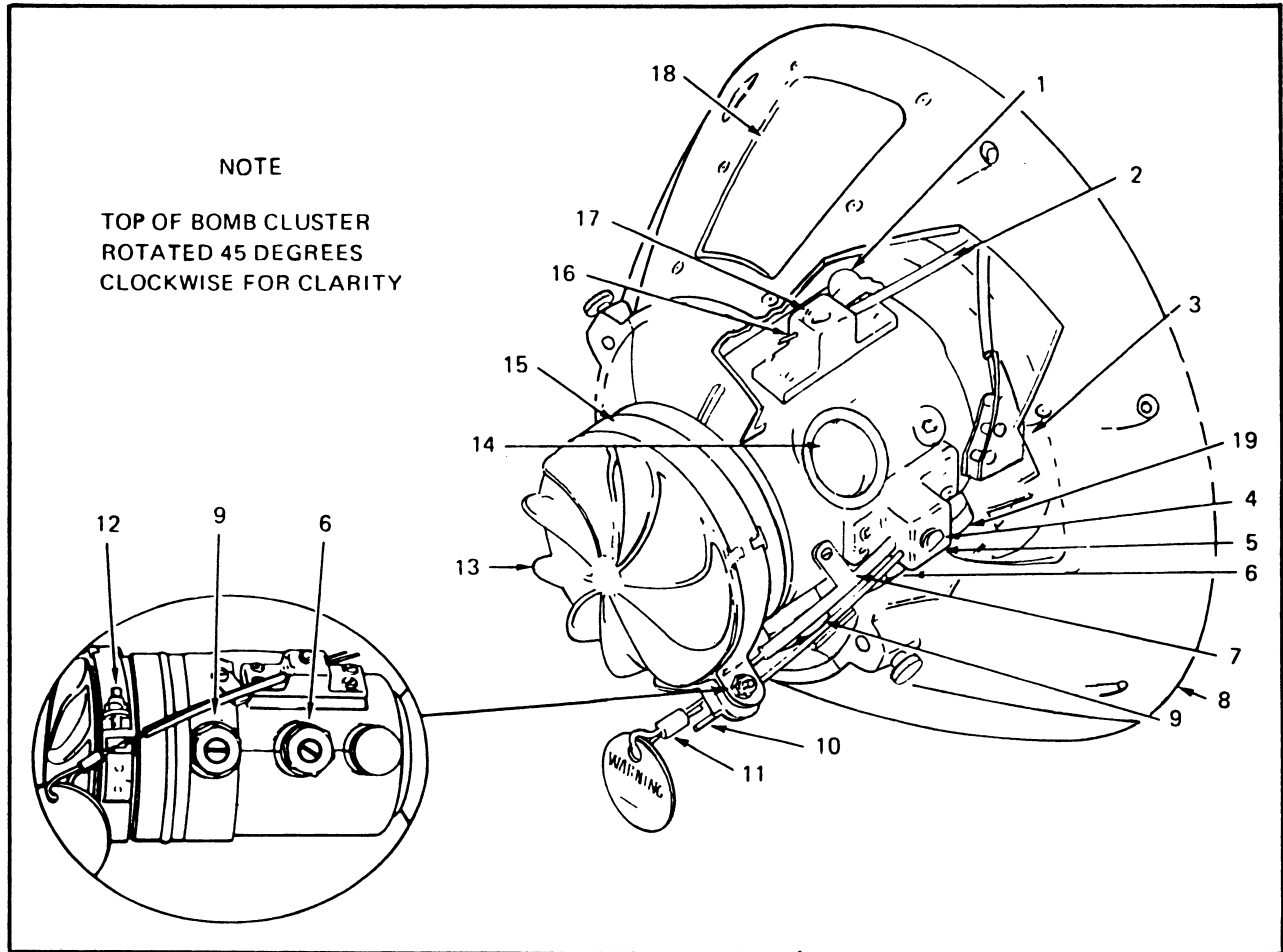
You can tell if the fuze has shifted from the primary to the option mode by the functional mode indicator. You do this by checking the time setting observation window for both the Mod 0 and Mod 1 fuzes. If the arming wire has been accidentally pulled during handling, the fuzes shift

REVIEW NUMBER 2 ANSWERS

- A1. *The M904 is a detonator-safe, mechanical impact nose fuze.*
- A2. *The M904 series fuze is used with Mk 80 (series) bombs.*
- A3. *The M904 fuze has nine arming delays, which you can set for 2 to 18 seconds in 2-second increments; there are any combination of six functioning delays from instantaneous to 250 milliseconds.*
- A4. *It is important for the M904 to be thermally protected because it increases the "cook-off" time of bombs subjected to intense heat or flame.*
- A5. *There are three conditions of the M904 fuze—safe, partially armed, and fully armed. You can check for these conditions by looking in the two observation windows in the fuze body.*
- A6. *If you can't tell if a fuze is "safe," you should notify explosive ordnance disposal (EOD) personnel.*
- A7. *The M904 arms and functions by rotation of arming vanes and alignment of internal components.*

to the option mode. Once the option wire is pulled, the Mod 0 fuze is committed to the option mode and cannot be reset to the primary mode. However, the Mod 1 fuze can be reset to the primary mode by reinstalling the option time wire.

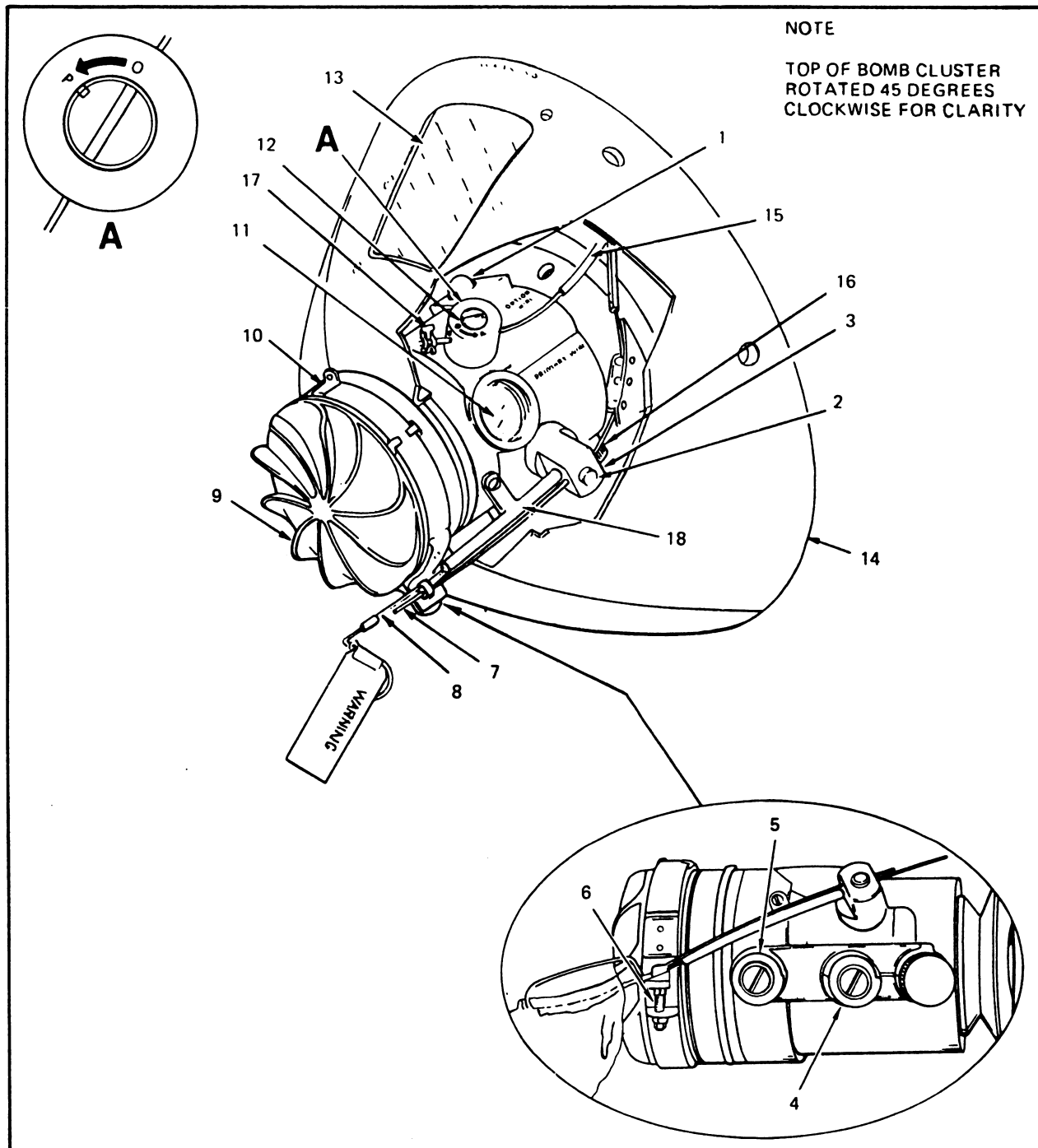
The fuze safe/arm indicator (callout 1 of figs. 3-2, 3-3, and 3-4) provides external evidence of arming (EEA) for the Mk 339 Mod 0 and Mod 1 fuzes. The fuze safe/arm indicator is viewed through the indicator observation window in the upper nose fairing. Mod 0 fuzes (lots 1 through



- | | |
|-------------------------------------|--|
| 1. FUZE SAFE/ARM INDICATOR | 11. SAFETY PIN ASSEMBLY |
| 2. OPTION TIME WIRE | 12. BAND RELEASE STUD AND NUT |
| 3. FUZE SETTING OBSERVATION WINDOW | 13. IMPELLER |
| 4. TIMER STARTING PIN | 14. TIME SETTING OBSERVATION WINDOW |
| 5. TIMER STARTING PIN BRACKET | 15. IMPELLER BAND ASSEMBLY |
| 6. OPTION TIME SETTER AND RETAINER | 16. OPTION TIME PIN BRACKET |
| 7. SAFETY PIN ASSEMBLY GUIDE TUBE | 17. OPTION TIME PIN |
| 8. NOSE FAIRING | 18. FUZE SAFE/ARM INDICATOR OBSERVATION WINDOW |
| 9. PRIMARY TIME SETTER AND RETAINER | 19. SLIDER RETAINER |
| 10. FUZE ARMING WIRE | |

220.806

Figure 3-3.—Installed mechanical time fuze Mk 339 Mod 0 (with option time wire bomb-clusters Mk 20 Mods 3 and 4 and CBU-59/B).



- | | |
|---|--|
| <ol style="list-style-type: none"> 1. FUZE SAFE/ARM INDICATOR 2. TIMER STARTING PIN 3. TIMER STARTING PIN BRACKET 4. OPTION TIME SETTING ADJUSTMENT 5. PRIMARY TIME SETTING ADJUSTMENT 6. BAND RELEASE STUD AND NUT 7. FUZE ARMING WIRE 8. SAFETY PIN ASSEMBLY 9. IMPELLER | <ol style="list-style-type: none"> 10. IMPELLER BAND ASSEMBLY 11. TIME SETTING OBSERVATION WINDOW 12. OPTION TIME PIN 13. INDICATOR OBSERVATION WINDOW 14. NOSE FAIRING (REFERENCE) 15. OPTION TIME WIRE 16. RETAINER SLIDE 17. CLIP 18. SAFETY PIN ASSEMBLY GUIDE TUBE |
|---|--|

220.807

Figure 3-4.—Installed mechanical time fuze Mk 339 Mod 1 (with option time wire bomb clusters Mk 20 Mods 3, 4, and 6 and CBU-9/B).

14) are in a safe condition when the tip of the indicator pin does not extend into the bubble (fig. 3-5, view A). The fuze is in an armed condition when the indicator pin extends into the bubble (fig. 3-5, view B). On newer models (lots 15 and above of Mod 0 and Mod 1 fuzes), there is a layer of green foil at the base of the indicator bubble. The fuze is in a safe condition when the green foil is intact (fig. 3-5, view C), and it is armed when the green foil is pierced by the indicator pin (fig. 3-5, view D).

Functional Description

The following paragraphs describe the sequence of events that must occur for Mk 339 fuzes to function.

MOD 0 (WITHOUT OPTION TIME WIRE).—When the Mk 20 bomb cluster is released in flight,

an impeller band assembly secures the impeller until the fuze arming wire is pulled out. As the weapon is released from the aircraft, the arming wire is pulled from the impeller band assembly, freeing the air-driven impeller. The arming wire also passes through a time starting pin, which initiates the fuze timing mechanism when the arming wire is pulled out. The airstream rotates the impeller, which physically aligns the firing train, and allows the fuze to detonate at the preset time.

MOD 1 (WITH OPTION TIME WIRE).—This fuze is physically and functionally the same as the fuze described in the preceding paragraph except that an option wire is installed. If the pilot selects the primary mode of delivery when the weapon is released from the aircraft, only the arming wire is pulled out and the primary mode of the fuze is initiated. If the pilot selects the

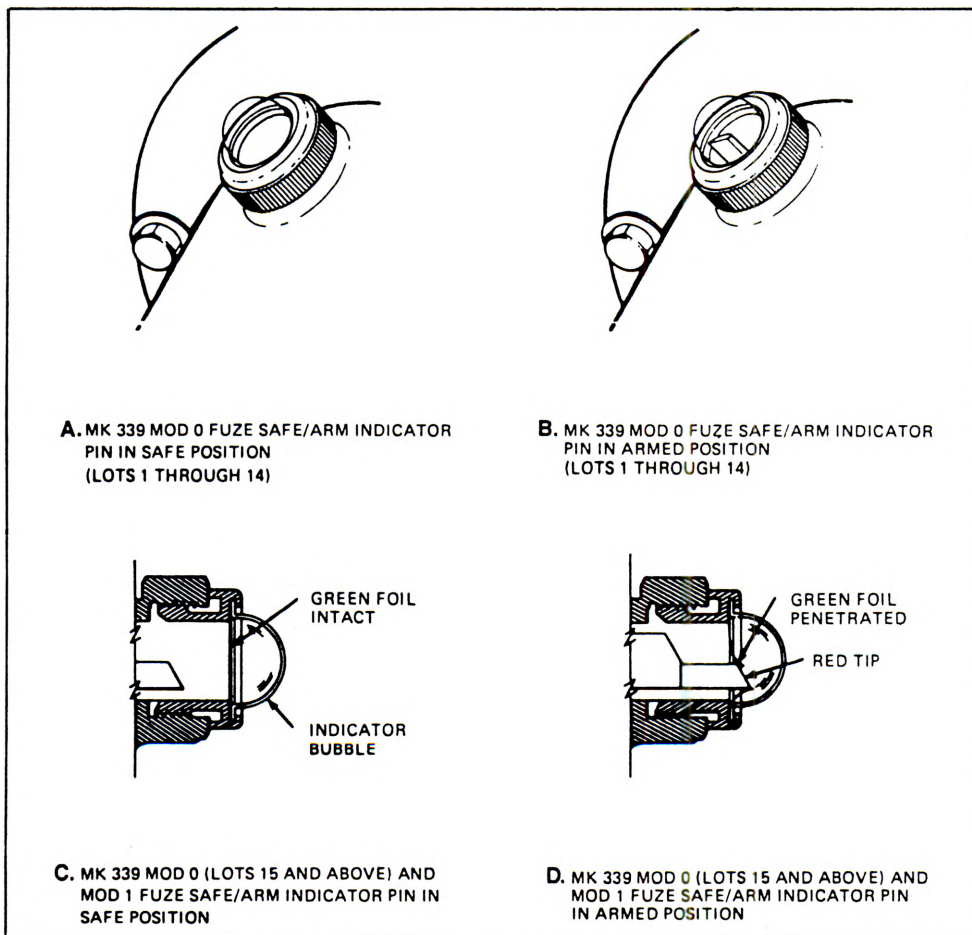


Figure 3-5.—Mechanical time fuze Mk 339 safe/arm indicator pin in safe and armed positions.

option mode of delivery, both the arming wire and the option wire are pulled out, initiating the option time mode of the fuze. If only the option time wire is pulled out on airborne release, the fuze will dud. Both the fuze arming wire and option wire must be pulled out for the fuze to function in the option mode.

REVIEW NUMBER 3

Q1. What bombs are used with the Mk 339 mechanical time fuze?

Q2. List the characteristics shared by the Mod 0 and Mod 1 of the Mk 339 fuze.

Q3. The primary and option delays of the Mod 1 and 0 fuzes are set at the factory. What means can be used to change settings for tactical requirements?

Q4. How can you tell if the fuze has shifted from the primary to the option delay?

Q5. Describe what you will see in the observation window of a Mk 339 Mod 0 fuze for the conditions listed below:

Safe

Armed

Q6. Describe what you will see in the observation window of a Mk 339 Mod 0 (lots 15 or above) or Mod 1 fuze for the conditions listed below:

Safe

Armed

MK 346 MOD 0 MECHANICAL LONG-DELAY TAIL FUZE

The mechanical long-delay fuze Mk 346 Mod 0 is an all-mechanical clockwork fuze that is used in the tail well of the Mk 80 (series) LDGP bombs. The functioning delays are preselected for the total number of hours, in increments of 15 minutes. The range of the functioning delay time is from 30 minutes to 33 hours.

Description

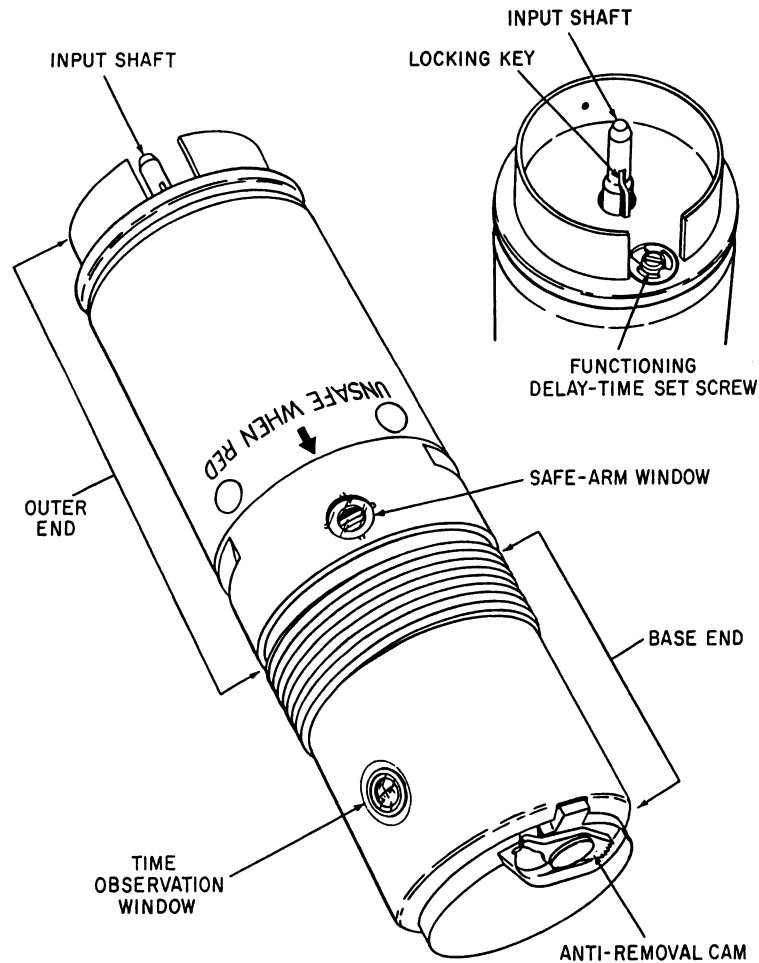
The Mk 346 fuze (fig. 3-6) is approximately 6 3/8 inches long and threaded for a 2-inch adapter booster well. For purposes of description, the terms *outer end* and *base end* are used. The outer end couples to the arming assembly; the base end fits into the adapter booster well.

The input shaft and the delay functioning setting shaft are located on the outer end of the fuze. The input shaft is coupled directly to a centrifugal clutch that engages the speed reduction gear assembly when the input shaft reaches 1,200 rpm. The input shaft is fitted with a key that engages a locking slot to prevent accidental rotation. The key is automatically freed when the arming assembly is fitted to the input shaft.

The delay function setting shaft is located in the outer end and may be rotated in either direction by a screwdriver. The setting shaft is coupled through a gear train to the dial, which is seen in the time delay observation window.

The safe-armed band, visible through the safe-arm window, is coupled to the speed reduction gear. The red band covers the window when the input shaft and clutch have rotated 45 revolutions, thus completing the first stage arming. The red band starts to appear after the input shaft and the clutch have rotated approximately 22 of the required 45 revolutions. A slip clutch lets the setting shaft rotate past the minimum or maximum delay setting without further rotation of the indicator dial or damaging the mechanism.

The base end of the fuze houses the timer, firing pin, detonator-rotor, lead-in, arming shaft, and the functioning delay indicator dial. On the face of the base end plate is the toothed cam,



220.208

Figure 3-6.—Mechanical long-delay fuze Mk 346 Mod 0.

which operates as an antiremoval device. The arming shaft moves forward at impact to initiate the timer mechanism; this allows the detonator-rotor to align with the firing pin and release the antiremoval cam.

Operation

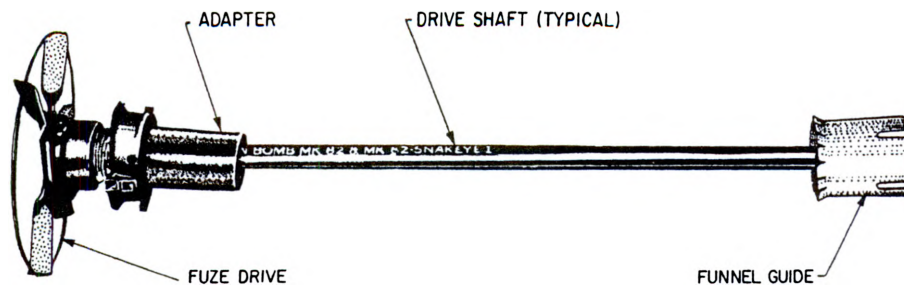
After the bomb is released from the aircraft, the arming assembly is freed from the arming wire and allowed to rotate. After approximately 45 revolutions of the input shaft at 1,200 rpm or more, first stage arming is complete. Usually this takes about 1.5 to 2 seconds. Upon impact, the second stage arming is initiated, which aligns the fuze firing train, starts the delay-to-burst timer, and releases the antiremoval cam. After the preselected

time on the delay-to-burst timer has expired, the bomb detonates.

NOTE: First stage arming must be completed before impact, and impact must be sufficient to initiate second stage arming.

Arming Assemblies Mk 3, 4, and 5 Mods

Mk 3, 4, and 5 arming assemblies are used with the tail assemblies of LDGPs (except Mk 84) and Snakeye weapons. They provide arming action for the Mk 346 fuze. The arming assemblies consist of a Mk 5 Mod 1 or 2 fuze drive, an adapter, an appropriate drive shaft, which couples to the input shaft of the fuze, and a funnel guide. The Mod of the drive unit denotes the Mod of the assembly.



220.222

Figure 3-7.—Typical arming assembly.

ARMING ASSEMBLIES.—Figure 3-7 shows a typical arming assembly. The three Mk assemblies are identical except for the length of the drive shaft. The drive shaft is color-coded to indicate the bomb with which it is used.

- orange—Mk 81
- blue—Mk 82
- red—Mk 83 (conical fin only)

The Mod 1 arming assembly (Mk 5 Mod 1 drive) has a maximum rotational output of 1,800 rpm. A centrifugally operated governor limits the rotational speed delivered to the input shaft of the fuze. The governor effects a degree of constant arming time for the fuze between 200 and 600 knots delivery speed. At rotational speeds below 1,800 rpm, the governor has **no** effect and rotation is imparted to the fuze input shaft on a one-for-one basis.

REVIEW NUMBER 3 ANSWERS

- A1. *The Mk 20 and Mods and the CBU-59/B are used with the Mk 339 mechanical time fuze.*
- A2. *The characteristics shared by Mod 0 and Mod 1 of the Mk 339 fuze are nose-mounted, air-enabling, and detonator-safe.*
- A3. *The primary and option delays of the Mod 0 and Mod 1 fuzes can be changed by adjusting the primary and option time-setting dials.*
- A4. *You can tell if the fuze has shifted from the primary to the option delay by checking the time setting observation windows of the fuzes.*
- A5. *Safe—Tip of indicator pin does not extend into bubble.*
Armed—Indicator pin extends into bubble.
- A6. *Safe—Green foil is intact.*
Armed—Green foil is pierced by the indicator pin.

The Mod 2 arming assembly (Mk 5 Mod 1 drive) operation is uncontrolled. It operates like the Mod 1 does below 1,800 rpm. The words **DIRECT DRIVE** are stenciled on the governor housing.

FUZE DRIVE MK 5 MODS.—This device consists of the following:

- A four-bladed, 7-inch, wire-shrouded arming vane
- A governor (Mod 1 only)
- Fuze drive barrel with a locknut and a toothed retaining ring (fig. 3-8, view A)

As you read this section refer to figure 3-8. The fuze drive can be quickly and securely fastened to either the conical or Snakeye fins. The adapter (view B) fastens to the conical tail by three socket-head setscrews. To fasten the fuze drive to the Snakeye, screw the threads beneath the adapter collar into the mating threads of the Snakeye tail assembly, and use setscrews to further secure the drive. Two latches on the adapter collar are secured over the fuze drive locknut when the entire assembly is installed in the weapon.

The drive shaft couples the output spindle of the fuze drive to the input shaft of the fuze. Each

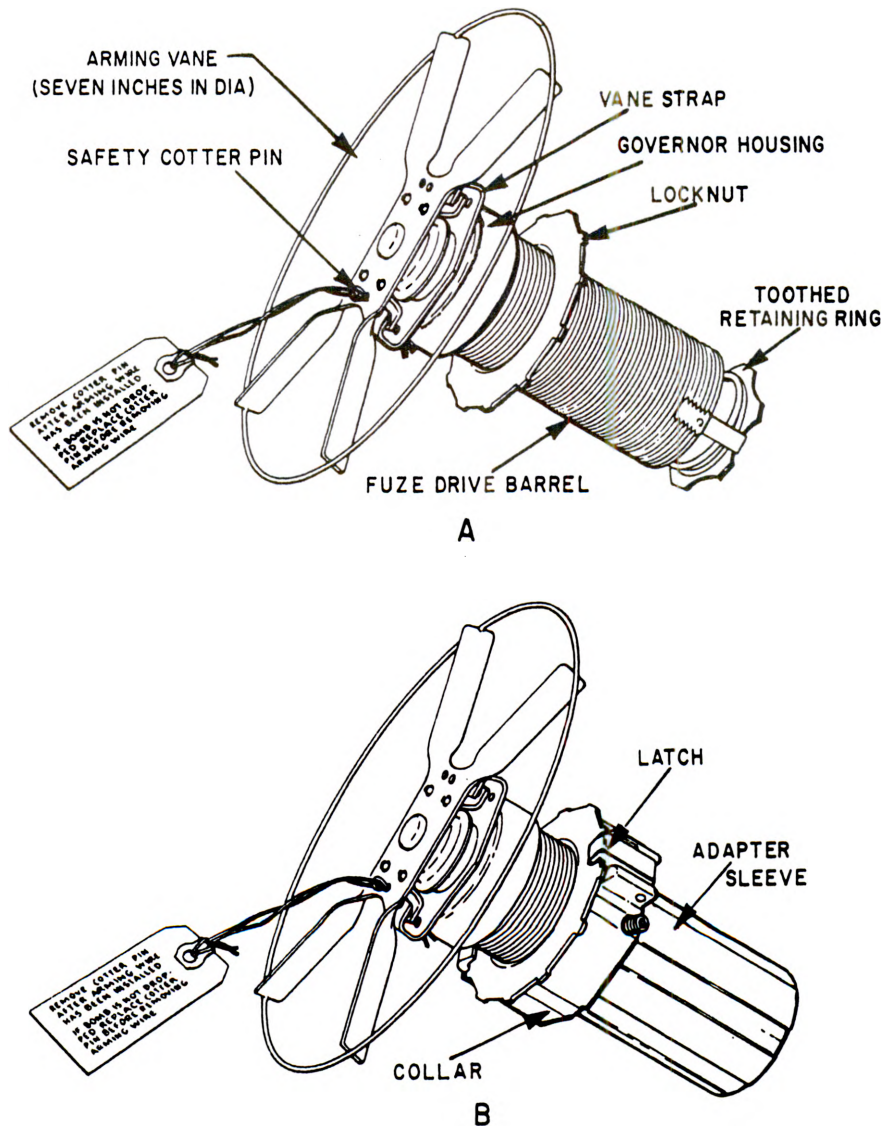


Figure 3-8.—View A, fuze drive Mk 5 Mod 0; view B, fuze drive Mk 5 Mod 0 with adapter.

220.223

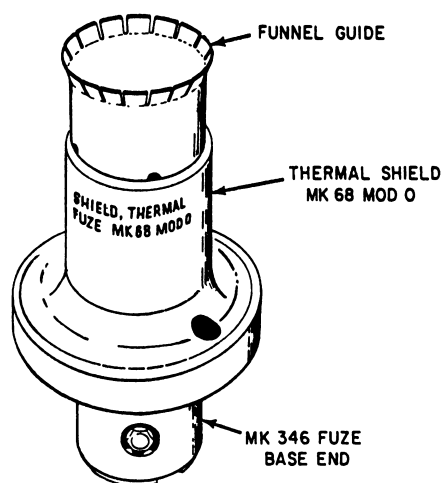
end of the extension drive shaft contains identical spring assemblies, which key the shaft to the output spindle of the fuze drive and the input shaft of the fuze. The drive shaft also depresses the locking key on the input shaft of the Mk 346 fuze and frees the input shaft for rotation.

A funnel guide fits inside the thermal shield and snaps over the outer end of the fuze. This makes it easier to install the extension drive shaft after the tail assembly is installed on the bomb body.

THERMAL SHIELD MK 68 MOD 0.—The Mk 68 thermal shield (fig. 3-9) protects the fuze and adapter booster when used in the Mk 82 Mod 2 thermally protected bomb. The fuze is hand-pressed into the booster. The base of the shield covers the exposed portion of the adapter booster after fuze/shield installation.

Identification of a Fully or Partially Armed Fuze

Normally, the Mk 346 fuze is removed from an unused bomb, returned to its shipping container, reset, and reinstalled for a subsequent mission. However, if an arming wire is lost or the arming wire installation is faulty, first stage arming can occur while the bomb is aboard the aircraft. You can identify the first stage arming condition by the red band covering all or part of the safe-arm observation window on the body of the fuze. You should examine all unused bombs returned from a mission as soon as possible. If



220.635

Figure 3-9.—Mk 346 fuze with Mk 68 thermal shield installed.

evidence of a malfunction is present, immediately remove the fuze from the bomb on the flight deck. A partially armed fuze is safe for handling and disposal; however, if the fuze is jarred or dropped, complete arming may result.

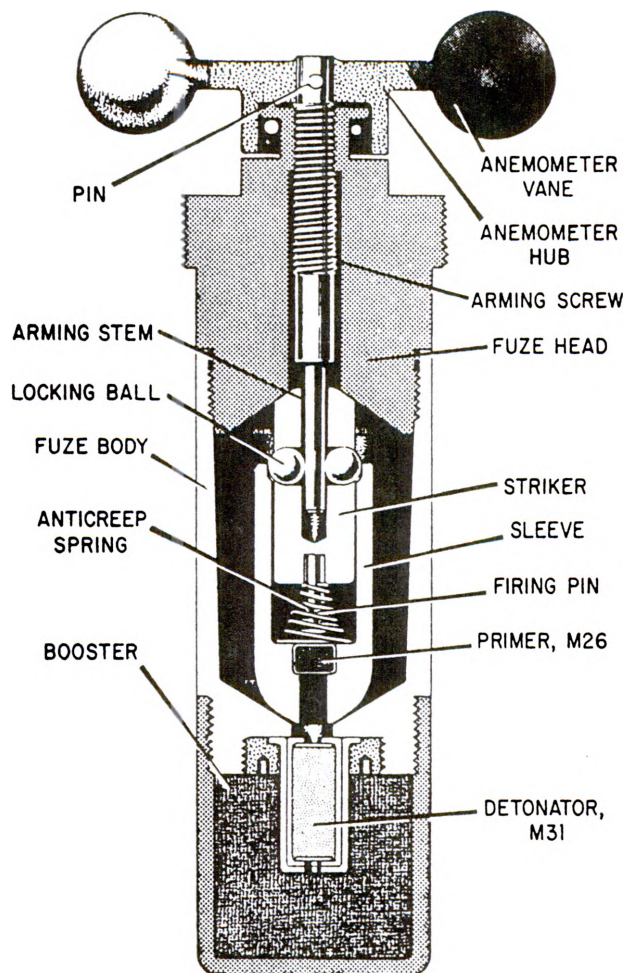
Second stage arming of the fuze does not occur unless first stage arming is complete and the fuze is accidentally jolted or jarred. Then, the fuze is locked in the bomb and isn't easily removed. This condition is unlikely, but it could happen with a hung bomb, or with a bomb that is inadvertently released because of a bomb rack structural failure. This is a dangerous situation. If a safe condition is in doubt, immediately notify explosive ordnance disposal (EOD) personnel.

REVIEW NUMBER 4

- Q1. What is the range of the functioning delay time on the Mk 346 mechanical long-delay tail fuze?
- Q2. At what point does second-stage arming of the Mk 346 fuze begin?
- Q3. The difference between the Mk 3, 4, and 5 arming assemblies is the _____.
- Q4. A drive shaft color-coded red is used with _____ bombs.
- Q5. What device is used to thermally protect the Mk 82 Mod 2 bomb?
- Q6. How can you tell if first stage arming of the Mk 346 fuze occurs?

MECHANICAL IMPACT FUZE AN-M173A1

The AN-M173A1 mechanical bomb fuze (fig. 3-10) is an inertia-firing, impact, multiposition fuze armed by vane action. The fuze, with the M23A1 igniter, is installed in the fuze cavities of fire bombs.



220.214

Figure 3-10.—Sectional view of an AN-M173A1 fuze.

Description

The basic components of the AN-M173A1 mechanical impact fuze are a four-blade arming vane with an attached arming stem, fuze head, fuze body, booster cup, striker sleeve, and explosive elements.

There are two off-center pairs of holes through the hub of the arming vane for a safety cotter pin and an arming wire. When either the safety pin or the arming wire is inserted through the hub rotation of the arming vane, subsequent arming of the fuze is prevented.

Operation

After the arming wire is withdrawn from the fuze, the arming vane starts rotating in the airstream. After approximately 18 revolutions, the arming stem is unscrewed enough to clear the

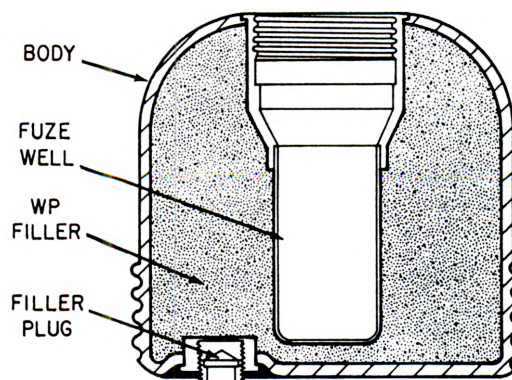
locking balls. At this point, the fuze is partially armed and will detonate if it impacts with the force exerted in a line nearly parallel to the longitudinal axis of the fuze. (Functioning at this stage is a characteristic of the design and has no tactical application.)

When approximately 45 revolutions of the arming vane are complete, the arming stem withdraws from the striker. At this point, the fuze is fully armed; the unit, consisting of the striker and sleeve assemblies, is free to respond to an impact force in any direction. Upon impact, the striker and sleeve are forced together so that the primer is stabbed by the firing pin. Fuze functioning is instantaneous and causes the AN-M23A1 igniter to burst.

CAUTION

This fuze contains an in-line explosive train and, consequently, is not classified as being detonator-safe. A safety pin inserted through the vane hub prevents premature arming of the fuze. The safety pin is withdrawn only after an arming wire is installed. The explosive train of the fuze remains in alignment at all times. The fuze must be handled carefully, as severe shock could initiate the primer. This lack of an out-of-line explosive train establishes the possibility of initiation from the shock of impact on a hard target, even though it is released safe.

The AN-M23A1 igniter is an incendiary device. It ignites the gelled fuel of Mk 77 Mods fire bombs, when burst occurs by fuze action. The igniter (fig. 3-11) is cylindrical, rounded at one



220.636

Figure 3-11.—Sectional view of AN-M23A1 igniter.

end, and externally threaded at the other end. The fuze well is located at the rounded end. The igniter body is filled with white phosphorus (WP).

Upon impact, the fire bomb shatters and spreads the gelled fuel. Simultaneously, the instantaneous AN-M173A1 fuze functions and bursts the AN-M23A1 igniter. When the igniter bursts, the WP scatters and ignites spontaneously upon exposure to the air. The burning WP then ignites the gelled fuel.

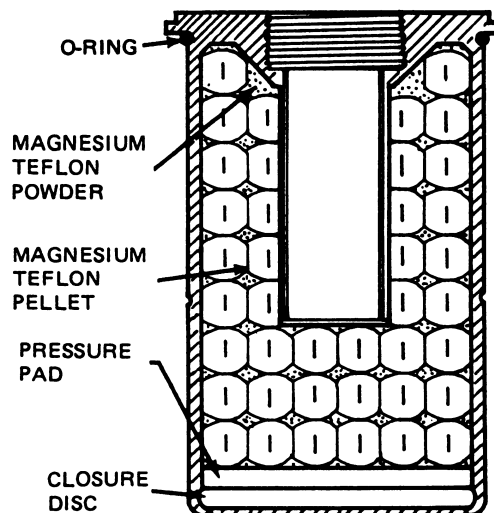
WARNING

The AN-M23A1 igniter should be handled carefully. WP ignites spontaneously upon exposure to air, and its fumes are noxious. Avoid dropping or mishandling the igniter.

MECHANICAL IMPACT FUZE M918

The M918 mechanical impact bomb fuze is an inertia-firing, impact, multiposition fuze armed by vane action. The fuze is used with the Mk 273 igniter and installed on the Mk 77 Mod 4 fire bomb. The fuze is identical in appearance to the AN-M173A1 fuze and functions in a similar manner. The M918 has a much smaller booster charge and functions with a 0.3-second delay. The two fuzes are **not** interchangeable.

The Mk 273 Mod 0 igniter (fig. 3-12) is a flanged, cylindrical container with a fuze well designed for the M918 fuze. The igniter body is made of aluminum alloy and is filled with magnesium-Teflon powder and pellets. The igniter, with an O-ring under the flange, mounts in the filler holes of the Mk 77 Mod 4 fire bomb and is secured by a retaining ring.



220.637

Figure 3-12.—Sectional view of Mk 273 Mod 0 igniter.

REVIEW NUMBER 4 ANSWERS

- A1. *The range of the functioning delay time on the Mk 346 mechanical long-delay tail fuze is 30 minutes to 33 hours, in 15-minute increments.*
- A2. *Second-stage arming of the Mk 346 fuze begins upon impact with the target.*
- A3. *The difference between the Mk 3, 4, and 5 arming assemblies is the length of the drive shaft.*
- A4. *A drive shaft color-coded red is used with Mk 82 (conical fin only) bombs.*
- A5. *The Mk 68 Mod 0 thermal shield is used to thermally protect the Mk 82 Mod 2 bomb.*
- A6. *You can tell if first stage arming of the Mk 346 fuze has occurred by looking in the safe-arm observation window in the bomb body. If a red band covers all or part of the safe-arm window, first stage arming is complete.*

Upon bomb impact, the 0.3-second delay of the fuze lets fuel cover the target. When the fuze bursts the igniter, it ignites the magnesium-Teflon powder, which, in turn, ignites the magnesium-Teflon pellets. These pellets then ignite the gelled fuel of the fire bomb.

MECHANICAL IMPACT FUZE MK 343 MOD 0

The Mk 343 Mod 0 mechanical impact fuze (fig. 3-13) is an instantaneous or 0.27-second delay, inertia-firing, impact fuze. The fuze is

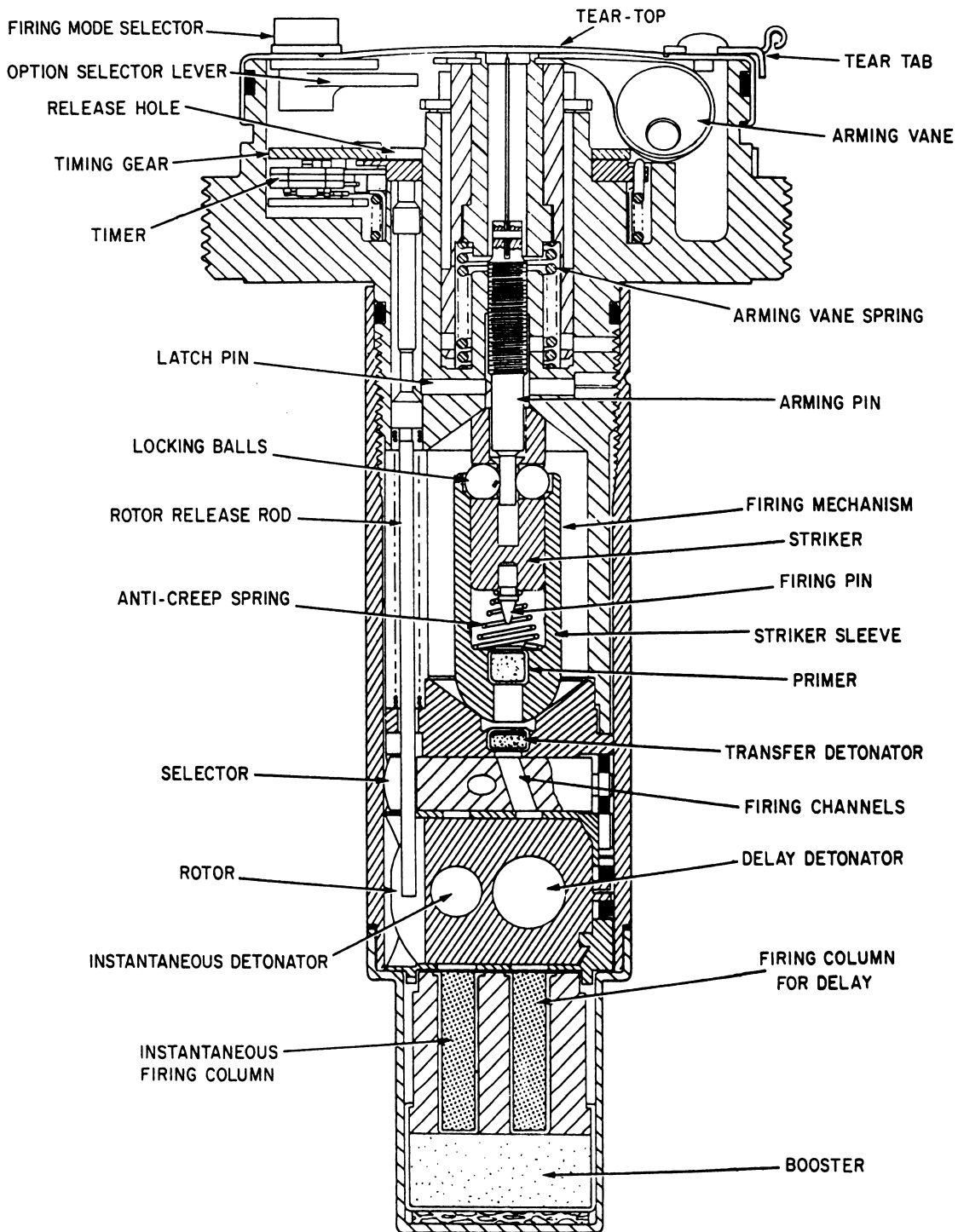


Figure 3-13.—Mk 343 Mod 0 mechanical impact fuze.

220.638

detonator safe, has an 80-KIAS (knots indicated airspeed) minimum no-arm velocity, a 1 ± 0.2 second arming time (independent of the airspeed), and a self-dud feature.

The firing assembly is basically the same as the AN-M173A1 and M918, but the arming method depends on two concurrent actions—mechanical timer and vane rotation. The entire upper fuze housing is enclosed and covered by a prescored tear top (beer can style).

Operation

As the weapon separates from the aircraft, a lanyard attached to the arming solenoid “pops” the tear top. This initiates the two separate and simultaneous arming actions—

1. the arming vane pops up and rotates in the airstream, and
2. the timing mechanism is started.

The vane rotates, withdraws the arming pin from the firing mechanism, and frees the latch pin (within 0.8 second), enabling the fuze.

At the same time, the timing gear rotates to align a hole in the gear with the rotor release (gag) rod (0.8 to 1.2 seconds). The rod pushes the latch pin aside and pops up through the hole in the gear, freeing the detonator rotor.

If the firing mode selector is set for delay, the top of the rod is stopped by the option selector lever. The detonator rotates, aligns with the delay firing channel of the selector, and the fuze is armed for delay firing.

If the fuze is set for instantaneous, the option selector lever is to one side, and the rod moves further upward, freeing the selector. The selector rotates and aligns the instantaneous firing channel with the instantaneous detonator.

Self-dud

Should the tear top be popped by any amount, the timer can start rundown without concurrent vane rotation. In this case, the hole in the timing gear aligns with the gag rod (0.8 to 1.2 seconds), the rod starts to move upward through the hole and is retained by the latch pin held by the arming pin. Continued timer rundown jams the rod in this position.

If the tear top is completely pulled and the vanes are exposed to deck winds of 80 KIAS or less, timer rundown occurs before the arming pin clears the latch pin, and the fuze self-duds. In

either case, notify EOD personnel to dispose of the fuze.

Igniter Mk 273 Mod 1

The Mk 273 Mod 1 igniter is the same as the Mod 0, except the fuze well is designed for the Mk 343 fuze only.

Initiator Mk 13 Mod 0

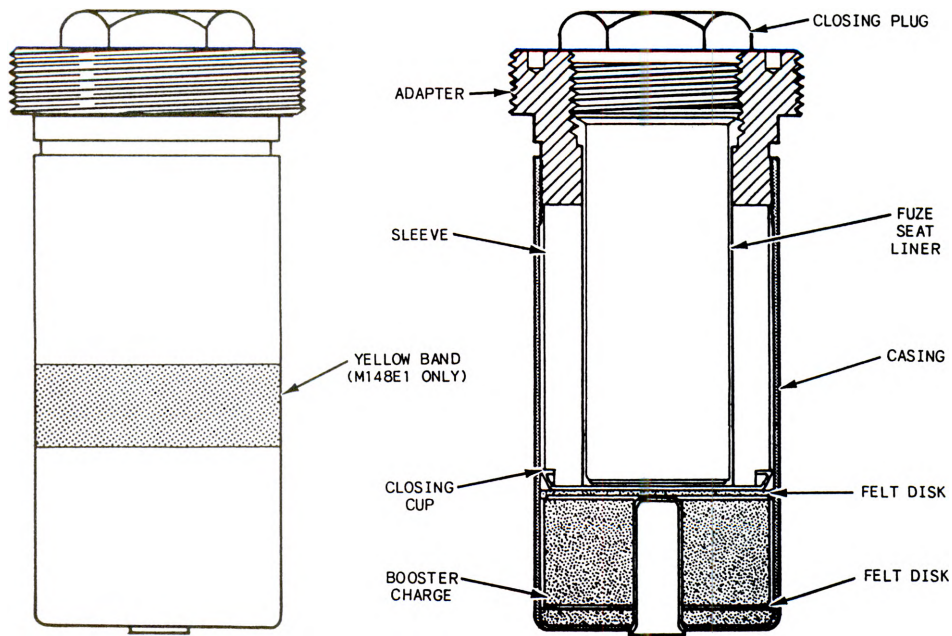
The Mk 13 Mod 0 initiator consists of a Mk 343 Mod 0 fuze and Mk 273 Mod 1 igniter. It is assembled, stored, and shipped as a unit, and is used in the Mk 77 Mod 4 fire bomb. The fuze and igniter are compatible only with each other.

REVIEW NUMBER 5

- Q1. List the mechanical impact fuzes used with fire bombs.*
- Q2. What type of explosive train is included in the AN-M173A1 fuze?*
- Q3. List the igniters used with the AN-M173A1, Mk 343 Mod 0, and M918 mechanical impact fuzes.*
- Q4. What type of device is the AN-M173A1?*
- Q5. List the components that make up the Mk 13 Mod 0 initiator used with the Mk 353 Mod 0 mechanical impact fuze.*

ADAPTER BOOSTERS

An adapter booster is needed to install mechanical fuzes in the Mk 80 (series) general-purpose bombs. The adapter boosters currently in use are the M148/T45E, M148E1 (nose), and the M150, T46 (tail).



220.589

Figure 3-14.—M148/T45E (series) adapter booster.

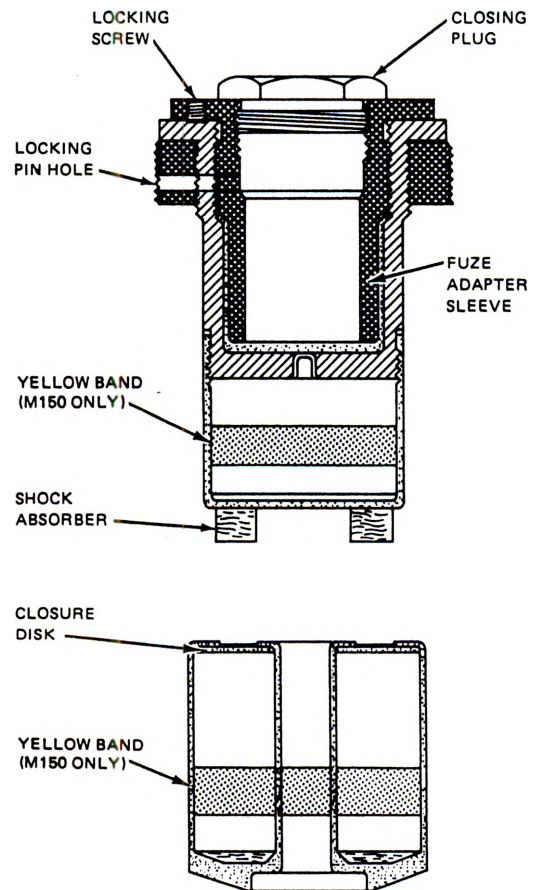
**M148/M148E1/T45 (Series)
Adapter Booster**

The M148/M148E1/T45 (series) adapter booster (fig. 3-14) permits the use of mechanical nose fuzes in the Mk 80 (series) bombs. The adapter booster is externally threaded for installation in the bomb fuze well and internally threaded for installation of the fuze. The casing contains the booster charge and is threaded onto the base of the adapter.

The M148E1 adapter booster is similar in external appearance to the earlier M148/T45 (series). Differences are the nomenclature marking on the face of the adapter booster collar, the words **THERMALLY PROTECTED** in bold black letters, and a yellow band around the adapter booster casing, which indicates that it is loaded with explosives. The M148E1 was developed for use with thermally protected bombs.

Adapter Booster M150/T46 (Series)

The adapter booster M150/T46 (series) (fig. 3-15) permits use of mechanical tail fuzes with Mk 80 (series) bombs. The M150 and T46 adapter boosters differ only in internal construction, and they may be used interchangeably.



220.811

Figure 3-15.—T46E4 adapter booster.

The M150 and T46 (series) adapter boosters consist of two separate explosive components. The primary adapter booster receives a 2.0-inch diameter fuze. The T46 (series) contains a fuze adapter sleeve for use with the 1.5-inch diameter fuze. A hole is drilled through the threads of the primary adapter booster for insertion of a locking pin for use with the long-delay fuze. This pin locks the adapter booster to the base plug of the bomb and prevents removal of the adapter booster while the fuze is installed. The M150 has a yellow band around the adapter booster casing, which indicates that it is loaded with explosives.

ELECTRICAL FUZES

Learning Objective: Identify the various types of electrical fuzes to include their physical description and functional operation.

The Mk 344 (fig. 3-16) and Mk 376 (fig. 3-17) electric bomb fuzes provide an all-electric capability for the Mk 80 (series) bombs with either conical or retarding fins, thermally protected bombs, and laser-guided bombs (LGB). Electric fuzes require an electric pulse from the aircraft fuze function control (FFC) system. The FFC gives in-flight selection of function delay and arming delay times. The Mk 344 and 376 fuzes are used with the Mk 43 target-detecting device

for airburst capability. They may also be used with mechanical nose fuzes for additional fuzing options.

DESCRIPTION

The Mk 344 Mod 0 and Mod 1 and Mk 376 Mod 0 electric tail fuzes are detonator safe. The boosters contain 4.3 ounces of tetryl explosive. They are classified HERO SAFE, and no unusual RADHAZ precautions are required under normal operating conditions. The Mk 344 Mod 0 and Mod 1 fuzes are identical, except that the retard sensor has been removed from the Mod 1. The Mk 344 Mod 0 or Mod 1 is **not** used in the retarded mode of delivery and should **never** be configured for this type of delivery. The fuzes are similar in appearance, but they are readily identifiable by decals.

Four discreet dc voltages for in-flight selection of functioning delay times are used in the Mk 344 Mods and Mk 376 fuzes. Arming delay times are automatically selected by the Mk 31 safety device.

MK 31 SAFETY DEVICE

The Mk 31 safety device is used to adapt the fuze to the fuze well of the bomb, provide mechanical safing of the fuze, and unlock the timer-declerometer. The safety device contains a pop-out pin that locks the fuze in an unarmed

REVIEW NUMBER 5 ANSWERS

- A1. The fuzes used with fire bombs are the AN-M173A1, M918, and Mk 343 Mod 0 mechanical impact fuzes.
- A2. An in-line explosive train is included in the AN-M173A1 fuze. Because of the in-line explosive train, the AN-M173A1 fuze is not classified as detonator safe.
- A3. The M23A1 igniter is used with the AN-M173A1 mechanical impact fuze, the Mk 273 Mod 1 igniter is used with the Mk 343 Mod 0 mechanical impact fuze, and the Mk 273 igniter is used with the M918 mechanical impact fuze.
- A4. The AN-M173A1 is an incendiary device.
- A5. The components that make up the Mk 13 Mod 0 initiator used with the Mk 353 Mod 0 mechanical impact fuze include a Mk 343 Mod 0 fuze and a Mk 273 Mod 1 igniter.

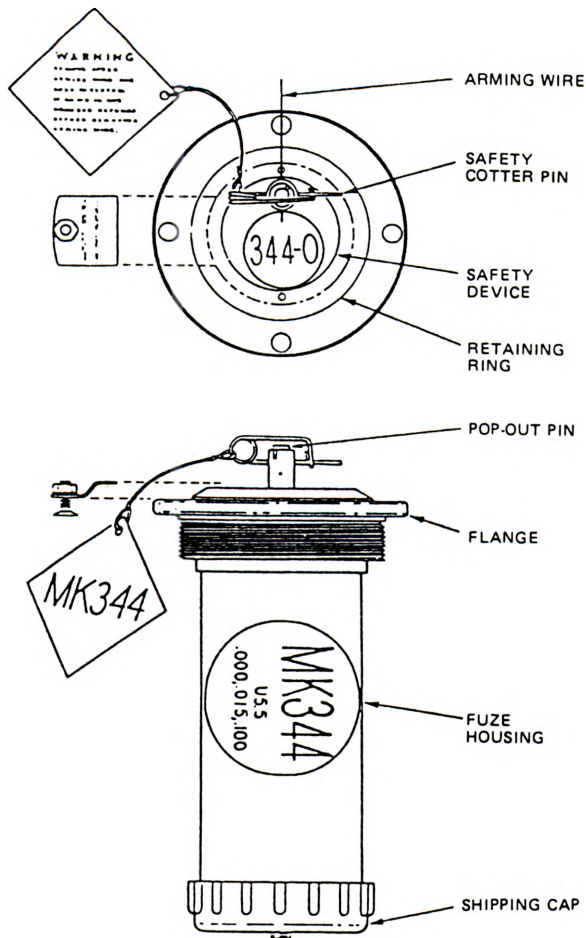
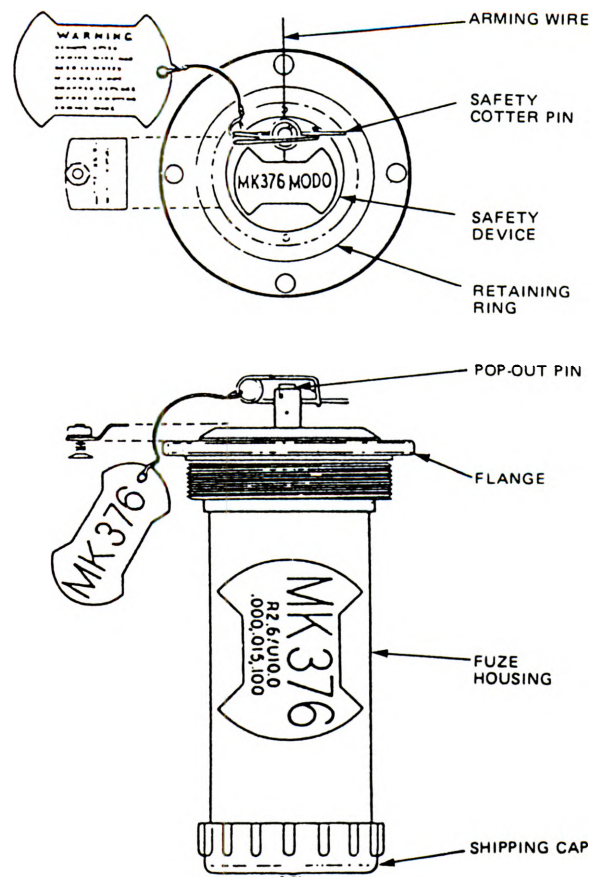


Figure 3-16.—Mk 344 Mod 0/1 electric fuze.

condition. The spring-loaded pin is held in the safe position by either a safety cotter pin or an arming wire. When the weapon is released from the aircraft, the arming wire is pulled from the pop-out pin, allowing the pin to pop-out, unlock the decelerometer, thus initiating the arming time. When using the Mk 344 Mod 0 or Mod 1 fuze, the arming is completed 5.5-seconds after the pop-out pin is released. When using the Mk 376 fuze, arming is completed 10.0 seconds after release from the aircraft if the free-fall mode of delivery is used. If the Mk 31 safety device senses weapon deceleration (Snakeye fins open), the internal circuits of the fuze are switched, and the fuze becomes armed in 2.6 seconds. The quicker arming time is required to ensure the fuze is fully armed for low-altitude delivery. If deceleration is not sensed by 2.6 seconds, the fuze arming delay continues to the 10.0-second arming time.



220.810

Figure 3-17.—Mk 376 Mod 0 electric fuze.

FUNCTIONAL OPERATION

The following description applies specifically to the Mk 376 fuze. However, the Mk 344 fuze operates identically to the Mk 376, except that it is operationally restricted to the unretarded (5.5-second delay) delivery only.

Two arming delays are used in the Mk 376 fuze—2.6 seconds for retarded delivery and 10.0 seconds for unretarded delivery. The appropriate arming delay is automatically selected by the fuze according to the actual delivery mode of the weapon. That is, if the weapon does not retard, whether intentionally or unintentionally, the fuze automatically provides a 10.0-second arming delay.

At release, the arming wire is withdrawn and a charging voltage (+300, +195, -195, or -300 Vdc) is applied to the fuze. The pilot selects the voltage in flight by the fuze function control set located in the cockpit. The fuze polarity and level

of the fuze charging voltage is important only with respect to functioning delay. Arming is the same in any case. A regulator in the fuze converts the applied voltage to the required level and polarity. It is then applied to the energy storage unit and the 2.6-second timer. If the weapon decelerates, the Mk 31 safety device senses the deceleration and causes the retard switch to close. At 2.6 seconds, the timer completes its cycle and transfers the voltage to the rotor-actuating bellows. The bellows operate and turn the rotor to the armed position.

If the weapon does not decelerate, the retard switch does not close. The 2.6-second timer continues to run. At 3.8 seconds, the Mk 31 safety device causes the voltage to transfer to the input of the rotor-actuating bellows. At 10.0 seconds, the bellows operates and turns the rotor to the armed position.

ARMING SAFETY SWITCH MK 122 MOD 0

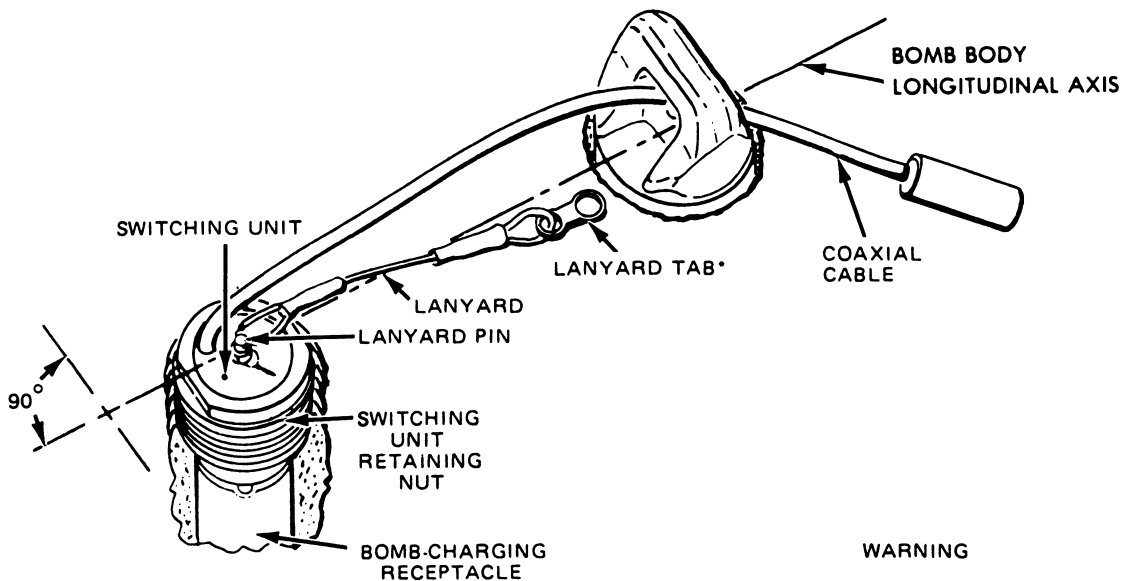
The Mk 122 Mod 0 arming safety switch (fig. 3-18) connects the fuze control circuits of the bomb in the aircraft to the electric fuze circuits in the bomb. This switch provides an open circuit and a RADHAZ shield to prevent electromagnetic radiation from entering the fuze circuits.

While the weapon is loaded, the coaxial cable of the switch is plugged into the receptacle of the aircraft's electrical arming unit. When the bomb is suspended from the rack, the lanyard is attached to a fixture on the rack or pylon. Upon bomb release, the lanyard pulls the lanyard pin and closes the fuze circuit. The lanyard is long enough so the weapon separates from the bomb rack suspension hooks before the lanyard pin is pulled from the switch. This ensures that the fuze does not receive charging voltages in case of weapon release failure. The coaxial cable is longer than the lanyard, which permits sufficient time for the charging voltage to pass from the electrical arming unit on the aircraft to the fuze electric circuits on the bomb before the cable is pulled free or breaks from the arming unit receptacle.

NOTE: The Mk 122 Mod 0 switch must be installed and removed in a RADHAZ-free environment.

MK 43 Mod 0 TARGET DETECTING DEVICE

The Mk 43 Mod 0 target detecting device (fig. 3-19) is a proximity variable time (VT) nose element that gives airburst capability for electric-fuzed Mk 80 (series) bombs.



*NOT PRESENT ON LATER PRODUCTION SWITCHES

WARNING
DISCARD ENTIRE MK 122 ARMING SAFETY SWITCH IF LANYARD BREAKS AWAY. DO NOT ATTEMPT TO REPLACE THE LANYARD PIN. DO NOT USE SEPARATED SWITCHES ON A BOMB.

220.812

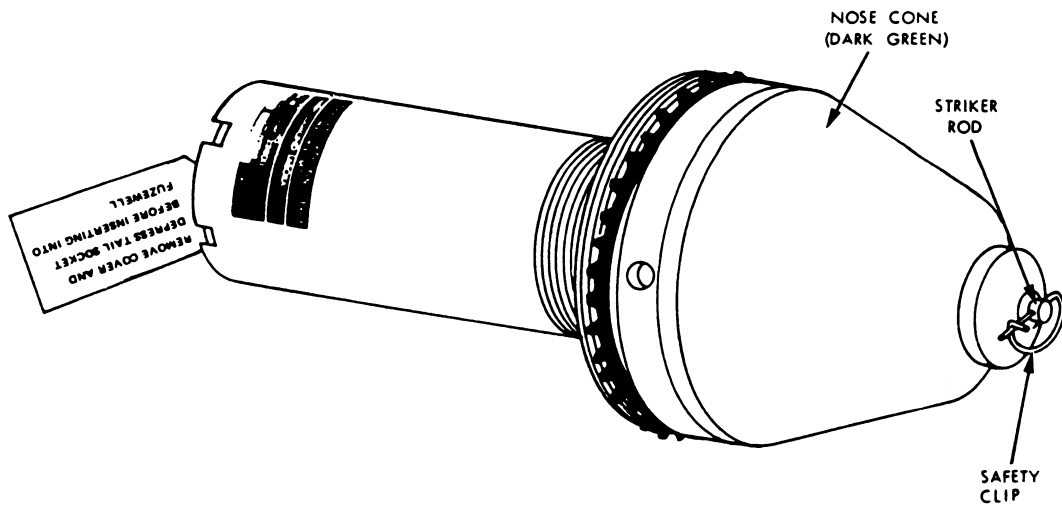
Figure 3-18.—Mk 22 Mod 0 arming safety switch.

The Mk 43 Mod 0 TDD is compatible with all electric tail fuzes and is identified by the dark green color of the nose cone. Its internal circuitry is powered by a thermal battery. The thermal battery is initiated by +300 volts dc or by the striker rod.

The Mk 43 is initiated mechanically (striker rod) only when a delay airburst is desired. This is the alternate method used to provide VT

operation when the fuze is not initiated with the +300 Vdc. The conventional VT mode is selected by initiating the fuze with +300 Vdc. When the fuze is initiated with +300 Vdc, the Mk 43 operates automatically.

The fuze circuitry produces a lobe pattern. It radiates a pattern at right angles (fig. 3-20) to the longitudinal axis of the weapon.



220.642

Figure 3-19.—Mk 43 Mod 0 VT element.

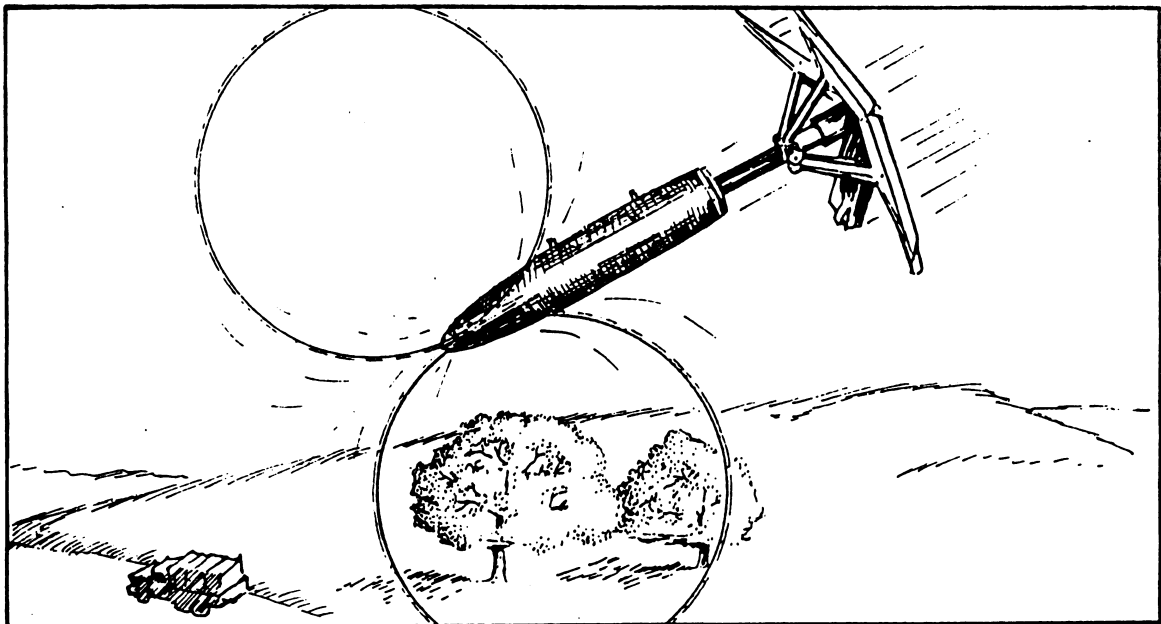


Figure 3-20.—Mk 43 lobe pattern.

When the Mk 43 is initiated by the conventional method, fuze functioning occurs instantaneously when a firing pulse is received from the thermal battery. If the alternate method is used (striker rod), the fuze is set for either of the two functioning delays—DLY 1 for 0.015-second delay or DLY 2 for 0.100-second delay. Detonation of the bomb is delayed by either 0.015 second or 0.100 second, depending on the delay that is selected.

REVIEW NUMBER 6

- Q1. All electric capability for Mk 80 with either conical or retarding fins, thermally protected bombs, and laser-guided bombs is provided by _____.
- Q2. No unusual RADHAZ precautions are taken when using Mk 344 or Mk 376 fuzes because they are classified as _____.
- Q3. Name the electric fuze that is used for retarded delivery of the Mk 80 (series) bomb.
- Q4. List the functions of the Mk 31 safety device.
- Q5. What is the purpose of the Mk 122 Mod 0 arming safety switch?
- Q6. What is the purpose of the Mk 43 Mod 0 target detecting device?
- Q7. What is used to power the internal circuitry of the TDD?

SAFETY PRECAUTIONS

Learning Objective: *Recognize the safety precautions to follow when working with bomb fuzes and associated components.*

Most fuzes contain a charge of high explosives and must be handled carefully. When compared to the burster charge, the amount of explosives is small, but, the explosives in fuzes are much more sensitive. Fuzes are manufactured to meet all safety requirements when used properly. However, the safety features designed in any weapon or explosive component are only as reliable as the person using it.

Fuzes are packed in sealed, moistureproof containers. Do not unseal them until the fuzes are required for use. Fuzes unpacked and not used should be returned to their original condition, repacked, and dated. Once the hermetic seal is broken, these fuzes should be used before those that are still hermetically sealed. Mk 344 or Mk 376 electric fuzes that have been removed from their sealed containers and whose shipping caps have been removed and repacked for more than 30 days must be disposed of according to current directives. Additionally, dispose of electric fuzes exposed to excessive moisture, regardless of length of time.

Fuzes must be handled carefully at all times and should never be dropped, tumbled, dragged, or thrown. They should not be struck with a hammer or any tool, either to open the container or to align them in a stowage rack.

Fuzes should not be packed or unpacked in the magazine. When a fuze is unpacked, it should be examined to ensure that the shipping seals are intact and that the arming stem is not unscrewed. Safety cotter pins, shipping wires, and seals should be left in place until the arming wire is assembled into the fuze. Arming vane assemblies must not be bent or distorted.

REVIEW NUMBER 7

- Q1. What is the maximum length of time that a Mk 344 or Mk 376 electrical tail fuze can be used after they are removed from their container?
- Q2. In what location should you never pack or unpack fuzes?

(THIS PAGE IS INTENTIONALLY LEFT BLANK.)

REVIEW NUMBER 6 ANSWERS

- A1. *All electric capability for Mk 80 with either conical or retarding fins, thermally protected bombs, and laser-guided bombs is provided by Mk 344 and Mk 376 electric bomb fuzes.*
- A2. *No unusual RADHAZ precautions taken when using Mk 344 or Mk 376 fuzes because they are classified as HERO SAFE.*
- A3. *The Mk 376 electric fuze is used for retarded delivery of the Mk 80 (series) bomb.*
- A4. *The functions of the Mk 31 safety device are to adapt the fuze to the fuze well of the bomb, mechanically safe the fuze, and to unlock the timer-decelerometer.*
- A5. *The Mk 122 Mod 0 arming safety switch is used to open a circuit and provide a RADHAZ shield to prevent electromagnetic radiation from entering the fuze circuits.*
- A6. *The Mk 43 Mod 0 target detecting device is used to provide airburst capability for electrically fuzed Mk 80 bombs.*
- A7. *A thermal battery, initiated by a +300 volts dc or striker rod, is used to power the internal circuitry of the TDD.*

REVIEW NUMBER 7 ANSWERS

- A1. *Don't use a fuze that has been removed from its hermetically sealed container for over 30 days.*
- A2. *Never unpack fuzes from their containers in the magazine.*

CHAPTER 4

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 missile that could be fired without recoil from an aircraft.

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

AIRCRAFT ROCKETS

Learning Objective: State the principles of rocket propulsion. Identify rocket components to include motors, warheads, and fuzes. Identify the purpose and use of service rocket assemblies to include the 2.75-inch FFAR and LSFFAR and 5.00-inch FFAR.

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

ROCKET AND ROCKET FUZE TERMINOLOGY

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

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

Igniter. The initiating device that ignites the propellant grain. It is usually an assembly

consisting of an electric squib, match composition, black powder, and magnesium powder.

Hangfire. A misfire that later fires from delayed ignition.

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

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

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

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

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

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

PRINCIPLES OF ROCKET PROPULSION

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

As you read this section, refer to figure 4-1. To understand how a rocket operates, visualize a closed container containing 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. The size of the opening is restricted by a Venturi-type nozzle (view C). The Venturi-type nozzle decreases the turbulence of escaping gases and increases the thrust. In this design, gas pressure inside the container provides about 70 percent of the force, and the escaping gases provide about 30 percent of the force necessary to move the container forward.

ROCKET COMPONENTS

A complete round of service rocket ammunition consists of three major components—the

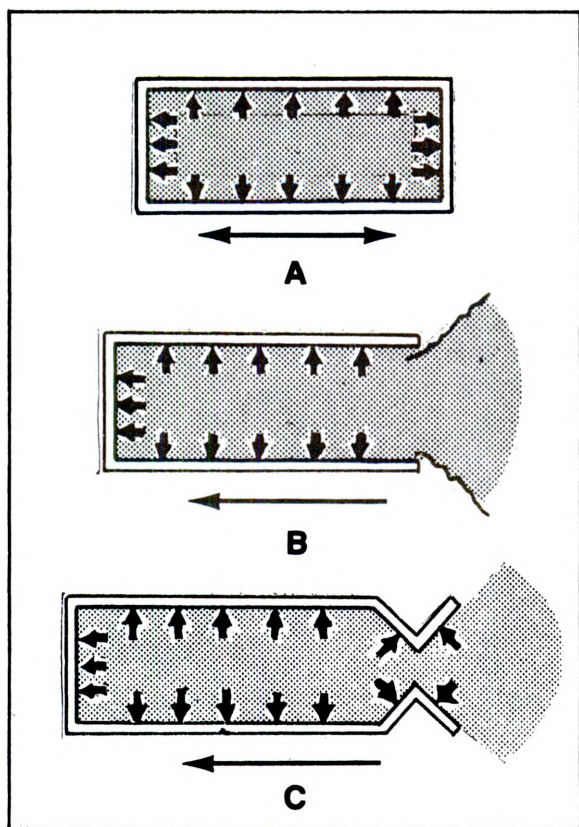


Figure 4-1.—Principles of rocket propulsion.

motor, the warhead, and a fuze. A general description of these components is given in the following paragraphs.

Motors

The rocket motor consists of components that propel and stabilize the rocket in flight. Not all rocket motors are identical, but they do have certain common components. These components are the motor tube, propellant, inhibitors, stabilizing rod, igniter, and nozzle and fin assembly. The rocket motors discussed in the following paragraphs are for the 2.75-inch Mk 4 Mods, Mk 40 Mods, and the 5.0-inch Mk 16 Mods, and Mk 71 Mods.

MOTOR TUBE.—The motor tube (fig. 4-2) 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 4 Mods 1 through 6 and the Mk 40 Mod 0 have a nonintegral (two-piece) bulkhead at the forward end of the tube. This bulkhead has a disc that *blows out* in case of accidental propellant ignition before installation of the warhead. This action neutralizes rocket thrust by allowing gas produced by the burning propellant to escape from both the forward and aft ends of the motor tube, making it nonpropulsive. **It is still a fire hazard.** All other Mark and Mod motors discussed in this chapter have tubes with integral bulkheads that do not rupture. In case of accidental propellant ignition, these motors are propulsive, becoming a missile hazard as well as a fire hazard.

PROPELLANTS.—The propellant grain (fig. 4-2) 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.

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 diametral surface. The forward and aft end inhibitors are molded plastic (ethyl cellulose) components bonded to the propellant ends. The outer surface inhibitor is spirally

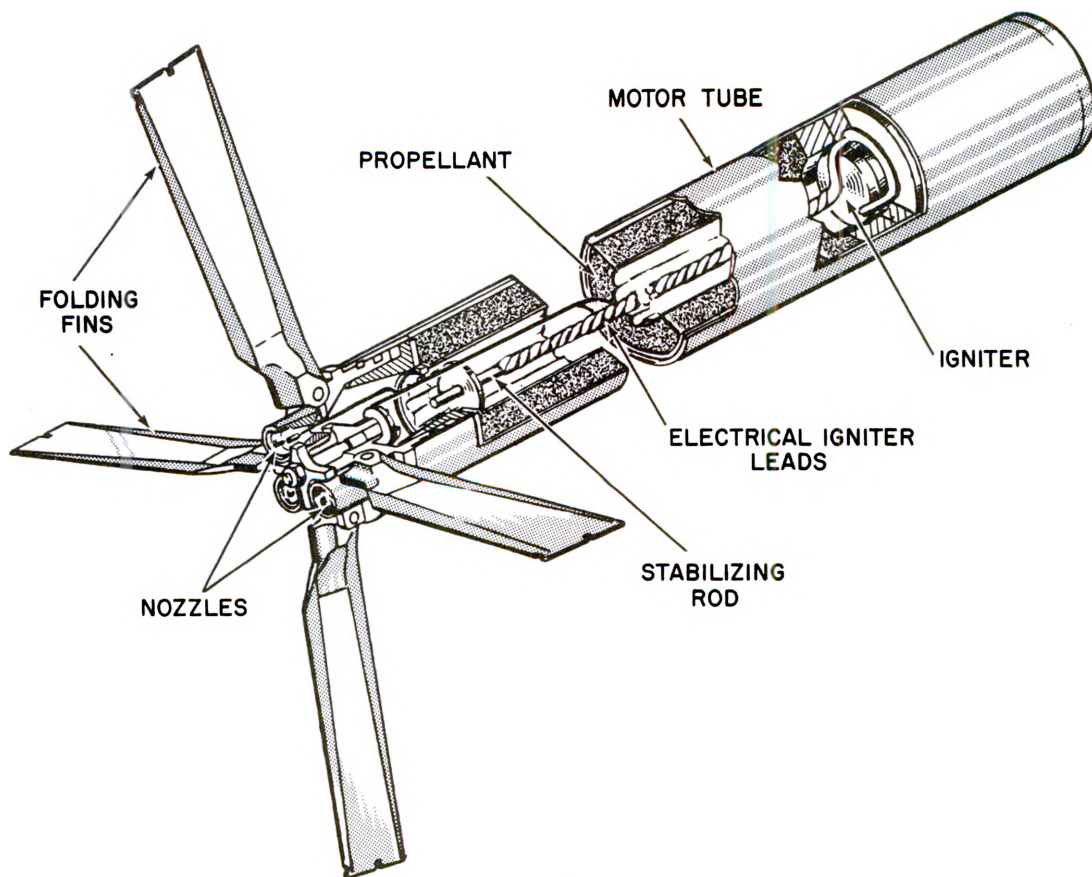


Figure 4-2.—Components of a typical rocket motor.

wrapped ethyl cellulose tape bonded to the propellant surface.

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

STABILIZING ROD.—The stabilizing rod (fig. 4-2), located in the perforation of the motor propellant grain, is salt coated to prevent unstable burning of the propellant. It also reduces flash and afterburning 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 (fig. 4-2) 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 pellet charge, two squibs, and electrical lead wires. It is located at the forward end of the motor. A contact disc or a contact band transmits the firing impulses to the motor igniter.

The 2.75-inch motor has electrical leads that extend from the squib through the wall of the igniter. They are routed through the propellant perforation to the nozzle fin assembly. One of the wires is connected to the nozzle plate (ground), and the other passes through either one of the

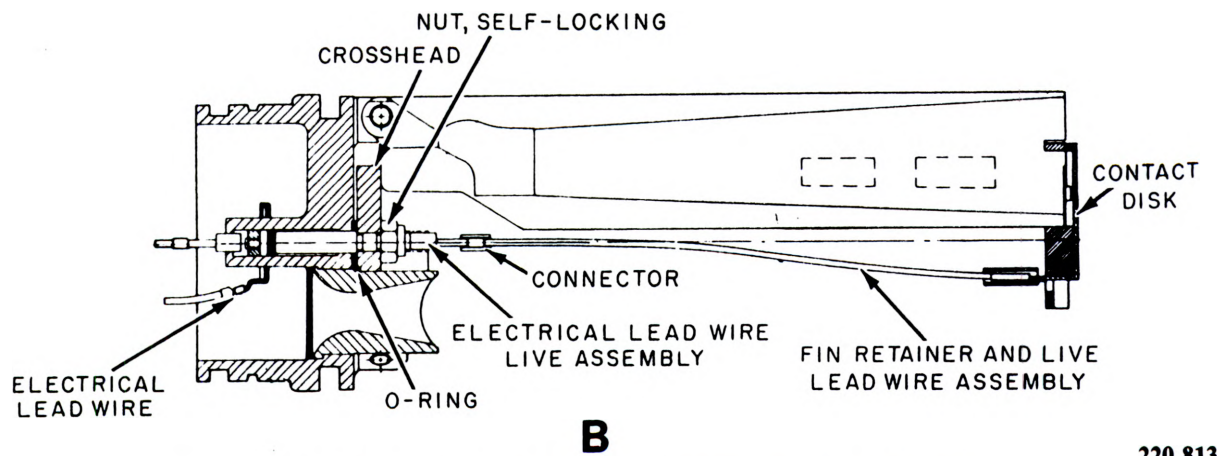
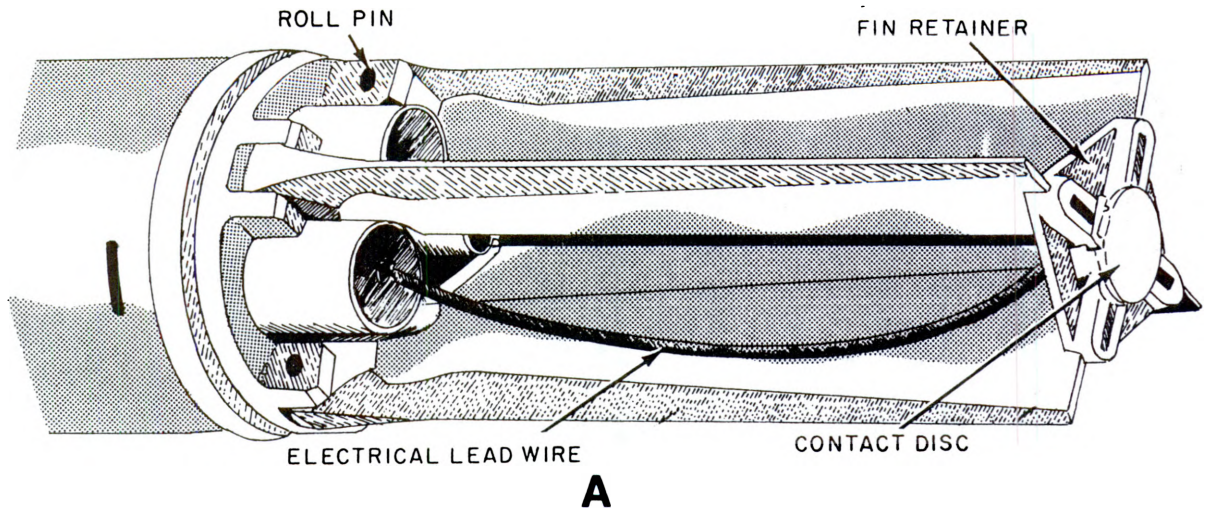


Figure 4-3.—Typical center electrical lead wire connection (2.75-inch motor).

220.813

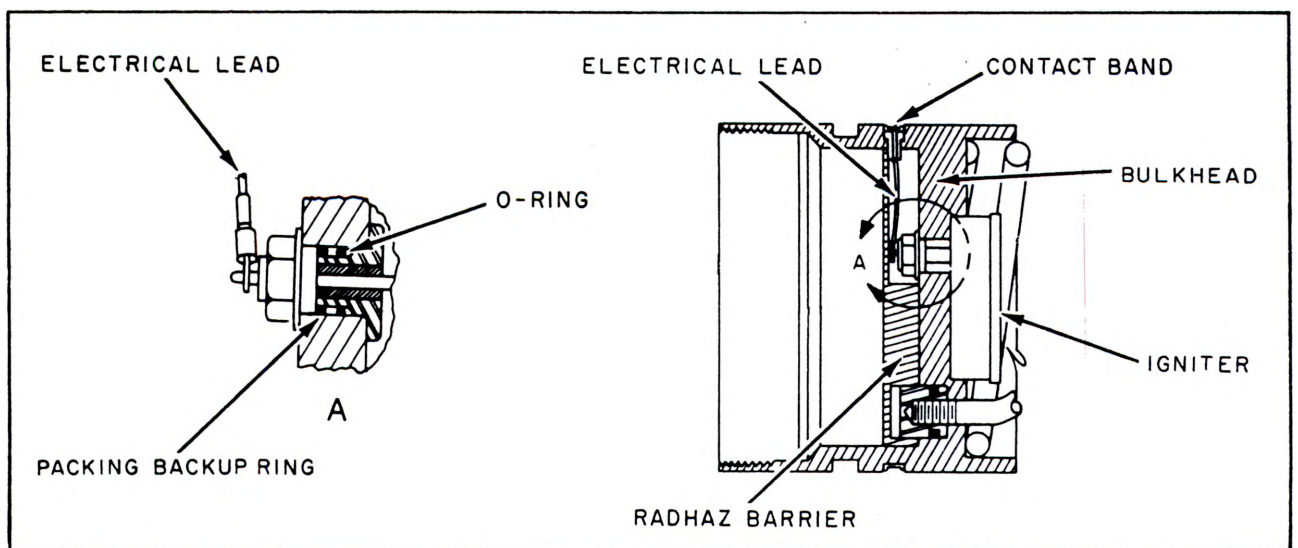


Figure 4-4.—Typical center electrical lead wire connection (5.0-inch motor).

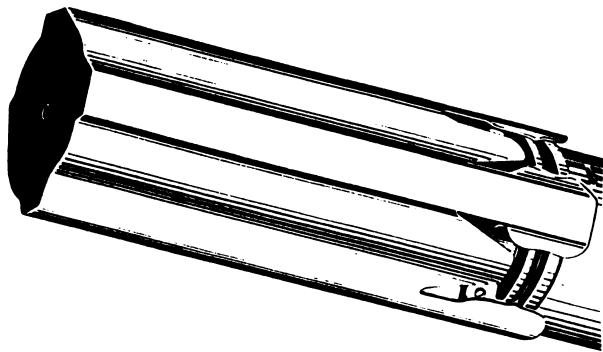


Figure 4-5.—Fin protector in place.

nozzles (fig. 4-3, view A) or the fin-actuating piston (fig. 4-3, view B) to the contact disc (fig. 4-3, views A and B) on the fin retainer. When the rocket is placed in the launcher, the contact disc is automatically in contact with an electrical terminal that transmits the firing impulse to the rocket.

The igniter in the 5.0-inch motor (fig. 4-4) 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 is automatically in contact with an electrical terminal, which transmits the firing impulse to the rocket.

Both the 2.75-inch and 5.0-inch rockets are susceptible to radio-frequency energy when they are not installed in the launchers.

When stowed and shipped separately from the launcher, the Mk 4 and Mk 40 motor fins are covered with a fin protector (fig. 4-5), which is an elongated steel can. A conical-coiled steel spring riveted to the center of the base inside the fin protector makes contact with the insulated contact disc at the aft end of the fins. This shorts out the igniter firing circuit to prevent accidental firing of the motor.

If Mk 16 and Mk 71 motors aren't shipped and stowed in a launcher. They are shipped and stowed in individual, padded, wooden crates. Fin protectors are not used. Until actually loaded into a launcher, a metal shielding band (fig. 4-6) is always in place over the ignition contact band.

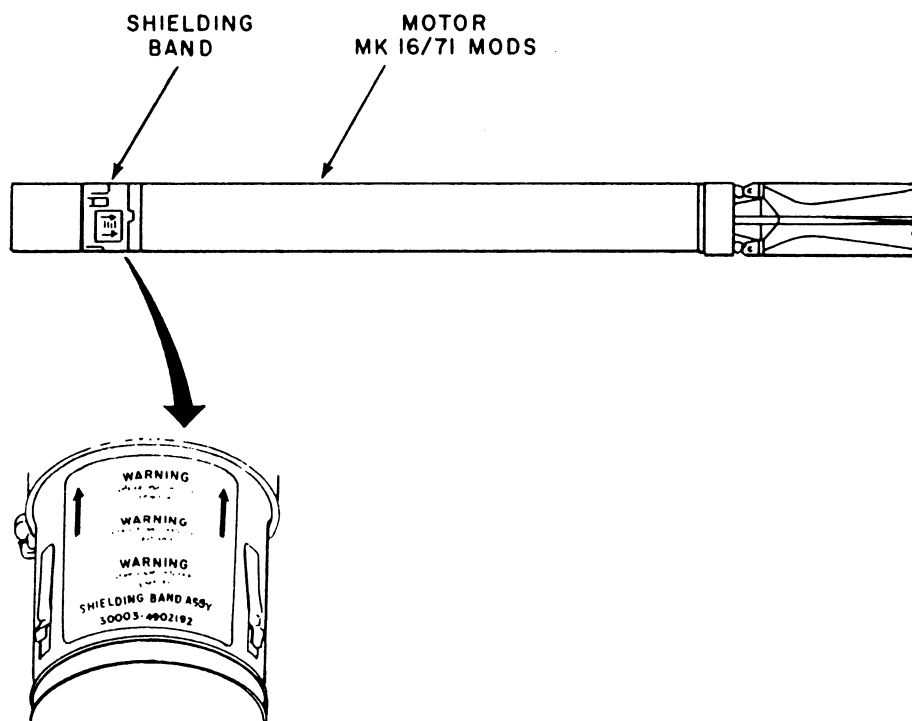


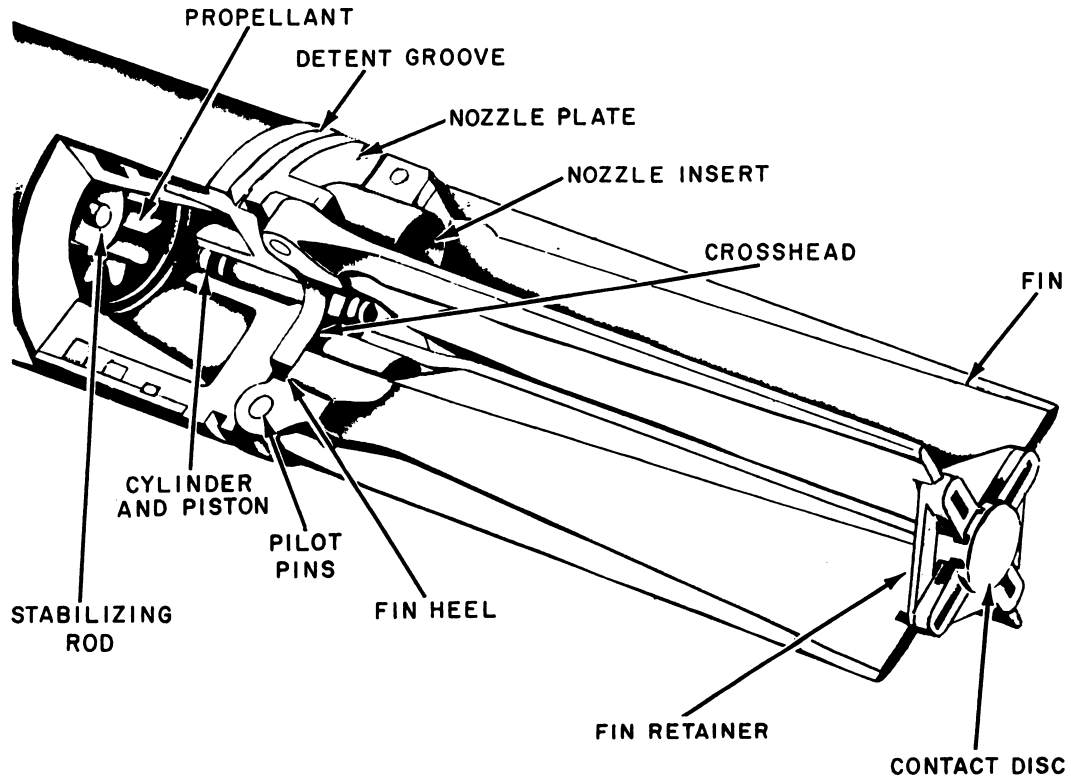
Figure 4-6.—Shielding band for 5.0-inch FFAR.

NOZZLE AND FIN ASSEMBLIES.—The nozzle and fin assembly (fig. 4-7) used with the Mk 4 and Mk 40 motors consists of a nozzle plate, four nozzle inserts, a fin-actuating mechanism, four fins, and a fin retainer contact disc.

The fins are attached by pivot pins 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



220.815

Figure 4-7.—Nozzle and fin assembly (2.75-inch).

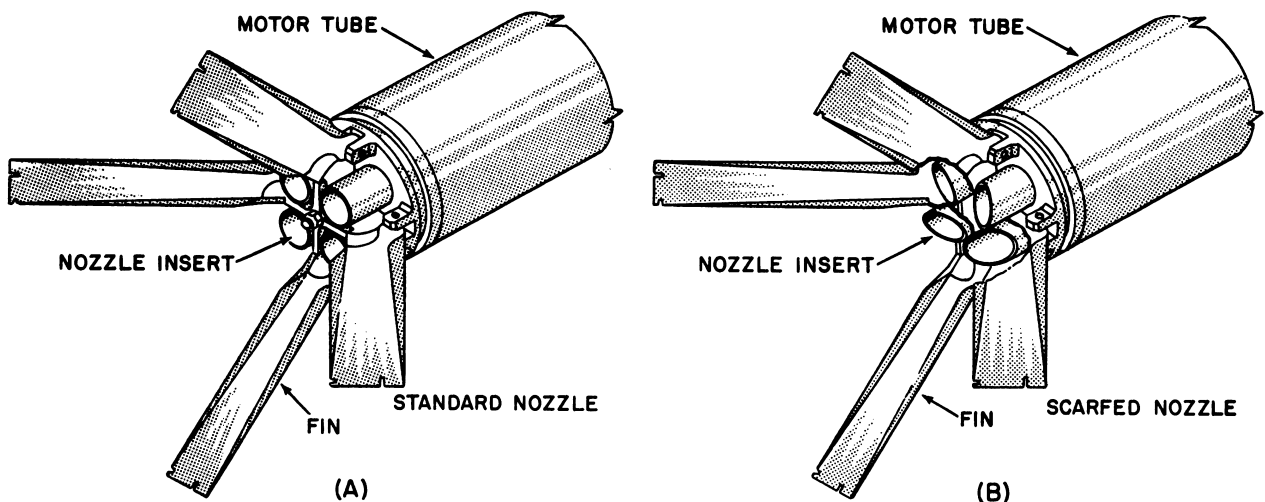


Figure 4-8.—Nozzle and fin assemblies. (A) Mk 4 Mods motor; (B) Mk 40 Mods motor.

the motor operates the piston, cylinder, and crosshead. The crosshead is pushed against the heels of the fins, causing the fins to rotate on the fin pivot pins to the open position after the rocket leaves the launcher. After the fins have opened to the final flight position, the crosshead prevents the fins from closing.

There are four nozzle inserts and the detent groove in the aft end of the nozzle plate. They hold the rocket in position after it is loaded in the launcher (fig. 4-8). The major difference between the nozzle and fin assemblies used on the Mk 4

and Mk 40 motors is the type of nozzle inserts used.

The nozzle inserts of the Mk 4 motors are standard, or straight cut (fig. 4-8, view A), while the Mk 40 motor nozzle inserts are scarfed, or cut at an angle (fig. 4-8, view B). The scarfed nozzles used on the Mk 40 motor impart a stabilizing spin to the rocket when launched at low initial-launch speeds, such as from helicopters and low-speed aircraft. A rocket using the Mk 40 motor is designated a LSFFAR (low-speed, folding-fin, aircraft rocket) and is used only on helicopters or low-speed aircraft.

All Mk 16 motors have a single nozzle with four straight folding fins (fig. 4-9) that attach to the aft end of the motor tube by threads. To protect the propellant grain from moisture and to promote propellant grain ignition, the nozzle opening is closed by a thin metal seal and a foam plug. A light plastic fin retainer holds the fins folded within the diameter of the rocket until propellant ignition. On ignition, the fin retainer is blown off. Gas pressure exerted on the heels of the fins pushes the fins open as they emerge from the launcher tube. The fins are then locked in the flight position by the spring-loaded pawls.

The Mk 16 Mod motor has a modified igniter and a modified nozzle and fin assembly. The nozzle and fin assembly (fig. 4-10) contains four, spring-loaded, wrap-around 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

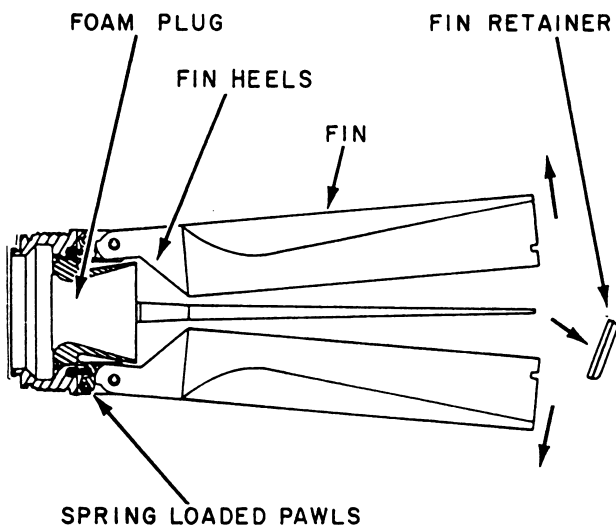


Figure 4-9.—Mk 16 motor, nozzle, and fin assembly.

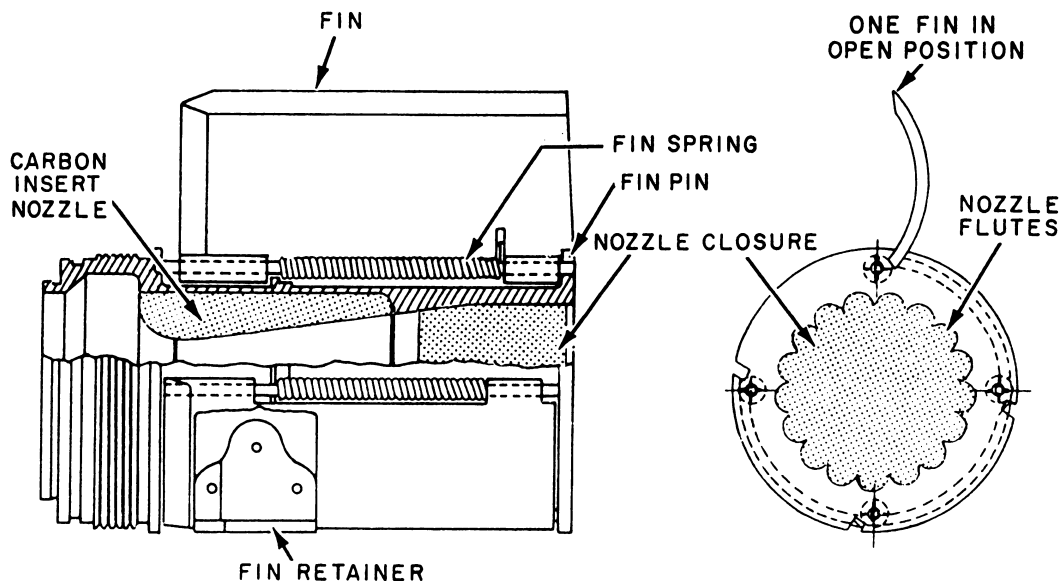
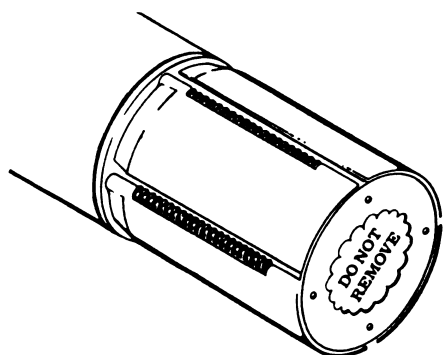


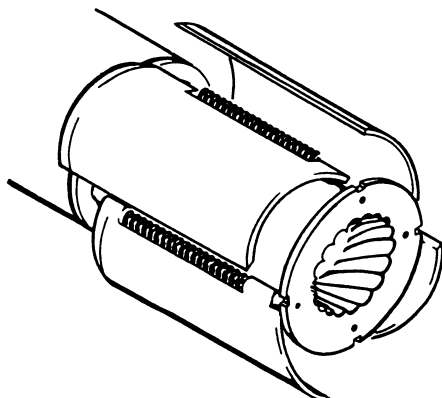
Figure 4-10.—Mk 71 Mod 0 motor, nozzle, and fin assembly.

high-speed aircraft, helicopters, and low-speed aircraft.

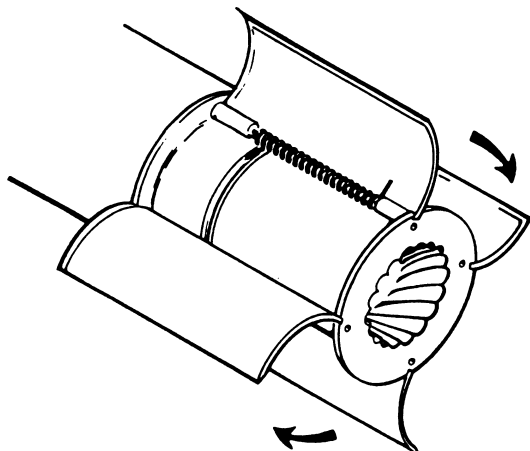
The Mk 71 Mods spring-loaded fins (fig. 4-11) deploy after emerging from the rocket launcher tube. They lock in place (open) by sliding into a locking slot in the flange at the aft end of the fin nozzle assembly. When not actually installed in the launcher, the fins are held in the closed



CLOSED-IN LAUNCHER TUBE



PARTIALLY OPEN-LAUNCHED



FULLY OPEN-SPINNING 60 RPS

Figure 4-11.—Mk 71 Mods motor, nozzle, and fin assembly.

position by a fin retainer band, which must be removed when the rocket is installed into the launcher tube.

REVIEW NUMBER 1

- Q1. List the two rockets currently used by the Navy.

- Q2. If a rocket does not fire when the firing circuit is energized, it is known as a _____.

- Q3. What is meant by the rockets thrust?

- Q4. In rocket propulsion, the Venturi nozzle decreases turbulence of escaping gases and increases thrust. Gas pressure inside the container provides about _____, and the escaping gases provide about _____ to move the container forward.

- Q5. List the three components of a rocket.

- Q6. List the components of rocket motors.

- Q7. What is the purpose of the inhibitor?

- Q8. What rocket component is salt coated to prevent unstable burning of the rocket propellant?

- Q9. When are rockets most susceptible to radio-frequency (RF) energy?

Q10. Name the type of nozzle installed in the Mk 40 rocket motor.

Q11. Explain the difference between the M16 and Mk 71 rocket motors.

Q12. When should you remove the fin retainer band on a Mk 71 rocket motor?

Warheads

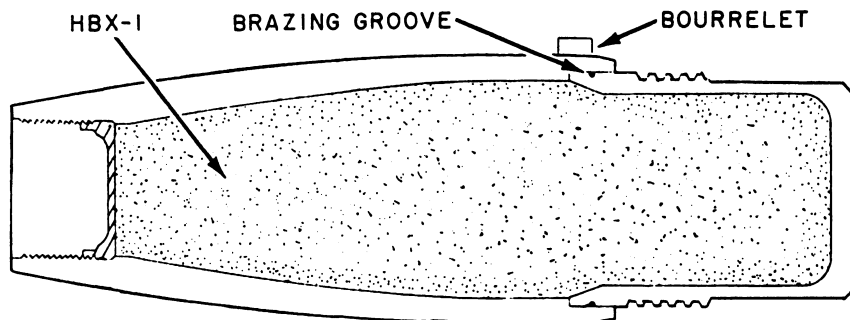
Different tactical requirements demand different types of rocket warheads be used with airborne rockets. Warheads are classified as either 2.75 inch or 5.0 inch warheads. They may be further classified as high-explosive, flechette, smoke, flare, or practice. Warheads for 2.75-inch rockets are normally received with the fuzes installed.

There are many different warheads, fuzes, and motor combinations available. Therefore, the following discussion is general. For specific component information, you should refer to *Airborne Rockets*, NAVAIR 11-85-5.

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

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

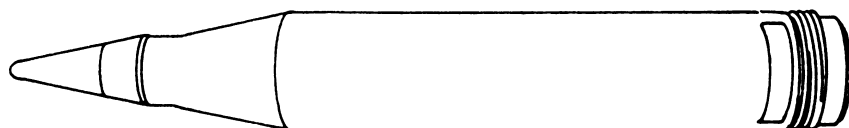
HE-FRAG WARHEADS.—High-explosive fragmentation (HE-FRAG) warheads (fig. 4-12) are used against personnel and light material targets such as trucks and parked aircraft. Upon detonation, a large quantity of metal fragments accelerate to a high velocity. This action damages



MK I MOD 5 CONFIGURATION



MK 64 MOD 0 CONFIGURATION (WITH FUZE INSTALLED)



MK 63 MOD 0 CONFIGURATION (WITH FUZE INSTALLED)

Figure 4-12.—High-explosive fragmentation (HE-FRAG) warheads.

the target. The types of HE-FRAG warheads currently in use are listed in table 4-1.

HEAT WARHEADS.—High-explosive antitank (HEAT) warheads (fig. 4-13) are used against armored targets such as tanks, bunkers, and armored vehicles. The warhead contains a shaped-charge. When detonated, it produces a

high-energy jet that penetrates armored targets. The only HEAT warhead currently in use is the Mk 5 Mod 0.

AT/APERS WARHEAD.—The high-explosive antitank/antipersonnel (AT/APERS) warhead (fig. 4-14) combines the effectiveness of the HE-FRAG and HEAT warheads. The

REVIEW NUMBER 1 ANSWERS

- A1. *The two rockets currently used by the Navy are the 2.75-inch Mighty Mouse and the 5.0-inch Zuni.*
- A2. *If a rocket does not fire when the firing circuit is energized, it is known as a misfire.*
- A3. *Thrust is the force exerted by the gases produced by the burning of the rocket motor propellant.*
- A4. *In rocket propulsion, the Venturi nozzle decreases turbulence of escaping gases and increases thrust. Gas pressure inside the container provides about 70% of the force, and the escaping gases provide about 30% of the force to move the container forward.*
- A5. *The three components of a rocket are the motor, warhead, and fuze.*
- A6. *The components of rocket motors include the motor tube, propellant, inhibitors, stabilizing rod, igniter, and nozzle and fin assembly.*
- A7. *The inhibitor restricts or controls burning on the propellant.*
- A8. *The stabilizing rod is salt coated to prevent unstable burning of the rocket propellant.*
- A9. *Rockets most susceptible to radio-frequency (RF) energy when they aren't installed in the launcher.*
- A10. *The scarfed nozzle installed in the Mk 40 rocket motor.*
- A11. *The Mk 16 rocket motor has a modified igniter, nozzle, and fin assembly.*
- A12. *You should remove the fin retainer band on the Mk 71 rocket motor when the rocket is installed into the launcher tube.*

Table 4-1.—Service Warheads

TYPE	2.75-INCH	5.0-INCH
HE-FRAG	Mk 1 Mod 1, 3, 4, 5 and 7 Mk 64 Mod 0	Mk 63 Mod 0
HEAT	Mk 5 Mod 0	-----
AT/APERS	-----	Mk 32 Mod 0
GP	-----	Mk 24 Mod 0
FLECHETTE	WDU-4/A WDU-4A/A	-----
SMOKE	M156 Mk 67 Mod 0	Mk 34 Mod 0 and 1
FLARE	-----	Mk 33 Mod 1

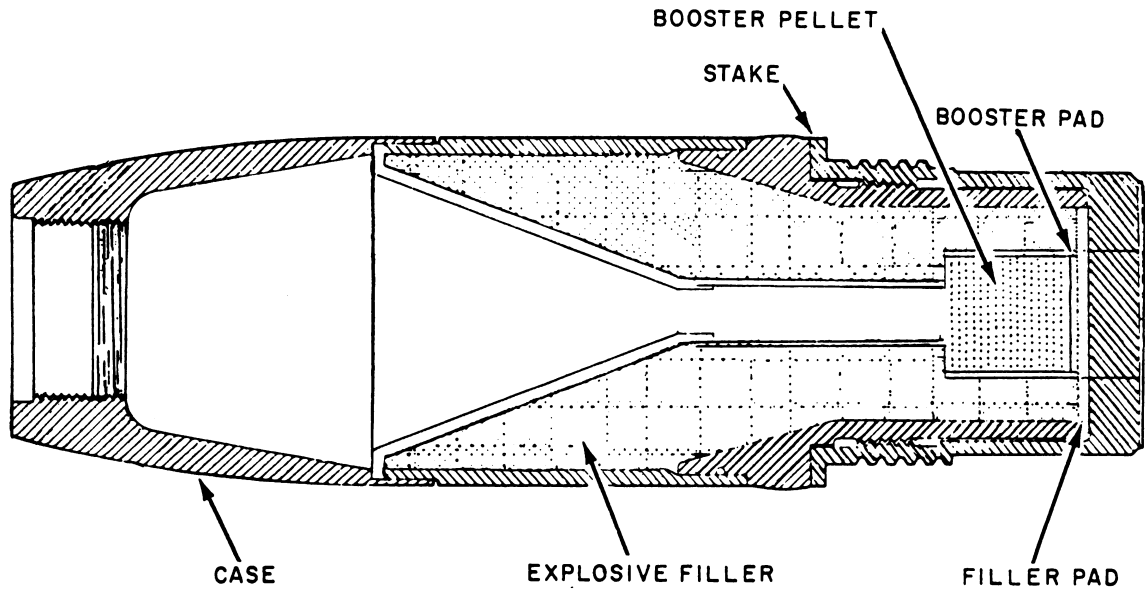


Figure 4-13.—Mk 5 Mod 0 high-explosive antitank warhead (HEAT).

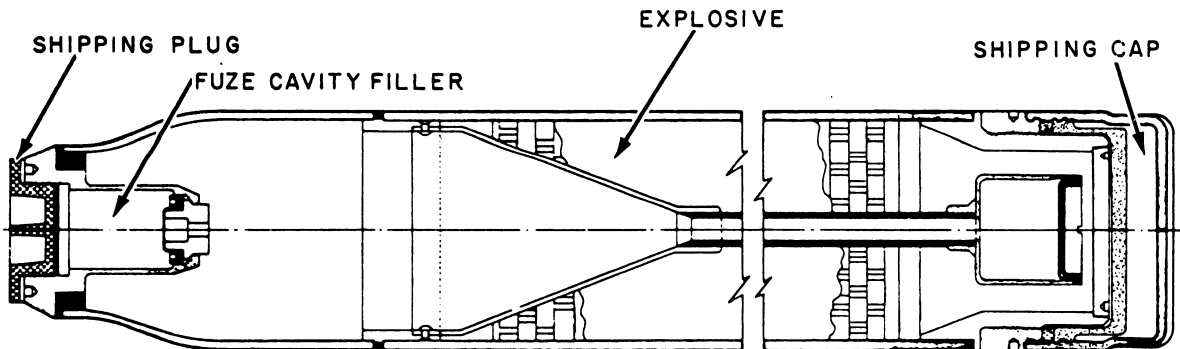


Figure 4-14.—Mk 32 Mod 0 high-explosive antitank/antipersonnel warhead (AT/PERS).

explosive shaped-charge in the AT/APERS warhead detonates at the aft end, producing the jet from the cone at the forward end. The booster in the aft end detonates the warhead by transmitting an explosive impulse along a length of detonating cord. It connects the booster charge to the initiating charge, which is next to the nose fuze. The combination of an instantaneous-acting nose fuze and rapid-burning detonating cord permits detonation of the explosive load in time for the shaped-charge to produce its explosive jet before being disintegrated upon target impact. The only AT/APERS warhead currently in use is the Mk 32 Mod 0.

GP WARHEAD.—The high-explosive general-purpose (GP) warhead (fig. 4-15) 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.

The GP warhead is used against a variety of targets. Maximum penetration is obtained by using a solid nose plug and the delayed-action base fuze. Its maximum blast effect is obtained by using an instantaneous-acting nose fuze. The only GP warhead currently in use is the Mk 24 Mod 0.

FLECHETTE WARHEADS.—Flechette warheads (fig. 4-16) are 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

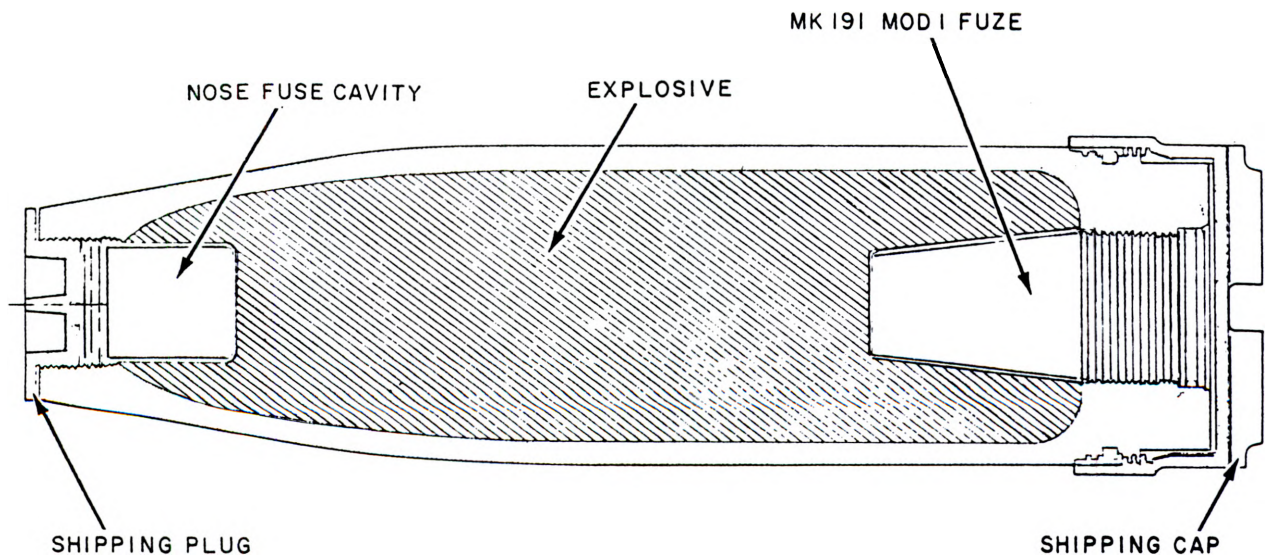


Figure 4-15.—Mk 24 Mod 0 high-explosive general-purpose warhead (GP).

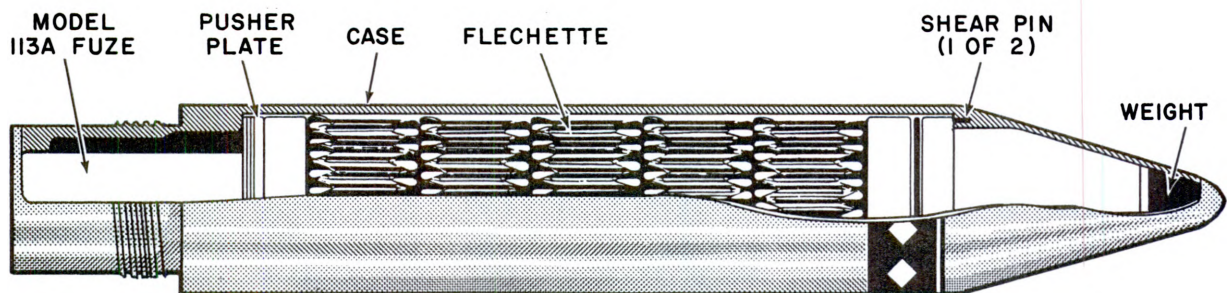


Figure 4-16.—WDU-4/A flechette warhead.

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.

The two flechette warheads currently in use are the WDU-4/A (fig. 4-16) and the WDU-4A/A. They differ only in the size and

number of flechettes contained in the warhead. The olive drab warhead may have a brown band around the nose. The brown band has a band of white diamond shapes painted on it.

SMOKE WARHEADS.—Smoke warheads (fig. 4-17) are used to produce a volume of heavy

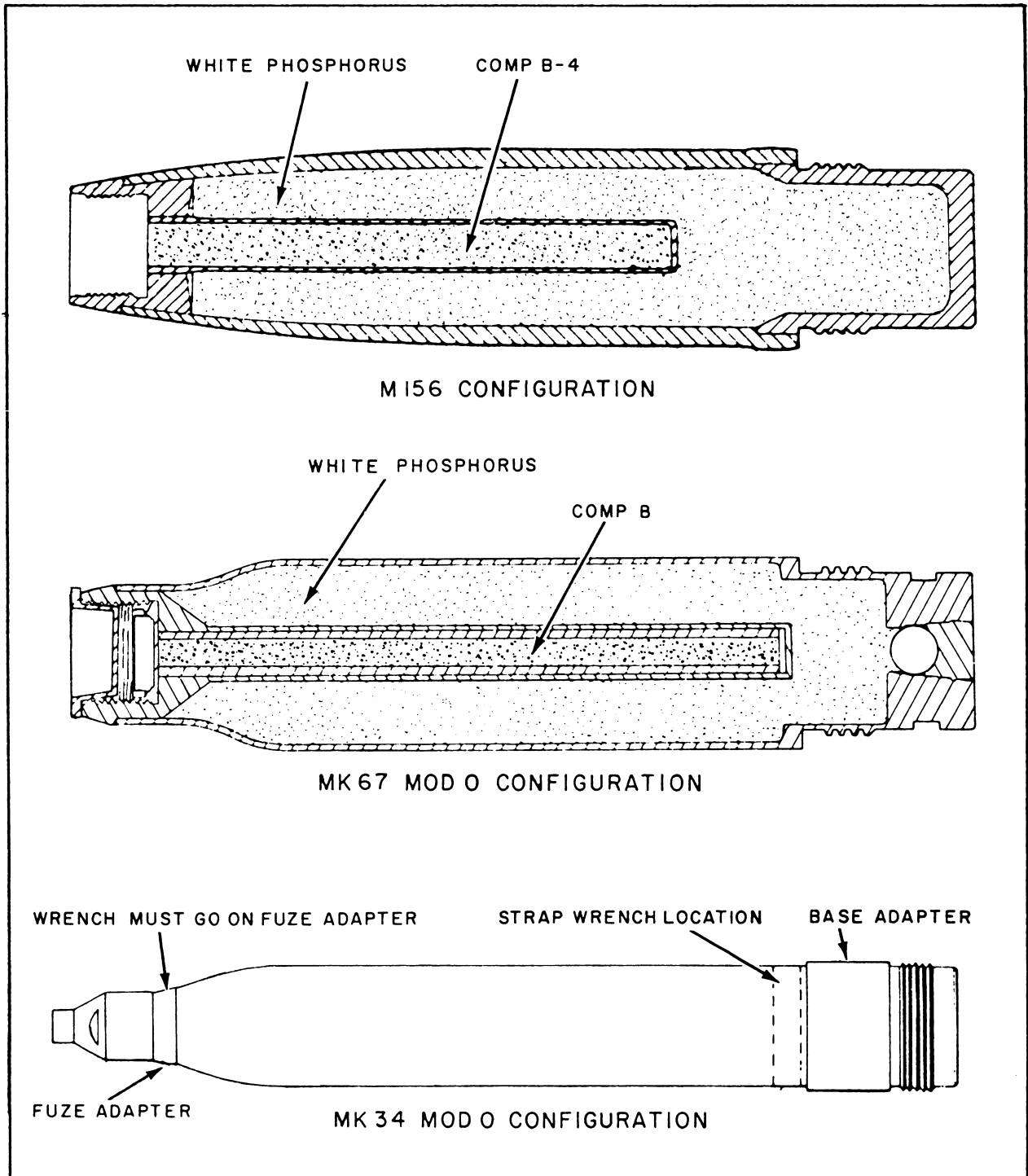
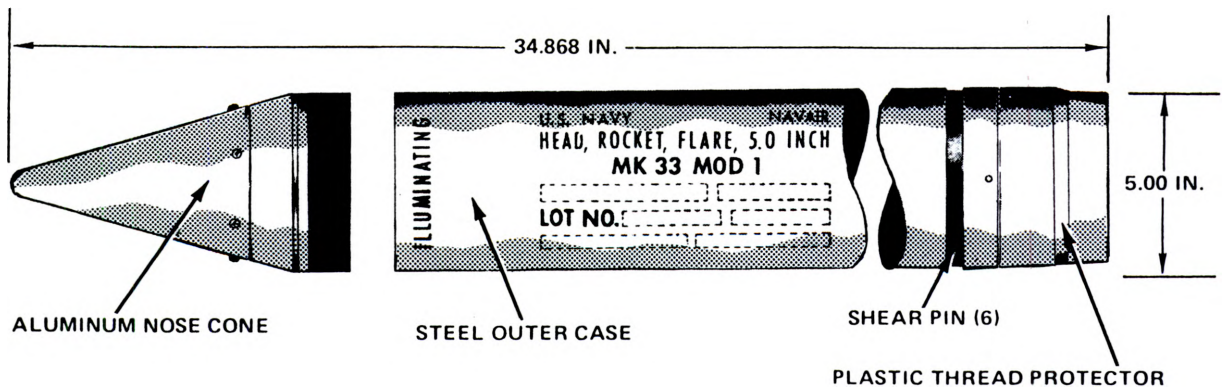


Figure 4-17.—Smoke warheads.



220.822

Figure 4-18.—Mk 33 Mod 1 flare warhead.

smoke for target marking. The warhead contains a burster tube of explosives, usually comp-B, which bursts the walls of the warhead, dispersing the smoke. These warheads are designated SMOKE, followed by the abbreviation for the smoke producing agent it contains. For example, WP for white phosphorus, or PWP for plasticized white phosphorus. The types of smoke warheads currently in use are listed in table 4-1.

FLARE WARHEADS.—Flare warheads (fig. 4-18) are used to illuminate tactical operations. They consist of a delay-action fuze, an illuminating candle, and a parachute assembly. The fuze ignites the expelling charge, which separates the case from the candle and parachute assembly. The wind stream forces the parachute open, suspending the burning candle. The only flare warhead currently in use is the Mk 33 Mod 1.

PRACTICE WARHEADS.—Practice warheads (fig. 4-19) are either dummy configurations or inert-loaded service warheads. In the inert-loaded service warheads, the weight and placement of the filler gives the practice warhead the same ballistic characteristics as the explosive-loaded service warhead. A steel nose plug is assembled in the practice heads in place of the nose fuze. The entire surface, except for the stenciled marking, is painted blue. The practice warheads currently in use are listed in table 4-2.



110.147

Figure 4-19.—Typical practice warhead.

REVIEW NUMBER 2

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

Fuzes

Table 4-2.—Practice Warheads

2.75-INCH	5.0-INCH
Mk 1 Mod 1, 2, 3, 4, and 5 WTU1/B Mk 61 Mod 0	Mk 6 Mod 7 Mk 62 Mod 0

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

A representative fuze from each class is discussed in the following paragraphs. The fuzes currently in use and their primary application are listed in table 4-3. For more detailed information

Table 4-3.—Rocket Fuzes

FUZE	CLASSIFICATION	APPLICATION
Mk 176 Mod 1	Nose impact (PD)	2.75-inch
Mk 178 Mod 1 and 2	Nose impact (PD)	2.75-inch
Mk 181 Mod 0 and 1	Nose impact (PD)	2.75-inch
Mk 188 Mod 0	Nose impact (PD)	5.0-inch
Mk 352 Mod 2	Nose impact (PD)	2.75 and 5.0-inch (Note 1)
FMU-90/B	Nose impact (PD)	2.75 and 5.0-inch (Note 1)
M423	Nose impact (PD)	2.75-inch (Note 2)
M427	Nose impact (PD)	2.75-inch
Mk 191	Base detonating impact (BD)	5.0-inch
Mk 193 Mod 0	Mechanical time	5.0-inch
Model 113A	Acceleration-deceleration	2.75-inch
Mk 93 Mod 0/M414A1	Proximity	5.0-inch
M429	Proximity	2.75-inch

Note 1: Requires use of BBU-15/B adapter booster for 5.0-inch configurations.

Note 2: Designed for use with 2.75-inch LSFFAR's only.

on fuzes, refer to *Airborne Rockets*, NAVAIR 11-85-5.

IMPACT FIRING FUZES.—Impact firing fuzes (fig. 4-20) function when the rocket strikes a target that offers sufficient resistance to cause crushing or other disarrangement of actuating parts.

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

When located in the nose of the warhead, impact firing fuzes are known as *point-detonating* (PD) fuzes (fig. 4-20, view A). If they are located in the base of the warhead, they are known as *base-detonating* (BD) fuzes (fig. 4-20, view B). Nose and base fuzes function either instantaneously or after a short delay that gives the warhead time to penetrate the target before functioning.

MECHANICAL TIME FUZES.—Mechanical time fuzes (fig. 4-21) 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.

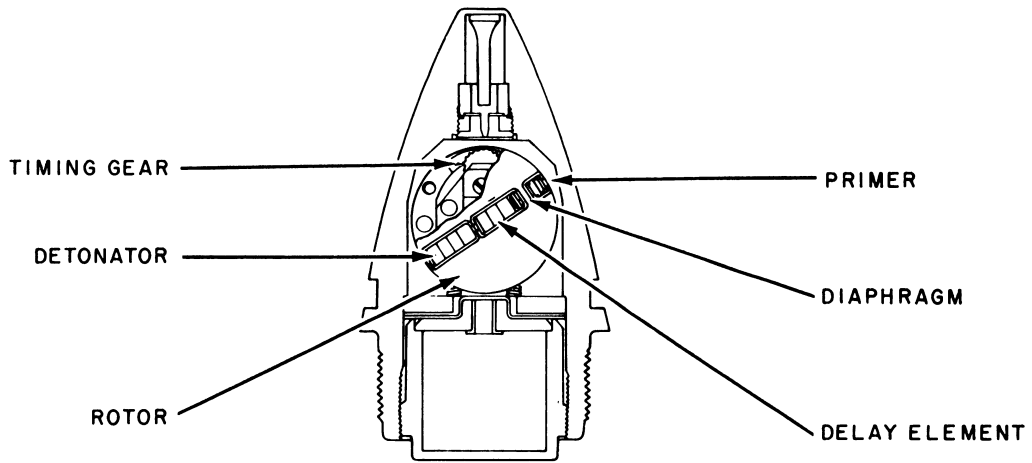
ACCELERATION-DECELERATION FUZES.—Acceleration-deceleration fuzes are similar to impact and time fuzes because they require acceleration for a given time to complete the arming cycle. After the arming cycle is completed and the rocket velocity begins to drop, deceleration causes the fuze to function.

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

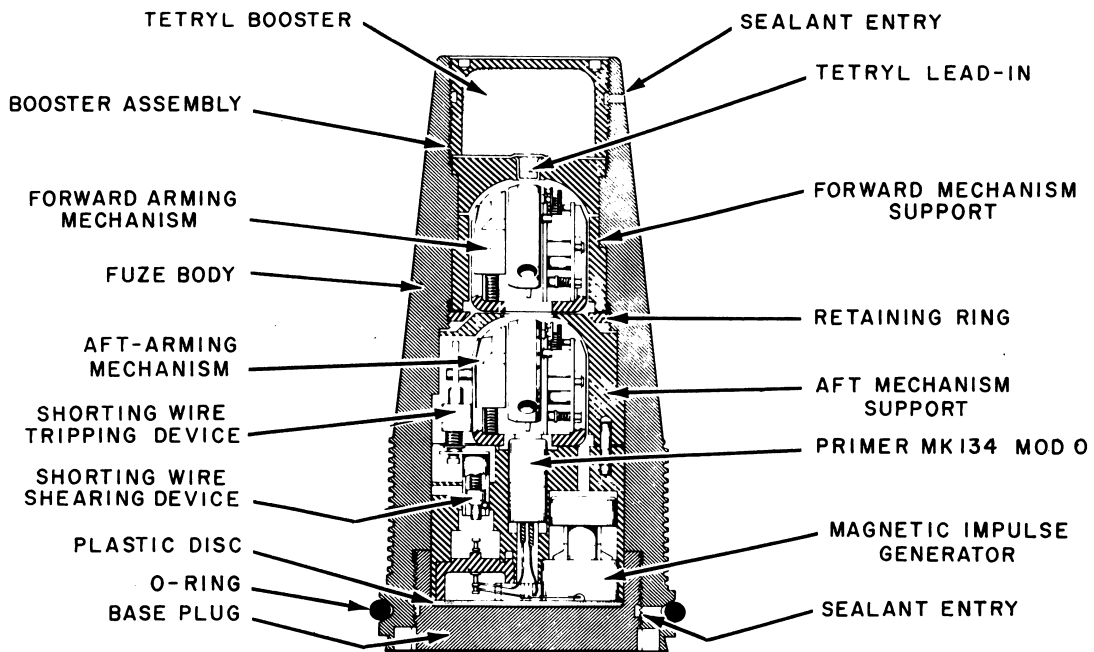
PROXIMITY FUZES.—Proximity fuzes, sometimes referred to as *VT fuzes* (fig. 4-22), initiate by “sensing,” usually by electronic means, the presence and distance of a target. Proximity fuzes are primarily used in air-to-ground operations where air bursts above the target are desired. They are not suitable for use against

REVIEW NUMBER 2 ANSWERS

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



A. MK 176 MOD 1 POINT DETONATING (PD)



B. MK 191 MOD 1 BASE DETONATING (BD)

Figure 4-20.—Impact firing fuzes.

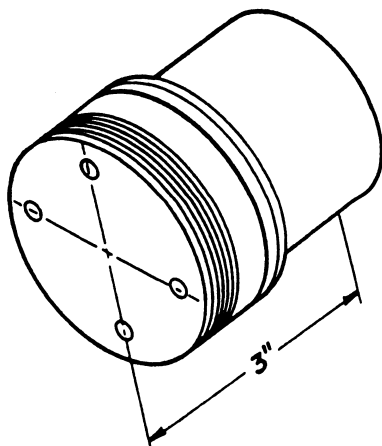


Figure 4-21.—Mk 193 Mod 0 mechanical time fuze.

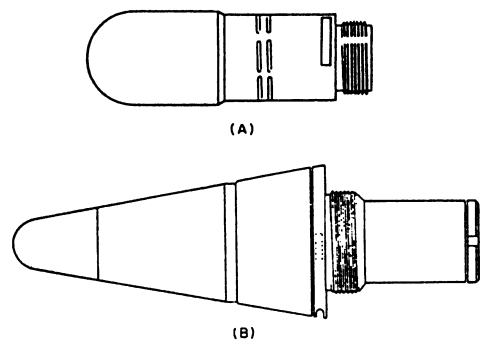


Figure 4-22.—Proximity fuzes. (A) M429; (B) Mk 93 Mod 0/M414A1.

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 (fig. 4-23).

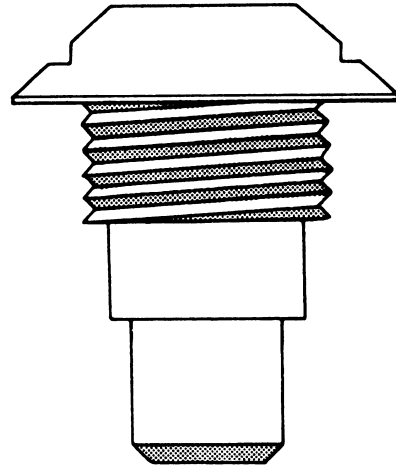


Figure 4-23.—Adapter booster BBU-15/B.

REVIEW NUMBER 3

- Q1. When classified by their mode of operation, fuzes are classified as _____.
- Q2. At what point do impact-firing fuzes function?
- Q3. List the two types of impact firing fuzes.
- Q4. At what point does the mechanical time fuze initiate the firing train?
- Q5. In acceleration-deceleration fuzes, what force causes the fuze to function?
- Q6. Name the fuze that senses, usually by electronic means, the presence and distance of a target.

SERVICE ROCKET ASSEMBLIES

Airborne rockets, consisting of fuzes, warheads, and motors, are combined and assembled in various configurations to meet specific tactical

requirements. For example, a rocket assembly consisting of a fragmentation warhead armed with a proximity fuze is entirely unsuitable for use against an armored tank or bunker. Likewise, the GP warhead fuzed only with the Mk 191 base fuze is relatively ineffective against personnel or unarmored targets. With each specific type of target, the right combination of warhead, fuze, and motor is assembled from the wide variety of components available.

2.75-Inch FFAR and LSFFAR

The 2.75-inch airborne rocket (fig. 4-24) is an effective air-to-ground weapon against most targets. The FFAR is an air-to-air weapon. Fired in large numbers to produce a shotgun pattern, FFARs are carried and launched from 7- or 19-round launcher packages. These packages are described later in this chapter.

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

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

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

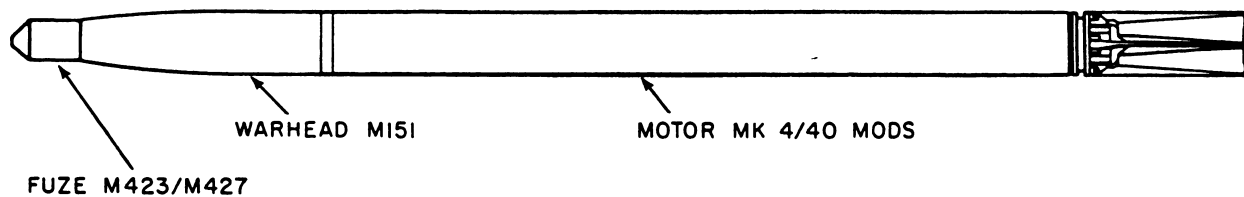


Figure 4-24.—2.75-inch FFAR/LSFFAR (typical configuration).

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

For detailed information, such as authorized assemblies, safety precautions, and restrictions,

you should refer to *Airborne Rockets*, NAVAIR 11-85-5. You can find additional information in specific aircraft loading and tactical manuals.

5.0-Inch FFAR

Like the 2.75-inch rocket, the 5.0-inch FFAR (fig. 4-25) can be assembled in various warhead and fuze combinations. The Mk 71 motor gives the additional advantage

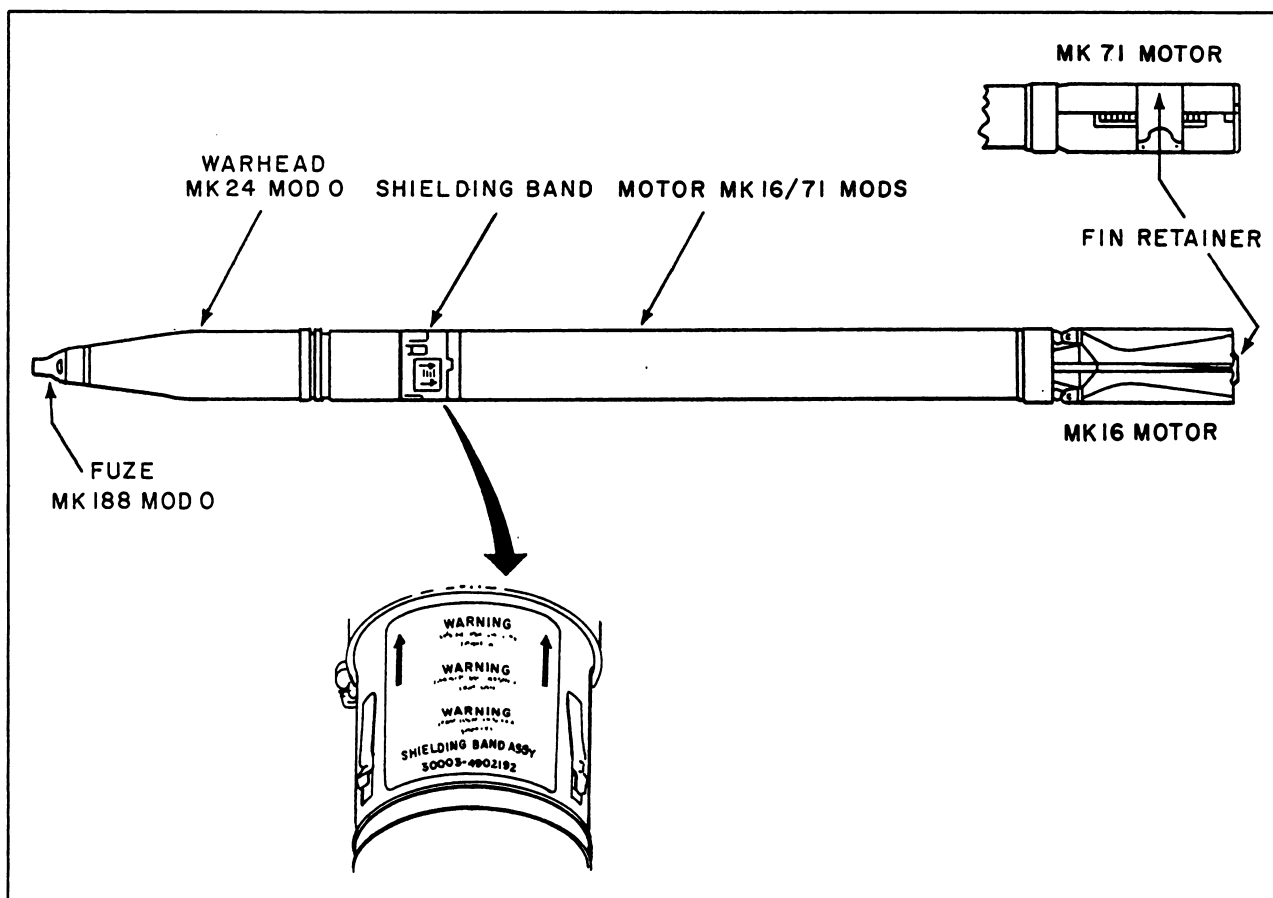


Figure 4-25.—5.0-inch FFAR (typical configuration).

of one motor for all launch-speed applications.

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

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

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

2. Separate components in separate shipping containers

REVIEW NUMBER 4

Q1. What is the usual configuration of the 2.75-inch airborne rocket?

Q2. Aboard ship, who assembles rocket components for current operations?

AIRCRAFT ROCKET LAUNCHERS

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

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

Aircraft rocket launchers are classified as either 2.75-inch or 5.0-inch. They may be further classified as either reusable or nonreusable. Launcher tubes that are constructed of metal are considered reusable and are usually returned for reloading. Under certain conditions, they may be jettisoned at the pilot's discretion. Launcher tubes constructed of paper material are designed for one-time use only, and are jettisoned by the pilot after use.

The 2.75-inch rocket launchers currently in use are the LAU-32B/A, LAU61/A, LAU-68/A, and the LAU-69/A. Characteristics and specifications for these launchers are listed in table 4-4. For detailed information about

REVIEW NUMBER 3 ANSWERS

- A1. When classified by their mode of operation, fuzes are classified as impact firing, mechanical time, acceleration-deceleration, or proximity.*
- A2. Impact-firing fuzes function when the rocket strikes the target that offers enough resistance to cause actuation of the parts.*
- A3. The two types of impact firing fuzes are the nose detonating and base detonating types.*
- A4. Upon arming, the mechanical timer starts, and after a set time, the mechanical time fuze initiates the firing train.*
- A5. In acceleration-deceleration fuzes, deceleration causes the fuze to function.*
- A6. Proximity fuzes sense, usually by electronic means, the presence and distance of a target.*

Table 4-4.—2.75-Inch Rocket Launchers

LAUNCHER TYPE	NO. OF TUBES	TUBE MATERIAL	REUSABLE	METHOD OF FIRING
LAU-32B/A	7	Alum.	Yes	Ripple or Single
LAU-61/A	19	Alum.	Yes	Ripple or Single
LAU-68/A	7	Alum.	Yes	Ripple or Single
LAU-69/A	19	Paper	No	Ripple or Single

Table 4-5.—5.0-Inch Rocket Launchers

LAUNCHER TYPE	NO. OF TUBES	TUBE MATERIAL	REUSABLE	METHOD OF FIRING
LAU-10/A	4	Alum.	Yes	Ripple or Single
LAU-10A/A-1	4	Alum.	Yes	Ripple or Single
LAU-10B/A	4	Alum.	Yes	Ripple or Single
LAU-10C/A	4	Alum.	Yes	Ripple or Single
LAU-10D/A*	4	Alum.	Yes	Ripple or Single
*Thermally protected				

the LAU-32B/A launcher, refer to *2.75-Inch Airborne Rocket Launcher*, NAVAIR 11-75A-41. For detailed information about the LAU-61/A, LAU-68/A, and LAU-69/A, refer to *2.75-Inch Airborne Rocket Launchers (LAU-61, 68, and 69 series)*, NAVAIR 11-75A-61.

The 5.0-inch rocket launchers are the LAU-10/A, LAU-10A/A-1, LAU-10B/A, LAU-10C/A, and the LAU-10D/A. Characteristics and specifications for these launchers are listed in table 4-5. For detailed information on the LAU-10 series launchers, you should refer to *5.0-inch Airborne*

Rocket Launchers (LAU-10, 33, and 35 series), NAVAIR 11-75A-63.

houses or supports all other components of the launcher.

SHIPPING CONFIGURATION

The rocket launcher shipping configuration shown in figure 4-26 is typical of all launcher shipping configurations, except for the RF barriers.

The center section for the LAU-10 (series) allows either 14-inch or 30-inch suspension. The center section for the LAU-32B/A, LAU-61, LAU-68, and LAU-69 (series) provides for 14-inch suspension only.

Center Section

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

Shipping Ends

The shipping ends are a multipurpose arrangement consisting 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

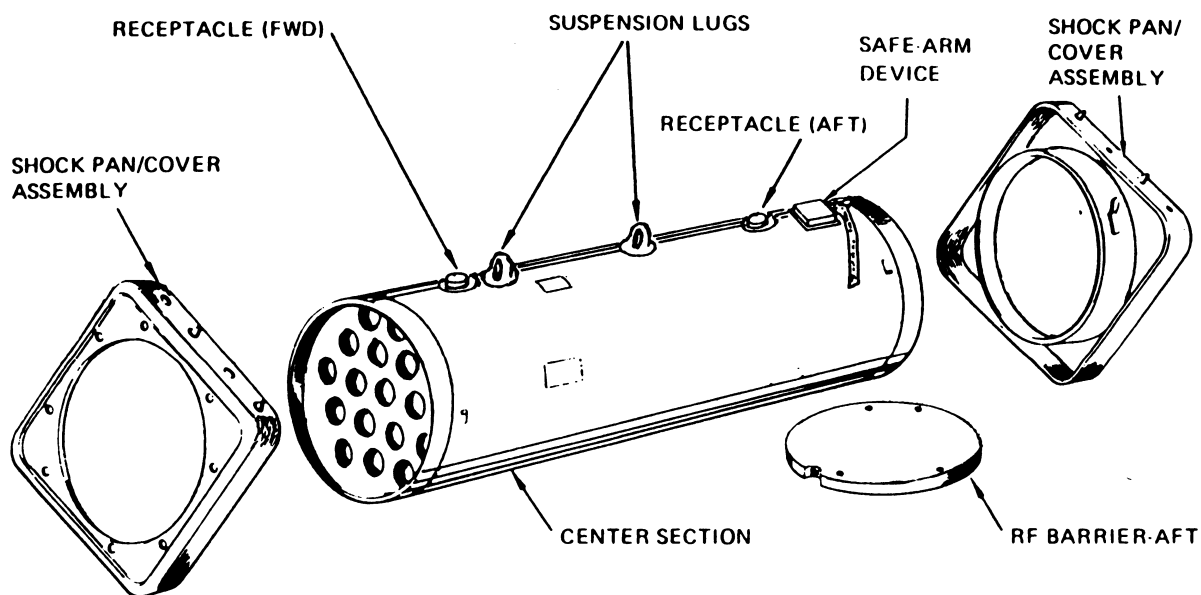


Figure 4-26.—Typical launcher shipping configuration.

REVIEW NUMBER 4 ANSWERS

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

stacked. The cover is equipped with a rubber seal ring that, when compressed by the locking ring assembly, forms a watertight closure over the end of the launcher.

RF Barriers

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

COMMON COMPONENTS

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

Fairings

Frangible fairings (fig. 4-27) are made of an impregnated molded fiber designed with a waffle- or grenade-type structure that shatters readily upon rocket impact or from a blast. The fairings fit flush with the outside surface of the center section and form an aerodynamically smooth joint. The forward fairing consists of a one-piece molded section that disintegrates on rocket impact. The tail fairing for the LAU-10 (series) (fig. 4-27, 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-32B/A, LAU-61, LAU-68, and LAU-69 (series) are distinctively different in appearance (fig. 4-27, 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

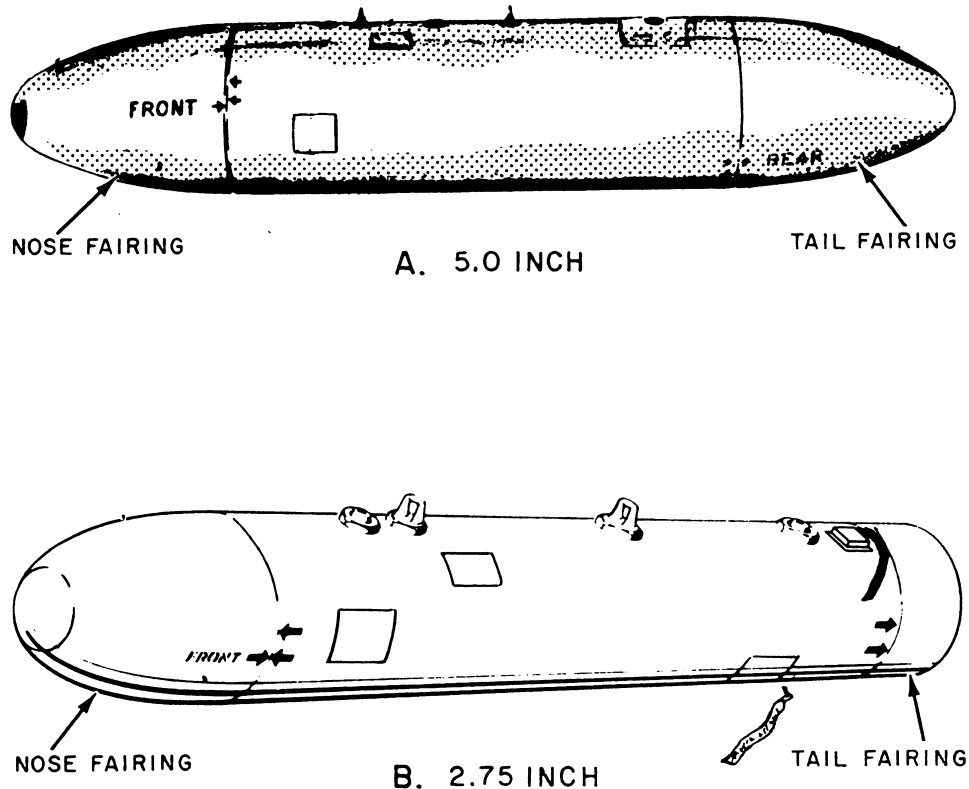


Figure 4-27.—Rocket launcher airborne configurations.

cylindrical-shaped cardboard fairing containers (fig. 4-28).

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

Breaker Switch

A breaker switch is used on all rocket launchers. The breaker switch is a safe-arm device that prevents loaded rockets from firing. It is usually located on the top of the center section of the launcher between the aft end and the aft electrical receptacle. Figure 4-29 shows the various safe-arm devices currently in use.

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

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

Mode Selector Switch

The mode selector switch (figs. 4-30, view A, 4-31, view A, and 4-32, view A) 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 (fig. 4-30, view A) and in the aft bulkhead for the LAU-32B/A, LAU-61, LAU-68, and LAU-69 (series) (figs. 4-31, view B; and 4-32,

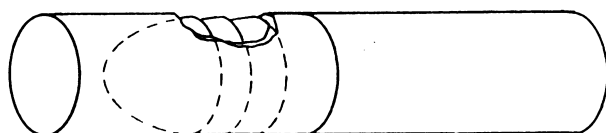


Figure 4-28.—Frangible fairing shipping and stowage container.

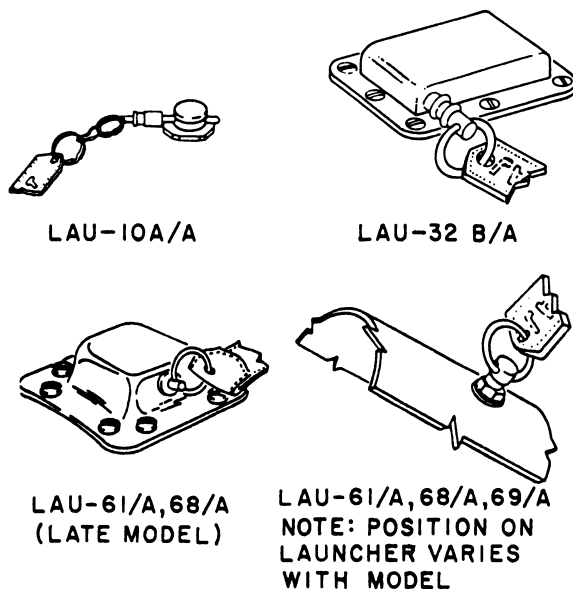


Figure 4-29.—Rocket launcher safe/arm device.

view B). Intervalometers, whether installed in 5.0-inch or 2.75-inch launchers, perform the same function.

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

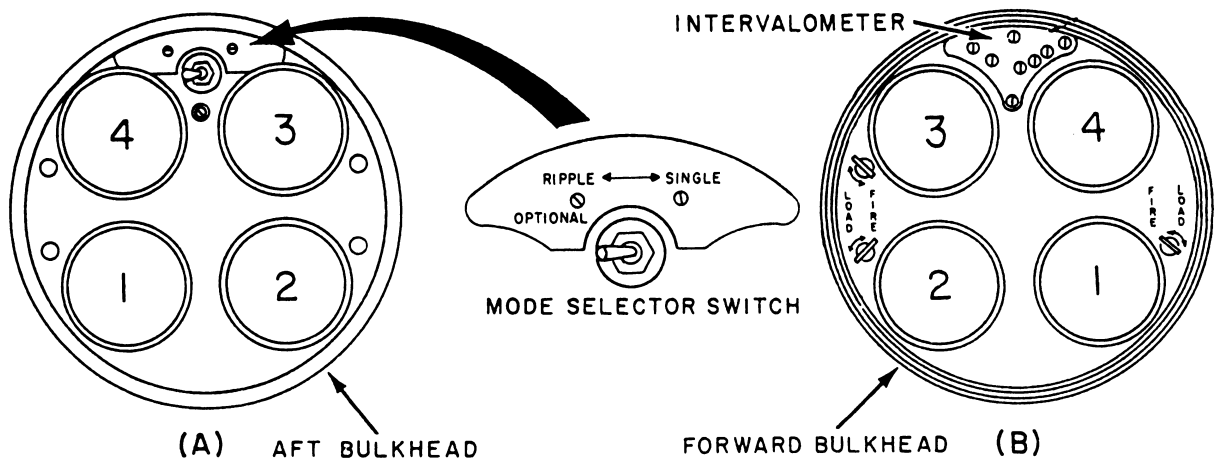


Figure 4-30.—Mode selector switch and intervalometer (5.0-inch launcher).

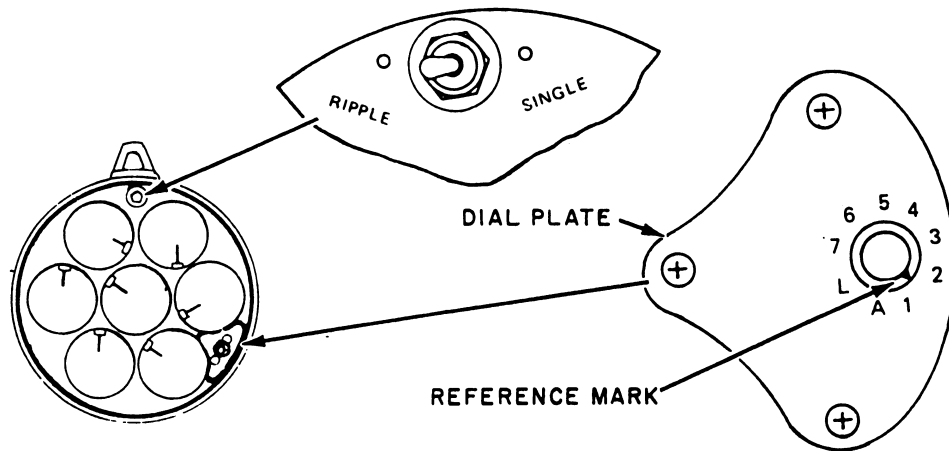


Figure 4-31.—Mode selector switch and intervalometer (2.75-inch, 7-tube launcher).

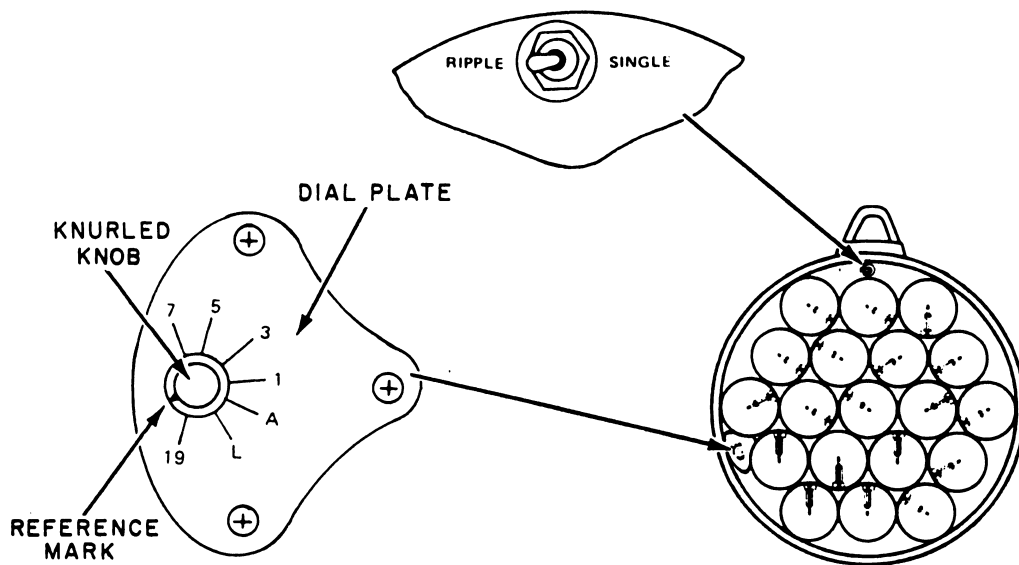


Figure 4-32.—Mode selector switch and intervalometer (2.75-inch, 19-tube launcher).

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 (fig. 4-33). 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 located at the forward end of the launcher. The detent also supports the firing pin. Each firing pin (fig. 4-33) 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 located aft of the rocket detent groove.

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

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

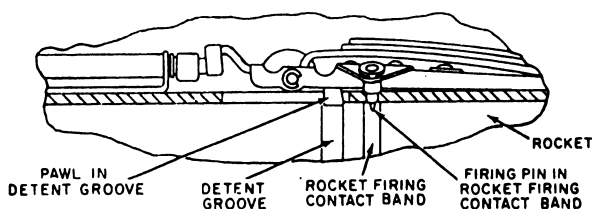


Figure 4-33.—LAU-10 (series) detent pin and firing pin assembly.

2.75-INCH (SERIES) LAUNCHERS

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

The rockets are retained in the launcher tubes during shipping, handling, and flight by engagement of a leaf-spring type of detent with integral blast paddles (fig. 4-34). During loading, the rocket motor depresses the detent until the detent snaps into the detent grooves located on the aft end of the motor. To remove rocket motors, use a rocket loading and release tool to depress the detent. A spring-loaded firing contact (fig. 4-35) 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.

REVIEW NUMBER 5

- Q1. Name the section of the launcher that houses or supports all other components of the launcher.
- Q2. RF barriers are used on 2.75-inch rocket pods to _____.
- Q3. List the components that are common to rocket launcher packages.
- Q4. What device, found on all rocket launchers, prevents loaded rockets from firing?

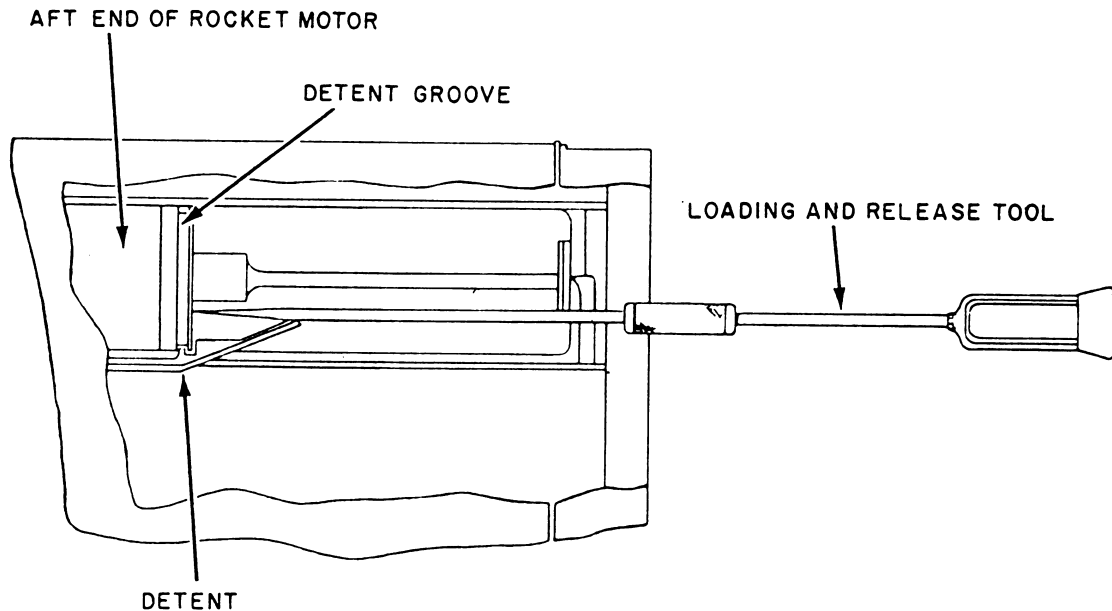


Figure 4-34.—Rocket launcher detent (2.75-inch).

ROCKET SAFETY PRECAUTIONS

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

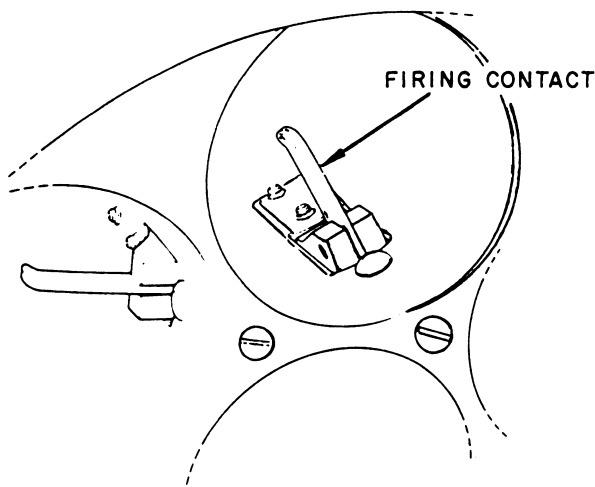


Figure 4-35.—Launcher firing contact assembly (2.75-inch launcher).

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

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

Rocket motors should be stowed in the same manner as smokeless powder. **Never allow**

Q5. *When is the detent pin in the rocket launcher safe/arm device removed?*

Q6. *What is the weight, depending on configuration, of a fully loaded LAU-10 rocket launcher?*

matches and open flames in the stowage area. Smoking should NOT be permitted in the loading area within 200 feet of ammunition. Do not stow rocket motors in the same compartments with or near radio apparatus or antenna leads. Induced currents might ignite the motor. Do NOT fire rocket motors when the propellant temperature is outside the safe-firing temperature limits specified on the motor tube.

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

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

A fuze is relatively sensitive and must be handled with care to avoid extreme shock that might cause damage. Conduct fuzing, unfuzing, assembly, or disassembly operations of all types of ammunition away from other explosives and

vital installations. Only the minimum number of persons and rounds required should be in the vicinity. The ideal situation is to permit work on only one round at a time. This work should be done on a deck or at some other location remote from all magazines, ready stowage, explosive supplies, or vital installations.

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

CAUTION

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

You should NOT tamper with (or attempt to repair) any parts of the round. If the round is damaged or defective, remove the head from the motor and mark the defective part for return to the issuing agency. Disassembly or alteration of

REVIEW NUMBER 5 ANSWERS

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

rocket components is NOT authorized except under specific instructions from Naval Air Systems Command.

Fuzes and/or warheads dropped 5 feet or more onto a hard surface and rockets that have been accidentally released from aircraft launchers upon aircraft landing must be disposed of according to current directives.

If a loaded launcher is dropped, you should NOT use it until the launcher tubes, latching mechanisms, and rockets are inspected for damage.

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

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

The detent pin must be in the breaker switch at all times. The only exceptions are when you

are making certain electrical checks, or when the aircraft is ready for flight. Do NOT, under any circumstances, perform an electrical test with rockets in the launcher.

REVIEW NUMBER 6

- Q1. If you are working around rockets or loaded pods, the preferred position is _____.*
- Q2. Smoking is not permitted within what minimum range of rocket ammunition?*
- Q3. What is the maximum distance that a rocket motor can be dropped and still be used as a serviceable motor?*
- Q4. What minimum distance must be maintained between gas turbine exhaust paths and rockets?*

REVIEW NUMBER 6 ANSWERS

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

CHAPTER 5

AIR-LAUNCHED GUIDED MISSILES, GUIDED MISSILE LAUNCHERS, AND GUIDED MISSILE HANDLING

Guided missiles are self-propelled objects. After launching, they automatically alter their direction of flight in response to signals received from outside sources. They usually carry high-explosive charges and are equipped with a means to explode them at or near a target. The majority of guided missiles used in the Navy are essentially rockets that are maneuvered while in flight.

AIR-LAUNCHED GUIDED MISSILES

Learning Objective: Recognize air-launched guided missile classification to include range, speed, and types. Identify air-launched guided missiles and recognize the methods used to designate them. Identify missile components to include guidance and control, armament, and propulsion systems. Identify the guided missiles used in the Navy today.

The purpose of a guided missile is to reach and destroy or damage its target. The type of target involved influences the characteristics of the missile; however, each missile meets the following basic requirements:

- It must have sufficient speed to intercept or catch its target.
- It must be maneuverable in flight to correct its flight path as required to intercept the target.
- It must be capable of inflicting a satisfactory degree of damage to the target on intercept.
- It must have an acceptable operating envelope (range/altitude) within which it is effective.

- It must be capable of launching when required and at a satisfactory rate.
- The missile and its components must be safe to handle, store, and use.

In general, a typical guided missile has a long cylindrical shape, with an oval or a hemispherically shaped nose. It is fitted with a series of stabilizing or maneuvering fins, wings, or canards around its outer surface.

MISSILE CLASSIFICATION

Guided missiles are classified according to their range, speed, launch environment, mission, and vehicle type.

Range

Long-range guided missiles are usually capable of traveling a distance of at least 100 miles. Short-range guided missiles often do not exceed the range capabilities of long-range guns. The Navy has air-launched guided missiles that function within these ranges; they are medium-range or extended-range missiles.

Speed

The speed capability of guided missiles is expressed in Mach numbers. A 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. Under standard atmospheric conditions, sonic speed is about 766 miles per hour (Mach 1.0). Guided missiles are classified according to their speed as shown below:

- Subsonic—Up to Mach 0.8
- Transonic—Mach 0.8 to Mach 1.2
- Supersonic—Mach 1.2 to Mach 5.0
- Hypersonic—Above Mach 5.0

When considering the speed of an air-launched guided missile, the speed of the launching aircraft is added to the speed of the missile. For example, 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's speed is Mach 4.5.

Types of Guided Missiles

Guided missiles are divided into two types—service missiles and nonservice missiles.

SERVICE MISSILES.—These missiles are generally referred to as tactical missiles. Service missiles are fully operational and fully explosive loaded rounds, designed for service use in time of war.

NONSERVICE MISSILES.—These include all types of missiles other than service or tactical. They are subdivided as practice (or exercise) missiles, training (or inert operational) missiles, and dummy (or shape) missiles.

Some practice and training missiles are used for actual launching. They contain live propulsion and guidance systems with inert loaded warheads. They are fitted with pyrotechnic fuze indicator signals and/or tracking flares that give a visual indication of missile/target impact. These missiles can also be fitted with a telemetry-type warhead, which transmits electronic signals to a monitoring station. The monitoring station displays the missile's in-flight performance and missile/target hit. Some types of exercise missiles contain explosive-destruct charges so the missiles destroy themselves in flight. These explosive destruct charges, when installed, are used as a safety measure so the missile does not travel beyond the established target range.

The dummy type of missile is a completely inert shaped charge. It is used for training in handling and loading procedures and for testing and checking loading procedures and launching equipment.

Service missiles are fired as practice or training missiles when approved by proper authority. Normally, approval is restricted to missiles that are obsolete or to missiles that have exceeded their normal service life.

Guided missiles used in naval aviation include air-to-air and air-to-surface missiles. Air-to-air guided missiles are fired by one aircraft against another aircraft. Air-to-surface guided missiles are fired from an aircraft against a target on the land or water surface.

For further information on the classification of guided missiles, you should refer to *United States Navy Ammunition Historical and Functional Data*, NAVSEA SWO10-AB-GTP-010.

MISSILE DESIGNATION

The Department of Defense established a missile and rocket designation sequence. The basic designation (table 5-1) of every guided missile are letters, which are in sequence. The sequence indicates—

1. the environment from which the vehicle is launched,
2. the primary mission of the missile, and
3. the type of vehicle.

Examples of guided missile designators common to the Aviation Ordnanceman are as follows:

<u>Basic Designator</u>	<u>Meaning</u>
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 designator is followed by a design number. In turn, the number may be followed by consecutive letters showing a modification. For example, the designation of AGM-45C means the missile is an air-launched (A), surface-attack (G), missile (M), forty-fifth missile design (45), third modification (C).

In addition, most guided missiles are given popular names such as Sparrow, Sidewinder, Harpoon, and Shrike. These names are retained regardless of subsequent modifications to the original missile.

MISSILE IDENTIFICATION

The external surfaces of all Navy guided missiles, except radome and antenna surfaces, are painted white. The color white has no identification color-coding significance when used on guided missiles.

Table 5-1.—Guided Missile and Rocket Designations

FIRST LETTER DESIGNATING LAUNCH ENVIRONMENT	DESCRIPTION
<p>A Air</p> <p>B Multiple</p> <p>C Coffin</p> <p>F Individual</p> <p>M Mobile</p> <p>P Soft Pad</p> <p>U Underwater</p> <p>R Ship</p>	<p>Air launched.</p> <p>Capable of being launched from more than one environment.</p> <p>Stored horizontally or at less than 45 degree angle in a protective enclosure and launched from the ground.</p> <p>Carried and launched by one man.</p> <p>Launched from a ground vehicle or movable platform.</p> <p>Partially or non-protected in storage and launched from the ground.</p> <p>Launched from a submarine or other underwater device.</p> <p>Launched from a surface vessel such as a ship, barge, etc.</p>
SECOND LETTER DESIGNATING MISSION SYMBOL	DESCRIPTION
<p>D Decoy</p> <p>E Special Electronic</p> <p>G Surface Attack</p> <p>I Intercept-Aerial</p> <p>Q Drone</p> <p>T Training</p> <p>U Underwater Attack</p> <p>W Weather</p>	<p>Vehicles designed or modified to confuse, deceive, or divert enemy defenses by simulating an attack vehicle.</p> <p>Vehicles designed or modified with electronics equipment or communications, countermeasures, electronic relay missions.</p> <p>Vehicles designed to destroy enemy land or sea targets.</p> <p>Vehicles designed to intercept aerial targets in defensive roles.</p> <p>Vehicles designed for target reconnaissance or surveillance.</p> <p>Vehicles designed to be modified for training purposes.</p> <p>Vehicles designed to destroy enemy submarines or other underwater targets or to detonate underwater.</p> <p>Vehicles designed to observe, record, or relay data pertaining to meteorological phenomena.</p>
THIRD LETTER DESIGNATING VEHICLE TYPE SYMBOL	DESCRIPTION
<p>M Guided Missile</p> <p>R Rocket</p> <p>N Probe</p>	<p>An unmanned, self-propelled vehicle with remote or internal trajectory guidance.</p> <p>A self-propelled vehicle whose flight trajectory cannot be altered after launch.</p> <p>A non-orbital instrumented vehicle to monitor and transmit environmental information.</p>

NOTE: The designations listed in the above table cover all the guided missiles and rockets used within the Department of Defense. Therefore, all designations listed may not be used by the Navy.

There are three significant color codes used on guided missiles and their components—yellow, brown, and blue. These color codes indicate the explosive hazard in the missile component. They have the same explosive hazard meaning as the color code discussed in chapter 1 of this manual. If components are painted blue on a practice missile and have a yellow or brown band painted on them, the component has an explosive component that doesn't have a comparable part in a service missile.

Each component of the missile, besides being color coded, is identifiable by lettering stenciled on the exterior surface of the component. The lettering on a component gives information such as the Mark and Mod, type and weight of explosive filler, loading activity symbol and date of loading, temperature range restrictions, and unit serial number.

All missiles used in naval aviation are assigned missile serial numbers. These numbers are shipped with the missile's logbook. The missile serial number is normally the serial number of the leading component of the missile, such as the guidance and/or control components. The serial number is important because it is the number used to track the missile from assembly at a weapons station until it is fired or discontinued from service.

For further information concerning identification of guided missiles, refer to NAVSEA OP 2238/NAVAIR 11-1-117, *Identification of Ammunition* (latest revision).

REVIEW NUMBER 1

Q1. The speed of a guided missile is given in terms of Mach numbers. If a guided missile is traveling at Mach 1, how fast is it going?

Q2. A missile traveling at Mach 3 is traveling at _____ speeds.

Q3. List the two types of guided missiles.

Q4. What two types of guided missiles are used in naval aviation?

Q5. The first letter of a missile designation describes the missile's _____.

Q6. Define the missile designation ATM.

Q7. Where would you find the serial number in an assembled missile?

Q8. What do the color codes identify on guided missiles?

MISSILE COMPONENTS

Guided missiles are made up of a series of subassemblies (figs. 5-1 and 5-2). The various subassemblies form a major section of the overall missile to operate a missile system such as guidance, control, armament (warhead and fuzing), and propulsion. The major sections are carefully joined and connected to each other. They form the complete missile assembly. The arrangement of major sections in the missile assembly varies, depending on the missile type.

The guidance section is the brain of the missile. It directs its maneuvers and causes the maneuvers to be executed by the control section. The armament section carries the explosive charge of the missile, and the fuzing and firing system by which the charge is exploded. The propulsion section provides the force that propels the missile.

Guidance and Control Section

The complete missile guidance system includes the electronic sensing systems that initiate the guidance orders and the control system that carries them out. The elements for missile guidance and missile control can be housed in the same section of the missile, or they can be in separate sections.

There are a number of basic guidance systems used in guided missiles. Homing-type, air-launched guided missiles are currently used. They use radar or infrared homing systems.

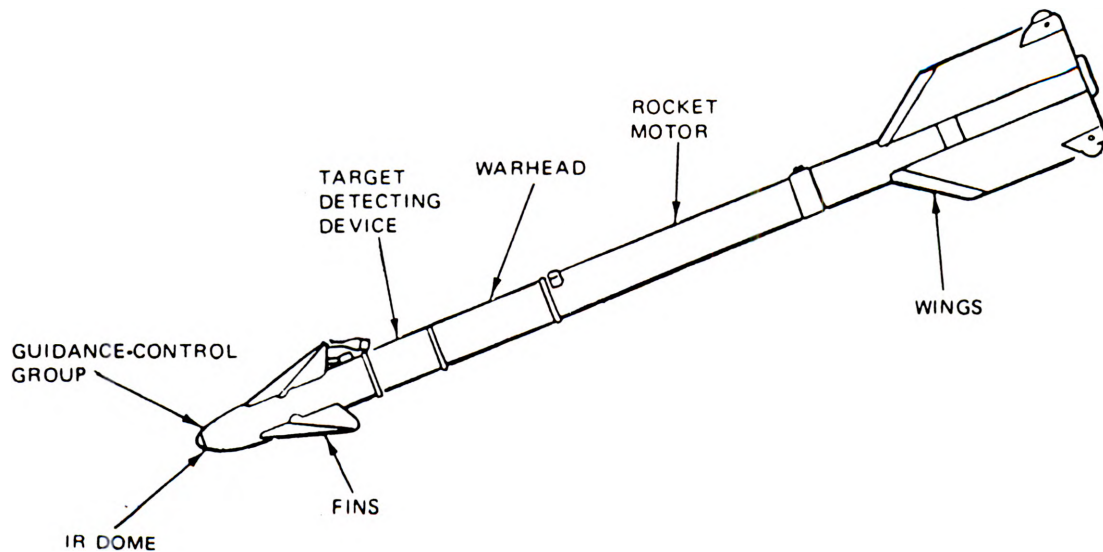


Figure 5-1.—Typical air-to-air guided missile.

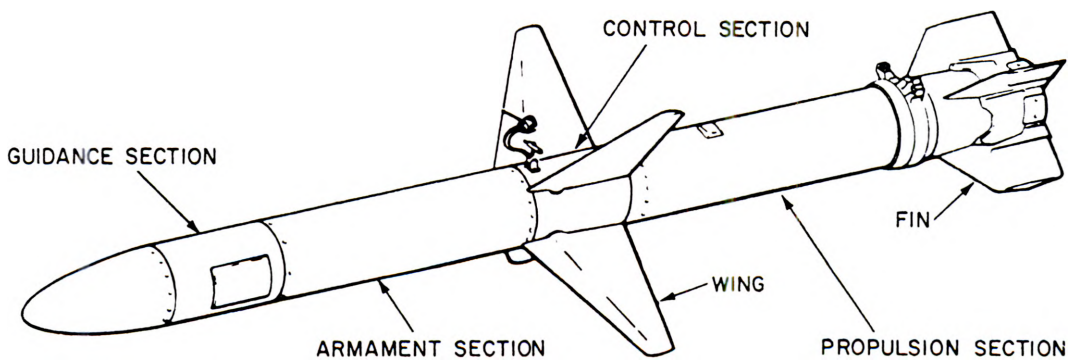


Figure 5-2.—Typical air-to-surface guided missile.

A homing guidance system is one in which the missile seeks out the target, guided by some physical indication from the target itself. Radar reflections or thermal characteristics of targets are possible physical influences on which homing systems are based. Homing systems are classified as active, semiactive, and passive.

ACTIVE.—In the active homing system, target illumination is supplied by a component carried in the missile, such as a radar transmitter. The radar signals (fig. 5-3) transmitted from the missile are reflected off the target back to the receiver in the missile. These reflected signals give the missile information such as the target's distance and speed. This information lets the guidance section compute the correct angle of attack to intercept the target. The missile's angle

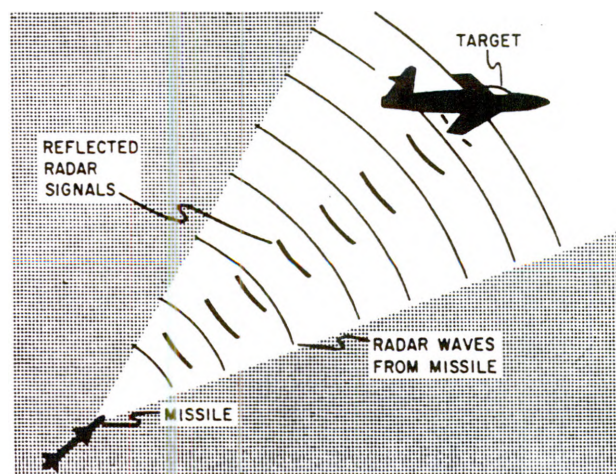


Figure 5-3.—Active homing system.

of attack is controlled by the control section that receives electronic commands from the guidance section. Mechanically manipulated wings, fins, or canard control surfaces are mounted externally on the body of the weapon. They are actuated by hydraulic, electric, or gas generator power, or combinations of these to alter the missile's course.

SEMIACTIVE.—In the semiactive homing system (fig. 5-4), the missile gets its target illumination from an external source, such as a transmitter carried in the launching aircraft. The receiver in the missile receives the signals reflected off the target, computes the information, and sends electronic commands to the control section. The control section functions in the same manner as previously discussed.

PASSIVE.—In the passive homing system (fig. 5-5), the directing intelligence is gotten from the target. Examples of passive homing include homing on a source of infrared rays (such as the hot exhaust of jet aircraft) or radar signals (such as those transmitted by ground radar installations). Like active homing, passive homing is completely independent of the launching aircraft. The missile receiver receives signals generated by the target, then the missile control section functions in the same manner as previously discussed.

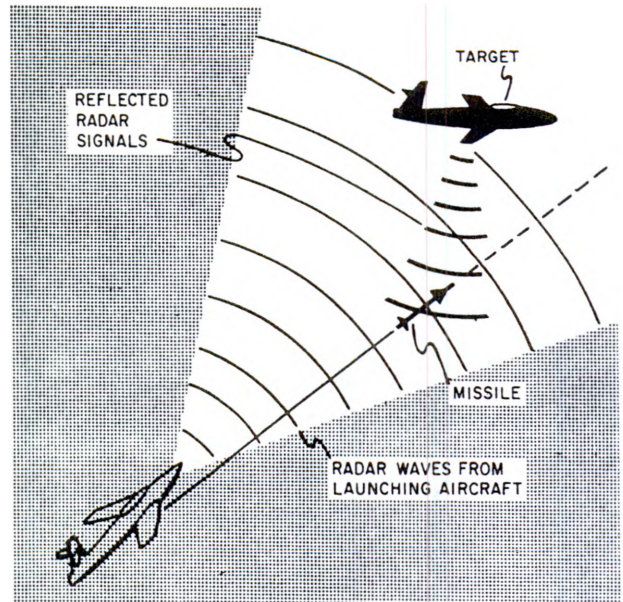


Figure 5-4.—Semiactive homing system.

Armament Section

The armament system contains the payload (explosives), fuzing, safety and arming (S&A) devices, and target-detecting devices (TDDs).

REVIEW NUMBER 1 ANSWERS

- A1. *If a guided missile is traveling at Mach 1, it is traveling at approximately 766 miles per hour.*
- A2. *A missile traveling at Mach 3 is traveling at supersonic speeds.*
- A3. *The two types of guided missiles are service and nonservice guided missiles.*
- A4. *The two types of guided missiles used in naval aviation are air-to-air and air-to-surface guided missiles.*
- A5. *The first letter of a missile designation describes the missile's launch environment.*
- A6. *The missile designation ATM stands for an air-launched training guided missile.*
- A7. *The serial number in an assembled missile is usually found on the leading component.*
- A8. *The color codes on guided missiles identify the explosive hazard in the missile component.*

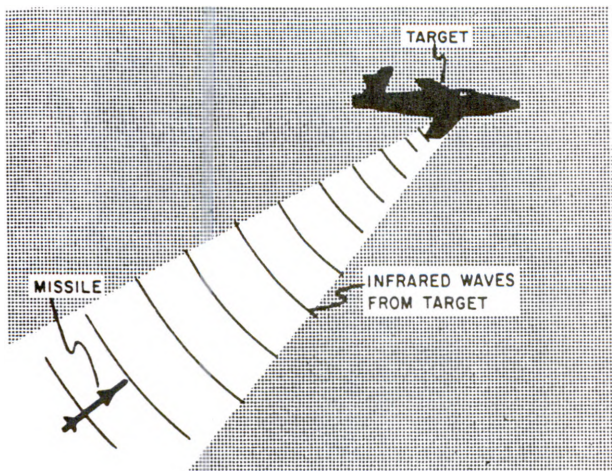


Figure 5-5.—Passive homing system.

PAYLOAD.—The payload is the element or part of the missile that does what a particular missile is launched to do. The payload is usually considered the explosive charge carried in the warhead of the missile. High-explosive warheads (fig. 5-6) used in air-to-air guided missiles contain a rather small explosive charge, generally 10 to 18 pounds of H-6, HBX, or PBX high explosives. The payload contained in high-explosive warheads used in air-to-surface guided missiles varies widely, even within specific missile types, depending on the specific mission. Large payloads, ranging up to 450 pounds, are common. Comp B and H-6 are typical explosives used in a payload.

Most exercise warheads used with guided missiles are pyrotechnic signaling devices. They signal fuze functioning by a brilliant flash, by smoke, or both. Exercise warheads frequently contain high explosives, varying from live fuzes and boosters to self-destruct charges that can contain as much as 5 pounds of high explosive.

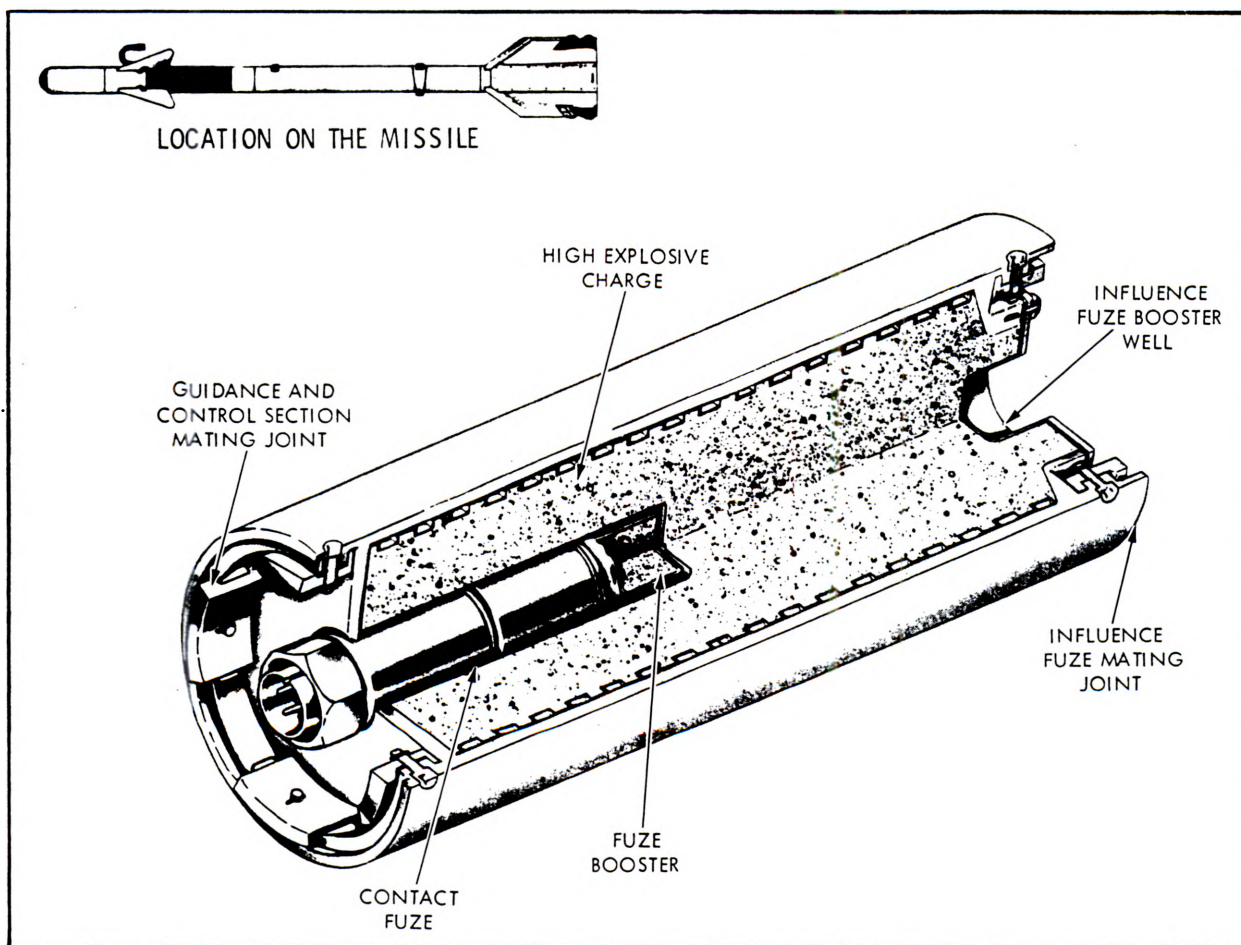


Figure 5-6.—Typical high-explosive loaded tactical warhead.

FUZING.—The fuzing and firing system (fig. 5-6) is normally located in or next to the missile's warhead section. It includes those devices and arrangements that cause the missile's payload to function in proper relation to the target. The system consists of a fuze, a safety and arming (S&A) device, a target-detecting device (TDD), or a combination of these devices.

There are two general types of fuzes used in guided missiles—proximity fuzes and contact fuzes. Both fuzes are armed by acceleration forces upon missile launching. Arming is usually delayed until the fuze is subjected to a given level of accelerating force for a specified amount of time. In the contact fuze (fig. 5-6), the force of impact closes a firing switch within the fuze to complete the firing circuit, detonating the warhead. Where proximity fuzing (fig. 5-7) is used, the firing action is very similar to the action of proximity fuzes used with bombs and rockets.

SAFETY AND ARMING (S&A) DEVICES.—S&A devices (fig. 5-8) are electromechanical explosive control devices. They maintain the explosive train of a fuzing system in a safe (unaligned) condition until certain requirements of acceleration are met after the missile is fired.

TARGET-DETECTING DEVICES (TDD).—TDDs (fig. 5-8) are electronic detecting devices similar to the detecting systems in VT fuzes. They detect the presence of a target and determine the moment of firing. When subjected to the proper target influence, both as to magnitude and change rate, the device sends an electrical impulse to trigger the firing systems. The firing systems then act to fire an associated S&A device to initiate detonation of the warhead.

Air-to-air guided missiles are normally fuzed for a proximity burst using a TDD with an S&A device. In some cases, a contact fuze may be used as a backup. Air-to-surface guided missile fuzing consists of influence (proximity) and/or contact fuzes. Multifuzing is common in these missiles.

Propulsion Section

Guided missiles use some form of jet power for propulsion. There are two basic types of jet propulsion power plants used in missile propulsion systems—the atmospheric (air-breathing) jet and the thermal jet propulsion systems. The basic difference between the two systems is that the atmospheric jet engine depends on the atmosphere to supply the oxygen necessary to start and sustain

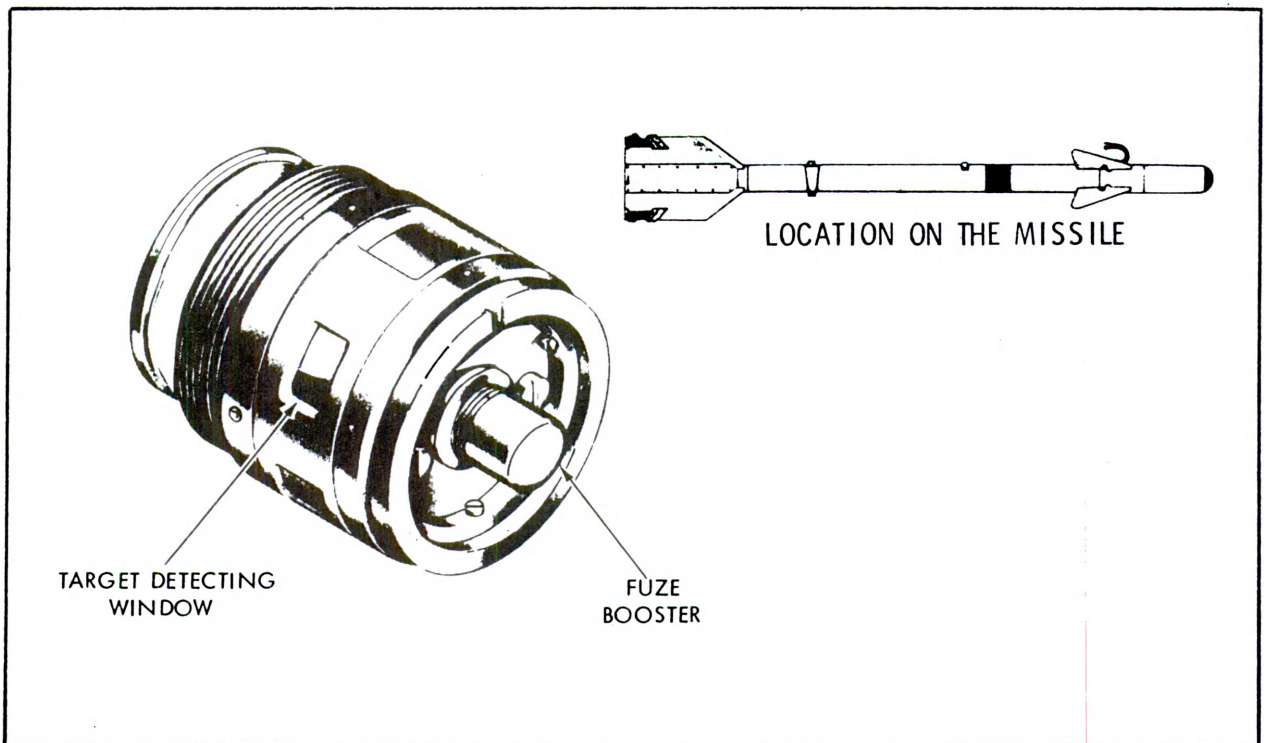


Figure 5-7.—Typical guided missile proximity fuze.

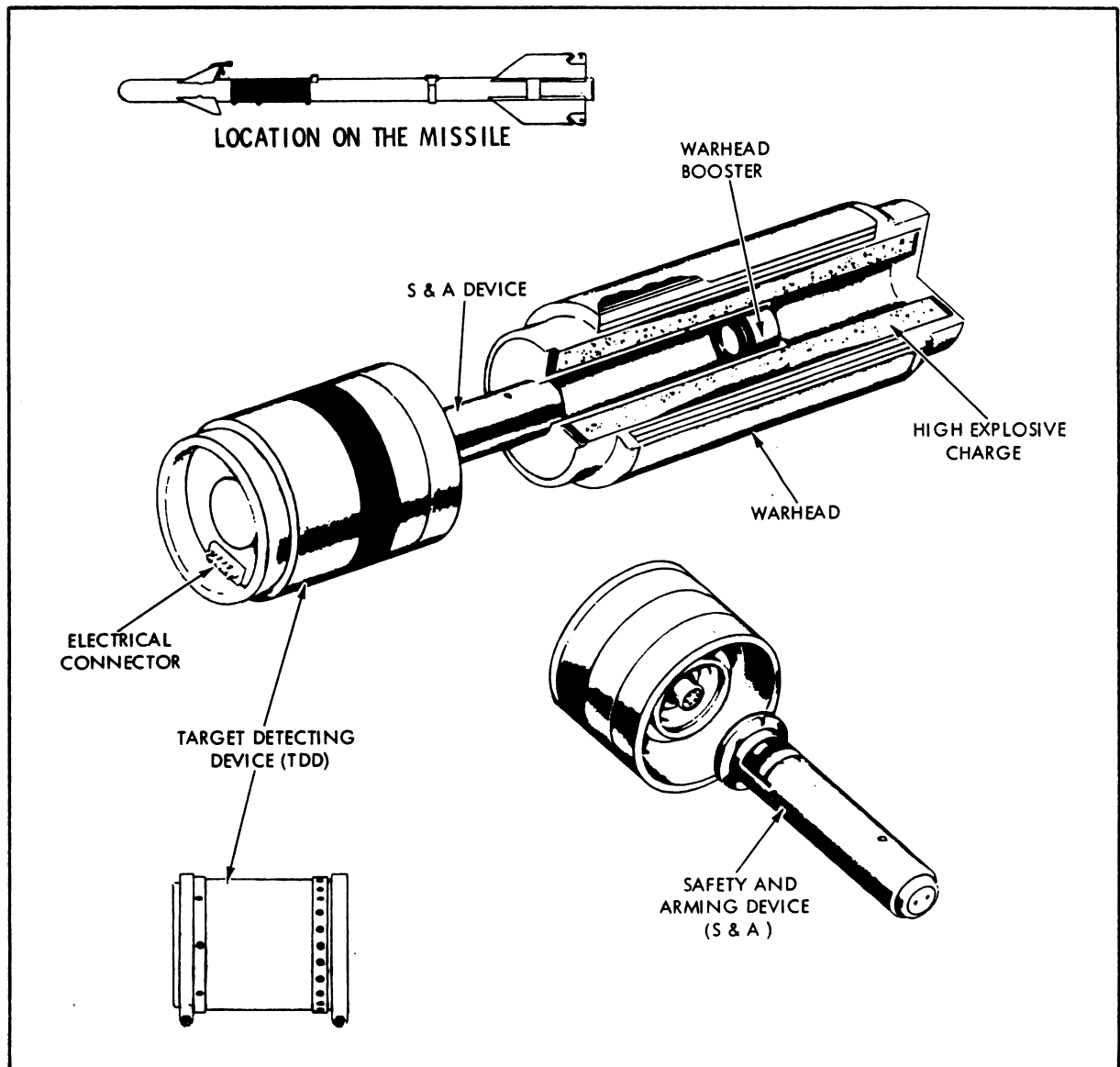


Figure 5-8.—A TDD/S&A combined fuzing system and a guided missile warhead.

burning of the fuel. The thermal jet engine operates independently of the atmosphere by starting and sustaining combustion with its own supply of oxygen contained within the missile.

ATMOSPHERIC JET PROPULSION SYSTEM.—There are three types of atmospheric jet propulsion systems—the turbojet, pulse-jet, and ramjet engines. Of these three systems, only the turbojet engine is currently being used in Navy air-launched missiles. A typical turbojet engine includes an air intake, a mechanical compressor driven by a turbine, a combustion chamber, and an exhaust nozzle. The engine does not require

boosting and can begin operation at zero acceleration.

THERMAL JET PROPULSION SYSTEM.—Thermal jets include solid propellant, liquid propellant, and combined propellant systems. As an AO, you come in contact with all three systems. The solid propellant and combined propellant systems are currently being used in some air-launched guided missiles.

The majority of air-launched guided missiles used by the Navy use the solid propellant rocket

motor (fig. 5-9). They include the double-base and multibase smokeless powder propellants as well as the composite mixtures. Grain configurations vary with the different missiles. Power characteristics and temperature limitations of the individual rocket motors also vary.

In some guided missiles, different thrust requirements exist during the boost phase as compared to those of the sustaining phase. The dual thrust rocket motor (DTRM) is a combined system that contains both of these elements in one motor. The DTRM contains a single propellant grain made of two types of solid propellant—boost and sustaining. The grain is configured so the propellant meeting the requirements for the boost phase burns at a faster rate than the propellant for the sustaining phase. After the boost phase propellant burns itself out, the sustaining propellant sustains the motor in flight over the designed burning time (range of the missile).

REVIEW NUMBER 2

- Q1. List the major sections of guided missiles.
- Q2. What section is considered the brains of the missile?
- Q3. List the three types of homing systems.
- Q4. If a missile gets its target illumination from the launching aircraft, what type of homing system does it have?
- Q5. List the components of the armament section.

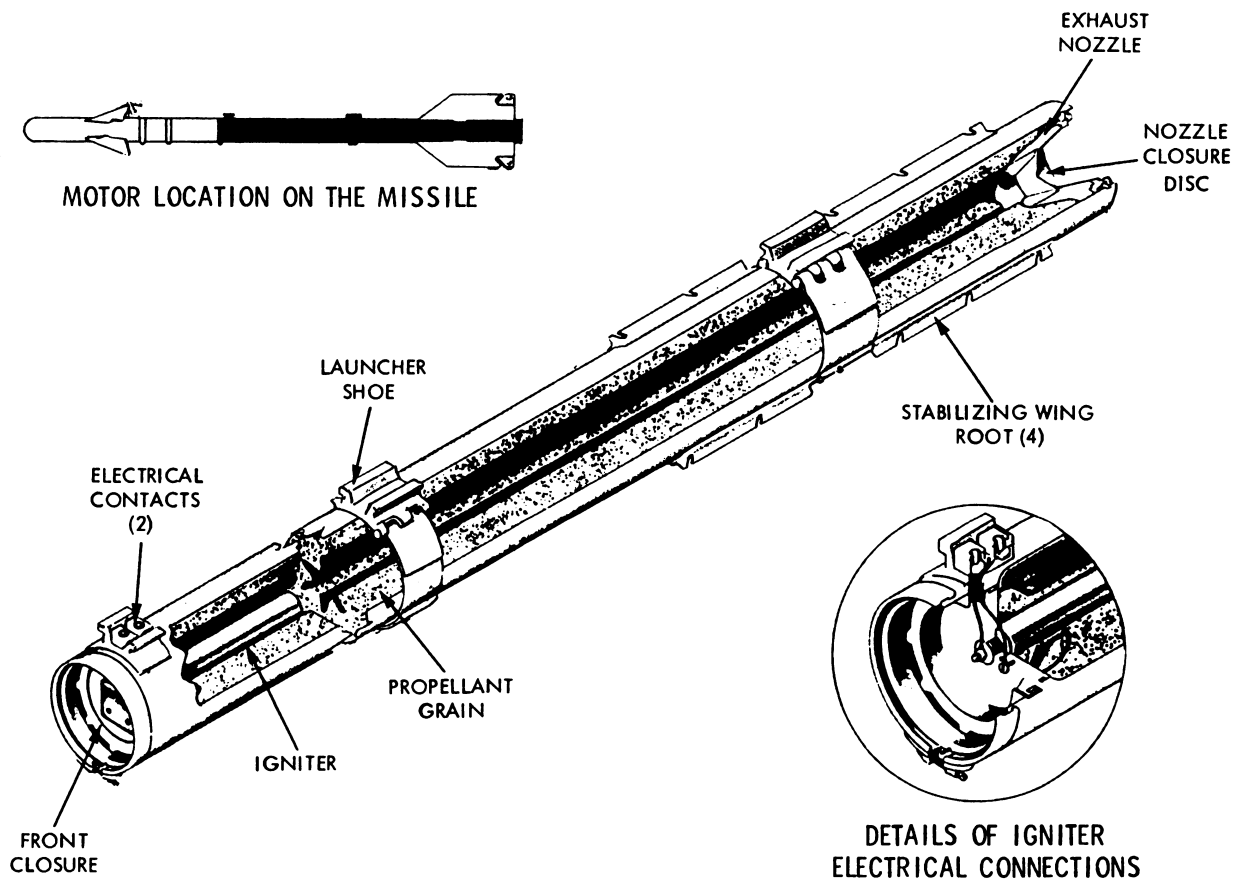


Figure 5-9.—Typical solid propellant motor for a guided missile.

Q6. Describe the function of safety and arming (S&A) devices.

Q7. What are the two types of propulsion used with guided missiles?

Q8. Describe the basic difference between the two types of propulsion.

by the launching aircraft and reflected by the target. Excluding the radome, the missile body has four sectional tubular shells that house the major functional components. The four major functional components are the target seeker, flight control, warhead, and rocket motor. The overall length of the missile is approximately 142 inches with a diameter of 8 inches. It weighs approximately 510 pounds. The missile is issued to the fleet as an all up round (AUR). The only assembly required at fleet level is the installation of the wing and fin assemblies, which are shipped in separate shipping containers.

The radome is ceramic and forms the nose piece of the missile. It does not obstruct RF energy. It covers the RF head assembly of the target seeker and provides protection against environmental damage.

The target seeker receives and interprets the radar energy reflected from the target. Then it produces signals that are sent to the flight control section to direct the missile to intercept the target or come within lethal range of it.

The flight control consists of the autopilot and the hydraulic group. These function to provide control signals and mechanical energy to move the external control surfaces that guide the missile toward the point of intercept, and to stabilize the missile in pitch, yaw, and roll.

The warhead is located between the target seeker and flight control section. The warhead is explosive-loaded, and it contains the fuze, fuze

SERVICE GUIDED MISSILES

Missiles have been operational for several years. Still, research on missiles continuously produces changes in the missile field. The missiles discussed in this manual are presently operational.

Sparrow III Guided Missile

The AIM-7F missile (fig. 5-10) is a supersonic air-to-air DTRM guided missile. It is designed to be rail or ejection launched from an interceptor aircraft. The missile's tactical mission is to intercept and destroy enemy aircraft in all-weather environments. It is designed to be launched from the F-4, F-14, and F/A-18 aircraft.

The AIM-7F missile is a semiactive missile. Missile guidance depends on RF energy radiated

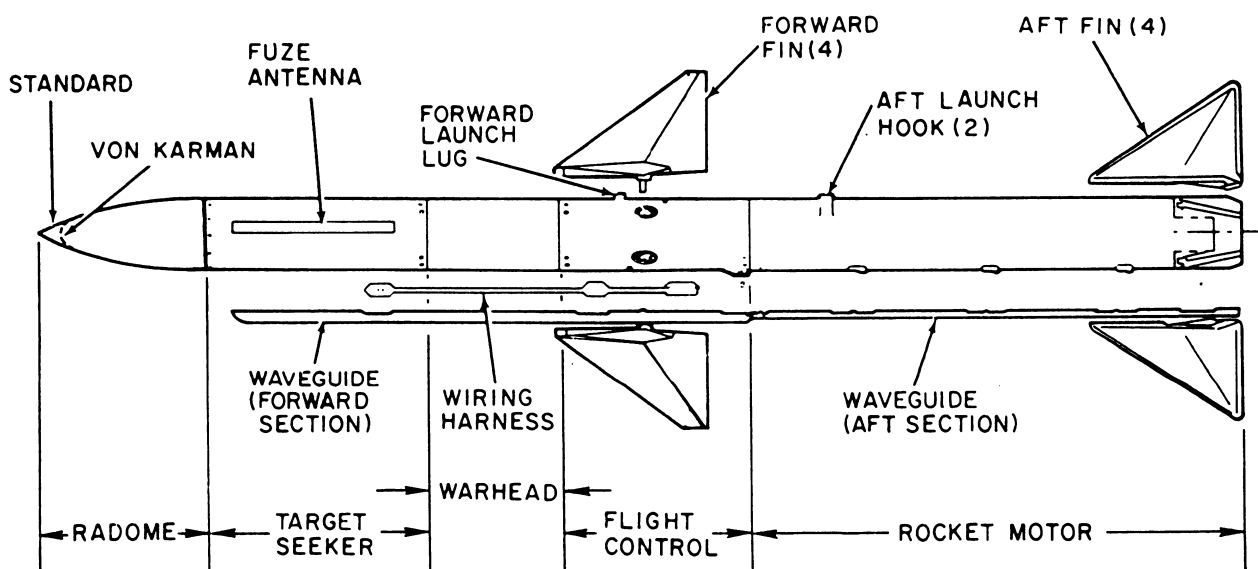


Figure 5-10.—AIM-7F Sparrow III guided missile.

booster charge, and the S&A device. It is a continuous-rod type of warhead. At detonation, the rod sections expand into a continuous ring. Target kill is accomplished by collision of the continuous ring with the target. Detonation is triggered either by a fuze pulse from the target seeker at the nearest point of intercept or a fuze pulse from the flight control upon impact with the target.

The DTRM attaches to the aft end of the missile flight control section. It is equipped with a SAFE/ARM igniter assembly that is manually locked in either the SAFE or ARMED position. This switch can only be repositioned with an arming key. When in the SAFE position, the arming key cannot be removed. This switch prevents accidental firing of the motor. It should not be moved to the ARMED position until immediately before aircraft launch.

The control surfaces consist of four delta-shaped wing and fin assemblies. The wings and fins are designed for quick attachment and release without the use of tools. The wing assemblies attach to the flight control section, which controls their rotary motion to produce the desired pitch, yaw, and roll. The tail fin assemblies attach to

fittings on the rear of the rocket motor and provide stability to the missile.

Another series of the Sparrow III guided missile is the RIM-7E and RIM-7H. These missiles are surface-to-air guided missiles. They are used in some ships in the ship's Basic Point Defense Surface Missile System (BPDSMS) and Improved Point Defense Surface Missile System (IPDSMS), respectively. As an Aviation Ordnanceman, your responsibility for these missiles is in the area of handling and stowage only.

For further information concerning the Sparrow III (series) missiles, refer to publication *NWS-MMMU Maintenance Manual*, NAVAIR 01-265GMAD-9-3 (series).

Harpoon Guided Missile

The Harpoon surface attack guided missile, AGM-84A-1 (tactical) air-launched missile (fig. 5-11), is an all-weather antiship attack weapon. It is capable of being launched from the A-6 and P-3 aircraft. The missile is AUR and requires no assembly other than installation of the wing and control fin assemblies. The missile consists of the guidance section, warhead section, sustainer

REVIEW NUMBER 2 ANSWERS

- A1. Guidance, control, armament, and propulsion are the major sections of guided missiles.
- A2. The guidance section is considered the brains of the missile.
- A3. The three types of homing systems are active, semiactive, and passive homing.
- A4. If a missile gets its target illumination from the launching aircraft, it is semiactive homing.
- A5. The armament section consists of the payload, fuzing, safety and arming (S&A) devices, and target-detecting devices (TDDs).
- A6. Safety and arming devices maintain the explosive train of a fuzing system in a safe condition until the acceleration requirement is met after launch.
- A7. The two types of propulsion used with guided missiles are atmospheric (air breathing) jet and thermal jet.
- A8. The atmosphere jet depends on the atmosphere to supply the oxygen for proper fuel burning, and the thermal jet contains its own supply of oxygen and is independent from the atmosphere.

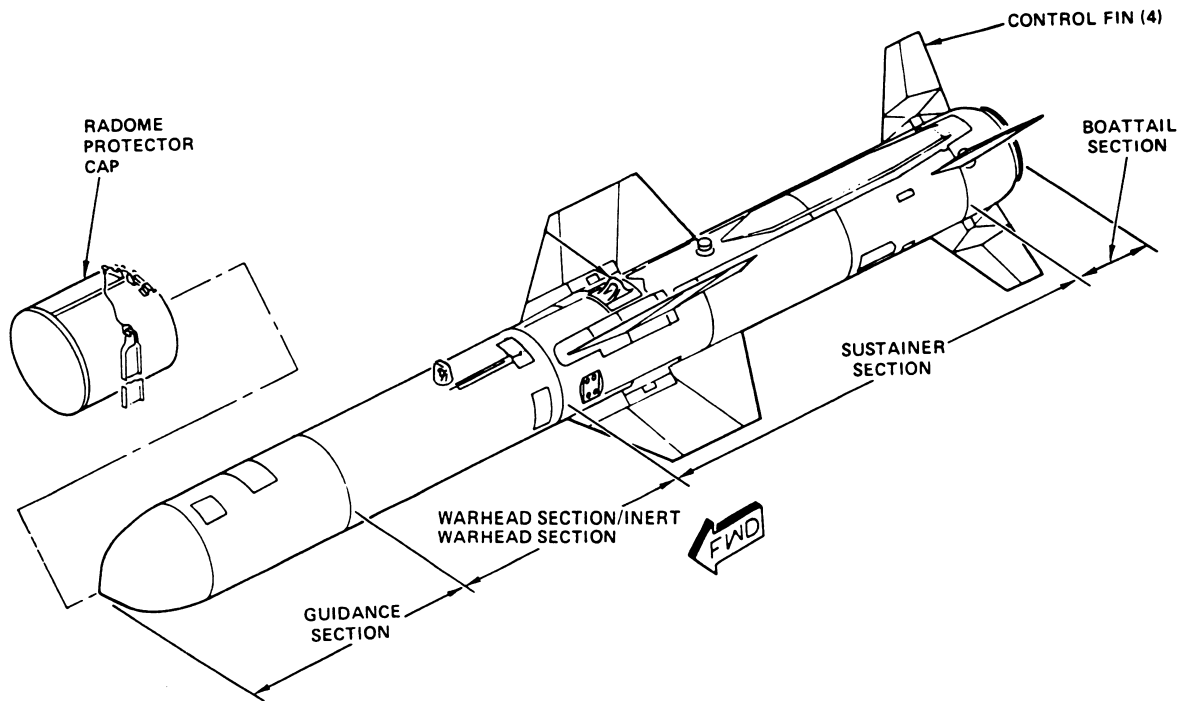


Figure 5-11.—AGM-84A-1 Harpoon guided missile.

section, boattail section, wings, and control fins. The missile is approximately 151 inches in length and weighs approximately 1,144 pounds.

The Harpoon 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. There are four air-launched configurations

of the Harpoon missile in service use. For identification and usage of the different configurations, refer to table 5-2.

The guidance section contains the seeker, radar altimeter, midcourse guidance unit, and power supply. A radome on the front of the guidance section provides the required aerodynamic shield to protect the internal components

Table 5-2.—Air-Launched Missile Identification and Usage

Designation	Nomenclature	Use	Color
AGM-84A-1	Surface Attack Guided Missile, Air	Tactical anti-ship weapon	White and yellow band around warhead section. Brown band around sustainer section.
ATM-84A-1	Exercise Training Missile, Air	Training, test, and evaluation	White with blue band around exercise section. Brown band around sustainer section.
ATM-84A-1B	Training Missile, Inert, Air	Handling, training	White with blue band around guidance section.
ATM-84A-1A	Training Missile, Inert Warhead, Air	Training, handling and evaluation	White with blue band around inert warhead section. Brown band around sustainer section.

of the seeker. During ground handling, the radome is protected by a radome protector cap.

The warhead section contains a penetration blast type of explosive, the guided missile fuze, fuze booster, and the pressure probe assembly. It also provides internal routing of the interconnecting cable from the guidance section to other parts of the missile.

The sustainer section contains the fuel tank and fuel supply system, missile battery, pyrotechnic relay panel, and the turbojet engine. Three BSU-4/B missile wings and one BSU-43/B missile wing are attached to the sustainer section by quick-attach clevis-type fittings. These wings are attached to the missile at the organizational level. They provide the aerodynamic lift required to sustain missile flight. They are made of a framed aluminum honeycomb construction and are nonfolding.

The boattail section contains four control actuators, which control the control fins. Four identical nonfolding missile control fins (BSU-44/B) provide directional control of the missile's airframe proportional to the input signal received from the guidance section. The control fins are one-piece aluminum castings, and are attached to the control fin actuators by means of an integral torque-limiting screw type of device.

For further information concerning the air-launched AGM-84 (series) Harpoon guided missiles, refer to the publications *Harpoon Missile Configurations*, *Surface Attack*, *Air Launch*

AGM-84A-1; Exercise Training, Air Launch ATM-84A-1; Training Inert, Air Launch, ATM-84A-1B; and Training Inert Warhead, Air Launch, ATM-84A-1A, NAVAIR 01-AGM84A-2-1.

Sidewinder Guided Missile

The Sidewinder guided missiles, AIM-9L and ATM-9L-1 (fig. 5-12), are supersonic, air-to-air weapons with passive infrared target detection, proportional-navigation guidance, and torque-balance control systems. They are capable of being launched from the A-6, A-7, F-4, F-14, and F/A-18 aircraft. The AIM-9L and ATM-9L-1 missiles are issued to the fleet as AURs. The components of the ATM-9L-1 are identical to the AIM-9L, except that a training warhead is substituted for the tactical warhead in the ATM-9L-1. The AIM-9L missile is used strictly for tactical purposes. The ATM-9L-1 missile is used for pilot training in target acquisition and missile firing.

The Sidewinder guided missile is approximately 113 inches in length, 5 inches in diameter, weighs approximately 190 pounds, and consists of five major components. These components are the guidance and control section, the target detector section, the S&A device, the warhead section, and the rocket motor section (fig. 5-13).

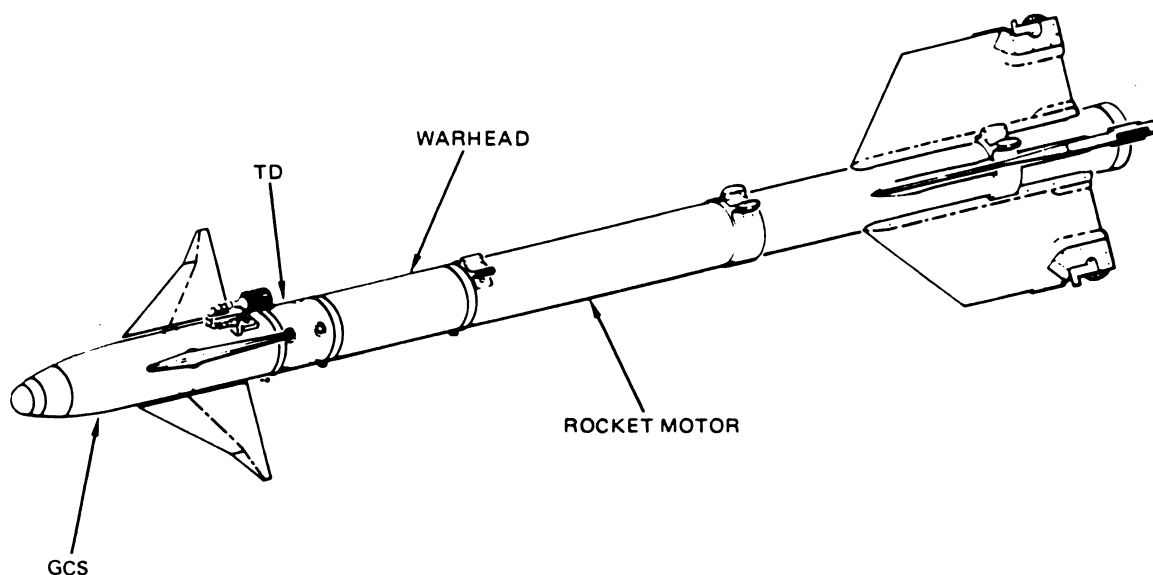


Figure 5-12.—AIM-9L and ATM-9L-1 Sidewinder guided missile.

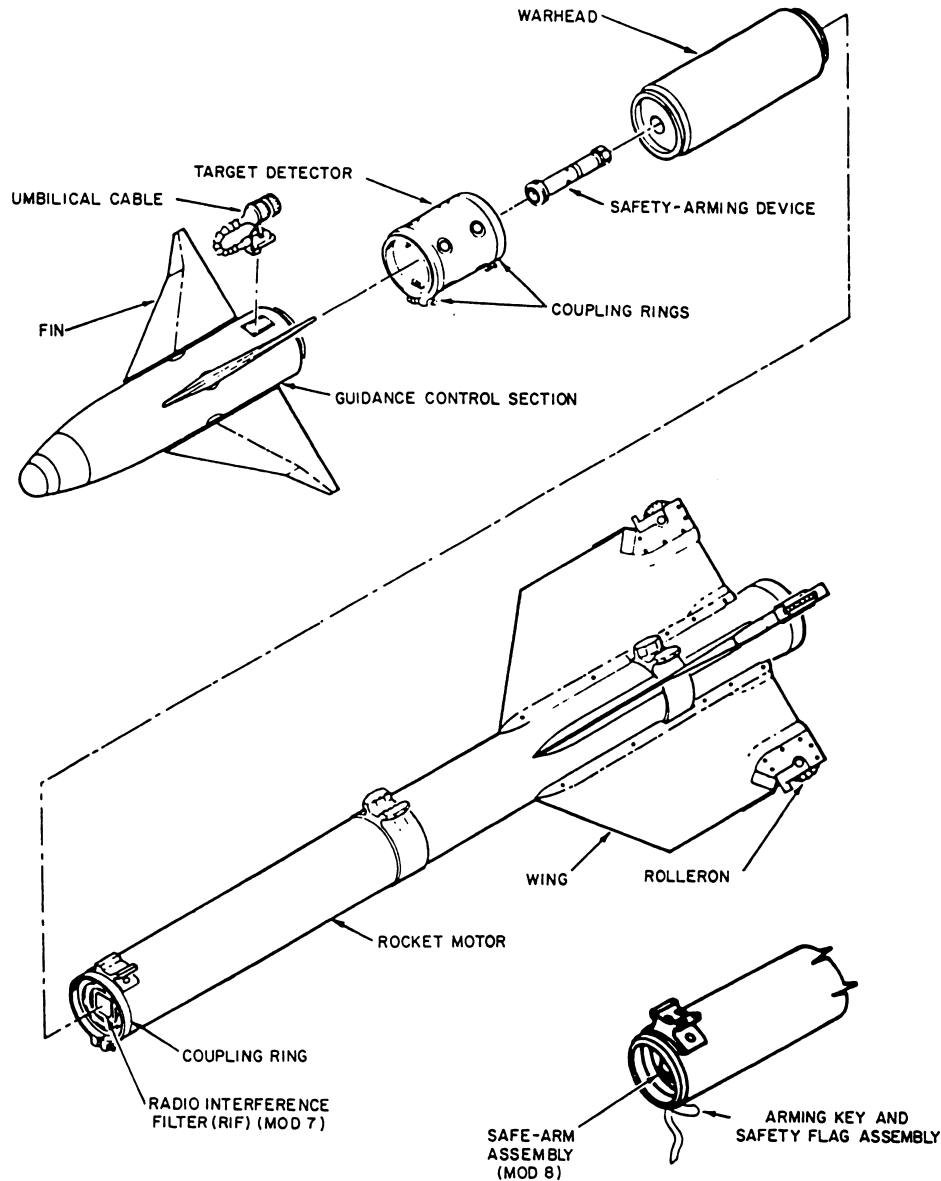


Figure 5-13.—AIM-9L and ATM-9L-1 Sidewinder guided missile (exploded view).

The guidance and control section consists of three major assemblies:

1. an infrared seeker assembly, which is used for detecting the target;
2. an electronic assembly, which is used for converting detected target information to tracking and guidance command signals; and
3. a gas servo assembly (consisting of a gas generator, manifold, pistons, rocker arms, electrical solenoids, and thermal battery), where the electrical guidance commands are converted to mechanical movement of the control fins.

Four BSU-32/B control fins are mounted on the guidance and control section to provide aerodynamic lift and course alterations to the missile during free flight. They are movable surfaces that are electrically controlled and pneumatically operated by the gas servo assembly. The missile umbilical cable is also attached to the guidance and control section. A shorting cap/dust cover must be installed on the umbilical connector at all times when the missile is not electrically connected to the LAU-7 launcher. The umbilical cable provides the necessary path for the exchange of electronic signals between the missile and

aircraft before missile launch. It also provides a connection to the launcher-mounted cooling gas supply, which prevents the electronic components of the guidance and control section from becoming overheated during operation before missile launch. The umbilical cable is sheared off at missile launch.

The target detector (TD) is a narrow-beam, active-optical, proximity fuze system. The purpose of the TD is to detect the presence of an air target within the burst range of the missile warhead and generate an electrical firing signal to the S&A device.

The S&A device attaches to the target detector and is located between the TD section and the warhead section. The S&A device contains an interrupted firing train that is aligned by an acceleration arming device. It contains the necessary high explosives, switches, and circuits to initiate detonation of the warhead.

The WDU-17/B warhead (used in the AIM-9L configuration) is an annular blast fragmentation warhead consisting of a case assembly, two booster plates, an initiator, high explosive, and fragmentation rods. The explosive output from the S&A device is transferred through the initiator to the booster plates. The initiation is then transferred through the explosive-loaded channels of the booster plates to the booster pellets at each end of the warhead. Detonation of the booster pellets sets off the high explosive, causing warhead detonation.

The WDU-9A/B warhead (used in the ATM-9L-1 configuration) is mechanically interchangeable with the WDU-17/B tactical warhead. The WDU-9A/B contains a smoke-flash mix with CH-6 booster to provide visual observation of the missile/target hit.

The Mk 39 Mod 7 rocket motor uses a single-grain propellant. A nonpropulsive head closure, located on the forward end of the motor tube, blows out if the motor is accidentally ignited without the warhead installed, making the motor nonpropulsive (a fire hazard vice a missile hazard). The Mk 39 Mod 8 rocket motor is basically identical to the Mod 7 motor except that the Mod 8 motor is equipped with a safe-arm ignition assembly. The purpose of this assembly is to prevent accidental or inadvertent rocket motor ignition. The safe-arm ignition assembly must be manually rotated to the armed position before flight. This is accomplished by the use of a hex-head T-handle.

Four Mk 1 Mod 0 or Mod 1 wings are attached to the aft end of the motor tube. They provide

aerodynamic lift and stability during flight. Each wing has a rolleron assembly that provides pitch, yaw, and roll stabilization during free flight. When the missile is fired, the rolleron is uncaged by acceleration and is free to move through its longitudinal axis during flight. The rolleron wheel is designed so that the passing airstream causes it to spin at a very high speed, thus acting as a gyroscope, which helps to stabilize the missile and reduce roll during flight.

For further information about the AIM-9L and ATM-9L-1 Sidewinder guided missile, you should refer to the *Sidewinder Guided Missile AIM-9L and Training Missile*, NAVAIR 01-AIM9L-2.1.

REVIEW NUMBER 3

- Q1. *Within the radome of the Sparrow III missile, what feature receives and interprets the radar energy reflected from the target?*
- Q2. *What part of the Sparrow III missile provides control signals and mechanical energy to move external control surfaces that guide the missile?*
- Q3. *To what part of the Sparrow missile is the DRTM attached?*
- Q4. *Name the aircraft from which the Harpoon guided missile is launched.*
- Q5. *The Harpoon missile is less susceptible to radar detection because _____.*
- Q6. *List the sections of the Harpoon missile.*
- Q7. *Sidewinder missiles are equipped with _____ target detection.*

Q8. List the five major components of the Sidewinder missile.

Q9. By what means is the S&A device aligned?

Q10. What feature of the Sidewinder missile provides aerodynamic lift and stability during flight?

The Walleye weapon is issued to the fleet as an AUR. The only assembly required at the organizational maintenance level is the installation of the wings and fins.

The weapons are grouped into three basic series—Walleye I (small scale), Walleye II (large scale), and Walleye II Extended Range Data Link (ERDL). Note that the Walleye II and Walleye II ERDL weapons are larger in diameter and length and weigh more than the Walleye I weapon. The Walleye II ERDL weapon also has larger wings. A Walleye weapon representative of each basic series is discussed in this chapter.

Walleye Guided Weapon

The Walleye guided weapon does not contain a propulsion system as do guided missiles. It is included in this chapter because it contains a guidance system, a control system, externally mounted control surfaces, and is listed in the Air Launched Guided Missiles and Components section of TW010-AA-ORD-010/NAVAIR 11-1-116A.

The Walleye guided weapon system (fig. 5-14) is designed to deliver a self-guided, high-explosive weapon from an attack aircraft to a surface target.

WALLEYE I.—The Mk 1 Walleye I tactical weapon consists of a guidance section, a warhead section (including the fuze and fuze booster), a control section, four wings, and four fins. The weapon has provisions for 14- and 30-inch suspension, and an ejector foot pad that is used to adapt the weapons to various types of aircraft bomb racks. The Walleye I (series) weapons are in the 1,000-pound class weapon category.

To form a typical attack situation, the weapon, pilot, and aircraft must perform as a complete weapon system. The weapon uses aircraft electrical power (via an umbilical cable that connects the weapon to the aircraft) from the

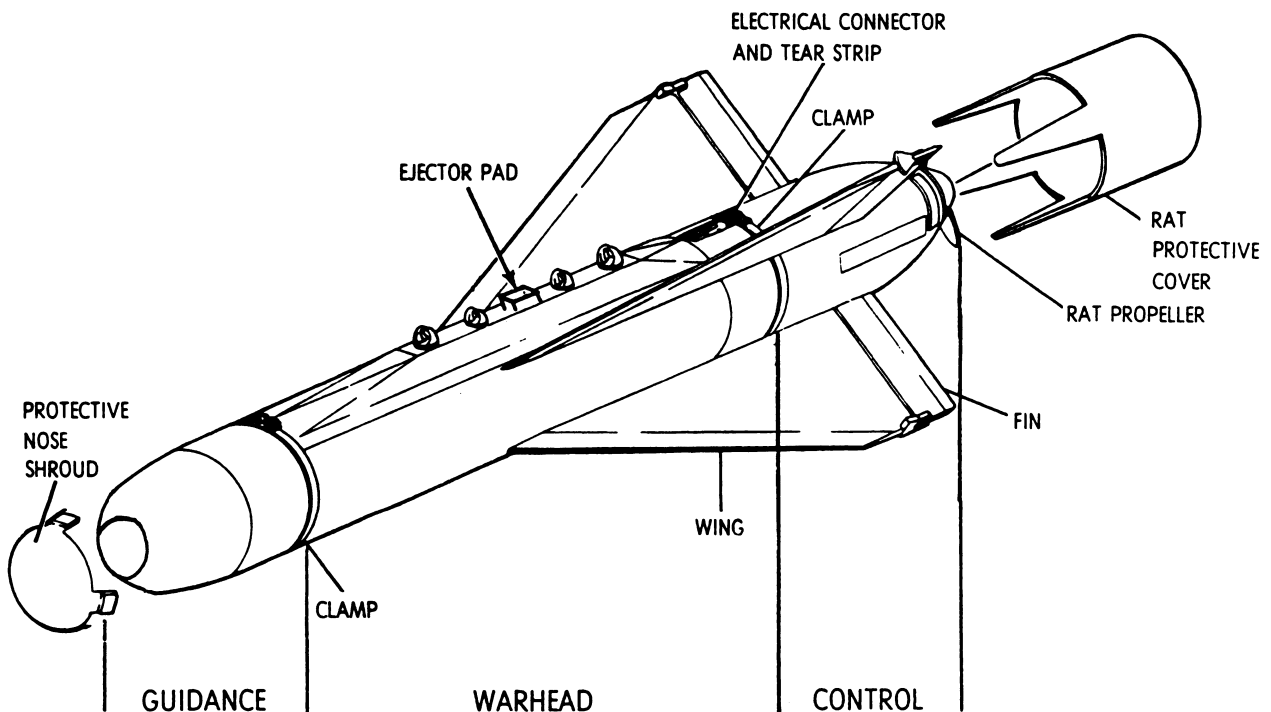


Figure 5-14.—Walleye guided weapon (typical).

time electrical power is applied to the aircraft until the aircraft reaches a speed of approximately 180 knots. The automatic power changeover circuit in the weapon then switches the weapon to ram air turbine (RAT) generator power.

Basically, the guidance section of the weapon and the aircraft system form a closed-circuit television system. A television camera mounted in the nose of the guidance section provides a picture of the area forward of the aircraft and displays this information on a television monitor located in the cockpit of the aircraft. Additional circuits provide a cross-hair grid on the pilot's television monitor, which is a pair of vertical and a pair of horizontal lines. This intersection of horizontal and vertical cross hairs (the square in the middle) defines the tracking area. By looking at the video scene displayed on

the television, the pilot is able to boresight the weapon and aircraft to acquire the target, initiate lock-on, and confirm weapon tracking.

After boresighting the weapon, selecting the proper fuze option, and achieving satisfactory lock-on, the pilot initiates release and escapes the target area. The weapon continues to track the target until it reaches the point of impact.

The Walleye I Mk 4 practice weapon is identical to the Mk 1 weapon except for the warhead and control sections. The warhead is entirely inert, does not contain a fuze or fuze booster, and has ballast to maintain weapon CG (center of gravity) compatibility with the Mk 1 weapon. This weapon is used for captive-flight pilot training and for aircraft loading and ground handling training purposes. Four models of the Mk 4 weapon (Mod 1, Mod 4, Mod 6, and Mod 7)

REVIEW NUMBER 3 ANSWERS

- A1. Within the radome of the Sparrow III missile, the target seeker receives and interprets the radar energy reflected from the target.
- A2. The flight control section, consisting of the autopilot and hydraulic group, provides the Sparrow III missile with control signals and mechanical energy to move external control surfaces to guide the missile.
- A3. The DRTM is attached to the aft end of the missile flight control section of the Sparrow missile.
- A4. The Harpoon guided missile is launched from A-6 and P-3 aircraft.
- A5. The Harpoon missile is less susceptible to radar detection because of its low-level cruise trajectory with over-the-horizon range.
- A6. The sections of the Harpoon missile include the guidance, warhead, sustainer, and boattail sections.
- A7. Sidewinder missiles are equipped with passive infrared target detection.
- A8. The five major components of the Sidewinder missile include the guidance and control section, target detector section, S&A device, warhead section, and rocket motor section.
- A9. The S&A device is aligned by an interrupted firing train that is aligned by an acceleration arming device.
- A10. Four Mk 1 Mod 0 or Mod 1 wings attached to the aft end of the motor tube provide aerodynamic lift and stability to the Sidewinder missile during flight.

have a video tape recorder (VTR) that allows the pilot to make postflight analysis of the attack sequence.

For further information concerning the Walleye I guided weapon, you should refer to the *Walleye I Guided Weapon*, NAVAIR 01-15MGA-1.

WALLEYE II.—The Mk 5 tactical Walleye II guided weapon consists of a guidance section, a fairing assembly, a warhead section (including the fuze and fuze booster), a control section, four wings, four fin adapters, and four fins. The weapon has provisions for 30-inch suspension only, and is in the 2,000-pound class weapon category. The Walleye II (series) weapons are essentially the same as the Walleye I weapons except they are physically larger in size and have improved electronics. Functional operation of the weapon and delivery tactics are basically the same as Walleye I.

For further information concerning the Walleye II (series) weapons, you should refer to the *Guided Weapon (Walleye II)*, NAVAIR 01-15MGB-2.2.

WALLEYE II ERDL.—The Walleye II Extended Range Data Link (ERDL) guided weapon Mk 23 Mods 0, 1, and 2 (frequency channels A, C, and E) consists of the same basic items as the Walleye II Mk 5 weapons. However, these assemblies include added data link functions and extended range capability. The addition of

the larger wings enables the weapon to be launched with longer slant ranges to a target complex. The addition of the data-link pod (guided weapon control-monitor set AN/AWW-7B) and a joystick controller (guided weapon control group OK-293/AWW) on the aircraft allow the pilot to remotely steer the weapon to a specific target within the complex with pinpoint accuracy.

The Guided Weapon Control-Monitor Set AN/AWW-7B, data-link pod (fig. 5-15), is the communications link between the pilot and the weapon. The pod is suspended from a standard Walleye-configured bomb rack. It can be jettisoned in an emergency. The pod contains the necessary electronics to allow the pilot to receive the transmitted video from the weapon and to transmit the command signals to the weapon. In addition, the pod contains a video tape recorder (VTR) that records the video transmitted by the weapon all the way to impact on the target. This allows low-cost weapon performance monitoring, which can be played back for mission evaluation or for training purposes.

The weapon system may be used in one- or two-aircraft operations. In a single aircraft operation, the aircraft carries both the weapon and the pod, and the aircraft performs both launch and control functions. In the two-aircraft operation, one aircraft carries the weapon and a second aircraft carries the pod. In this operation, both the launch aircraft and the pod aircraft

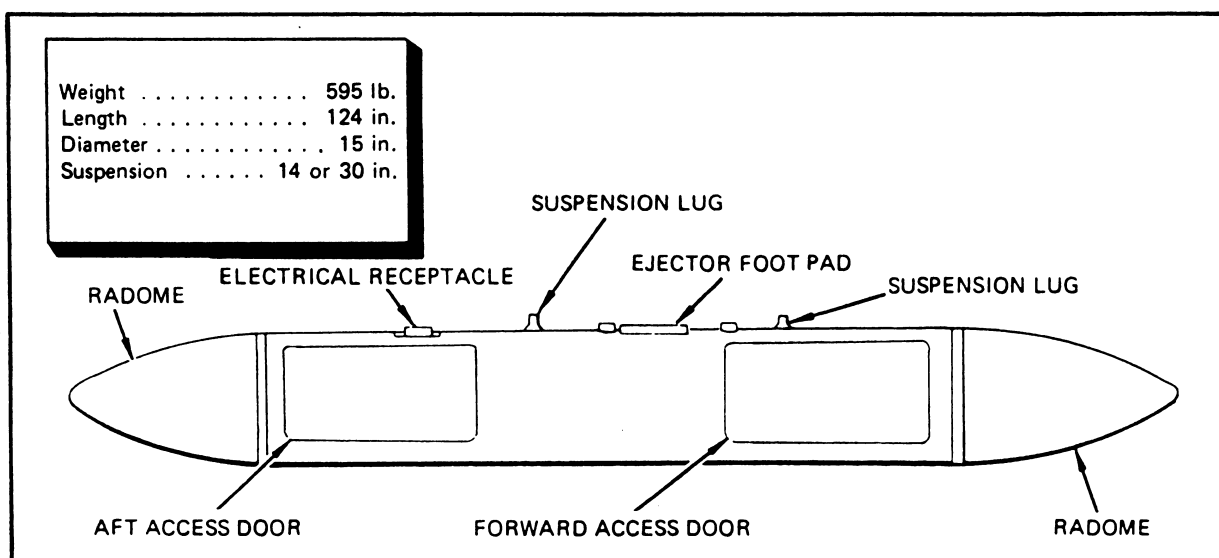


Figure 5-15.—AN/AWW-7 data pod.

receive a video picture of the target area from the weapon. After weapon launch, the pod aircraft monitors the flight of the weapon and can update the weapon aim point all the way to impact.

Tactically, the two-aircraft operation dominates because of the limited number of available pods. For example, a one-pod configured aircraft monitors the weapon control functions for several individual weapon launchings during one mission (not simultaneously). The three frequency channels (A, C, and E) are used to control the individual weapons launchings. The three channels prevent the control section of the weapon from responding to override (steering) commands from a pod that is not set to that weapon's specific frequency channel. Therefore, more than one weapon/pod operation can be conducted in the same area.

The Walleye II ERDL Mk 27 Mods 3, 4, and 5 (frequency channels A, C, and E) practice guided weapon are used for captive flight, data-link training for pilots of data link configured A-7 aircraft. The practice guided weapon contains the same data link components as the tactical Walleye I ERDL Mk 23 weapon except that the warhead in the Mk 27 is filled with inert material.

REVIEW NUMBER 4

- Q1. Name the three basic series of Walleye guided weapon systems.*
- Q2. List the sections of the Walleye I tactical weapon.*
- Q3. When the Walleye I is used, how is a typical attack situation formed?*
- Q4. What type of suspension does the Walleye II have?*
- Q5. What is the difference between the Walleye I and Walleye II weapons?*
- Q6. Name the functions the Walleye II ERDL have that the Walleye I and Walleye II don't have.*
- Q7. The data-link pod provides the _____.*
- Q8. What prevents the control section of one weapon from responding to commands not set to its channel?*

Phoenix Missile

The tactical AIM-54C Phoenix (fig. 5-16) is an air-launched, air-to-air guided missile that employs active, semiactive, and passive homing capabilities. The AIM-54C is used as a long-range, air-intercept missile launched from the F-14 aircraft. It is equipped with the AWG-9 Airborne Missile Control System (AMCS). The missile can be launched in multiple missile attacks, as required, against hostile forces. A maximum of six AIM-54C Phoenix missiles can be launched from a single aircraft, with simultaneous guidance against widely separated targets. In addition, the missile has dogfight, electronic counter-countermeasures (ECCM), and anticruise missile capabilities.

The physical description of the Phoenix missile is extremely brief as this missile is classified as Secret. The overall length of the missile is 13 feet with a diameter of 15 inches. It weighs approximately 1,020 pounds. The missile consists of the guidance section, the armament section, the propulsion section, and the control section. The missile is an AUR. The wings and fins can be mounted or removed to facilitate handling.

Maverick Missile

The tactical AGM-65E Maverick (fig. 5-17) is a laser-guided, rocket-propelled, air-to-ground missile. It is used against fortified ground installations, armored vehicles, and surface combatants. The Maverick missile is compatible with the A-4M, A-6E, AV-8B, and F/A-18 aircraft.

The AGM-65E missile has two major sections—the guidance and control section and the

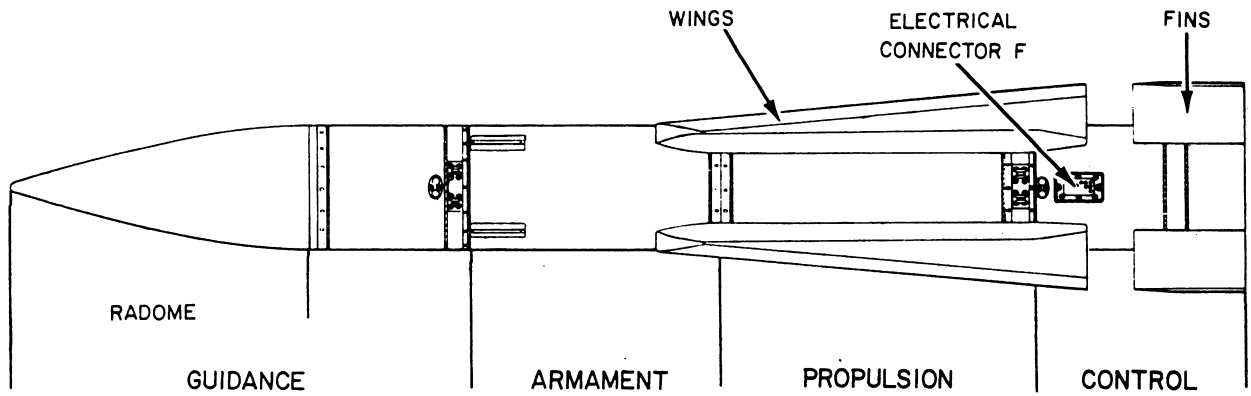


Figure 5-16.—AIM-54C Phoenix guided missile (typical).

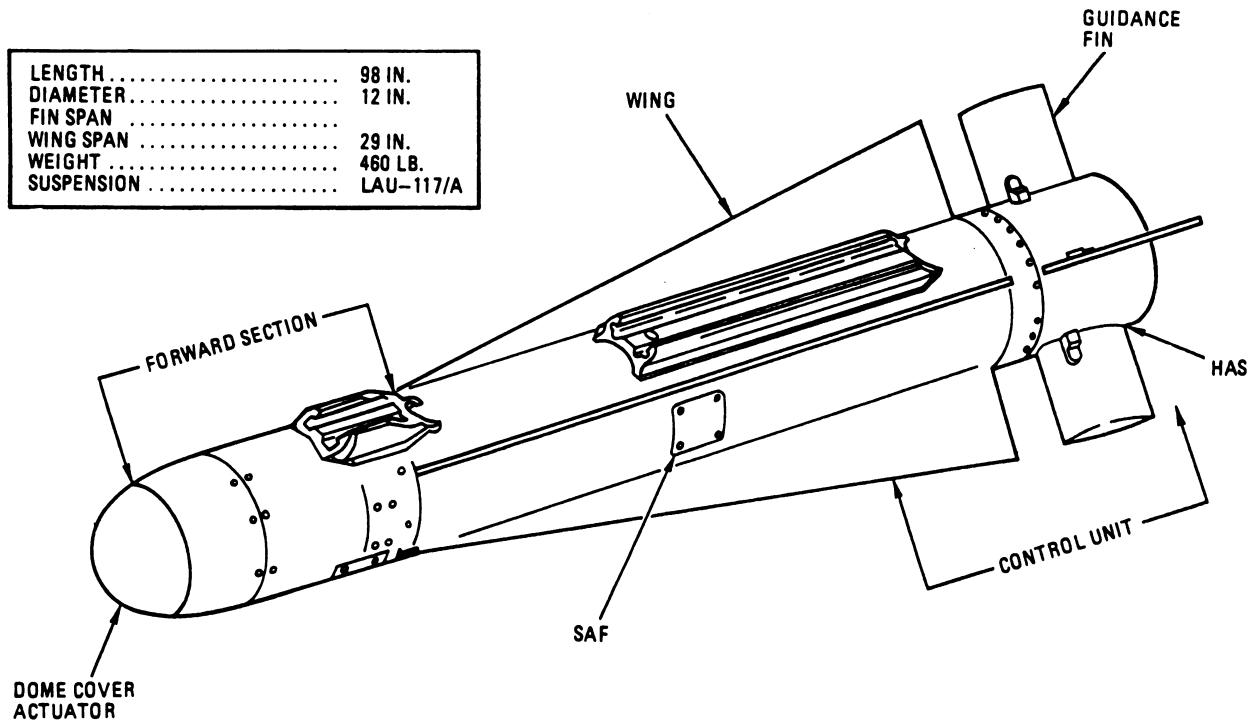


Figure 5-17.—AGM-65E Maverick missile.

center/aft section. Four fixed wings are an integral part of the center/aft section, and four movable control surfaces (fins) are located at the aft section. These fins are installed or removed to aid in handling. The missile is issued to the fleet as an AUR. Installation of the fins is the only assembly required at the organizational maintenance level.

The AGM-65E missile system has all the laser missile features, including automatic terminal homing on laser energy reflected from the target illuminated by a laser designator. The laser

designator can be a ground device, either hand-held or tripod mounted. It can also be a stabilized airborne device, mounted either on a separate aircraft or on the launching aircraft. Additionally, the warhead provides kinetic penetration into earth-barricaded or concrete fortifications and ships. The fuzing system allows a selectable detonation delay to optimize kill capability.

For further information on the AGM-65E Maverick, you should refer to *Laser-Guided Missile AGM-65E (Maverick)*, NAVAIR 11-120-58.

Standard ARM Missile

Standard ARM guided missiles are air-launched, supersonic guided missiles. They are used against surface targets that radiate microwave electromagnetic energy. Tactical configurations of the Standard ARM guided missile currently in use are the AGM-78B, AGM-78C, and AGM-78D-1. Current training

configurations are the ATM-78B, ATM-78C, and ATM-78D-1. The missile is ejection launched from the A-6 aircraft, which is capable of carrying four launcher/missile combinations. The major differences between the various AGM-78 missile configurations are the guidance sections and smoke signals.

The AGM-78 missile (fig. 5-18) has six cylindrical sections—guidance section, ordnance

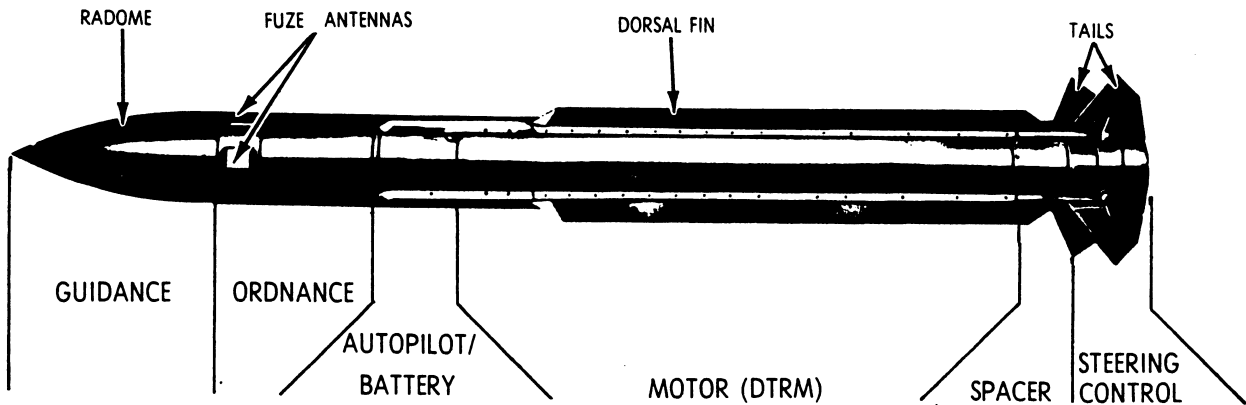


Figure 5-18.—AGM-78 Standard ARM guided missile (typical).

REVIEW NUMBER 4 ANSWERS

- A1. The three basic series of Walleye guided weapon systems are the Walleye I, Walleye II, and Walleye II ERDL.
- A2. The sections of the Walleye I tactical weapon include the guidance section, warhead section, control section, four wings, and four fins.
- A3. When the Walleye I is used, a typical attack situation is formed by the weapon, pilot, and aircraft performing as a complete weapon system.
- A4. The Walleye II has a 30-inch suspension.
- A5. The Walleye I and Walleye II weapons are basically the same; however, the Walleye II is physically larger and has improved electronics.
- A6. The Walleye II ERDL has added data link functions and extended range capability.
- A7. The data-link pod provides the communications link between the pilot and weapon.
- A8. Three frequency channels (A, C, and E) prevent the control section of one weapon from responding to commands not set to its channel.

section, autopilot-battery section, dual-thrust rocket motor, spacer assembly, and steering control unit. It has four fixed-dorsal fins located in line with four independently movable control surfaces (tails).

The AGM-78 missile uses a passive homing guidance system to develop guidance intelligence from the energy radiated by the target. The missile control system uses this guidance intelligence along with prelaunch instructions from the launch aircraft avionics and feedback from missile instruments to develop steering commands. These commands control the deflections of the four aerodynamic control surfaces (tails). The tail deflections steer the missile on an optimum course to the target. The propulsive power is provided by a DTRM, which is fired shortly after the missile is ejected from the launcher. Electrical power is provided by primary batteries activated shortly before launch. Target destruction is accomplished by a warhead detonated by a fuze system. The missile impact area is identified by a guided missile smoke signal. This smoke signal uses a white phosphorous marking agent dispersed when the smoke signal canister is broken by the warhead explosion.

For further information about the AGM-78 (series) guided missile, you should refer to *Standard ARM Missile AGM-78B, AGM-78C,*

and AGM-78D-1, and Training Guided Missile ATM-78B, ATM-78C, and ATM-78D-1, NAV-AIR 01-5GMAA-20/T.O.21M-AGM78B-2.

HARM Missile

The AGM-88A high-speed antiradiation missile (HARM) (fig. 5-19) missile offers performance improvements over the existing Shrike and Standard ARM missiles when used for defense suppression and similar operations.

The HARM missile, in conjunction with the launching aircraft's avionics, detects, identifies, and locates enemy radars, displays threat information, and computes target parameters. The HARM missile is 10 inches in diameter, 194 inches long, and weighs 780 pounds. The missile operates in three basic modes—self-protect (attack targets that pose immediate threat to the aircraft), target of opportunity (attack discrete targets important to the tactical situation), and prebrief (missile programmed to the vicinity of known or expected targets, and to attack when lock-on is achieved) modes. Launch aircraft for the HARM are the A-6E, A-7E, and F/A-18.

LENGTH	
DIAMETER	
FIN SPAN	
WING SPAN	
WEIGHT	
SUSPENSION	LAU-118/A

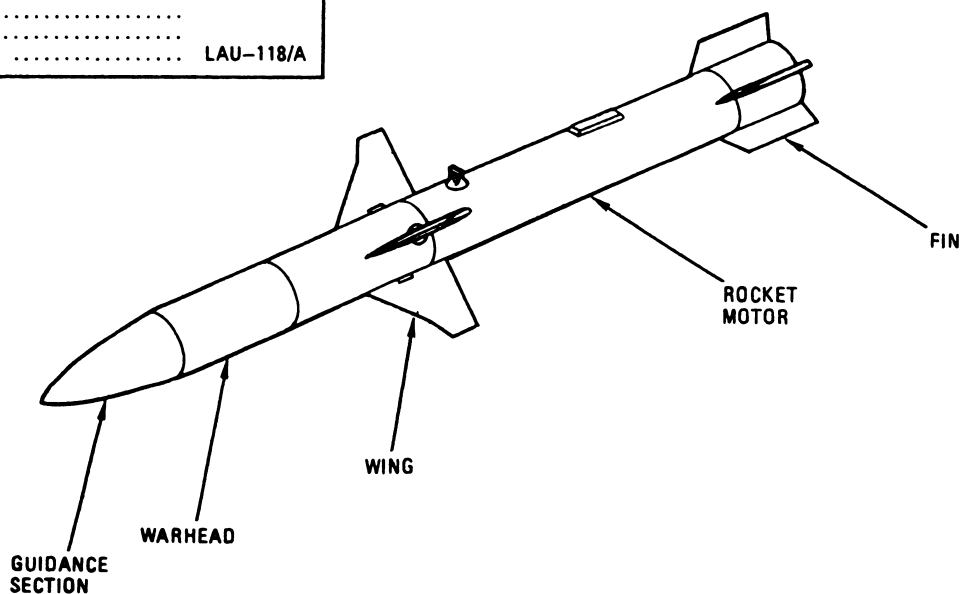


Figure 5-19.—AGM-88 HARM missile.

Shrike Missile

The AGM-45 Shrike surface attack guided missile (fig. 5-20) is a passive homing air-to-ground antiradar guided missile. The Shrike missile is issued to the fleet as an AUR, except for wings and fins that must be ordered separately. There are two tactical models of the Shrike—the AGM-45A and AGM-45B. Each model is issued in different modifications—AGM-45A-2, -3, -3A, -4, -6, and -7; and AGM-45B-2, -3, -3A, -4, -6, and -7. The difference between the two models and model modifications depends on the Mark and Mod of the particular component section used during missile assembly. For all practical purposes, the two missiles function the same way. The AGM-45A and AGM-45B are assembled in four sections—guidance section, warhead section, control section with wings, and rocket motor section with fins. Wings and fins are shipped in separate shipping containers and are installed at the organizational maintenance level. The missiles are approximately 10 feet long and 8 inches in diameter with a wing span of 36 inches. They weigh approximately 414 pounds each.

The different sections of the Shrike missile perform the same functions as the sections of other missiles previously discussed. The guidance section processes and relays target acquisition data and provides wing steering commands to the control section. The control section converts aircraft voltage to guided missile voltages during missile captive flight, converts guidance commands to operate the wings for steering, relays the missile firing signal to the rocket motor section at missile launch, and provides circuitry and altitude sensing for arming.

The rocket motor provides propulsion for the guided missile. The AGM-45A uses a single grain solid propellant, and the AGM-45B uses a solid propellant dual-thrust (DTRM) propulsion unit. The warhead contains the explosives necessary for target destruction and is a patterned fragmentation warhead. Fuzing is also located in the warhead section.

A series of Shrike missiles are configured as training missiles. The configuration varies depending on the intended use of the missile.

The ATM-45A-1 is used by missile shop personnel to perform exercises in unpacking and packing, assembly, preparation for ready-service stowage of the guided missile, and by aircraft loading crews to practice aircraft loading.

The ATM-45A-2 and ATM-45B-2 practice missiles are used for safe-separation tests.

The ATM-45A-3 exercise missile is used by pilots to gain experience in acquiring target indication signals. The exercise missile is also used by missile shop personnel and aircraft loading crews for training purposes.

The ATM-45A-4, ATM-45B-4, ATM-45A-6, and ATM-45B-6 exercise missiles are used to train pilots in guided missile launching and target run-in exercises.

For further information on tactical and training Shrike missiles, refer to the publication *Surface Attack Guided Missile AGM-45A and AGM-45B (Shrike) and Trainers ATM-45A and ATM-45B*, NAVAIR 01-80MGA-2.1.

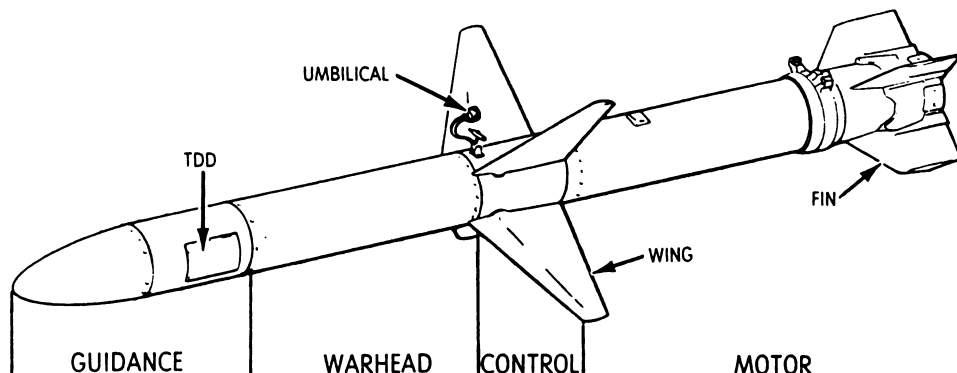


Figure 5-20.—AGM-45 Shrike guided missile (typical).

REVIEW NUMBER 5

- Q1. List the homing capabilities incorporated into the Phoenix missile.
- Q2. How many Phoenix missiles can be launched from a single aircraft?
- Q3. List the sections of the Phoenix missile.
- Q4. List the types of targets the Maverick missile is used against.
- Q5. How does the laser guidance system work in the Maverick missile?
- Q6. The Standard ARM missile is ejection launched from what aircraft?
- Q7. What type of homing system is used with the Standard ARM missile?

Q8. Name the three basic modes of HARM missile operation.

Q9. Name the sections of the Shrike missile.

Q10. What is the purpose of the ATM-45-1 Shrike missile?

GUIDED MISSILE LAUNCHERS

Learning Objective: *Identify the purpose and recognize the use of guided missile launchers. Identify the components of the LAU-7/A (series) guided missile launcher.*

Guided missile launchers provide the mechanical and electrical means of suspending and air-launching a guided missile from an aircraft. As the physical, mechanical, and functional requirements for each particular missile-to-aircraft configuration vary, a brief description of each type of missile launcher is discussed in the following paragraphs.

LAU-7/A (SERIES) GUIDED MISSILE LAUNCHER

The LAU-7/A (series) guided missile launcher (fig. 5-21) is a reusable launcher that provides

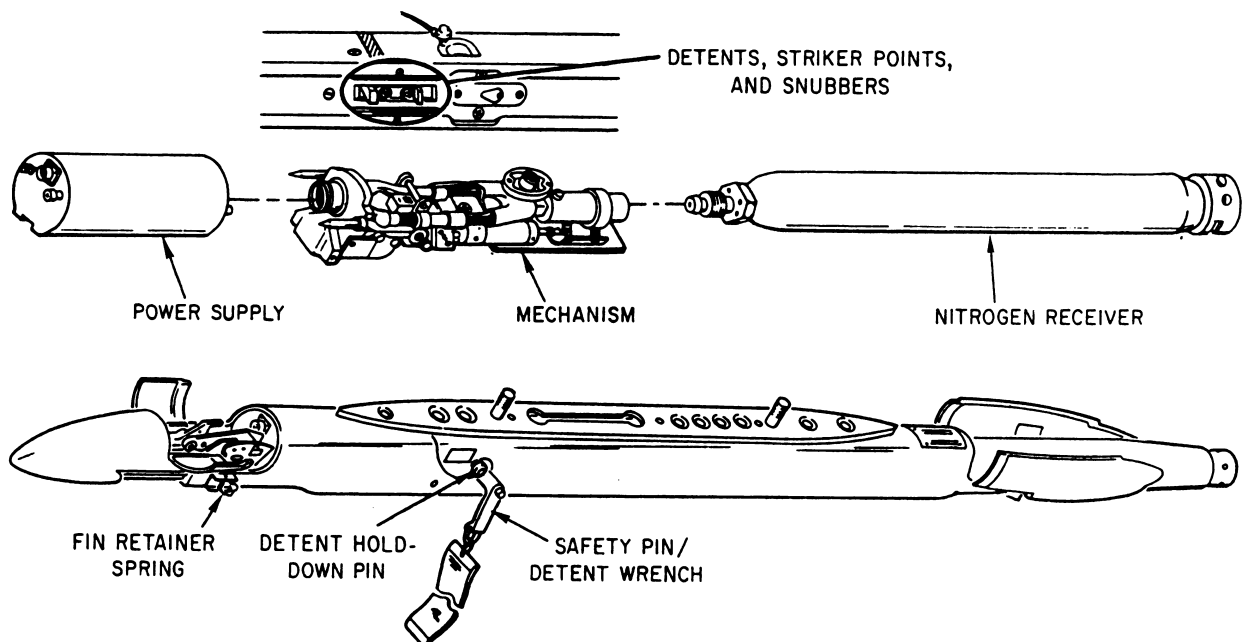


Figure 5-21.—LAU-7/A (series) guided missile launcher.

a complete launching system for use with the AIM-9 Sidewinder (series) missiles. The launcher (fig. 5-21) has four major assemblies—the housing assembly, nitrogen receiver assembly, mechanism assembly, and power supply.

Housing Assembly

The housing assembly is the main structural member of the launcher. It is an extruded, machined aluminum member that provides structural rigidity to the launcher and includes provisions for mounting all other assemblies. It also includes provisions for mounting the launcher to the aircraft.

Nitrogen Receiver Assembly

The nitrogen receiver assembly stores the high-pressure nitrogen (3,200 psig) used to cool the

missile's IR detector in the guidance system. Two nitrogen receiver assemblies are available for use with the launcher. One is a cylindrical fiber glass container with a corrosion-resistant metal liner, and the other is a plain cylindrical steel container. The receiver mounts in the aft section of the housing assembly and screws into the aft end of the mechanism assembly. All receivers contain a charging valve (for refilling), relief valve, and a pressure indicator mounted in the aft end of the cylinder. The pressure indicator is color coded to ensure correct readings as follows:

- Red 0 to 2.2 psi
- Yellow 2.2 to 2.8 psi
- Green 2.8 to 3.5 psi
- White 3.5 to 5 psi

All readings listed must be multiplied by 1,000 psi.

REVIEW NUMBER 5 ANSWERS

- A1. *The Phoenix missile use active, semiactive, and passive homing.*
- A2. *Six Phoenix missiles can be launched from a single aircraft.*
- A3. *The Phoenix missile consists of the guidance, armament, propulsion, and control sections.*
- A4. *The Maverick missile is used against fortified ground installations, armored vehicles, and surface combatants.*
- A5. *The Maverick missile has automatic terminal homing on laser energy reflected from the target illuminated by a laser designator.*
- A6. *The Standard ARM missile is ejection launched from the A-6 aircraft.*
- A7. *The Standard ARM missile uses a passive homing system.*
- A8. *The three basic modes of HARM missile operation are self-protect, target of opportunity, and prebrief.*
- A9. *The Shrike missile consists of the guidance, warhead, control, and rocket motor sections.*
- A10. *The purpose of the ATM-45-1 Shrike missile is to perform exercises in packing/unpacking, assembly, and preparation for ready-service stowage, and practice loading by aircraft loading crews.*

Mechanism Assembly

The mechanism assembly is an electromechanical device that holds the missile for takeoffs and landings and releases the missile for launching. It mounts in the center of the housing assembly forward of the receiver assembly. The subassemblies of the mechanism assembly are discussed in the following paragraphs.

ELECTRICAL HARNESS ASSEMBLY.—

The electrical harness assembly consists of the appropriate connectors and wiring to interconnect between the aircraft power and firing circuits and the launcher. Also, the nitrogen system supply tube is routed through the electrical wiring harness to the power supply.

DETENT, DETENT LOCK, DETENT-LOCK SOLENOID, AND SNUBBERS.—The detent, detent lock, detent-lock solenoid, and forward snubbers make up an electromechanical system that restricts longitudinal and lateral motion of the mounted missile. This system prevents accidental launch or release during catapult takeoff or arrested landings. A slotted detent wrench/safety pin is installed through the mechanism assembly to prevent movement of the aft detent and to safe the launcher firing circuits. It is also used to raise the aft detent lug sufficiently to clear the missile hanger during loading. The slotted detent wrench/safety pin is removed before flight. When the detent is down (normal), the striker points make contact with the buttons (contacts) on the forward hanger of the missile. The forward striker point does not have a function for the missile; the aft striker point makes contact between the missile and the firing safety switch.

NITROGEN CONTROL VALVE.—The nitrogen control valve is a solenoid-operated shutoff valve that controls the flow of nitrogen from the receiver assembly to the missile. Operation of the control valve is controlled from the cockpit by the pilot.

Power Supply

One power supply is available for use in the launcher. Power supply PP-2581/A is a single-phase power supply. It is a self-contained unit with connectors on each end. The aft connector links the power supply and the mechanism assembly. The forward connector provides the connection to the missile's umbilical cable.

Forward Fairing Assembly

The forward fairing assembly is an aluminum casting that mounts to the forward end of the outer housing to provide an aerodynamic nose to the front of the launcher. It has two doors that are spring-loaded to open. These doors provide access to the umbilical hook support assembly.

Umbilical Hook Support Assembly

The umbilical hook support assembly mounts to the forward housing rails and, during missile loading, is connected to the missile umbilical shear block. At missile launch, the mechanism snaps up, retracting the sheared end of the umbilical cable into the launcher to prevent interference with the missile hangers.

Fin Retainer Assemblies

Two fin retainer assemblies are mounted to the forward end of the housing assembly beneath the forward fairing assembly. The fin retainer is a small, U-shaped bracket containing two spring retainers that snap over the missile fins to prevent movement during captive flight.

Snubber Mount Fitting Assembly, Aft Fairing Latch Assembly, and Aft Fairing Assembly

The aft snubber mount fitting assembly, aft snubber assembly, and aft fairing latch are assembled together as a group and mounted to the aft end of the housing assembly. When the aft fairing latch assembly is in the open position, you can access the nitrogen receiver. It also releases the aft snubbers to allow missile loading. When in the closed position, it allows the snubbers to spring over the aft missile hanger, locking it in place.

Functional Description

The guided missile launcher LAU-7/A (series) provides a complete system that lets the pilot monitor the condition of the missile during flight, control the mode of operation of the missile guidance system, and initiate the arming and launch sequence. In this TRAMAN, functional operation is broken into the captive mode, missile launch sequence (electrical), and missile launch sequence (mechanical).

CAPTIVE MODE.—The captive mode includes taxi, takeoff, normal flight, and landing, or when electrical power is applied to the aircraft. In this mode, power is supplied to the launcher power supply on all loaded stations. In turn, the power supply supplies all required voltages to the missile. Nitrogen flow to the missile's IR detector is controlled by the pilot through an ON/OFF switch in the cockpit. At this point, the launcher is in an electrical static condition, except for the missile audio circuit. It passively transmits to the pilot and the aircraft's armament system. When the pilot selects a loaded Sidewinder station, the missile audio (a 1500 Hz signal) is amplified in the power supply and routed through the station select switch to the aircraft intercom system and to the pilot's headphone. Any tone from the missile indicates a potential target.

MISSILE LAUNCH SEQUENCE (ELECTRICAL).—To prepare the launcher to launch a missile, the pilot must first energize the master arm circuit. The master arm signal is routed to the power supply and from the power supply to the mechanism assembly, energizing the detent-lock solenoid and mechanically unlocking the mechanism assembly detent. This allows the mechanical linkage to close the fuzing and firing safety switches. At this point, the launcher is ready to launch a missile.

When a target is acquired, as indicated by an audio tone in the pilot's headphones and visual identification verifies the target, the pilot actuates the firing button on the flight control stick. The firing signal enters the selected Sidewinder station launcher and is routed to the power supply. The master arm signal is routed from the power supply to the missile safe and arm device. Simultaneously, the firing signal is routed to the gas grain generator squib of the missile (AIM-9D, G, and L) or to the thermal battery squib of the AIM-9H missile. When the gas grain generator or thermal battery reaches the proper voltage output, a signal is routed to the fuze thermal battery to initiate the fuze arming sequence. A signal is simultaneously routed through the firing safety switch and the rear striker point to ignite the squib in the rocket motor of the missile.

MISSILE LAUNCH SEQUENCE (MECHANICAL).—Preliminary mechanical actions of the launch sequence are initiated by application of the master arm signal. The master arm signal actuates the detent-lock solenoid. Through mechanical linkage the detent-lock is unlocked, and the detent

is now held down by heavy spring tension only. The mechanism assembly is now configured to permit the missile to leave the launcher upon missile motor ignition.

Application of the firing signal ignites the missile motor. When the thrust of the motor overcomes the spring tension of the detent, the detent and forward snubbers are pushed upward into the mechanism assembly by the missile's forward hanger. The snubbers lock in the up position to prevent interference with the other missile hangers. Simultaneously, the missile moves forward and the umbilical hook support assembly shears the missile's umbilical block from the missile. The umbilical hook support assembly snaps upward, retracting the umbilical cable into the launcher. This prevents the interference of the umbilical cable with the missile hangers as the missile leaves the launcher.

For further information on the LAU-7/A (series) guided missile launcher, refer to *Guided Missile Launcher LAU-7/A*, NAVAIR 11-75A-54.

REVIEW NUMBER 6

- Q1. What missile launcher is used to carry and launch the Sidewinder missile?*
- Q2. List the four major assemblies of the LAU-7/A launcher.*
- Q3. What is the purpose of the nitrogen receiver assembly?*
- Q4. What is the purpose of the detent, detent lock, detent-lock solenoid, and snubber subassemblies of the mechanism assembly?*
- Q5. What is provided by the LAU-7/A guided missile launcher?*
- Q6. List the functional operation of the LAU-7/A missile launcher.*

AERO 5B-1 GUIDED MISSILE LAUNCHER

The Aero 5B-1 guided missile launcher (fig. 5-22) provides a rail to carry a single Shrike missile. It may be launched from the Aero 5B-1. This launcher is suspended from the bomb rack of the launching aircraft by 14- or 30-inch suspension lugs.

The launcher housing is the main structure of the launcher. It contains the assemblies and components necessary to suspend and launch a missile. The top of the launcher is rounded and extends out from the sides of the housing, providing an area for tightening the bomb rack sway braces and securing the launcher. Provisions for suspension lugs are also located in the top surface of the launcher housing.

The launcher contains circuits for interconnecting launcher and missile prelaunch circuits to the control circuits of the launch aircraft. All electrical components are located in the electrical equipment housing except for the electrical wiring harness. The electrical components provide for electrical testing and for distribution of power to the missile before launch.

The missile is held on the launcher between the forward and aft detent latches. The forward detent is unlocked by a solenoid at the time of missile launch, and missile propulsion overrides the spring tension of the detent. During missile loading/unloading, you manually unlock the detent by pulling the detent handle out and up, lifting the detent clear of the missile lugs.

The breakaway hooks retain the umbilical cable of the missile at launch. In an emergency, the emergency jettison of a missile is accomplished by either firing the missile in an unguided mode (unarmed) or ejecting the launcher and missile from the bomb rack.

For further information on the Aero 5B-1 guided missile launcher, refer to *Guided Missile Airborne Launcher, Navy Model Aero 5B-1*, NAVAIR 11-75A-38.

LAU-17/A WING MISSILE PYLON

Additional missile capability for the F-4 aircraft exists at armament stations 2 and 8 by the wing missile pylon LAU-17/A. The basic

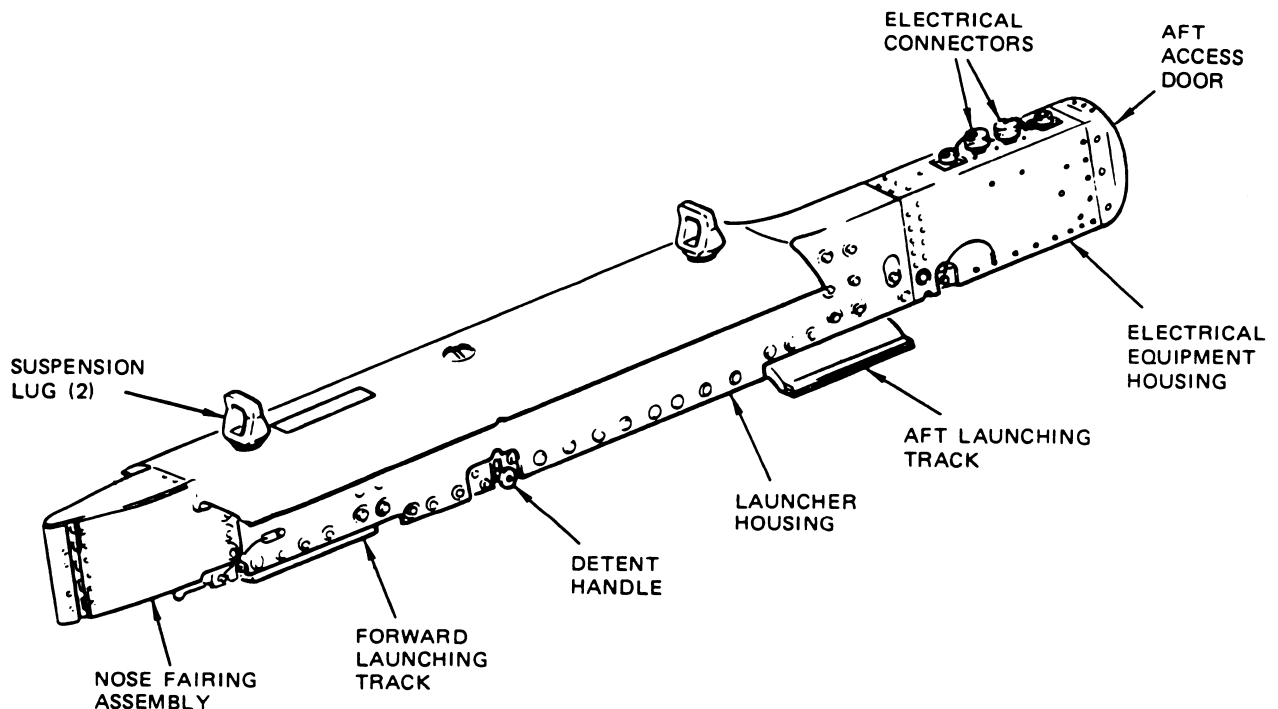


Figure 5-22.—Aero 5B-1 guided missile launcher.

pylon, with integral missile rail (fig. 5-23), can carry, retain, and rail launch an AIM-7E Sparrow III missile. (NOTE: Do **not** load the AIM-7F Sparrow III missile on the LAU-17/A wing missile pylon. It isn't authorized.) With the addition of an adapter, a LAU-7/A launcher can be bolted to each side of the pylon, and two Sidewinder missiles can be carried in place of the Sparrow III missile. Multiple weapons adapters are fitted to the pylon to provide other weapon configurations such as bombs and rockets.

The Sparrow III missile is mounted to the launcher by aligning the missile lugs with the back of the aft rail fitting and the wide area at the back end of the forward slot, then sliding the missile forward. The forward missile lug pushes the keeper up and moves past it to be stopped by the detent cam. The keeper then snaps down behind the lug and prevents rearward movement of the missile. The detent cam prevents forward movement of the missile until unlocked by an internal mechanism at the time of launch. A sway brace roller can be manually positioned against the missile to prevent excessive lateral movement.

A safety pin, the same as used for the Aero 7A launcher, electrically safes the launcher by opening the jettison circuit. This, in turn, prevents energizing the motor firing circuit.

The pylon is mounted to the aircraft by an explosive bolt at the forward mount and a support fitting at the aft mount. In an emergency, if the jettison circuit is activated, the explosive bolt is blown apart, separating the forward end of the pylon from the aircraft. This allows the pylon to pivot downward against the aft support fitting, separating the entire pylon and missile from the aircraft.

For further information on the LAU-17/A, refer to *Wing Missile Pylon, LAU-17/A*, NAV-AIR 11-75A-60.

LAU-115/A GUIDED MISSILE LAUNCHER

The LAU-115/A guided missile launcher (fig. 5-24) is a reusable launcher. It completes the F/A-18 aircraft suspension and launching system for the AIM-7 Sparrow missile. The rail provides suspension capabilities for the AIM-7 missile. The forward internal grooves of the rail guide and support for forward missile mounting button. The external rail flanges are a guide for the aft missile suspension lugs during firing. The aft section of the rail consists of a removable fitting that provides mounting for the aft missile suspension lugs.

REVIEW NUMBER 6 ANSWERS

- A1. The LAU-7/A missile launcher is used to carry and launch the Sidewinder missile.
- A2. The four major assemblies of the LAU-7/A launcher include the housing, nitrogen receiver, mechanism, and power supply assemblies.
- A3. The nitrogen receiver assembly is used to store high pressure nitrogen (3,200 psig) that is used to cool missile IR detector guidance systems.
- A4. The detent, detent lock, detent-lock solenoid, and snubber subassemblies of the mechanism assembly are an electromechanical system that restricts longitudinal and lateral movement of mounted missiles. This prevents accidental launch or release during catapult takeoffs or arrested landings.
- A5. The LAU-7/A guided missile launcher provides a complete system that lets the pilot monitor the condition of the missile during flight, control mode of operation of the missile guidance system, and initiate arming and launch sequence.
- A6. The functional operations of the LAU-7/A missile launcher include captive mode, missile launch sequence (electrical), and missile launch sequence (mechanical).

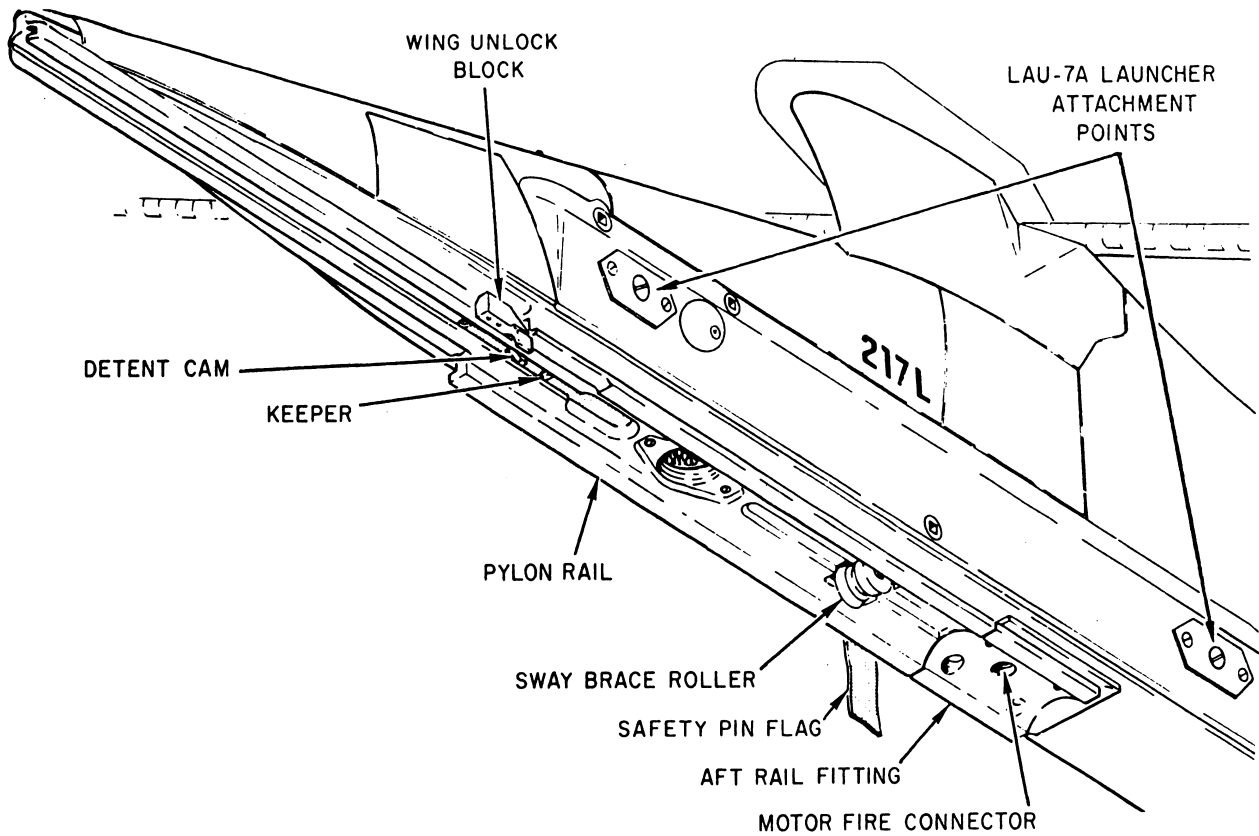


Figure 5-23.—LAU-17/A wing missile pylon.

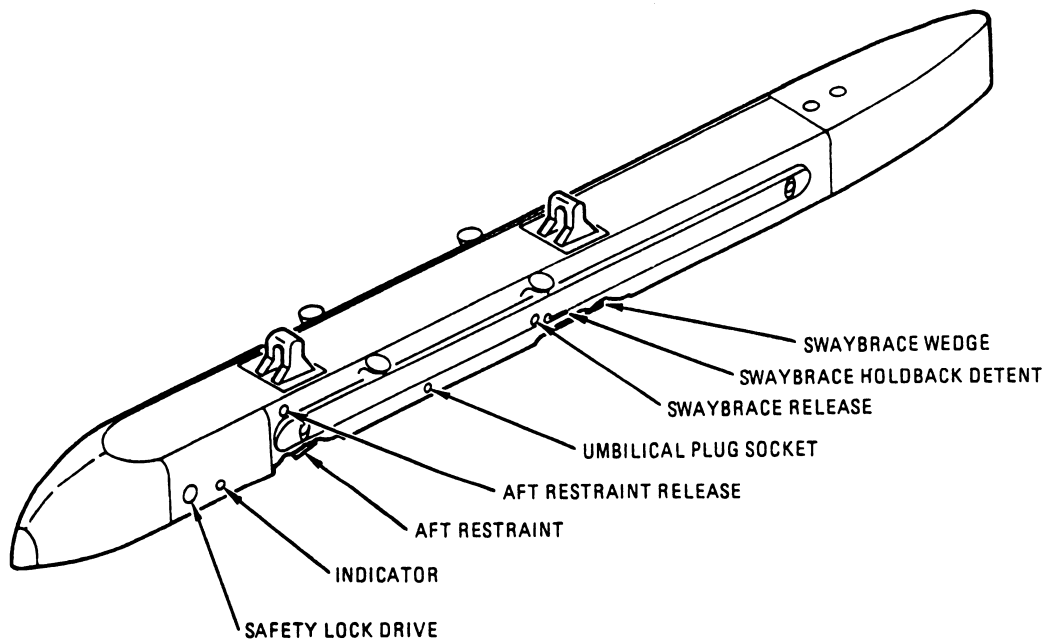


Figure 5-24.—LAU-115/A guided missile launcher.

The latch mechanism is composed of a detent cam and keeper. The detent cam is spring-loaded down and acts as a stop during missile loading. The cam mechanism is constructed so the force created by the missile motor during normal missile firing overcomes the detent cam spring tension. This action lets the missile button push the detent cam up, actuating the missile-gone switch.

An electrically operated solenoid is used to assure that the missile is retained during sudden deceleration, such as an arrested landing. The keeper portion of the latch mechanism is spring-loaded to the down position and retains the missile during all periods of aircraft acceleration. The keeper mechanism has an indicator. When the keeper is in the down or latched position, the indicator is flush with the launcher skin. If, during missile loading, the missile button is not in its maximum forward position, the indicator extends beyond the upper launcher mold line. This

indicates that the missile is not properly latched in place. During loading, the missile button can slide past the keeper, stopping when contact is made with the detent cam.

During unloading a missile, the indicator bell crank is supported in the launcher structure. It is manually operated by using a 3/8-inch square drive tool. The square drive end of the bell crank is accessible from the side of the launcher. The launchers are suspended from BRU-32 bomb racks in the outboard pylons. Two LAU-7/A launchers can be attached for suspension of the AIM-9 missiles. For ground safety, an actuator-operated safety device prevents inadvertent loss of the AIM-7 missile.

LAU-116/A GUIDED MISSILE LAUNCHER

The LAU-116/A guided missile launcher (fig. 5-25) is a reusable launcher of the F/A-18 aircraft

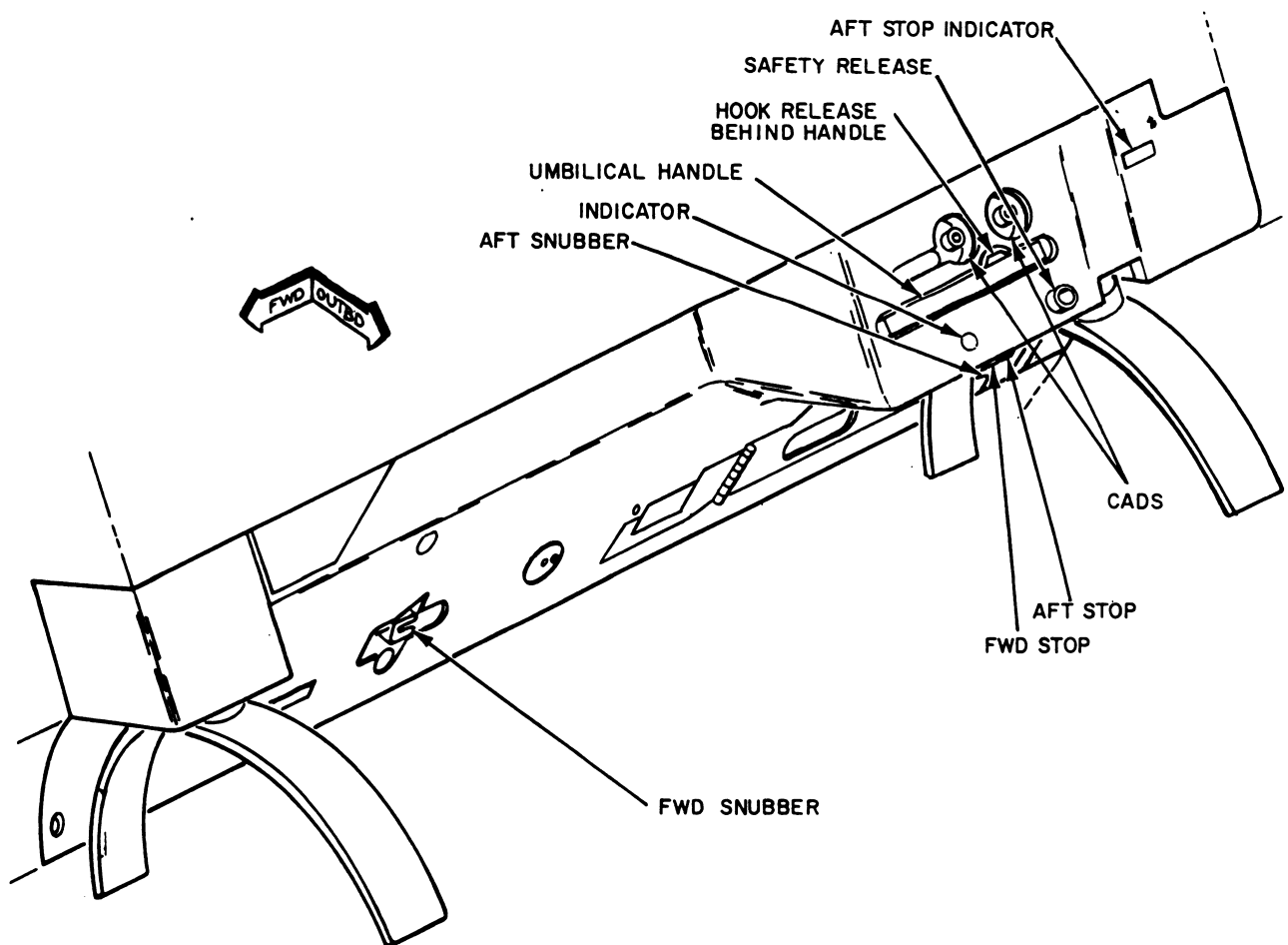


Figure 5-25.—LAU-116/A guided missile launcher.

suspension and launching system for the AIM-7 Sparrow missile. The launchers are mounted internally in the fuselage structure. They are self-contained gas-operated mechanisms, capable of suspending and ejecting the AIM-7 Sparrow missile. Ejection force is supplied by two CCU-45 impulse cartridges ignited by an electrical impulse applied by the missile firing switch. The rapidly expanding gases actuate the ejector pistons and release the missile from the launcher. Power is applied to the missile guidance control system through the umbilical plug. An actuator-operated safety device prevents inadvertent firing of launcher cartridges.

LAU-117/A GUIDED MISSILE LAUNCHER

The LAU-117/A guided missile launcher (fig. 5-26) is a reusable launcher that completes the F/A-18 aircraft suspension and launching system for the Maverick, AGM-65, air-to-ground missile. The mechanical structure of the launcher is built around a box-section channel or rail, which

supports the missile. The missile hooks contact the rail surface or tracks, which are hard anodized metal and treated with a dry lubricant. Two lug fittings and lugs provide mechanical interface with the bomb rack. The two lug fittings provide smooth surfaces for the bomb rack sway braces. The missile restraint device is recessed into the rail channel between the lug fittings. A stop on one side of the rail track engages the missile aft hook to prevent damage to the umbilical connector during loading. The rear of the rail channel provides mounting for the launcher electronic assembly and the umbilical engaging assembly. The launcher electronic assembly houses all electronic circuitry. Fairings at the front of the rail, the front of the front lug fitting, and the rear of the launcher electronic assembly provide aerodynamic surfaces. Special brackets and bushings are provided for the Navy's single hoist ordnance loading system. The launcher can be suspended from the BRU-32 bomb rack on the inboard and outboard pylons. An electrically operated safety device prevents inadvertent loss of the missile.

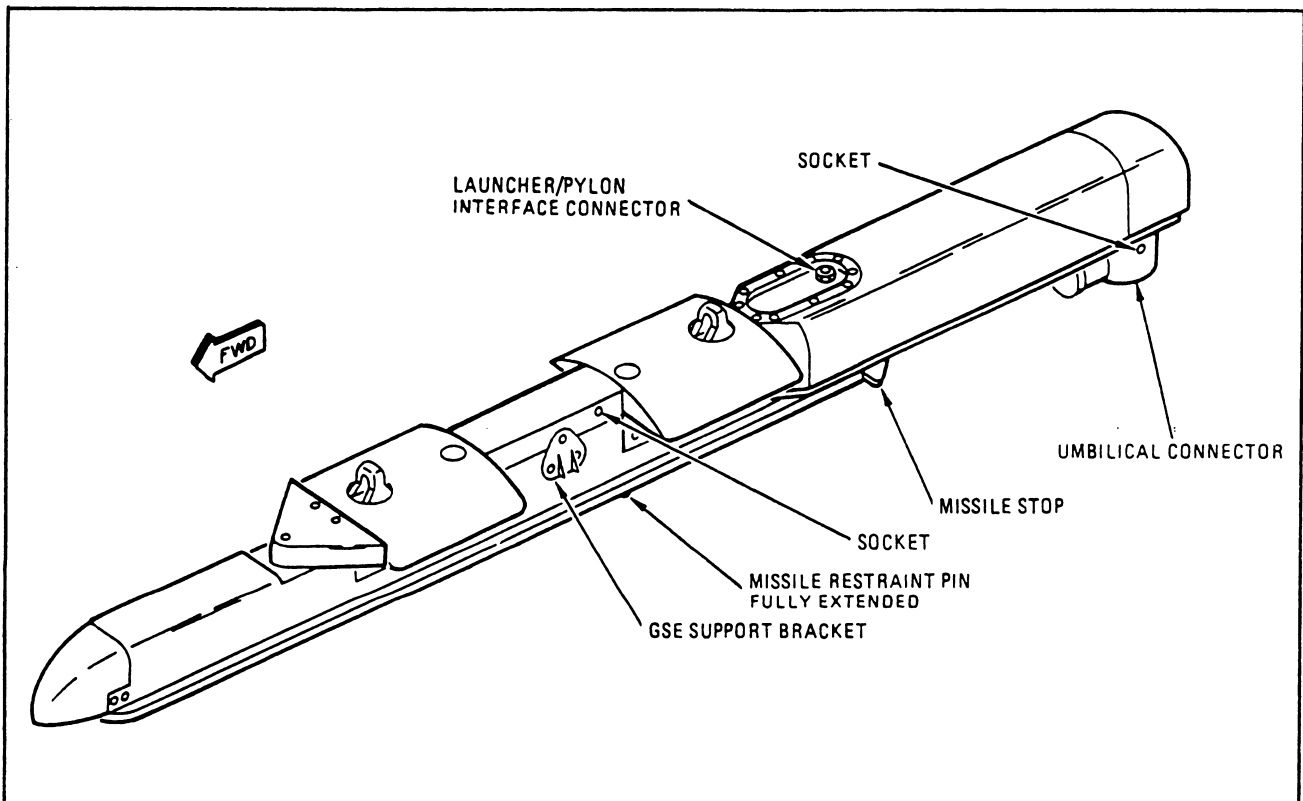


Figure 5-26.—LAU-117/A guided missile launcher.

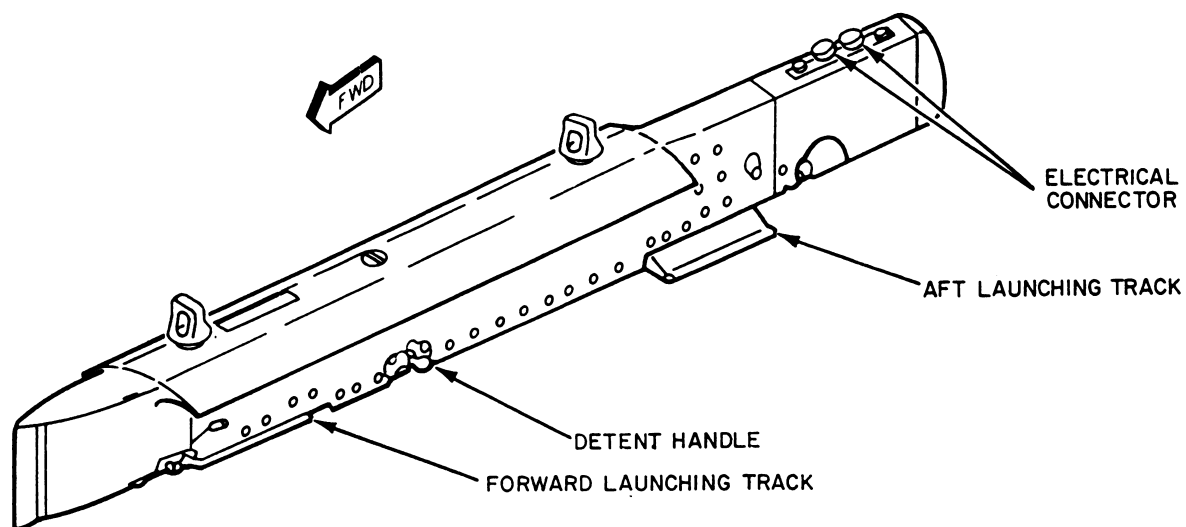


Figure 5-27.—LAU-118/AW guided missile launcher.

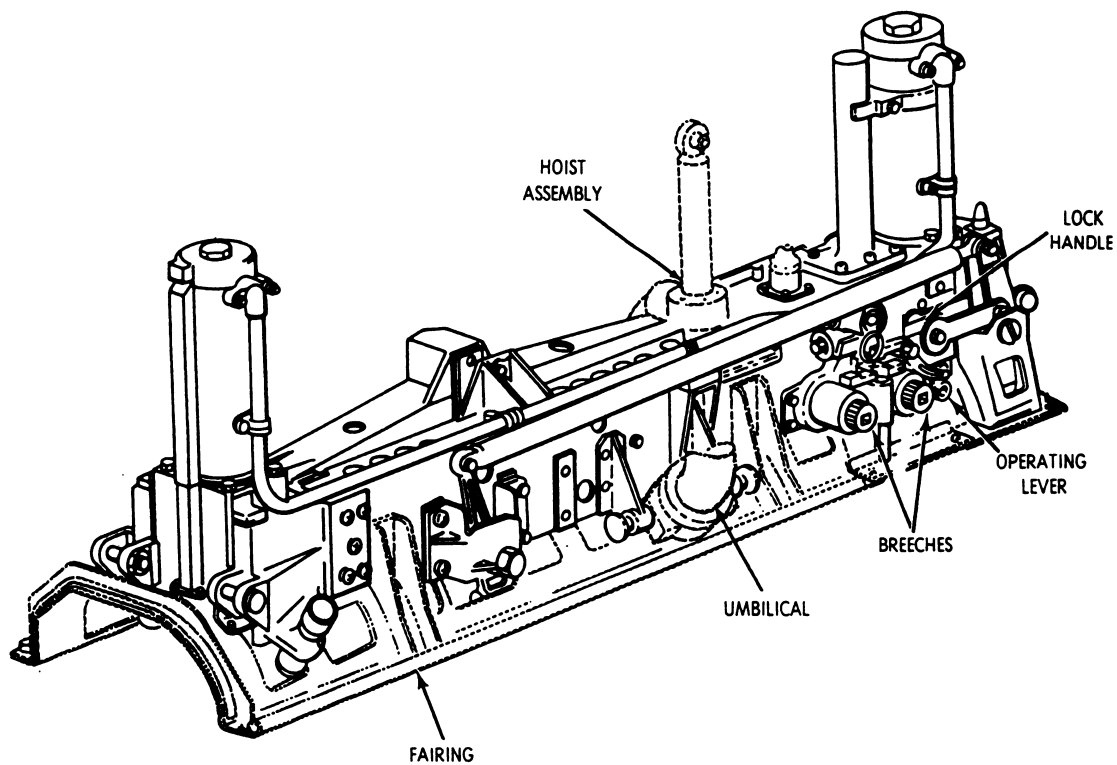


Figure 5-28.—LAU-92/A guided missile launcher.

LAU-118/A GUIDED MISSILE LAUNCHER

The LAU-118/A guided missile launcher (fig. 5-27) is a reusable launcher that completes the F/A-18 and A-7E aircraft suspension and launching system for the HARM, AGM-88, air-to-ground guided missile. The launcher consists of the launcher housing, forward and aft fairing assemblies, forward and aft launcher tracks, suspension lugs, insert plugs, and internal electrical components. The launcher is a structurally modified Aero 5B-1. The LAU-118/A is suspended from the BRU-32 bomb rack (BRU-10 on A-7E aircraft and Aero 7 on A-6 aircraft) on the inboard and outboard pylons. An electrically operated retention mechanism prevents inadvertent loss of the missile.

LAU-92/A GUIDED MISSILE LAUNCHER

The LAU-92/A guided missile launcher (fig. 5-28) carries and launches the AIM-7 (series)

Sparrow guided missile on the F-14 aircraft. The launcher is installed in semisubmerged fuselage stations 3, 4, 5, and 6. It is retained on the weapons rail by means of four hooks operated by a latch mechanism. The launcher can also be installed on the wing-mounted multipurpose pylon, using an LAU-92/A adapter. The launcher components are accessible by means of a door in the adapter.

LAU-93/A GUIDED MISSILE LAUNCHER

The LAU-93/A guided missile launcher (fig. 5-29) carries and launches the AIM-54 Phoenix missile, and is installed on the weapons rail of the F-14 aircraft. The launcher provides electrical and coolant connections between the weapons rail and the missile. The mechanical components of the launcher consist of a gas-operated, hook-opening linkage and two ejectors, a ground safety lock and positive launch pin, coolant, and electrical umbilicals. The launcher can also be installed on the wing-mounted multipurpose pylon using an LAU-93/A adapter.

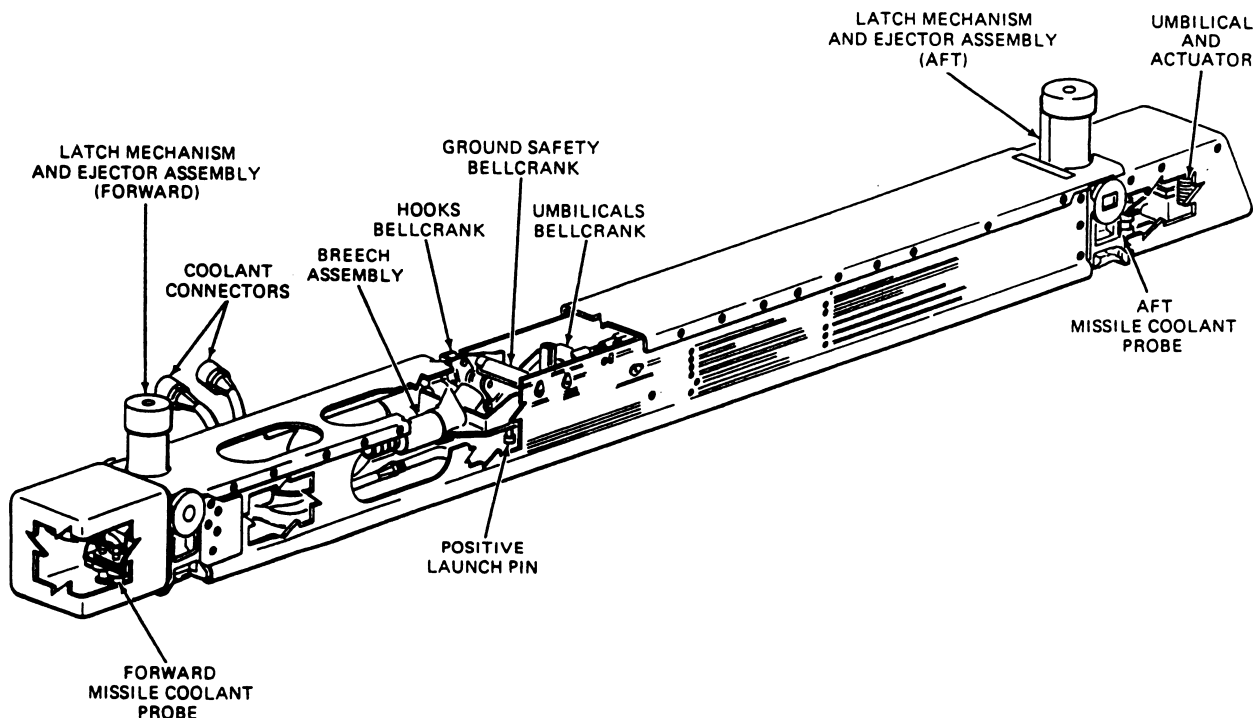


Figure 5-29.—LAU-93/A guided missile launcher.

LAU-77A/A GUIDED MISSILE LAUNCHER

The LAU-77A/A guided missile launcher (fig. 5-30) is a reusable launcher that completes the A-6 aircraft suspension and launching system for the AGM-78 Standard ARM missile. The launcher is installed on wing-mounted Aero 7A (series) ejector racks carried on wing stations 1, 2, 4, and 5. The launcher has unarmed launch, but no jettison capability. In an emergency situation, both the launcher and missile can be jettisoned from the Aero 7A ejector rack. Two launch shoes, attached to the missile rocket motor, are locked into the latch/ejector mechanism of the launcher. The forward and aft latch portions of the latch/ejector mechanism are mechanically locked and controlled by push-pull rods connected to the breech assembly. Impulse cartridges provide gas pressure to the push-pull rods, which release the missile launcher shoes and force the missile down during ejection. Missile sway braces are provided on the launcher. The umbilical cable is an integral part of the launcher and connects the aircraft to the missile.

ADU-299/E MISSILE LAUNCHER ADAPTER

The ADU-299/E missile launcher adapter (fig. 5-31) is attached to the parent rack of wing

stations 1 and 8 on A-7 aircraft and wing stations 1, 2, 4, and 5 on A-6 aircraft. The adapter is used to adapt the LAU-7 missile launcher to the parent rack, providing Sidewinder missile capabilities for A-6 aircraft and increasing Sidewinder capability of A-7 aircraft. Mechanical attachment of the adapter to the ejector rack is provided by two suspension lugs on 30-inch centers. Mechanical attachment of the adapter to the LAU-7 launcher is provided by two swivel nuts positioned on 30-inch centers to mate with the launcher bolts. When the launcher and adapters are electrically connected and mechanically mated, electrical power is supplied by an adapter harness from the wing pylon to the aft end of the adapter.

REVIEW NUMBER 7

- Q1. *What missile is carried and launched by the Aero 5B-1 guided missile launcher?*
- Q2. *How is the Aero 5B-1 guided missile launcher suspended?*
- Q3. *What is the purpose of the electrical components of the Aero 5B-1 launcher?*

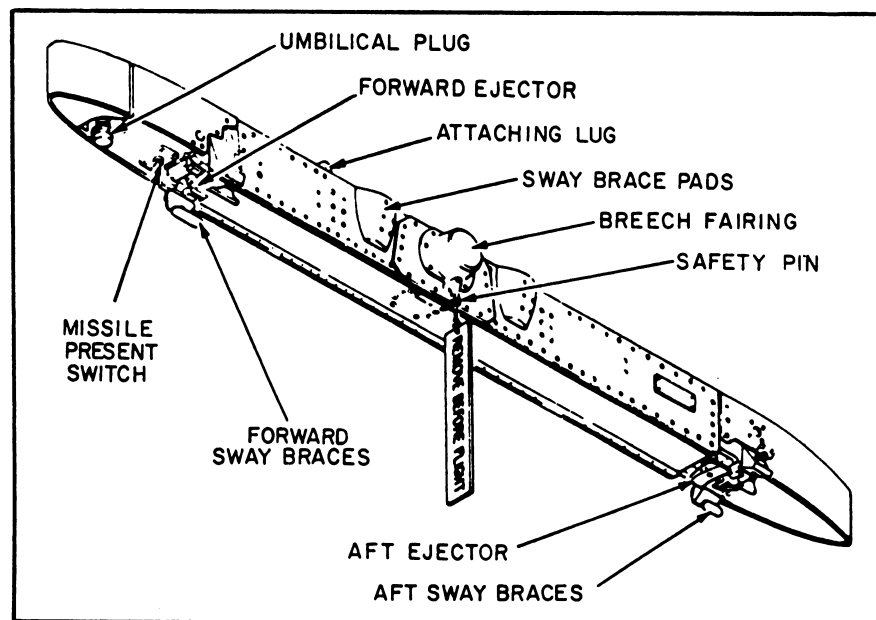


Figure 5-30.—LAU-77A/A guided missile launcher.

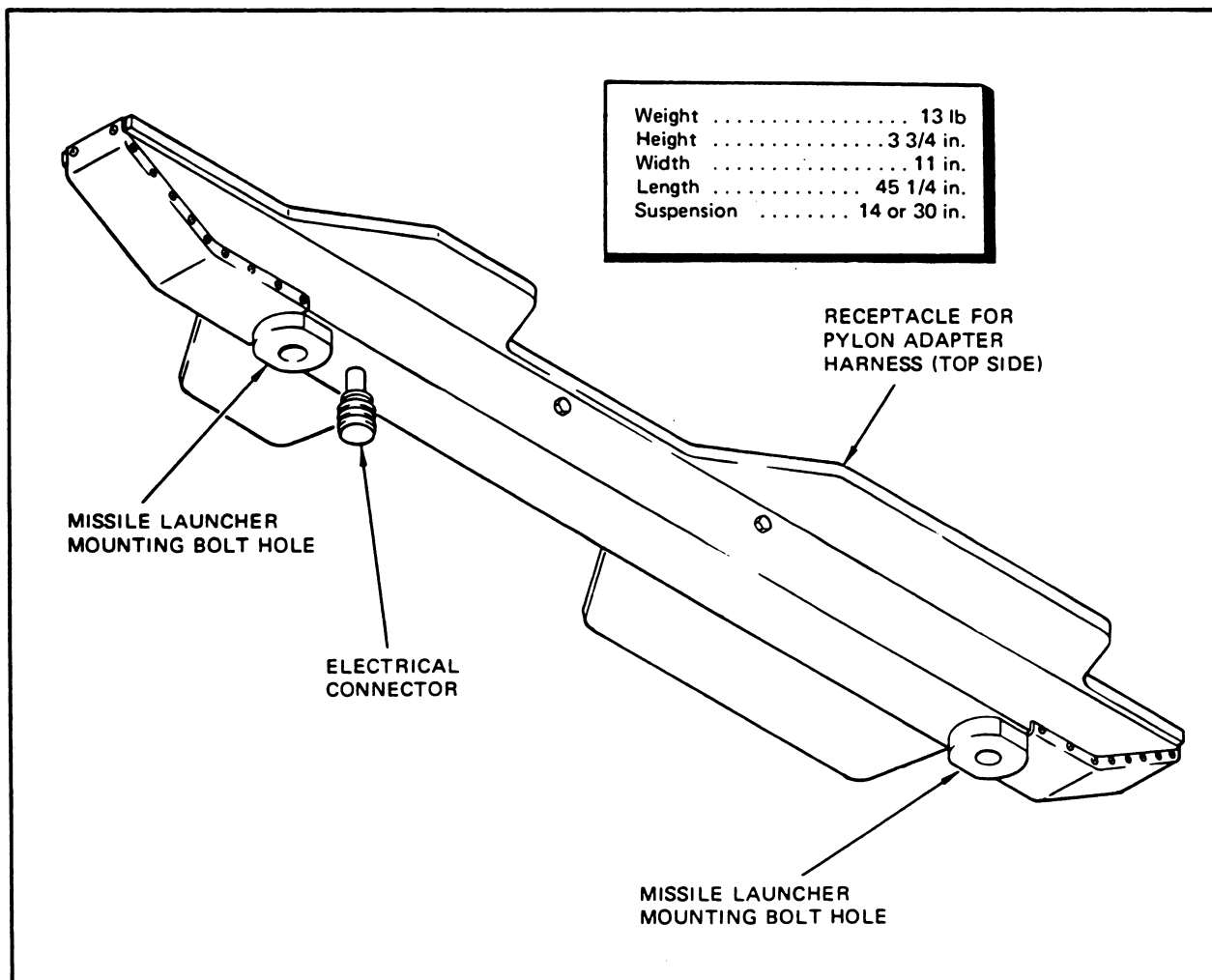


Figure 5-31.—ADU-299/E missile launcher adapter.

Q4. What missile is carried at armament stations 2 and 8 by the wing missile pylon LAU-17/A?

Q8. What missile launcher is used to carry and launch the AIM-54 Phoenix missile on the F-14 aircraft?

Q5. What missile launcher is used to carry an AIM-7 Sparrow missile on the outboard pylon of an F/A-18 aircraft?

Q9. What missile adapter is used to hang a LAU-7/A missile launcher on station 1 of an A-6 aircraft?

Q6. What guided missile launcher completes the F/A-18 aircraft suspension and launching system for the Maverick missile?

GUIDED MISSILE HANDLING

Q7. What missile is compatible with the LAU-118/A guided missile launcher?

Learning Objective: *Identify the methods used in guided missile handling afloat and ashore with regard to NADS/NSW/MMMUs.*

The establishment of the all-up-round (AUR) concept simplified the handling of guided missiles at the user level. The AUR concept has improved the reliability, availability, and logistics support of current guided missiles being used by fleet activities.

NAD/NWS/MMMUs

The service life of an AUR missile begins at a naval ammunition depot (NAD) or a naval weapons station (NWS). The NAD or NWS receives the individual components of a missile from the manufacturer. The NAD or NWS assembles the components to make up a complete round, performing the required operational checks and tests. The AUR is then packed into a missile container (fig. 5-32) and is stored as RFI (ready for issue). The missile logbook is also packed inside the missile container. The missile logbook is compiled from the operational records

that are received with each component. This logbook remains with the missile until the missile is either expended (fired) or disassembled.

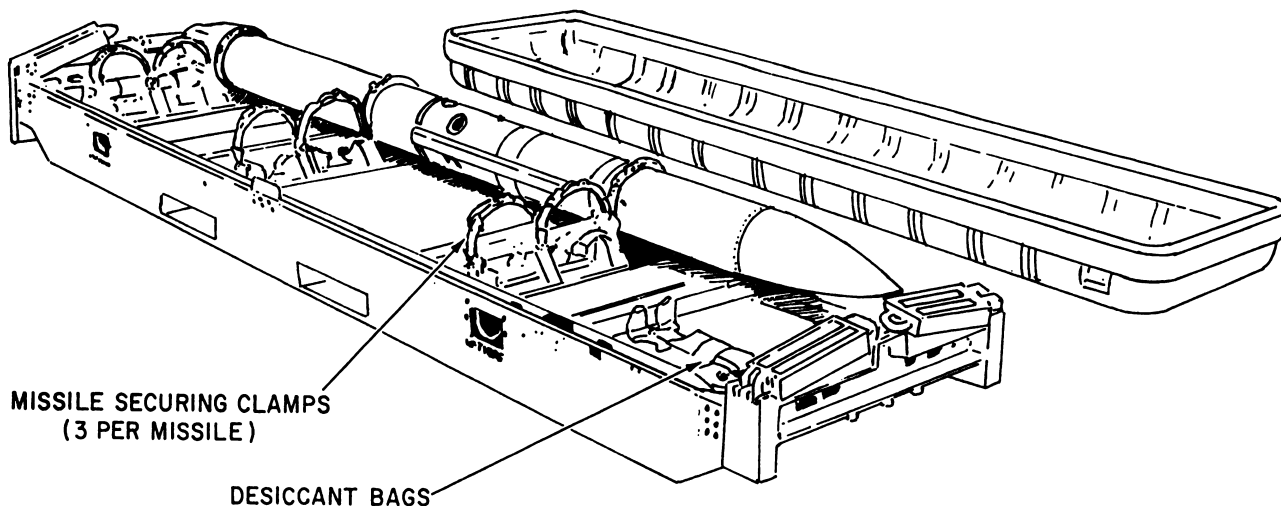
Mobile missile maintenance units (MMMUs) are assigned to areas close to overseas operating forces. Generally, they are located at a naval air station (NAS) or a naval magazine station (NAVMAGSTA). The purpose of MMMUs is to upgrade missiles from a non-RFI (not ready for issue) status to an RFI status. This prevents the time-consuming and costly procedure of shipping non-RFI missiles from overseas operating areas back to the United States for component replacement or scheduled checks and tests. This quick turnaround time increases missile availability to deployed operating units in the fleet.

AFLOAT

Under the AUR concept, missiles are received aboard ship in containers completely assembled

REVIEW NUMBER 7 ANSWERS

- A1. A single Shrike missile is carried and launched by the Aero 5B-1 guided missile launcher.*
- A2. The Aero 5B-1 guided missile launcher is suspended from the bomb rack of the launching aircraft by 14- or 30-inch suspension lugs.*
- A3. The electrical components of the Aero 5B-1 launcher provide electrical testing and distribution of power to the missile before launching.*
- A4. The AIM-7E Sparrow III missile is carried at armament stations 2 and 8 by the wing missile pylon LAU-17/A.*
- A5. The LAU-115/A guided missile launcher is used to carry an AIM-7 Sparrow missile on the outboard pylon of an F/A-18 aircraft.*
- A6. The LAU-117/A guided missile launcher completes the F/A-18 aircraft suspension and launching system for the Maverick missile.*
- A7. The AGM-88 HARM missile is compatible with the LAU-118/A guided missile launcher.*
- A8. The LAU-93/A missile launcher is used to carry and launch the AIM-54 Phoenix missile on the F-14 aircraft.*
- A9. The ADU-299E missile adapter is used to hang a LAU-7/A missile launcher on stations 1, 2, 4, and 5 of an A-6 aircraft.*



220.609

Figure 5-32.—Guided missile cradle, open (typical).

except for the wings and fins. Depending upon the particular missile and the type of container involved, the wings and fins may or may not be shipped in the same container as the missile. In most cases, the wings and fins are shipped in separate containers (fig. 5-33), which contain either one complete set of wings and fins (4 wings and 4 fins) or two sets of wings and fins (8 wings and 8 fins).

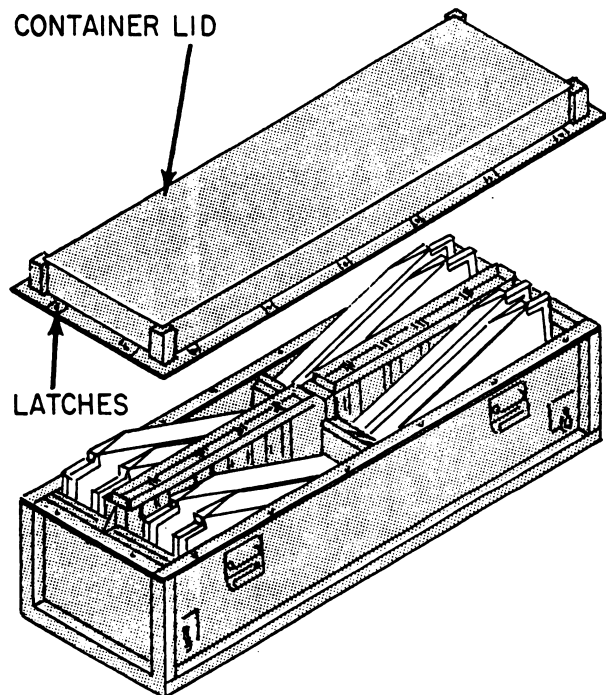


Figure 5-33.—Typical missile wing and fin container.

When containerized missiles, wings, and fins are received aboard ship, the containers are inspected for any obvious damage. When the inspection reveals a damaged container, it must be sent to the decanning area to be opened for inspection of the missile or wings and fins. When a container, missile, or wings and fins do not meet the inspection criteria listed in the appropriate technical manual, they must be tagged non-RFI and kept separate from RFI material for later turn-in. Missiles, wings, and fins can be either deep stowed in magazines still in their sealed containers, or they can be decanned, inspected, and stowed in stanchions located in ready-service magazines or missile magazines. Missiles that are deep stowed in their sealed containers can be off-loaded as RFI. However, when the seal has been broken and/or the missiles, wings, or fins removed from the container, the missiles, wings, and fins must be tagged non-RFI and off-loaded to the appropriate NAD, NWS, or MMMU.

When missiles are decanned for ready service, the missile logbooks are removed from the empty containers and turned in to the aviation ordnance control station (AOCS), where they are kept on file until the missile is fired (expended) or off-loaded. When the missile is fired, the missile logbook is mailed to the appropriate NAD or NWS. When the missile is to be off-loaded, the logbook must be placed in the missile container.

ASHORE

Guided missile handling functions for naval air stations or shore-based squadrons are the same

as shipboard functions except for the obvious difference in working environments. Space limitations are not as critical ashore and allow for an increase in handling capability.

Other details of missile handling, such as MOAT (missile on aircraft test), supply procedures, missiles firing reports, quality deficiency reports, and loading procedures, are discussed in the appropriate chapters throughout this manual.

REVIEW NUMBER 8

- Q1. What concept simplified the handling of guided missiles at the user level?*
- Q2. The responsibility for assembling individual missile components into complete RFI missiles rests with _____.*
- Q3. What is the purpose of a mobile missile maintenance unit (MMMU)?*

SAFETY PRECAUTIONS

Learning Objective: Recognize the safety precautions to follow when working with guided missiles.

Safety precautions have been established for each particular type of missile. All of the safety precautions cannot be discussed in this chapter. However, some of the general safety precautions are contained in the following paragraphs:

- All missile handling must be carried out according to the approved local safety regulations of the ship, depot, or wherever the work is being done. Observe detailed precautions. Follow specific instructions for each type of guided missile. You will find the specific instructions in the manual issued for each particular type of aircraft.

- Keep work areas clear of obstructions, loose cables, hoses, and any unneeded equipment during missile assembly and testing. Permit only assigned personnel engaged in the work in the area or vicinity of the missile.

- Use only the authorized handling equipment with any missile, or any missile section, component, or related parts, including shipping crates and containers.

- Make sure that all electrical equipment used in missile handling operations is adequately shielded and grounded. Also, avoid injury from sharp edges often present on nose assemblies, wings, and fins. After assembly, cover all sharp edges with protective covers.

- Use tools specified in the missile manual when uncrating missile components and for assembling missiles. Do not force any unit. If it does not fit or function properly, determine the cause and correct it before proceeding.

- Before connecting igniters in missile motors, check the firing leads for stray or induced voltages and for static charges.

- Before handling any piece of ordnance material, inspect the safety device to be sure that it is in a SAFE position. If not, the unit must be made safe by experienced personnel before further work is performed.

- The wing servo units in many missiles are supplied with primary power by means of an accumulator charged from gas bottles (or cylinders) containing compressed air or nitrogen; both of which contain pressure. Use extreme caution when charging accumulators and when handling the gas bottles or containers in which the gases are stowed.

- When testing for leaks in a gas container, use soapy water.

- When cleaning hydraulic units, use only the cleaning solvents or other materials specified in the particular missile publication.

- Keep your hands and other parts of your body clear of exhaust vents when working with test equipment that use high pneumatic pressure.

- When any hydraulic unit is disassembled for inspection or repair, make sure that the workbench is thoroughly cleaned of dirt and metal filings.

- Missile ordnance materials, including rocket motors, igniters, fuzes, warheads, and in

some cases boosters or auxiliary rockets, are potentially dangerous. Handle each unit according to the specific procedures authorized in the appropriate publication.

- Load forward-firing ordnance in authorized loading areas only, with aircraft facing uninhabited areas.

- When leading/handling forward-firing ordnance, working in front or behind the ordnance are held to a minimum.

REVIEW NUMBER 9

Q1. What solution is used to leak test gas containers?

Q2. When handling forward-firing ordnance, what is the desired place you should work?

REVIEW NUMBER 8 ANSWERS

- A1. *The handling of guided missiles at the user level was simplified by the introduction of the all-up-round (AUR) concept.*
- A2. *The responsibility for assembling individual missile components into complete RFI missiles rests with Naval Ammunition Depot (NAD) or Naval Weapons Station (NWS).*
- A3. *The purpose of a mobile missile maintenance unit (MMMU) is to upgrade missiles from a non-RFI to an RFI status.*

REVIEW NUMBER 9 ANSWERS

- A1. *A soapy water solution is used to leak test gas containers.*
- A2. *When handling forward-firing ordnance, you should work on the sides. Working in the front or rear of the ordnance should be kept to a minimum.*

CHAPTER 6

PYROTECHNICS

Pyrotechnics are fireworks adapted to military use. The word *pyrotechny* means *the art of fire*. Therefore, pyrotechnics are items that produce their effect by burning, and are consumed in the process. Pyrotechnics, as used in the military, are items that produce a bright light for illumination or colored lights or smoke for signaling.

All Navy pyrotechnic devices contain combustible chemicals. When ignited, these chemicals generate a flame, flash, infrared radiation, smoke, sound display, or combinations of these effects for many purposes. Some of these effects are visual and audible signaling, area and target illumination, reference point marking, indication of practice weapon impact or fuze action, tracking, decoying, simulating, and smoke-screen generation.

Dye-marking devices are pyrotechnics and screening devices, even though their display is not the product of combustion. They are classed as pyrotechnic or screening devices because their end purposes are quite similar to those of the true pyrotechnic. Dye-marking devices are used to establish reference points on the surface of the water. In some cases, the dye is spread on the surface by explosive means.

Pyrotechnics generally function by means of an ignition train, similar to the explosive train of high-explosive ammunition. Some pyrotechnic devices contain an out-of-line ignition train. An out-of-line train requires an external force, such as centrifugal force or a change in hydrostatic pressure, to bring the out-of-line element in line.

For further information on pyrotechnics, you should refer to *Pyrotechnic, Screening, Marking, and Countermeasure Devices*, NAVSEA SW050-AB-MMA-010/NAVAIR 11-15-7.

HAND-MANIPULATED SIGNALING DEVICES

Learning Objective: *Identify the purpose and use of hand-manipulated signaling devices.*

Hand-manipulated devices are used for various signaling purposes such as identification, recognition, warning, and distress.

MK 13 MOD 0 MARINE SMOKE AND ILLUMINATION SIGNAL

The Mk 13 Mod 0 (fig. 6-1) is used as a day or night signal by personnel on land or sea. Its small size and weight (6.4 ounces) allow you to carry it in life vests or flight suit pockets and on life rafts. This signal is especially adapted for use by aircrew personnel downed at sea.

The Mk 13 Mod 0 signal is a metal cylinder approximately 5 inches long and slightly more than 1.5 inches in diameter. It emits orange smoke for day use and red flame for night use. Burning time for each end is about 20 seconds. The protective plastic cap on the flame (night) end is molded so there are three prominent protrusions or beads across the face. You can identify this end by the sense of touch. The face of the cap at the smoke (day) end is smooth. A label on the outer surface around the whole body of the signal further identifies the smoke (day) and flame (night) ends. This label has instructions for its use.

To use the signal, remove the plastic cap from the end of the signal. Flip the pull ring over the signal rim and push downward to break the seal. After the seal is broken, NEVER point the signal toward your face or body. Then, ignite the signal with a quick pull on the ring. Hold the signal firmly at arm's length and at a 45-degree angle to prevent burns from hot drippings. If you only use one end, douse the signal in water to cool it. Save the other end for later use.

MK 79 MOD 0 ILLUMINATION SIGNAL KIT

The Mk 79 Mod 0 signal kit (fig. 6-2) consists of a Mk 31 Mod 0 signal projector, a plastic bandoleer holding seven Mk 80 Mod 0 signals, and an instruction sheet.

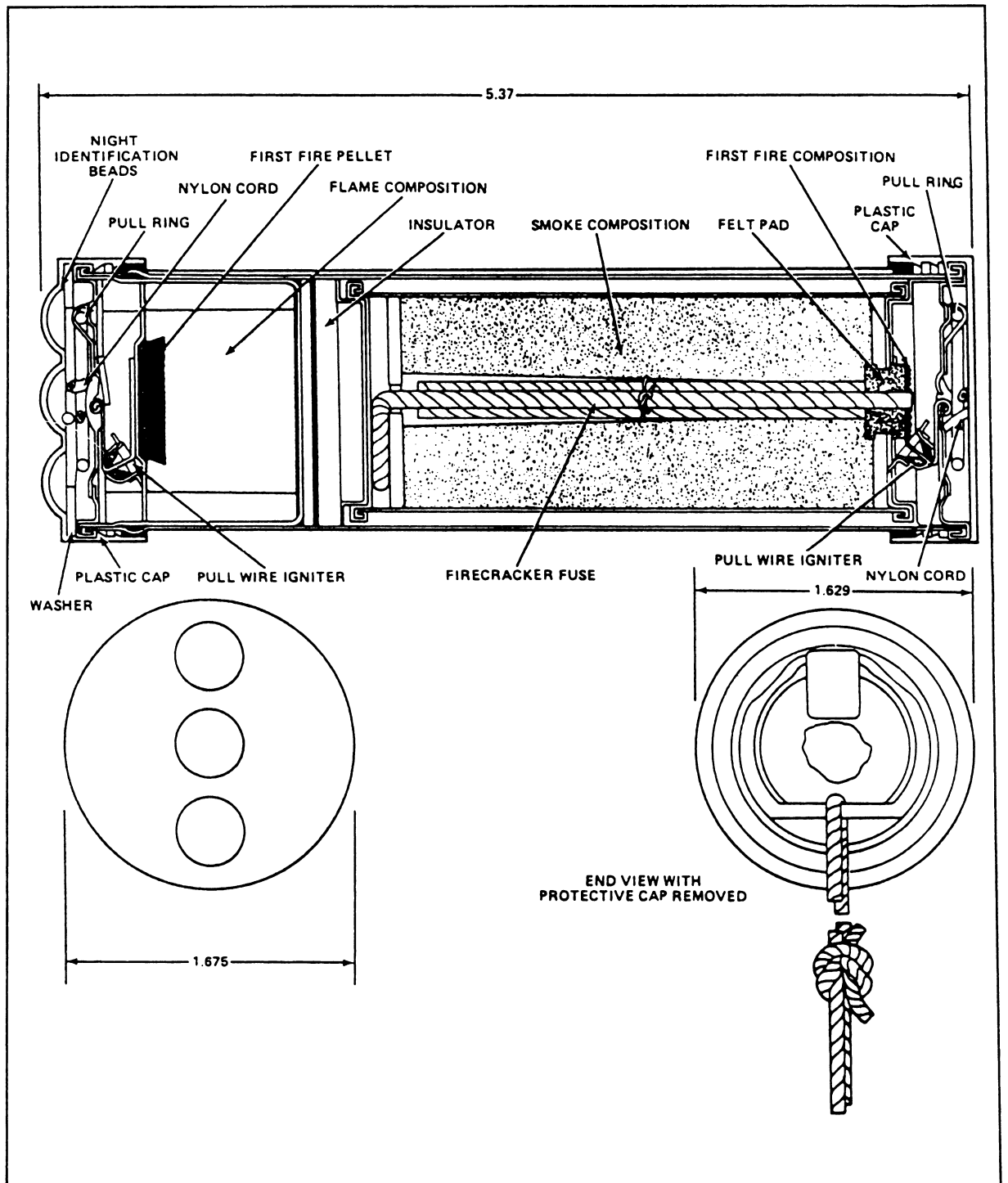


Figure 6-1.—Mk 13 Mod 0 marine smoke and illumination signal.

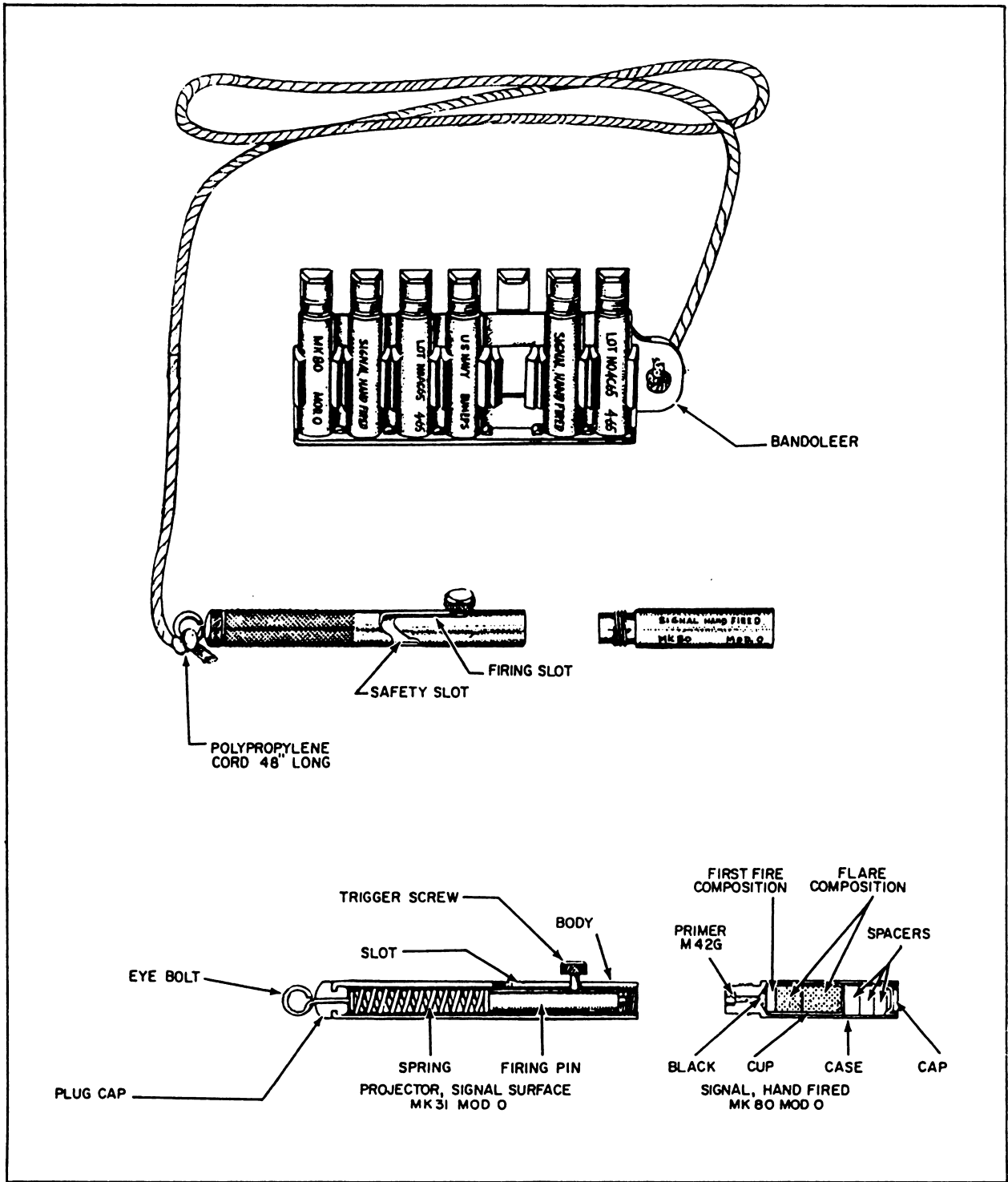


Figure 6-2.—Mk 79 Mod 0 illumination signal kit.

220.121

The kit is used by downed aircrew personnel as a distress signaling device. It is small and lightweight, so you can carry it in pockets of flight suits or in 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 between 250 and 650 feet. The star burns for a minimum of 4 1/2 seconds.

To operate the device, you cock the projector firing pin by moving the trigger screw to the bottom of the vertical slot, and slip it to the right so that it catches at the top of the angular slot. (Note: This first step is very important because the signal is threaded and screwed into the end of the projector. If you don't cock the projector before screwing in the signal, the firing pin could be forced into the primer of the signal, possibly firing the signal prematurely.) After cocking the firing pin, remove a signal from the bandoleer and mate the projector with the signal. Now, rotate the projector clockwise until the signal is seated. Hold the projector overhead, pointed at a slight angle away from your body. While firmly gripping the projector, fire the signal by slipping the trigger screw to the left, out of the safety slot and into the firing slot.

REVIEW NUMBER 1

- Q1. Navy pyrotechnic devices contain what type of material?
- Q2. Why are dye-marking devices classified as pyrotechnic devices?
- Q3. When used during the day, what color smoke is emitted from the Mk 13 Mod 0 marine smoke and illumination signal?
- Q4. What is the burning time for each end of the Mk 13 Mod 0 signal?
- Q5. You can identify the night end of the Mk 13 Mod 0 signal by the _____.

Q6. List the components of the Mk 79 Mod 0 illumination signal kit.

Q7. When you activate the Mk 79 Mod 0 signal kit, the star is propelled upward to a height of _____.

Q8. What is the burn time of the Mk 79 Mod 0 star?

AREA AND TARGET ILLUMINATING DEVICES

Learning Objective: *Identify the purpose and use of area and target illuminating devices to include components and operation.*

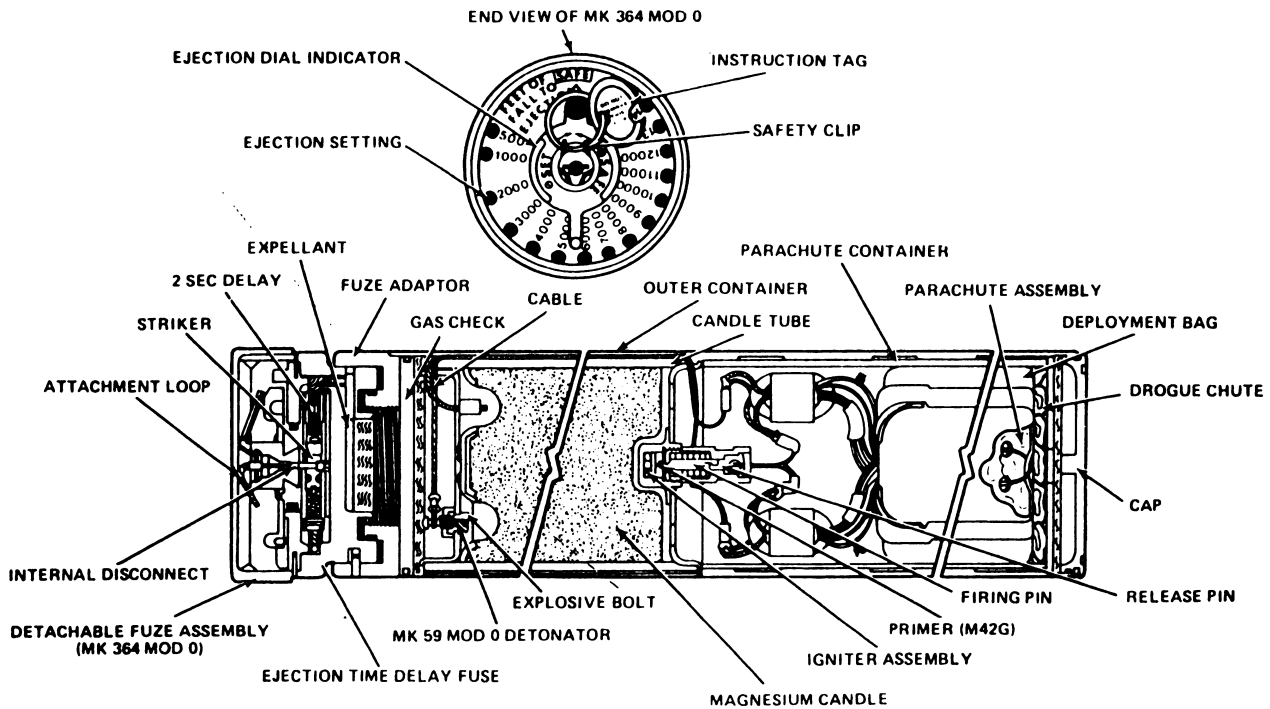
The illuminating devices discussed in this chapter are designed to be launched or dropped from aircraft. Aircraft flares are used to illuminate large areas for bombardment, reconnaissance, emergency aircraft landing, or any other purpose where a high-intensity light is required.

MK 45 MOD 0 AIRCRAFT PARACHUTE FLARE

The aircraft-launched Mk 45 Mod 0 aircraft parachute flare (fig. 6-3) is used for night illumination of surface areas in search-and-attack operations. It replaces the Mk 24 Mods aircraft parachute flare.

The Mk 45 Mod 0 aircraft parachute flare is as an AUR, complete with the candle, parachute assembly, and fuze. All components are encased in a cylindrical aluminum body approximately 36 inches long (including the fuze assembly) and 4.9 inches in diameter.

The Mk 364 Mod 0 fuze is shipped installed in the flare. Its sole purpose is to control the altitude of flare ejection in relation to launch altitude. It does not directly control candle ignition. The fuze has 15 functional settings and 1 SAFE setting. The functional settings are at 1,000-foot intervals from 1,000 to 14,000 feet, except that 1 minimum setting of 500 feet is provided. The fuze-setting mechanism consists of



220.833

Figure 6-3.—Mk 45 Mod 0 aircraft parachute flare (cross section).

a single yellow dial indicator you can easily turn by hand—clockwise for setting and counter-clockwise for safing. A spring-loaded detent holds the dial indicator at a selected setting or at SAFE and prevents accidental changing of the setting by vibration forces.

The Mk 45 Mod 0 flare is launched from an available external launching system, such as bomb racks. The launching system provides a 14-inch

suspension, or the flare is launched from an aircraft by hand. It is usually dispenser launched. A drogue tray (fig.6-4) is used to dispenser launch the flare. Normally, the drogue tray is configured to the flare at the time of manufacture. The drogue tray is a quarter-round, lightweight aluminum channel with perpendicular ends. The fuze end has an attachment tab and a circular opening to allow for flare fuze setting. It is

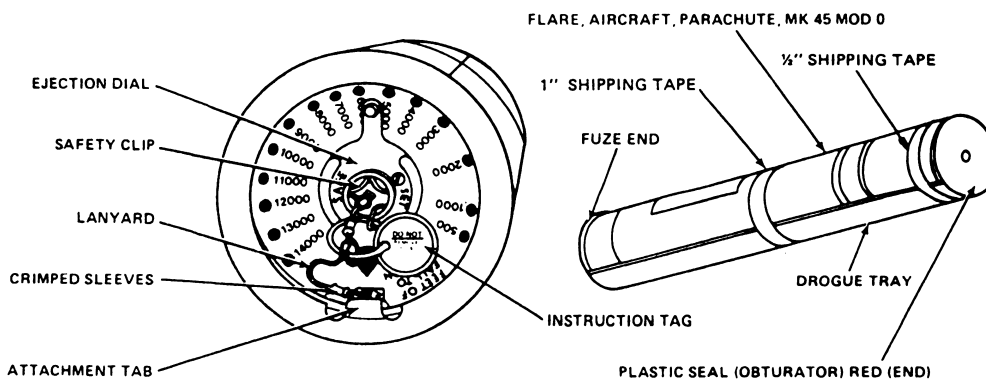


Figure 6-4.—Mk 45 Mod 0 aircraft parachute flare with drogue tray.

attached to the safety clip by a lanyard. The opposite end is solid and has a red plastic seal that acts as a pressure seal for dispenser ejection cartridge gases. Flares and trays are loaded into the dispenser as a unit.

Regardless of launch method, the flare is initiated by exerting pull on the lanyard. When the lanyard is pulled, it snaps the safety clip from its position over the toggle. A force of 18 to 35 pounds pulls the internal disconnect completely out of the fuze mechanism, allowing the spring-loaded striker to strike the primer. The primer ignites a fixed, 2-second delay element and drives the plunger into the ejection time-delay fuze at a point determined by the selected setting. After 2 seconds, the delay element ignites black powder in the plunger. Ignition is transferred through a perforation in the plunger to the time-delay fuze. After the preset delay, the fuze ignites the expellant. The expellant forces off the aluminum end cap and expels the candle and the parachute assembly from the flare case with considerable force.

Upon opening, the main parachute pulls on the cables of the suspension/ignition system. The shorter cable pulls the release pin from the igniter assembly, cocking and releasing the firing pin so that it strikes the primer. The primer ignites an ignition pellet, which, in turn, ignites the

magnesium candle. The burning candle is then suspended on the fully deployed main parachute. When the candle approaches the end of its burning time, its heat activates the explosive bolt. (Ten of the eighteen shroud lines are attached to the explosive bolt.) Release of these shroud lines causes the parachute to collapse and flutter to the ground.

LUU-2B/B AIRCRAFT PARACHUTE FLARE

The LUU-2B/B flare is the same size as the Mk 45 flare. It is 36 inches long, 4.9 inches in diameter, and weighs about 30 pounds. The flare is supplied only as an AUR, and it is shipped assembled with drogue trays for dispenser launch. The flare is hand launched, or configured for launching from MER or TER aircraft bomb racks.

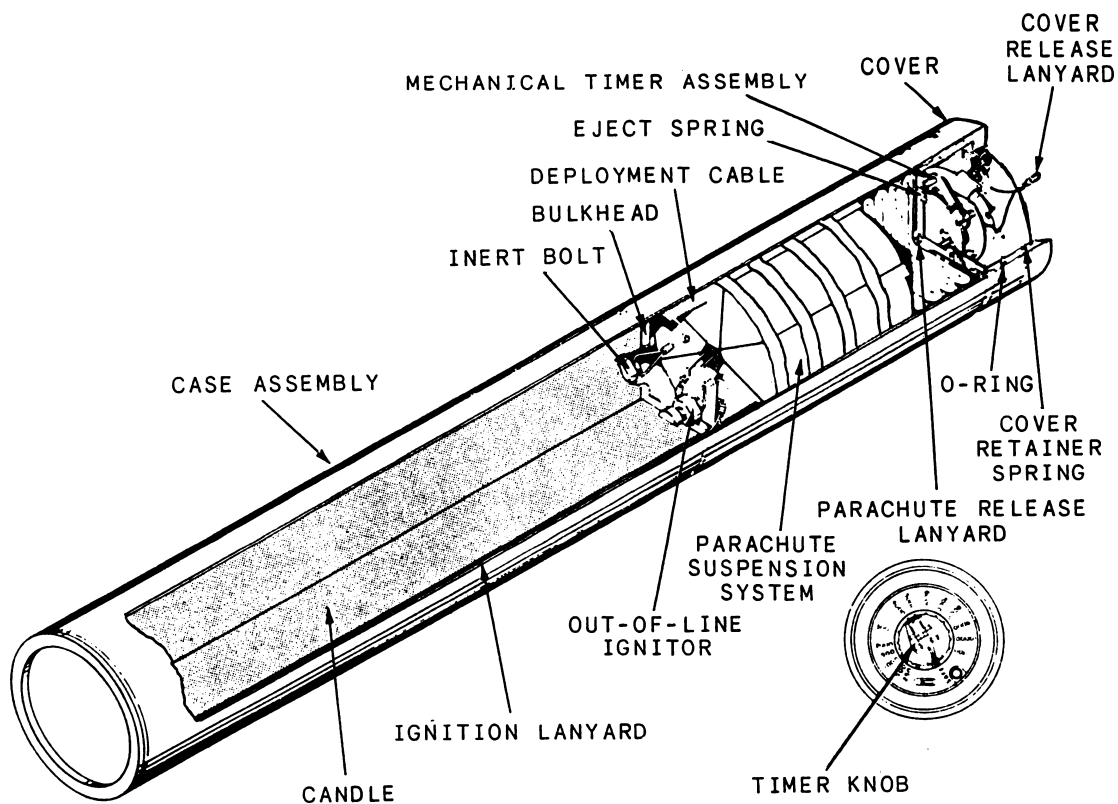
Components

The LUU-2B/B flare (fig. 6-5) has four major components:

1. The mechanical timer assembly
2. The parachute suspension system
3. The out-of-line igniter
4. The case assembly with the tamped candle

REVIEW NUMBER 1 ANSWERS

- A1. Navy pyrotechnic devices contain combustible chemicals.
- A2. Dye-marking devices are classified as pyrotechnic devices because they are used for about the same purpose as the true pyrotechnic.
- A3. Orange smoke is emitted from the Mk 13 Mod 0 marine smoke and illumination marker when it is used during the day.
- A4. The burning time for each end of the Mk 13 Mod 0 signal is 20 seconds.
- A5. You can identify the night end of the Mk 13 Mod 0 signal by the three prominent beads across its face.
- A6. The components of the Mk 79 Mod 0 illumination signal kit include the Mk 31 Mod 0 signal projector, a plastic bandoleer, and an instruction sheet.
- A7. When you activate the Mk 79 Mod 0 signal kit, the star is propelled upward to a height of 250 to 650 feet.
- A8. The burn time of the Mk 79 Mod 0 star is a minimum of 4 1/2 seconds.



220.835

Figure 6-5.—LUU-2B/B aircraft parachute flare.

The mechanical timer assembly consists of a mechanical timer and related hardware in a Lexan plastic housing. The nonexplosive mechanical timer functions like the explosive Mk 364 fuze on the Mk 45 flare. The mechanical timer is a three-gear timer, powered by a torsional mainspring. A phosphorescent plastic decal with calibrated markings from 250 to 11,000 feet of fall is located on the face of the timer cover. A white, plastic dial timer knob is used to set the desired drop distance. Settings of 150, 500, and 1,000 to 11,000 feet can be selected. A safe setting is also provided.

An 18-foot diameter cruciform-shaped canopy parachute suspension system is used for good stability. The riser cables connect the parachute to a bulkhead. The bulkhead separates the parachute compartment from the remainder of the flare assembly. One cable is attached to an explosive bolt for parachute dump at candle burnout, just like the Mk 45 flare.

In the ignition system, a lanyard is attached to one of the parachute riser cables. This lanyard is threaded through the bulkhead and past the candle in an internal raceway along the side of the aluminum case. This leads to the ignition

assembly in the ignition housing near the candle's face. The lanyard is attached to a triggering mechanism, which consists of the out-of-line igniter (OLI-2/A). Upon ignition, the firing pin initiates the pyrotechnic firing train.

The aluminum case assembly contains a tamper-cast illuminating candle that consists of a composition of magnesium, sodium nitrate, and a polymer binder. The flare is designed so the outer aluminum case is partially consumed during candle burning.

Operation

A lanyard is attached to the timer knob on the flare timer during flare uploading procedures. The lanyard is also connected to the flare drogue tray or bomb rack, depending on the launch configuration. At launch, the timer knob is pulled out of the timer (requires approximately 30 pounds of force) by the lanyard, starting the clock mechanism. After the preset time (drop distance) ends, the three locking pawls in the timer assembly release, retracting and releasing the timer assembly. A spring, located between the timer assembly and

the packaged parachute, expels the timer assembly, which, in turn, initiates removal of the parachute from the flare case. When the cord breaks, it separates the timer assembly from the parachute. As the parachute system deploys and its main cables are pulled taut, the ignition lanyard is pulled to activate the ignition system. The ignition lanyard must exert a pull force in excess of 90 pounds to pull the slider assembly in line. This, in turn, releases the firing pin against the primer. The primer ignites a propellant wafer that produces sufficient heat for candle ignition. Pressure buildup during candle ignition blows off the igniter housing, and the candle power reaches a nominal value. Just before candle burnout, the explosive bolt functions to release one of the suspension cables causing the parachute to dump.

The LUU-2B/B flare has several advantages over the Mk 24 and Mk 45 flares. The most important advantage is that the candle is not ejected from the case on the LUU-2B/B. Only the parachute is removed from the case. This is accomplished by a mechanical timer instead of an explosive fuze, as is done in the Mk 24 and Mk 45. Therefore, if the timer knob should be accidentally pulled during handling when the timer is not on the SAFE setting, the timer and release mechanisms can be forcibly hand-held onto the flare housing to prevent ejection of the timer and release mechanisms. When the timer completes its cycle, the timer mechanism can be taped on the flare housing and marked for disposal. If the timer is ejected from the flare and a portion of the parachute comes out of the housing, the parachute can be stuffed back into the housing, taped, and marked for disposal.

Another advantage of the LUU-2 B/B flare is the increased pull force on the parachute lanyard to initiate the ignition sequence. If the parachute should accidentally deploy on the flight deck/line, the opening shock from deck winds or jet blast is not sufficient to ignite the candle.

REVIEW NUMBER 2

- Q1. *What is the length and diameter of the Mk 45 Mod 0 aircraft parachute flare?*
- Q2. *What fuze is used with the Mk 45 Mod 0 flare?*

- Q3. *What are the settings of the Mk 45 Mod 0 flare?*
- Q4. *List the component that holds the dial indicator at a selected setting or at SAFE.*
- Q5. *What amount of force needs to be exerted to pull the internal disconnect completely out of the fuze mechanism?*
- Q6. *What is the approximate weight of the LUU-2B/B aircraft parachute flare?*
- Q7. *The components of the LUU-2B/B flare are _____.*
- Q8. *What is the minimum drop distance setting of the LUU-2B/B flare?*
- Q9. *What is the diameter of the parachute suspension system?*
- Q10. *At launch, the timer knob is pulled off of the timer by what amount of force on the lanyard?*
- Q11. *Using the LUU-2B/B flare instead of the Mk 45 Mod 0 flare is more advantageous because the LUU-2B/B flare candle _____.*

AIRCRAFT-LAUNCHED SMOKE AND FLAME MARKING DEVICES

Learning Objective: *Identify the physical and functional description of aircraft-launched smoke and flame marking devices. Recognize the methods used to launch them.*

Smoke and flame marking devices are pyrotechnic devices dropped on the ground or on

the water's surface to emit smoke and/or flame. Reference points established by these devices serve a variety of purposes. They can be used to determine wind direction and approximate velocity, mark the location on the surface for emergency night landings, establish an initial contact point for continued search for a

submarine, or locate target areas in antisubmarine warfare.

MK 25 MODS 2 AND 3 MARINE LOCATION MARKER

The Mk 25 Mods 2 and 3 (fig. 6-6) marine location markers are launched from aircraft or

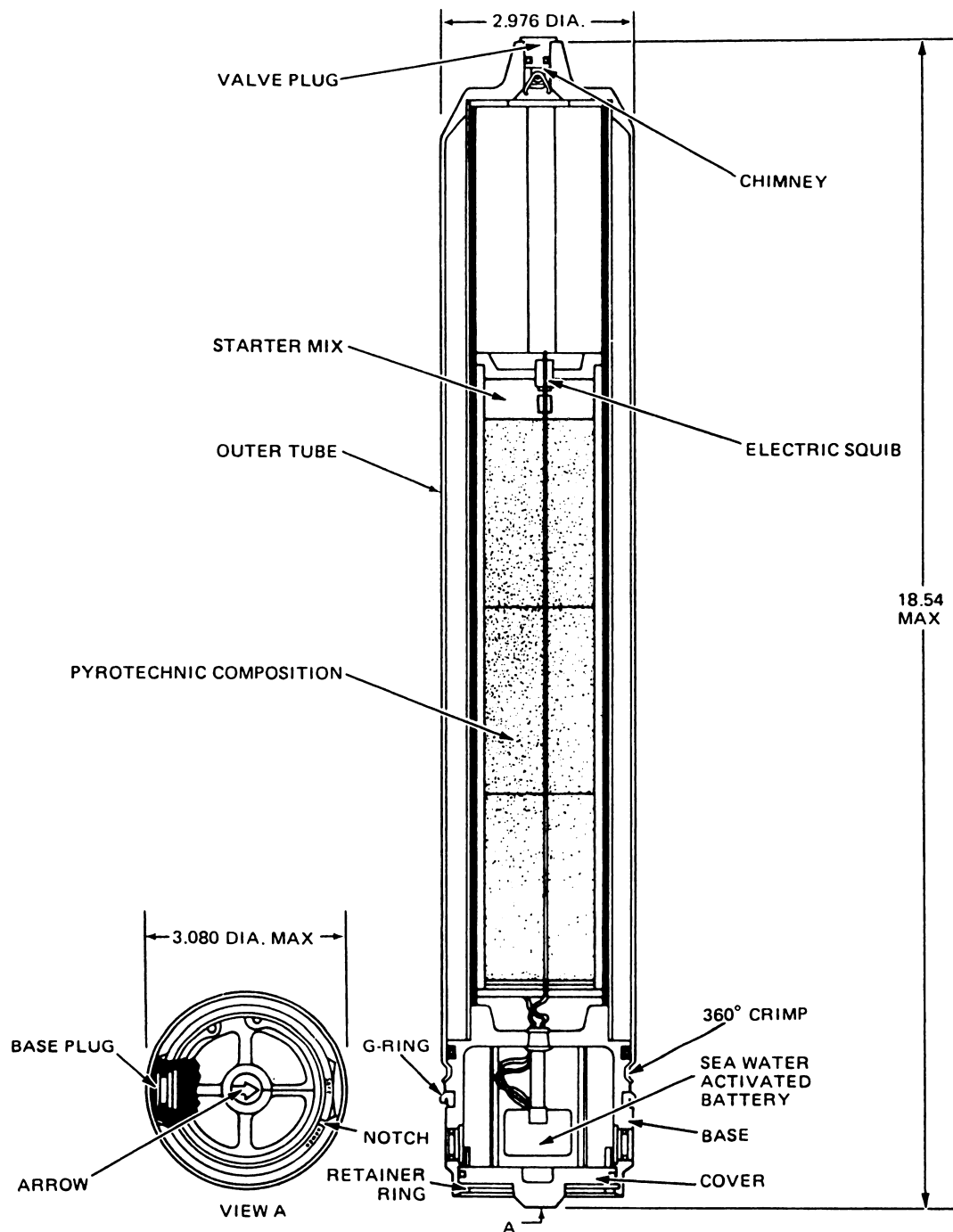


Figure 6-6.—Mk 25 marine location marker.

surface craft. They are launched from aircraft to provide day or night reference points marking the course of enemy submarines in antisubmarine warfare operations. They are suitable for any type of sea-surface reference-point marking that calls for both smoke and flame for a period of 10 to 20 minutes. Mods 2 and 3 function identically. The only significant difference is that Mod 2 contains two seawater-activated batteries and two related squibs while Mod 3 contains a single battery and squib.

Physical Description

The Mk 25 marker consists of a cylindrical outer tube about 18.5 inches long and 2.9 inches in diameter. A valve assembly is fitted into the projecting chimney at the marker's nose end. The smoke and flame are emitted from this opening. At the opposite end is a heavier aluminum base assembly to which the outer tube is crimped. The

heavy base end causes the marker to float in the water with the chimney out of the water and the base in the water.

Within the base assembly is a Mk 72 Mod 0 seawater-activated battery (two batteries in the Mod 2). The battery is shielded from water contact by two plugs fitted into 1/2-inch holes on two opposite sides of the base assembly. A rigid cover (arming plate), held in place by a retainer ring, is recessed into the base end. An arrow in the center of the arming plate indicates its safe or armed position. The words SAFE and ARMED are stamped into the base rim. Also, a machined notch in the rim at the armed position helps during night use. When the arming plate is in the safe position, it physically blocks the base plugs internally to prevent them from being accidentally pushed in. When in the armed position, the arming plate no longer blocks the base plugs, allowing them to be pushed in at the appropriate

REVIEW NUMBER 2 ANSWERS

- A1. *The Mk 45 Mod 0 aircraft parachute flare is 36 inches long and approximately 4.9 inches in diameter.*
- A2. *The Mk 364 Mod 0 fuze is used with the Mk 45 Mod 0 flare.*
- A3. *The Mk 45 Mod 0 flare has 15 functional settings, from 1,000 to 14,000 feet in 1,000-foot increments. There is one minimum setting of 500 feet.*
- A4. *A spring-loaded detent holds the dial indicator at a selected setting or at SAFE.*
- A5. *The Mk 45 Mod 0 flare is initiated by exerting a force of 18 to 35 pounds to pull the internal disconnect completely out of the fuze mechanism.*
- A6. *The LUU-2B/B aircraft parachute flare weighs about 30 pounds.*
- A7. *The components of the LUU-2B/B flare are the mechanical timer assembly, the out-of-line igniter, the parachute suspension system, and the case assembly with tamped candle.*
- A8. *The minimum drop distance setting of the LUU-2B/B flare is 150 feet.*
- A9. *The diameter of the parachute suspension system is 18 feet.*
- A10. *At launch, the timer knob is pulled off of the timer by approximately 30 pounds of force on the lanyard.*
- A11. *Using the LUU-2B/B flare instead of the Mk 45 Mod 0 flare is more advantageous because the LUU-2B/B flare candle is not ejected from the case of the LUU-2B/B.*

time. A black rubber G-ring circles the base assembly approximately 1/4 inch from the crimp holding the outer case.

Functional Description

To activate the seawater battery, the base plugs are pushed in before the marker is actually launched. The marker is ignited by an electric squib, and power is supplied by the seawater-activated battery (two batteries and two squibs in Mod 2). When the marker enters the water, seawater enters the battery cavity and serves as an electrolyte, causing the battery to produce a current that activates the squib. The squib ignites the starter mix, which, in turn, ignites the red phosphorous pyrotechnic composition. Gas build-up forces the valve assembly from the chimney in the nose, and yellow flame and white smoke are emitted. Burning time averages 13.5 to 18.5 minutes. Although this marker is normally used in seawater, it can be used in inland bodies of fresh water by using table salt and following the procedures outlined in *Pyrotechnic, Screening, Marking, and Countermeasure Devices*, NAVSEA SW050-AB-MMA-010/NAVAIR 11-15-7.

Launching Methods

Currently, there are two methods of launching the Mk 25 marker—by hand or by sonobuoy

launcher. To launch by hand, rotate the base arming plate clockwise to the armed position. Push the base plugs into the battery cavity located in the marker base, and throw the marker into the water. It functions as previously discussed.

If the base plugs (one or both) of a marker are disturbed so the watertight integrity of the battery cavity is compromised and the marker is not launched immediately, a marine marker adapter kit Mk 34 Mod 0 (fig. 6-7) must be installed. The Mk 34 Mod 0 adapter kit is also used when the marker is launched from sonobuoy launchers. The adapter kit fits over the base end of the marker, and, when properly installed, seals the battery cavity. The adapter kit is installed by rotating the marker base arming plate to the armed position and pushing the base plugs into the battery cavity. Remove the black G-ring and install the adapter kit around the marker base so the seal plugs on the leaf-spring ends cover the holes into the battery cavity. Insert the U-pin to hold the adapter in place. To hand-launch a marker with a Mk 34 adapter kit installed, remove the U-pin and the adapter and throw the marker into the water.

Before launching the Mk 25 marker from sonobuoy launchers, you should install a Mk 34

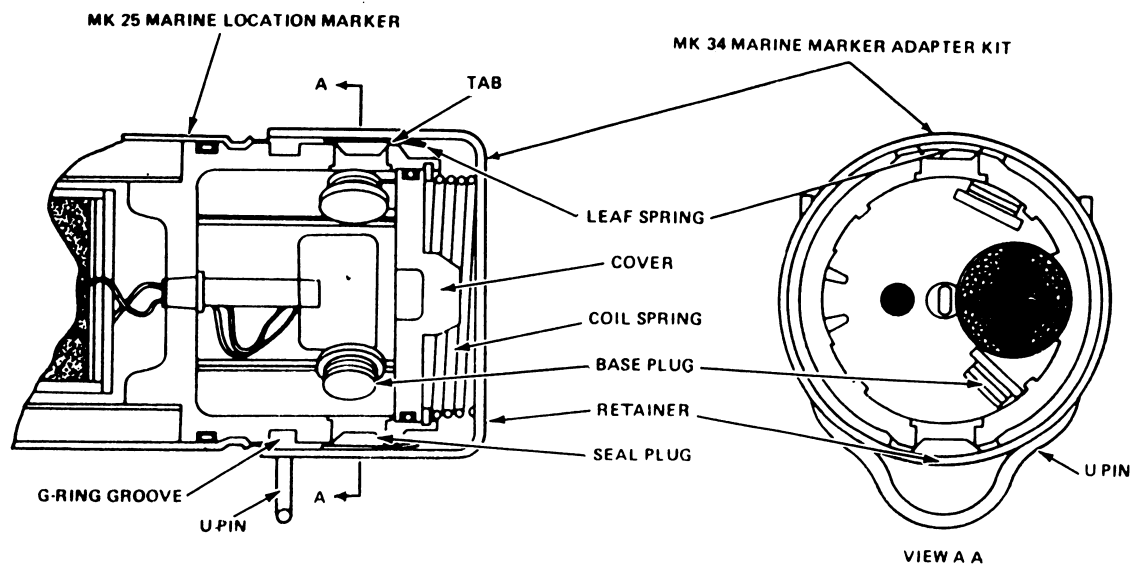


Figure 6-7.—Mk 34 marine marker adapter kit.

adapter kit (fig. 6-8) on the marker. The adapter kit provides a safe environment for the marker until the last possible moment before launch. Because of the physical difference in size between the Mk 25 marker and the sonobuoy launch tubes, a sonobuoy launch container (SLC) and spacer assembly (fig. 6-8) is used to launch the Mk 25 marker from a sonobuoy launcher.

The Mk 25 marker, with the Mk 34 adapter kit installed, is installed into the cavity half of the split foam spacer assembly section with the U-pin of the Mk 34 adapter in the UP position. Then, remove the U-pin and place the other half of the split foam spacer assembly section over the marker, which completely encloses the marker. The foam spacer assembly containing the marker is then installed into the SLC against the obturator. Foam pads are installed, and the end cap is locked into slots in the SLC, retaining the assembly inside the SLC. A JAU-1/B cartridge is installed in the SLC, and the loaded SLC is

installed in the sonobuoy launcher aboard the aircraft.

To launch the Mk 25 marker, the JAU-1/B cartridge is initiated through the aircraft circuitry. It develops sufficient gas pressure inside the SLC to force off the SLC end cap and expel the foam spacer assembly containing the Mk 25 marker. Once out of the SLC, the split foam spacer assembly is separated by the airstream, freeing the marker. The airstream then separates the Mk 34 adapter kit from the marker, allowing them to fall to the water as separate units. Upon entry into the water, the marker functions as previously discussed.

MK 58 MODE 1 MARINE LOCATION MARKER

The Mk 58 Mod 1 marine location marker (fig. 6-9) is designed for day or night use in any condition calling for long-burning, smoke and

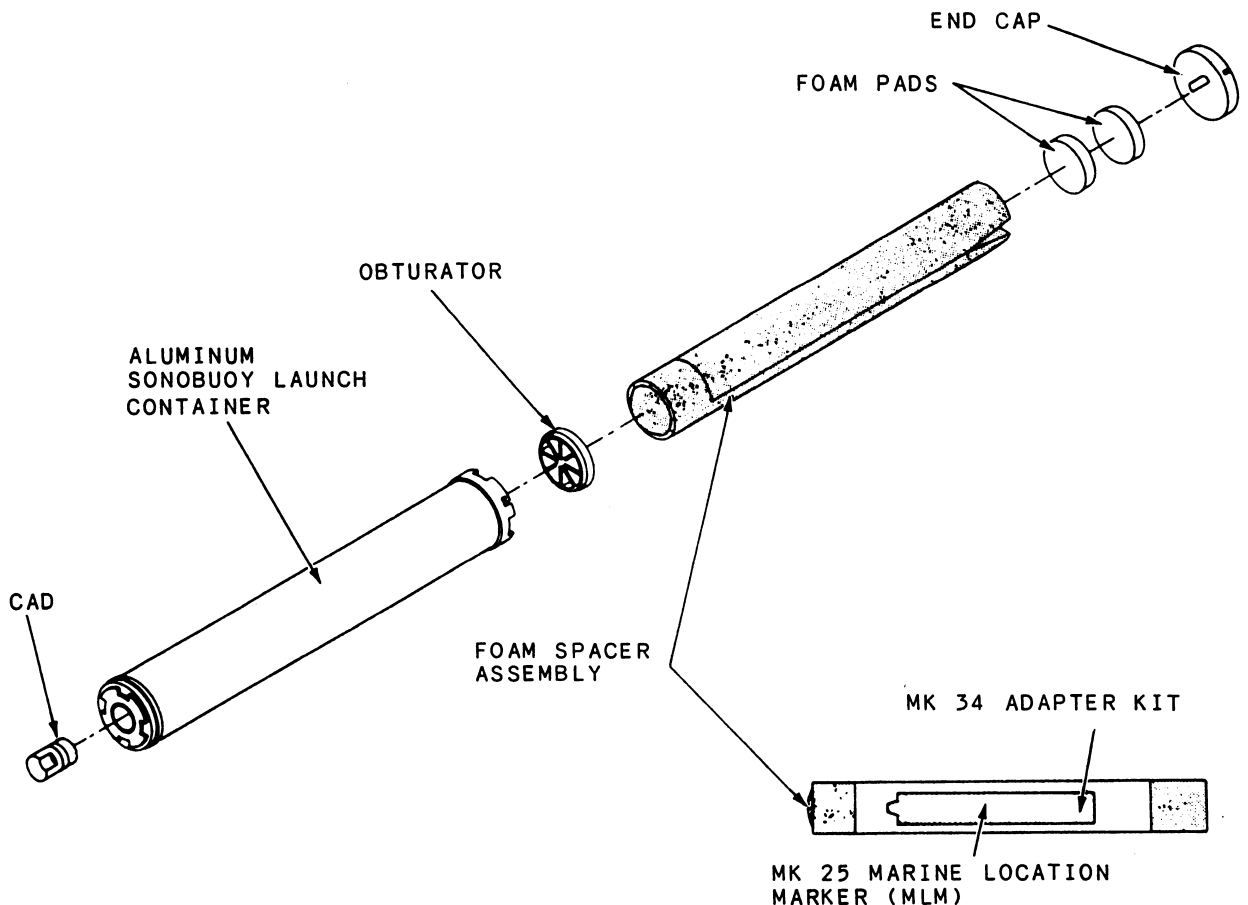
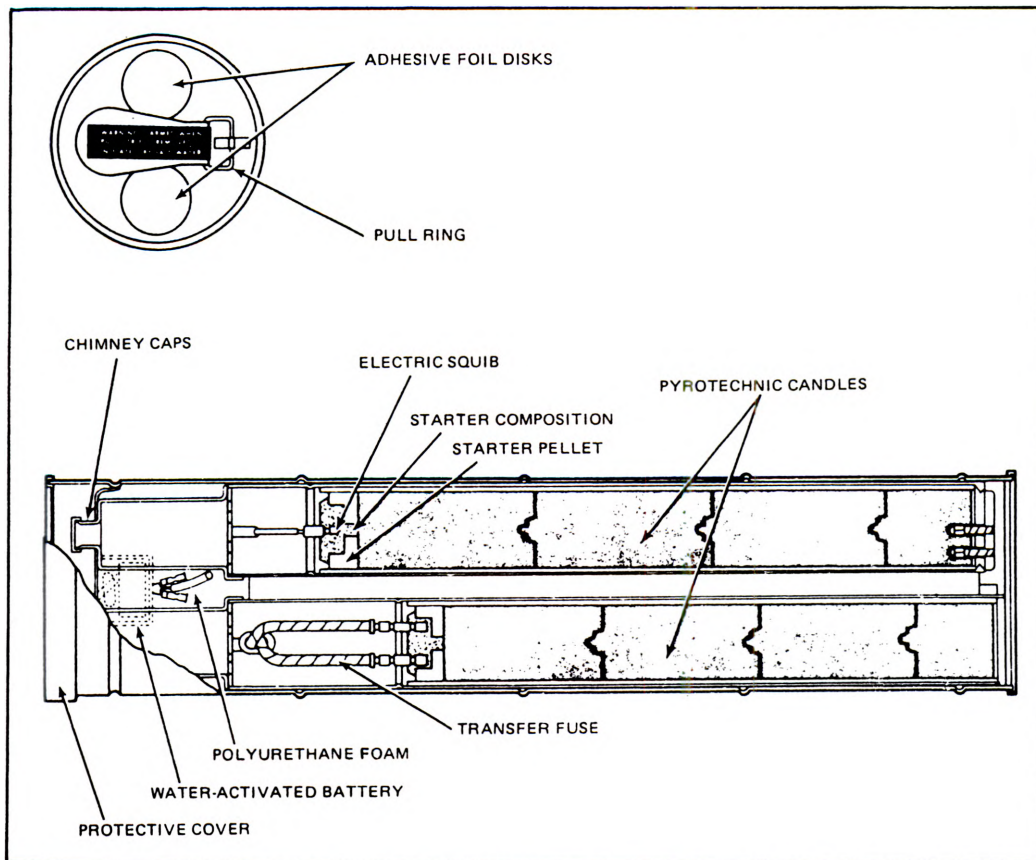


Figure 6-8.—Spacer assembly and sonobuoy launch container.



220.839

Figure 6-9.—Mk 58 Mod 1 marine location marker.

flame reference-point marking on the ocean's surface. In addition to being used for anti-submarine warfare, it is used for search-and-rescue operations, man-overboard markings, and as a target for practice bombing at sea. The marker produces a yellow flame and white smoke for a minimum of 40 minutes and a maximum of 60 minutes. It is visible for at least 3 miles under normal operating conditions.

Physical Description

The Mk 58 Mod 1 marine location marker consists of a cylindrical tin can approximately 21.78 inches long and 5.03 inches in diameter. The can contains two pyrotechnic candles of a red phosphorus composition. The ignition end of the marker has three holes—two for smoke and flame emission and one for water to enter the Mk 72 Mod 1 seawater-activated battery. Adhesive foil disks hermetically seal the two emission holes. A

reinforced adhesive foil strip with a rectangular pull ring hermetically seals the battery cavity hole. The adhesive foil seals are protected during handling and shipping by a replaceable polyethylene protective cover.

Launching Methods

The Mk 58 Mod 1 marker may be hand launched, externally launched from suitable aircraft bomb racks using breakaway suspension bands, or launched from sonobuoy launchers using a sonobuoy launcher container (SLC) and the appropriate foam spacer. No matter how the marker is launched, the protective cover and the pull ring and reinforced adhesive foil strip over the battery cavity hole is removed.

When launching the marker from a sonobuoy launcher, you remove the protective cover and pull ring and reinforced adhesive foil strip. Then, load the marker onto the bomb rack. After

securing the marker to the bomb rack, attach the pull ring to an arming wire, which is attached to the bomb rack. When the marker is released from the bomb rack, the arming wire retains the pull ring and removes the foil strip covering the battery cavity hole. When submerged, the Mk 72 Mod 1 battery is activated by seawater. Current from the battery initiates a Mk 13 electric squib, which ignites the starter composition of the first pyrotechnic candle. The composition ignites the starter pellet, which, in turn, ignites the first candle. When the first candle is nearly burned out, its heat ignites the transfer time fuze, which carries ignition to the second candle starter composition. This starter composition initiates the second pyrotechnic candle.

REVIEW NUMBER 3

- Q1. What is the burn time of the Mk 25 Mods 2 and 3 marine location marker?*
- Q2. The Mk 25 Mods 2 and 3 marine location markers function in the same way. Describe the difference between them.*
- Q3. What is the purpose of the heavy aluminum base assembly crimped to the outer tube?*
- Q4. List the methods used to launch the Mk 25 and Mods marine location marker.*
- Q5. What adapter kit is used when the Mk 25 and Mods marine location marker is launched from sonobuoy launchers?*
- Q6. List the uses of the Mk 58 Mod 1 marine location marker.*
- Q7. The Mk 58 Mod 1 marker produces a yellow flame and white smoke for what length of time?*
- Q8. Under normal conditions, the flame and/or smoke of the Mk 58 Mod 1 marker is visible for _____.*
- Q9. List the methods used to launch the Mk 58 Mod 1 marine marker.*
- Q10. What seawater-activated battery is used with the Mk 58 Mod 1 marker?*

PHOTOFLASH CARTRIDGES

Learning Objective: *Identify the purpose and use of photoflash cartridges.*

Photoflash cartridges are used for low-altitude aerial photographic reconnaissance missions. Altitude limitations are determined by the type of aircraft, photographic equipment being used, and by the illumination required for satisfactory pictures. These pyrotechnic devices produce an instantaneous, high-candlepower flash of light for night photography purposes. While these devices illuminate target areas, they must not be confused with aircraft parachute flares discussed earlier in this chapter.

M112A1 (SERIES) PHOTOFLASH CARTRIDGE

The M112A1 (series) photoflash cartridge (fig. 6-10) is initiated electrically at speeds up to Mach 0.95 from a multibarreled ejector, type A6. The firing circuit for this cartridge includes an intervalometer that fires the cartridges at 1-second intervals, or greater intervals if desired.

The cartridge consists of a rimmed aluminum case with an M59 electric primer covered by a shunt clip. This clip short-circuits and protects the primer against accidental ignition. The end opposite the primer is closed with a steel cap. Cartridges in this series differ only in respect to their delay times; they are marked to show a 1-, 2-, or 4-second delay.

Electric current, controlled by an intervalometer in the aircraft, fires the primer. The primer ignites the propelling charge that expels the charge case containing photoflash powder and ignites the delay pellet, which is held within the charge case. When the delay pellet burns to the end, it ignites the 7 ounces of photoflash powder that explodes

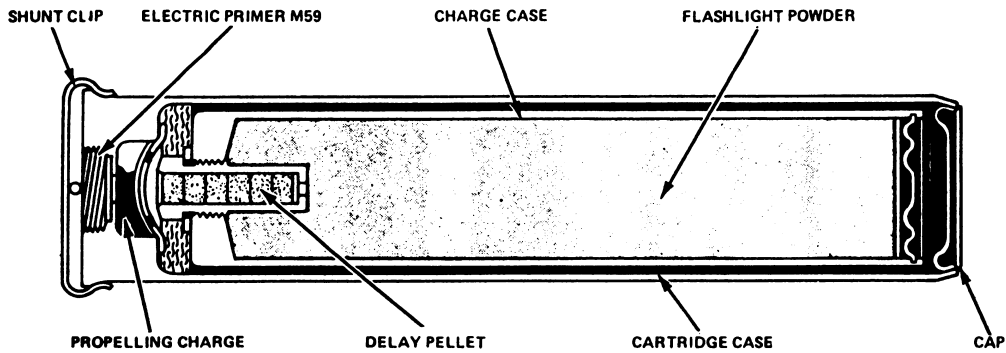
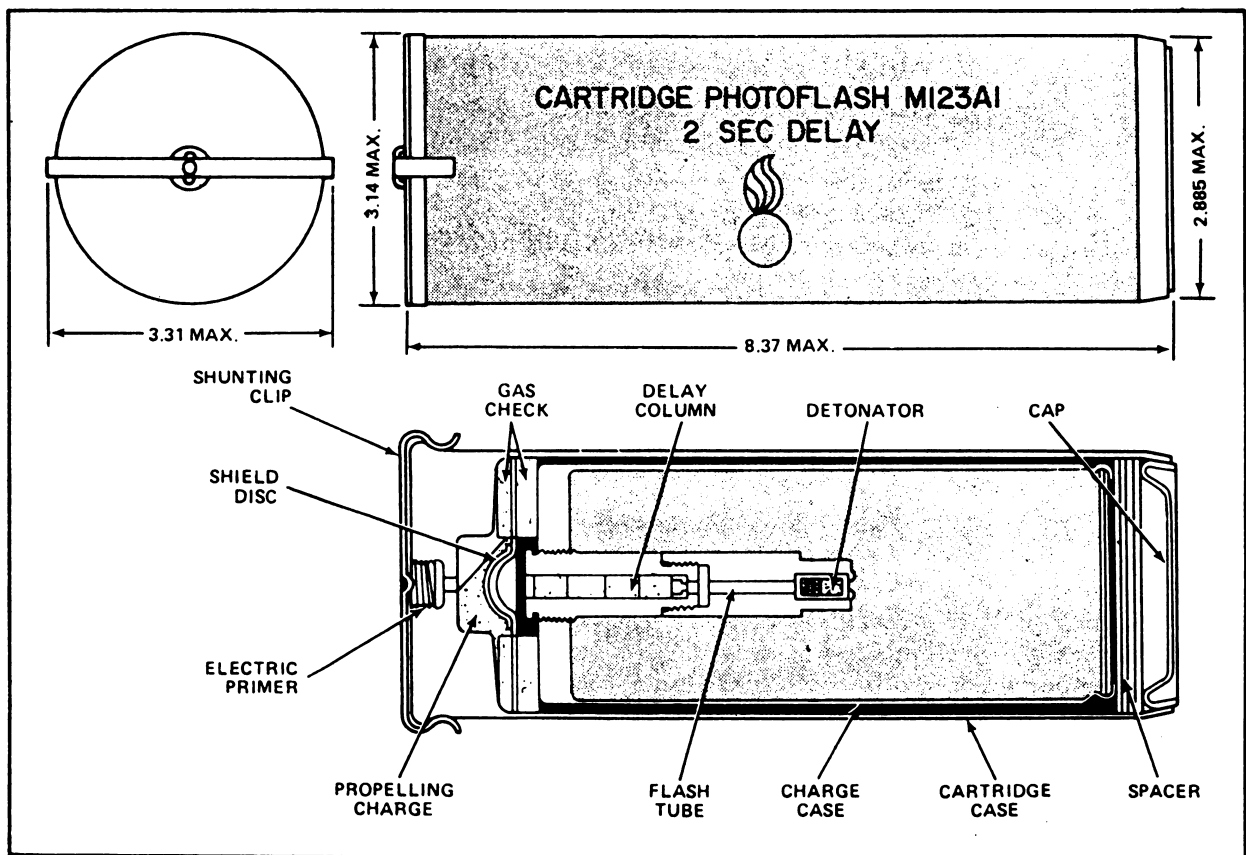


Figure 6-10.—M112A1 photoflash cartridge.



220.491

Figure 6-11.—M123A1 photoflash cartridge.

the cartridge and produces the desired flash of light.

M123A1 (SERIES) PHOTOFLASH CARTRIDGE

The M123A1 (series) photoflash cartridge (fig. 6-11) is designed to be fired from an outer case

projector for aerial photography during night reconnaissance missions. It contains 1.75 pounds of photoflash powder that provides 260 million candlepower for 0.040 second. Cartridges in this series differ only in respect to their delay times; they are marked to show a 2-, 4-, or 6-second delay.

The M123A1 cartridge consists of a rimmed aluminum case fitted with an M59 electric primer in the base end. The rimmed end is equipped with a shunt clip that prevents accidental ignition. The other end is closed with a steel cap. The M123A1 (series) of photoflash cartridges function in the same manner as the M112A1 (series).

Q3. *What delay times can be used with the M112A1 cartridge?*

Q4. *What is the purpose of the M123A1 photoflash cartridge?*

REVIEW NUMBER 4

Q1. *What is the purpose of M112A1 photoflash cartridges?*

Q2. *What means is used to initiate the M112A1 photoflash cartridge?*

Q5. *What electric primer is used in the base end of the M123A1 photoflash cartridge?*

DECOYING DEVICES

Learning Objective: *Identify the purpose and use of decoy devices.*

REVIEW NUMBER 3 ANSWERS

A1. *The burn time of the Mk 25 Mods 2 and 3 marine location marker is between 10 and 20 minutes.*

A2. *The Mk 25 Mods 2 and 3 marine location markers function in the same way. Mod 2 contains two saltwater-activated batteries and two related squibs. Mod 3 contains one battery and one squib.*

A3. *The heavy aluminum base assembly crimped to the outer tube sits in the water and causes the candle to sit out of the water.*

A4. *The Mk 25 and Mods marine location marker is launched by hand or by sonobuoy launcher.*

A5. *The Mk 34 adapter kit is used when the Mk 25 and Mods marine location marker is launched from sonobuoy launchers?*

A6. *The Mk 58 Mod 1 marine location marker is used for antisubmarine warfare, search-and-rescue operations, man-overboard markings, and as a target for practice bombing at sea.*

A7. *The Mk 58 Mod 1 marker produces a yellow flame and white smoke for 40 to 60 minutes.*

A8. *Under normal conditions, the flame and/or smoke of the Mk 58 Mod 1 marker is visible for 3 miles.*

A9. *The Mk 58 Mod 1 marine marker is hand launched, externally launched from aircraft bomb racks, or launched from sonobuoy launchers.*

A10. *The Mk 72 Mod 1 seawater-activated battery is used with the Mk 58 Mod 1 marker.*

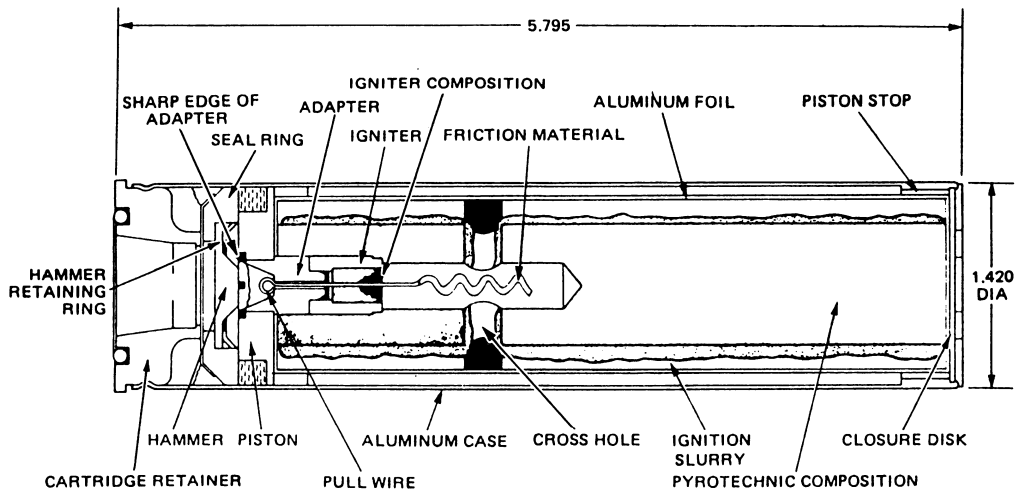


Figure 6-12.—Mk 46 Mod 1A decoy flare.

Decoy flares are dispensed from launching mechanisms on aircraft. They are fired during evasion tactics when threatened by enemy heat-seeking missiles.

The Mk 46 Mods 1, 1A, and 1C decoy flares are loaded into and launched from either the AN/ALE-39 dispensing set or the AN/ALE-37A chaff dispenser. The decoy flare (fig. 6-12) consists of a cylindrical aluminum case about 5.8 inches long and 1.42 inches in diameter. The base end of the flare is flanged to a maximum diameter of 1.495 inches to fit the counterbore in the chamber of the dispenser. The end of the flare case opposite the flanged base is closed with an aluminum closure disk.

When properly installed in the chamber of a dispenser, the cartridge retainer fits snugly over and around the firing end of a corresponding Mk 131 impulse cartridge. When the cartridge is fired, gas pressure causes the hammer to move into the adapter, locking the adapter and the piston together. Gases from the fired cartridge expand to exert a pushing force against the piston. This removes the closure disk and ejects the flare grain. As the piston strikes the piston stop, the adapter to which the pull wire is firmly attached separates from the igniter cup. Then the adapter travels with the flare grain. This action causes the igniter to move over the friction material on the crinkled end of the pull wire, igniting the igniter composition. Flame flashes through the longitudinal hole in the flare grain and ignites the first-fire composition in both the longitudinal hole and the cross hole. The first-fire composition ignites the flare grain on all surfaces.

The flare is rendered safe during normal handling operations by the segmented adapter. If the closure disk is accidentally displaced, the entire grain and the igniter assembly slips out of the flare case without igniting. The device arms only after an impulse cartridge is fired and bends the sharpened edges of the adapter so it is locked to the piston.

PRACTICE BOMB SIGNAL CARTRIDGES

Learning Objective: *Identify the purpose and use of practice bomb signal cartridges.*

Practice bomb signal cartridges are used for day and night operations and as a visual indication of bomb impact and fuze function. Three types of signal cartridges are discussed in this section.

Mk 4 Mod 3 signal cartridge. The Mk 4 Mod 3 practice bomb signal cartridge (fig. 6-13)

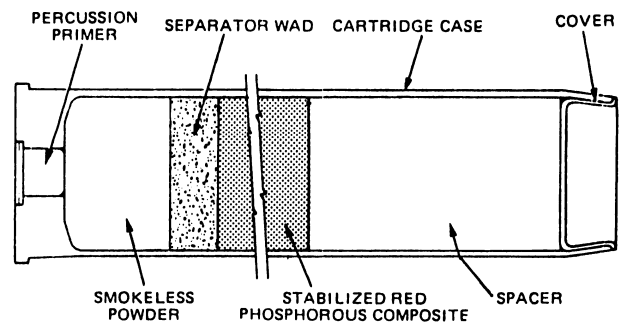


Figure 6-13.—Practice bomb signal cartridge.

consists of an aluminum case. The rim end has a percussion primer, and the opposite end is sealed with an aluminum disk. The cartridge produces a flash of light and a white smoke puff. The Mk 4 Mod 3 is primarily used for night operations.

CXU-3/B and CXU-3A/B signal cartridges. The CXU-3/B and CXU-3A/B practice bomb signal cartridges (fig. 6-14) consists of a cylindrical aluminum case. The case is closed on one end with a percussion primer, and the opposite end is closed with a crimped-in-place aluminum cover (cap). The cartridge produces a dense white smoke display for day missions.

CXU-4/B spotting charge. The CXU-4/B spotting charge (fig. 6-15) is a fire-free signal used with practice bomb BDU 45/B to provide a daytime visual indication of bomb impact point and fuse function.

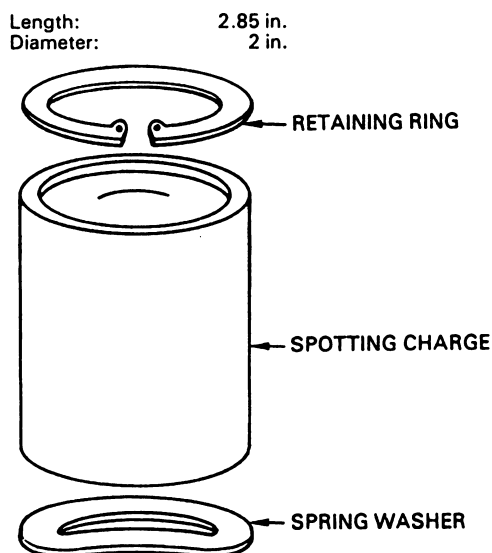


Figure 6-15.—CXU-4/B spotting charge.

Length:
 Mk 4 Mod 3: 5 in.
 CXU-3/B and 3A/B: 6 in.
 Diameter: 0.85 in.

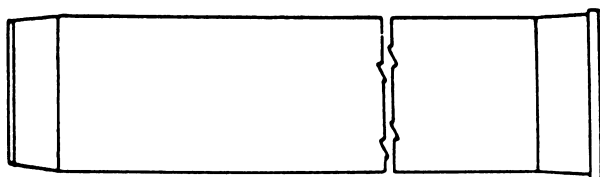


Figure 6-14.—Mk 4 Mod 3, CXU-3/B, and CXU-3A/B practice bomb signal cartridge.

REVIEW NUMBER 5

- Q1. Describe the primary purpose of decoy flares.
- Q2. What means are used to launch the Mk 46 Mods 1, 1A, and 1C decoy flares?
- Q3. What cartridge is used to fire a decoy flare from a chaff dispenser?
- Q4. What practice bomb signal cartridge is used primarily for night operations?

REVIEW NUMBER 4 ANSWERS

- A1. To provide a high-candlepower light for photo reconnaissance at speeds up to mach .95.
- A2. The M112A1 photoflash cartridge is initiated electrically.
- A3. A 1, 2, or 4 second delay time can be used with the M112 photoflash cartridge.
- A4. The purpose of the M123A1 (series) photoflash cartridge is to provide an outer case projector for aerial photography for night reconnaissance missions.
- A5. The M59 electric primer is used with the M123A1 photoflash cartridge.

Q5. *What practice bomb signal produces white smoke for day missions?*

HANDLING AND SAFETY PRECAUTIONS

Learning Objective: *Recognize the safety precautions to follow when working with pyrotechnics.*

Pyrotechnic ammunition is one of the most widely used types of ammunition in naval aviation. Pyrotechnics of one type or another are carried in almost every Navy aircraft, including unarmed transport and training aircraft.

All pyrotechnic and screening devices, while designed and tested to be safe under normal conditions, are subject to accidental ignition. A general rule for the handling of pyrotechnic devices is as follows:

You should be constantly aware that pyrotechnics contain chemical components that are intended to burn with intense heat, and you should act accordingly.

Pyrotechnic and screening devices are normally equipped with some type of safety pin, lock, or tape that is designed to prevent accidental activation of the initiation mechanism. Do **NOT** tamper with such equipment. Do **NOT** strike, bend, or otherwise remove the safety equipment until just before the device is launched. Any devices that show signs of damage to the safety features are considered unserviceable; carefully put them to one side and promptly dispose of them according to current directives.

If a pyrotechnic device should accidentally ignite, it will result in a fire hazard. In a confined area, the gases generated by this combustion could present a serious toxic hazard. Signaling charges containing propellant charges, designed to propel the pyrotechnic candle into the air, create an extremely dangerous missile hazard.

Pyrotechnic compositions characteristically contain their own oxidants; therefore, they do not depend on atmospheric oxygen for combustion. For this reason, exclusion of air, by whatever means, from a pyrotechnic fire is usually ineffective. Many pyrotechnic mixtures, particularly illuminating flare compositions, burn with intense heat (up to 4,500°F). Extinguishers are normally not useful in this kind of fires. Carbon dioxide extinguishers, in addition to being ineffective, are potential sources of danger

because they tend to produce oxygen, which supports the combustion. Foam-type extinguishers are equally ineffective because they work on the exclusion-of-air principle.

Water, in flooding quantities and at low pressure, should be used to cool the surrounding area and to prevent the spread of the fire. Properly controlled and directed, water is the best fire-extinguishing agent for aircraft parachute flares burning in the open.

Pyrotechnic hazards are frequently increased by such factors as age, improper storage conditions, rough handling, moisture penetration, excessive temperatures, damage to shipping containers, and other mishaps that causes the devices to become unserviceable. In most cases, immediate danger does not exist. Unserviceable pyrotechnic and screening devices on ships at sea are put to one side for normal return to an appropriate shore station for disposition according to the instructions and regulations contained in NAVSEA OP 5, volume 1.

Conditions may develop that demand emergency disposal of potentially hazardous devices. In such cases, disposition is the responsibility of the commanding officer. Under **NO** circumstances, other than an extreme emergency, should ammunition, explosives, or other related hazardous materials be dumped at sea by a Navy vessel, aircraft, or activity without prior approval of the CNO. If, in the commanding officer's best judgment, immediate disposition is necessary to protect lives and property, the commanding officer should order such disposition by the most appropriate means available. In all cases, the commanding officer must notify Naval Sea Systems Command, at the earliest practical time, of the facts and circumstances.

REVIEW NUMBER 6

- Q1. *Pyrotechnics are dangerous to handle because they are composed of _____*
- Q2. *Combustion requires oxygen. By what method is oxygen supplied to pyrotechnic devices?*
- Q3. *What means should you use if there is a fire involving parachute flares?*

REVIEW NUMBER 5 ANSWERS

- A1. The purpose of decoy flares is to provide evasion tactics for naval aircraft when threatened by enemy heat seeking missiles.*
- A2. Mk 46 (Mods) decoy flares are launched from either the AN/ALE-39 dispenser set or the AN/ALE-37A chaff dispenser.*
- A3. The Mk 131 impulse cartridge is used to fire a decoy flare from a chaff dispenser.*
- A4. The Mk 4 Mod 3 signal cartridge is used primarily for practice bomb night operations.*
- A5. The CXU-3A/B signal cartridge is used for practice bomb day missions.*

REVIEW NUMBER 6 ANSWERS

- A1. Pyrotechnics are dangerous to handle because they are composed of chemicals that are intended to burn with intense heat.*
- A2. Combustion requires oxygen. Generally, pyrotechnic devices contain their own oxygen supply; they don't depend on the atmosphere for it.*
- A3. If there is a fire involving parachute flares, water, in flooding quantities and at low pressure should be used.*

CHAPTER 7

UNDERWATER WEAPONS

Since World War II, the U.S. Navy has developed sophisticated air-launched torpedoes and air-laid mines. These weapons incorporate components so sensitive that their operation is classified information. Therefore, the information in this TRAMAN on air-launched torpedoes and air-laid mines is limited. You will be referred to publications containing detailed information for the weapons discussed throughout the chapter.

MK 46 AND MODS TORPEDOES

Learning Objective: *Identify the purpose and use of the Mk 46 and Mods torpedo. Recognize the torpedo configurations to include warshot and exercise and aircraft-launched torpedoes. Identify Otto Fuel II.*

The Mk 46 and Mods torpedo (fig. 7-1) is the primary weapon used in antisubmarine warfare

(ASW). It is used to search, detect, attack, and destroy submarines. The torpedo can be assembled into exercise configurations and used to train personnel. For further general information concerning torpedoes, you should refer to *United States Navy Ammunition Historical and Functional Data*, NAVSEA SW010-AB-GTP-010.

TORPEDO CONFIGURATIONS

The Mk 46 and Mods torpedo can be assembled into three configurations—warshot (tactical), exercise extender, or exercise.

Warshot Configuration

The warshot configuration of the Mk 46 and Mods torpedo consists of a nose section, warhead, control group, long fuel tank, and afterbody. A tactical warhead (contains explosives) is used in the warshot configuration.

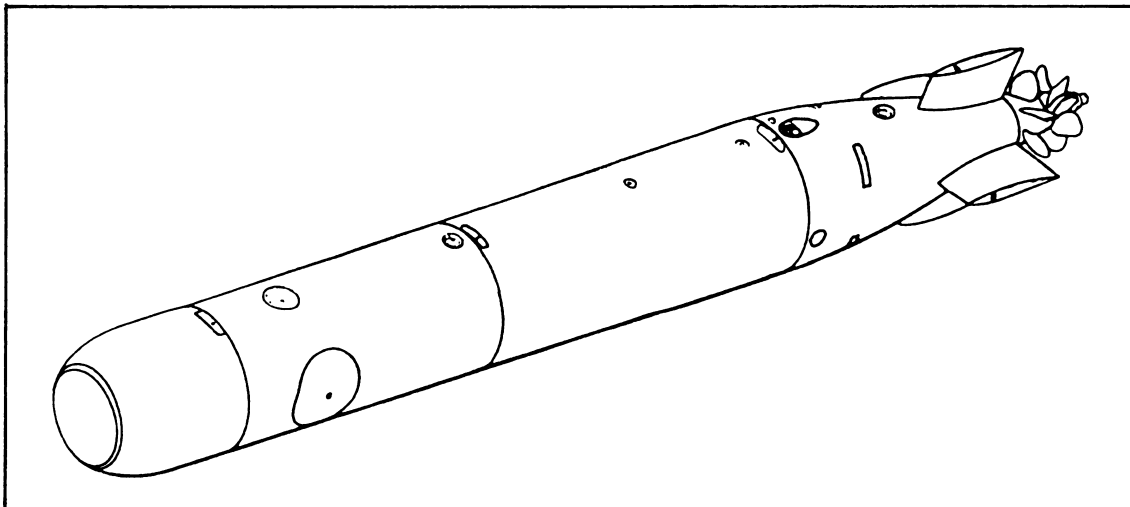


Figure 7-1.—Mk 46 torpedo.

Exercise Configuration

The exercise configuration of the Mk 46 and Mods torpedo consists of a nose section, exercise head, control group, short fuel tank, and afterbody. The positive buoyant exercise configuration torpedo consists of a nose section, exercise head, control group, extender section, short fuel tank, and afterbody. Both of these configurations use Mk 85 and Mods exercise heads.

For detailed information concerning the component configuration of the Mk 46 and Mods torpedo, you should refer to *Mk 46 Mod 1-2 and Torpedo Mark 46 Description, Operation and Organizational Maintenance, Checklist, and Quality Assurance for Mk 46 Mod 5*, NAVSEA SW515-A1-MMM-010/(C).

AIRCRAFT-LAUNCHED TORPEDO CONFIGURATIONS

To air-launch torpedoes, you will use launch accessory equipment. This equipment includes suspension bands to attach the torpedo to the aircraft and torpedo air stabilizers to ensure a predictable air trajectory and water entry. Torpedoes are configured and issued to the fleet depending on tactical or training requirements.

As an Aviation Ordnanceman (AO), you are **not** responsible for the assembly of the torpedo at the organizational level. However, you **are** responsible for the installation of launch accessory equipment.

The physical characteristics, such as weight, length, etc., of the Mk 46 torpedo vary. These characteristics depend on the configuration of the torpedo itself (warshot or exercise) and the configuration of the attached launch accessories. The Mk 46 torpedo (fig. 7-2) is configured with aircraft-launch accessories for either helicopter or fixed-wing aircraft launching.

The basic items of accessory equipment used in launching torpedoes from fixed-wing aircraft and helicopters are the torpedo air stabilizer and suspension band assembly.

The torpedo air stabilizer ensures a predictable air trajectory and water entry without torpedo structural damage. The air stabilizer reduces the descent speed of the torpedo relative to the speed of the launching aircraft. A static line or release lanyard deploys the parachute when the torpedo is dropped from the aircraft. The deployed parachute stabilizes the torpedo during descent to the water, slows the descent speed to an acceptable velocity for water entry, and assures the proper water entry angle. The Mk 28 Mod 2 (fig. 7-3) or the Mk 28 Mod 3 (fig. 7-4) air stabilizers are used on torpedoes configured for

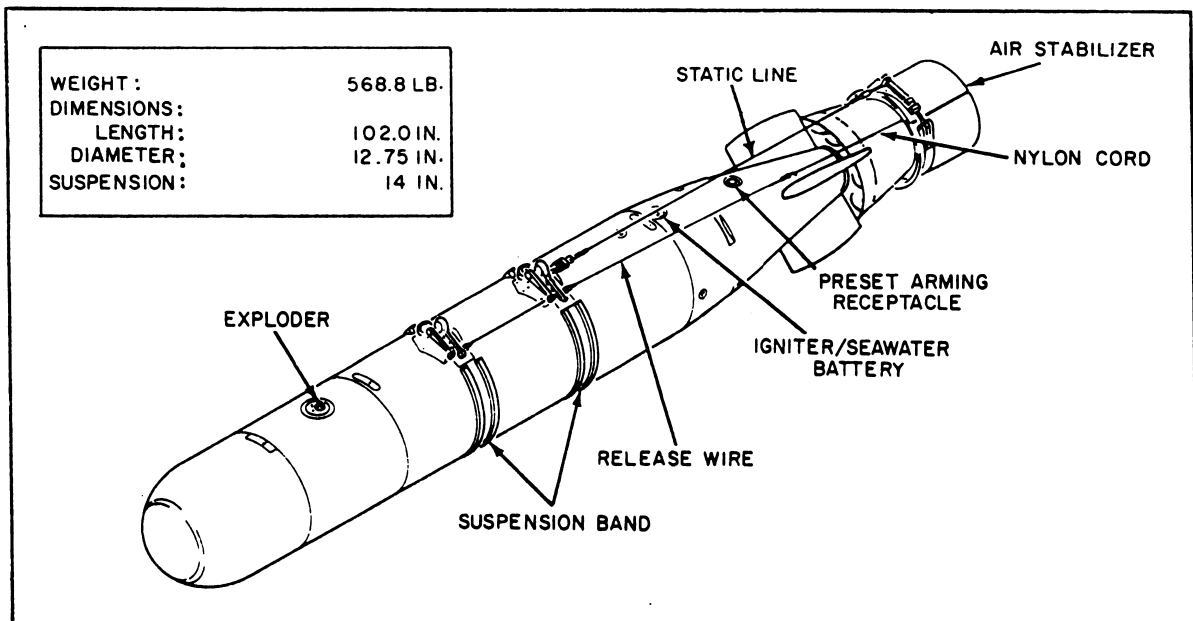


Figure 7-2.—Mk 46 torpedo with attached aircraft launch accessories.

220.865

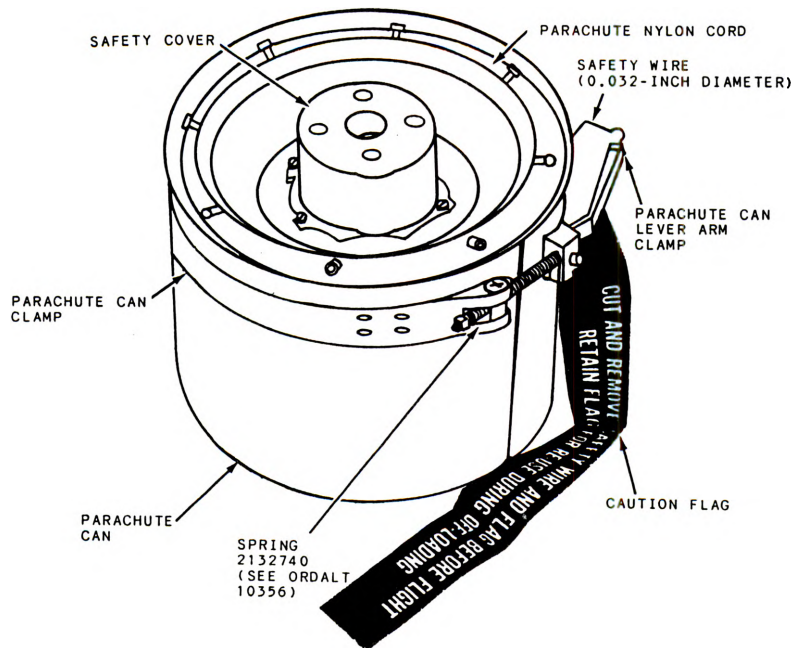


Figure 7-3.—Mk 28 Mod 2 torpedo air stabilizer.

220.866

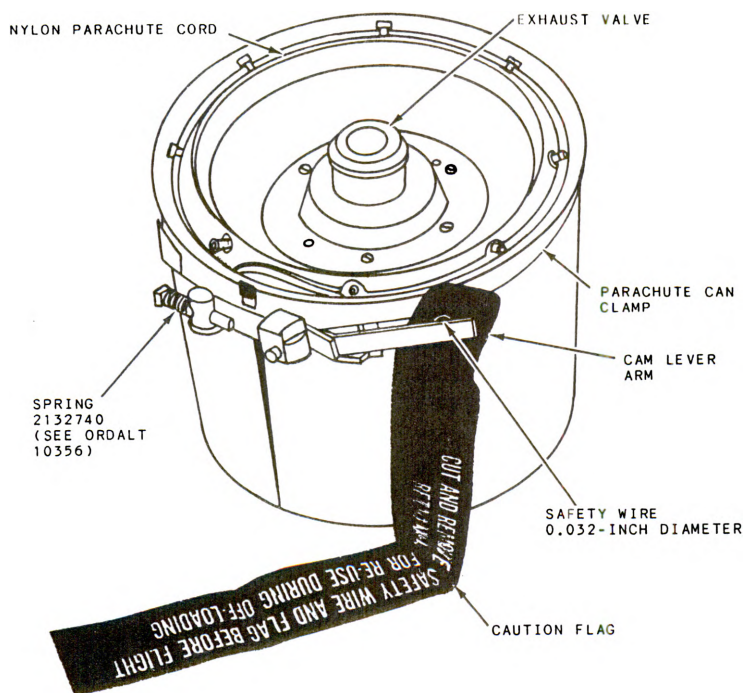
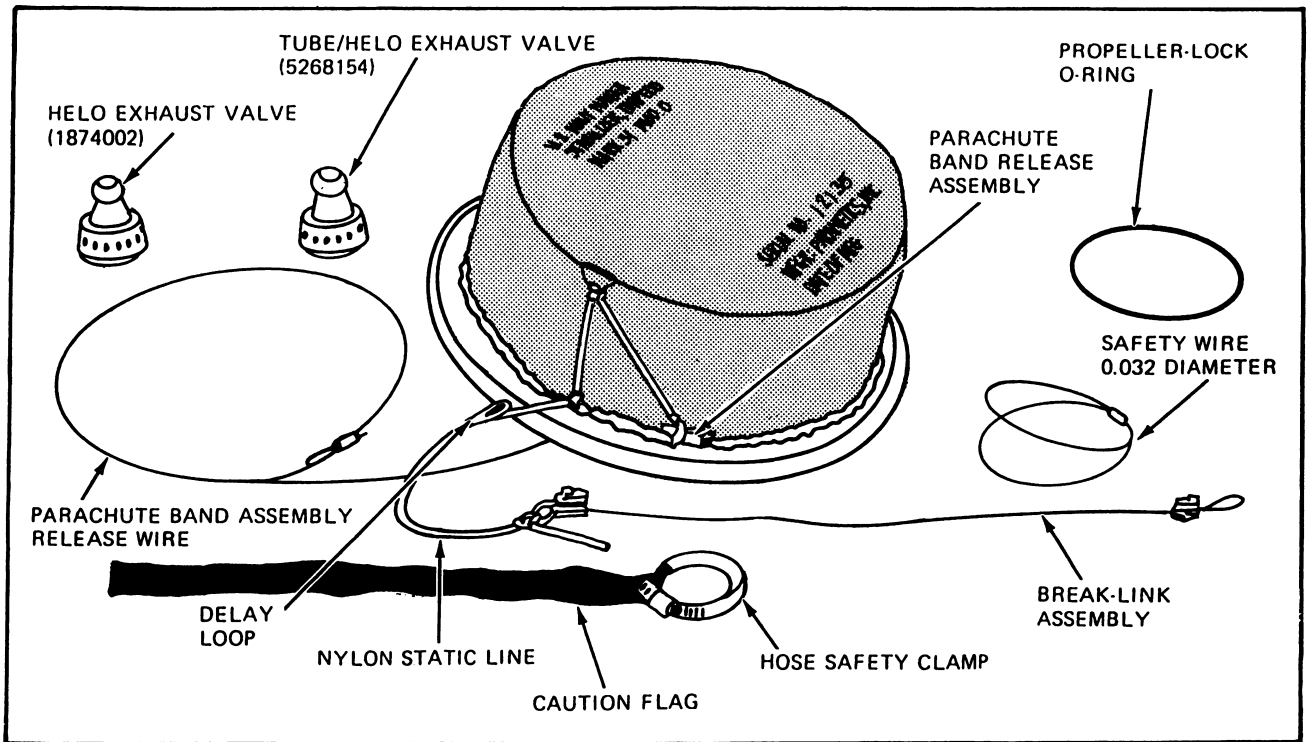


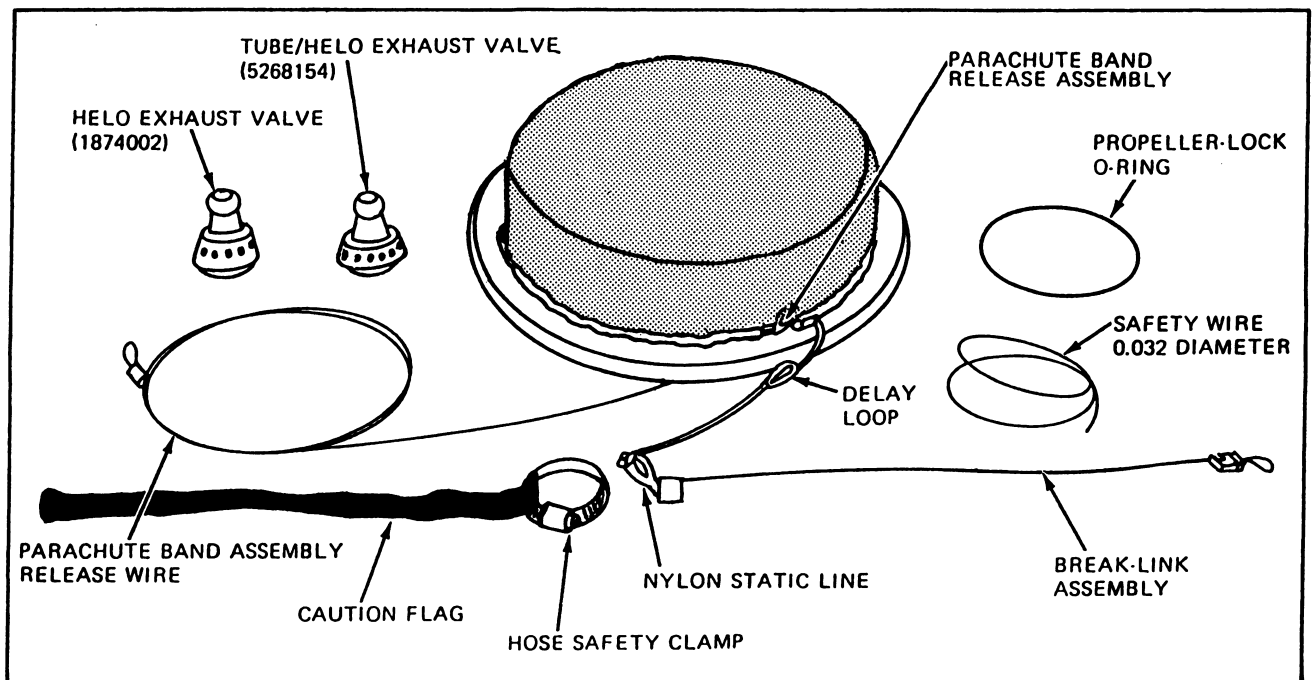
Figure 7-4.—Mk 28 Mod 3 torpedo air stabilizer.

220.867



220.868

Figure 7-5.—Mk 31 Mod 0 torpedo air stabilizer.



220.869

Figure 7-6.—Mk 31 Mod 1 torpedo air stabilizer.

fixed-wing aircraft. The Mk 31 Mod 0 (fig. 7-5) or the Mk 31 Mod 1 (fig. 7-6) air stabilizers are used on torpedoes configured for helicopters.

Mk 78 Mod 0 or Mod 1 suspension bands (fig. 7-7) are used in pairs to suspend the torpedo from the bomb racks or shackles of the launching aircraft. The bands wrap around the torpedo and are secured by tension bolts. After the bands are installed, the torpedo is loaded aboard by engaging the suspension band lugs in the bomb racks or on the bomb shackles of the aircraft. The torpedo is loaded internally for fixed-wing aircraft launch and externally for helicopter launch. When

the bomb rack/shackle hooks are released, the torpedo drops. Release wires unlatch the suspension bands, allowing them to break away from the torpedo as it is launched from the aircraft.

For detailed information concerning aircraft launch accessories, you should refer to the *U.S. Navy Aircraft Torpedoes Accessories and Trajectory Data and Quality Assurance Test and Inspection Plan for Installation of Torpedo Mk 46 Launch Accessories*, NAVSEA SW512-AO-ASY-010.

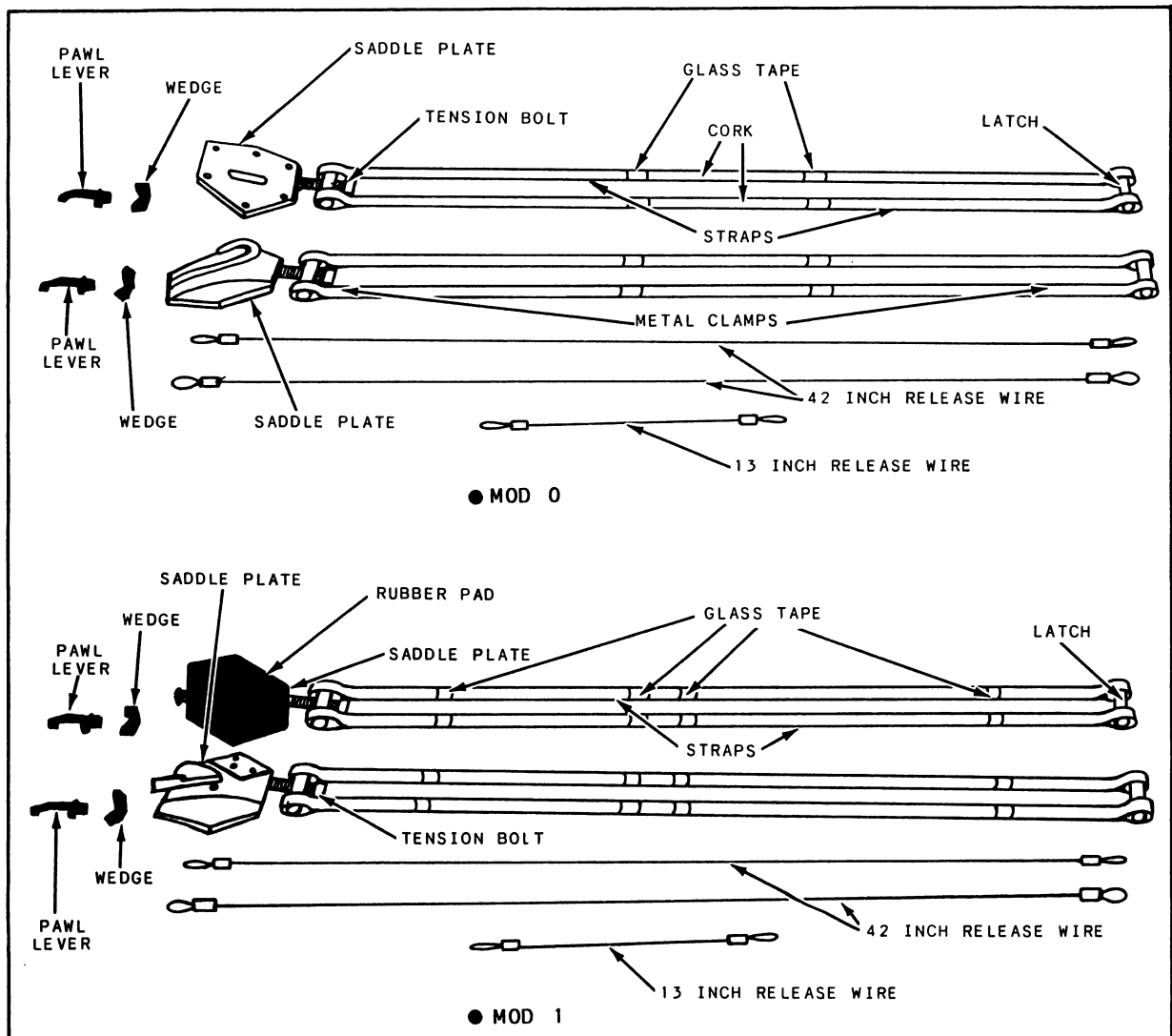


Figure 7-7.—Mk 78 Mod 0 and Mod 1 suspension band assemblies.

OTTO FUEL II

Otto Fuel II is the propellant for the propulsion system of the Mk 46 (all Mods) torpedo. Otto Fuel II is first sprayed under pressure into a combustion chamber where it is ignited. The exhaust gases from the burning fuel are used to drive the torpedo engine. The major advantage of this system is the short turnaround time required for exercise weapons.

Otto Fuel II is a stable, liquid monopropellant composed of a nitrate ester in solution with a desensitizing agent and a stabilizer. It is a bright-red, free-flowing, oily liquid that is heavier than water. (NOTE: When in a thin layer, such as a spill, stain, or leak, Otto Fuel II is a yellow-orange color.) Otto Fuel II is noncorrosive. It has an extremely low vapor pressure, minimizing explosive and toxic hazards. Otto Fuel II can detonate, but the conditions and stimulus required are so extreme that it is considered a nonexplosive. The propellant has a high flash point and other safety characteristics. It is classified as a low fire hazard material.

The ingredient of medical concern in Otto Fuel II is the nitrated ester. Nitrated esters are known for their acute effects on the human body. Symptoms of exposure to Otto Fuel II include the following:

- Headache
- Dizziness
- Drop in blood pressure
- Nasal congestion

NOTE: Depending upon the sensitivity of the individual, a temporary symptom-free tolerance may develop during the remainder of the working period. After exposure to a vapor-free environment, the first contact with Otto Fuel II vapor often causes these symptoms to recur.

A stowage space is specifically designated for each type of torpedo stowed aboard a combat ship. When handling Otto Fuel II, at least two crew members should handle the fuel. All personnel must know the general characteristics of Otto Fuel II, the safety precautions for handling the fuel, and protective equipment required. To avoid hazardous situations when handling Otto Fuel II, personnel should be well trained and supervised. For further information concerning Otto Fuel II, you should refer to *Otto Fuel II Safety, Storage, and Handling Instructions*, S6340-AA-MMA-010.

REVIEW NUMBER 1

- Q1. *What is the primary weapon used for antisubmarine warfare?*
- Q2. *List the Mk 46 configurations.*
- Q3. *When the Mk 46 is used in the exercise or exercise extender configuration, what exercise head is used?*
- Q4. *After launch, what equipment stabilizes the torpedo during its descent into the water?*
- Q5. *List the air stabilizers used for (a) fixed-wing and (b) rotary-wing aircraft.*
- Q6. *Torpedoes are suspended from bomb racks or shackles by Mk 73 Mod 0 or Mod 1 suspension bands. How do the suspension bands release when the torpedo is launched?*
- Q7. *What propellant is used in the propulsion system of the Mk 46 torpedo?*
- Q8. *Because Otto Fuel II has a high flash point, low vapor pressure, and is noncorrosive, it is classified as _____.*
- Q9. *List the symptoms you might exhibit if you were exposed to Otto Fuel II.*
- Q10. *For safety reasons, how many crew members should be present when handling Otto Fuel II?*

AIRCRAFT-LAID MINES

Learning Objective: *Identify aircraft-laid mines and recognize their classifications. Describe aircraft-laid mine components and identify operational aircraft mines.*

Naval mines are used in offensive or defensive mining operations. The primary objective is to effectively defend or control vital straits, port approaches, convoy anchorages, and seaward coastal barriers.

Aircraft mine delivery is the principal method of making large scale mining attacks on enemy coastal and port areas. Aircraft-laid mines are usually carried and dropped in the same way as bombs, but they have different ballistic flight paths. Air-laid mines usually require parachutes that are released from the mine on water entry.

CLASSIFICATIONS

Mines are classified by intended use, method of delivery, position assumed when laid, method of actuation, or weight.

Mines classified by their intended use are further classified as service, exercise (recoverable), and training mines. Service mines are fully explosive-loaded mines assembled with service components for use in wartime. Exercise

(recoverable) and training mines are inert loaded to service weight. They have many uses such as assembly and laying in fleet exercises. After exercise completion, they are recovered, analyzed, and overhauled for reuse. When assembled, exercise and/or training mines may contain minor explosive components.

Mines classified by method of delivery are submarine-laid, surface-laid, or air-laid. The classification depends on the laying vehicle.

Mines classified by the position they take in the water after being laid are moored or bottom mines. Bottom mines rest on the bottom of the sea. Their effective depth is controlled by the amount of charge they contain relative to the depth of the area in which they are planted. Their design includes sufficient negative buoyancy to provide good stability on the bottom of the sea.

Moored mines are buoyant mines. They are connected by cable to an anchor resting on the bottom (fig. 7-8). There are two important

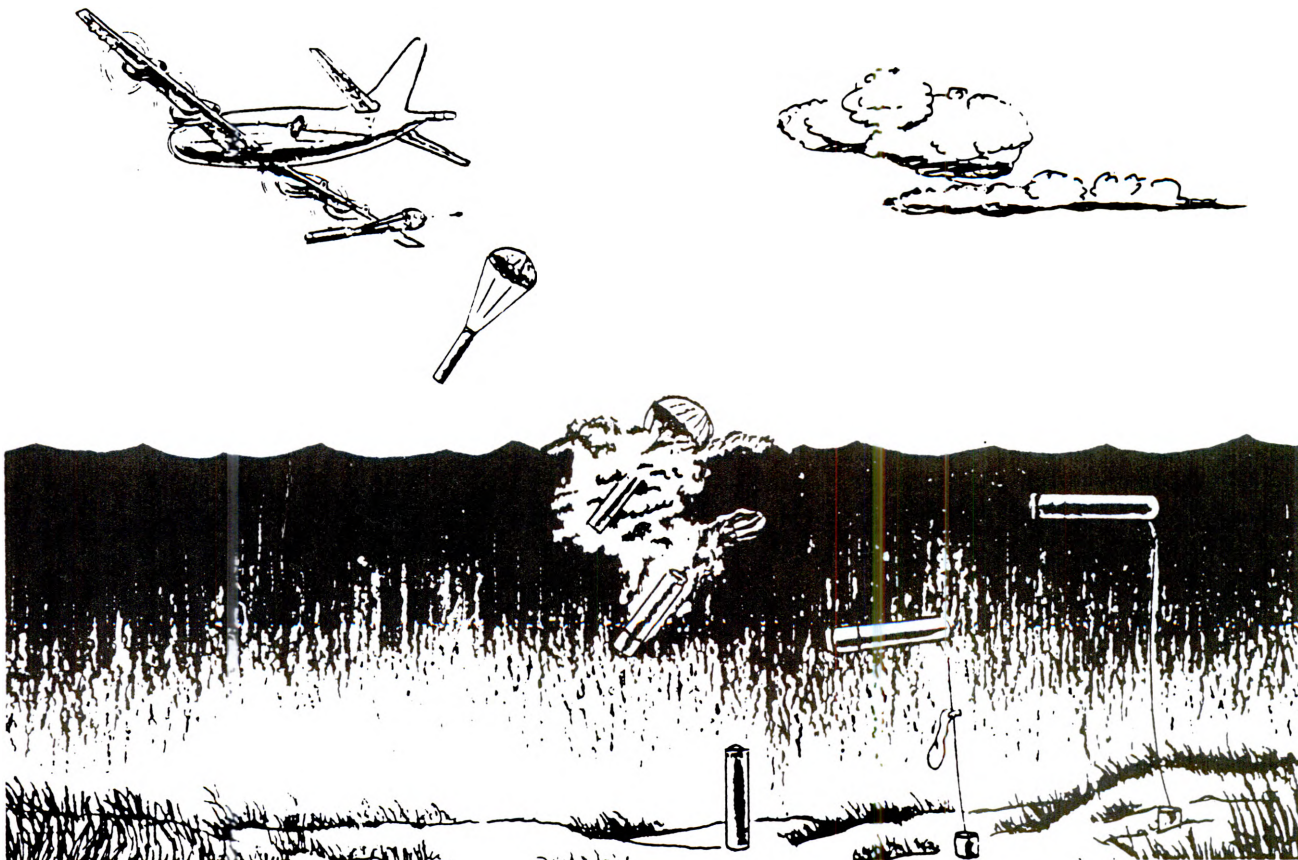


Figure 7-8.—Aerial mine delivery sequence of moored mines.

Table 7-1.—Air-laid Mines Currently in Use

MINE DESIGNATION	WEIGHT CLASS	TYPE OF ACTUATION	POSITION IN WATER	RETARDED
Mk 52	1,000 lb	Influence	Bottom	Parachute
Mk 55	2,000 lb	Influence	Bottom	Parachute
Mk 56	2,000 lb	Influence	Moored	Parachute
Mk 60	2,400 lb	Influence	Bottom	Parachute

REVIEW NUMBER 1 ANSWERS

- A1. The Mk 46 torpedo is the primary weapon used for antisubmarine warfare.
- A2. The Mk 46 configurations include warshot, exercise, and exercise extender.
- A3. When the Mk 46 is used in the exercise or exercise extender configuration, the Mk 85 and Mods exercise head is used.
- A4. After launch, the air stabilizer stabilizes the torpedo during its descent into the water.
- A5. Fixed-wing aircraft use Mk 28 Mod 2 or Mod 3 air stabilizers, and rotary-wing aircraft use Mk 31 Mod 1 air stabilizers.
- A6. Torpedoes are suspended from bomb racks or shackles by Mk 73 Mod 0 or Mod 1 suspension bands. As torpedoes are launched from the aircraft, release wires unlatch the suspension bands, letting them break away from the aircraft.
- A7. Otto Fuel II is the propellant used in the propulsion system of the Mk 46 torpedo.
- A8. Because Otto Fuel II has a high flash point, low vapor pressure, and is noncorrosive, it is classified as a low fire hazard material.
- A9. If you were exposed to Otto Fuel II, you might exhibit the following symptoms: headache, dizziness, blood pressure drop, and/or nasal congestion.
- A10. For safety reasons, at least two crew members should be present when handling Otto Fuel II.

considerations in laying moored mines—stability and moored depth. Mine stability is achieved by an anchor with sufficient negative buoyancy to retain the mine in its position (without moving) on the bottom of the sea.

Mines are classified by the methods used to activate them. Methods of activation are contact and influence, or a combination of both methods. Influence-actuated mines are the only mines used tactically in an air-laid operation. Influence-actuated mines are further classified as magnetic, acoustic, or pressure mines. These classifications are generally combined to describe a given mine; for example, an air-laid, pressure-fired, bottom mine or an air-laid, magnetic-fired, moored mine. Table 7-1 provides a list of the air-laid mines currently in use.

REVIEW NUMBER 2

- Q1. Mines classified by their intended use are classified as _____.
- Q2. What mines are fully loaded with explosives and designated for use in wartime?
- Q3. What mines are classified by the position they take in the water after being laid?

Q4. The effective depth of a bottom mine is controlled by _____.

Q5. Moored mines are stabilized by what means?

Q6. List the classifications of influence-actuated mines.

MINE COMPONENTS

The components used in a mine vary, depending on the type of mine and its specific use. In addition to the mine case and explosive system, mine components provide mine arming, target sensing, actuation, laying control, countermeasure resistance, firing power, and sterilization. Exercise components are used in the exercise (recoverable) mines. Figure 7-9 shows component configuration of a typical air-laid mine.

Mine Case

The mine case is the main element of the mine. It contains or carries all other components. The mine case is normally made of sheet steel, but

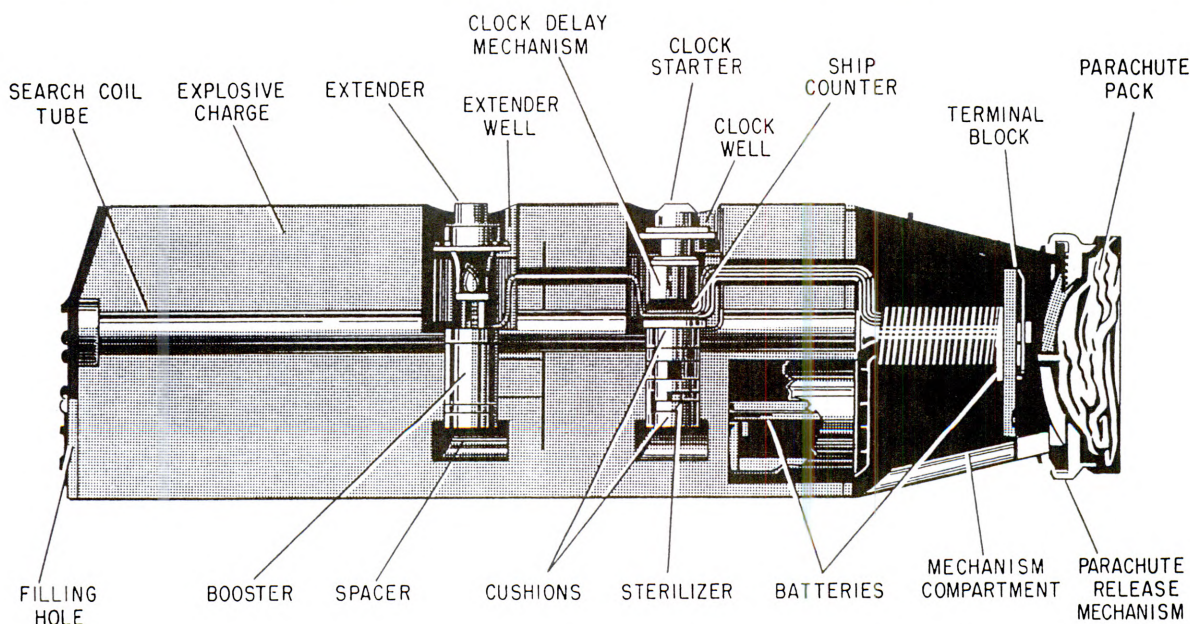


Figure 7-9.—Cutaway view of a typical aircraft mine and accessories.

220.408

aluminum, spun glass, or various plastics are used in some types of mine cases. The case is watertight and strong to resist water pressure. Mine case openings are carefully sealed with suitable gaskets.

Explosive Components

The explosive system of a mine includes the main charge, the booster, the initiating system, and auxiliary explosive devices.

MAIN CHARGE.—The main charge is the mine's payload. It is a high explosive cast directly into the mine case, or into an explosive section attached to the mine case when the mine is assembled. The amount of explosives used in air-laid mines ranges from 160 pounds to 1,300 pounds. Types of explosives used include Comp B, TNT, H6, or HBX mixtures. The HBX mixtures are commonly used explosives.

BOOSTER.—The booster varies from a few ounces to several pounds of explosive. Generally, the smaller boosters contain tetryl, and the larger boosters contain granular grade A TNT. The intermediate size booster contains Comp B. In some cases, the booster consists of a sub-booster. The booster is housed in either a brass, terneplate, plastic, or fiber container. When assembled in the mine case, the booster is in intimate contact with the main charge explosive.

INITIATING SYSTEM.—An electric primer in an explosive fitting is used to set off a flash

detonator. This initiates the leads to the booster or sub-booster, causing the mine to detonate. Explosive fittings may contain a primer or a detonator, depending on their design function.

AUXILIARY EXPLOSIVE DEVICES.—

Auxiliary devices are usually small explosives that blow or open a hole in the mine case to sink it. A small explosive device, such as the explosive driver, is used during the mine planting or operating sequence. For example, it is used to close or open electrical switches, unlock mechanical linkages, open gas bottles, and jam cables from further payout. Other types of auxiliary explosive devices are used to cut cables and to release pyrotechnic signals from exercise and training mines.

Arming Components

An arming device (fig. 7-10) is a combination of a hydrostatic switch piston and an explosive aligning piston. They are internally mounted in a single assembly. The hydrostatic piston acts to open and close electrical switches. The explosive piston aligns the explosive train when the hydrostatic piston and the explosive piston are forced in by water pressure after the mine is laid. These pistons are held in the retracted or safe position by safety pins during ground handling. The safety pins are replaced by arming wire assemblies after the mines are loaded aboard the aircraft.

REVIEW NUMBER 2 ANSWERS

- A1. *Mines classified by their intended use are classified as service, exercise (recoverable), and training mines.*
- A2. *Service mines are fully loaded with explosives and designated for use in wartime.*
- A3. *Moored or bottom mines are classified by the position they take in the water after being laid.*
- A4. *The effective depth of a bottom mine is controlled by the amount of charge contained in the mine relative to the depth to which the mine is planted.*
- A5. *Moored mines are stabilized by a cable connected to an anchor resting on the ocean floor.*
- A6. *Influence-actuated mines are classified as magnetic, acoustic, and pressure.*

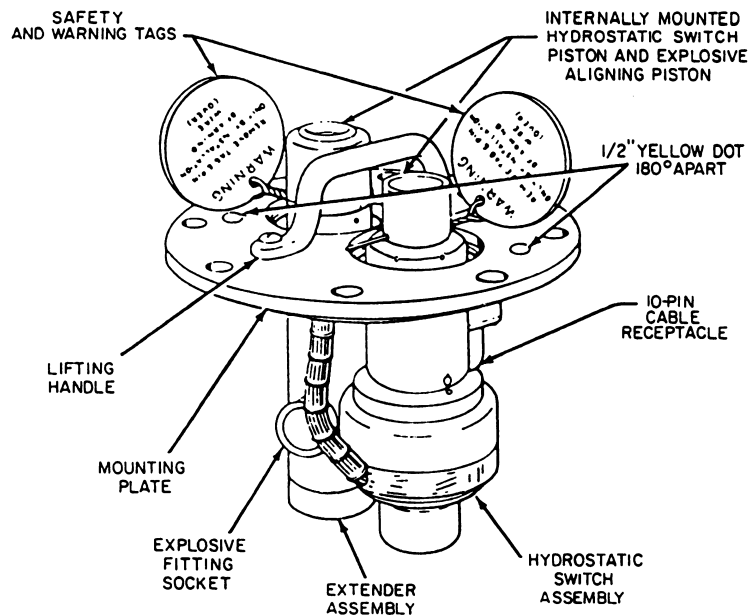


Figure 7-10.—Arming device.

After planting, a clock-delay mechanism prevents firing until the mine has been submerged for a predetermined period of time. A switch in the detonator circuit of the mine controls the firing mechanism. This switch remains open until the clock-delay device has run its predetermined time. This time could vary from 8 minutes to 10 days, depending upon the type of clock installed. Sometimes another clock is also used to sterilize the mine after a preselected period of armed life.

Firing Components

Firing components include elements that detect the target, analyze target information, and act to fire the mine. In simple systems these functions are done by a single device. However, in most systems, these functions are performed by two or more components.

The types of firing mechanisms used in mines vary widely in appearance and configuration. In older mines, the firing mechanism might be a circuit arrangement. In newer mines, the firing mechanism might be a color-coded rectangular box.

Since influence-actuated mechanisms are the only type of firing mechanisms currently used in aircraft mines, they are discussed in the following paragraphs. Influence-actuated firing mechanisms may be subdivided into three general categories—acoustic, pressure, and magnetic.

ACOUSTIC.—An acoustic mine is fired by the initiation of an enclosed microphone. The microphone picks up the sound waves generated by a nearby ship's rotating screws or other operating machinery. These mines are equipped with an anticountermining device that prevents detonation of the mine from explosions set off during minesweeping operations.

PRESSURE.—The pressure mine firing mechanism is actuated by a decrease in water pressure immediately surrounding the mine. Normally, this occurs **only** when a large ship passes over it. The pressure mine firing mechanism is used in conjunction with a magnetic-influence mechanism. The combination of these two mechanisms makes effective minesweeping operations nearly impossible.

MAGNETIC TYPE.—Magnetic mines are induction mines actuated by changes in the earth's magnetic field. Their actuation depends primarily on the rate at which the field changes rather than the amount of change. A change in the magnetic field induces an electromagnetic field in the winding of a coil. This electromagnetic field and the resulting current are proportional to the rate of change of the magnetic field. When the magnetic field increases to a predetermined level, a relay actuates and closes the firing circuit.

Parachute Packs

Some mines laid from aircraft use parachutes to prevent them from building up too much speed before entering the water. The parachute reduces the impact velocity and protects the mine components from damage. The use of parachute packs permits the mines to be released from an aircraft at high altitudes, which may be required when ports or sea passages are heavily armed.

The parachute pack currently used is the delayed-opening type. In this type of parachute pack, a control mechanism is used to open the parachute at some point in the air trajectory of the mine. A typical delayed-opening parachute pack contains a drogue-type parachute, release gear, and a control device. The parachute release gear consists of a metal ring that attaches the parachute to the mine during air travel. It is released from the mine upon water impact by inertia weights, wipe-off plates, or hydrostatic mechanisms. The control device opens the parachute during the mine's descent. It is usually controlled by an adjustable fixed-delay device. Since the parachute is deployed by firing an explosive fitting, parachute pack control devices contain explosive components.

REVIEW NUMBER 3

- Q1. What element of a mine carries all other components?*
- Q2. List the explosive components of a mine.*
- Q3. What amount of explosives are used in air-laid mines?*
- Q4. After a mine is planted, what device prevents the mine from firing until it has been submerged for a predetermined time?*
- Q5. What is the range of the delay time in planted air-laid mines?*
- Q6. List the influence-actuated firing mechanisms.*

Q7. What type of mine is detonated by the sound waves generated by nearby ships' rotating screws?

Q8. What force actuates the pressure mine?

Q9. What actuates the magnetic type of mine?

OPERATIONAL AIRCRAFT MINES

Air-laid mines currently in operational use are discussed briefly in the following paragraphs.

Mk 52 Mine

The Mk 52 service mine and the Mk 52 exercise mine (fig. 7-11) are air-laid bottom mines with identically shaped cylindrical bodies. Each mine is fitted with a nose fairing and a box fin for drop stability. Two suspension lugs are attached to the mine cases providing 14-inch suspension. Each mine uses a parapak designed to slow descent and reduce impact when the mine enters the water. A control unit, activated by a single arming wire, opens the parapak upon release from the aircraft. Each mine is equipped with a device for arming purposes. A double arming wire is used on the extender and hydrostatic switch pistons of the arming device. The Mk 52 mine is equipped with a firing system that responds, either singly or in combination, to the acoustic, magnetic, and/or pressure influence of a passing ship. The Mk 52 exercise mine is an inert service mine equipped with exercise mine components.

Mk 55 Mine

The Mk 55 service mine and the Mk 55 exercise mine (fig. 7-12) are air-laid bottom mines. Each mine is fitted with a nose fairing and box fins for drop stability. Each is suspended from the aircraft by two suspension lugs spaced 30 inches apart. Both mines use a parapak designed to slow descent and reduce impact when the mine enters the water. A control unit, activated by a single arming wire, opens the parapak. Each mine is equipped with an arming device and a double arming wire used on the extender and hydrostatic switch. The Mk 55 mine is equipped with a firing system that is

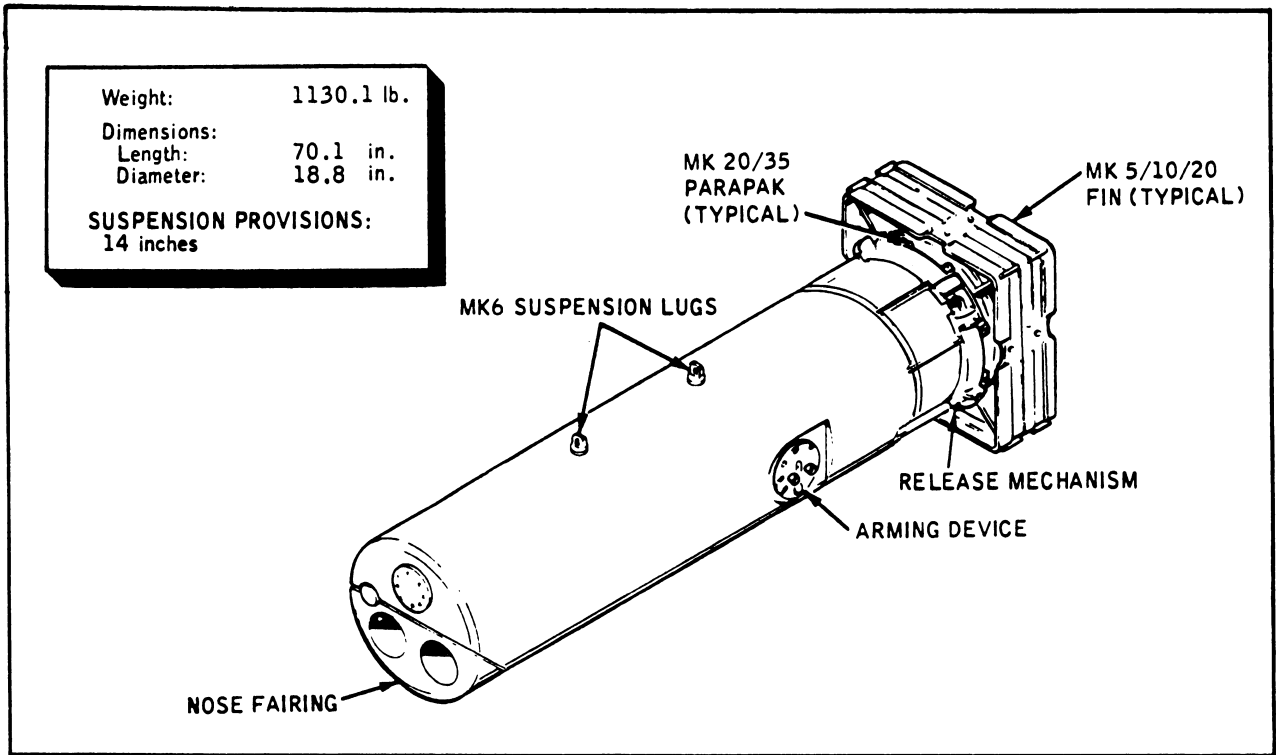


Figure 7-11.—Mk 52 service and Mk 52 exercise mine.

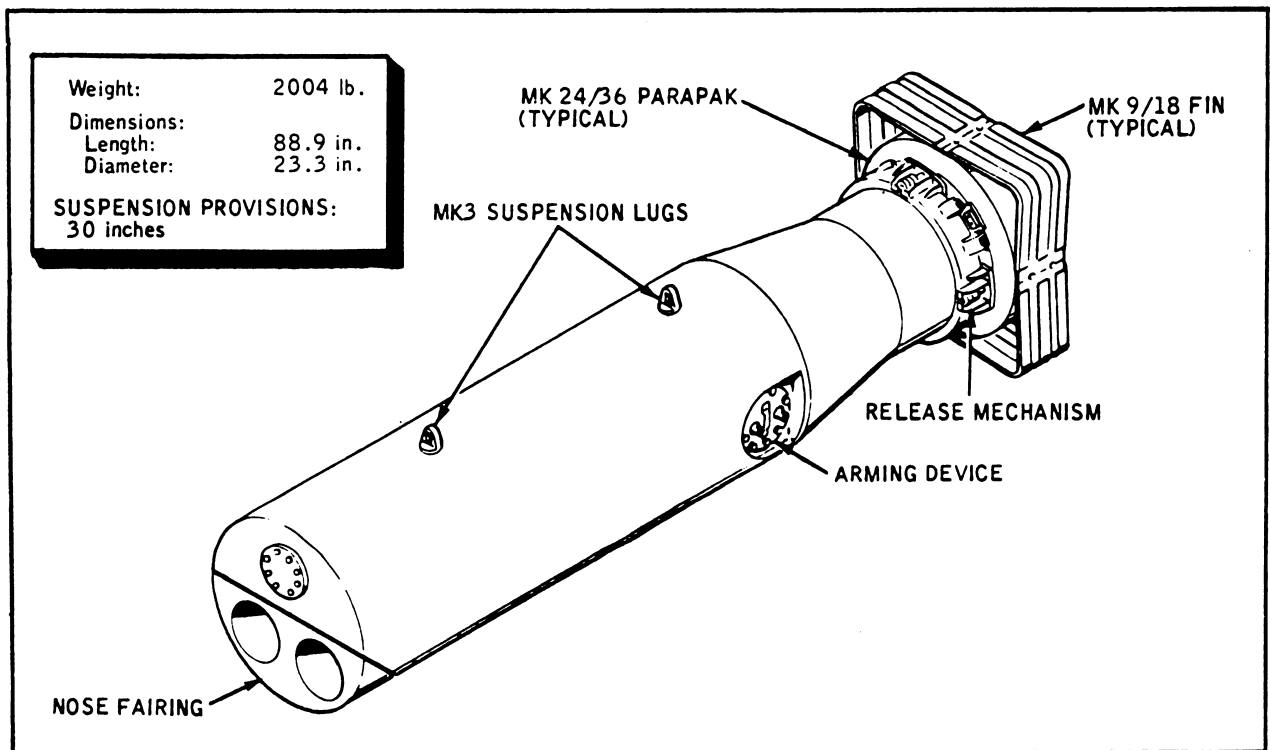


Figure 7-12.—Mk 55 service and Mk 55 exercise mine.

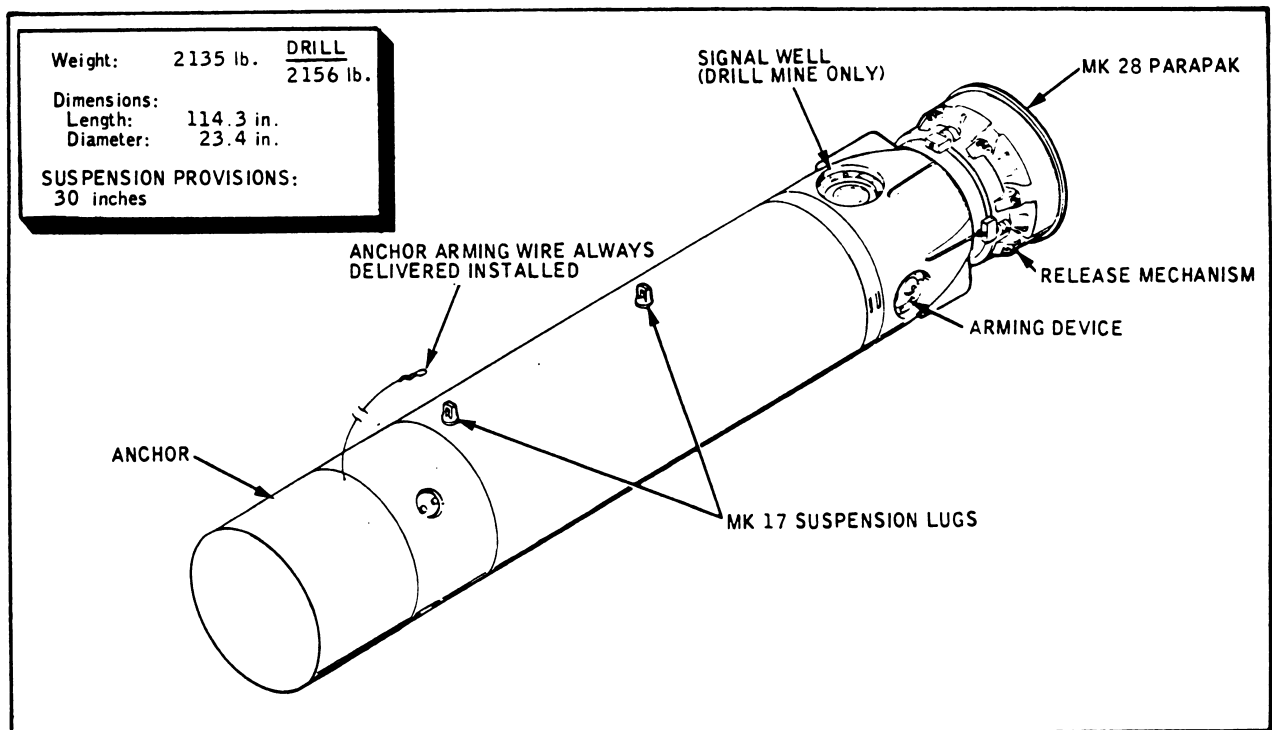


Figure 7-13.—Mk 56 service and Mk 56 exercise mine.

REVIEW NUMBER 3 ANSWERS

- A1. The mine case contains or carries all other components.
- A2. The explosive components of a mine include the main charge, booster, initiating system, and auxiliary explosive devices.
- A3. Between 160 and 1,300 pounds of explosives are used in air-laid mines.
- A4. After a mine is planted, a clock-delay mechanism prevents the mine from firing until it has been submerged for a predetermined time.
- A5. The range of the delay time in planted air-laid mines is from 8 minutes to 10 days.
- A6. Influence-actuated firing mechanisms include acoustic, pressure, and magnetic.
- A7. Acoustic mines are detonated by the sound waves generated by nearby ships' rotating screws.
- A8. A decrease in the water pressure immediately surrounding the mine actuates the pressure mine.
- A9. A change in the earth's magnetic field actuates the magnetic type of mine.

responsive, either singly or in combination, to the acoustic, magnetic, and/or pressure influence of a passing ship. The Mk 55 exercise mine is an inert service mine equipped with exercise components.

Mk 56 Mine

The Mk 56 service mine and the Mk 56 exercise mine (fig. 7-13) are air-laid, cylinder-shaped, moored mines. Two Mk 17 suspension lugs spaced 30 inches apart are attached to the mine case. A parapack is used to slow descent and to reduce impact when the Mk 56 mine enters the water. A control unit, activated by a single control wire,

opens the parapack. The mine is armed by an extender and a hydrostatic switch, which are controlled by a double arming wire. The mine is equipped with an anchor that separates from the mine for mooring. The mine remains moored at a predetermined distance beneath the surface of the water. The Mk 56 firing system responds to the magnetic influence of passing ships. The mine can be configured with inert components for exercise purposes.

Mk 60 Mine (Captor)

The Mk 60 mine (fig. 7-14) is an air-laid antisubmarine mine. This mine, when triggered

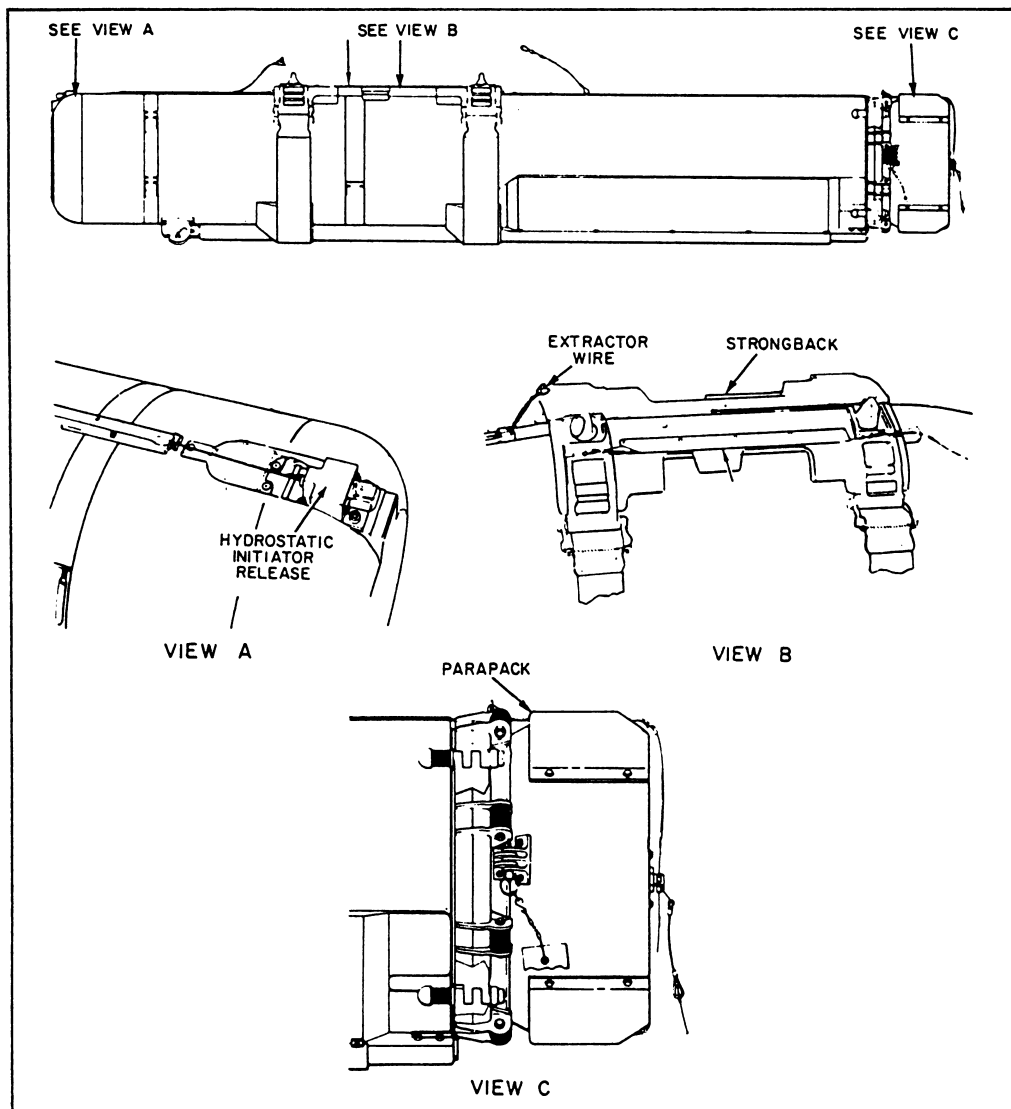


Figure 7-14.—Mk 60 captor mine.

by the influence of a submarine, launches a homing torpedo. A strongback assembly is used to attach the mine to aircraft bomb racks. Two Mk 3 suspension lugs threaded into the strongback provide a 30-inch suspension. The mine uses a parachute pack to slow descent and reduce impact when the mine enters the water. An explosive fitting actuated by a single arming wire opens the parachute. After entering the water, the parachute pack and strongback separate from the mine, and the stabilizer deploys. The mine is armed by a hydrostatic initiator, which is held in the safe position by a single arming wire. The Mk 60 configuration requires arming wire installation prior to aircraft loading.

REVIEW NUMBER 4

- Q1. *What type of mine is the Mk 52 service mine?*
- Q2. *What suspension is used on the Mk 56 mine?*
- Q3. *What components are used on the Mk 55 mine for drop stability?*
- Q4. *What is the suspension of the Mk 55 mine?*
- Q5. *What suspension lugs are used with the Mk 56 mine?*
- Q6. *List the components used to arm the Mk 56 mine.*
- Q7. *What suspension is used with the Mk 60 mine?*
- Q8. *In what mine should you install the arming wire before the aircraft is loaded?*

MINE HANDLING

Learning Objective: *Recognize the procedures to follow when handling mines.*

Prepositioned war-ready or war-reserve stocks of mines are maintained in one of five stages of assembly. These stages are designated by *Mine and Destructor Assembly Configurations; Definitions and Use*, OPNAVINST 8550.12, as assembly configurations A, B, C, D, or E. These assembled mine configurations are identified as operational assemblies (OA) and are described below.

Assembly Configuration A. Configuration A is a completely assembled mine and a specific OA ready for immediate delivery to the planting agent. This assembly includes all flight gear and launching accessories.

Assembly Configuration B. Configuration B is an assembled and tested mine of a specific OA. It includes flight gear and launching accessories in separate on-site storage.

Assembly Configuration C. Configuration C is an assembled and tested mine of a specific OA. This assembly includes flight gear, launching accessories, and arming devices (with explosive fitting installed) in separate on-site storage.

Assembly Configuration D. The Configuration D mine is assembled to a specific OA with explosive initiators, flight gear, and launching accessories in separate on-site storage.

Assembly Configuration E. The Configuration E mine is partially assembled, and it is identical to assembly configuration D except that the assembled instrument rack is packaged and stored separately.

The initial assembly of these configurations is a depot-level maintenance function. Occasionally, an intermediate activity must replace a damaged mine case or component.

To conform with safety and ammunition stowage requirements, mines are normally received aboard ship in assembly configurations C or D. Aviation ordnancemen are not required to assemble mines, but they are required to be qualified and certified in mine handling and aircraft loading procedures.

A Mobile Mine Assembly Group (MOMAG), composed of personnel from the Mineman rate,

is responsible for the proper assembly of all mines. It is the responsibility of the mine planting activity to notify the MOMAGs of scheduled mine operations and the exact dates their assistance will be required.

SAFETY PRECAUTIONS

Learning Objective: Recognize the safety precautions to follow when handling mines and torpedoes.

Handling mines is a specialized job. If you aren't qualified, don't disassemble mines or their components.

When handling mines, you should follow the same safety precautions you follow when handling bombs.

When a mine is jettisoned safe, the wires remain in the clock starter and booster extender. This prevents them from operating after the mine submerges. However, when the mine strikes the water, the arming wires may pull free. Hydrostatic pressure or countermining shock can cause the wires to shear. Also, after a mine is submerged for a long period, the wires can corrode and break. No mine is jettisoned safe in water that is less than 800 feet (243.8 meters) deep with positive assurance that it isn't a hazard. Depths greater than 800 feet will crush or flood the mine case, making the mine inoperative.

When handling mines during preflight operations, follow the same general handling techniques you use for bombs or torpedoes.

REVIEW NUMBER 5

- Q1. List the stages of mines in which war-ready or war-reserve stocks are maintained.*

- Q2. At what level of maintenance are war-ready stocks assembled?*

- Q3. In what configuration are mines normally received aboard ship?*

- Q4. The assembly of mines is the responsibility of _____.*

- Q5. To what minimum depth must a mine be jettisoned to be considered jettison safe and not constitute a hazard?*

REVIEW NUMBER 4 ANSWERS

- A1. The Mk 52 service mine is a air-laid bottom mine.
- A2. The Mk 52 mine is equipped with 14-inch suspension lugs.
- A3. A nose fairing and box fins are used on the Mk 55 mine for drop stability.
- A4. The Mk 55 mine is equipped with suspension lugs 30 inches apart.
- A5. The Mk 56 mine is equipped with two Mk 17 suspension lugs.
- A6. The Mk 56 mine is armed by an extender and a hydrostatic switch that are controlled by a double arming wire.
- A7. The Mk 60 mine is equipped with two Mk 3 suspension lugs.
- A8. You should install the arming wire in the Mk 60 mine before the aircraft is loaded.

REVIEW NUMBER 5 ANSWERS

- A1. Mines in which war-ready or war-reserve stocks are maintained in configurations listed as Assembly Configuration A, Assembly Configuration B, Assembly Configuration C, Assembly Configuration D, and Assembly Configuration E.
- A2. War-ready stocks are assembled at the depot maintenance level.
- A3. Normally, mines are received aboard ship in configurations C and D.
- A4. The assembly of mines is the responsibility of a mobile mine assembly group (MOMAG).
- A5. A mine must be jettisoned to a minimum depth of 800 feet (243.8 meters) to be considered jettison safe and not constitute a hazard.

CHAPTER 8

M61A1 AUTOMATIC GUN INSTALLATION AND LOADING EQUIPMENT

Gun systems installed in high-speed aircraft must meet demanding performance requirements and provide firepower. The General Electric M61A1 20-mm automatic gun system, installed in the A-7E, F-14, and F/A-18 aircraft, meets these requirements.

The M61A1 (fig. 8-1) is a six-barrel, rotary-action automatic gun based on the machine-gun design of Richard J. Gatling. The gun consists of a revolving cluster of barrels. Each barrel is fired once per revolution. The M61A1 automatic gun is hydraulically driven, electrically controlled, and can fire M50-series ammunition at 4,000 to 7,200 rounds per minute. As installed in Navy aircraft, the gun has a pilot selectable firing rate of either 4,000 (GUN LOW) or 6,000 (GUN HIGH) rounds per minute. It is designed for either air-to-ground or air-to-air gunnery missions.

Ammunition is supplied to the M61A1 gun by an ammunition handling and storage system that functions within a specific aircraft. The system uses an endless conveyor that transports 20-mm ammunition from the ammunition drum to the gun. The conveyor then returns the expended

cases and unfired rounds to the ammunition drum.

Although the physical location of components varies between different aircraft gun installations, the function and description of the components are essentially the same.

M61A1 AUTOMATIC GUN

Learning Objective: Identify the components of the M61A1 automatic gun and recognize the operating principles.

The primary parts of the gun are the barrels, housing assembly, and rotor assembly. Look at table 8-1 for M61A1 gun characteristics. The following paragraphs contain a description of each gun component and an explanation of how each component works. Figure 8-2 shows an exploded view of the gun components, and figure 8-3 shows the gun component locations. As each component is discussed, you should look at these figures.

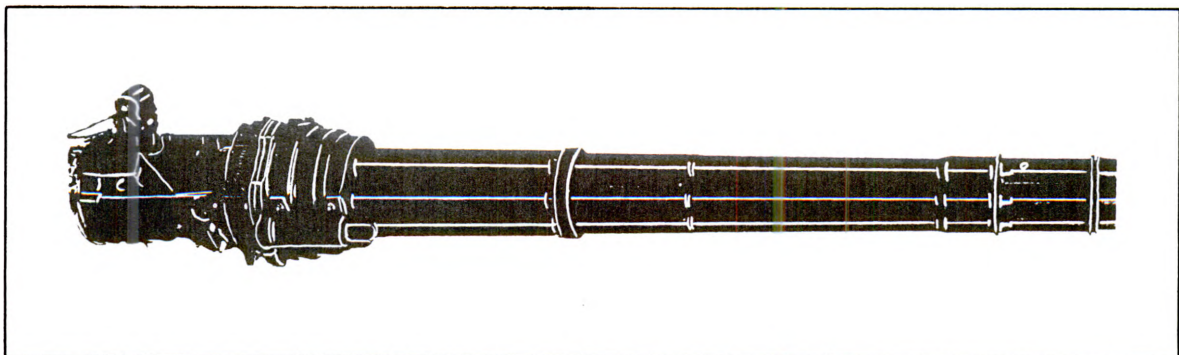
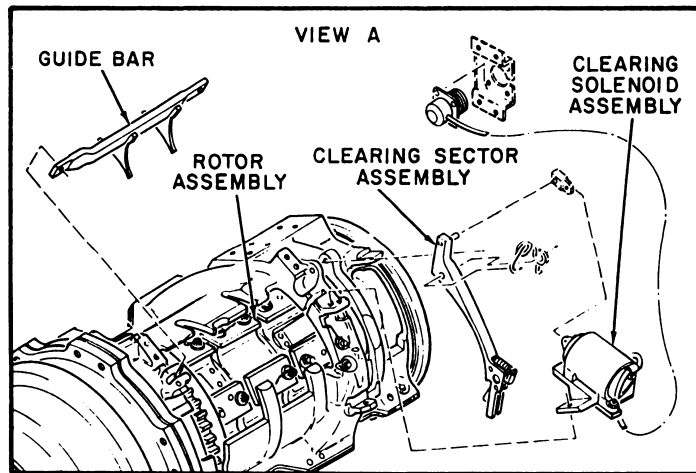
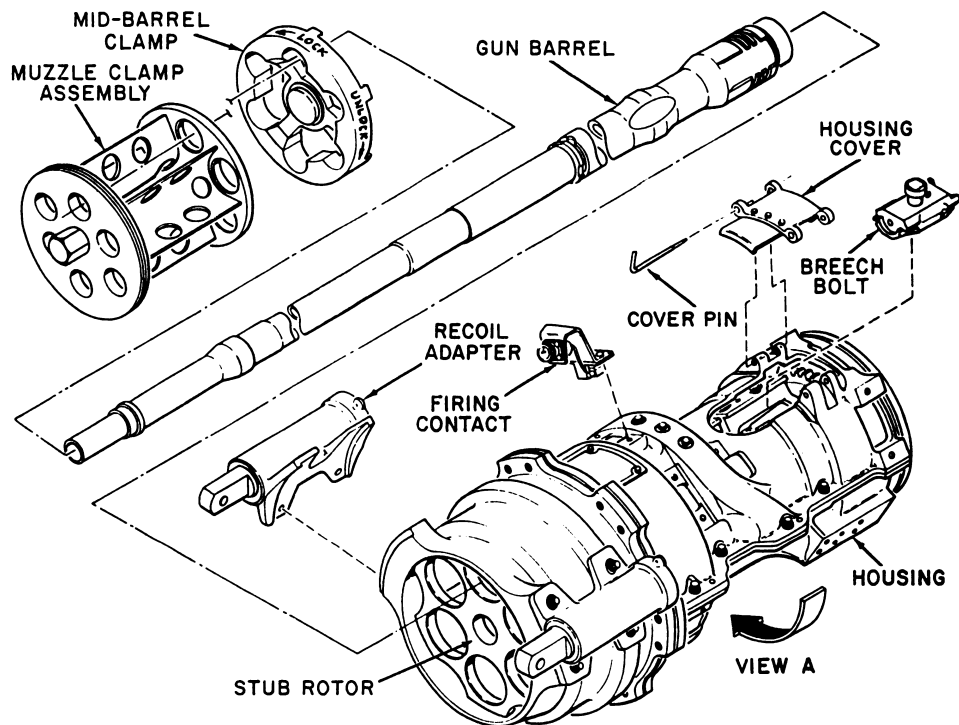


Figure 8-1.—M61A1 automatic gun.

220.794



220.528

Figure 8-2.—Gun components (exploded view).

GUN COMPONENTS

The primary parts of the gun are described in the following paragraphs.

Muzzle clamp assembly. The muzzle clamp assembly is positioned at the outer end of the barrels. It restrains individual barrel movement during firing. It is positioned against the shoulders on the barrels and secured by the pressure of the self-locking nut assembly against the opposite side of the shoulders.

Mid-barrel clamp assembly. The mid-barrel clamp assembly is positioned near the center of the barrels. The clamp tabs are engaged in the slots of the stop shoulders on the barrels. Secure the clamp in this position by rotating the locating disk to the locked position. The direction of rotation of the gun and barrel detents prevents the clamp from unlocking. Insert a cotter pin through the locking disk and clamp plate as an additional safety measure.

Table 8-1.—M61A1 Characteristics

<p>GUN</p> <p>Rotation Drive Caliber Length overall Weight Solenoid operating Voltage Solenoid resistance Firing Voltage</p>	<p>Counterclockwise viewed from breech end External Electric Motor or Hydraulic Unit 20mm Approximately 72 inches 283 pounds 28 vdc 1 ohm 250-400 vdc</p>
<p>BARRELS</p> <p>Number of Barrels Length Number of Lands Twist</p>	<p>6 60 inches 9 Right-hand gain twist</p>
<p>RATE OF FIRE</p>	<p>4000 to 7200 spm</p>
<p>AMMUNITION</p> <p>M51 Type (Except chrome plated) M53 M54 M55A1 M55A2 M56A3</p>	<p>20MM Electric Primed 20MM Dummy Cartridge Armor Piercing Incendiary (API) High Pressure Test Cartridge (HPT) Government Standard 20MM Cartridge 20MM Target Practice Ball Cartridge (TP) High Explosive Incendiary (HEI)</p>

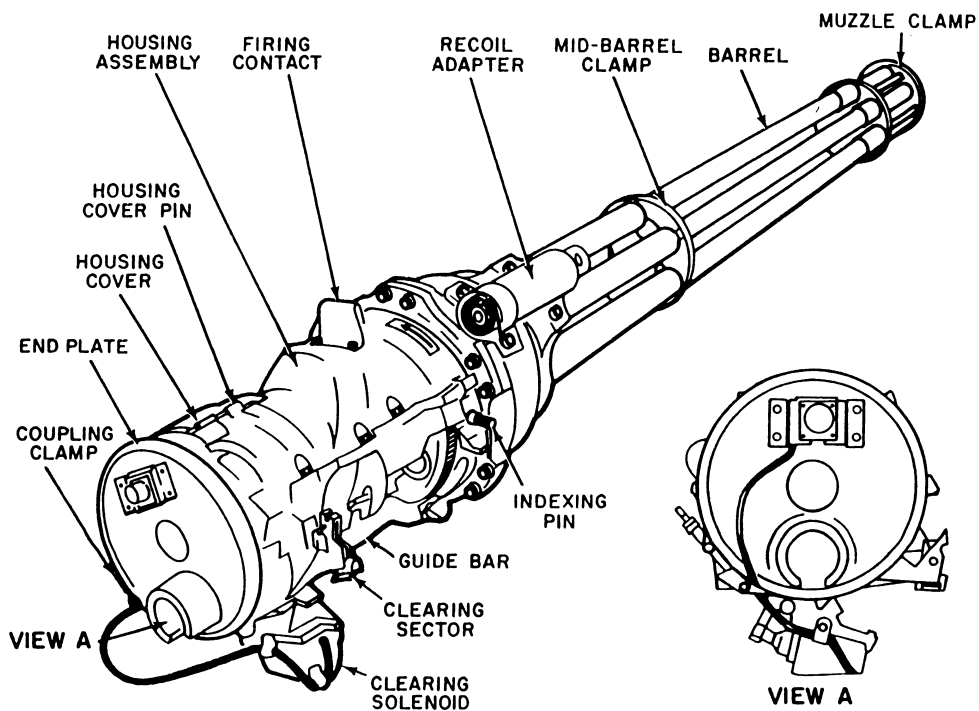


Figure 8-3.—Gun component locations.

220.796

Barrels. The M61A1 automatic gun has six rifled barrels. They are supported by a stub rotor attached to the rotor body. The three rows of interrupted locking lugs on the barrel engage similar interrupted locking lugs in the rotor to secure the barrel. There are three knurled bands near the center of the barrels. These bands give you a gripping surface for easy installation and removal of the barrels from the rotor.

Recoil adapters. The recoil adapters are mounted on the bearing retainer and provide the front mounting for the gun. There are alternate locations for the recoil adapters with respect to the gun's axis. These locations are possible because the bearing retainer can be mounted to the housing in increments of 60 degrees. The adapters reduce the amount of recoil and counter-recoil forces transmitted to the supporting structure when the weapon is fired.

Firing contact assembly. The firing contact assembly is mounted to the housing so that the connector is above the housing, and the spring-loaded cam is below the assembly. The contact assembly provides the necessary path for the current to enter the housing and reach the

breech-bolt assembly. This path goes through the connector to the conductor, to the insulated insert in the contact cam assembly, and then to the breech-bolt assembly.

Clearing solenoid assembly. The clearing solenoid assembly is mounted near the back of the gun housing. It is linked to and controls the movement of the clearing sector assembly.

Clearing sector assembly. The clearing sector assembly is linked to and controlled by the clearing solenoid assembly. When the solenoid is activated, the sector arm diverts the bolt assemblies into the clearing cam path.

Guide bar. The guide bar is located on the gun housing. It guides the rounds into and out of the extractor lip located on each of the six, breech-bolt assemblies.

Breech-bolt assembly. The breech-bolt assembly picks up a round as it enters the gun, transports it to the firing chamber, locks it into the firing position, transmits the firing voltage to the primer of the round, and returns the empty case to the guide bar, where it is cammed out of the gun. An extractor lip on the front of each bolt

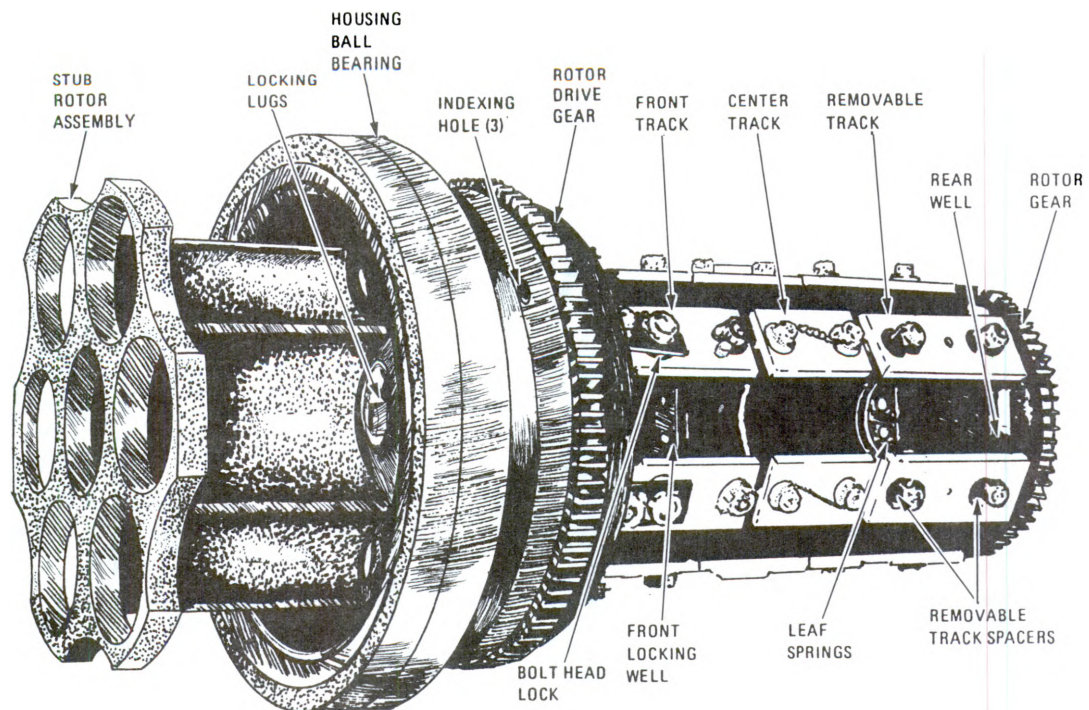


Figure 8-4.—Rotor assembly.

220.797

assembly engages the rim of a round throughout these actions.

There are six, breech-bolt assemblies in the gun. Guide slots or grooves on the side of the bolt body permit it to slide on the rotor tracks. The bolt roller shaft determines the position of the bolt as it follows the main cam path or the clearing cam path in the housing.

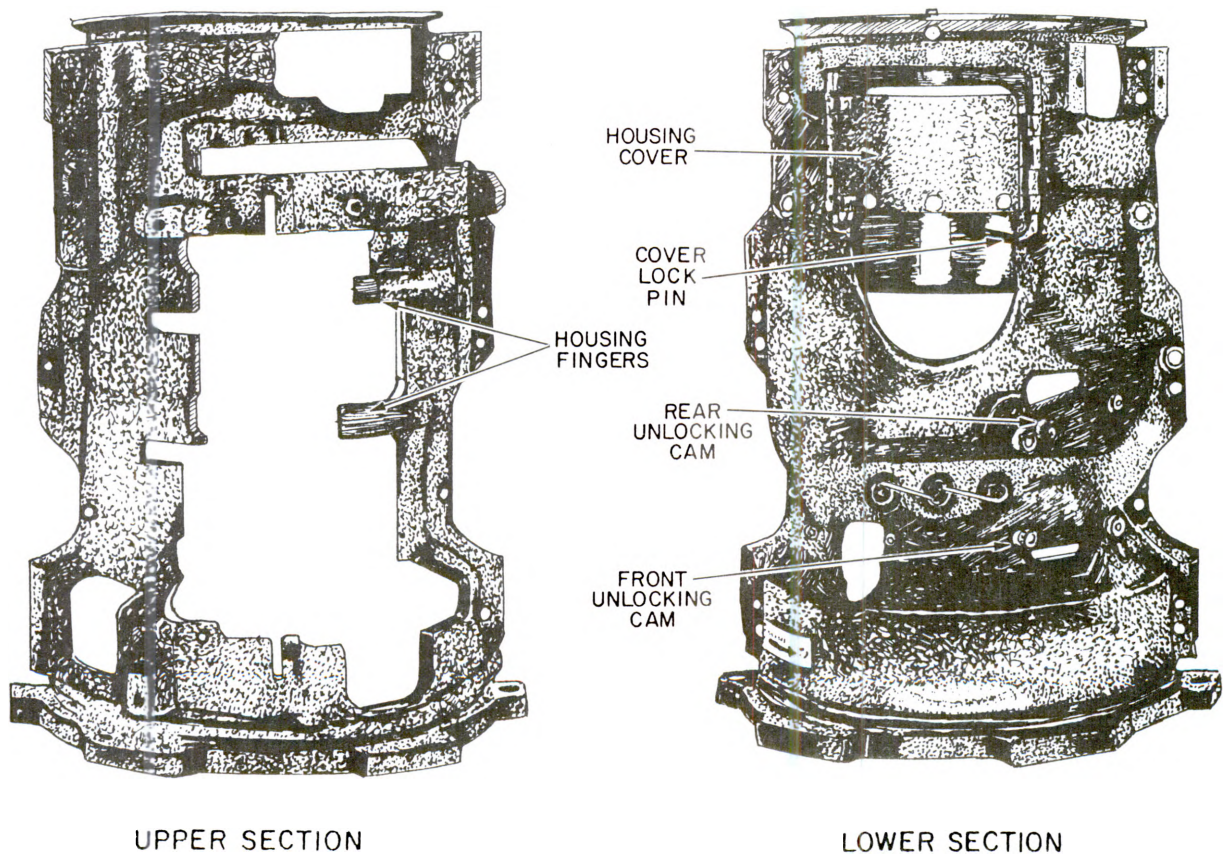
Rotor assembly. The rotor assembly (fig. 8-4) is a major unit of the M61A1 gun. The front section or stub rotor supports the six barrels. The main body of the rotor assembly contains the rotor tracks, rotor drive gear, and the locking lugs to lock the barrels in place.

The rotor tracks support the breech-bolt assemblies and provide a guide for the forward and backward movement of the bolt. There are six sets of rotor tracks attached to the ribs along the rotor body. Each set contains a front, center, and rear removable track. The removable track lets you install or remove a bolt assembly for

servicing or replacement. The necessary front support for the rotor assembly consists of a double row of ball bearings. The rear is supported by needle bearings located inside the rotor body. The end plate provides the inner race for the needle bearings and also provides for the gun's rear mount.

Rear housing assembly and associated parts.

The rear housing assembly (figs. 8-5 and 8-6) is a major unit of the gun. It consists of an upper section and a lower section assembled as one unit. The rear housing assembly provides the main cam path that controls the movement of the breech-bolt assemblies. The elliptical (oval) shape of the main cam path causes the forward and backward movement of the bolt assemblies. The clearing-cam path is circular and located at the rear of the housing. It provides a path for the bolt assemblies during the gun's clearing cycle. The housing cover, when in the closed position, forms a part of the clearing cam path. You may remove the housing cover to install or remove the bolt assembly.



UPPER SECTION

LOWER SECTION

Figure 8-5.—Rear housing assembly and related parts (external view).

220.798

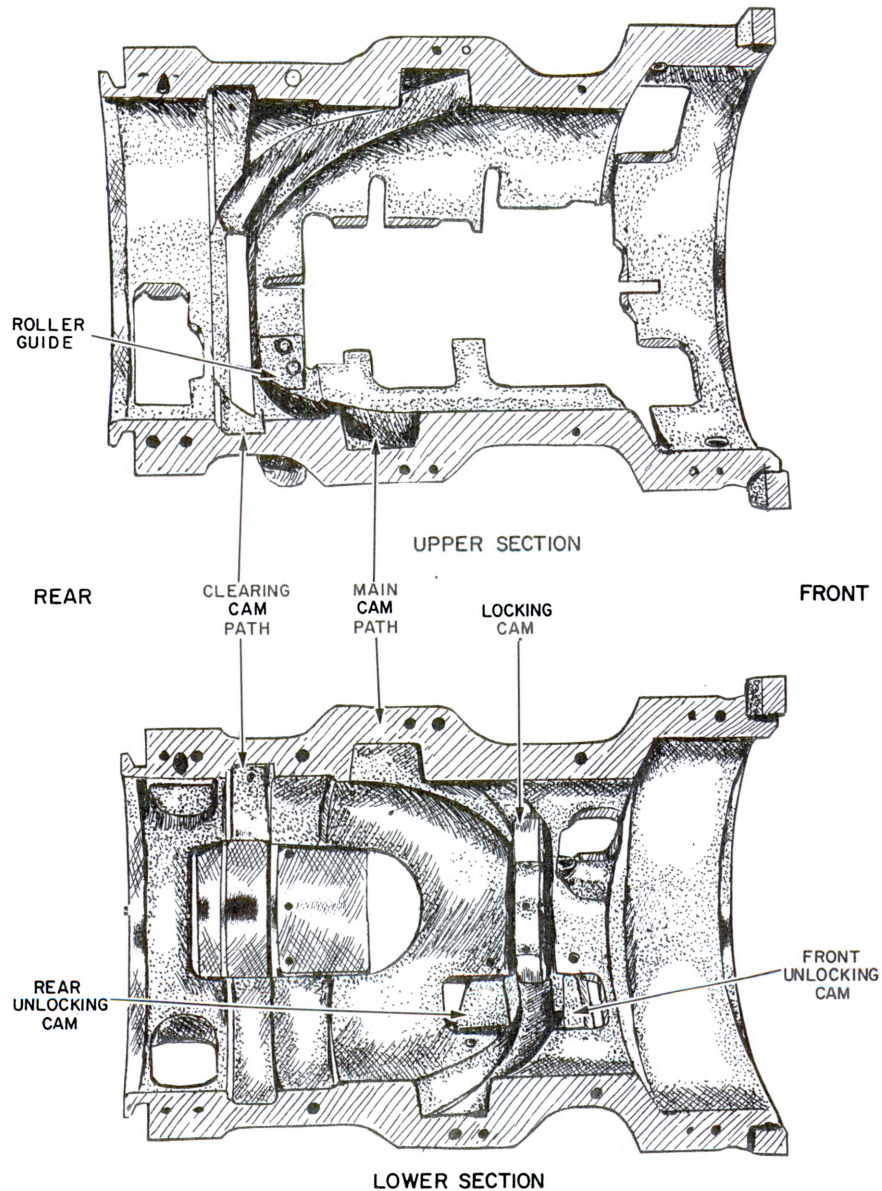


Figure 8-6.—Rear housing assembly and related parts (internal view).

220.531

The locking and unlocking cams are part of the housing assembly. The gun indexing pin (timing pin) is located on the housing (fig. 8-3). It is used to time the gun when it is mated with the ammunition handling system, or when you perform loading/unloading procedures.

Lubricator assembly. A lubricator assembly (fig. 8-7) is attached externally to the gun housing assembly. It is used to lubricate the bolt assemblies during gun operation. During gun acceleration/deceleration and when the gun is

firing, an inertia-actuated pump located within the lubricator assembly pumps the lubricant (MIL-L-46000) through a metal tube to the gun housing assembly. You can refill the lubricator assembly when performing normal maintenance procedures.

REVIEW NUMBER 1

Q1. List the naval aircraft that carry the M61A1 20-mm automatic gun.

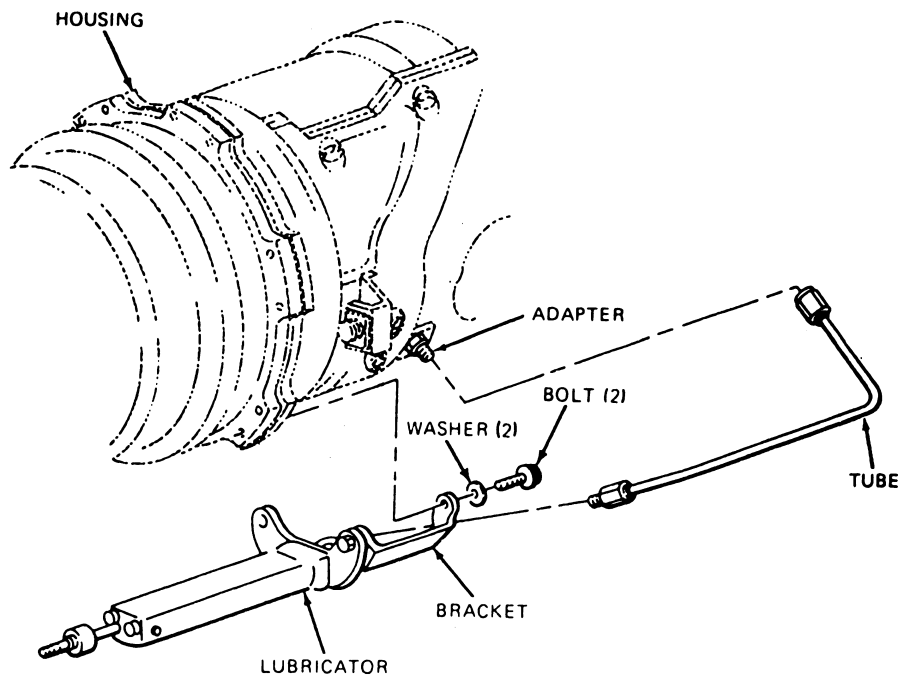


Figure 8-7.—Lubricator assembly installation (F-14).

Q2. When installed in naval aircraft, the M61A1 gun has a pilot selectable firing rate of _____.

Q3. List the primary parts of the M61A1 gun.

Q4. What is the purpose of the muzzle clamp assembly?

Q5. The M61A1 gun has six rifled barrels that are secured to the rotor by _____.

Q6. What component has front mounting points so the gun can be mounted in the aircraft?

Q7. The rounds are guided into and out of the extractor lip of the breech-bolt assemblies by _____.

Q8. List the parts contained in the main body of the rotor assembly.

Q9. What assembly provides the main cam path controlling the movement of the breech-bolt assemblies?

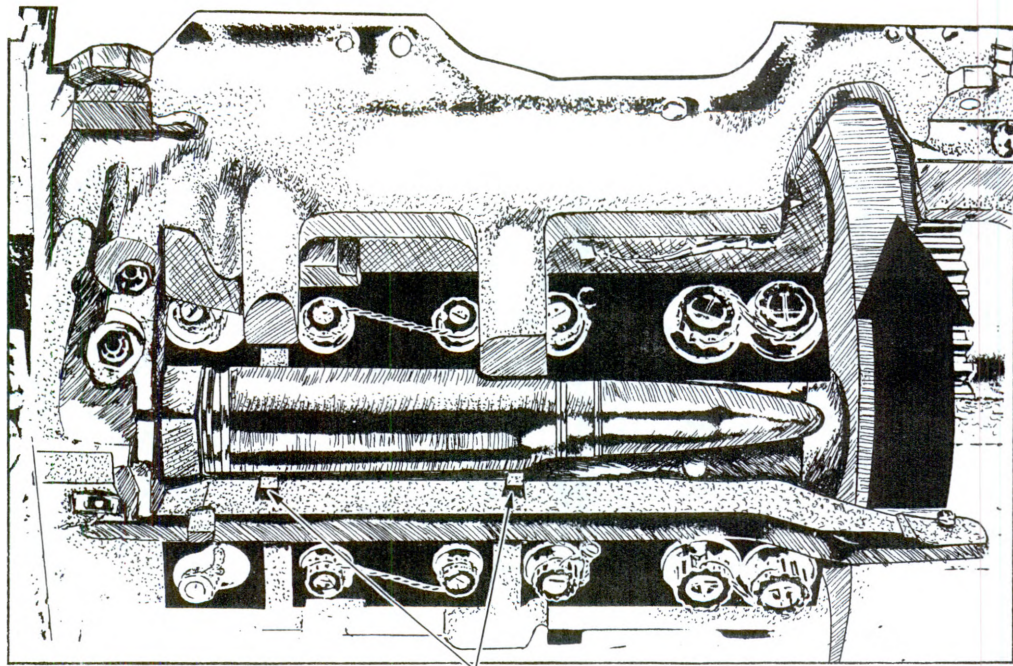
Q10. What lubricant should you use for the M61A1 gun?

M61A1 GUN PRINCIPLES OF OPERATION

The operation of the M61A1 gun is divided into two distinct cycles—the firing cycle and the clearing cycle.

Firing Cycle

The firing cycle begins when power is applied to the firing contact assembly and the gun drive unit simultaneously.



GUIDE BAR FINGERS

Figure 8-8.—Round guided into breech-bolt assembly.

220.532

REVIEW NUMBER 1 ANSWERS

- A1. *The naval aircraft that carry the M61A1 20-mm automatic gun are the A-7E, F-14, and F/A-18.*
- A2. *When installed in naval aircraft, the M61A1 gun has a pilot selectable firing rate of 4,000 rounds per minute (GUN LOW) and 6,000 rounds per minute (GUN HIGH).*
- A3. *The primary parts of the M61A1 gun are the barrels, housing assembly, and rotor assembly.*
- A4. *The muzzle clamp assembly restrains individual barrel movement during firing.*
- A5. *The M61A1 gun has six rifled barrels that are secured to the rotor by three rows of interrupted locking lugs.*
- A6. *The recoil adapters have front mounting points so the gun can be mounted in the aircraft.*
- A7. *The rounds are guided into and out of the extractor lip of the breech-bolt assemblies by the guide bar.*
- A8. *The rotor tracks, rotor drive gear, and the locking lugs to lock the barrels in place are contained in the main body of the rotor assembly.*
- A9. *The rear housing assembly and associated parts provide the main cam path controlling the movement of the breech-bolt assemblies.*
- A10. *You should use MIL-L-46000 lubricant for the M61A1 gun.*

If you look at the rotor from the rear, you see that it revolves in a counterclockwise direction. The ammunition is received from an external source. It is guided into the extractor lip on a breech-bolt assembly by the guide bar fingers (fig. 8-8). The bolt roller shaft follows the main cam path and moves the bolt assembly forward along the rotor tracks, chambering the round.

As the breech-bolt assembly enters the front dwell area of the main cam path, the locking cam forces the bolt shaft down, locking the bolt in the front locking well of the rotor (fig. 8-9). The insulated portion of the contact cam in the firing contact assembly depresses the firing pin cam in the breech-bolt assembly. This moves the firing pin forward against the primer of the round. The conductor portion of the contact cam makes

contact with the firing pin cam, allowing a firing voltage to pass through the firing pin, firing the round.

The breech-bolt assembly remains locked throughout the locking cam period until the projectile leaves the barrel. After the projectile leaves the barrel, the barrel pressure is reduced. The unlocking cam lifts the bolt shaft, retracts the bolt locking block, and unlocks the bolt.

The main cam path guides the breech-bolt assembly rearward. The empty case is removed from the chamber by the extractor lip of the bolt assembly. Then, the bolt assembly travels back along the rotor tracks until the guide bar removes the empty case from the bolt extractor lip and ejects it from the gun

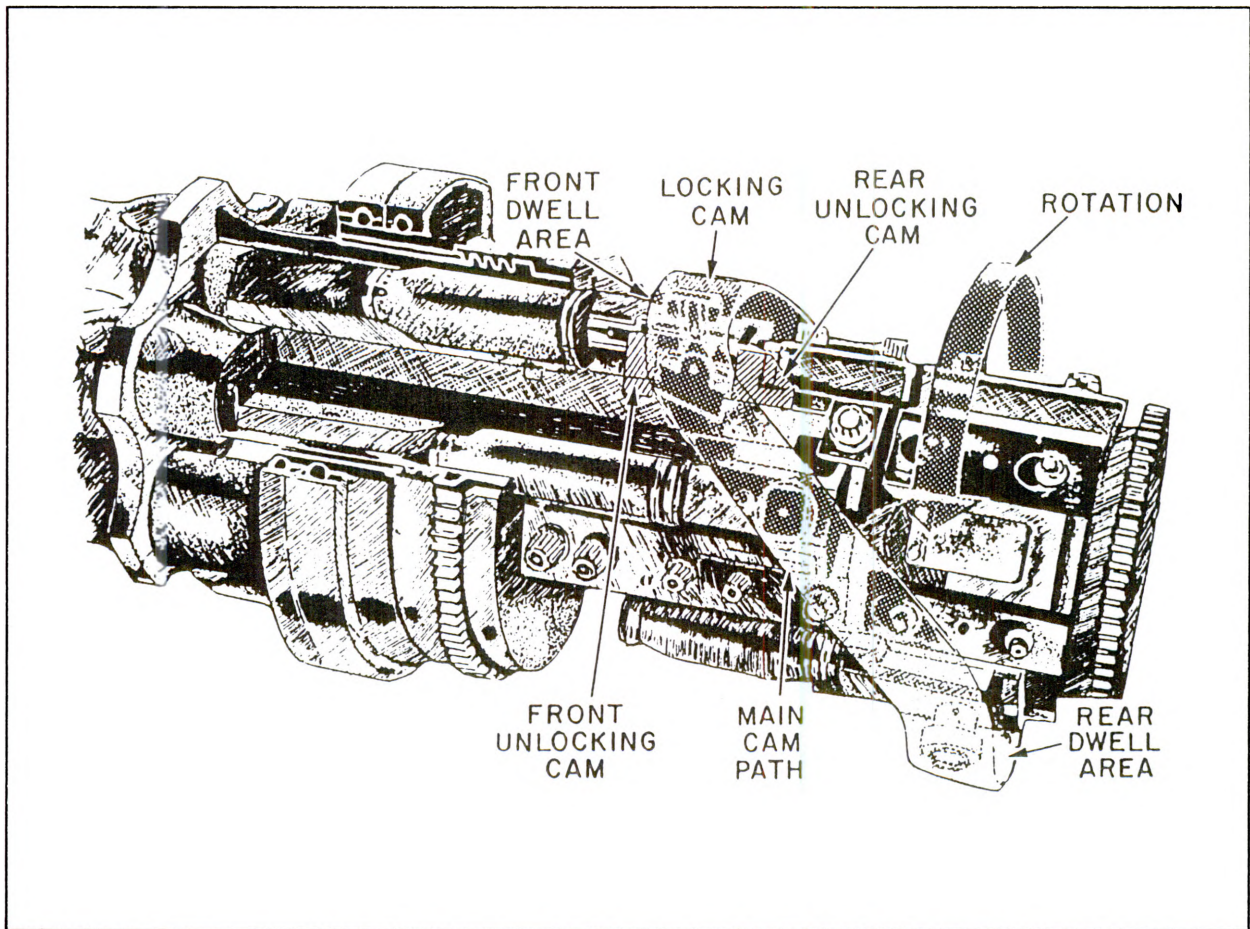


Figure 8-9.—Breech-bolt assembly in firing cycle.

(fig. 8-10). To complete the cycle, the bolt assembly travels along the rear cam dwell area and into position to receive the next round.

The breech-bolt assembly has now completed a full firing cycle through the elliptical-shaped main cam path. It has performed six actions or operations in the following sequence:

1. Feed
2. Chamber
3. Lock and fire
4. Unlock
5. Extract
6. Eject

All six, breech-bolt assemblies repeat this firing cycle until the clearing solenoid is actuated, and the gun starts the clearing cycle.

Clearing Cycle

The clearing cycle starts when the clearing solenoid is energized. The clearing solenoid depresses the clearing sector arm to the gun housing. This places the clearing sector arm in a ready position. The first bolt assembly passing the

sector arm triggers the actuating pin that lets the sector arm continue to the clearing mode position. This diverts the succeeding bolt assemblies into the clearing cam path (fig. 8-11).

As the breech-bolt assembly picks up a round at the guide bar, the clearing sector arm depresses the bolt roller shaft. This locks the bolt assembly in the rear locking well of the rotor. While locked in this position, the bolt assembly cannot follow the main cam path, so it follows the clearing cam path. The clearing cam path isn't as deep as the main cam path and keeps the bolt roller shaft depressed. This firmly locks the bolt assembly in the rear of the rotor body.

The M61A1 gun continues to receive rounds during the clearing cycle. However, because each bolt assembly remains positioned at the back of the rotor during rotation, the guide bar cam fingers eject all unfired rounds. When the clearing solenoid is deactivated, the clearing sector arm pivots out of the main cam path. This allows the leaf springs in the rear locking well to force the bolt locking block upward. The bolt roller shaft follows the main cam path that permits the gun to be fired.

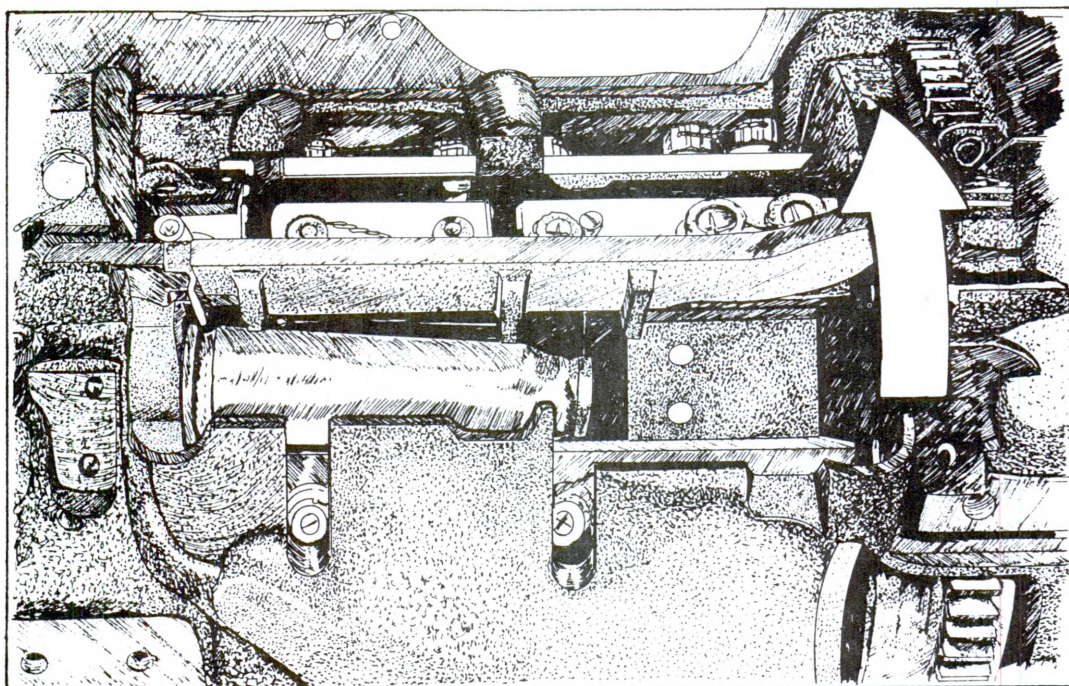


Figure 8-10.—Ejection of empty case.

220.534

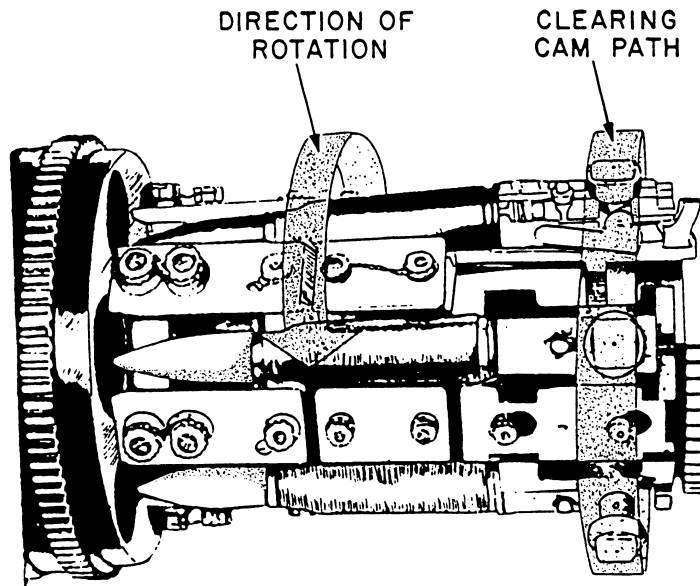


Figure 8-11.—Breech-bolt assembly in clearing cycle.

220.535

If necessary, you may clear the gun manually. To do this, manually pivot the clearing sector cam into the main cam path while turning the rotor by hand.

For further information on the M61A1 automatic gun, you should refer to the *M61A1 Automatic Gun*, NAVAIR 11-95M61A1-1. NAVAIR 11-95M61A1-1 provides intermediate-level maintenance procedures and includes associated special support equipment.

Q5. List, in sequence, the six operations the breech-bolt assembly performs during a full firing cycle.

Q6. At what point does the clearing cycle start?

Q7. The M61A1 gun continues to receive rounds during the clearing cycle. What component ejects all unfired rounds?

REVIEW NUMBER 2

Q1. Name the two cycles of the M61A1 gun.

Q2. When does the firing cycle begin in the M61A1 gun?

Q3. After the projectile leaves the barrel, what component removes the empty case from the chamber?

Q4. The main cam path is _____ shaped.

AMMUNITION HANDLING AND GUN DRIVE SYSTEMS

Learning Objective: Identify the ammunition handling and gun drive systems of the M61A1 automatic gun. Describe the principles of operation of each system and identify the interrelationship of the various systems.

The ammunition and gun drive subsystems are discussed in the following paragraphs.

DRUM UNIT ASSEMBLY

Live ammunition and expended cases are stowed in the drum unit assembly. This assembly

has four major parts—drum unit, entrance cover, exit cover, and scoop disk. Refer to figure 8-12 as you read about these parts.

Drum Unit. The drum unit is a cylindrical structure consisting of an outer drum and an inner drum helix. The live ammunition rounds and expended cases are stored radially around the longitudinal axis of the outer drum with their bases in an outward direction. The rounds are suspended by their bases in partitions. These partitions are mounted lengthwise with respect to the inner surface of the outer drum. With the outer drum mounted stationary to the aircraft's structure, the rounds are moved along the length of the partitions by the rotation of the double-lead helix (inner drum). It's easy to understand this movement if you think of the inner drum helix as the threads on a screw. The projectile end of the casing protrudes into the threads. As the inner drum helix is rotated, it produces a screwing-type motion, causing the rounds to slide along the partitions from one end to the other end of the outer drum.

Entrance Cover. The entrance cover is stationary mounted to the entrance end of the outer drum. The entrance cover contains a retainer gear and 252 steel ball bearings that support the scoop disks and the inner drum helix.

The retainer partitions are mounted to the retainer gear that controls the position of the rounds as they are passed from the entrance cover to the scoop disk. A spring-loaded timing pin on the entrance cover is used to index the drum for installation of the entrance unit.

Exit Cover. The exit cover is stationary mounted to the exit end of the outer drum. The exit cover is constructed like the entrance cover. It controls the position of the rounds as they pass from the scoop disk to the exit cover. A spring-loaded timing pin on the exit cover is used to index the drum for installation of the exit unit.

Scoop Disk. A scoop disk is mounted on each end of the inner drum helix. Each scoop disk has two sets of sprocket spur gears located 180 degrees apart. These spur gears mesh with the retainer gear in the entrance/exit covers that provide rotating support for the inner drum helix. The sprockets attached to the spur gear transfer rounds from the entrance cover retainer partitions to the drum partitions, and from the drum partitions to the retainer partitions in the exit cover.

EXIT UNIT

The exit unit is attached over an opening in the exit cover and geared to the exit cover retainer

REVIEW NUMBER 2 ANSWERS

- A1. *The two cycles of the M61A1 gun are the firing cycle and the clearing cycle.*
- A2. *The firing cycle begins in the M61A1 gun when power is applied to the firing contact assembly.*
- A3. *After the projectile leaves the barrel, the extractor lip of the breech-bolt assembly removes the empty case from the chamber.*
- A4. *The main cam path is elliptical shaped.*
- A5. *The six operations the breech-bolt assembly performs during a full firing cycle are feed, chamber, lock and fire, unlock, extract, and eject.*
- A6. *The clearing cycle starts when the clearing solenoid is energized.*
- A7. *The M61A1 gun continues to receive rounds during the clearing cycle. The guide bar cam fingers eject all unfired rounds.*

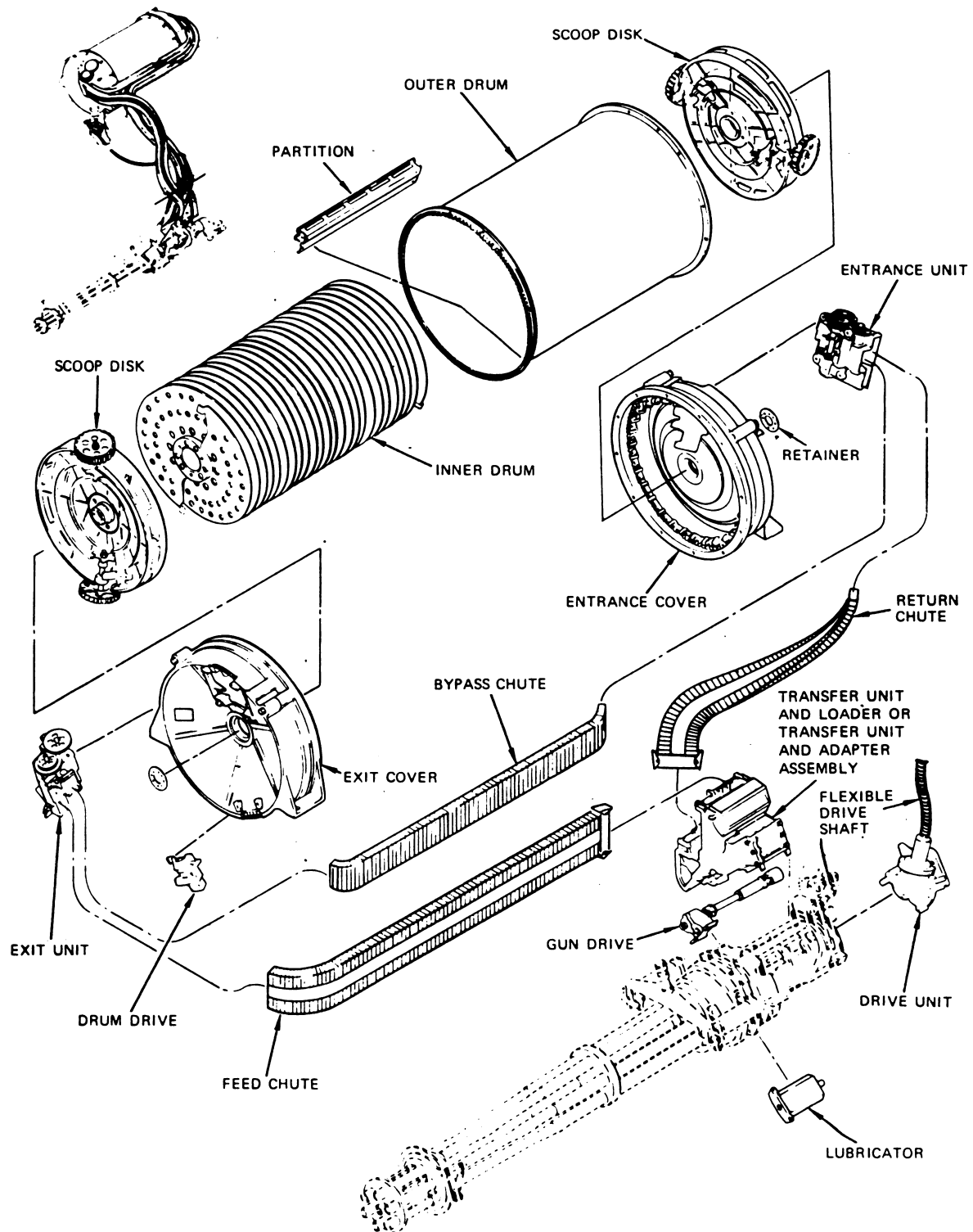


Figure 8-12.—Ammunition handling components (exploded view).

gear. The exit unit contains two gear-driven sprocket assemblies. The sprocket assemblies remove live rounds or expended cases from the retainer partitions in the exit cover and place them in the conveyor elements. Before you install the exit unit to the exit cover, press and hold the exit unit timing pin and the exit cover timing pin to make sure there is proper gear alignment between the two components. Once the exit unit is properly attached to the exit cover, make sure that the spring-loaded timing pins release.

The exit unit also contains a last-round switch that is electrically connected to the gun control firing circuits. The switch is actuated by the projectiles of the 20-mm rounds. The switch prevents expended rounds (empty cases) from being fed into the gun and jamming it. Before the gun will fire, the ammunition must be cycled through the ammunition drum until the first round actuates the last-round switch. When there is no more ammunition present or when expended rounds are present, the last-round switch is released. This automatically initiates the gun clearing cycle and terminates gun firing. Before the gun can be fired again, live ammunition must be manually positioned by the ground loading crew to actuate the last-round switch.

ENTRANCE UNIT

The entrance unit is attached over the opening in the entrance cover and geared to the entrance cover retainer gear. The entrance unit contains three gear-driven sprocket assemblies. The sprocket assemblies remove live rounds or expended cases from the conveyor elements and place them in the entrance cover retainer partitions. Before installation, press the spring-loaded timing pin and align the scoop sprocket stud pin with the entrance unit timing mark. With the entrance unit properly timed and aligned, you must press the entrance cover timing pin and align the timing mark on the scoop disk with the timing mark on the entrance cover. You need to properly time and align both the entrance unit and the entrance cover to ensure proper gear alignment between the two components. Once the entrance unit is attached to the entrance cover, you should make sure that the spring-loaded timing pins release.

TRANSFER UNIT AND ADAPTER ASSEMBLY

The transfer unit and adapter assembly are actually two separate components bolted together

to form one unit. They are **never** separated at the organizational maintenance level. The function of each component is discussed in the following paragraphs.

Transfer Unit

The transfer unit is gear-driven by the gun and attached to the M61A1 gun housing by quick-release pins to make maintenance easier. The gear-driven sprocket assemblies and guides maintain positive control of the rounds and conveyor elements passing through the transfer unit. The transfer unit removes the rounds from the conveyor and places them into the extractor lip of the gun breech bolts. The transfer unit also receives expended cases and unfired rounds from the gun breech bolts and places them in the conveyor elements. When you install the transfer unit and the adapter assembly as a single unit, press and hold the timing pin on the transfer unit and the gun housing. Once the transfer unit/adapter assembly is properly attached, you must make sure that the spring-loaded timing pins release.

Adapter Assembly

The adapter assembly bolts directly to the transfer unit. During downloading and loading operations, the adapter assembly interfaces with the linkless ammunition loading system (LALS).

REVIEW NUMBER 3

- Q1. List the major parts of the drum unit assembly.*
- Q2. What component of the drum assembly looks like the threads of a screw?*
- Q3. What is the purpose of the retainer gear and steel ball bearings contained in the entrance cover?*
- Q4. What component should you use to index the drum for installation of the exit unit?*

- Q5. What is the purpose of the two sets of sprocket spur gears located on the scoop disk?
- Q6. What switch in the exit unit prevents expended rounds from being fed into the gun and jamming it?
- Q7. What is the purpose of the sprocket assemblies in the entrance unit?
- Q8. What part of the transfer unit and adapter assembly interfaces with the linkless ammunition loading system (LALS)?

bypass chute provides a path from the entrance unit to the exit unit, through which the conveyor elements pass. The feed chute provides a path from the exit unit to the adapter assembly, through which the conveyor transports live rounds or unexpended cases. The return chute provides a path from the transfer unit to the entrance unit, through which the conveyor transports expended cases or unfired rounds.

The construction of the chute assemblies lets the conveyor elements pass through in only one direction. If the system is rotated in the wrong direction, the element tabs will jam in the chute segments and damage the system. The chute ends are color-coded red and green to key the right connection to other components. Additionally, each end is clearly marked with a metal labeling plate. This identifies the component to which a particular chute end **must** be connected. The ends of the chutes are equipped with quick-release latches for ease of removal and installation.

CHUTE ASSEMBLIES

The chute assemblies are interlocking segments. They provide a flexible path through which the conveyor elements transport live rounds and expended cases around an aircraft structure. The

CONVEYOR ASSEMBLY

The conveyor assembly consists of individual conveyor elements shaped to cradle a 20-mm case. The elements are joined together by removable hinge pins to form an endless conveyor assembly. (See figure 8-13.) During system operation, the

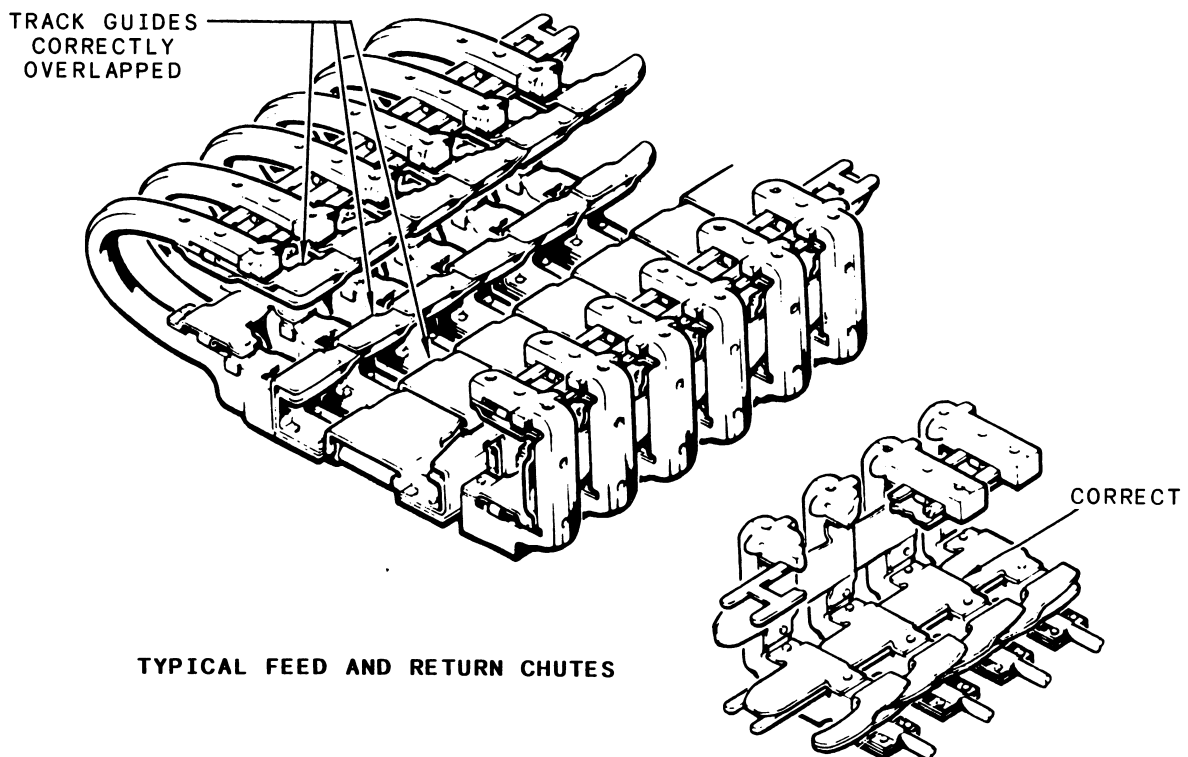


Figure 8-13.—Typical conveyor assembly construction.

conveyor receives rounds of ammunition from the exit unit and delivers them through the feed chute to the transfer unit. The conveyor also receives expended cases and unfired rounds from the transfer unit and transports them through the return chute to the entrance unit. After receipt by the entrance unit, the expended cases and unfired rounds are removed from the conveyor elements and stored in the ammunition drum. The empty conveyor passes from the entrance unit to the exit unit through the bypass chute. Positive control of the conveyor elements is maintained by tabs on the conveyor elements, which engage guides in the chutes,

exit unit, entrance unit, adapter assembly, and transfer unit. The total number of elements required for a system vary according to aircraft application.

GUN DRIVE AND DRUM DRIVE SYSTEMS

The M61A1 gun and the ammunition handling system is simultaneously driven by a hydraulic drive unit run by the aircraft's hydraulic system. The hydraulic pressure is supplied through a hydraulic fluid manifold electrically controlled by

REVIEW NUMBER 3 ANSWERS

- A1. The major parts of the drum unit assembly are the drum unit, entrance cover, exit cover, and scoop disk.*
- A2. The inner drum helix of the drum assembly looks like the threads of a screw and produces a screwing-type motion, causing rounds to slide along partitions from one end to the other end of the outer drum.*
- A3. The purpose of the retainer gear and steel ball bearings contained in the entrance cover is to support the scoop disks and the inner drum helix.*
- A4. A spring-loaded timing pin on the entrance cover is used to index the drum for installation of the exit unit.*
- A5. The two sets of sprocket spur gears located on the scoop disk mesh with the retainer gear in the entrance/exit covers that provide rotating support for the inner drum helix.*
- A6. The last round switch in the exit unit prevents expended rounds from being fed into the gun and jamming it.*
- A7. The sprocket assemblies in the entrance unit remove live rounds or expended cases from the conveyor elements and place them in the entrance cover retainer partitions.*
- A8. The adapter assembly of the transfer unit and adapter assembly interfaces with the linkless ammunition loading system (LALS).*

a dual-rate solenoid valve. This solenoid valve is controlled from the cockpit through the gun control unit (GCU), which results in the gun firing at 6,000 (GUN HIGH) or 4,000 (GUN LOW) rounds per minute. Attached to the hydraulic drive unit is a mechanical drive unit that consists of a gear train with one input shaft (from the hydraulic drive unit) and, depending upon the type of aircraft, one or two output shafts.

A-7E aircraft. The mechanical drive unit in the A-7E aircraft has two output shafts. The physical location of the drum unit, with respect to the mechanical drive unit, requires that a flexible drive shaft be attached to one of the output shafts and routed around the aircraft's structure to the drum drive. The drum drive consists of two gears that are enclosed in a housing attached to the ammunition drum exit cover. A gear in the drum drive meshes with the retainer gear in the exit cover to rotate the inner drum. Power is transmitted through the flexible drive shaft by a flexible core rotating within a flexible casing. The other output shaft from the mechanical drive unit transmits power through a two-piece telescoping shaft and two universal joints. This causes the gun rotor to rotate. The output shaft is also equipped with quick-disconnect collars on each end. One end connects to the mechanical drive unit, and the other end connects to the gun drive. For the gun to actually rotate, a gear in the gun drive meshes with a gear on the gun rotor.

F-14 aircraft. The F-14 aircraft also uses a mechanical drive unit with two output shafts. The A-7E aircraft uses a flexible drive shaft to drive the ammunition drum while the F-14 aircraft does not; this is the major difference between the two aircraft. The mechanical drive unit causes a telescoping shaft, similar to the one previously discussed, to drive the gun and the drum unit assembly.

F/A-18 aircraft. The F/A-18 aircraft uses a mechanical drive unit with one output shaft. Because the ammunition drum is near the mechanical drive unit, a gear on the output shaft of the mechanical drive unit meshes directly with the drum drive. A two-piece telescoping shaft transmits power from the same output shaft of the mechanical drive

unit to the gun drive. This, in turn, drives the gun rotor.

All three aircraft have provisions to manually rotate the gun system by using a manual hand crank. During ground maintenance, the gun system may be rotated hydraulically. This is done by actuating a manual control on the hydraulic drive unit when the aircraft's hydraulic system is operating.

GUN GAS PURGE SYSTEM

The M61A1 gun is internally mounted in the aircraft's fuselage. When the gun is fired, the temperature of the gun barrels increases rapidly, and the gun compartment is filled with gun gas from the fired rounds. If the barrels are not properly cooled, the rounds may *cook-off* due to excessive barrel temperatures. Gun gas, when confined to an enclosed area such as a gun compartment, is highly explosive. The gun gas purge system cools the barrels and purges gas from the compartment during gun firing operations.

The gun gas purge system of the A-7E aircraft uses engine bleed air. Air is routed to the gun compartment through a series of air tubes and a solenoid-operated gun gas purge control valve that controls the airflow. The gas is vented through the gun gas purge door, which is hydraulically opened during gun-firing operations. Both the gun gas purge control valve and the gun gas purge door are electrically interlocked through the gun-firing circuits. This prevents the gun from firing (cycling) if either one of these components does not function.

The gun gas purge system in the F-14 aircraft functions basically like the system used in the A-7E aircraft. The major difference is that the F-14 aircraft uses purge air from the aircraft's environmental cooling system instead of engine bleed air.

The F/A-18 gun gas purge system differs from the A-7E and F-14 aircraft. It uses engine bleed air and has an additional gas control provided by a hydraulically actuated ram-air scavenge door that opens automatically during gun-firing operations. The gun gasses are vented through louvers in the lower mold line of the aircraft fuselage.

REVIEW NUMBER 4

- Q1. *What chute provides a path from the exit unit to the adapter assembly?*
- Q2. *What chute provides a path from the transfer unit to the entrance unit of the drum?*
- Q3. *How many output shafts does the mechanical drive unit of the A-7E aircraft contain?*
- Q4. *Describe the main difference between the M61A1 gun systems used in the A-7E and F-14 aircraft.*
- Q5. *What is the purpose of the gun gas purge system?*
- Q6. *Describe the difference between the gun gas purge systems of the A-7E and F-14 aircraft and the F/A-18 aircraft.*

M61A1 GUN SYSTEM INSTALLATIONS

Learning Objective: *Identify M61A1 gun system installations to include those used on the F/A-18, F-14, and A-7E aircraft.*

M61A1 gun and ammunition handling system installations have the same basic components. However, some components are peculiar to specific aircraft. These differences are discussed in the following paragraphs.

F/A-18 GUN SYSTEM INSTALLATION

The F/A-18 M61A1 gun system (fig. 8-14) is internally mounted in the nose of the aircraft on

the center line. The fired projectiles exit the aircraft through the gun blast diffuser assembly, located just forward of the cockpit windscreen. Depending upon the mission objective, the gun can be operated in the air-to-ground (A/G) or air-to-air (A/A) computer mode. There are two A/G modes—continuously computed impact point (CCIP) and manual (MAN). There are three A/A modes—director, disturbed, and cage. The pilot selects any of the A/G or A/A modes while in flight.

The ammunition handling system holds a maximum of 578 rounds of ammunition. A rounds limiter, located in the gun compartment, can be preset to limit the total number of rounds the pilot can fire. The rounds limiter is used during training missions, and permits two or three gunnery missions from one gun load-out.

For example, the rounds limiter is set at 200 rounds by ground maintenance personnel. When the pilot has fired 200 rounds, the gun's electrical system automatically initiates the gun clearing cycle. This prevents further firing until the rounds limiter is manually reset by ground maintenance personnel.

While in flight, the pilot has the option of selecting unrestricted firing or presetting the number of rounds per burst. If the pilot selects unrestricted firing, the gun fires continuously as long as the trigger is depressed and ammunition is available.

For example, if the pilot presets 50 rounds, the gun fires a burst of 50 rounds each time the trigger is pulled and released. A display panel in the cockpit continuously indicates the number of rounds remaining.

The clearing sector retainer assembly (fig. 8-14) is used to manually clear the gun. When the manual clearing handle is in the cleared position, a wire rope assembly depresses the gun clearing sector assembly against the gun housing. This directs the breech-bolt assemblies into the clearing cam path when the gun is manually rotated. The manual clearing handle is held in the clearing position by a locking tab. **For safety reasons, the manual clearing handle should remain in the cleared position until you are actually performing gun-arming procedures.** When the gun access door

is closed, you can determine the position of the manual clearing handle by the position of the indicator located on the door. If the indicator is flush with the door surface, the manual clearing handle is in the firing position. If the indicator protrudes from the door surface, the manual clearing handle is in the cleared position.

The entire gun system is handled as a single palletized unit. This includes the M61A1 gun, drum unit assembly, ammunition chutes, element chutes, and hydraulic motor. The system bolts directly to the aircraft structure with four bolts and does not require any other boresighting or alignment. Other than minor adjustments in the aircraft, all maintenance is performed at the intermediate-maintenance level. The system is removed from

the aircraft as a unit by using gun-handling adapters, a weapon skid or trailer, and an Aero 14C bomb-hoisting unit. The bomb-hoisting unit is used to raise or lower the gun system as it is being removed or installed. A gun system hoist adapter, designed to support the hoist boom, is attached to the aircraft during the raising or lowering operation. A gun-handling adapter, attached to a weapons skid or trailer, supports the gun system after it is removed from the aircraft.

For further information concerning the F/A-18 M61A1 gun installation, you should refer to *Description and Principles of Operation*, A1-F18AA-750-100; *Testing and Troubleshooting*, A1-F18AA-750-200; *Maintenance*, A1-F18AA-750-300; and *System Schematics*, A1-F18AA-750-500.

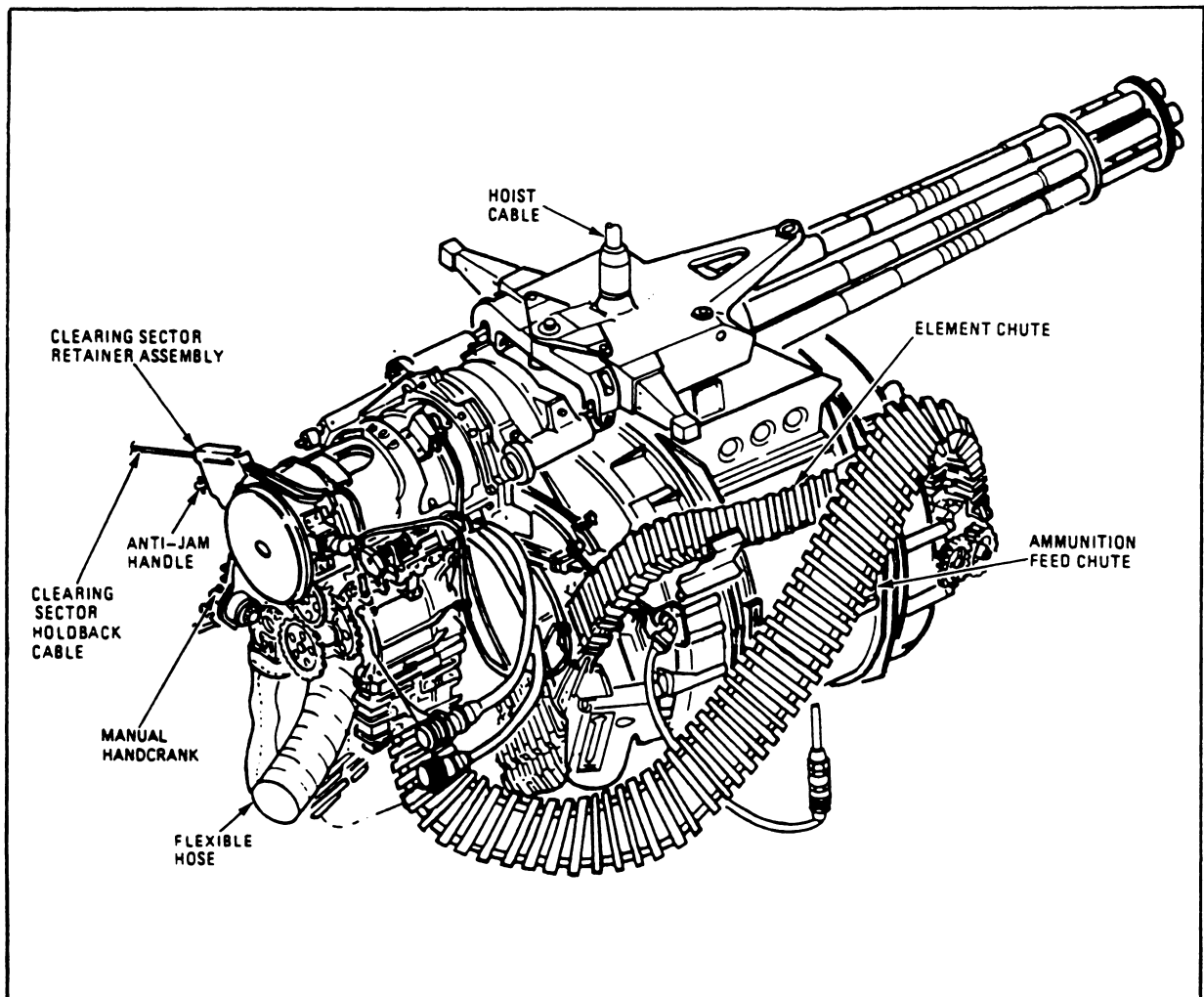


Figure 8-14.—F/A-18 M61A1 gun installation.

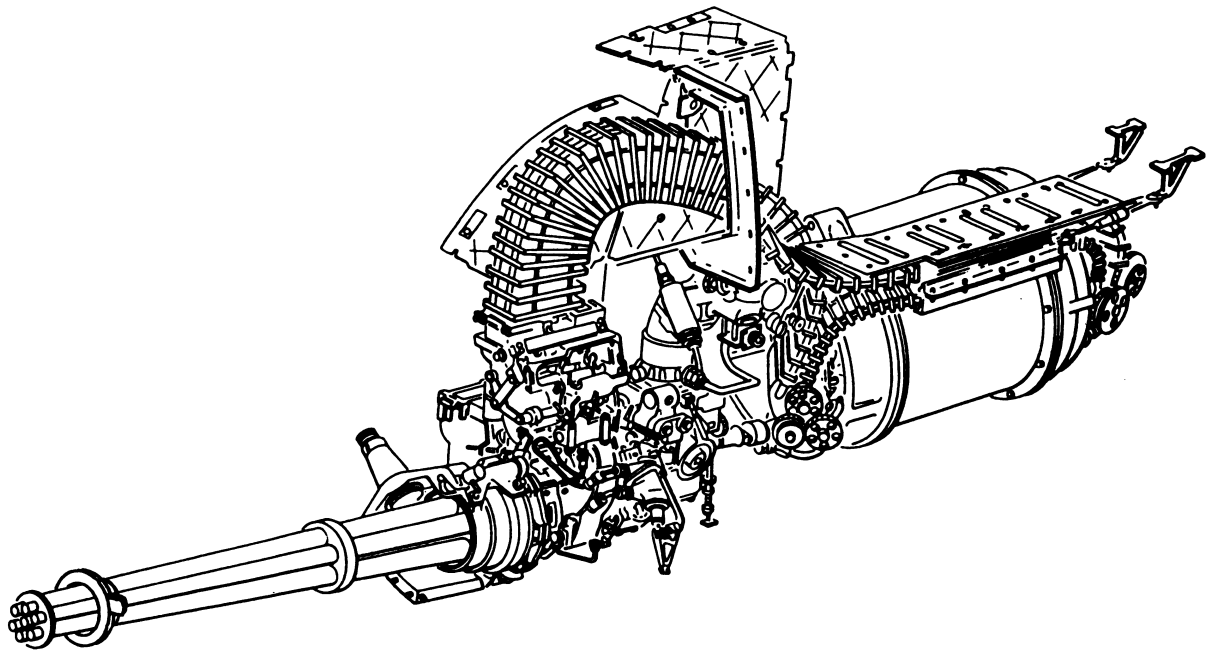


Figure 8-15.—F-14 M61A1 gun installation.

220.526

REVIEW NUMBER 4 ANSWERS

- A1. The feed chute provides a path from the exit unit to the adapter assembly.
- A2. The return chute provides a path from the transfer unit to the entrance unit of the drum.
- A3. The mechanical drive unit of the A-7E aircraft contains two output shafts.
- A4. The main difference between the M61A1 gun systems used in the A-7E and F-14 aircraft is that the A-7E uses a flexible drive shaft to drive the ammunition drum while the F-14 does not.
- A5. The gun gas purge system cools the barrels and purges gas from the gun compartment during gun-firing operations.
- A6. The gun gas purge systems of F/A-18 aircraft use engine bleed air and have additional gas control provided by a hydraulically actuated, ram-air scavenge door that opens automatically during gun-firing operation. This is not present in the A-7E and F-14 aircraft.

F-14 GUN SYSTEM INSTALLATION

The F-14 M61A1 gun system (fig. 8-15) is mounted in the forward fuselage on the left side of the aircraft. Depending upon the mission objective, this gun system can be operated in an A/G mode, A/A mode, or an air combat maneuver (ACM encounter) mode. The computer pilot attack (ACM encounter mode) mode operates in conjunction with the weapon control system, computer signal data converter (CSDC), and the vertical display indicator system to display target data. The manual attack mode is normally used in the A/G mode. It is also used as the primary backup for the ACM encounter mode in case of system malfunction.

The M61A1 gun system accommodates a maximum of 676 rounds of 20-mm ammunition. There are 576 rounds in the drum and a total of 100 rounds in the chutes, transfer adapter assembly, and gun. The system can be set by ground maintenance personnel for unrestricted firing, or for rounds limit of 50, 100, or 200 rounds per burst. The HOOK/GUN panel contains a gun-rounds counter that gives a digital readout countdown of the rounds remaining in the gun system.

The clearing sector holdback assembly and safety pin (fig. 8-16) is used to clear the gun manually. With the clearing sector holdback assembly installed, the breech-bolt assemblies are diverted to the clearing cam path. Keep the

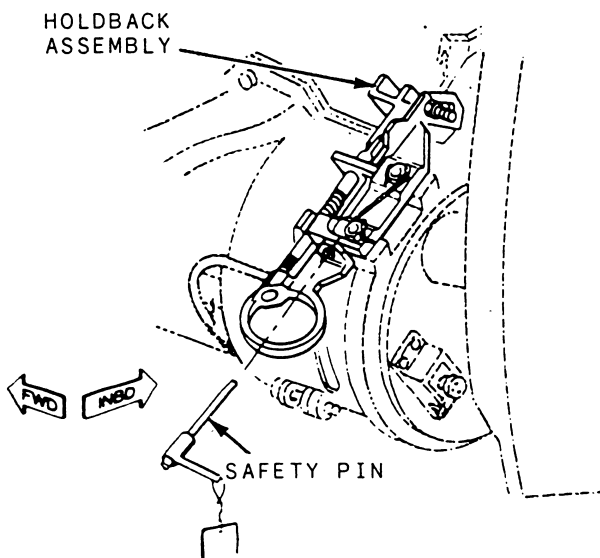


Figure 8-16.—F-14 clearing sector holdback assembly and safety pin.

clearing sector holdback assembly and safety pin installed until just before aircraft flight.

A-7E GUN SYSTEM INSTALLATION

The A-7E M61A1 gun system (fig. 8-17) is internally mounted in the forward port side of the aircraft. The gun and hydraulic drive motor are located in the lower fuselage, while the drum unit assembly is located in the upper fuselage center line just aft of the cockpit. When fully loaded, the gun system accommodates 1,019 rounds of 20-mm ammunition.

The system has a rounds counter located in the gun compartment, but it does not incorporate a rounds-limiter switch. The pilot does not have the option of restricted firing, and a rounds remaining indicator is not found in the cockpit.

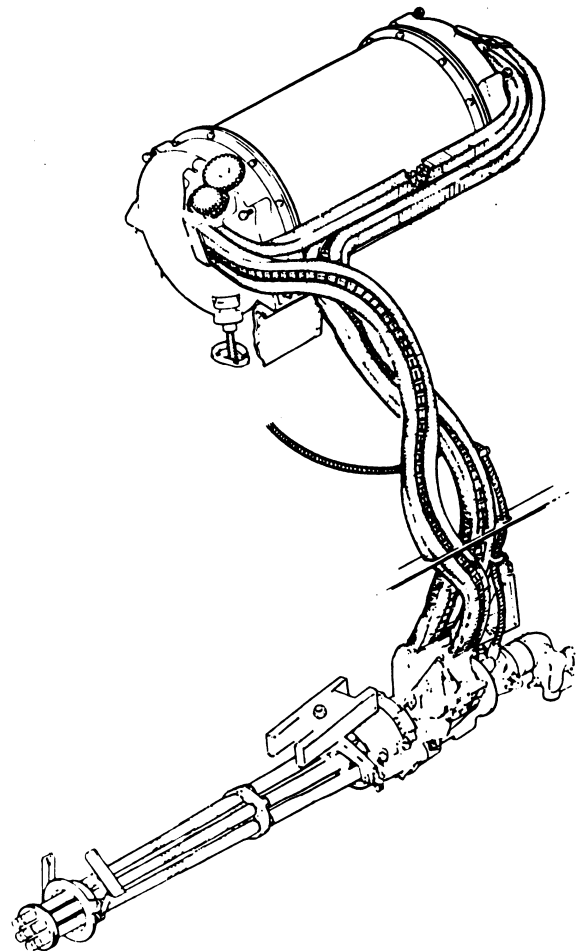


Figure 8-17.—A-7E M61A1 gun installation. 220.525

The only positive way of limiting the total number of rounds to be fired during one gunnery mission is to load the ammunition in belts.

For example, when a total of 250 rounds per mission is desired, you load a belt with 250 rounds, leave a space in the conveyor, and then start the next 250-round belt. During gun firing, when the end of the first belt passes through the exit unit and the empty space appears, the last-round switch will automatically initiate the gun clearing cycle. This prevents any further gun firing until the next belt is manually cycled through the exit unit.

This loading procedure is used primarily for training missions. Combat missions normally require the gun system to be fully loaded without any empty spaces in the ammunition belt.

The clearing sector clamp (fig. 8-18) is used to clear the gun manually. Install the clearing sector clamp by hooking the lower hook over the housing cover hinge pin and hooking the upper hook over the clearing sector lever. Then, rotate the knurled adjusting knob until the clearing

sector arm is flush with the gun housing. When the gun access panels are closed, there is no external indication that the clearing sector clamp is installed. Therefore, when you prepare the aircraft for a gunnery mission, place a part of the red streamer (REMOVE BEFORE FLIGHT) that is attached to the clearing sector clamp between the gun access panel and the aircraft fuselage so it is externally visible. Do this so that the arming crew removes the clearing sector clamp before flight.

REVIEW NUMBER 5

- Q1. In F/A-18 aircraft, fired projectiles exit the aircraft through the gun blast diffuser assembly that is located _____.
- Q2. What maximum number of rounds does the system hold when used on the F/A-18 aircraft?

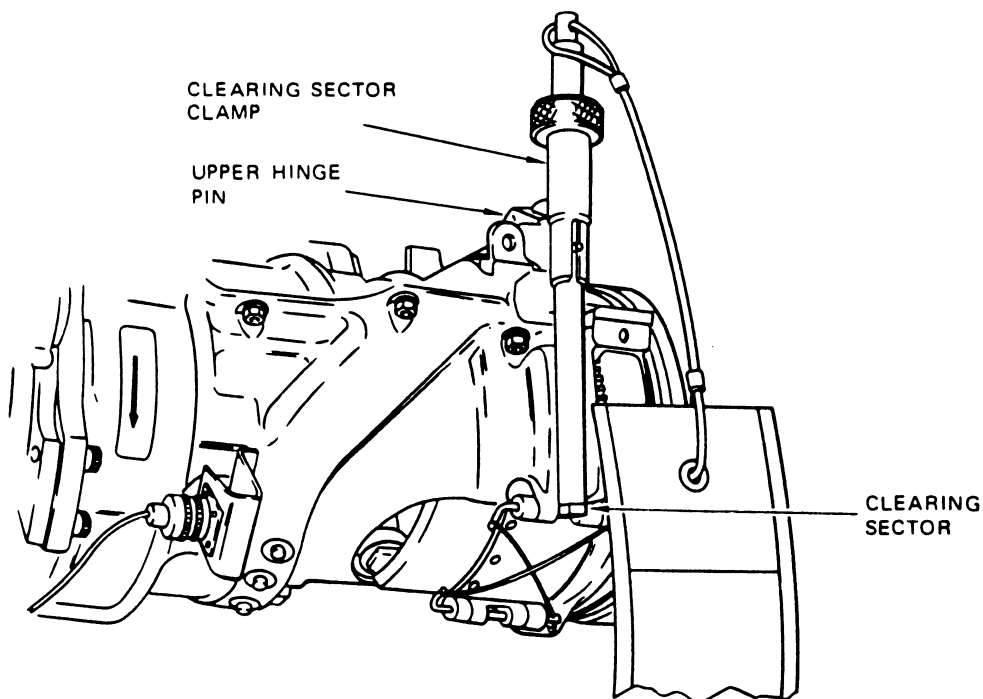


Figure 8-18.—A-7E clearing sector clamp installed on gun.

220.548

Q3. What component, located in the gun compartment, can be preset to limit the total number of rounds the pilot can fire?

Q4. When used on F-14 aircraft, where is the M61A1 gun system mounted?

Q5. What is the maximum capacity of the gun system when used on the F-14 aircraft?

Q6. When used in the A-7E aircraft, the gun system is mounted _____.

Q7. When fully loaded, what is the capacity of the M61A1 gun as it is used on A-7E aircraft?

LINKLESS AMMUNITION LOADING SYSTEM

Learning Objective: *Identify the components of the linkless ammunition loading system to include loader ammunition transporter, drum loader and drum unload assemblies, and the conveyor system. Identify the operating procedures to follow when loading/downloading the transporter and aircraft gun system.*

The Linkless Ammunition Loading System (LALS) (fig. 8-19) consists of a loader ammunition transporter, a drum loader assembly, a conveyor system, and a drum unload assembly. The components of the LALS allow 1,400 rounds

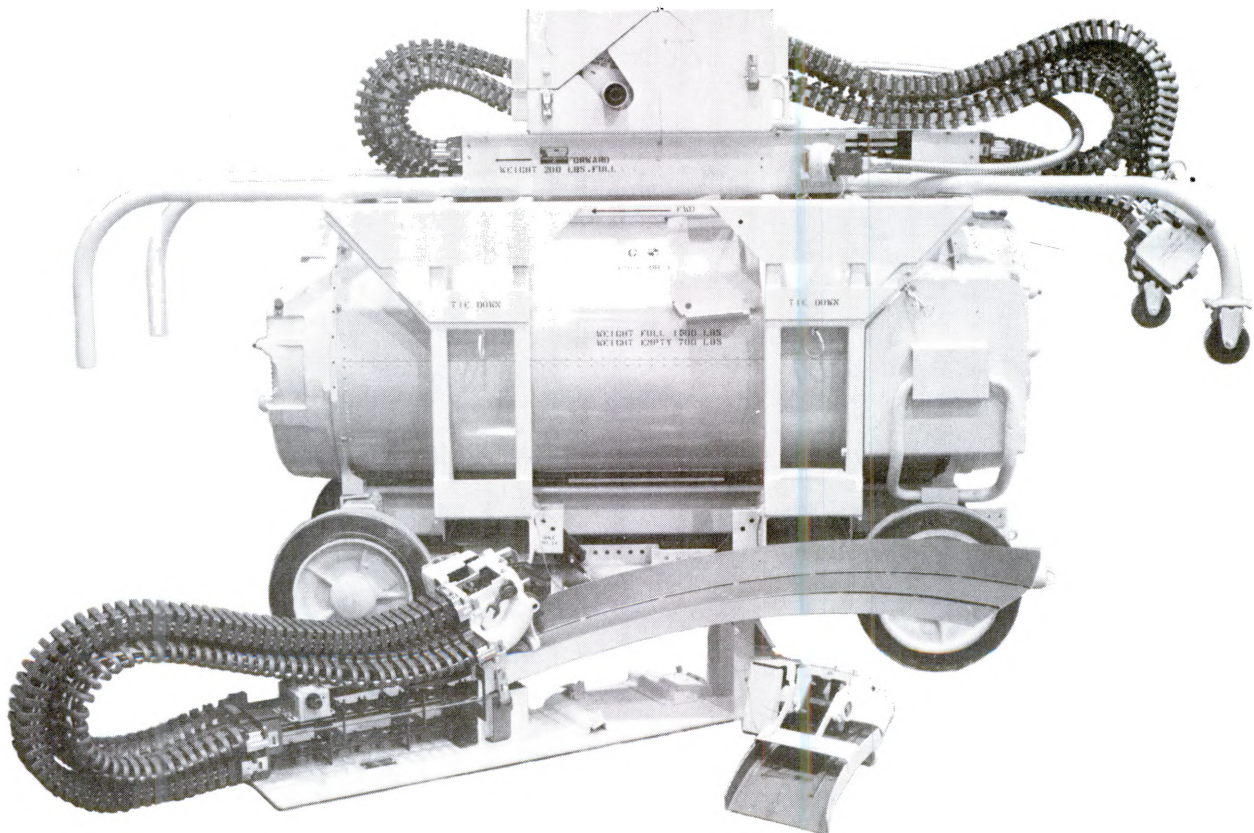


Figure 8-19.—Linkless ammunition loading system (LALS).

of electrically primed, M50-series ammunition to be handled without the use of links while the ammunition is still RADHAZ safe. The system is used to transport ammunition, load and download aircraft, and load and download the loader ammunition transporter.

COMPONENTS

A brief description of the components in the Linkless Ammunition Loading System (LALS) is contained in the following paragraphs.

Loader Ammunition Transporter

Unfired rounds and/or empty cases are stored in the loader ammunition transporter, also known as the *transporter* (fig. 8-20). The transporter is primarily intended to move rounds/cases through the exit and entrance ends during operation. Except for size, the transporter is similar to the aircraft drum assembly.

The transporter can be locked onto the Aero 21 skid or stacked three high for storage purposes. The transporter has an ammunition drum mounted in a rigid-frame drum adapter assembly.

The drum adapter assembly is a box-type structure that lets the transporters be stacked. There are four hinge plates and four quick-release

pins used to lock the transporter onto the Aero 21 skid. Two lifting lugs (on 30-inch centers) mate with a weapons carrier so that an overhead crane can be used to lift the transporter. Additionally, there are two forklift pockets, so the forklift truck can move the transporter. There are four tie-down rings to secure the transporter to the deck. Fold-out steps, if needed, are located at the exit end of the transporter to provide personnel with the additional height to operate the LALS.

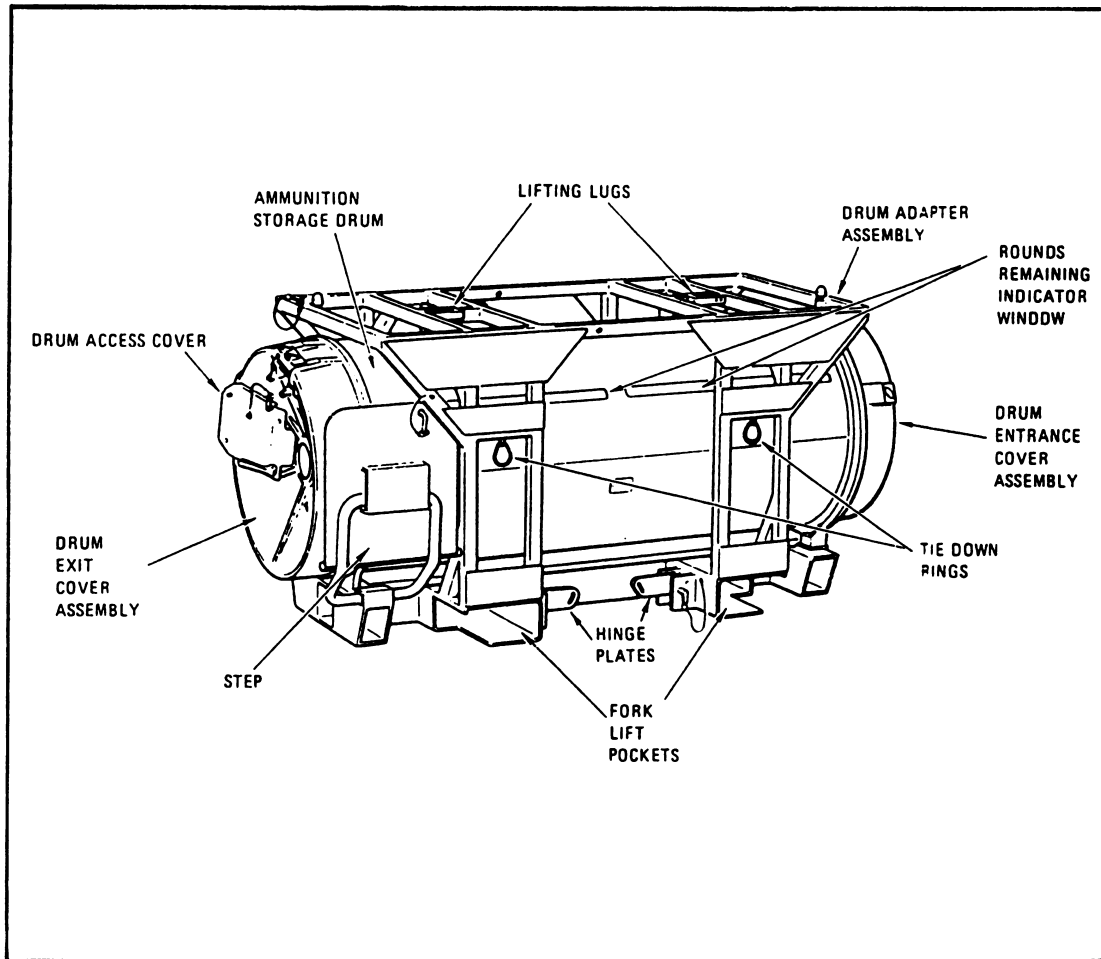
The ammunition drum is a cylindrical structure consisting of an outer drum structure, an inner drum, two scoop disk assemblies, and two cover assemblies.

OUTER DRUM.—The outer drum is a storage container for ammunition and provides a housing for the inner drum. There is a rounds-remaining indicator window so you can determine the number of rounds remaining in the drum. The drum partitions, mounted longitudinally within the outer drum to hold the rounds in place, hold the rounds radially around the outer drum with their bases in an outward direction.

INNER DRUM.—The inner drum is a welded assembly with a mounting ring at each end. There are sheet metal leaves welded to the outer surface of the core that form a double-lead helix. When

REVIEW NUMBER 5 ANSWERS

- A1. *In F/A-18 aircraft, fired projectiles exit the aircraft through the gun blast diffuser assembly that is located just forward of the cockpit windscreen.*
- A2. *When used on the F/A-18 aircraft, the system holds a maximum of 578 rounds.*
- A3. *A rounds limiter, located in the gun compartment, can be preset to limit the total number of rounds the pilot can fire.*
- A4. *When used on F-14 aircraft, the M61A1 gun system is mounted in the forward fuselage on the left side of the aircraft.*
- A5. *The maximum capacity of the gun system used on the F-14 aircraft is 676 rounds; 576 rounds in the drum and 100 rounds in the chute.*
- A6. *When used in the A-7E aircraft, the gun system is mounted internally in the forward port side of the aircraft.*
- A7. *When fully loaded, the capacity of the M61A1 gun as it is used on A-7E aircraft is 1,019 rounds.*



220.515

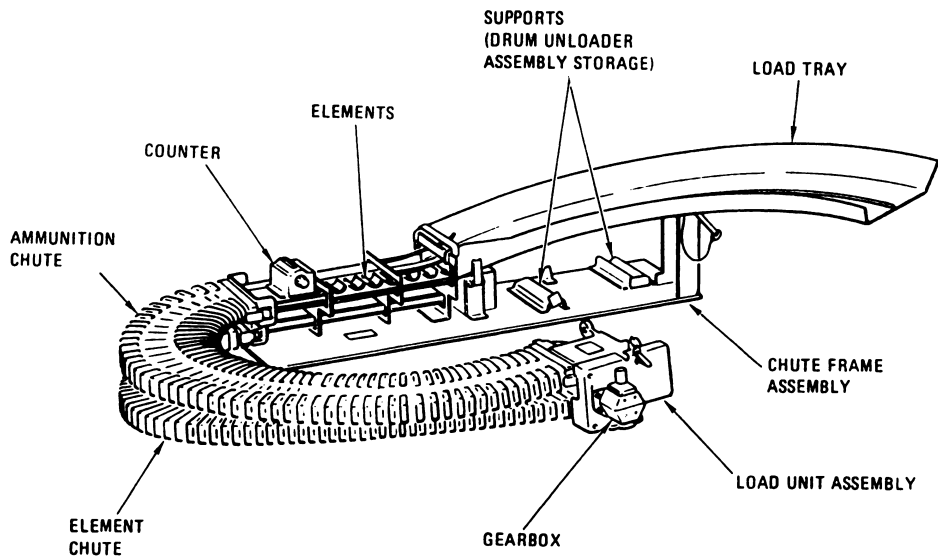
Figure 8-20.—Transporter.

the inner drum is rotated, it moves the rounds along the drum partitions from the entrance end to the exit end of the drum.

SCOOP DISK ASSEMBLIES.—A scoop disk assembly is mounted on each end of the inner drum. There are three rails on the scoop disk assemblies, forming a continuation of the inner drum helix. Also, two sets of gear-driven sprockets and scoop extensions are located on the scoop disks 180 degrees apart. These sprockets and scoop extensions transfer the rounds from the entrance cover to the outer drum partitions and from the outer drum partitions to the exit cover. The entrance scoop disk has two pins that hold the scoop extensions closed when they are activated by a cam in the outer drum. This prevents feeding rounds into the empty space

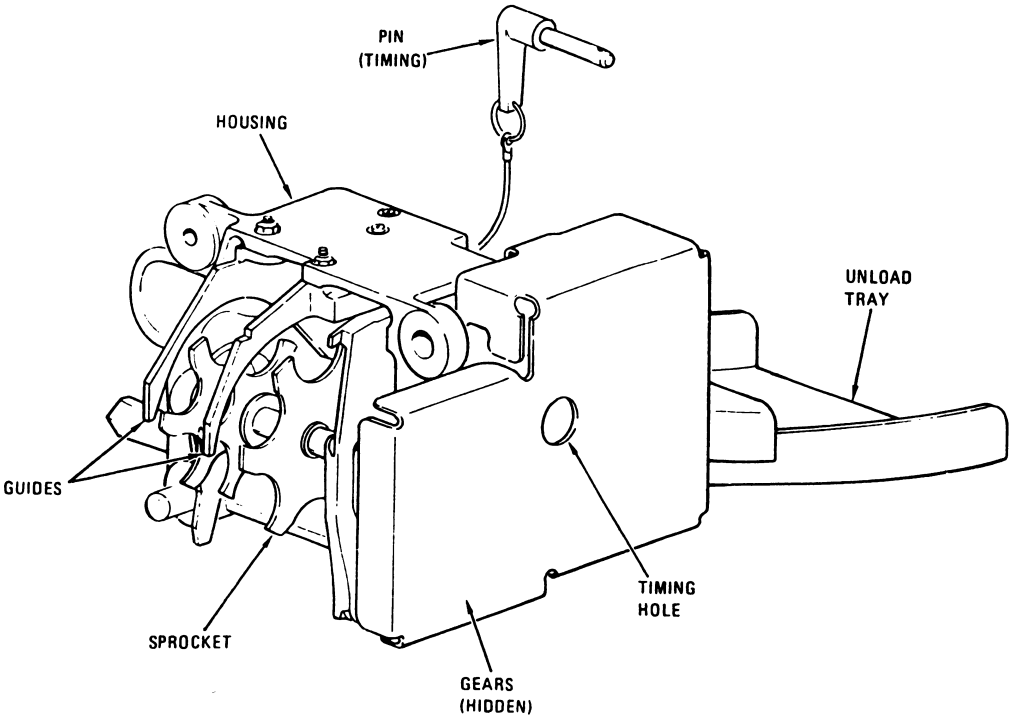
where the drum partitions cannot control the rounds.

DRUM COVER ASSEMBLIES.—A drum cover assembly is mounted on each end of the outer drum. The drum cover assemblies accept rounds from the entrance unit, load units, or from the scoop disk assembly. It then places the rounds into the scoop disk assembly (entrance end) or exit unit, respectively. The retainer partitions on the retainer gear maintain control of the rounds between the scoop disk assemblies and the entrance or exit units. A spring-loaded timing pin on each drum cover is used to index the drum during installation of the entrance and exit units. The exit drum cover assembly also contains brackets for mounting a drive assembly.



220.516

Figure 8-21.—Drum loader.



220.517

Figure 8-22.—Drum unloader.

Drum Loader Assembly

The drum loader assembly (fig. 8-21) is used to load the transporter with unlinked ammunition. The drum loader assembly places the unlinked

rounds into the conveyor elements, which carry the rounds to the load unit assembly. The load unit assembly removes the rounds from the elements and places them into the retainer partitions in the entrance drum cover. You can

time the load unit assembly by inserting a pin through the cover, through a hole in one of the gears, and into a hole in the housing. The drum loader consists of a load tray (onto which the rounds are placed), a belt of elements, two chutes (that control the rounds and elements when they are between the tray and the load unit), and a load unit assembly. The load unit assembly contains two gear-driven sprocket assemblies that transfer the rounds from the belt of elements to the drum cover partitions and a gearbox that drives the drum loader assembly. The gearbox can be driven by a 1/2-inch drive hand crank, making it easier to transport the rounds. A resettable counter indicates the number of rounds that have been loaded into the transporter.

Drum Unload Assembly

The drum unload assembly (fig. 8-22) removes rounds and/or spent cases from the transporter and separates them from each other. The drum unload assembly contains a gear-driven sprocket that removes the rounds/spent cases from the drum

exit cover and places them on a tray. The tray has a hole that lets spent cases drop through while the rounds must travel the length of the tray. You can time the drum unload assembly by inserting a pin through the cover, through a hole in one of the gears, and into a hole in the housing.

Conveyor System

The conveyor system (fig. 8-23) transports rounds from the transporter to the aircraft system. It simultaneously transports spent cases and cleared rounds from the aircraft system to the transporter. The conveyor system is mounted on the top of the transporter. It consists of a chute support assembly, three ammunition chutes, two element chutes, an exit unit assembly, an interface unit assembly, an entrance unit assembly, and a drum drive assembly that is driven by a flexible drive shaft.

CHUTE SUPPORT ASSEMBLY.—The chute support assembly is a rigid structure supporting other units. It also provides stowage for other units when they aren't in use. A portion

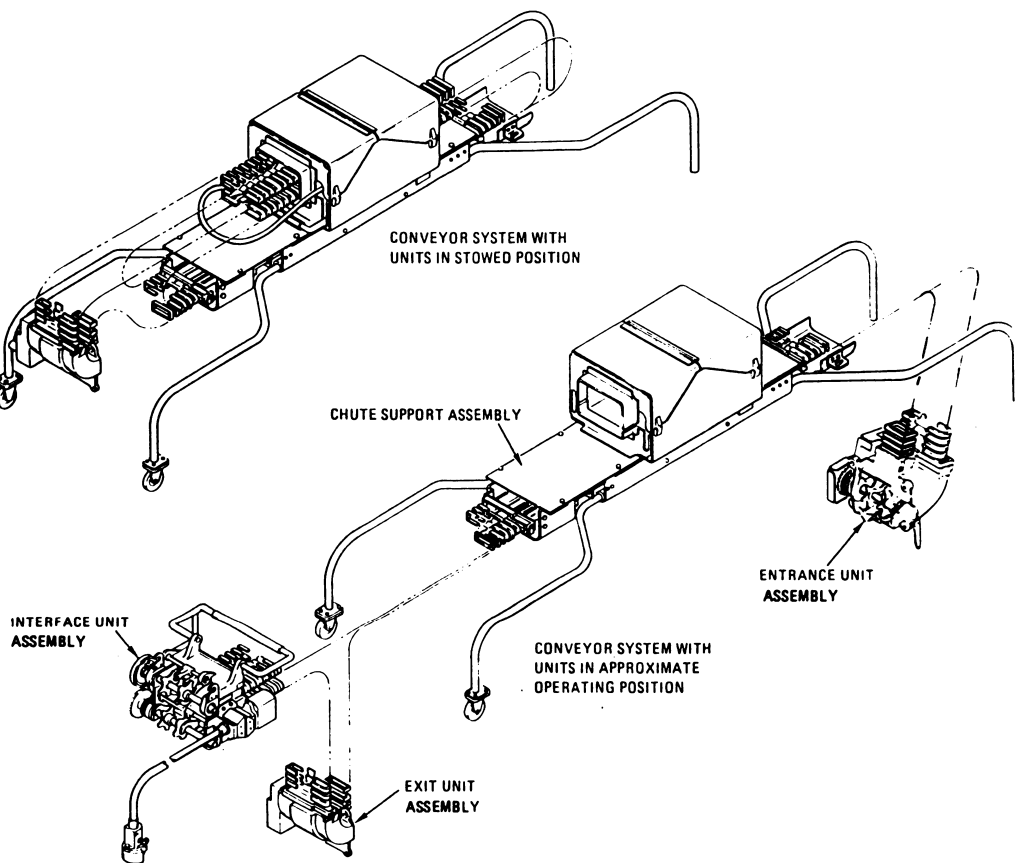


Figure 8-23.—Conveyor system.

of the chute that is required for the control of spent cases and elements is a rigid wire-form chute. This chute is part of the chute support assembly. Casters are provided on one end of the chute support assembly to aid in moving the assembly when it is not mounted on a transporter.

CHUTES.—The ammunition and element chutes control the elements and rounds or spent cases when the system is operating. The chutes are flexible enough to permit interconnection of the various units.

EXIT UNIT ASSEMBLY.—The exit unit assembly removes rounds from the transporter and places them into the elements. Two gear-driven sprocket assemblies are used to transfer the rounds from the transporter to the elements. You can time the exit unit assembly by inserting a pin through the cover, through a hole in one of the gears, and into a hole in the housing.

INTERFACE UNIT ASSEMBLY.—The interface unit assembly transfers the rounds coming from the exit unit assembly to the aircraft system and the spent cases coming from the aircraft system to the elements going to the entrance unit. A bypass mode of operation permits the rounds to be cycled through the transporter/conveyor system without an interchange of rounds at the interface unit. The interface unit assembly has a gearbox drive that drives the transporter/conveyor system at the speed required for correct hand-off between the interface unit and the aircraft system. The three gear-driven sprockets control the elements and rounds as they pass through the interface unit assembly. A resettable counter indicates the number of rounds that have been loaded into the aircraft system.

ENTRANCE UNIT ASSEMBLY.—The entrance unit assembly removes spent cases/cleared rounds from the elements and places them into the transporter. There are three gear-driven sprockets that control the elements and spent cases as they pass through the entrance unit assembly. A counter indicates the total number of elements that have been cycled.

DRUM DRIVE ASSEMBLY AND FLEXIBLE DRIVE SHAFT.—The drum drive assembly is mounted on the exit end of the transporter and drives the transporter drum. The drive power is transmitted from the interface unit to the drum drive assembly by the flexible drive shaft.

REVIEW NUMBER 6

- Q1. List the components of the Linkless Ammunition Loading System (LALS).*
- Q2. How many rounds of electrically primed, M50 ammunition can be loaded on the components of the LALS?*
- Q3. What weapons skid is used with the LALS?*
- Q4. What is the purpose of the loader ammunition transporter?*
- Q5. What is the purpose of the drum loader assembly?*
- Q6. What is the purpose of the conveyor system?*
- Q7. What components transfer rounds from the transporter to the elements in the exit unit assembly?*
- Q8. The drive power is transmitted from the interface unit to the drum drive assembly by the _____.*

OPERATION

Operation of the LALS is divided into three modes: loading/downloading the transporter; loading/downloading aircraft; and bypass.

Loading/Downloading Transporter

Ammunition primers are exposed when you conduct transporter loading/downloading operations. Therefore, loading/downloading **must** be done in a RADHAZ safe area.

As you read this section, refer to figure 8-24. When you are loading the transporter, attach the timed drum loader assembly to the timed drum entrance cover of the transporter, and attach the timed drum unload assembly to the timed drum exit cover. If you are simultaneously

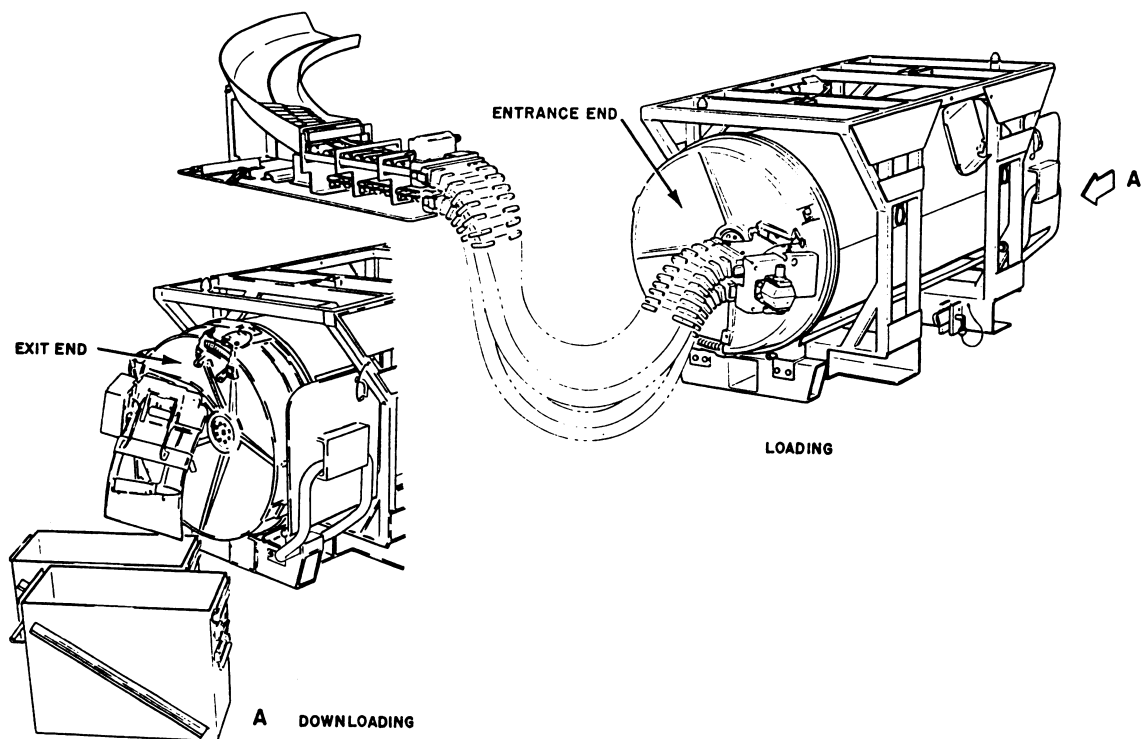


Figure 8-24.—Loading and downloading transporter.

220.519

loading/downloading, attach both the timed drum loader assembly and drum unload assembly to the timed drum entrance cover and to the timed drum exit cover. When downloading only, the transporter is driven by a hand crank in the retainer at the center of the entrance end of the transporter. When loading or simultaneously loading/downloading, the transporter is driven by the load unit assembly.

Ammunition is placed in the load tray of the drum loader at the specified ratio. The curve and tilt of the tray lets the rounds roll freely toward the elements. As the load unit assembly is driven by the hand crank, each element picks up one round and carries it through the ammunition chute to the load unit assembly. As the rounds enter the ammunition chute, the rounds counter is actuated. The load unit assembly removes the rounds from the elements and places them in the retainer partitions of the drum entrance cover. The scoop disk assembly removes the rounds from the retainer partitions and places them into the drum partitions, where the inner drum (helix) moves them from the entrance cover toward the exit cover. Since there is a space in the outer drum where no controlling partitions exist, a cam on the outer drum engages a pin on the scoop disk assembly that closes the scoop extension. With the

scoop extension closed, no rounds can be placed in the empty space. As the inner drum moves the rounds/spent cases toward the drum unload assembly, the scoop disk assembly removes the rounds from the drum partitions and places them into the retainer partitions of the drum exit cover.

The drum unload assembly removes the rounds from the retainer partitions and places them on the unload tray. A hole in the unload tray lets spent cases drop into a spent case container. Rounds are moved across the hole in the tray to a live-rounds container. These rounds must be restrained to prevent impact with the container or other rounds.

Loading/Downloading Aircraft Gun Systems

In a load and/or download operation, any combination of the following conditions may exist: A fully loaded, partially loaded, or empty transporter may be mated to a fully loaded, partially loaded, or empty gun system. Each set of possible combinations dictates a unique load and/or download operational sequence. The load/download operational sequence explained in the following paragraph refers to a fully loaded transporter mated to a fully loaded gun system.

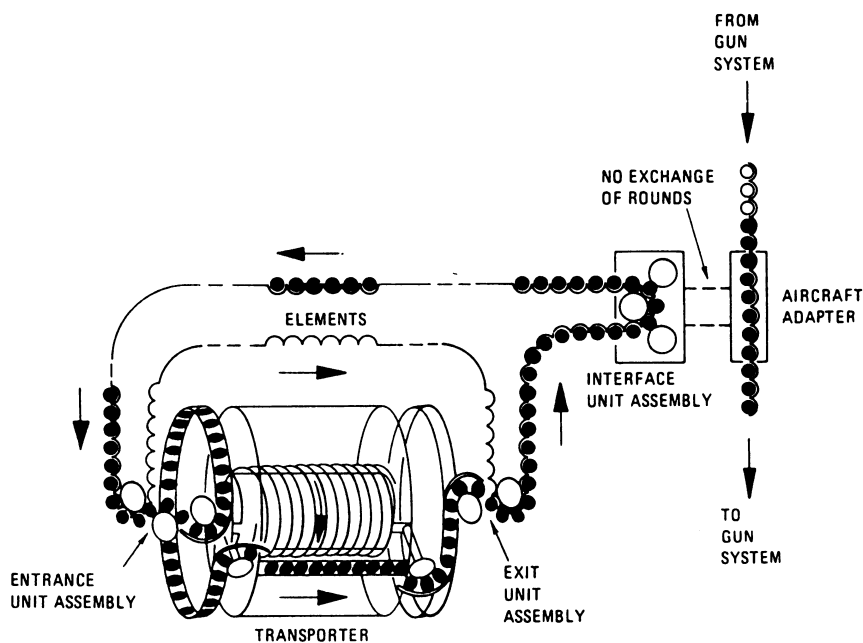


Figure 8-25.—Ammunition flow in bypass mode.

220.520

REVIEW NUMBER 6 ANSWERS

- A1. The Linkless Ammunition Loading System (LALS) consists of a loader ammunition transporter, a drum loader assembly, a conveyor system, and a drum unload assembly.
- A2. The LALS can hold 1,400 rounds of electrically primed, M50 ammunition.
- A3. The Aero 21 weapons skid is used with the LALS.
- A4. The loader ammunition transporter is used to move rounds/cases through the exit and entrance ends during operation.
- A5. The purpose of the drum loader assembly is to load the transporter with unlinked ammunition.
- A6. The conveyor system is used to transport rounds from the transporter to the aircraft system. It simultaneously transports spent cases and cleared rounds from the aircraft system to the transporter.
- A7. Two gear-driven sprocket assemblies in the exit unit assembly transfer rounds from the transporter to the elements.
- A8. The drive power is transmitted from the interface unit to the drum drive assembly by the flexible drive shaft.

For you to load/download an aircraft gun system, the conveyor system must be mounted on the transporter with the timed entrance and exit unit assemblies mounted to a timed drum. The timed interface unit assembly must be mated to the timed aircraft gun system by the aircraft adapter assembly. The rounds pass from the transporter, through the exit unit assembly, through an ammunition chute, to the interface unit assembly. When the interface unit assembly mode selector is in the bypass position (fig. 8-25) and the system is cycled, the rounds are guided around the element sprocket and into an ammunition chute, which returns them to the entrance end of the transporter.

When you first connect or remove the interface unit to or from the aircraft adapter, the interface unit assembly must be in the bypass position. When the interface unit assembly mode selector is in the load position (fig. 8-26) and the system is cycled, the rounds are removed from the elements by a sprocket and guided into the elements in the aircraft adapter.

The rounds are carried from the aircraft adapter to the aircraft drum. The elements entering the aircraft adapter from the aircraft system contain spent cases or cleared rounds. These rounds are removed from the aircraft elements and are guided by a sprocket into the elements of the conveyor system for transfer to the transporter.

REVIEW NUMBER 7

- Q1. In what type of environment must transporter loading/downloading operations be conducted?
- Q2. List the conditions that might exist in a given load/download operation.
- Q3. When you connect or remove the interface unit to or from the aircraft adapter, it must be in what position?

MAINTENANCE AND TESTING

Learning Objective: *Identify maintenance and testing procedures at the organizational and intermediate levels.*

Maintenance of the LALS is concentrated at the intermediate maintenance level. The scheduled maintenance procedures are outlined on preoperational and calendar MRCs. The unscheduled maintenance procedures are outlined

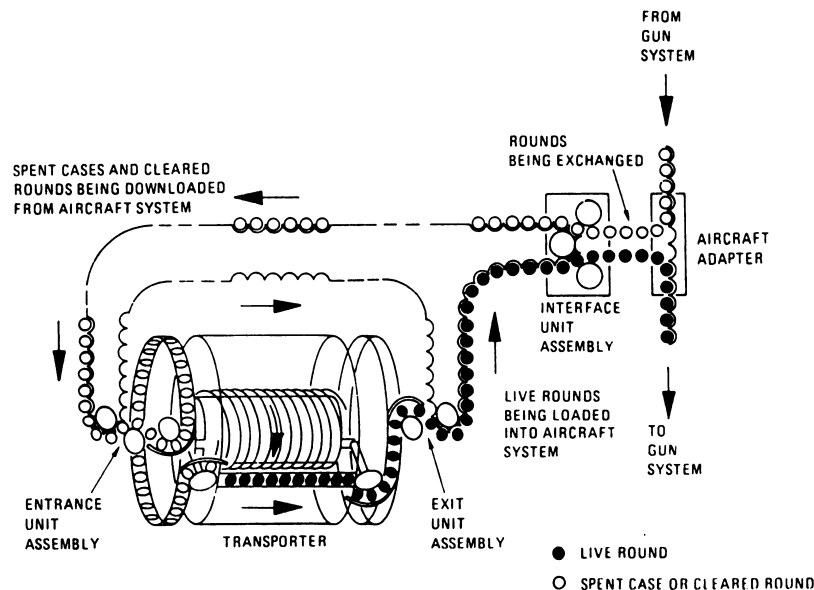


Figure 8-26.—Ammunition flow in load/download mode.

220.521

in *Linkless Ammunition Loading System*, NAVAIR 19-01-125.

Organizational-level maintenance requirements are minimal. Proper use of the LALS reduces unscheduled maintenance. Before use, you need to check the general condition of the LALS for obvious damage. Proper timing of the LALS system before mating one unit with another unit or to the aircraft gun system is the most important part in the organizational maintenance of the LALS.

The maintenance and testing responsibilities of an M61A1 gun installation are distributed evenly between the organizational and intermediate levels of maintenance. The basic responsibilities of these two levels of maintenance are discussed in the following paragraphs.

ORGANIZATIONAL MAINTENANCE

Organizational maintenance includes servicing (loading and unloading), preflight, postflight, minor periodic maintenance, malfunction troubleshooting, and removal and installation of components on the aircraft. Maintenance of the aircraft system and controls must also be included in the AO's organizational responsibilities.

The gun firing record or log is kept at this level. The cumulative total of rounds fired is the basis for most of the maintenance. The number of rounds fired per firing flight is obtained from a counter located within the aircraft. For record accuracy, each time the gun installation is loaded the counter must be reset (usually to zero) according to the instructions applicable to the aircraft. The two primary tasks that depend upon the round interval (rounds fired) are (1) torquing the two forward front track bolts (3,750 rounds),

and (2) changing the breech-bolt assemblies (15,000 rounds).

Organizational responsibilities are **not** included in NAVAIR 11-95M61A1-1 or the NAVAIR 11-95M61A1-2. Organizational responsibilities are outlined in MRCs, aircraft MIMs, and aircraft loading manuals.

If a component is being removed for sudden stoppage (jam) maintenance, be careful and take extra precautions. Loose propellant powder from ruptured cartridge cases may be scattered about the gun compartment. This creates an extremely hazardous situation. The loose powder must be removed in a RADHAZ-free environment before you begin to remove a component.

INTERMEDIATE MAINTENANCE

Intermediate maintenance responsibilities are tasks associated with repair or replacement of unserviceable or damaged assemblies, components, or parts of the gun installation that do not require the special maintenance facilities of an overhaul depot. When a gun reaches a round interval of 100,000 rounds or requires major repair or alteration, it is sent to a depot-maintenance activity. The ammunition handling and gun drive system maintenance procedures are identical at both the intermediate- and depot-maintenance levels; therefore, such maintenance is generally performed at the intermediate level. Intermediate maintenance may be divided into two categories—scheduled and unscheduled.

Scheduled Maintenance

Scheduled maintenance includes inspecting, disassembling, replacing parts, lubricating, assembling, and functionally checking components based on the round interval specified

REVIEW NUMBER 7 ANSWERS

- A1. *When transporter loading/downloading operations are conducted, they must be done in a RADHAZ-free environment.*
- A2. *In a given load/download operation, any of the following conditions may exist: A fully loaded, partially loaded, or empty transporter may be mated to a fully loaded, partially loaded, or empty gun system.*
- A3. *When you connect or remove the interface unit to or from the aircraft adapter, it must be in the bypass position.*

in technical manuals. Scheduled gun maintenance begins at 15,000 rounds and proceeds through various interval states for different parts replacement up to the 100,000-round overhaul interval. Scheduled maintenance for the handling and drive system is set at an interval of 30,000 rounds.

Unscheduled Maintenance

Unscheduled maintenance is required because of a long firing burst, firing stoppage, component malfunction, or misfire. This type of maintenance consists of troubleshooting, detailed inspection, repair, and functional testing. Parts replaced during unscheduled maintenance have no effect on the round interval for the gun installation.

REVIEW NUMBER 8

Q1. The LALS is maintained at the _____.

Q2. Scheduled maintenance procedures for the LALS are outlined in _____.

Q3. At the organizational level, what is the most important maintenance practice followed when working on the LALS?

Q4. The breech bolts are changed out when what number of rounds have been fired from the M61A1 gun system?

Q5. What is the overhaul interval for the M61A1 gun?

Q6. At what interval should scheduled maintenance for the handling and drive system be done?

SAFETY PRECAUTIONS

Learning Objective: *Identify safety precautions to follow when working with the M61A1 gun.*

The weapons systems described in this chapter are safe systems. Live rounds are isolated from the firing circuits except when the gun system is deliberately being fired. The gun system is RADHAZ safe and completely shielded from radiation fields. The gun is charged and cleared in flight, so the aircraft can take off and land without live rounds in the firing position. Although the sole purpose of all ordnance is to destroy an enemy, the equipment cannot identify friend from foe. Therefore, all safety precautions must be followed at all times.

The following general safety precautions are not related to any specific equipment or procedure. These precautions are recommended safety precautions that all personnel should follow when operating and maintaining equipment.

- All persons who supervise or perform work in connection with the ammunition handling should be familiar with the *United States Ordnance Safety Precautions*, NAVSEA OP 3347.

- When test firing is conducted using live ammunition, observe all existing range regulations.

- Before undertaking any operation for which a checkoff list exists, the checkoff list is read so all personnel know what to do.

- When provided, always use safety devices to prevent accidents. Keep safety devices in good operating order at all times.

- Do not make changes, modifications, or additions to a weapons system without the prior approval and authorization from the appropriate authority.

- A hazardous condition exists if a gun malfunction occurs and there is anything in line with the gun muzzle. Observe area clearance requirements during maintenance periods.

- Electrically primed ammunition can be fired by percussion. NEVER cycle live ammunition through a gun for testing purposes.

- The explosive elements in electric primers are highly sensitive to static electricity. Make sure the primer button does not come into contact with the human body.

- Observe fire regulations and maintain good ventilation when using cleaning solvents and other volatile maintenance materials.

- Before performing maintenance actions involving pneumatic or hydraulic pressurized components, ensure that all pressure is removed and the component is in the safest possible condition.

REVIEW NUMBER 9

Q1. If a checkoff list is to be used during an operation, what action must take place first?

Q2. To prevent explosive primers on gun ammunition from being exposed to static electricity, what action should be taken?

Q3. When does a hazardous condition exist?

REVIEW NUMBER 8 ANSWERS

A1. The LALS is maintained at the intermediate level of maintenance.

A2. Scheduled maintenance procedures for the LALS are outlined in the preoperational and calendar MRCs.

A3. At the organizational level, proper timing of the LALS system before mating one unit with another unit or to the aircraft gun system is the most important maintenance practice to follow when working on the LALS.

A4. The breech bolts are changed out when 15,000 rounds have been fired from the M61A1 gun system.

A5. The overhaul interval for the M61A1 gun is 100,000 rounds.

A6. Scheduled maintenance for the handling and drive system of the LALS should be done when the gun has fired 30,000 rounds.

(THIS PAGE IS INTENTIONALLY LEFT BLANK.)

REVIEW NUMBER 9 ANSWERS

- A1. If a checkoff list is to be used during an operation, it must be read to all personnel who will take part in the operation.*
- A2. To prevent explosive primers on gun ammunition from being exposed to static electricity, make sure that the primer button of the ammunition doesn't come into contact with the human body.*
- A3. A hazardous condition exists if a gun malfunctions and there is anything in line with the gun muzzle.*

CHAPTER 9

AERIAL TARGETS AND ASSOCIATED EQUIPMENT

Aerial targets and associated equipment are used in gunnery, rocketry, and for missile practice by ships and shore installations. They are also used in air-to-air firing exercises. Firing at targets that simulate moving aircraft improves the battle efficiency of the Navy and provides useful information for evaluating armament control/weapons systems under development for operational use by the fleet.

Aerial targets are classified as towed targets and powered targets. This chapter discusses towed targets and their associated equipment; however, powered targets are discussed briefly.

TOWED TARGETS

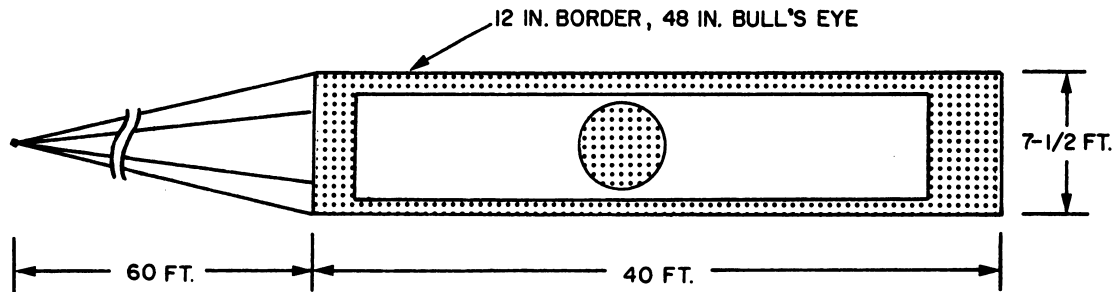
Learning Objective: *Identify tow targets and rigid tow targets.*

There are two basic classes of tow targets—textile and rigid tow targets. Textile tow targets are flexible targets woven from a synthetic fiber such as nylon.

Rigid tow targets are made of a rigid material such as fiber glass. They are shaped and constructed to prevent drag and withstand severe air loads when towed at high speeds. This type of target is normally fin stabilized. All rigid targets provide an auxiliary aid for the radar fire control system in the attacking aircraft.

TEXTILE TOW TARGETS

The TDU-32A/B and TDU-32/B aerial banner tow targets (fig. 9-1) are effective low-cost devices for air-to-air and surface-to-air gunnery training. They are constructed of nylon fabric and



RADAR REFLECTIVITY	90% (A), 0% (B)
SCORING	VISUAL HOLE COUNT
COLOR	WHITE, ORANGE BORDER AND BULL'S EYE
WEIGHT	23 POUNDS
MAXIMUM TOWING VELOCITY	250 KNOTS
TOW AIRCRAFT	A-4, T-2, A-6, F-4, F-14, A-7, F/A-18
AUGMENTATION	NONE

Figure 9-1.—Characteristics of the TDU-32A/B and TDU-32/B aerial banner tow target.

are rectangular in shape. The TDU-32/B is made of nonreflective nylon fabric, while the TDU-32A/B fabric is 90 percent radar reflective.

The TDU-32/B target has a tow bar and bridle assembly attached to a nonradar-reflective panel. The TDU-32A/B target consists of an identical tow bar and bridle assembly attached to a radar-reflective panel. The tow bar is constructed of tubular steel and is integrally weighted to hold it vertical while in flight. There is a 60-foot safety nylon webbing bridle attached between the tow bar and tow cable. Both nonradar- and radar-reflective panels are 7 1/2 feet by 40 feet. For visual tracking, the panels have a 12-inch orange border and a 48-inch orange bull's eye centered on the white portion.

The targets, attached approximately 1,800 feet behind the tow aircraft, are launched from the runway by standard drag takeoff procedures. Target recovery is accomplished by dropping the target in a recovery area following the mission.

RIGID TOW TARGETS

A rigid target is specially designed to simulate high-speed aircraft in speed and maneuverability. It can be towed by jet aircraft at speeds within the attacking range of jet fighters. The target is aerodynamically designed to reduce drag and limit the performance of the tow plane as little as possible. A rigid target can be used for air-to-air and surface-to-air gunnery and guided missile training.

TDU-10/B Tow Target

The TDU-10/B Dart tow target (fig. 9-2) is a lightweight, high-speed, rigid target used for

air-to-air gunnery exercises. The fins consist of a wood frame filled with honeycombed cardboard and covered with foil. The four fins are attached to aluminum angles. The tow cable attaches to the angles at the approximate center of gravity. The center of gravity may be changed slightly to meet different aircraft requirements. This is done by adjusting a movable weight at the forward end of the angles.

Because of its fragile construction, this target cannot be drag launched. It is air launched from the A/A37U-15A tow system. This tow system is discussed later in this chapter.

TDU-34/A Aerial Tow Target

The TDU-34/A aerial tow target (fig. 9-3) is a training device that will replace other tow targets now in use with the exception of the banner targets discussed in this chapter. Its primary purpose is for air-to-air and surface-to-air missile and gunnery training.

The TDU-34/A is a passive radar target. It can be adapted to carry other payloads internally. It consists of a reinforced aluminum tube body, four aluminum fins, a steel towline adapter, and radar-reflective nose and tail sections. The nose is a thin fiber glass shell with four aluminum corner reflectors and a lead ballast weight bonded inside. The tail section is a short ABS plastic tube with a single aluminum corner reflector riveted inside. The dimensions and weight of the target are shown in figure 9-3.

The TDU-34/A can be towed by any aircraft capable of using the A/A47U-3 or A/A47U-4 reeling machine-launcher systems.

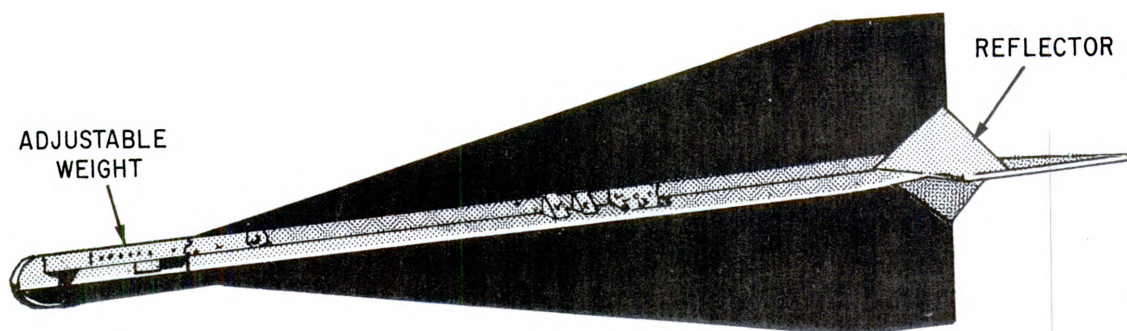
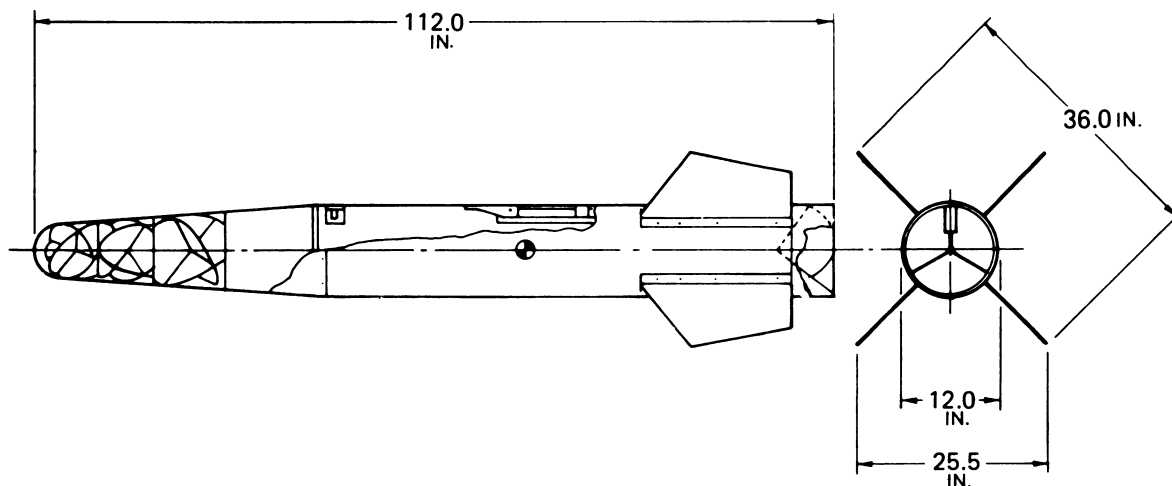


Figure 9-2.—TDU-10/B aerial tow target.

220.549



ALTITUDE	35,000 FEET
WEIGHT	75 POUNDS
MAXIMUM TOWING VELOCITY	0.9 MACH
TOW AIRCRAFT	A-4, A-6, F-4
AUGMENTATION	RADAR REFLECTORS

Figure 9-3.—Characteristics of the TDU-34/A aerial tow target.

REVIEW NUMBER 1

- Q1. What are the two basic classes of tow targets?
- Q2. Textile targets are made of _____.
- Q3. What type of target is an auxiliary aid for the radar fire control system in the attacking aircraft?
- Q4. List the textile targets that are effective low-cost devices for air-to-air and surface-to-air gunnery training.
- Q5. Describe the difference between the TDU-32A/B and TDU-32/B targets.
- Q6. What is the size of the TDU-32A/B?
- Q7. Rigid tow targets are specifically designed to _____.
- Q8. What tow system is used to launch the TDU-10/B tow target?
- Q9. What tow target is a passive radar target that can be adapted to internally carry other payloads?

TARGET TOWING SYSTEMS AND ASSOCIATED TOWING EQUIPMENT

Learning Objective: Identify towing systems and associated equipment to include external gunnery tow systems, tow target reeling machine-launcher systems, and tow cables and associated equipment. Describe the operating theory of the external gunnery tow system.

Three target towing systems and their associated equipment are discussed in the following paragraphs.

A/A37U-15A EXTERNAL GUNNERY TOW SYSTEM

The A/A37U-15A external tow system (fig. 9-4) has complete facilities for air launching and towing the TDU-10/B target with an A-4 aircraft. The system, mounted on the aircraft, permits the target uncoupling and paying out the tow cable after the aircraft is within air-to-air firing range. When the mission is completed, the tow cable is cut by an electrically actuated cutter squib mounted in the tow reel pod.

The A/A37U-15A tow system has a tow reel pod with a tow reel installed in the center section, a boom, and launcher for installing the TDU-10/B target.

Description

The tow reel pod is approximately 160 inches long and 18 inches in diameter. Attached to the tow reel pod is a boom and launcher for the tow target. A duct in the forward section of the tow reel pod provides cooling air for the tow reel mounted in the center section. In addition to the tow reel, the center section contains lugs for mounting the tow reel and housing to the Aero 20A bomb rack. Doors in the bottom of the housing center section permit access to the cable reel for maintenance or replacement of the cable spool. The aft section of the tow reel housing contains the electrically actuated cable cutters, in addition to the electrical wiring connecting the aircraft and the tow reel pod.

The boom and launcher attached to the side of the tow reel pod have mounting facilities for the TDU-10/B tow target. A standard

REVIEW NUMBER 1 ANSWERS

- A1. The two basic classes of tow targets are the textile and rigid tow targets.*
- A2. Textile targets are made of woven synthetic fiber, such as nylon.*
- A3. The rigid tow target is an auxiliary aid for the radar fire-control system in the attacking aircraft.*
- A4. The TDU-32A/B and TDU-32/B textile targets are effective low-cost devices for air-to-air and surface-to-air gunnery training.*
- A5. The TDU-32/B target is 90 percent radar reflective.*
- A6. The TDU-32A/B is 7 1/2 feet by 40 feet.*
- A7. Rigid tow targets are specifically designed to simulate high-speed aircraft.*
- A8. The A/A37U-15A tow system is used to launch the TDU-10/B tow target.*
- A9. The TDU-34/A tow target is a passive radar target that can be adapted to internally carry other payloads.*

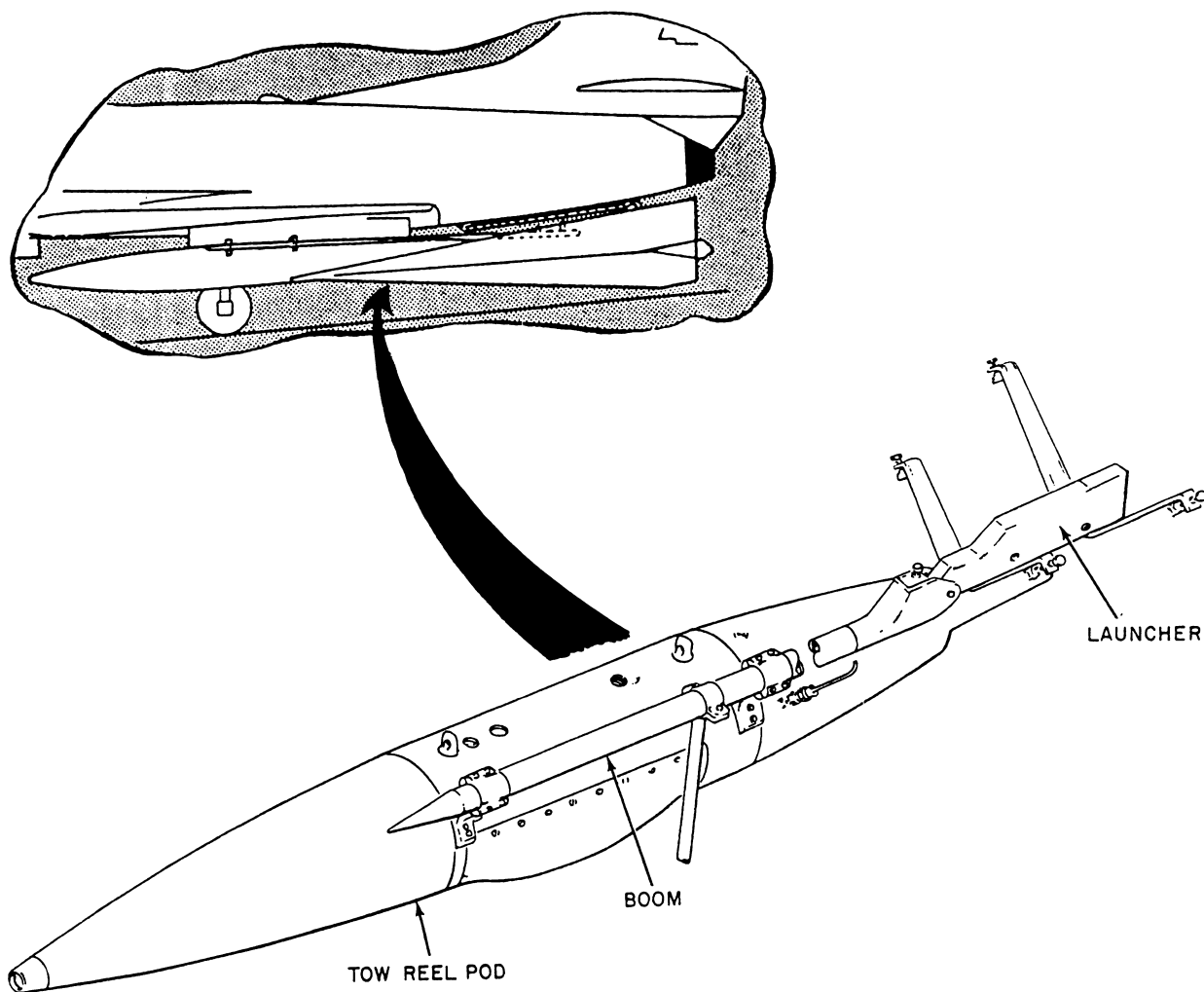


Figure 9-4.—A/A37U-15A external gunnery tow system.

220.551

military-type MA-4A bomb rack is used in the launcher for attachment of the tow target.

The tow reel, mounted in the center section of the tow reel pod, is a one-way reel capable of carrying approximately 2,000 feet of 3/16-inch cable or 5,000 feet of 1/8-inch cable. A self-energized inertial brake, actuated by flyweights and mounted on the reel drum, is used in the tow reel. This brake drum controls the pay-out speed of the tow cable. As the reel rotates, the flyweights are forced out by centrifugal force and exert pressure on the brake disc, thus increasing the friction on the cable reel.

Theory of Operation

When electrical power is supplied to the tow system through existing aircraft wiring, the tow

system electrical wiring carries the signal to the standard MA-4A bomb rack in the launcher. When this electrical signal is received by the bomb rack, the bomb rack release mechanism is actuated, and the target is allowed to fall free of the aircraft. As the target falls free of the aircraft, the target cable is pulled taut and the drag on the target brakes the safety wire holding the cable spool. Continued drag on the target causes the tow cable to unwind from the spool in the tow reel. As the reel rotates, the flyweights on the brake assembly are forced out by centrifugal force and exert pressure on the brake disc, thus increasing friction on the cable reel. This increased friction controls the speed that the cable unwinds from the spool.

For further information concerning the A/A37U-15A external gunnery tow system, you

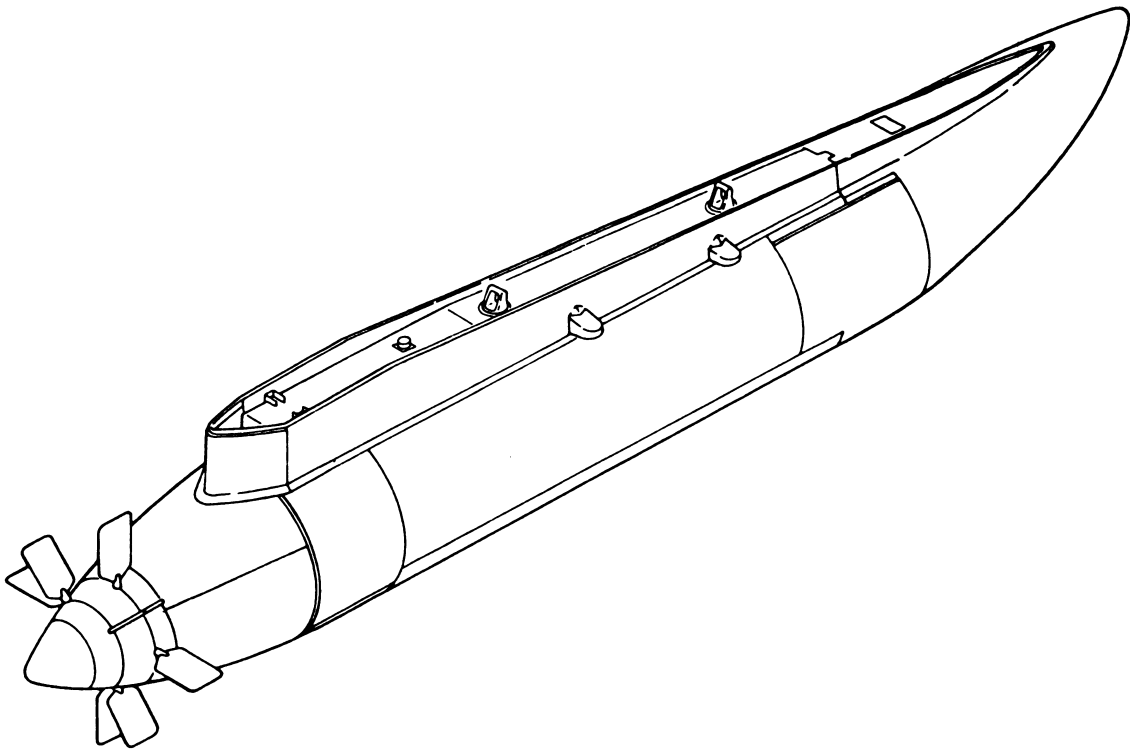


Figure 9-5.—A/A47U-3A tow target reeling machine-launcher system.

should refer to *Tow Systems, External Gunnery, Type A/A37U-15A*, NAVAIR 28-10A-14.

**A/A47U-3A AND A/A47U-4
TOW TARGET REELING
MACHINE-LAUNCHER SYSTEM**

The A/A47U-3A tow target reeling machine-launcher system (fig. 9-5) is an airborne weapon training system. It is used to tow aerial targets for gunnery and aircraft missile firing exercises. The system is a semiautomatic tow-reel and target-launching mechanism externally mounted on the aircraft.

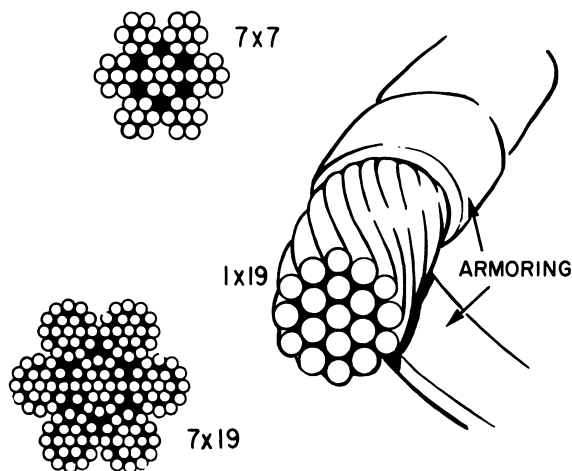
The A/A47U-3A system consists of an RMK-19A/A47U-3 reeling machine launcher, a PEK-84/A47U-3 reeling machine-launcher control, and the applicable interconnection cable assemblies. The system uses saddle-mounted aerial targets from 7 to 12.5 inches in diameter that weigh up to 225 pounds. Target towlines, having constant diameters or stepped diameters with combinations of monofilament and/or stranded wire, are used. The system operates with various towline splices, ranging in diameter up to 0.250 inch and with flexible lengths up to 106 inches. Typical towlines consist of 10,000 feet of 0.190-inch diameter 3 × 7 stranded steel cable

(5,400-pound tensile strength) or 42,000 feet of 0.097-inch diameter 1 × 7 stranded steel cable (2,060-pound tensile strength). The reeling machine-launcher system has a nominal reeling speed capability of 3,500 feet of towline per minute. Adjusting the power unit blade angle limitations increases the speed to a maximum of 5,000 feet per minute.

The system is manually controlled by the operator, and it provides launcher up/down, brake on/off, and reel in/out functions. You can control target reeling and recovery speeds by manually adjusting the power unit blade angle. Operation of the system is controlled from the PEK, which is located in the cockpit of the launching aircraft.

The A/A47U-4 tow target reeling machine-launcher system is identical to the A/A47U-3A except for weight and size. The lighter weight and smaller size design of the A/A47U-4 was developed to adapt this towing system to a variety of aircraft.

If you want more information on the A/A47U-3A tow target reeling machine-launcher system, refer to *Tow Target Reeling Machine-launcher System A/A47U-3A*, NAVAIR 28-10A-16.



220.118

Figure 9-6.—Cross-sectional view of tow cables.

TOW CABLES AND ASSOCIATED EQUIPMENT

Steel cables used in target towing are manufactured specifically for that purpose. Three of the several types of cables used are discussed here: the 3/32-inch, 7 × 7 cable; the 1/8-inch, 7 × 19 cable; and the 1/8-inch, 1 × 19 armored cable.

The 3/32-inch cable comes in 10,000-foot spools, has a minimum breaking strength of 920 pounds when new, and is 7 × 7 in construction. It consists of seven strands; each strand has seven wires, and is commonly referred to as 7 × 7. This cable weighs 1.5 pounds per 100 feet.

The 1/8-inch cable is shipped in either 11,500- to 12,500-foot spools or 7,000- to 7,500-foot spools. It has a minimum breaking strength of 2,000 pounds when new. It is 7 × 19

in construction (7 strands, 19 wires per strand) and weighs 2.9 pounds per 100 feet.

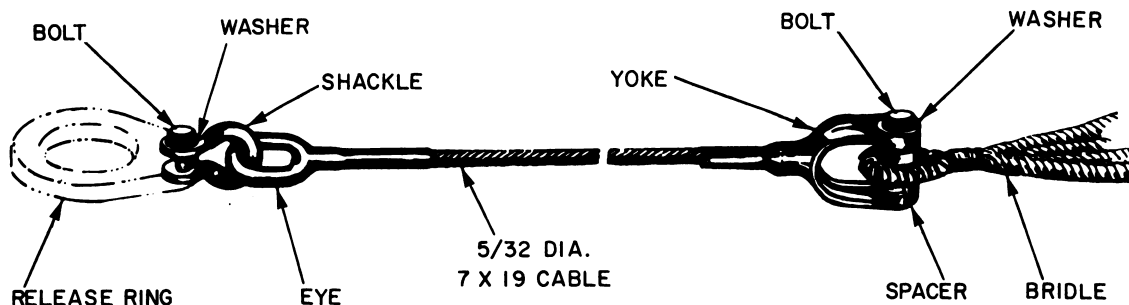
The 1/8-inch armored cable is shipped in spools. It has a minimum breaking strength of 2,160 pounds. It is constructed of one strand of 19 wires, with a flat armoring wire swaged spirally around the strand with a minimum of six turns per inch. The armored cable weighs 4 pounds per 100 feet. Cross-sectional views of these three cables are shown in figure 9-6.

These cables are not lubricated. The use of grease, oil, paraffin, or other lubricants on the cable is a fire hazard. An explosive vapor is created in the towing aircraft as the cable is reeled out at high speeds. Since the cables are not lubricated, they must be stored in a dry place, or cleaned and coated with corrosion-preventive compound according to instructions.

Continual use of a cable reduces its strength. Target towing subjects the cable to severe stress in addition to the damage caused by gunfire. You need to inspect cables frequently. The cable should be repaired or replaced if there are indications of fraying (broken wires), birdcaging (partial unwinding of the strands along the cable), or snarling (unwinding of the strands and wires at the end of the cable). Running a cloth along the cable will help you locate broken wires, as they will catch in the cloth. Never run your bare hand along the cable because the broken wires will catch in the flesh. Also, you should never use a knot to attach a target, since the knot weakens the cable by 50 percent or more. An eye splice is recommended for this purpose.

Mk 1 Target Leader

The Mk 1 target leader (fig. 9-7) is used to attach targets and target-release messengers to the



220.147

Figure 9-7.—Mk 1 target leader.

release ring. In turn, the target ring is held by the Mk 7 Mod 4 target release. When the target is dropped, the leader and ring drop with it.

The leader is a 34-inch length of 5/32-inch diameter 7 × 19 steel cable swaged into a yoke at one end with an eye at the other end. To use the leader, you attach the bridle eye of the target to the yoke of the leader. Then, secure the eye end of the leader with a shackle to the release ring or snarl catcher that slides along the tow cable.

Mk 8 Target Release Ring

The Mk 8 target release ring (fig. 9-8) is made of case-hardened alloy steel and is about 3 inches long. The smaller eye is 1/2 inch in diameter, while the larger eye is 1 1/2 inches in diameter. You should attach the target leader to the smaller eye (securing eye). The larger loop (hole) slides along the cable, and is held by the target release when the target is towed with a reel.

Release rings are also used in drag take-offs and container launchings. In container launchings, you should attach the ring directly to the towline and then to the target-release device of the aircraft.

Klein "Chicago" Grip

The Klein "Chicago" grip (fig. 9-9) provides a means of transferring the target drag load from the reel to a structural member of the towing aircraft. This procedure is used to take the strain off the reel while the target is streamed.

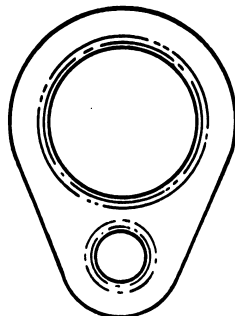


Figure 9-8.—Mk 8 target release ring.

220.156

The grip is a standard commercial item. It is about 10 inches long and composed of a series of spring-loaded linkages and a shackle. The jaws are opened by compressing the entire grip in line with the extended shackle. It will grip bare wires, solid or stranded, from 0.081 to 0.162 inch in diameter.

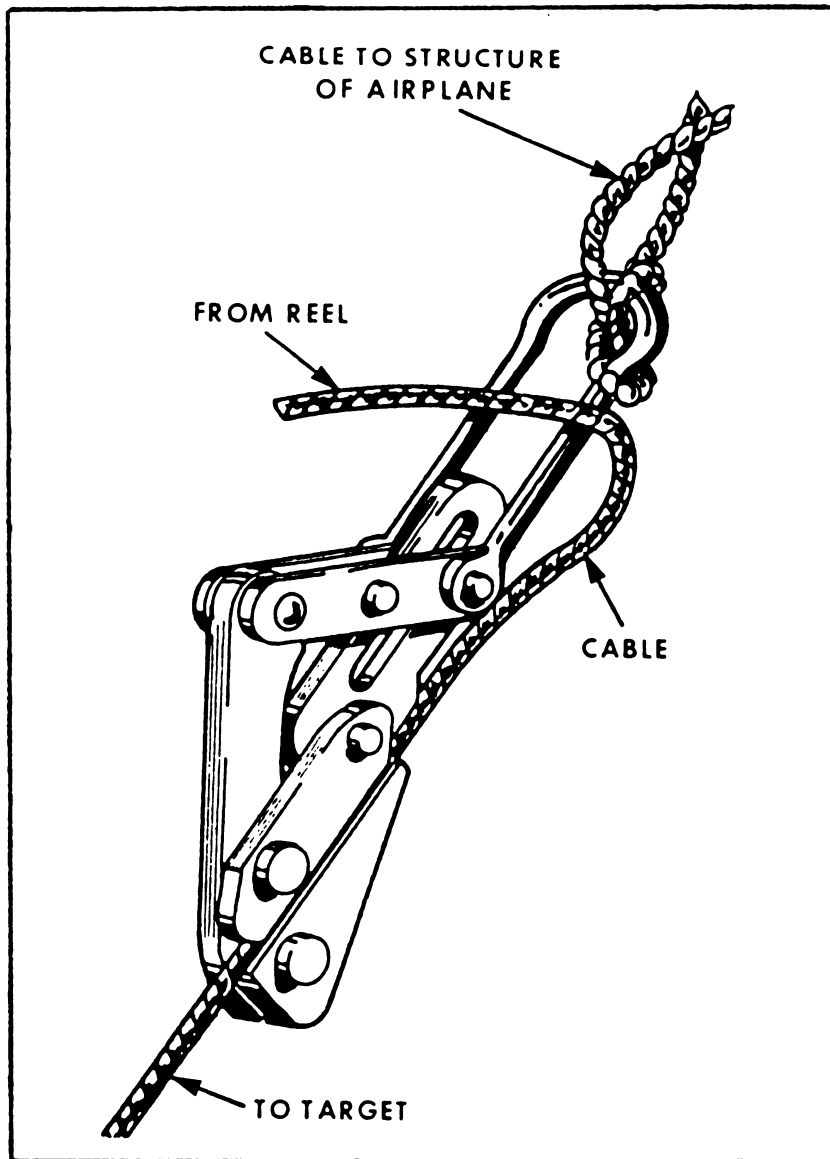
The grip is first secured by a cable to the aircraft's internal structure. Then, it is attached to the tow cable near the outrigger sheave. Slightly unwinding the reel transfers the load from the reel to the grip. The greater the drag load, the tighter the jaws grip the cable.

CAUTION

Do NOT apply loads greater than 1,500 pounds to the grip. It will accept cable with a much greater breaking strength than that of the grip itself. As a safety measure, set the reel brake while the grip is in use, keep the clutch in the IN position, and keep the slack in the tow cable between the grip and reel at a minimum.

REVIEW NUMBER 2

- Q1. *What is the approximate size of the A/A37U-15A tow reel pod?*
- Q2. *The one-way reel mounted in the center section of the tow reel pod carries _____ on its spool.*
- Q3. *List the components of the A/A47U-3A tow target launching system.*
- Q4. *What is the major difference between the A/A47U-3A and A/A47U-4 tow target reeling machine-launcher systems?*
- Q5. *List the types of steel cables used in target towing.*



220.163

Figure 9-9.—Klein "Chicago" grip.

Q6. Why are cables frequently inspected?

Q9. What maximum load can be applied to the Klein "Chicago" grip?

Q7. The Mk 8 target release ring is made of _____.

Q8. What component provides a means of transferring the target drag load from the reel to a structural member of the towing aircraft?

POWERED TARGETS

Learning Objective: *Identify powered targets to include the missile target, target drone, and target system.*

The Navy uses three powered targets—the AQM-37A missile target, BQM-74C target drone,

and BQM-34E/T target system. A simplified discussion of powered targets is presented in this section of the TRAMAN.

AQM-37A MISSILE TARGET

The AQM-37A missile target (fig. 9-10) is a realistic simulation of offensive missile and aircraft threats. It is used to conduct weapon system evaluation, operationally train air-to-air missile crews, and exercise missile weapon systems. The AQM-37A missile target is an expendable, rocket-powered missile target capable of flying at various altitudes and cruise speeds. The target is designed for straight-and-level flight at selectable speeds from Mach 0.7 to Mach 2.0 at cruise altitudes of 1,000 to 70,000 feet, with a maximum range of approximately 155 nautical miles.

The AQM-37A is an air-launched target. It is launched from both carrier- and land-based

aircraft. The launcher carries the target as an external store. The target's mission profile is determined by launch altitude, speed, and heading. This profile has controlled rocket engine thrust, cruise altitudes, and flight time parameters preset by ground crew personnel before flight.

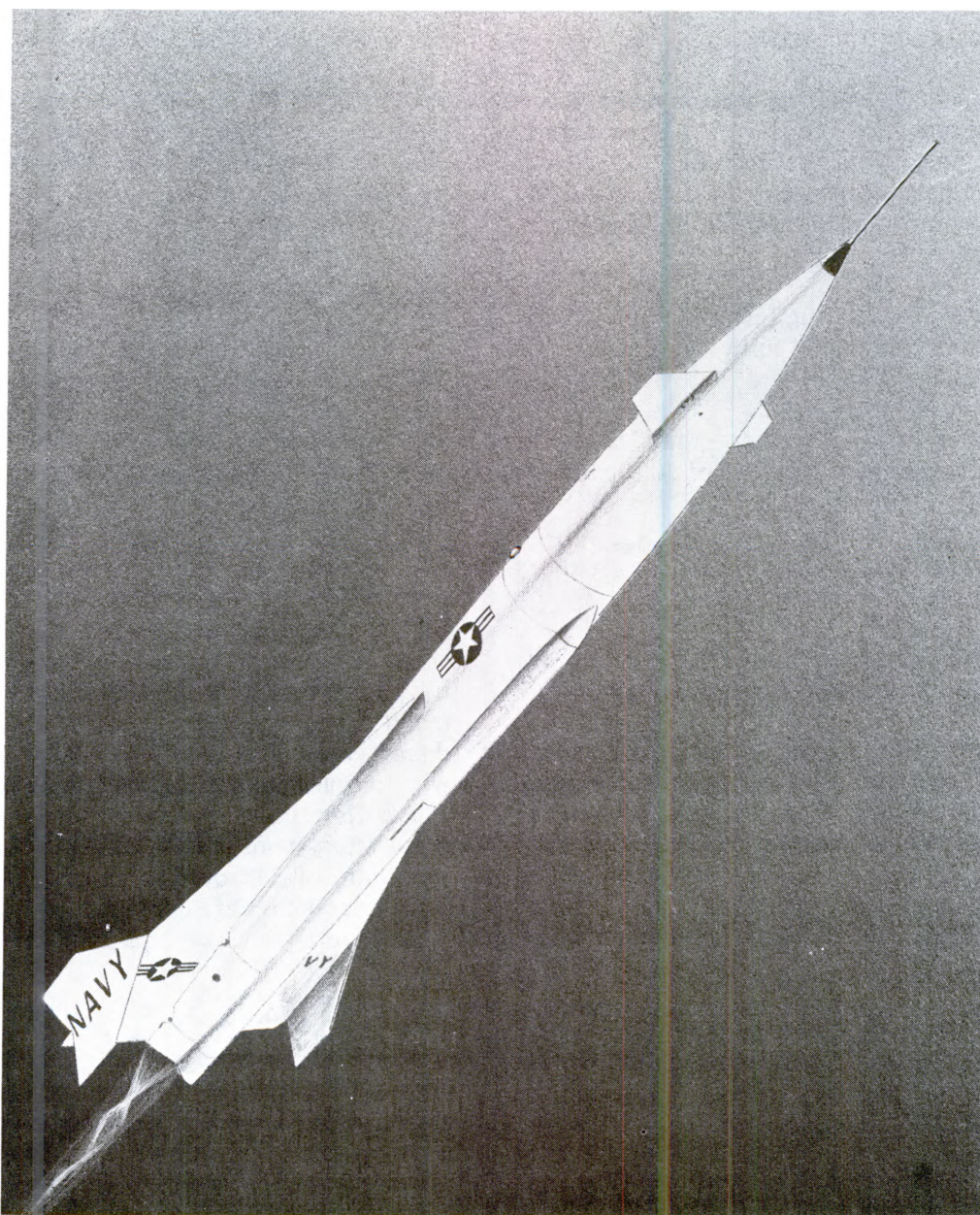
The target is equipped with a gyro-referenced autopilot, radar augmentation, infrared augmentation, antennas, and an aerodynamic destruct system for flight termination. It is powered by the LR-64 liquid propellant rocket engine, which is a self-contained propulsion system. The maximum weight of the target, including radar augmentation, IR flare, and scorer, is 559 pounds.

Scoring System

The AQM-37A missile target contains the antennas and necessary interconnecting cables for

REVIEW NUMBER 2 ANSWERS

- A1. *The A/A37U-15A tow system is about 160 inches long and 18 inches in diameter.*
- A2. *The one-way reel mounted in the center section of the tow reel pod carries 2,000 feet of 3/16-inch cable or 5,000 feet of 1/8-inch cable on its spool.*
- A3. *The A/A47U-3A tow target launching system consists of an RMK-19A/A47U-3 reeling machine launcher, a PEK-84/A47U-3 reeling machine launcher control, and applicable interconnecting cable assemblies.*
- A4. *The major difference between the A/A47U-3A and A/A47U-4 tow target reeling machine-launcher systems is their weight and size.*
- A5. *The types of steel cables used in target towing are 3/32-inch, 7 × 7 cable; 1/8-inch, 7 × 19 cable; and 1/8-inch, 1 × 19 armored cable.*
- A6. *Cables are frequently inspected because continual use reduces its strength.*
- A7. *The Mk 8 target release ring is made of case-hardened steel alloy.*
- A8. *The Klein "Chicago" grip provides a means of transferring the target drag load from the reel to a structural member of the towing aircraft.*
- A9. *The maximum load can be applied to the Klein "Chicago" grip is 15,000 pounds.*



220.178

Figure 9-10.—AQM-37A missile target.

the installation of the AN/DRQ-4 transponder. The primary purpose of the transponder is to receive a frequency-modulated signal from the missile, convert the signal to a new center frequency-modulated signal, and transmit the new signal to the miss-distance measuring system ground station.

The ground station receiver compares the shifted frequency of the target signal with the reference frequency of the strike missile signal.

The outputs from the ground station accurately measure the miss distance between the target and the missile. The transponder is installed only in a target that is used for a surface-to-air missile with a telemetering head. The transponder is not used in an air-to-air weapons system. Only one telemetering missile at a time should be shot at a target. After the first missile has destroyed, a second shot may be attempted if the target was not destroyed.

Aerodynamic Destruct System

The AQM-37A missile target's aerodynamic destruct system causes the target to enter a spiral dive to impact. This prevents the target from becoming a hazard to other aircraft or impacting the ground in undesired areas. The destruct system is activated by any of four conditions:

1. Flight timer setting (ground adjustable at 2-minute intervals after 4 minutes of flight time have elapsed)
2. Off-course flight (more than 10-degree heading deviation) for a period of 30 seconds or longer
3. Loss of electrical power or low-battery voltage
4. 12.5 seconds after jettison from the launching aircraft

For further details concerning the AQM-37A missile target, you should refer to *Manual Operational Mission Planning Guide for Navy Model AQM-37A Missile Target*, NAVAIR 01-90TBA-1T. Procedures for loading/unloading of the AQM-37A are contained in the appropriate aircraft airborne weapons/stores loading manual.

BQM-74C TARGET DRONE

The BQM-74C target drone (fig. 9-11) is a high midwing monoplane of conventional design with an inverted-Y empennage. The airframe is a modified monocoque structure made of aluminum alloy and reinforced fiber glass construction. There is a vertical rack in the target nose section for mounting equipment. Equipment is mounted on both sides of the rack for convenient equipment removal, installation, and checkout. The target is powered by a YJ400-WR-402 variable speed, turbojet engine, which produces a minimum of 180 pounds of static thrust at sea level. The 16.2-gallon fuel tank is mounted in the fuselage center section.

The BQM-74C target drone is air launched from either the A-6E or TA-4J aircraft. The target can be surface launched from the ground or a ship. The target flight path is remote controlled by radio commands. Target stabilization is maintained by a gravity-erected, two-axis, vertical displacement gyroscope. The target is equipped with a parachute recovery subsystem and an active flotation subsystem. After water entry, these subsystems keep the target afloat for a minimum of 24 hours. The target has retrieval attachments that are compatible with shipboard or helicopter retrieval equipment.

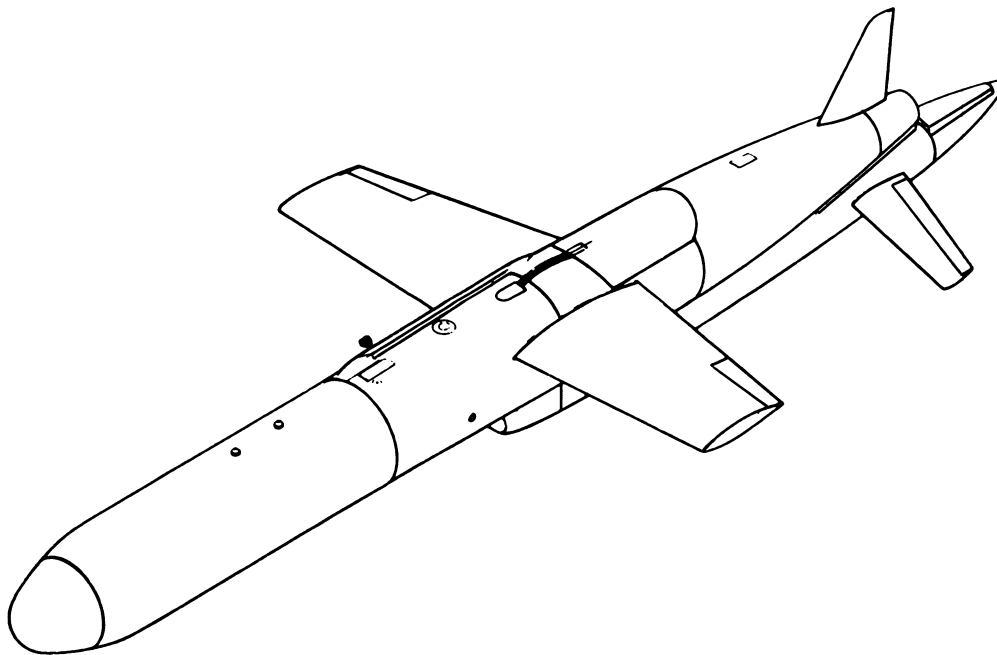
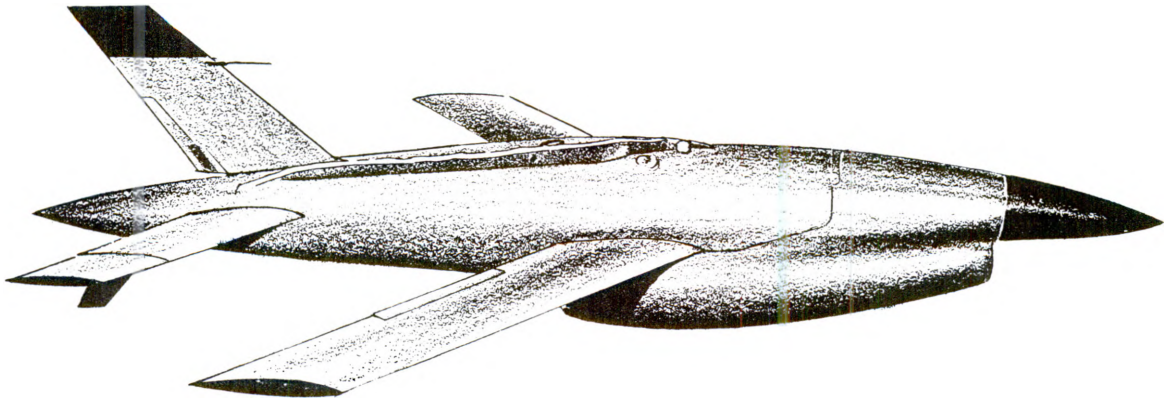


Figure 9-11.—BQM-74C target drone.



220.187

Figure 9-12.—BQM-34A/S target system.

When the basic BQM-74C target drone is configured for mobile sea range (MSR) and on-range target (ORT) operations, specific mission-peculiar equipment is added. The mission-peculiar equipment and installation and checkout procedures are listed in *Maintenance Manual Instructions*, NAVAIR 01-BQM-74C-2-1. For further information concerning the basic BQM-74C target drone, you should refer to *Maintenance Instructions Target Drone Navy Model BQM-74C*, NAVAIR 01-BQM-74C-2-2.

BQM-34A/S TARGET SYSTEM

The BQM-34A/S target system (fig. 9-12) is a recoverable jet-powered target with a service ceiling of 55,000 feet and a maximum speed of 600 knots. Unlike the AQM-37A, this target requires extensive support equipment and preparation before launching.

REVIEW NUMBER 3

- Q1. List the three powered targets used by the Navy.
- Q2. The AQM-37A has a speed range between _____.
- Q3. What means is used to launch the AQM-37A?

Q4. What propellant is used in the self-contained propulsion system of the AQM-37A?

Q5. What is the purpose of the aerodynamic destruct system of the AQM-37A?

Q6. The BQM-74C is powered by a _____.

Q7. What aircraft are used to launch the BQM-74C target drone?

Q8. What is the maximum speed of the BQM-34A/S target system?

SAFETY PRECAUTIONS

Learning Objective: *Identify safety precautions to follow when working with aerial targets and associated equipment.*

There are many safety precautions associated with the target towing service. Some of these safety precautions are discussed as follows:

- Preservatives and lubricants may NOT be used on tow cables. Friction caused by high-speed

reeling-out generates heat. This heat can generate explosive vapors from the lubricants in the tow compartment.

- A cable should be uncoiled by standing the coil on its edge, holding the end, and unrolling the coil. Do NOT attempt to take cable from either a coil or roll by pulling the cable when the coil or roll is lying flat. The cable will snarl and kink.

- When you cut nylon towline, the ends have to be bound. Otherwise, apply enough heat to the cut ends to melt the nylon. This prevents raveling.

- Safety tow webbing must be used between the target and the end of the towline. When the pilot shoots off the towline, this webbing can prevent it from becoming tangled in the target. Multistrand safety webbings (100 feet long) are used with banner targets.

- The snarl catcher must NOT be used during air-to-air gunnery exercises. It may clamp on the towline before it reaches the end of the cable. This means there will be a long, free

section of the cable whipping about behind the target.

- All personnel involved in target towing operations must know the standard hand signals for controlling aircraft on the ground.

- Perform a preflight inspection of all tow equipment.

- Make sure you are clear of the cable when launching a target.

- Do NOT wear loose clothing when operating rewind equipment. Keep your hands clear of moving parts when the equipment is in operation.

- Observe RADHAZ precautions when working with cable-cutting cartridges and tracking flares.

- Exercise caution when it is necessary to work in close proximity of pneumatic, hydraulic, spring, or cartridge-operated components.

REVIEW NUMBER 3 ANSWERS

A1. *The three powered targets used by the Navy are the AQM-37A, BQM-74C, and BQM-34A/S.*

A2. *The AQM-37A has a speed range between Mach 0.2 and Mach 2.0.*

A3. *The AQM-37A is an air-launched target.*

A4. *LR-64 liquid propellant is used in the self-contained propulsion system of the AQM-37A.*

A5. *The aerodynamic destruct system of the AQM-37A is used to prevent the target from becoming a hazard to other aircraft and from impacting the ground in undesired areas.*

A6. *The BQM-74C is powered by a YJ400-WR-402 variable speed, turbojet engine.*

A7. *The A-6E and TA-4J aircraft are used to launch the BQM-74C target drone.*

A8. *The maximum speed of the BQM-34A/S target system is 600 knots.*

CHAPTER 10

AMMUNITION HANDLING EQUIPMENT

How you handle aviation ammunition depends on the time, place, and situation. The ammunition and explosives handling task is hazardous. Equipment is designed so you can safely handle ammunition in any given situation. This includes railroad, industrial, and automotive equipment used for transporting ammunition. It also includes equipment used to manually handle ammunition such as skids, pallets, carriers, and aircraft loading equipment.

Often, the equipment you use to handle ammunition afloat and ashore is the same. However, differences in stowage accommodations, fixed installations, working areas, and space limitations require the use of equipment and techniques especially designed for the job. Regardless of the situation, only use the equipment designed for a particular task and approved by NAVSEASYSKOM/NAVAIRSYSKOM.

You can identify the command having control over a particular item of ammunition handling equipment by the item designation. If the item is identified by Mark and Mod number designations, NAVSEASYSKOM controls it. If the item is identified by designations such as Aero, ADU, ADK, and HLK, NAVAIRSYSKOM controls its.

The number and availability of different ammunition handling equipment configurations are extremely large. The equipment that is routinely used by most of the operating units (ashore and afloat) is discussed in the following paragraphs. You can find a complete listing and description of approved handling equipment in *Approved Handling Equipment for Weapons and Explosives*, NAVSEA OP 2173, Volume 1 (NAVAIR 19-100-1.1) and Volume 2 (NAVAIR 19-100-1.2).

PALLETS

Learning Objective: *Identify the purpose and use of pallets to include safe loads.*

A pallet is a wood or metal platform used to stack material for movement from one area to another. You use pallets to store and handle bombs, cartridge tanks, projectiles, rocket containers, rocket heads, rocket motors, and unit loads. When live ammunition and explosives are involved, use metal pallets. Metal pallets are more durable than wood pallets, are not subject to warping, and do not present a fire hazard.

STANDARD FOUR-WAY WOOD PALLET

The standard four-way pallet (fig. 10-1) is a nine-post wood pallet to provide four-way entry for forklift and pallet trucks. The wings (overhang) at each end allow sling installations. The slots in the two top-deck members are used to install steel strapping, providing load restraint. The pallet measures 48 inches in length and 40 inches in width. It has a safe working load (SWL) of 4,000 pounds. It is a general-purpose pallet used primarily for shipment of domestic unit loads of ordnance.

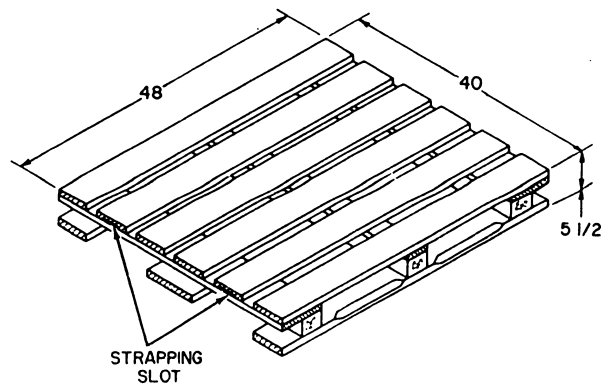


Figure 10-1.—Standard four-way pallet.

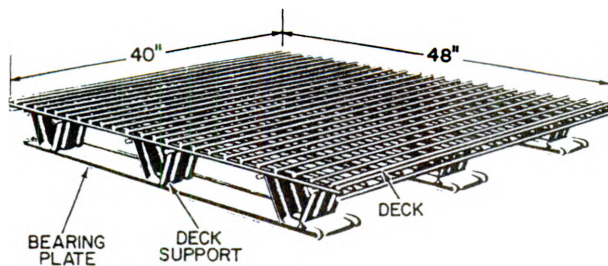


Figure 10-2.—Mk 3 Mod 0 pallet.

MK 3 MOD 0 PALLET

The Mk 3 Mod 0 pallet (fig. 10-2) is a steel wire weldment. It consists of a deck, deck supports, and steel bearing plates. The deck is made of steel wire, formed into a grid pattern of 2-inch squares, and is welded to the deck supports. The bearing plates run fore and aft beneath the deck, with one plate on each side and one in the center of the pallet. Nine steel deck supports are welded to the bearing plates and to the deck. The complete pallet is galvanized. The pallet measures 48 inches in length and 40 inches in width. It has an SWL of 4,000 pounds.

The Mk 3 Mod 0 pallet is a general-purpose four-way pallet used to handle unit loads aboard ship and at shore stations. A forklift or pallet truck is used to transport and stack loads. It is also used to hoist loads using pallet slings. The Mk 3 Mod 0 pallet is used for fleet issue unit loads.

MK 12 MOD 1 PALLET

The Mk 12 Mod 1 pallet (fig. 10-3) is a steel wire and formed sheet steel weldment. It consists

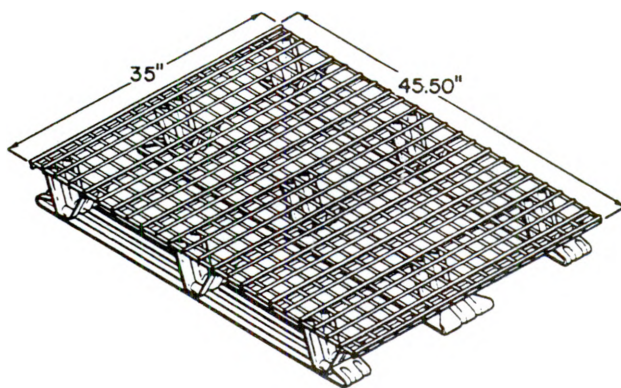


Figure 10-3.—Mk 12 Mod 1 material handling pallet.

of a deck, supports, and runners. The deck is made of steel wire bent and assembled into a grid pattern of 2.5-inch squares. The deck is welded to supports and runners. Steel edge strips protect the wire endings. Three sheet steel runners extend fore and aft beneath the deck—one running under each side and one under the center of the deck. The nine deck supports are integral with the cross support member that extends laterally below the deck and between the runners. This makes up a strong base for the pallet. The pallet measures 45.5 inches in length and 35 inches in width. It has an SWL of 4,000 pounds.

The Mk 12 Mod 1 pallet is a four-way pallet used to palletize weapon components and containers for storage, handling, and shipping. This pallet is used to transport and stack loads, using a forklift or pallet truck, and to hoist loads using pallet slings. The Mk 12 Mod 1 pallet is used for fleet issue unit loads.

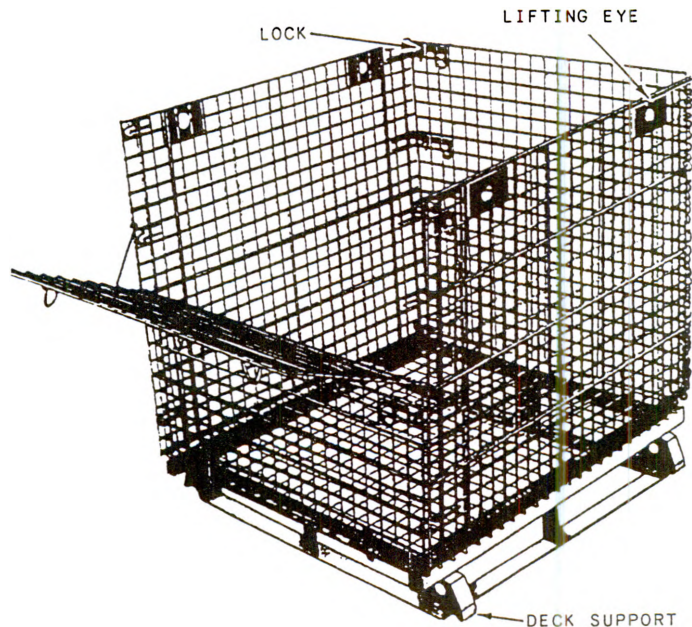
AMMUNITION PALLET CRATE

The ammunition pallet crate (fig. 10-4) comes in three sizes. It consists of a steel four-way pallet on which steel wire sides and ends are attached to form an open-top container. The sides and ends may be folded onto the pallet deck to make a compact unit for stowage and safe tying. One end of the pallet crate is removable. A hinge is located in the center so the top half folds down over the lower half for loading and unloading operations. Twelve locks secure the sides and ends, and four lifting eyes let it be used with hooks on appropriate slings. The deck supports are designed for stacking.

The ammunition pallet crate is used at naval shore activities to handle loose ammunition and inert items during on-station handling and transportation. This pallet is particularly useful in combatant ship loadouts/offloads at dockside or anchorage where palletization is either impractical or inefficient. Projectiles, cartridges, and powder tanks up to 6 inches in diameter, boxed ammunition, and various inert loads are typical of the items handled using this pallet-crate.

REVIEW NUMBER 1

Q1. For a complete listing and description of approved handling equipment, you should look in _____.



220.880

Figure 10-4.—Ammunition pallet crate.

Q2. What is the general purpose of the standard four-way wood pallet?

ammunition; therefore, only horizontal carriers are discussed in the following paragraphs.

Q3. What is the safe working load (SWL) of the Mk 3 Mod 0 and Mk 12 Mod 2 pallets?

Q4. What is the purpose of ammunition pallet crates?

MK 49 MOD 1 WEAPONS CARRIER

The Mk 49 Mod 1 weapon carriers (fig. 10-5) is constructed of two steel plates welded together. It has four hoisting points and two attaching studs. A fixed stud at the B end of the strongback is engaged in one of the weapon suspension lugs. Then, the pivoting stud at the A end is engaged in the remaining lug and locked in place with a quick-release pin. The Mk 49 Mod 1 weapon

CARRIERS

Learning Objective: *Identify weapons carriers and recognize their purpose and use.*

Carriers are a quick and safe means of attaching a crane cable or other hoisting device to ammunition for movement from one area to another. Some carriers are designed for horizontal lifting and some for vertical lifting. Others are used for both horizontal and vertical lifting. Vertical carriers are used for surface-employed

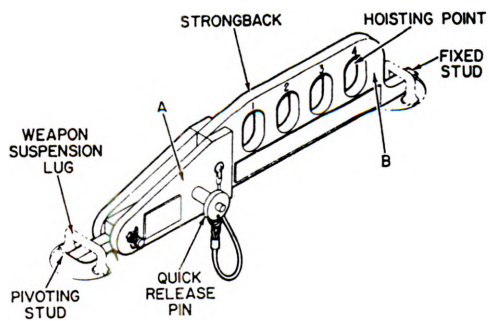


Figure 10-5.—Mk 49 Mod 1 weapons carrier.

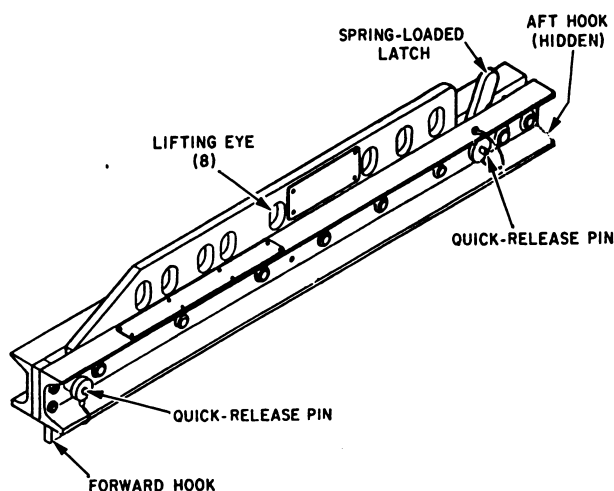


Figure 10-6.—Mk 51 Mod 1 weapons carrier.

carrier is used for horizontal lifting of weapons with 14-inch suspension lugs, and it has an SWL of 2,500 pounds.

MK 51 MOD 1 WEAPONS CARRIER

The Mk 51 Mod 1 weapons carrier (fig. 10-6) is an aluminum channel that is plate-carrier fitted with two steel hooks. A fixed position hook with a spring-loaded pinned latch is located at the aft end of the carrier. The forward hook is adjustable to let you attach the carrier to weapons or stores with 14- or 30-inch suspension lugs. The forward hook is held in place by a quick-release pin. Eight lifting eyes let you handle weapons with different centers of gravity.

Before you attach the carrier to the load, put the adjustable hook in the appropriate suspension placement hole, which is held in place by a quick-release pin. With the spring-loaded latch unpinned

and depressed, the carrier hooks are engaged with the weapon lugs. Release the spring-loaded latch and pin the latch in place with a quick-release pin to secure the load. An instruction plate, mounted on the carrier, makes it easier for you to match the correct lifting eye to the load. The Mk 51 Mod 1 weapons carrier is used for horizontal lifting. It has an SWL of 4,000 pounds.

REVIEW NUMBER 2

- Q1. What is the purpose of a carrier?
- Q2. The Mk 49 Mod 1 weapons carrier is constructed of _____.
- Q3. The Mk 49 Mod 1 and Mk 51 Mod 1 weapons carriers are used to _____.
- Q4. What is the SWL of the Mk 51 Mod 1 weapons carrier?

STANDS

Learning Objective: Recognize the purpose and use of stands to include the A/E32M-4 maintenance and reconfiguration stand and the A/F 32K-1/1A bomb assembly stand.

REVIEW NUMBER 1 ANSWERS

- A1. For a complete listing and description of approved handling equipment, you should look in NAVSEA OP 2173, Volume 1.
- A2. The general purpose of the standard four-way wood pallet is for use when shipping domestic unit loads of ordnance.
- A3. The safe working load (SWL) of the Mk 3 Mod 0 and Mk 12 Mod 2 pallets is 4,000 pounds.
- A4. Ammunition pallet crates are used at naval shore activities to handle loose ammunition and inert items during on-station handling and transportation.

Stands are metal frameworks used to support a weapon being assembled or maintained. Stands may be immobile or equipped with pivoting casters. The stands discussed in the following paragraphs are of the immobile type.

A/E32M-4 MAINTENANCE AND RECONFIGURATION STAND

The A/E32M-4 maintenance and reconfiguration stand (fig. 10-7) is made of steel and aluminum. The stand consists of maintenance ring assemblies MXK-663/E32M-4 (forward), MXK-664/E32M-4 (aft), and deck post assembly MXK-665/E32M-4 that supports each ring

assembly. The ring assemblies can be rotated 180 degrees for convenient load accessibility.

The A/E32M-4 maintenance and reconfiguration stand is used to hold the F-14 aircraft weapons rail during general maintenance. It is also used for configuring the F-14 weapons rail with associated bomb racks.

A/F 32K-1/1A BOMB ASSEMBLY STAND

The A/F 32K-1/1A bomb assembly stand (fig. 10-8) consists of three interchangeable and interlocking 49-inch sections. The stand must be secured to the deck. It has four trays placed on

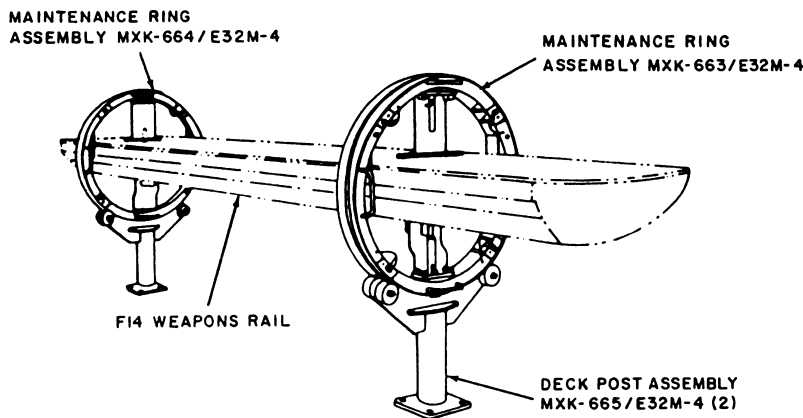


Figure 10-7.—A/E32M-4 maintenance and reconfiguration stand.

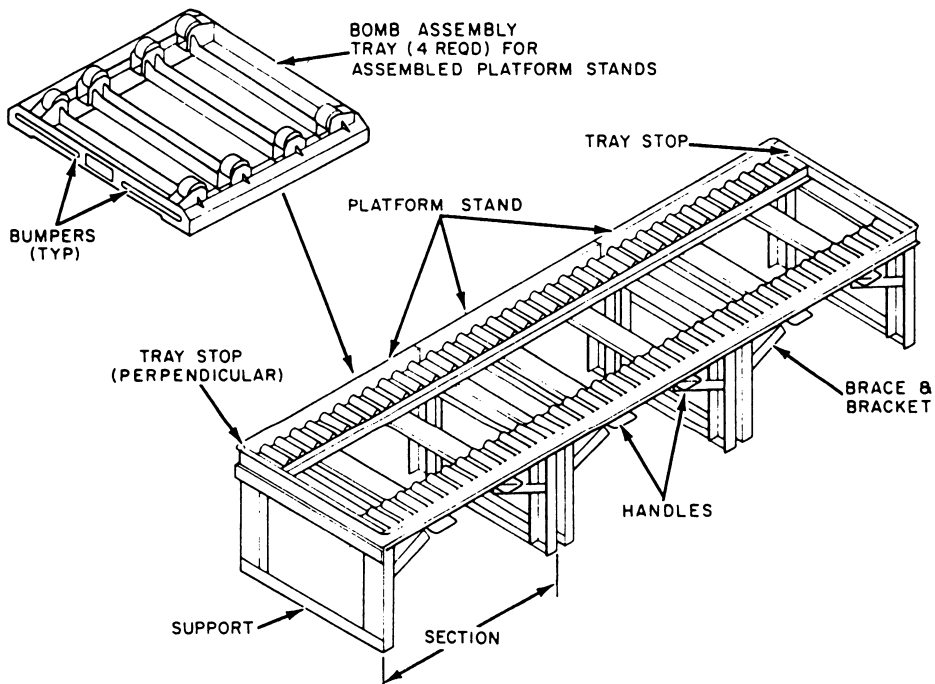


Figure 10-8.—A/F 32K-1/1A bomb assembly stand.

top of conveyor rollers to permit a 360-degree rotation of the weapon. Stops are located at each end to prevent the trays from moving beyond the end of the conveyor. Each of the sections are collapsible for stowage purposes.

The stand is designed to support Mk 80 series general-purpose bombs during the assembly process. However, the stand may be used to support various other weapons during the assembly process.

HOISTING BARS

Learning Objective: Recognize the purpose and use of hoisting bars.

Hoisting bars are used for carrying, lifting, and handling weapons. They are normally used during weapons handling and loading evolutions.

AERO 64A HOISTING BAR

The Aero 64A hoisting bar (fig. 10-9) consists of a cradle, strap, and two carrying handles. The cradle is a weldment frame that has four padded braces. The handles have knurled gripping surfaces. A missile is secured in the cradle by a web strap attached to the tie-down assembly and the bar buckle.

Two Aero 64A hoisting bars must be used to manually lift a Sparrow or Shrike missile from

a missile skid to an aircraft wing or fuselage-mounted launcher.

AERO 68A HOISTING BAR

The Aero 68A hoisting bar (fig. 10-10) is a bar within a bar that has a hook assembly attached. The length of the bar can be increased by extending the internal bars 15 7/8 inches each.

To manually lift the weapon, you must hook the Aero 68A hoisting bar into the weapon lugs. This bar is used to handle or transport any weapon having standard lugs. Weapons weighing up to 1,000 pounds can be lifted if two bars are used.

HLU-256/E MANUAL HOISTING BAR

The HLU-256/E manual hoisting bar (fig. 10-11) consists of a round steel bar with a removable bomb nose plug connector and tail stop plates on one end. A quick-release pin secures the nose plug connector to the bar. When a tee configuration is desired, the nose plug can be relocated to a position at the bar's midpoint. The opposite end of the bar can be used as a lift point in the bomb's tail end. A tail stop is situated 18 inches from this end of the bar.

The HLU-256/E manual hoisting bar is used to manually lift Mk 80 series general-purpose bombs that weigh up to 1,000 pounds during aircraft loading/unloading operations. It is also used for weapons assembly purposes.

REVIEW NUMBER 2 ANSWERS

- A1. A carrier is used as a quick and safe way of attaching a crane cable or other hoisting device to ammunition for movement from one area to another.*
- A2. The Mk 49 Mod 1 weapons carrier is constructed of two steel pallets welded together.*
- A3. The Mk 49 Mod 1 and Mk 51 Mod 1 weapons carriers are used to lift weapons with 14-inch suspension lugs. The Mk 51 Mod 1 carrier can also lift weapons with 30-inch suspension lugs.*
- A4. The SWL of the Mk 51 Mod 1 weapons carrier is 4,000 pounds.*

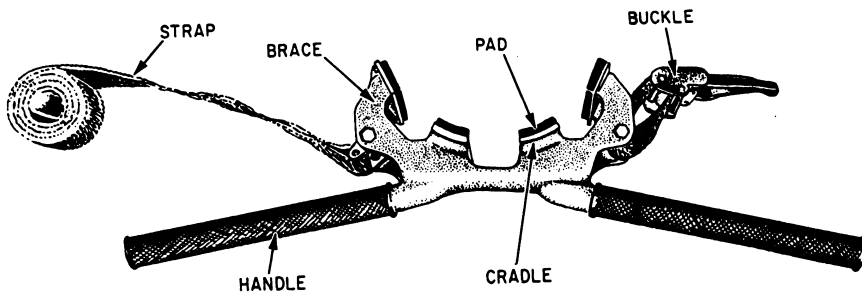


Figure 10-9.—Aero 64A hoisting bar.

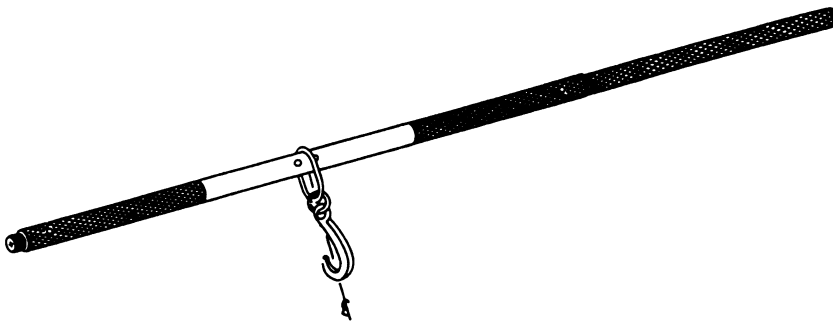


Figure 10-10.—Aero 68A hoisting bar.

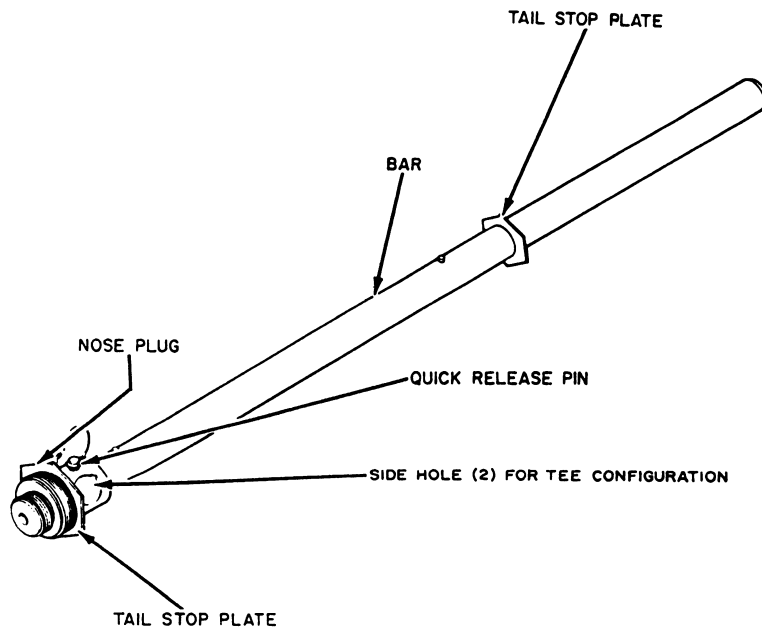


Figure 10-11.—HLU-256/E manual hoisting bar.

REVIEW NUMBER 3

- Q1. *What is the purpose of stands?*
- Q2. *What maintenance ring assembly is used with the A/E32M-4 maintenance and reconfiguration stand?*
- Q3. *What is the purpose of the A/E32M-4 maintenance and reconfiguration stand?*
- Q4. *What is the maximum rotation of the A/F 32K-1/1A bomb assembly stand?*
- Q5. *The Aero 64A hoisting bar is used to _____.*
- Q6. *When using two Aero 64A hoisting bars, what is the maximum weight that can be lifted?*
- Q7. *What hoisting bar is used to manually lift Mk 82 bombs?*

BEAMS

Learning Objective: *Recognize the purpose and use of beams and identify the loads that each carries.*

A beam is a rigid metal item that has an I, H, T, or circular cross section. The rigid portion is fitted with a lifting eye, a sling or sling attaching points, and devices for attaching a load.

HLU-210/E HOISTING BEAM

The HLU-210/E hoisting beam (fig. 10-12) is an aluminum strongback with shoe slots on each end. The shoe slots are designed to slide into the forward and aft launching shoes of the Standard Arm missile. A lift pin, two forklift pockets, and two handles for hand carrying and positioning are located along the top of the beam. The forward shoe slot is locked into place by a ball-lock pin inserted down through the beam to secure the missile to the beam.

The HLU-210/E hoisting beam is used to hoist or lift the Standard Arm missile in areas, such as magazines, that have restricted clearance aboard ship.

ADU-399/E GUIDED MISSILE HOISTING BEAM

The ADU-399/E guided missile hoisting beam (fig. 10-13) is an aluminum weldment consisting of a beam supported on forklift channels and structural members. These components form the base assembly. Rubber-lined cradles mounted fore and aft on the beam prevent metal-to-metal contact. The cradles have side supports held in position by quick-release pins. When you are loading or unloading the beam, remove the quick-release pins to let the side supports swing down out of the way. There are two adjustable tubular extenders on the fore end of the beam that support a vinyl-covered housing. The housing protects the weapon's radome. Quick-release pins secure the extenders to the beam and the radome protector to the extenders. There are cable hoists

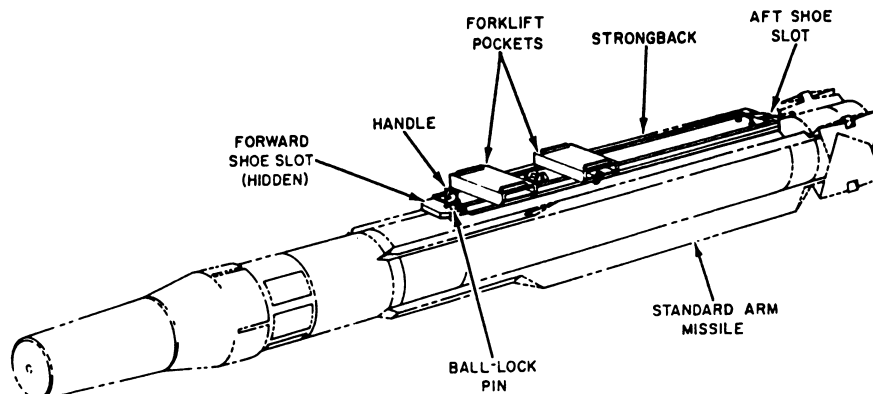


Figure 10-12.—HLU-210/E hoisting beam.

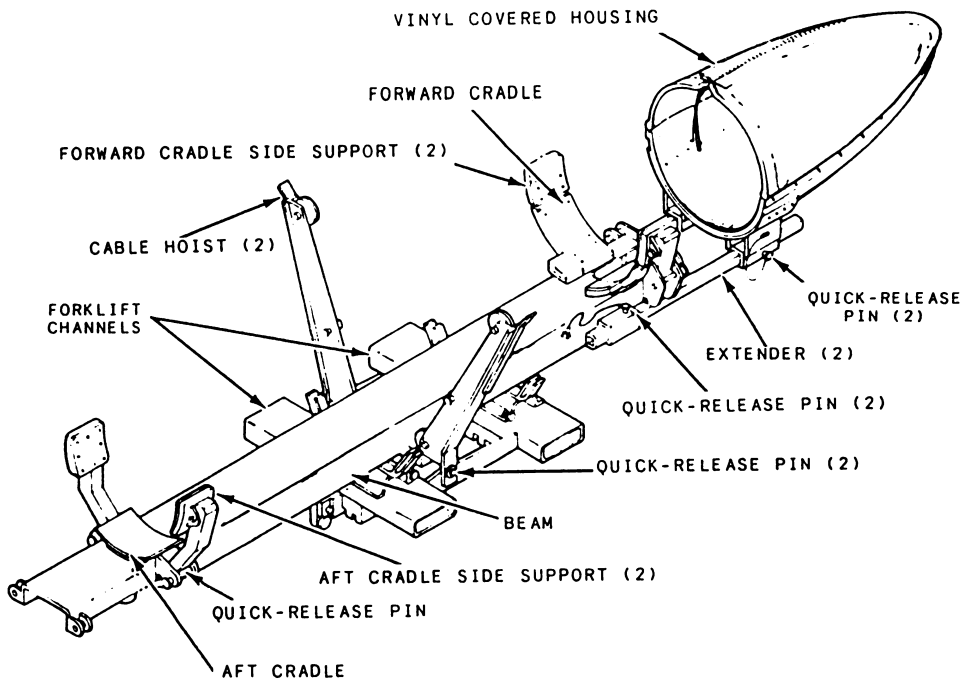


Figure 10-13.—ADU-399/E guided missile hoisting beam.

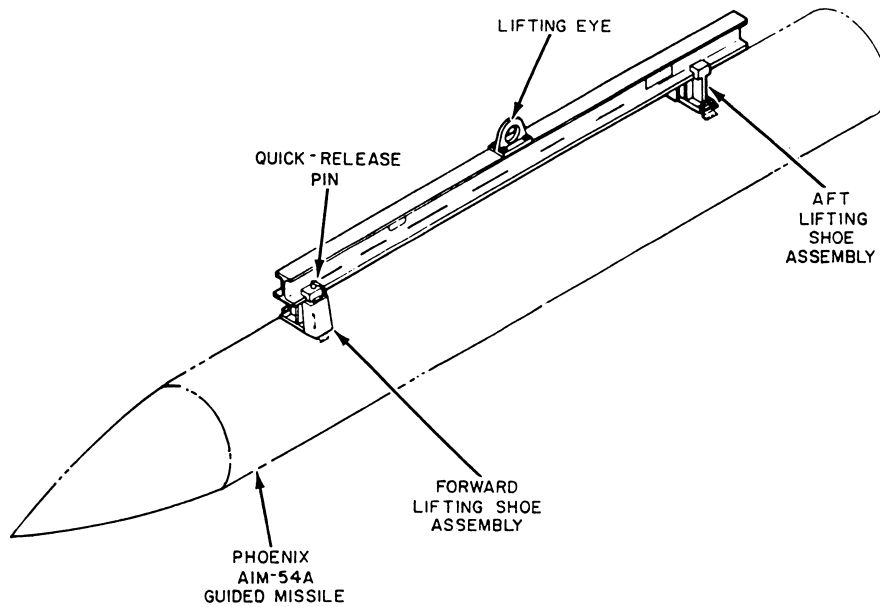


Figure 10-14.—MHU-129/E guided missile hoisting beam.

mounted on the base assembly held in the hoisting position by quick-release pins. When the pins are removed, the hoists swing down and forward into the stowed position.

The ADU-399/E guided missile hoisting beam is used for ground support handling of the Phoenix missile during aircraft loading/unloading operations. This beam may be used in

conjunction with the HLU-196B/E bomb hoist, the A/M32K-1A/1B/1C SATS loader, or the ADU-400/E weapon skid loading adapter.

MHU-129/E GUIDED MISSILE HOISTING BEAM

The MHU-129/E guided missile hoisting beam (fig. 10-14) is an aluminum I-beam with a lifting

eye mounted on the top of two removable lifting-shoe assemblies. The shoe assemblies are secured to the lower flange of the beam with quick-release pins designed to engage the forward and aft launch lugs of the Phoenix guided missile. The safety latches in the shoe assemblies secure the beam to the missile.

The MHU-129/E guided missile hoisting beam is used aboard ship (aircraft carriers) to handle a previously assembled Phoenix guided missile.

MK 37 MOD 0 LIFT BEAM

The Mk 37 Mod 0 lift beam (fig. 10-15) is an aluminum alloy beam with an adjustable lifting eye secured to it by two quick-release pins. The suspension lug adapters at each end of the lift beam are used to engage the forward and aft suspension lugs on the Harpoon air-launched missile. A quick-release pin in the aft suspension lug adapter is used for securing the beam to the missile.

The Mk 37 Mod 0 lift beam is used with an overhead crane or hoist to lift the Harpoon air-launched missile from the container to the missile assembly stand, or from the missile assembly stand into the container.

REVIEW NUMBER 4

- Q1. What is the shape of a beam?*
- Q2. What missile is the HLU-210/E used to hoist?*
- Q3. What beam is used during ground support handling of the Phoenix missile during aircraft loading/downloading operations?*
- Q4. When you move a Harpoon missile from its container to the missile assembly stand, you would use _____.*

BOMB HOISTS

Learning Objective: Recognize the purpose and use of bomb hoist and identify the loads for each.

REVIEW NUMBER 3 ANSWERS

- A1. Stands are used to support a weapon being assembled or maintained.*
- A2. The MXK-663/E32M-4 (forward) maintenance ring assembly is used with the A/E 32M-4 maintenance and reconfiguration stand.*
- A3. The A/E 32M-4 maintenance and reconfiguration stand is used to hold the F-14 aircraft weapons rail during general maintenance.*
- A4. The maximum rotation of the A/F 32K-1/1A bomb assembly stand is 360 degrees.*
- A5. The Aero 64A hoisting bar is used to manually lift Shrike and Sparrow missiles.*
- A6. When using two Aero 64A hoisting bars, 1,000 pounds is the maximum weight that can be lifted.*
- A7. The HLU-256/E hoisting bar is used to manually lift Mk 82 bombs.*

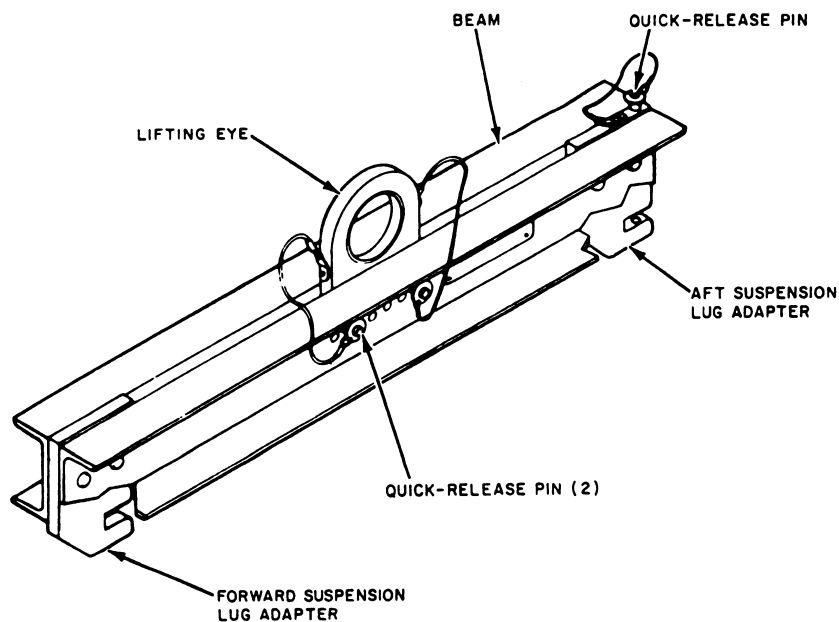


Figure 10-15.—Mk 37 Mod 0 lift beam.

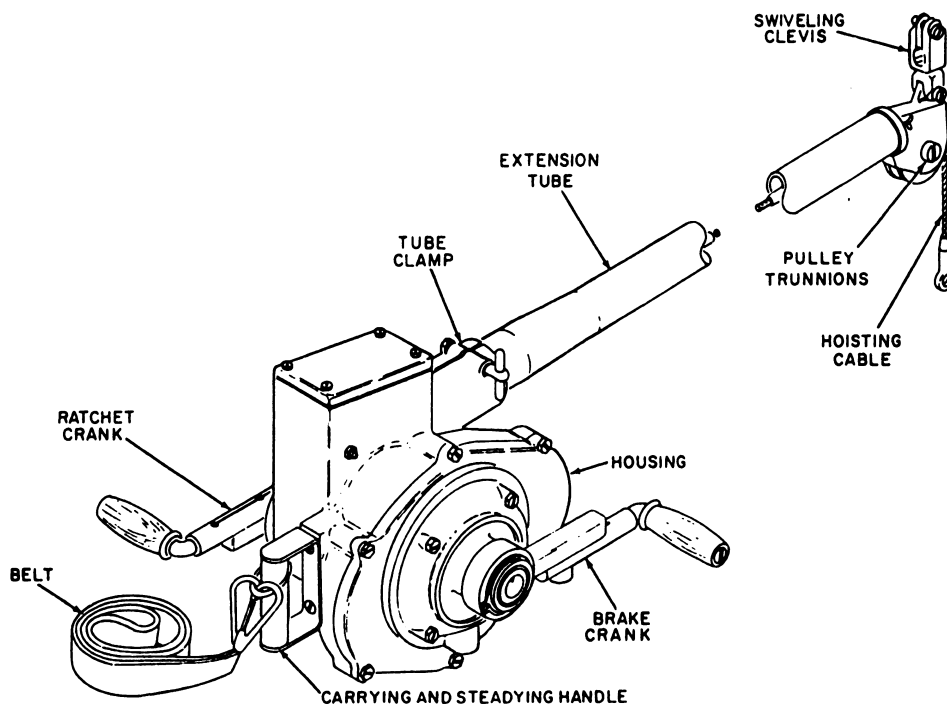


Figure 10-16.—Aero 14C bomb hoist.

A hoist is a mechanism that provides a mechanical advantage when raising or lowering heavy loads such as bombs, mines, and torpedoes.

AERO 14C BOMB HOIST

The Aero 14C bomb hoist (fig. 10-16) consists of a gear train, drum and cable, brake mechanism,

fishpole-type extension tube, and two cranks (a ratchet crank and a brake crank). The cable drum rotates in the opposite direction of the cranks. The ratchet crank is used only to help hoist the load. You can disengage it from the gear train by latching a ratchet pawl with a ratchet pawl latch. The brake crank is used to hoist and lower

the load. After the load is lifted, a clutch-type brake holds the gear train fast. A spring-loaded roller riding on the top of the cable drum and a cable guide inside the extension tube keep the cable lying firmly in its groove. This condition is also true under a no-load condition.

At the end of the extension tube, a swiveling clevis, which is used for hook suspension, couples the hoist to the bomb rack being loaded. The swiveling clevis lets you operate the hoist from different points on the ground. A tube clamp permits rotation of the cranking mechanism to any position around the extension tube.

The Aero 14C bomb hoist is used to hoist various weapons. This hoist is also used for maintenance of aircraft such as engine removal and installation and for loading/unloading operations of various aircraft stores. The hoist cable is attached to the load by putting a pin through the clevis. When you rotate the ratchet and brake cranks in a clockwise direction, the load is hoisted. When you rotate the brake crank in a counterclockwise direction, it lowers the load. The Aero 14C bomb hoist is used with a variety of hoisting beams, adapters, and trolleys.

HLU-196B/E BOMB HOISTING UNIT

The HLU-196B/E bomb hoisting unit (fig. 10-17) is a lightweight, portable, gasoline engine-driven unit. It consists of a gasoline engine, speed-reducing gearbox and brake, and a cable assembly and storage drum that incorporates a clutch and a boom. All components and controls are mounted on a two-wheeled frame assembly. The entire unit weighs 75 pounds. It has a direct single

cable lift capacity of 2,000 pounds. A double cable lift capacity of 4,000 pounds is obtainable by using various trolleys and rack adapters that are available. You can extend the cable by disengaging the clutch and manually pulling it until the necessary length is withdrawn. To reel the cable in, you must start the engine, engage the clutch, and carefully throttle the engine to control the reel-in speed of the cable. Maximum reel-in speed of the cable is 15 feet per minute.

The HLU-196B/E is used to single or, by the use of various trolleys and adapters, double hoist various weapons and stores.

HOISTING BANDS

Hoisting bands are used to encircle a load and provide a means for attaching hoisting equipment or other handling equipment. The hoisting bands are steel straps with either one or two points used to attach them to the hoist equipment.

Look at figure 10-18. It shows a hoisting band configured with a HLK-278/F32K-5 band latch assembly and a HLK-279/F32-5 anchor fitting assembly. The band latch assembly is used to clamp the band around the weapon. The anchor fitting assembly is used to secure the eyebolt of the latch to the band, or to attach the eye of a hoisting cable to the sling. Configuration of these two assemblies with the bands makes it possible to accommodate many different sizes, shapes, and weights of stores.

There are three different bands available—the short light-gauge hoisting band (HLK-275/F32K-5), the long light-gauge hoisting band

REVIEW NUMBER 4 ANSWERS

- A1. A beam is a rigid metal item that has an I, H, T, or circular cross section.*
- A2. The HLU-210/E is used to hoist the Standard Arm missile.*
- A3. The ADU-399/E guided missile hoisting beam is used during ground support handling of the Phoenix missile.*
- A4. When you move a Harpoon missile from its container to the missile assembly stand, you would use the Mk 7 Mod 0 lift beam.*

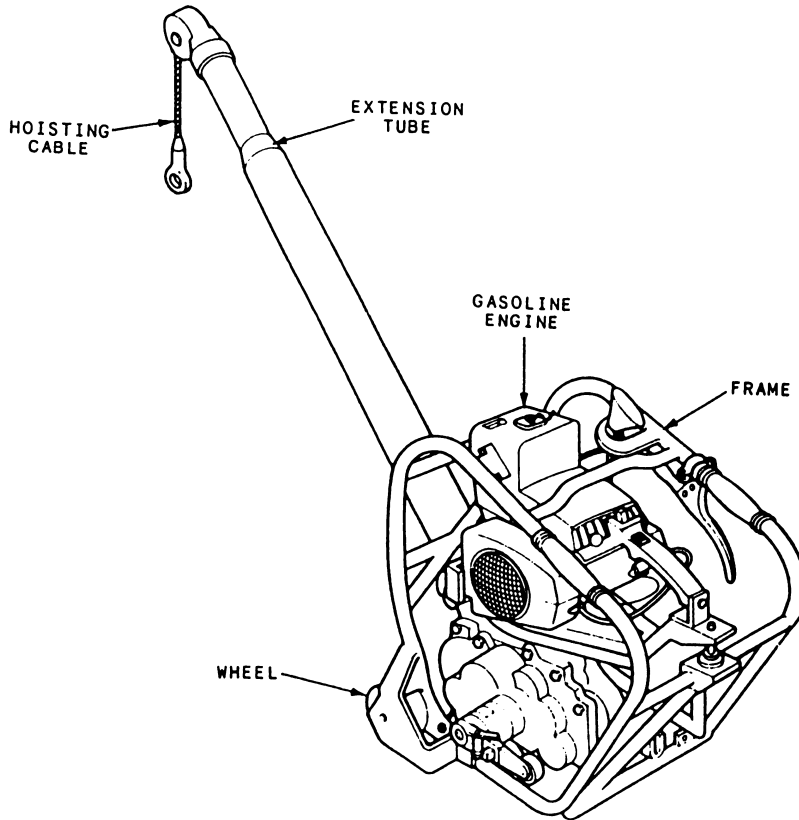


Figure 10-17.—HLU-196B/E bomb hoisting unit.

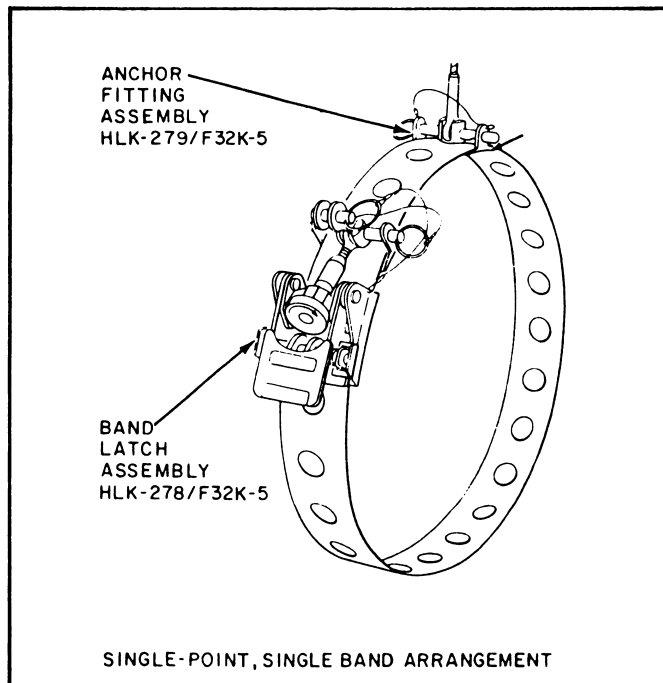


Figure 10-18.—Example of a hoisting band configuration.

Table 10-1.—Load Limitations for Common Arrangements of Hoisting Bands

CONFIGURATION	MAXIMUM DIAMETER	SWL	REMARKS
Single, long light-gauge band, single-point suspension	18 inches	1000 pounds	— — — —
Single, short light-gauge band, single-point suspension	15 inches	2500 pounds	— — — —
Single, heavy-gauge band, single-point suspension	30 inches	1500 pounds	— — — —
Single, long light-gauge band, double-point suspension	25 inches	2500 pounds	Latch-assembly point must be located above the horizontal centerline of the store
Single, heavy-gauge band, double-point suspension	30 inches	3200 pounds	An additional band is required if store exceeds 30 inches in diameter

(HLK-276/F32K-5), and the heavy-gauge hoisting band (HLK-277/F32K-5). These bands can be arranged for single- or double-point hoisting. (See table 10-1.)

There are many different types of hoisting bands available, but the hoisting bands described above are predominately used throughout the aviation ordnance field. They are used in with the Aero 14C and HLU-196B/E bomb hoists during aircraft loading operations.

Q4. What is the single cable lift capacity of the HLU-196B/E bomb hoist?

Q5. What is the purpose of hoisting bands?

Q6. List the types of available hoisting bands.

REVIEW NUMBER 5

Q1. List the components of the Aero 14C bomb hoist.

Q2. What component of the Aero 14C bomb hoist is used to hoist or lower the load?

Q3. List the components of the HLU-196B/E bomb hoisting unit.

SKIDS, WEAPONS TRANSPORTERS, AND ASSOCIATED ADAPTERS

Learning Objective: Identify the purpose and use of skids, weapons transporters, and associated adapters. Recognize the safe loads for each.

A skid or weapon transporter is a mobile piece of equipment with a welded frame-type construction mounted on two or four rubber-tired wheels. It is used with various adapters to support a load for movement from one area to another.

Wheeled skids or weapons transporters are generally equipped with a brake mechanism so the skid won't move when unattended. Handles are attached to all mobile skids and weapons transporters to provide a means of moving and controlling the units. The units are not self-propelled and require either manpower or power equipment to move them. They are used for handling various weapons and miscellaneous ammunition items during the aircraft rearming process aboard aircraft carriers and at shore stations.

You can't use skids and weapons transporters without adapters. Adapters are an interface between the skid or weapon transporter and the weapon or store to be supported. They provide a support surface and a means of securing the weapon or store to the skid or transporter. This prevents any inadvertent movement. There are many different types of adapters available for any one particular skid or weapon transporter, or an adapter may be compatible with several different skids or weapons transporters. Adapters are attached to the skids or weapons transporters by quick-release pins or other types of quick-change devices.

AERO 12C BOMB SKID

The Aero 12C bomb skid (fig. 10-19) is a wheelbarrow skid. It consists of a cradle frame mounted on two rubber-tired wheels and equipped with two supporting legs. The skid has two tubular steel handles that you can quickly latch or unlatch. This makes it easier to reposition or remove the handle, using a handle release on the aft end of each handle.

The wheels are braked by two brake shoes applied to the wheels by the support legs. Apply the brakes by lowering the skid so the supporting legs come in contact with the deck or runway. The brakes are released when the skid is raised high enough for the supporting legs to clear the deck or runway.

The skid is equipped with adjustable chocks on the bed of the frame. These chocks let you properly position the load on the skid. Each side of the skid is equipped with two hold-down brackets. One set of brackets accommodates the long or short handles. The other set of brackets is used for attaching tie-down straps.

The Aero 12C bomb skid is used to transport weapons having a diameter between 4 and 18 inches. With the exception of Mk 81 bombs,

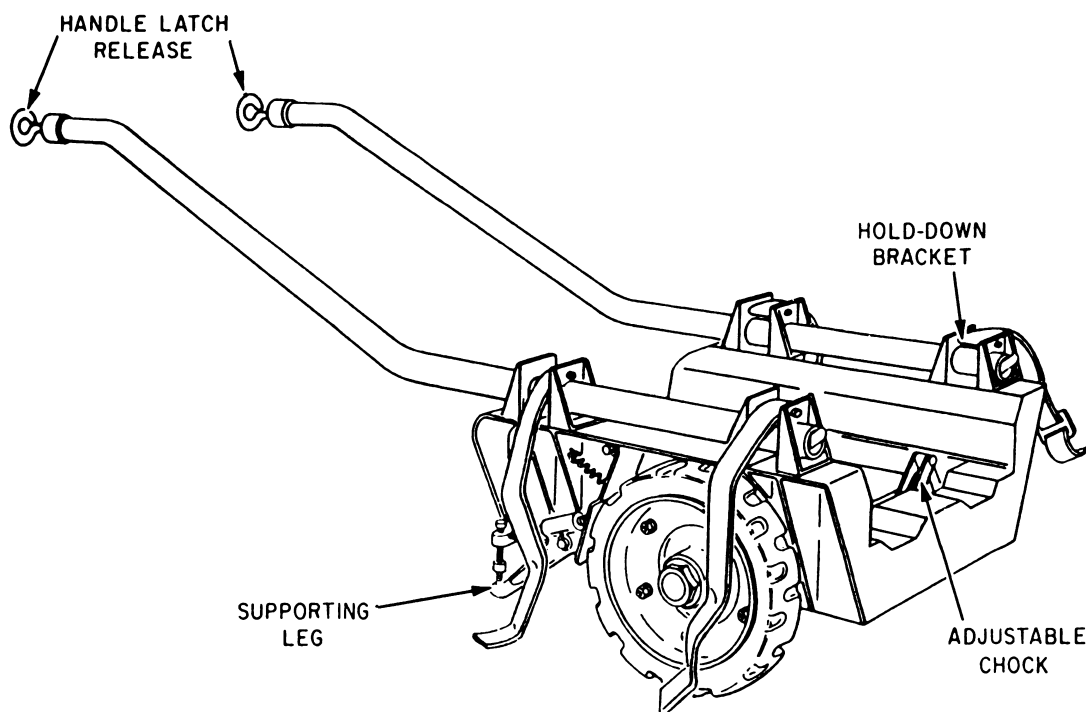


Figure 10-19.—Aero 12C bomb skid.

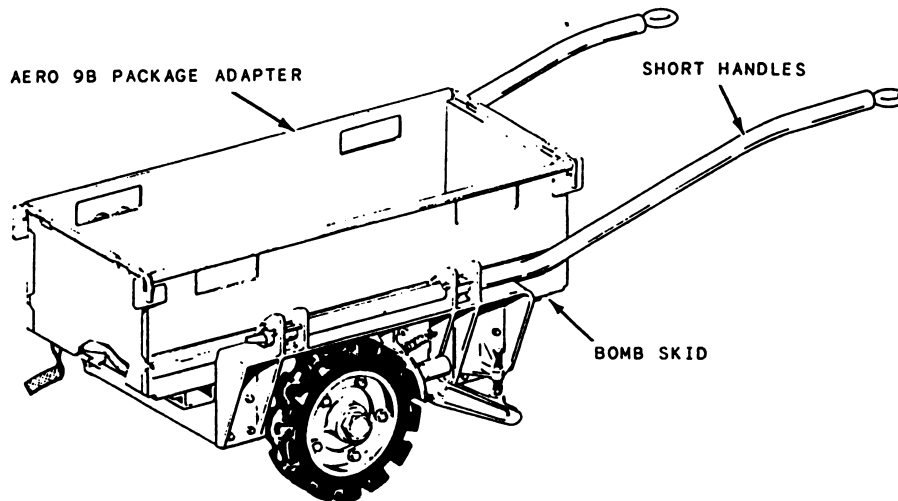


Figure 10-20.—Aero 9B/C bomb skid adapter mounted on an Aero 12C bomb skid.

weapons are transported singly or in pairs. The skid has an SWL of 1,250 pounds.

Aero 9B/C Bomb Skid Adapter

The Aero 9B/C bomb skid adapter (fig. 10-20) consists of an aluminum box-like frame with collapsible walls. It is constructed with stiffeners

at the sides and bottom. The adapter is secured to the skid by two spring-loaded latches. Hand holes are provided in the sides of the adapter for manual handling.

The Aero 9B/C bomb skid adapter is used with the Aero 12C bomb skid to handle and transport miscellaneous ammunition items. The adapter has an SWL of 1,000 pounds.

REVIEW NUMBER 5 ANSWERS

- A1. The components of the Aero 14C bomb hoist include a gear train, drum and cable, brake mechanism, fishpole extension tube, and two cranks.
- A2. The break crank of the Aero 14C bomb hoist is used to hoist or lower the load.
- A3. The components of the HLU-196/E bomb hoisting unit include gasoline engine, speed-reducing gearbox and brake, a cable assembly, and storage drum.
- A4. The single cable-lift capacity of the HLU-196/E bomb hoist is 2,000 pounds.
- A5. Hoisting bands are used to circle a load and as a means of attaching hoisting equipment or other handling equipment.
- A6. Hoisting bands include the short light-gauge hoisting band, long light-gauge hoisting band, and the heavy-gauge hoisting band.

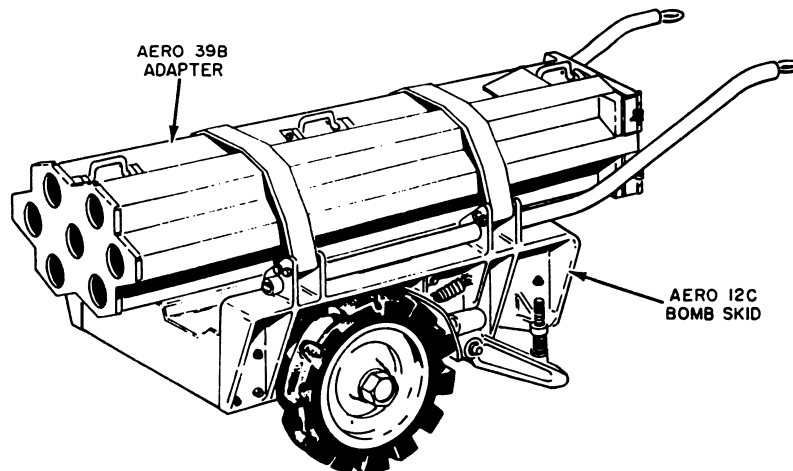


Figure 10-21.—Aero 39B bomb skid adapter mounted on an Aero 12C bomb skid.

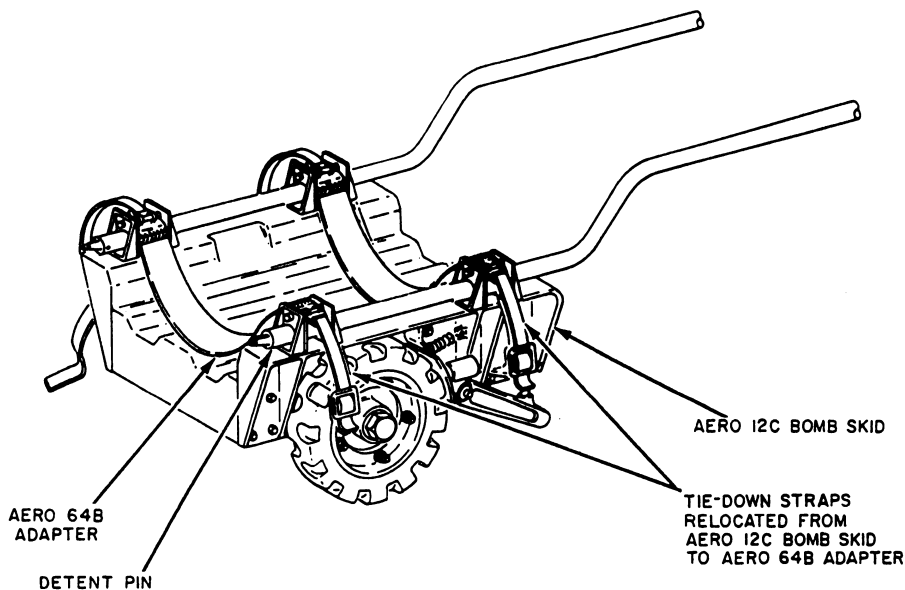


Figure 10-22.—Aero 64B soft-belt adapter mounted on an Aero 12C bomb skid.

Aero 39B Bomb Skid Adapter

The Aero 39B bomb skid adapter (fig. 10-21) consists of seven hexagonal aluminum tubes welded together. It is flat on one side and contoured around the hexagonal tubes on the other three sides. The assembly has three handles mounted on it for lifting and a hinged door at one end for loading.

The Aero 39B bomb skid adapter is used with the Aero 12C bomb skid to transport and store nitrogen-filled bottles used as a coolant on the

LAU-7A guided missile launcher. The adapter has an SWL of seven nitrogen bottles.

Aero 64B Soft-Belt Adapter

The Aero 64B soft-belt adapter (fig. 10-22) consists of a flexible, neoprene-covered, woven-wire sling. The adapter has slots at the ends for attaching tie-down straps. The adapter is also equipped with brackets for attaching it to the skid.

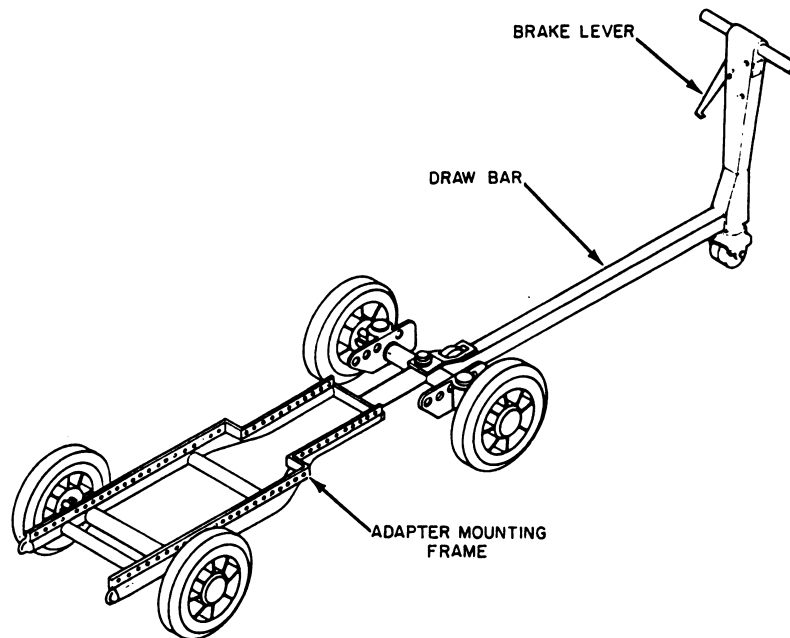


Figure 10-23.—Aero 21C weapon skid.

Two Aero 64B soft-belt adapters support or store a soft-skin weapon up to 20 inches in diameter on the Aero 12C bomb skid. Each Aero 64B adapter has an SWL of 2,500 pounds.

AERO 21C WEAPON SKID AND MHK-128/M32K-5(V) MUNITIONS TRANSPORTER

The Aero 21C weapon skid (fig. 10-23) is a welded tubular frame equipped with a box section of drilled steel bars, which provide the mounting holes for attaching various adapters. It has two axles and four rubber wheels. The two front wheels are equipped with drum brakes. The brakes are actuated by the brake lever located on the draw bar. The brakes are applied automatically when the spring-loaded brake lever is in the down position. To release the brakes, pull the brake lever upward toward the T on the drawbar. The brake shoes are actuated through the mechanical linkage located inside the drawbar. The brake lever is continually held in the upward position so the skid can move. Be careful when you release the brake lever; it is spring-loaded and can cause the lever to snap downward. This may result in damage to the mechanical linkage system. The drawbar is attached to the skid by a quick-release pin. This pin also connects the brake linkage between the skid and the brake lever on the drawbar.

Two drawbars are available for use with the Aero 21C weapon skid. Use the short drawbar to transport short weapons or when working in an area where a long handle cannot be used. Use the long drawbar to transport long weapons such as missiles, flare dispensers, or rocket launchers. The skid has an SWL of 5,000 pounds. It is used with various adapters to transport or load weapons, stores, and equipment.

The MHK-128/M32K-5(V) munitions transporter (fig. 10-24) consists of a frame assembly with 53 pairs of mounting holes, four 14-inch wheels with solid tires, and a retractable or nonretractable drawbar. It has a mechanically actuated deadman and drum brakes on the two front wheels. Release the brake using the hand lever on the drawbar handle. You steer the transporter by horizontally moving the drawbar.

The MHK-128/M32K-5(V) munitions transporter is used with the ADK-362/M32K-5(V) multiweapons adapter to transport a pre-configured multiweapon or single-weapon load from the stowage area to the aircraft. The transporter has a low-frame structure. It can be positioned under low wing stations of an aircraft. The MHK-128/M32K-5(V) munitions transporter has an SWL of 5,000 pounds. It is used with various adapters.

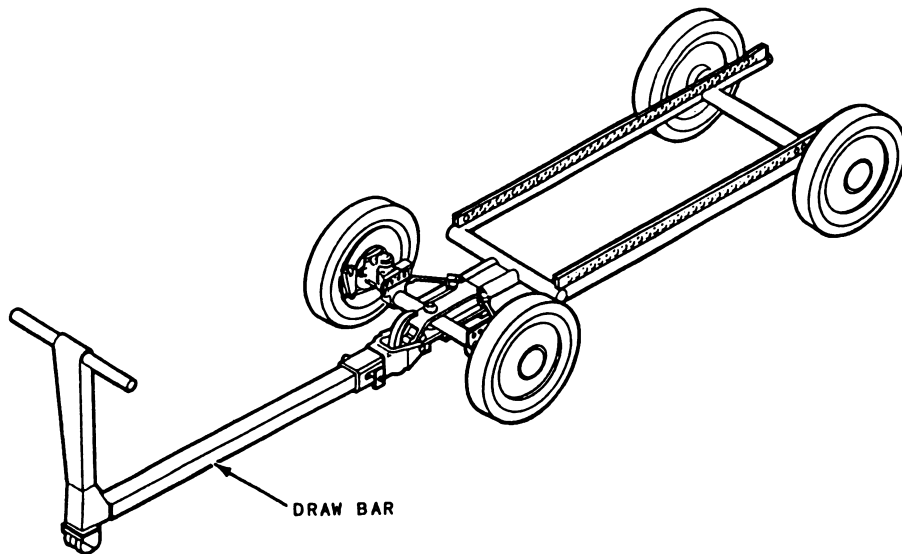


Figure 10-24.—MHK-128/M32K-5(V) munitions transporter.

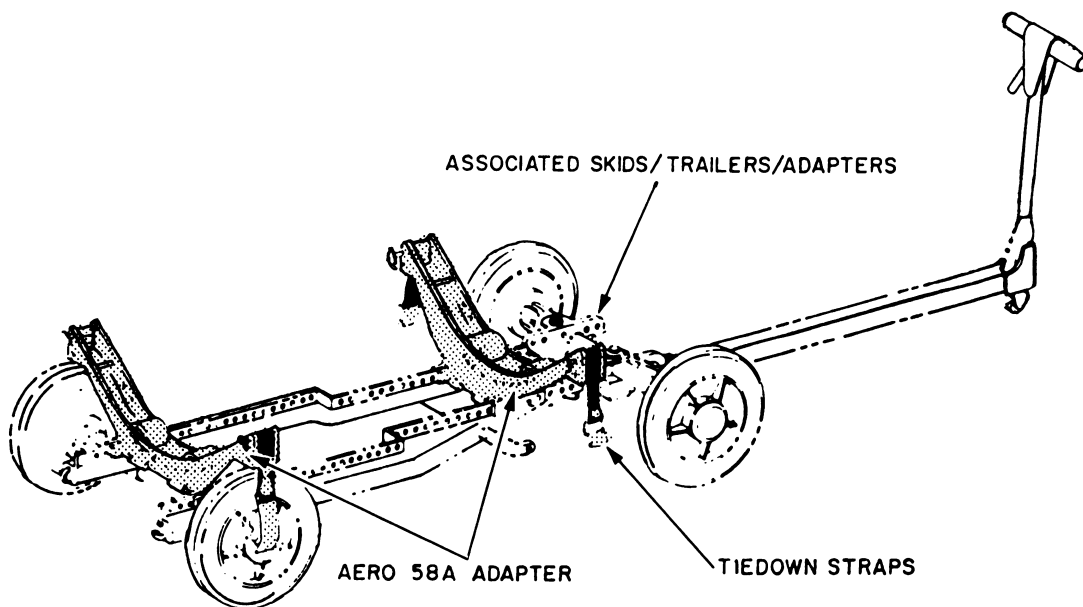


Figure 10-25.—Aero 58A skid adapter mounted on an Aero 21C weapon skid.

Aero 58A Skid Adapter

The Aero 58A skid adapter (fig. 10-25) has a front and rear section. These sections are similar in design. The primary difference is base—the front section has a 10-inch base and the rear section has a 15-inch base. These front and rear sections fit on the rails of the skid. Each adapter section has two removable rubber rollers supporting the weapon. These rollers are

adjustable from one to six positions to accommodate weapons of different diameters. Nylon straps hold the weapon in place.

One set of Aero 58A skid adapters has an SWL of 5,000 pounds. It holds a single weapon up to 30.5 inches in diameter. This adapter can also be used with the MHU-125/E platform skid, MHU-126/M munitions trailer, and the MHK-128/M32K-5 munitions transporter.

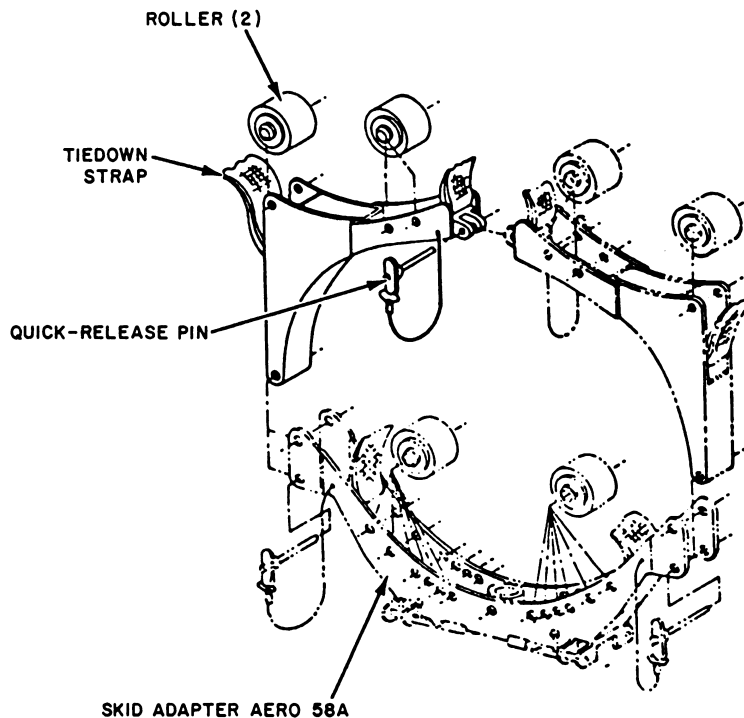


Figure 10-26.—ADU-483/E skid adapter assembly.

ADU-483/E SKID ADAPTER ASSEMBLY.—The ADU-483/E skid adapter assembly (fig. 10-26) consists of one steel upper-frame section with two removable rubber rollers and a nylon tie-down strap with buckle. A quick-release pin is used to attach and secure the two adapter assemblies together at the top. This forms a complete load-bearing assembly that supports two cylindrical weapons side by side. The position of the outboard roller is fixed. The inboard roller can be positioned in either of two positions to hold weapons of different diameters.

The ADU-483/E skid adapter assembly is used in pairs with the Aero 58A skid adapters. When mounted on the top of two Aero 58A skid adapters (front and rear) and secured with quick-release pins, the ADU-483/E skid adapter assembly supports two weapons from 9 to 16 inches in diameter. Two pairs of the ADU-483/E skid adapters have an SWL of 4,000 pounds. When the skid adapter assemblies are installed, the Aero 58A skid adapter is limited to weapons with a maximum diameter of 16 inches.

AERO 57A SKID ADAPTER.—The Aero 57A skid adapter (fig. 10-27) consists of four upper sections. Each section is similar, but only two of the four sections are equipped with detent pins for securing the sections together at the

center. The upper sections have one roller each for weapon support. There are nylon straps provided for holding the weapon in place. The adapters are mounted in pairs on the Aero 58A skid adapters, and they are attached with detent pins.

When the Aero 57A skid adapters are installed on the Aero 58A skid adapters, two 20-inch diameter weapons may be carried. The upper rollers adjust to two different positions to hold weapons with diameters ranging from 12 to 20 inches. The Aero 58A adapters hold weapons with diameters from 8 to 20 inches. One set of Aero 57A skid adapters has an SWL of 4,000 pounds.

AERO 91A BRACKET ADAPTER.—The Aero 91A bracket adapter (fig. 10-28) consists of an arm weldment, two sleeve weldments, connecting pins, hooks, T bolts, and clamp weldments. You can adjust the bracket to hold loads varying between 28 and 40 inches in width.

The Aero 91A bracket adapter is attached to the Aero 58A skid adapters to convert the Aero 21C weapon skid into a flatbed vehicle capable of handling weapon pallets, cradles, and containers. Two bracket adapters are required for each skid. A set of two Aero 91A bracket adapters has an SWL of 4,000 pounds.

AERO 71A SKID ADAPTER.—The Aero 71A skid adapter (fig. 10-29) consists of a

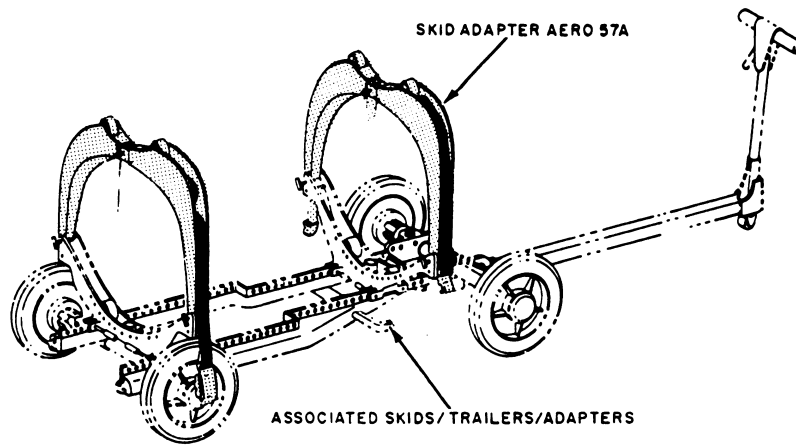


Figure 10-27.—Aero 57A skid adapter mounted to 58A skid adapter/Aero 21C weapon skid.

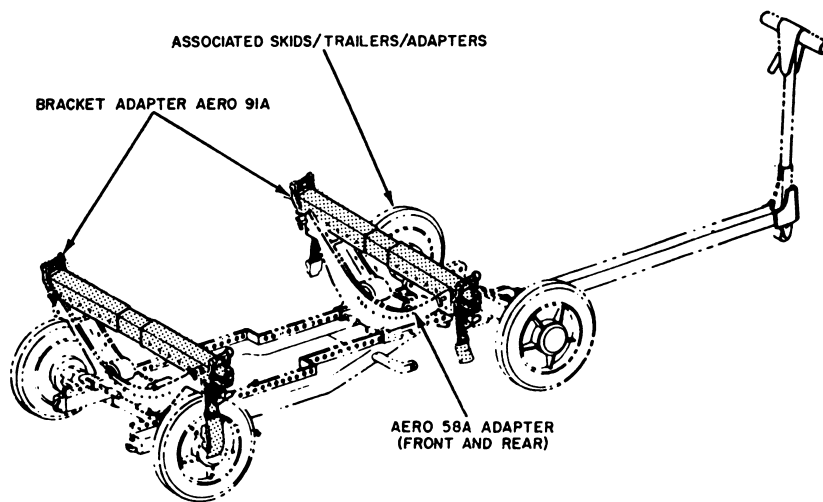


Figure 10-28.—Aero 91A bracket adapter mounted to Aero 58A skid adapters/Aero 21C weapon skid.

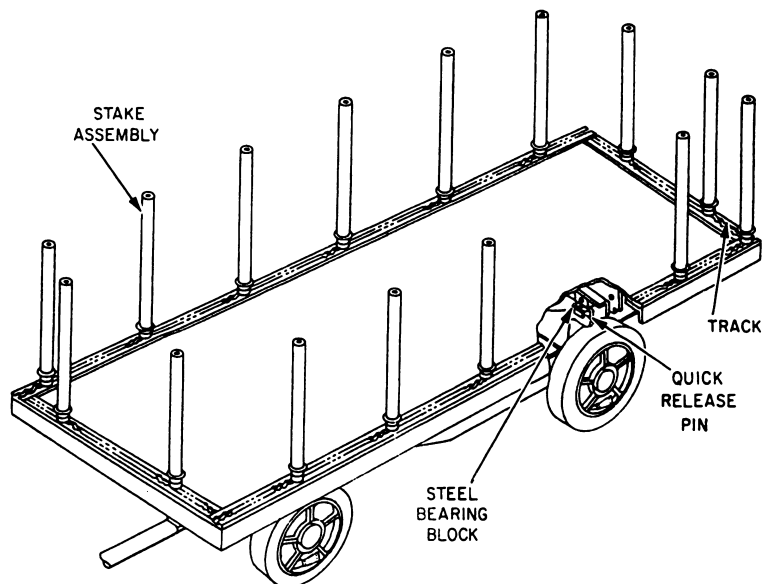


Figure 10-29.—Aero 71A skid adapter mounted to Aero 58A skid adapters/Aero 21C weapon skid.

welded aluminum angle frame, sheet aluminum deck, and steel tube stakes. The adapter is secured to a weapon skid by quick-release pins. An extruded aluminum track around the edges of the flatbed allows the attachment of the steel tube stakes.

When using the Aero 71A, you must use two Aero 58A skid adapters in order to form a flatbed conveyance for transportation of the weapon component containers and a variety of other materials. The Aero 71A can be used with various skids, transporters, and trailers. The adapter has an SWL of 4,000 pounds.

AERO 64A SOFT-BELT ADAPTER.—The Aero 64A soft-belt adapter (fig. 10-30) consists of a flexible neoprene-covered woven-wire

sling. The adapter has slots at the ends for attaching tie-down straps. The adapter is also equipped with brackets for attaching it to the skid.

Two soft-belt Aero 64A adapters support a soft-skin store up to 30 inches in diameter. Each adapter has an SWL of 2,500 pounds. The Aero 64A is designed for use with Aero 58A skid adapters, and is used with various skids, transporters, and trailers.

AERO 83A TRANSPORT ADAPTER.—The Aero 83A transport adapter (fig. 10-31) consists of a tubular aluminum frame with a system of movable suspension assemblies. The adapter is equipped with four rack-attachment hooks adjusted to accept 14- or 30-inch suspension

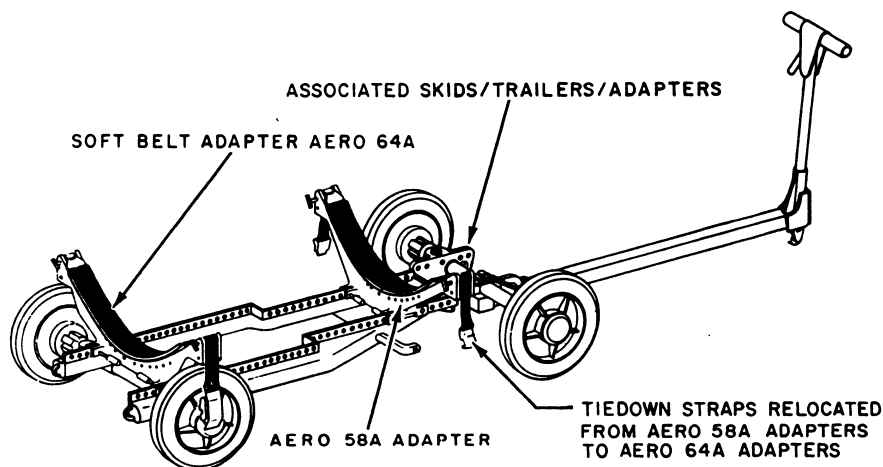


Figure 10-30.—Aero 64A soft-belt adapter mounted to Aero 58A skid adapters/Aero 21C weapon skid.

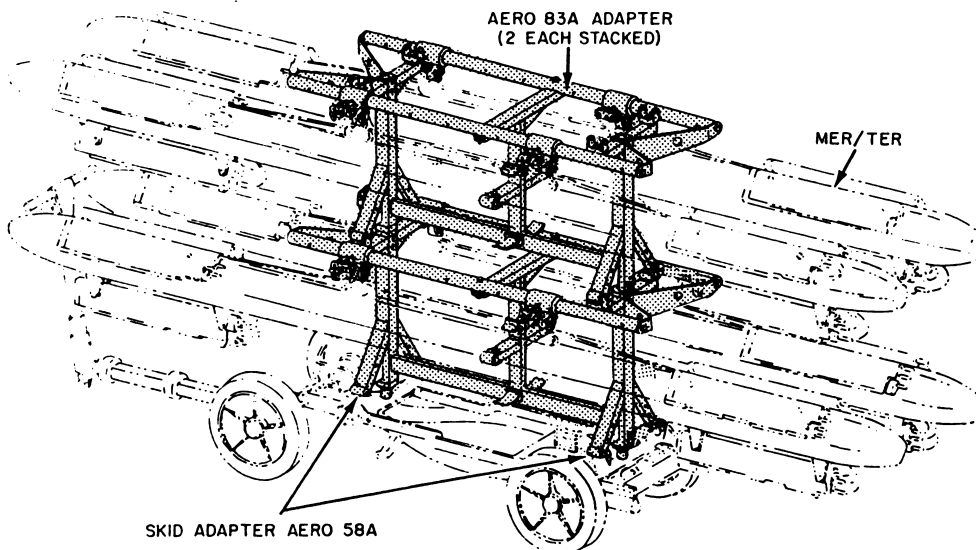


Figure 10-31.—Aero 83A transport adapter mounted to Aero 58A skid adapters/Aero 21C weapon skid.

lugs. The adapter is equipped with two tie-down straps to secure the load against the rubber bumpers.

The Aero 83A transport adapter is used with the Aero 58A skid adapter on the Aero 21C weapon skid for transporting empty multiple ejector racks (MERs) and triple ejector racks (TERs). One adapter can handle two MERs or two TERs. The adapters can be stacked two high so four racks can be transported. Stack the adapters by inserting the support pins of the

upper adapter into the stacking sockets of the lower adapter. Then mount the adapter on the skid by inserting the Aero 83A transport adapter support pins into the front and rear sockets of the Aero 58A. The Aero 83A has an SWL of 5,000 pounds.

MXU-661/E SKID PLATFORM ADAPTER ASSEMBLY.—The MXU-661/E skid platform adapter assembly (fig. 10-32) consists of an aluminum platform weldment, two side brackets with straps and buckles, and four stud assemblies. Two skid platform adapter assemblies are fastened to the side frames of the Aero 71A skid adapter. One MXU-661/E skid platform adapter assembly is located at each end of the Aero 71A skid adapter and attached by means of a platform stud assembly.

The MXU-661/E adapter is used on the Aero 71A. It is mounted on the front and rear parts of the Aero 58A skid adapter. This forms a flatbed on the Aero 21C weapon skid capable of holding and transporting up to 32 sonobuoys in containers.

ADU-475/E Guided Missile Adapter

The ADU-475/E guided missile adapter (fig. 10-33) consists of a steel frame of rectangular

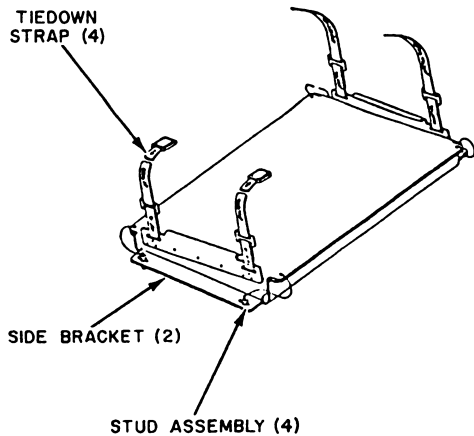


Figure 10-32.—MXU-661/E skid platform adapter assembly.

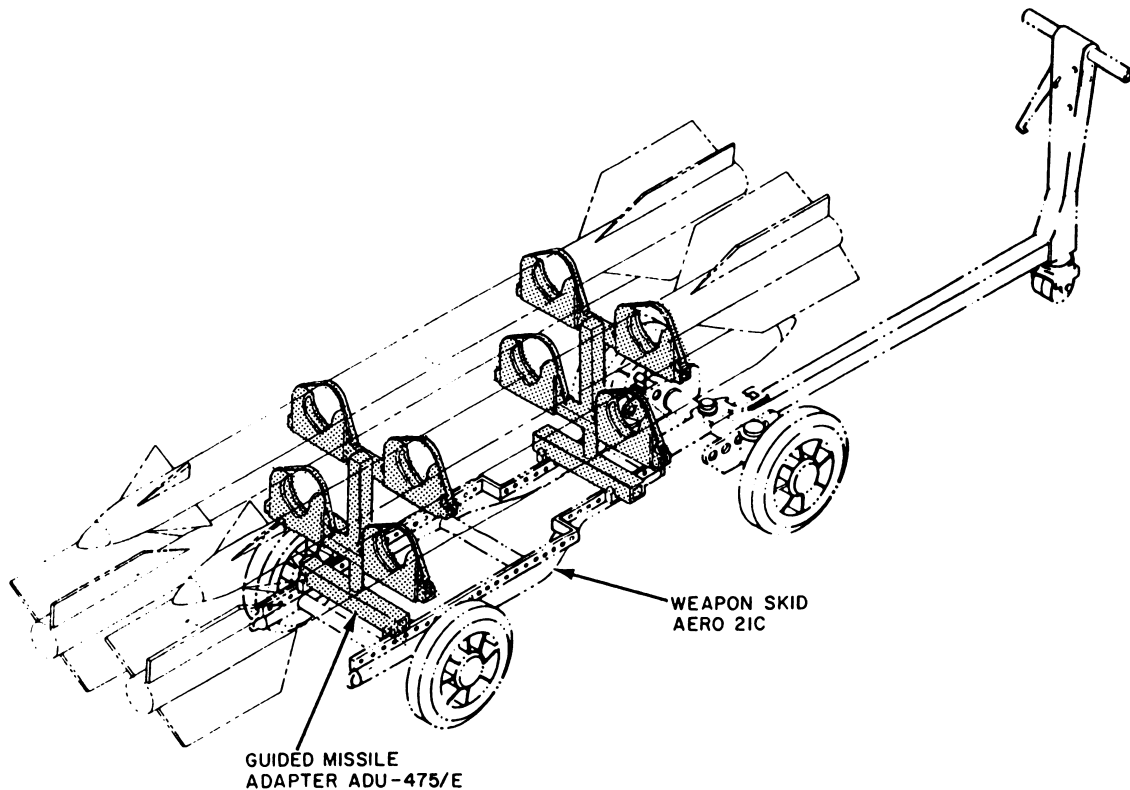


Figure 10-33.—ADU-475/E guided missile adapter mounted on an Aero 21C weapon skid.

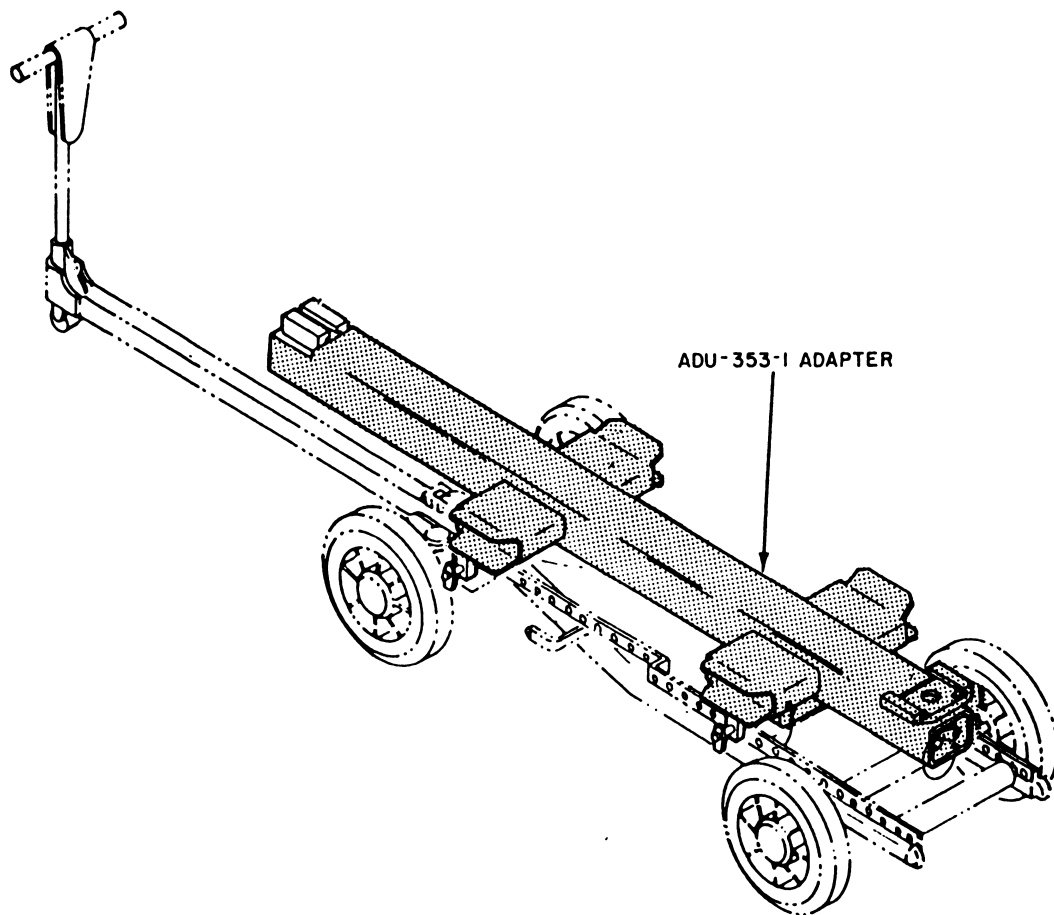


Figure 10-34.—ADU-353-1 skid adapter mounted to an Aero 21C weapon skid.

tubing and eight rubber-padded support saddles with tie-down straps. The frame has fore-and-aft end members separated by a two-piece adjustable longitudinal member. Once the desired length is adjusted, insert a quick-release pin into the appropriate guide hole to secure the longitudinal member. The saddles are sufficiently rigid to provide fore and aft damping. They also afford some degree of shock mitigation. The saddles fold inward to a stowed position.

The ADU-475/E guided missile adapter is used with various skids, transporters, and trailers for transporting as many as four Sidewinder AIM-9 series guided missiles.

ADU-353-1 Skid Adapter

The ADU-353-1 skid adapter (fig. 10-34) is a welded steel beam with two forklift pockets on

each side, two adapter bars, and a clevis assembly welded to its underside. A forward and aft missile launch-shoe adapter is mounted on top of the skid adapter at each end. The launch-shoe adapters are fastened by quick-release pins. Four 4-inch grip length quick-release pins, fastened with lanyards to each of the forklift sleeves, are used to secure the adapter to the Aero 21C weapon skid.

The ADU-353-1 adapter is used to transport and handle the Standard Arm missile aboard aircraft carriers (CVs). When installed on the Aero 21C weapon skid, the adapter supports the missile on the underside launching shoes located on the launch-shoe adapters. However, the adapter can be used without the skid. In this case, you must turn the ADU-353-1 adapter over and engage the launch-shoe adapters with the missile's topside

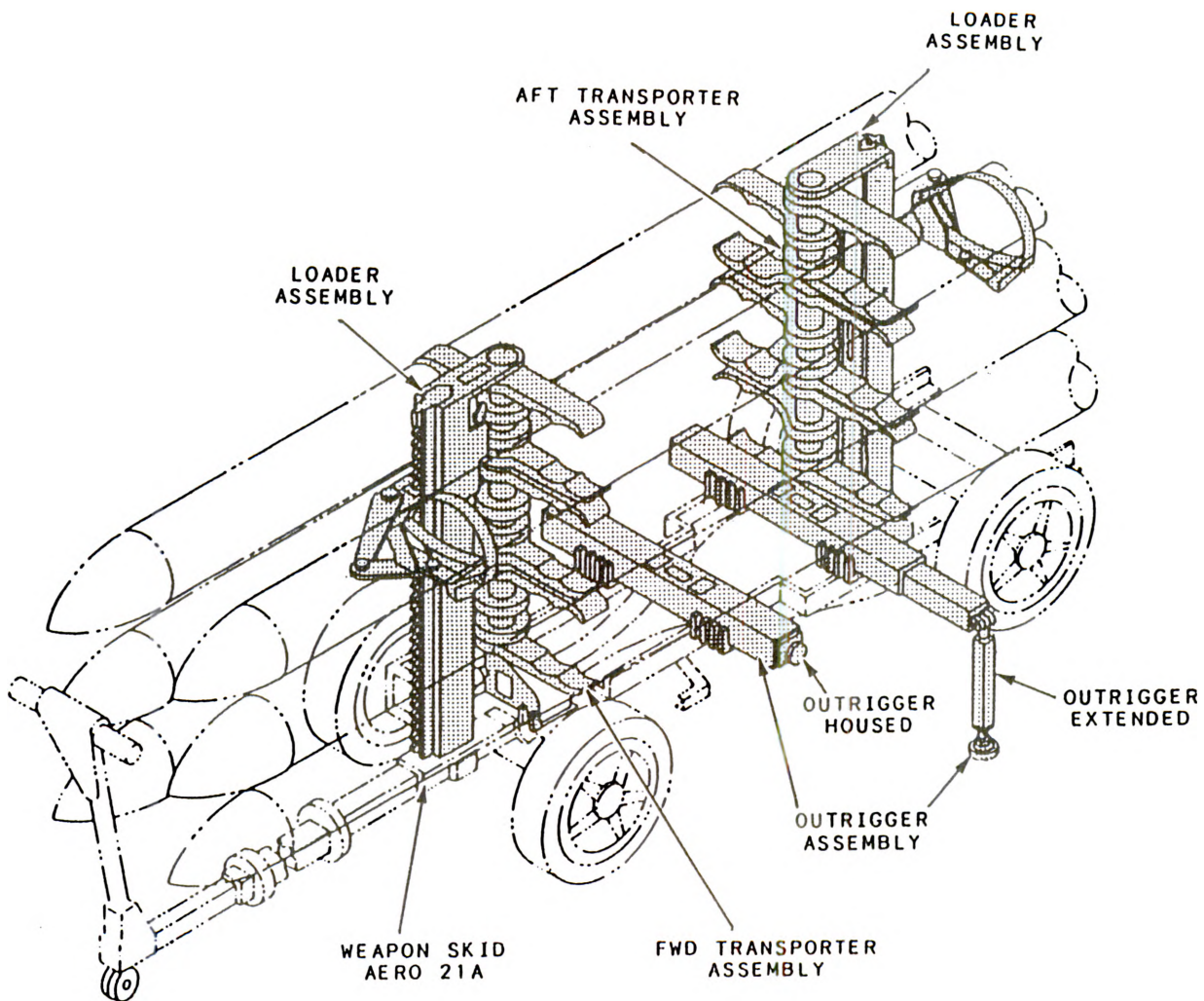


Figure 10-35.—Aero 67A small bomb and missile adapter mounted to an Aero 21C weapon skid.

launching shoes. The adapter can be used as a lifting beam by using a forklift truck or hoisting gear coupled to the clevis assembly to do the lifting. The ADU-353-1 adapter has an SWL of 1,500 pounds.

Aero 67A Small Bomb and Missile Adapter

The Aero 67A small bomb and missile adapter (fig. 10-35) consists of three separate assemblies—a transporter assembly with cradles, stanchion, and base; a loader assembly with main slide assembly, rack, linkage and head assembly, and wrench

assembly; and an outrigger assembly. A complete unit consists of a pair of loader assemblies, a pair of outriggers, and the forward and aft transporter adapter assemblies.

The Aero 67A is attached to the Aero 21C weapon skid. It is used to transport and load weapons having a 13-inch or smaller diameter. During loading operations, use the outriggers in the extended position for skid stabilization. The transporter adapter assembly can also be used to transport MERs and TERs. The Aero 67A has an SWL of 3,500 pounds. This adapter can be used with the MHU-126/M munitions trailer.

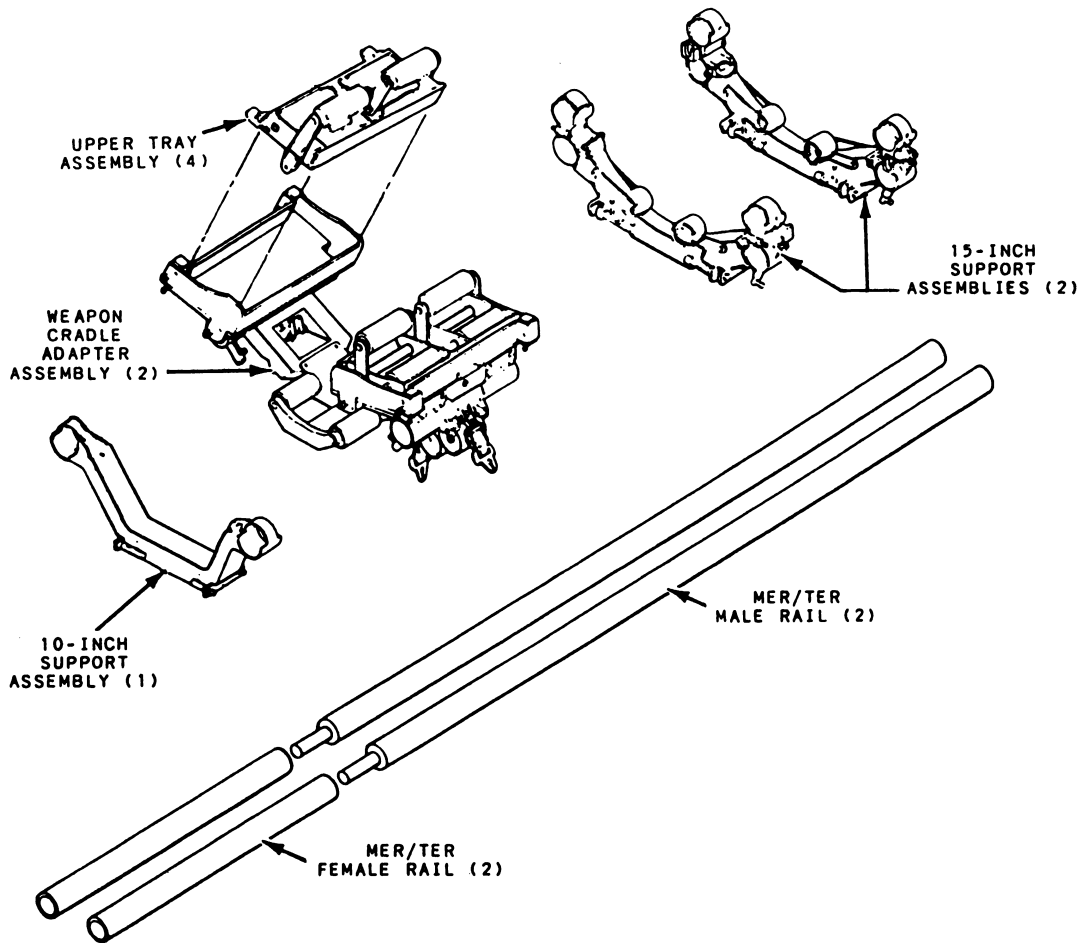


Figure 10-36.—ADK-362/A/B/M32K-5(V) multiple weapon adapter.

Table 10-2.—ADK-362/A/B Multiple Weapon Adapter Physical Data

Configuration	SWL (lbs)	*Weight (lbs)	*Length (in.)	*Width (in.)	*Height (in.)
Single Weapon, Hard Shell	4000	56	**	31.06	17.50
Single Weapon, Soft Shell	2000	84	**	31.06	17.50
Two Weapon (Alternate low position)	***2000	98	28.00	33.37	15.12
Three Weapon, High Position	***3000	202	32.00	Variable from: 31.50 to 39.00	Variable from: 22.20 to 23.71
Three Weapon, Low Position	***3000	202	32.00	Variable from: 31.50 to 39.00	Variable from: 18.11 to 19.62
Multiweapon	***5000	413	112.00	Variable from: 31.50 to 39.00	Variable from: 22.20 to 23.71

*Values do not include those of Munitions Transporter MHK-128/M32K-5(V). This item and related data are provided in Chapter 45A.

**Variable, depending upon weapon.

***1000 pounds each station (limited, for multiweapon configuration, to the capacity of the Munitions Transporter MHK-128/M32K-5(V).

**ADK-362/A/B/M32K-5(V)
Multiple Weapon Adapter**

The ADK-362/A/B/M32K-5(V) multiple weapon adapter (fig. 10-36) consists of a 10-inch support assembly, two 15-inch support assemblies, two weapon cradle adapter assemblies, two MER/TER (female) rails and two MER (male) rails. The A model added an F-14 aircraft weapon rail capability. The B model modified the weapon cradle for cost reduction purposes. These assemblies and rails are used

in various combinations on the MHK-128/M32K-5(V) munitions transporter. It can be fitted with a drawbar, which lets you use the transporter with any one of six munitions handling configurations. The ADK-384/M32K-5(V) space adapter provides an interface between the ADK-362 adapter and the Aero 21C weapons skid.

Various configurations of the ADK-362/A/B/M32K-5(V) multiple weapon adapter are to carry stores having different lengths, diameters, and weights. The physical data are listed in table 10-2. The single-weapon configuration (fig. 10-37) is

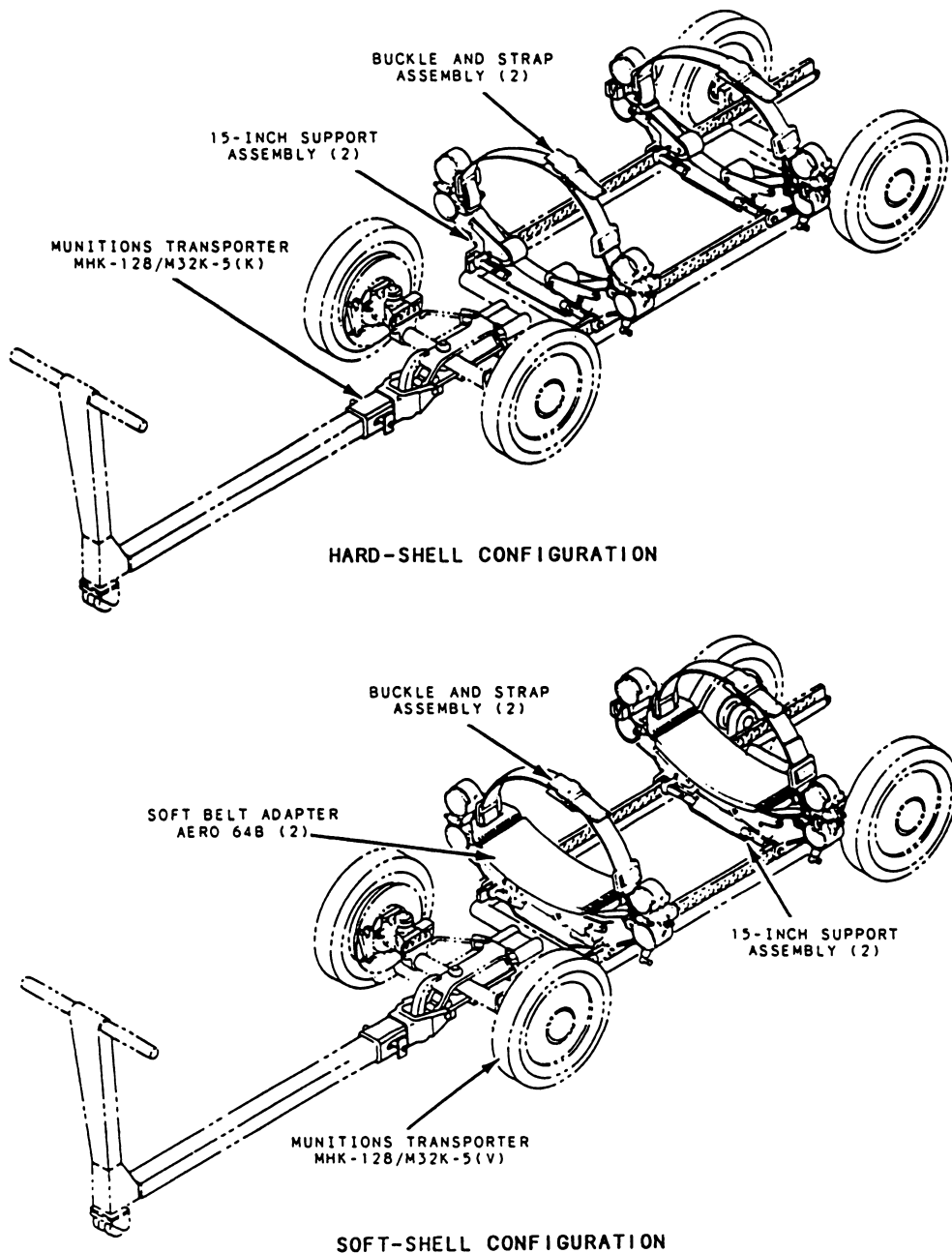


Figure 10-37.—Single-weapon configuration.

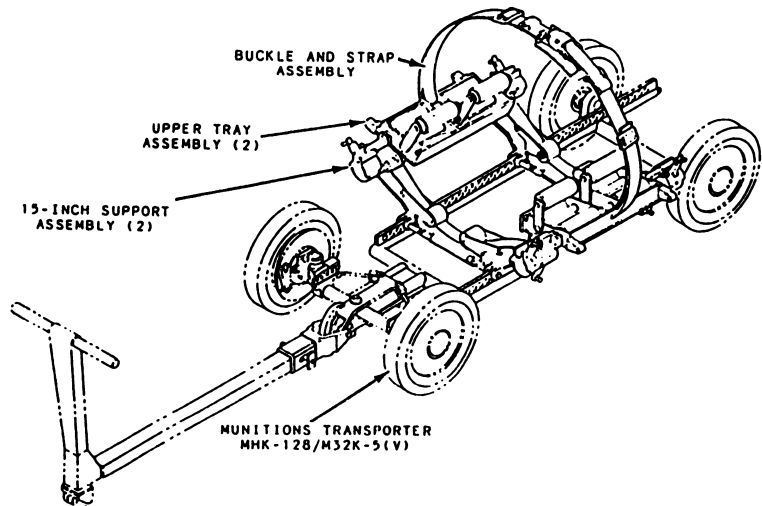


Figure 10-38.—Two-weapon configuration.

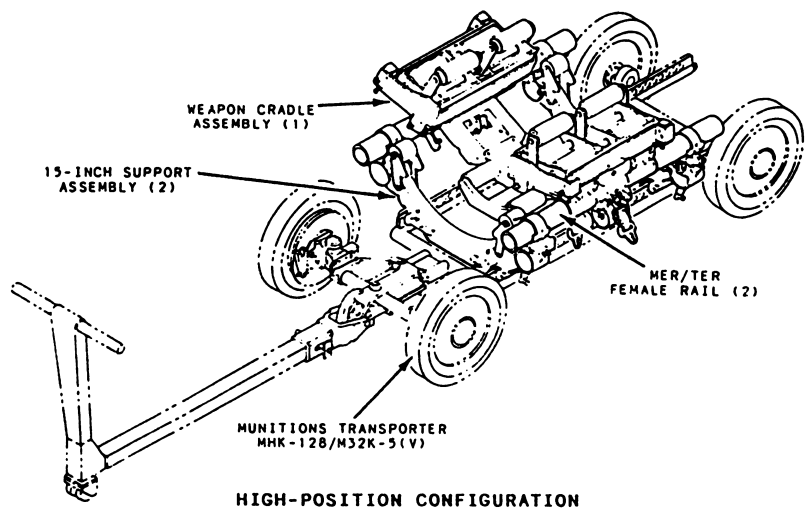
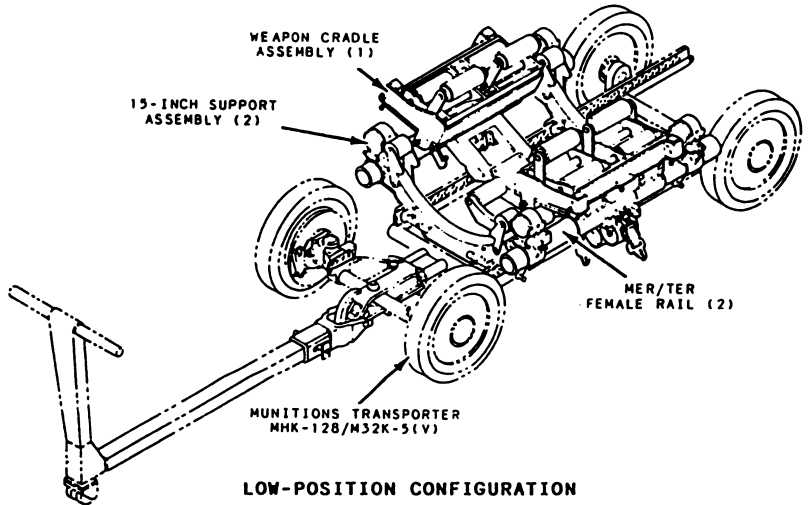


Figure 10-39.—Three-weapon configuration.

used for hard-shell and soft-shell weapons up to 24 inches in diameter. The two-weapon configuration (fig. 10-38) is for 13-inch to 14-inch diameter weapons. Its low-frame structure enables a two-weapon set to be positioned under the low wing stations of an aircraft. The three-weapon configuration (fig. 10-39) is arranged in either a low-position or a high-position assembly. The low-position assembly holds weapons up to 10 3/4 inches in diameter. The high-position assembly

is for weapons larger than 10 3/4 inches in diameter. The multiweapon configuration (fig. 10-40) can carry six weapons from 9 to 16 inches in diameter or four weapons from 9 to 18 3/4 inches in diameter.

ADU-400/E Weapon Skid Loading Lift Adapter

The ADU-400/E weapon skid loading lift adapter (fig. 10-41) consists of a hydraulically

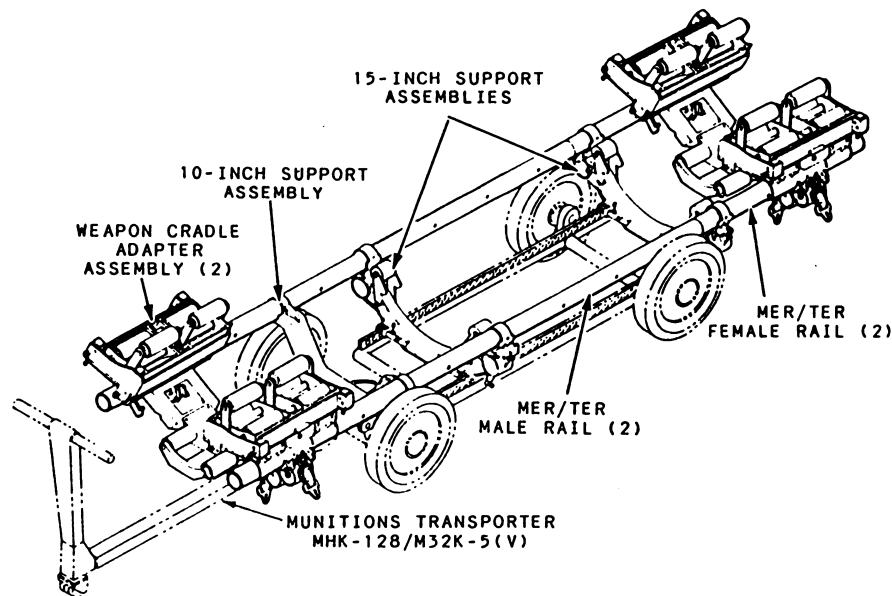


Figure 10-40.—Multiweapon configuration.

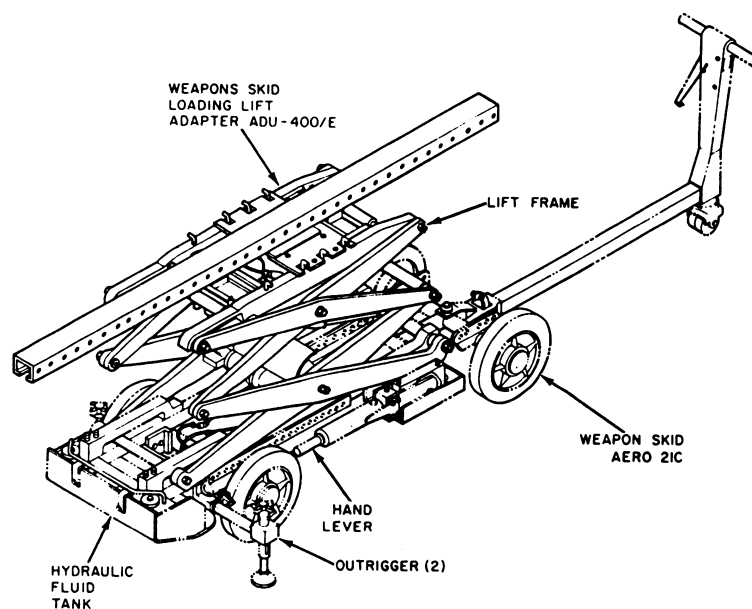


Figure 10-41.—ADU-400/E weapon skid loading lift adapter mounted to an Aero 21C weapon skid.

controlled steel lift frame supporting a drilled steel tubular beam. The hydraulic system includes a fluid tank, hand lever, cylinder, and pressure gauge. There are extendable outriggers with height adjustment handles to provide stability when the adapter is mounted on the appropriate transporter.

The ADU-400/E adapter is mounted on the Aero 21C weapon skid. It is used with a variety of adapters to lift and position armament and maintenance devices on the aircraft. This adapter has an SWL of 2,500 pounds.

Aero 36A Bomb Truck Adapter

The Aero 36A bomb truck adapter (fig. 10-42) consists of tie-rods, tubes, transverse screw, nut, brackets, protective sleeving, rollers and shafts, rocket brackets, baseplate, pins, cradle supports, and cradles for 14-inch, 22-inch, and 30-inch diameter stores. The cradles are adjustable horizontally, either left or right 8 1/4 inches from the center position.

The Aero 36A bomb truck adapter is used on the Aero 33D/E bomb truck or the Aero 21C weapon skid with the Aero 65A skid adapter. This allows you to center stores in the aircraft without moving the bomb truck or weapon skid. The Aero 36A has an SWL of 4,000 pounds.

REVIEW NUMBER 6

Q1. What is the purpose of adapters when used with skids and weapons transporters?

Q2. Describe how the brakes work on the Aero 12C bomb skid.

Q3. What is the SWL of the Aero 12C bomb skid?

Q4. List the adapters used with the 12C bomb skid.

Q5. What adapter should you use to store a soft-skin weapon on an Aero 12C bomb skid?

Q6. What is the SWL of the Aero 21C bomb skid?

Q7. What is the SWL of the MHK-128/M32K-5(V) munitions transporter?

Q8. List the adapters/adapter assemblies used with the Aero 58A skid adapter.

Q9. When mounted on the Aero 58A skid adapter, the ADU-483/E skid adapter assembly can support two weapons of what diameter?

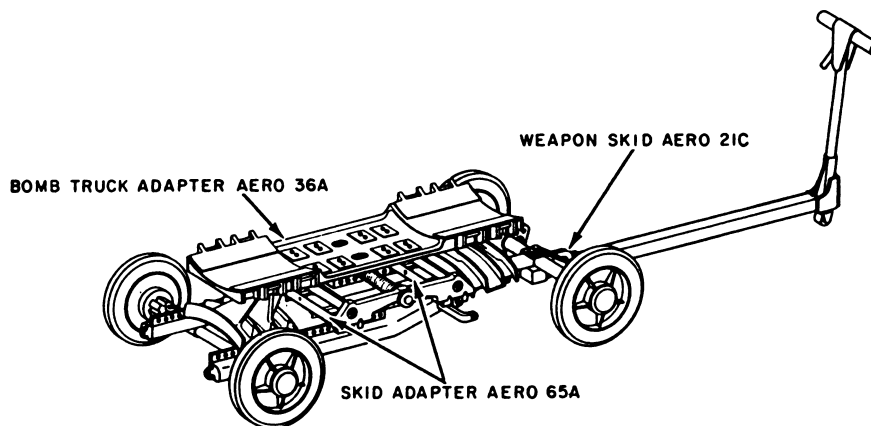


Figure 10-42.—Aero 36A bomb truck adapter mounted to an Aero 21C weapon skid.

Q10. The ADU-475/E guided missile adapter is used to _____

minimum established inspection and safety criteria in ordnance handling evolutions.

Q11. What weapons skid loading lift adapter consists of a hydraulically controlled steel lift frame?

Q12. What is the SWL of the Aero 36A bomb truck adapter?

AMMUNITION HANDLING TRUCK

The ammunition handling truck (fig. 10-43) is used to handle ordnance. It is a water-cooled gasoline engine stake and platform truck with a 24,000 pound gross vehicle weight (GVW). The platform size is 12 feet by 21 feet, and it is equipped with a hydraulically operated electrically controlled crane. This flatbed truck, with a hydraulic crane, can pick up ordnance, load and secure it on the truck, and transport it to its destination. The crane can be used to lift and position weapons for loading onto other equipment such as bomb skids, weapon skids, and weapon trailers. There are four jacks, one at each corner of the truck body, that are lowered to the ground to provide stability during ammunition handling operations.

TRUCKS

Learning Objective: *Identify trucks used for ordnance handling to include ammunition handling, forklift, pallet, and Aero 33D/E bomb trucks. Recognize the safe loads for each.*

The term *truck* applies to either a manually propelled or self-propelled vehicle. Self-propelled trucks are powered by gasoline engines, diesel engines, or electric motors.

Gasoline- or diesel-powered trucks are equipped with exhaust system spark arresting devices. They help ensure safe operation of the trucks in areas where there is danger of fire or explosion caused by sparks. These vehicles must meet rigid mechanical and safety inspections. **Do not use vehicles that don't meet the**

The crane is mounted on a self-propelled wheel carriage that transverses the full length of the truck bed on I-beam rails recessed into the truck body. The crane has a capacity of 4,000 pounds with a 10-foot radius, and 1,000 pounds with an 18-foot radius. When fully extended vertically, the boom reaches 16 1/2 feet and can be rotated 360 degrees in a vertical or horizontal direction. When stowed, the boom folds to a height of 79 inches above the truck chassis. A fork attachment is used to handle palletized loads. Otherwise, ordnance handling is done with slings, bomb carriers, and other hoist-interface equipment. All crane functions are controlled by a single operator with levers mounted on the crane assembly.

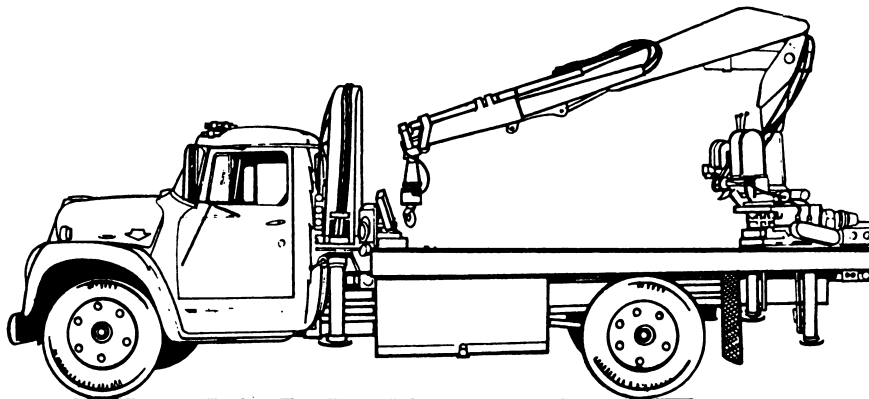


Figure 10-43.—Ammunition handling truck.

FORKLIFT TRUCKS

The forklift truck is a mobile four-wheel or three-wheel unit that lets one person pick up, transport, and lift the load to different heights. The forklift truck is designed on the cantilever principle. The front wheels act as a fulcrum. The load is counterbalanced because the weight of the truck is directly behind the front wheels.

The forklift truck has two fork tines secured to the supporting frame. Both tines and the supporting frame are located in the front of the

truck. The tines are moved vertically on the supporting frame by a hydraulic lift. The supporting frame may be either telescoping (to provide greater lift) or nontelelescoping. The tines and supporting frame can be tilted forward from the vertical position to pick up the load. The frame can be tilted backward from a vertical position to help balance the load.

Forklift trucks are powered by gasoline engines, electric motors, or diesel engines. The electric motor or diesel engine forklift trucks are usually used during ordnance evolutions. Forklift

REVIEW NUMBER 6 ANSWERS

- A1. *When used with skids and weapons transporters, adapters are used to support a load for movement from one area to another.*
- A2. *The brakes on the Aero 12C bomb skid are applied by lowering the aft end of the skid to the deck.*
- A3. *The SWL of the Aero 12C bomb skid is 1,250 pounds.*
- A4. *The adapters used with the 12C bomb skid include the Aero 9B/C bomb skid adapter, Aero 39B bomb skid adapter, and Aero 64B soft-belt adapter.*
- A5. *You should use a 64B soft-belt adapter to store a soft-skin weapon on an Aero 12C bomb skid.*
- A6. *The SWL of the Aero 21C bomb skid is 5,000 pounds.*
- A7. *The SWL of the MHK-128/M32K-5(V) munitions transporter is 5,000 pounds.*
- A8. *The adapters/adapter assemblies used with the Aero 58A skid adapter include the 58A skid adapter, ADU-483/E skid adapter assembly, Aero 57A skid adapter, Aero 91A bracket adapter, Aero 71A skid adapter, Aero 64A soft-belt adapter, 83A transport adapter, and MXU-661/E skid platform adapter.*
- A9. *When mounted on the Aero 58A skid adapter, the ADU-483/E skid adapter assembly can support two weapons between 9 and 16 inches in diameter.*
- A10. *The ADU-475/E guided missile adapter is used to transport up to four Sidewinder missiles.*
- A11. *The ADU-400/E weapon skid loading lift adapter is a hydraulically controlled steel lift frame.*
- A12. *The SWL of the Aero 36 bomb truck adapter is 4,000 pounds.*

trucks are equipped with braking systems and with either automobile- or lever-type steering mechanisms. Forklift trucks have solid rubber cushion tires for use over smooth and hard surfaces such as paved roads, magazine and warehouse floors, and piers. Pneumatic tires are used for rough and uneven terrain, in mud, or over soft, sandy ground.

Diesel Engine Forklift Trucks

A wide variety of diesel engine forklift trucks are available for use throughout the Navy. They range from a 4,000-pound capacity to a 20,000-pound capacity. Look at figure 10-44. It shows a typical 4,000- or 6,000-pound capacity forklift truck. This truck has a diesel engine and four pneumatic rubber tires. It is typical of the size and capacity ordnancemen usually use. A number of different models of this forklift truck are used at naval activities. Every model has an adjustable two-tine fork. The tines are secured to

a vertical supporting frame that can be telescoped and tilted. The lifting and tilting mechanisms are hydraulically operated. An overhead guard is also provided for the operator's safety. Forklift trucks have either dual or single front wheels, diesel engines, power-shifted transmissions, and either pneumatic or cushion tires. The main difference between the 4,000- and 6,000-pound trucks is in load-carrying capacity and in overall truck dimensions and weight. The exhaust systems of these trucks have a spark-arresting device, even when handling ammunition in the open.

Electric Forklift Trucks

Electric forklift trucks are used frequently by ordnancemen. They are discussed in the following paragraphs.

ELECTRIC FORKLIFT TRUCK, 6,000-POUND CAPACITY.—A typical 6,000-pound capacity electric forklift truck is shown in

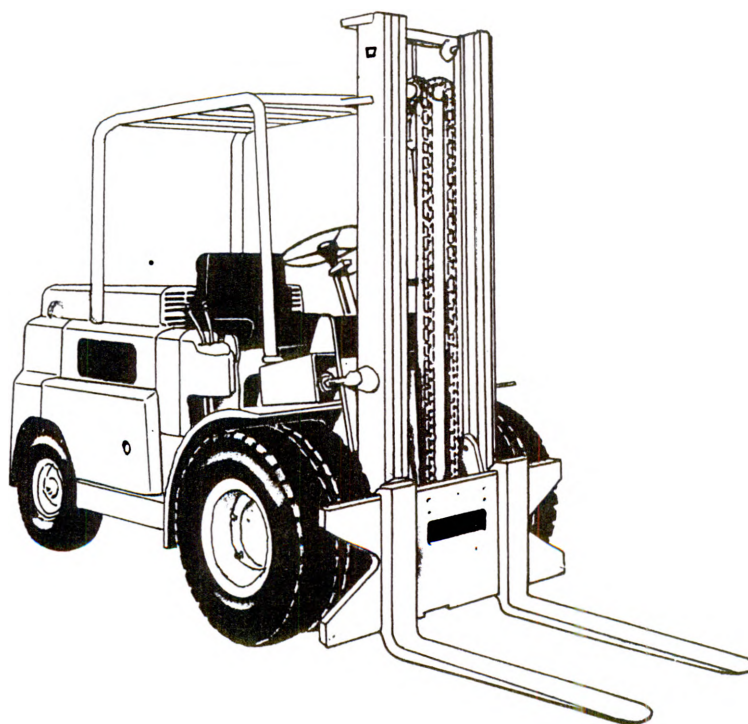
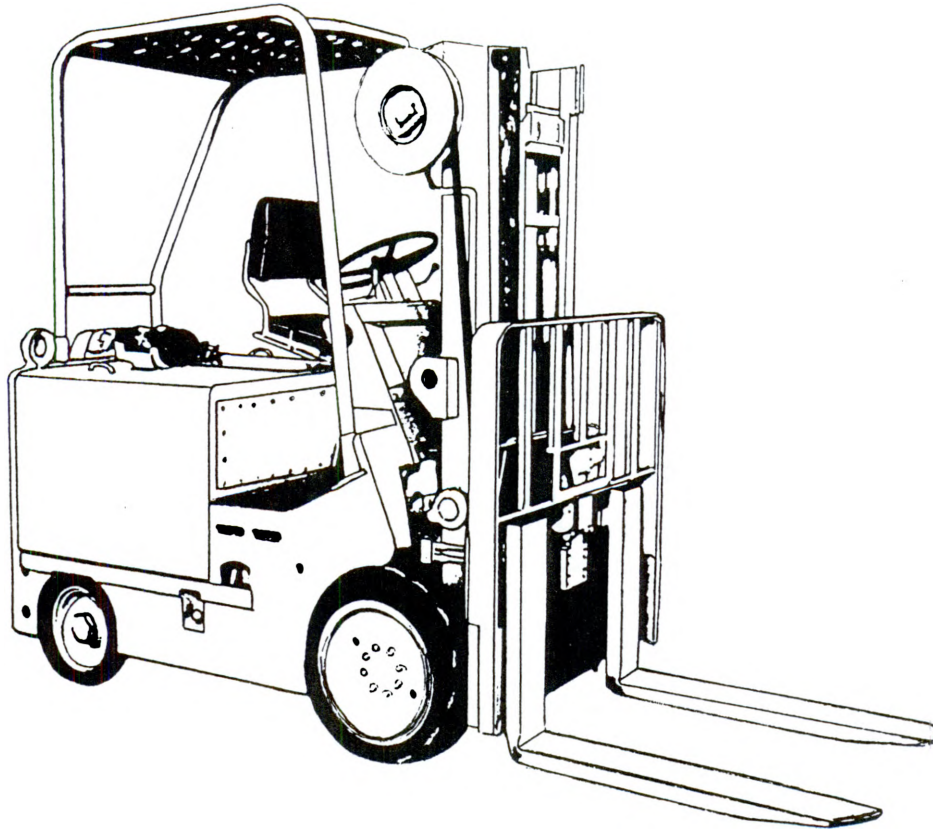


Figure 10-44.—Typical 4,000- and 6,000-pound capacity diesel forklift truck.

220.909



220.910

Figure 10-45.—Typical 6,000-pound capacity electric forklift truck.

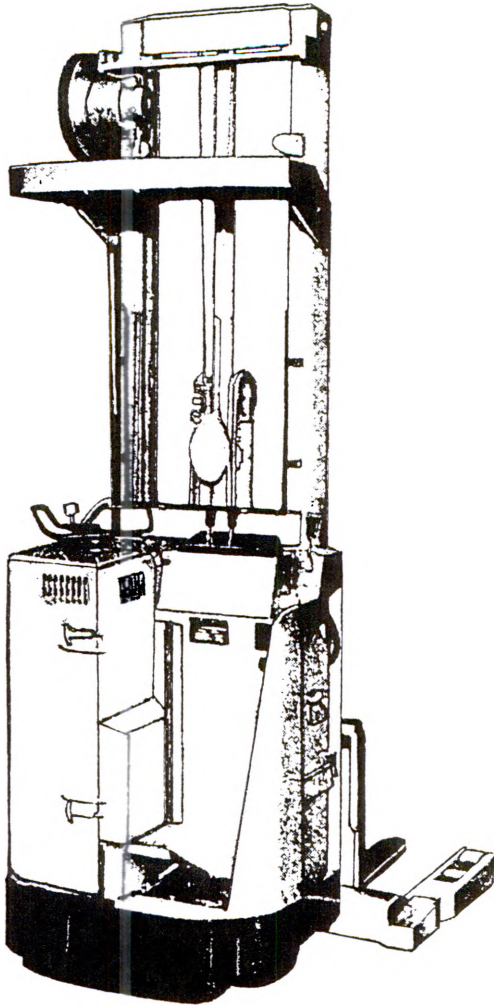
figure 10-45. Many different models are currently used at naval activities. Every model has an adjustable two-tine fork secured to a vertical supporting frame, which can be telescoped and tilted. An overhead guard may be provided for the operator's safety.

A rechargeable battery provides power for the operation of the truck and its hydraulic lift and tilt mechanisms. This type of forklift truck can pick up, transport, and lift loads weighing up to 6,000 pounds. It can also handle boxes of ammunition and other hazardous materials that can be properly supported across the fork tines. When you handle ammunition, the truck is spark-enclosed or explosiveproof.

ELECTRIC FORKLIFT TRUCK (REACHING AND TIEING, CONTINUOUS DUTY, NARROW AISLE), 4,000-POUND CAPACITY.— A typical 4,000-pound electric (reaching and tieing, continuous duty, narrow aisle) forklift

truck is shown in figure 10-46. Several different models of this type of truck are in use at naval activities. Every model has an adjustable two-tine fork. The tines are secured to a vertical supporting frame that can be telescoped and tilted. The tines are elevated by a hydraulic-mechanical lift mechanism. An overhead guard is provided for the operator's safety. All models of this truck have outriggers to provide a rigid structure. A rechargeable battery provides the power for the operation of the truck and its hydraulic lift and tilt mechanisms. The forklift truck has mechanical or hydraulic brakes that the operator applies using a foot pedal.

This truck is used to pick up, transport, stack, and unstack palletized unit loads weighing up to 4,000 pounds. It is intended for use in warehouses having narrow aisles, low floor-load ratings, and aboard aircraft carriers. When you use the truck to handle ammunition, it is spark-enclosed.



220.479

Figure 10-46.—Typical 4,000-pound capacity reaching and tying (continuous duty, narrow aisle) electric forklift truck.

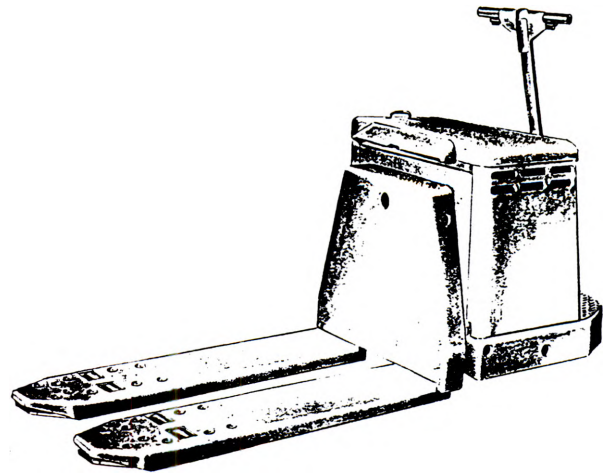
PALLET TRUCKS

The pallet trucks used most frequently by ordnancemen are discussed in the following paragraphs.

Electric Pallet Truck (Low Lift)

A typical 6,000-pound capacity electric (low lift) pallet truck is shown in figure 10-47. Several different models of this pallet truck are used at naval activities.

Each model of the pallet truck has a two-tine fork that supports a palletized load. The tines are raised or lowered by a hydraulic lift mechanism. Depending upon the model, the lift mechanism is either electrically or manually operated. The power source for truck traction is a rechargeable



220.243

Figure 10-47.—Typical 6,000-pound capacity low lift electric pallet truck.

battery. It is steered by using the steering handle, with a possible right-angle turn in either direction. The truck is equipped with mechanical brakes, which, when applied, automatically shut off the electrical power.

The pallet truck is used to pick up, transport, and deposit palletized loads that do not exceed 6,000 pounds. This truck is used on hard and smooth surfaces such as warehouse and magazine floors. The pallet truck is spark-enclosed when used to handle ammunition.

Hand Pallet Truck (Low Lift)

A typical 4,000-pound capacity (low lift) hand pallet truck is shown in figure 10-48. Many

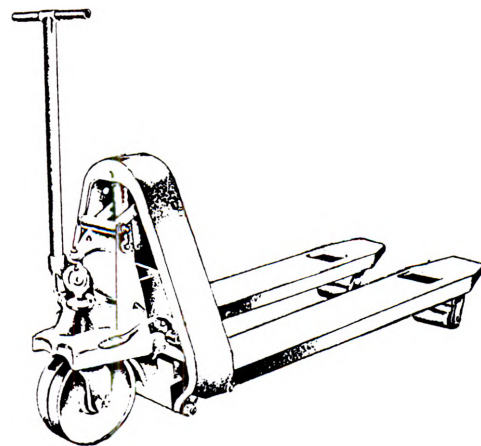


Figure 10-48.—Typical 4,000-pound capacity low lift hand pallet truck.

different models of this pallet truck are used at naval activities. Since the trucks all operate in the same way, the following general description applies to all models.

The 4,000-pound hand pallet truck has a two-tine fork supporting a palletized load. The tines are raised or lowered by a hydraulic or mechanical lift mechanism. The height of lift differs from model to model but is generally in the range of 2 to 4 inches. Depending upon the model, the lift mechanism is operated by the tow handle, a foot pedal, or a hand lever. The truck is not self-propelled and requires manpower for locomotion. It is steered by the tow handle. A right-angle turn is possible in either direction, without moving the truck. The drive wheel is located directly beneath the tow handle. It is usually one solid rubber tire. The load wheels, located approximately 6 inches from the ends of the fork tines, can be arranged in a single or double (tandem) fashion under each tine.

The hand truck is used to pick up, transport, and deposit palletized unit loads on single- or

double-faced pallets that don't exceed 4,000 pounds in weight. This truck is particularly useful and economical for moving loads a short distance. It must be used in areas that have hard and smooth surfaces.

AERO 33D/E BOMB TRUCK

The Aero 33D/E bomb truck (fig. 10-49) is a high-lift bomb truck designed to transport and load stores on naval aircraft. The major difference between the Aero 33D and the Aero 33E models is that the Aero 33D model has both electric and manual controls while the Aero 33E model features only manual controls for use with a hydraulic lift system. Except for the electrical features on the Aero 33D, the information contained in the following paragraphs is applicable to both models.

The Aero 33D/E bomb truck is a high-lift heavy-duty truck. The main frame is welded steel. The hydraulically operated arms have a variable

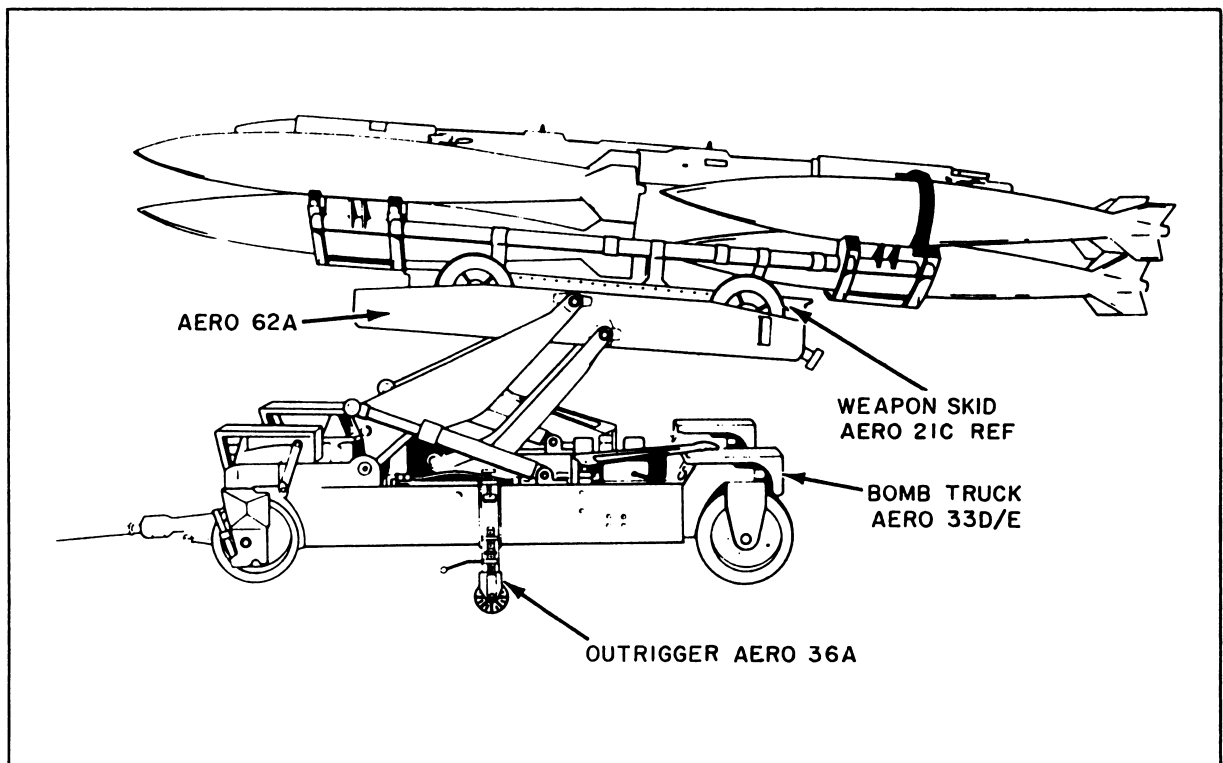


Figure 10-49.—Aero 33D/E bomb truck with an Aero 62A tray adapter and an Aero 36A outrigger assembly installed.

lifting height between 30 and 63 inches. The truck has an SWL of 4,000 pounds. The truck is equipped with front-wheel mechanical brakes that are normally in the locked position. You can release the brakes by actuating the brake release handle on the drawbar or by the deadman brake lever on the drawbar socket.

The bomb truck is equipped with an Aero 62A tray adapter (fig. 10-49) attached to the lifting arms. The Aero 62A adapter is a rectangular metal tray. One end is open so the Aero 21C weapon skid can be easily pushed onto the bottom plate. A pair of hooks mounted in two brackets on the bottom of the tray hold the skid in place. The brackets have 40 holes spaced 1 inch apart. This lets you move the hooks to a suitable position for holding stores of varying lengths. The hooks are secured to the brackets by two detent pins and can be swiveled from a vertical to a horizontal position. A cable assembly provides control of the hooks from outside the tray. You can tilt the tray in the fore and aft vertical plane (20 degrees nose up or 10 degrees nose down) by turning a tilt control crank located on either side of the truck. This lets you horizontally match the store being loaded with the attitude of the aircraft.

The bomb truck is a four-wheel vehicle equipped with solid rubber tires. By moving the drawbar, you can rotate the front wheels through an 84-degree arc. When positioning the bomb truck for store loading, you can rotate all four wheels through slightly more than a 180-degree arc as the wheel locking pins are pulled up and disengaged from the wheel swivel.

The hydraulic system is suitable for operation at a maximum of 3,000 psi hydraulic pressure. This is required to lift capacity loads with the truck. The hydraulic manual controls are duplicated on either side of the truck. A hydraulic control valve is located inboard and under the left battery box. It actuates part or all of the hydraulic system. With the valve in the open position, you can operate both the left and the right lifting arm simultaneously if either or both of the hydraulic pumps are actuated. Closing the control valve permits manual operation of either the left- or right-hand lifting arm. This is accomplished by manually operating

the appropriate left- or right-hand hydraulic pump. When only one lifting arm is being actuated, limit load movements to a few inches. When the control valve is open, both of the lifting arms can be lowered simultaneously by using either the left- or right-hand manual release valves. The manual release valves will lower the lifting arms at a variable rate of speed. Restrict this operation to moving the load only a few inches.

The pump speed-control valves have three positions—fast, medium, and slow. The speed-control valve lets the operator adjust the flow of hydraulic fluid from the manual pumps in proportion to the weight of the load—fast for light loads and slow for heavy loads. Set both the left- and right-hand speed controls at the same speed.

The electrical system (Aero 33D only) consists of cables, connectors, and a relay housed in a junction box. Closing the control handle up switch energizes the relay that makes the connection between the electrical power source and the power-pack assembly.

The power-pack assembly contains the electric motor, hydraulic pump, solenoid valve assembly, restrictor, relief and check valves, hydraulic fittings, and tubing. With the control handle up switch actuated, the motor drives the pump and energizes the solenoid valve up circuit. This opens the solenoid valve pressure port to the truck hydraulic cylinders. With the control handle down switch actuated, the solenoid valve down circuit is energized and the valve return port is opened. The restrictor prevents the lifting arms from being lowered too rapidly. The entire electrical system, including the batteries and battery boxes, may be removed from the truck because the electrical capabilities of the truck are seldom used.

When loading stores from an off-center position or during heavy seas, the Aero 36A outrigger assembly (fig. 11-49) is mounted on the Aero 33D/E bomb truck to overcome an imbalance condition. As you have already learned, the Aero 36A truck adapter assembly is installed in place of the Aero 62A truck adapter.

REVIEW NUMBER 7

- Q1. *What is the gross vehicle weight (GVW) of the ammunition handling truck?*
- Q2. *What is the maximum boom reach of the ammunition handling truck?*
- Q3. *What type of tires should you use on the forklift truck when using it in rough terrain?*
- Q4. *The electric forklift truck has rigid structures, which allow it to carry off-balance loads. What are these structures?*
- Q5. *What is the maximum capacity of the hand pallet truck?*
- Q6. *The Aero 33D/E bomb truck can lift loads to a height between _____.*
- Q7. *What is the SWL of the Aero 33D/E bomb truck?*
- Q8. *The Aero 62A tray adapter consists of _____.*
- Q9. *By moving the drawbar, the front wheels of the Aero 33D/E can be rotated through an arc of _____.*
- Q10. *What is the maximum hydraulic pressure of the Aero 33D/E?*
- Q11. *To overcome an imbalance condition when using the Aero 33D/E, what outrigger assembly should you use?*
- Q12. *What model of the Aero 33 has an electrical and a manual lift system?*

TRAILERS

Learning Objective: *Identify trailers used for ordnance handling to include the Mk 7 and Mods bomb, small munitions, SATS rough terrain, and Aero 51B munitions trailers.*

A trailer is a transport vehicle towed by another vehicle such as a truck or tractor. All trailers are equipped with load-supporting bodies or frames and with wheels for locomotion. Trailers may be divided into three categories—weapon trailers, weight handling trailers, and warehouse trailers. Only trailers within the weapon trailer category are discussed in this TRAMAN because they directly support aircraft weapon loading operations ashore.

A weapon trailer consists of a heavy channel or tubular frame mounted on two axles and wheels that are equipped with four pneumatic tires. The frame is supported by automotive leaf-type springs. The front axle is steerable and the rear axle is fixed. The trailer is equipped with a tow bar or tow handle that has a towing eye on its end. Use the towing eye to couple the trailer to the towing vehicle. Some trailers have draw heads at the rear to couple the towing eye of another trailer.

A weapon trailer has cradles or brackets that fit the contours of the weapon being transported. The cradles or brackets on the trailer can be removed or adjusted for carrying loads of various sizes. Hold-down devices, such as chains or straps, secure the load during transport. Some weapon trailers have hydraulic systems to load weapons on aircraft, or for similar uses.

Weapon trailers are used to transport weapons such as bombs, mines, missiles, and torpedoes of various sizes. In general, the trailers are capable of operating over moderately soft or moderately rough terrain. The short airfield tactical site (SATS) trailers operate over very rough terrain. These trailers are towed by vehicles such as the

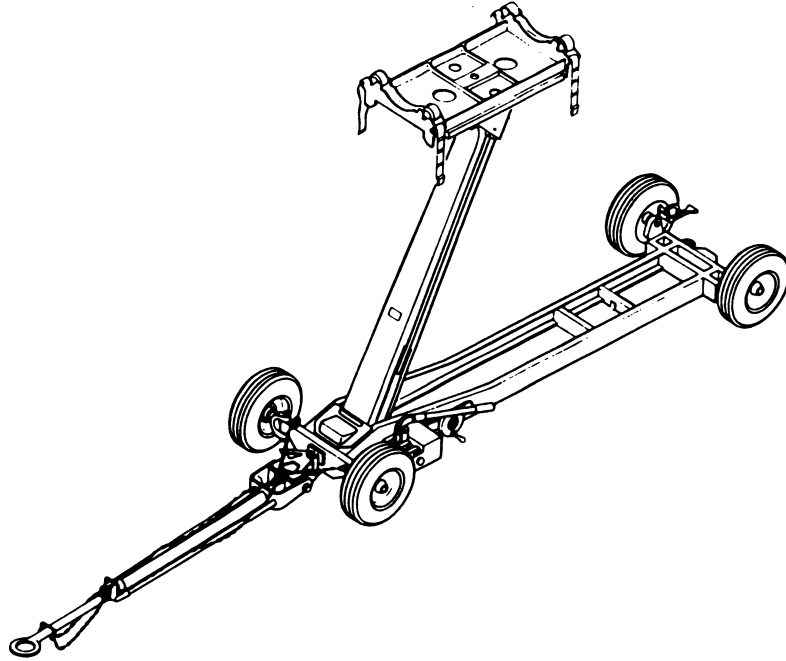


Figure 10-50.—Mk 7 Mods 3, 4, and 5 bomb trailer.

cargo truck (pickup). When coupled together, the SATS trailers form a train behind the truck. Don't use more than four trailers in one train.

MK 7 AND MODS BOMB TRAILER

The Mk 7 Mods 3, 4, and 5 bomb trailers (fig. 10-50) are made of a low-slung heavy channel steel frame mounted on four wheels. The trailers have a hydraulic elevating system actuated by a manually operated pump. The elevating assembly consists of an elevating arm upon which a cradle assembly is mounted. The cradle assembly consists of a tilting table and cradle. The cradle is equipped with rollers for positioning the weapon. The tilting table and cradle can be tilted 30 degrees forward or backward in a vertical plane by using a hand wheel. The cradle can be adjusted in the horizontal plane and rotated around its center with travel fixed by the table lock plate. The cradle is also capable of lateral movement. It can be rolled on table rollers from side to side with travel fixed by the table. The cradle movements are used to align and stabilize the weapon during loading. The cradle is equipped with tie-down straps to secure the load. Out-riggers may also be used to provide greater stability during weapon elevation.

The front axle is steerable and equipped with a drawbar, having a towing eye on its end. The towing eye is used to couple the trailer to a towing vehicle. A pintle hook welded to the rear frame lets you couple it with another trailer to form a train. Pad eyes are located on the front and rear of the trailer for use with a safety chain assembly provided with the trailer. The trailer is equipped with a safety chain connected to the towing vehicle. When multiple trailers form a train, the safety chain is connected between trailers to prevent the drawbar from dropping to the ground if a drawbar or pintle hook fails. The trailer is also provided with a static chain to ground static electricity. All Mods of the trailers are equipped with a rear-wheel mechanical parking brake.

Mk 7 Mods 3, 4, and 5 bomb trailers are used to transport and load a variety of weapons and stores. For transport, a towing vehicle is required, and more than one trailer can be towed. The Mk 7 bomb trailer has an SWL of 2,250 pounds. For aircraft loading and unloading operations, manpower is used to position the trailer. Tow the trailer at a safe speed. Speed is determined by the user activity; tow a single trailer with a specified load at a speed not to exceed 15 miles per hour. Tow multiple trailers in a train at a speed not to exceed 5 miles per hour.

MHU-126/M SMALL MUNITIONS TRAILER

The MHU-126/M small munitions trailer (fig. 10-51) has a low-slung channel steel frame and four wheels with pneumatic rubber tires. Lengths of drilled steel bars welded to crossmembers of the frame provide mounting holes for the various adapters. The front axle is steerable and equipped with a drawbar that has a towing eye on its end to couple the trailer to a towing vehicle. A pintle hook on the rear of the frame permits coupling with another trailer. The wheels are equipped with hydraulic service brakes. Mechanical parking brakes are provided on two of the four wheels.

When equipped with adapters, use the MHU-126/M small munitions trailer to transport and load various weapons, stores, and equipment. The recommended maximum towing speed is 15 miles per hour for a single trailer and 5 miles per hour for multiple trailers being towed in a train. The MHU-126/M has an SWL of 5,000 pounds.

A/M 32K-4A SATS ROUGH TERRAIN TRAILER

The A/M 32K-4A SATS rough terrain trailer (fig. 10-52) is a transport vehicle consisting of a chassis and a light weight flatbed aluminum body. The chassis has two axles and four single wheels equipped with pneumatic tires. A torque box

REVIEW NUMBER 7 ANSWERS

- A1. *The gross vehicle weight (GVW) of the ammunition handling truck is 24,000 pounds.*
- A2. *The maximum boom reach of the ammunition handling truck is 16 1/2 feet.*
- A3. *When using the forklift truck in rough terrain, pneumatic tires should be used.*
- A4. *The electric forklift truck has outriggers, which are rigid structures allowing it to carry off-balance loads.*
- A5. *The maximum capacity of the hand pallet truck is 4,000 pounds.*
- A6. *The Aero 33D/E bomb truck can lift loads to a height between 30 and 63 inches.*
- A7. *The SWL of the Aero 33D/E bomb truck is 4,000 pounds.*
- A8. *The Aero 62A tray adapter consists of a rectangular metal tray with one end open so the Aero 21C weapon skid can be pushed onto the bottom plate.*
- A9. *By moving the drawbar, the front wheels of the Aero 33D/E can be rotated through an arc of 84 degrees.*
- A10. *The maximum hydraulic pressure of the Aero 33D/E is 3,000 psi.*
- A11. *To overcome an imbalance condition when using the Aero 33D/E, the Aero 36A outrigger assembly should be used.*
- A12. *The Aero 33D has an electrical and a manual lift system, while the Aero 33E has only a manual lift system.*

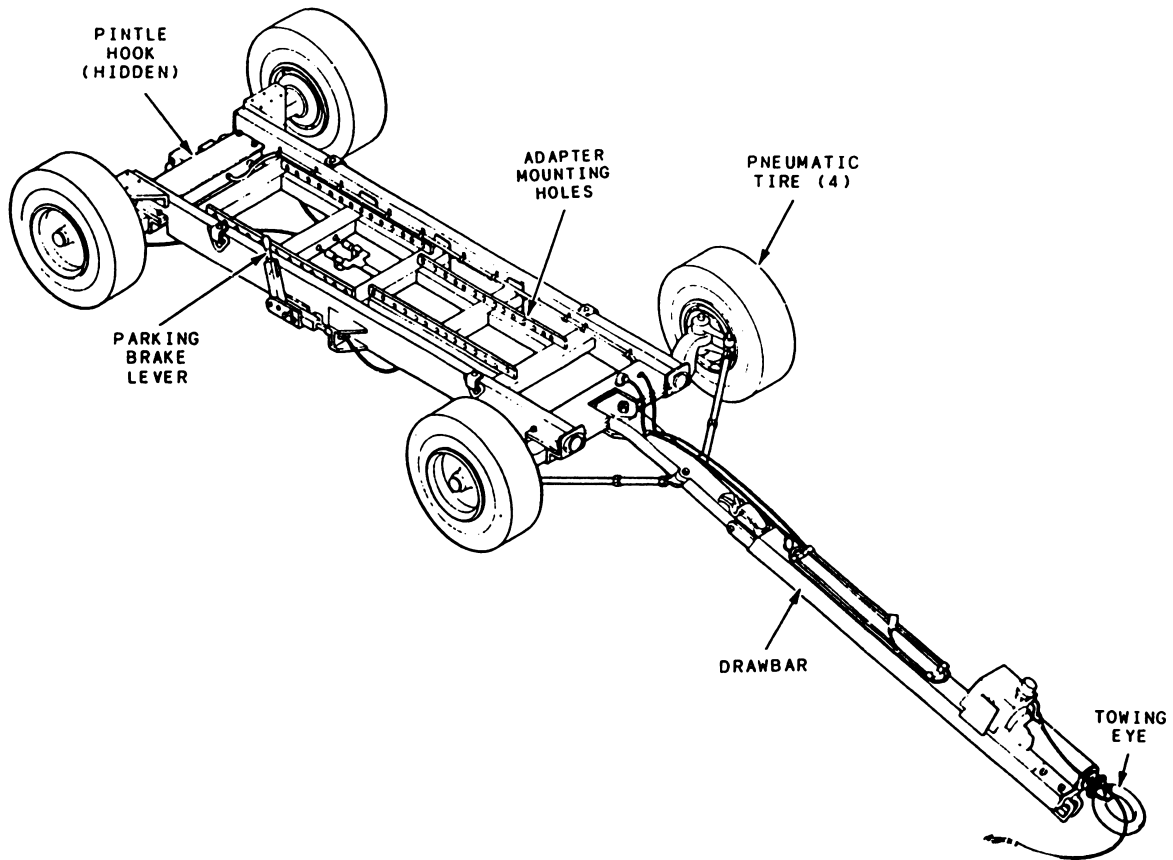


Figure 10-51.—MHU-126/M small munitions trailer.

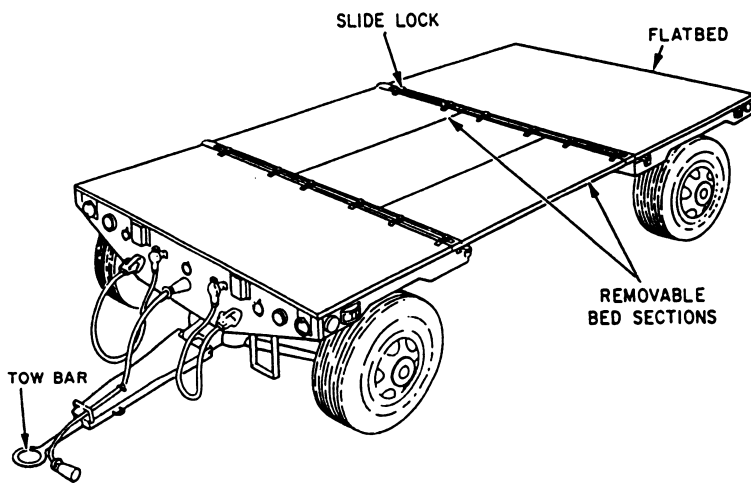


Figure 10-52.—A/M 32K-4A SATS rough terrain trailer.

provides strength and rigidity to the body. You can remove two sections of the nonskid flatbed to use a forklift truck to load and unload the trailer. The trailer is equipped with a tow bar, multiple leaf springs, service brakes, and parking brakes. The trailer is provided with 12 cradle tie-down fittings to hold the weapon cradles securely on the bed.

The A/M 32K-4A SATS rough terrain trailer is used to transport air-launched weapons from an ammunition dump to a SATS airstrip. You can operate it over very rough terrain. It is normally used at advanced bases. The trailer holds weapons in cradles that are two tiers in height when equipped with increased load-density weapon cradles. The cradles are secured to the trailer bed by quick-release positive-locking clips. The SATS trailer can also be equipped with stake sides and used as a utility vehicle for transporting weapon components. The A/M 32K-4A has an SWL of 8,000 pounds.

AERO 51B MUNITIONS TRAILER

The Aero 51B munitions trailer (fig. 10-53) is a transport vehicle having an automotive chassis and a flat-deck body. The chassis has two axles and four single wheels equipped with pneumatic tires. The center section of the nonskid flat deck is hinged. It can be opened to provide a hatchway across the full width of the vehicle. It also has hinged deck panels that have double rails with

holes at intervals to provide a mounting base for cradles and adapters.

The trailer has hydraulic surge brakes and mechanical parking brakes, a tow bar, and cable harness. The cable harness electrically connects the trailer to the towing vehicle for operation of the trailer lights. Accessory items (chocks, tie-down straps, interconnecting electrical harness, etc.) are stored in toolboxes mounted underneath the forward and aft decks.

The Aero 51B munitions trailer is used with a towing vehicle to transport and hold a variety of weapons in ready storage. The weapons are supported on the trailer by adapters or cradles. This trailer is used to transport stores and cargo. The Aero 51B munitions trailer is not used aboard ship. The Aero 51B has an SWL of 8,500 pounds.

REVIEW NUMBER 8

- Q1. *By using a hand wheel, the tilting table and cradle of the Mk 7 bomb trailer can be tilted _____ forward or backward on the vertical plane.*
- Q2. *What is the SWL of the Mk 7 bomb trailer?*

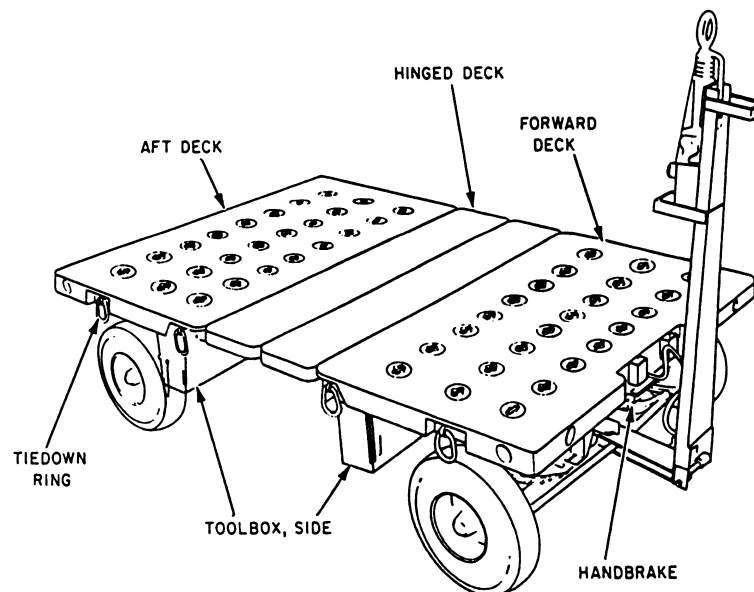


Figure 10-53.—Aero 51B munitions trailer.

- Q3.** *What is the maximum recommended towing speed of the MHU-126/M small munitions trailer when towed alone and in a train?*
- Q4.** *At what location should you use the Aero 51B munitions trailer?*
- Q5.** *What is the SWL of the Aero 51B munitions trailer?*

LOADERS

Learning Objective: *Identify the purpose and use of the SATS weapon loader, the Aero 47A, 47A-1, and MJ-7 weapon loaders.*

Loaders are generally used to handle a variety of loads such as weapons, ammunition, JATO bottles, rockets, pylons, or fuel tanks during naval aircraft loading operations. Some loaders are capable of operating over rough terrain while others are built for smooth surfaces. The types of loaders used to handle ammunition and explosives are equipped with flame- and spark-arresting mufflers.

A/S 32K-1A/1B/1C SATS WEAPON LOADERS

Each A/S 32K-1A/1B/1C SATS weapon loader (fig. 10-54) is a self-propelled vehicle with a low,

heavy-duty frame supported by six small, high capacity wheels. Each vehicle has two main functional components. The lifting mechanism has a lift boom, hydraulic system, and manipulating head. The lift boom is operated by a piston-type hydraulic cylinder mounted in the midsection of the boom support. The manipulating head is located at the upper end of the lift boom, and is capable of limited lateral and longitudinal motions as well as tilting and yawing motions. The head is equipped with lifting forks attached with quick-release pins and mounted in three positions—normal, inverted forward, and inverted rear.

The drive mechanism includes a hydrostatic drive system powered by a power-splitter gearbox, drive shaft with universal joints, limited-slip differential, axle/wheel disconnect hubs, and steerable drive wheels with power-assisted steering.

The power to operate the lift and drive mechanisms is supplied by a four-cylinder, air-cooled gasoline engine. The weapon loader is equipped with four-wheel hydraulic brakes, electric/hydraulic operated parking brakes, and a spark- and flame-arresting muffler. It is also equipped with nylon tie-down straps to hold the load securely during handling, a utility chain to lift items directly off the ground, and lights for night loading operations.

Each A/S 32K-1A/1B/1C SATS weapon loader has an SWL of 4,500 pounds. It is used to load externally carried munitions, weapons, and stores onto an aircraft. Each SATS weapon loader is used with a variety of adapters and cradles.

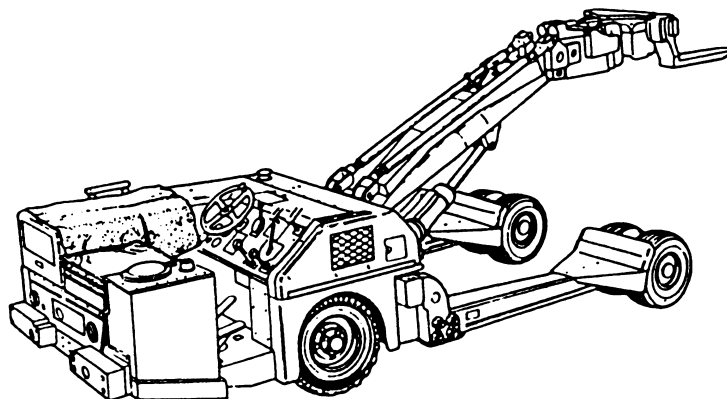
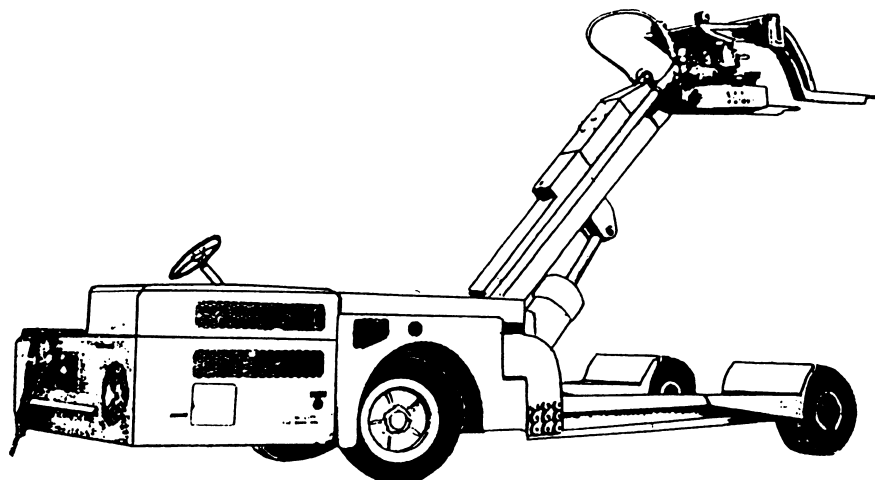


Figure 10-54.—A/S 32K-1A/1B/1C SATS weapon loader.



220.914

Figure 10-55.—Aero 47A, Aero 47A-1, and MJ-7 weapon loader.

AERO 47A, AERO 47A-1, AND MJ-7 WEAPONS LOADERS

The Aero 47A, 47A-1, and MJ-7 weapon loaders (fig. 10-55) are self-propelled vehicles with low, heavy-duty frames. Each weapon loader's frame is supported by six small high-capacity wheels. Each vehicle consists of two main functional components—the lifting mechanism and the drive mechanism.

The lifting mechanism has a lift boom, hydraulic system, and a manipulating head. The lift boom is operated by a piston-type hydraulic cylinder mounted in the midsection of the boom

support. The manipulating head is located at the upper end of the lift boom and is capable of limited ram, lateral and longitudinal motions, as well as tilting, rolling, and yawing motions. These weapon loaders have a lifting fork attached to the manipulating head by an adapter. The lifting fork can be mounted in three positions—normal forward, inverted forward, and inverted rear. By inverting the adapter plate, the maximum reach of the fork is extended in each of these position.

The drive mechanism includes a conventional automotive clutch, transmission, and rear-wheel drive. These weapon loaders are equipped with four-wheel hydraulic brakes, mechanical parking

REVIEW NUMBER 8 ANSWERS

- A1. By using a hand wheel, the tilting table and cradle of the Mk 7 bomb trailer can be tilted 30 degrees forward or backward on the vertical plane.*
- A2. The SWL of the Mk 7 bomb trailer is 2,250 pounds.*
- A3. The maximum recommended towing speed of the MHU-126/M small munitions trailer when towed alone is 15 mph and 5 mph when towed in a train.*
- A4. You should use the Aero 51B munitions trailer with a towing vehicle to transport and hold a variety of weapons in ready storage.*
- A5. The SWL of the Aero 51B munitions trailer is 8,500 pounds.*

brakes, and rear-wheel power steering. They also have spark- and flame-arresting mufflers, nylon tie-down straps to hold the load during handling, utility chains for lifting items directly off the ground, and lights for night-loading operations. The hydraulic system controls are located within reach of the operator's seat. The seat is located at the extreme rear of each vehicle. The controls are also located on the boom. Power to operate the lift and drive mechanisms is supplied by a four-cylinder, air-cooled diesel engine.

The AERO 47A, 47A-1, and MJ-7 weapon loaders have an SWL of 4,500 pounds each. They are used to load externally carried weapons, stores, and fuel tanks onto aircraft. These weapon loaders are used with a variety of adapters and cradles.

REVIEW NUMBER 9

Q1. The A/S 32K-1A/1B/1C SATS weapons loader is used to load _____.

Q2. List the two main functional components of the Aero 47A, Aero 47A-1, and MJ-7 weapons loaders.

Q3. What is the SWL of the Aero 47A, Aero 47A-1, and MJ-7 weapons loaders?

SAFETY PRECAUTIONS FOR HANDLING EQUIPMENT

Learning Objective: *Recognize the safety precautions to follow when using ordnance handling equipment.*

You must observe the safety precautions and instructions that pertain to the safe operation and use of ammunition and explosives handling equipment, both afloat and ashore. The task of ammunition and explosives handling is hazardous. Accidents involving ammunition and explosives handling kill and injure personnel, destroy essential supplies, and damage valuable equipment and property. These accidents don't *just happen*.

They are caused by carelessness or unfamiliarity with the use and limitations of handling equipment, as well as relaxation or failure to observe safety precautions, orders, and regulations pertaining to the handling and stowage of ammunition and explosives. You can prevent accidents caused by misuse of handling equipment if you take the time to understand the use and limitations of the handling equipment.

Many technical manuals and instructions contain information about safety, inspection, and tests for ordnance handling equipment. For general information, refer to the following publications:

- *Approved Handling Equipment for Weapons and Explosives*, NAVSEA OP 2173, Volume 1 (NAVAIR 19-100-1.1) and Volume 2 (NAVAIR 19-100-1.2)

- *Ammunition Afloat*, NAVSEA OP 4

- *Ammunition and Explosives Ashore, Safety Regulations for Handling, Storing, Production, Renovation, and Shipping*, NAVSEA OP 5, Volume 1

Use approved handling equipment to handle explosive ordnance. Approved handling equipment is described in NAVSEA OP 2173 and NAVSEA OP 4098. Before being assigned to operate any explosive ordnance handling equipment, you must receive a thorough indoctrination in general safety precautions applicable to explosive ordnance. You must also be indoctrinated in the specific precautions applicable to the equipment you will be operating. Additionally, you must be qualified and certified under OPNAVINST 8023.2 (series) and other appropriate command directives.

To assure reliability, explosive handling equipment must be inspected and periodically tested. Equipment such as slings, bands, beams, strongbacks, and spreader bars are static tested at 200 percent to 215 percent of SWL. If the date and the results of the latest static test are not marked on the equipment or the test is out of date, don't use the equipment.

You must possess a valid explosives drivers license before operating industrial material handling equipment such as forklift trucks, pickup trucks, platform trucks, crane trucks, and tractors and trailers.

You must never exceed the SWL of the equipment being used. If adapters are being used, you cannot exceed the **lowest** SWL of the equipment-adapter configuration. For example, if an Aero 12C bomb skid (SWL of 1,250 pounds) is used with an Aero 9C bomb skid adapter (SWL of 1,000 pounds), the maximum capacity of the skid-adapter configuration is limited to 1,000 pounds.

REVIEW NUMBER 10

Q1. What is the primary cause of accidents involving handling equipment?

Q2. To operate handling equipment that carries explosives, you must be qualified and certified according to what instruction?

Q3. Equipment such as slings, bands, beams, and strongbacks are weight tested at what percentage of their SWL?

Q4. If the date and results of the latest static test are not current or not marked on the equipment, what should you do?

REVIEW NUMBER 9 ANSWERS

A1. The A/S 32K-1A/1B/1C SATS weapons loader is used to load externally carried munitions, weapons, and stores onto aircraft.

A2. The two main functional components of the Aero 47A, Aero 47A-1, and MJ-7 weapons loaders are the lifting mechanism and the drive mechanism.

A3. The SWL of the Aero 47A, Aero 47A-1, and MJ-7 weapons loaders is 4,500 pounds.

(THIS PAGE IS INTENTIONALLY LEFT BLANK.)

REVIEW NUMBER 10 ANSWERS

- A1. The primary cause of accidents involving handling equipment is carelessness or unfamiliarity with the use and limitations of handling equipment, failure to observe safety precautions, orders, and regulations about handling and stowing ammunition and explosives.*
- A2. To operate handling equipment that carries explosives, you must be qualified and certified according OPNAVINST 8023.2 (series).*
- A3. Equipment such as slings, bands, beams, and strongbacks are weight tested at 200 to 215 percent of their SWL.*
- A4. If the date and results of the latest static test are not current or not marked on the equipment, don't use it.*

CHAPTER 11

SUSPENSION, ARMING, AND RELEASING EQUIPMENT

The Navy uses complex suspension, arming, and releasing devices in combat aircraft and weapons. The high speed and performance of potential targets and our own aircraft require the electronic operation of suspension, arming, and releasing equipment.

The equipment covered in this chapter is part of the aircraft search or kill stores systems. Generally, these devices operate electrically and are controlled by aircraft electrical circuits. They are actuated manually by a hand switch or automatically by a circuit-closing device in the system.

BOMB RACKS

Learning Objective: Identify the purpose and use of bomb racks. Recognize the bomb racks used for various configurations, and identify the operation of bomb racks to include electrical and manual release and arming.

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

AERO 65A SERIES BOMB RACK

Aero 65A bomb racks are used to suspend, selectively arm, and release 1,000-pound class stores. These stores have suspension hooks spaced 14 inches apart. When used with the Aero 1A adapter assembly, you can suspend weapons/stores with lugs spaced 30 inches apart and weighing up to 2,000 pounds. Some Aero 65A bomb rack models are pylon mounted to the wing stations of the P-3A, P-3B, and the P-3C aircraft. They may also be pylon mounted in the bomb bay stations of the P-3A and P-3B aircraft.

Aero 65A series bomb racks (fig. 11-1) consist of a frame. Mounted inside the frame are an electrical release unit, two arming solenoids, two hook assemblies (spaced 14 inches apart), a manual release cable assembly, a release linkage

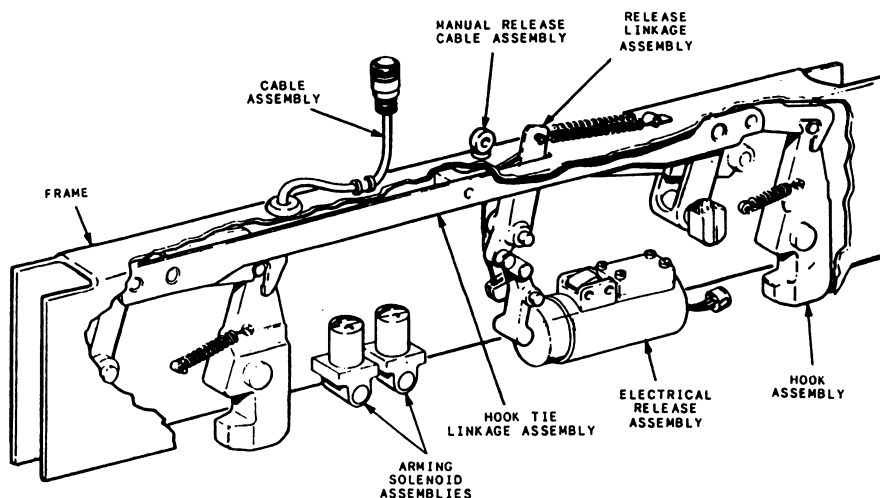


Figure 11-1.—Cutaway view of a typical Aero 65A bomb rack.

assembly, a hook tie linkage assembly, and a cable assembly.

The frame is a U-shaped, alloy steel channel. It has holes at both ends so you can mount it in an aircraft or attach Aero 1A adapter assemblies. Access holes in the frame let you visually verify that the hook closing is latched. These holes let you insert the safety pin, cocking lever, and hoist bracket.

The electrical release unit is a spring-loaded plunger. It is mechanically cocked and electrically released to provide the force that initiates hook release. The release unit bolts to the bottom of the bomb rack frame near the center. Before the hook tie linkage is cocked, you must cock the release unit plunger. The electrical cable assembly supplies 28-volts dc through a four-pin male connector. Three types of electrical release units are used—the Aero 7B release unit, the Aero 7B-1 release unit, and the linear electromechanical actuator (LEMA). The external difference between the Aero 7B and Aero 7B-1 is the two-piece plunger barrel on the Aero 7B-1. The LEMA is similar to the Aero 7B-1 release unit. You can identify it by the decal located on the release unit.

There are two arming solenoids at the bottom of the bomb rack frame, slightly forward of the center. The arming units are electrically controlled and mechanically operated continuous-duty solenoids. They provide fully selectable arming for nose, tail, or nose and tail when weapons are armed by arming wires. Arming is selectable in flight by the pilot. The pilot also has a safe selection, which does not energize the arming solenoids.

The weapon/store is suspended from two suspension hook assemblies protruding from the bottom of the bomb rack. Each hook latches independently. You mount it in the bomb rack frame by using a pivot pin. Each hook is made from chrome-plated steel or stainless steel. It has a bushing in the pivot hole, a latch pin engaging the hook tie linkage to latch the hook, and a threaded spring stud to attach a spring to preload the hook in the open position.

A manual release cable assembly is located at the center of the bomb rack. It consists of a pull ring and a cable extending for the depth of the bomb rack. The cable is attached to a manual-release link assembly or a manual-release lever located at the bottom of the bomb rack. When the pull ring is connected to the aircraft's externally routed manual-release cable, the pilot has the option of manual release.

The release-linkage assembly, located at the center of the bomb rack, contains a release bell crank and bell crank link, a sear link, and two attaching pins.

The hook tie linkage assembly extends end-to-end on the bomb rack. It contains a bumper and four moving parts—two latches and two links, which are set between two hook tie links. The tie linkage latch link contains cutouts so you can insert the lock-link assembly and the screw holding the latching pin in place.

The electrical cable assembly consists of five leads. Two leads are attached to the solenoids. The remaining leads are routed along the top inside surface of the bomb rack. They terminate in a female connector that mates with the release unit.

There are two accessories for the Aero 65A bomb rack—an Aero 1A adapter assembly and a safety interlock mechanism. These accessories are issued as required. They do not come with the bomb rack.

Aero 1A Adapter Assembly

The Aero 1A adapter assembly (fig. 11-2) lets you load and carry weapons/stores having suspension lugs spaced 30 inches apart and weighing up to 2,000 pounds. When you install two Aero 1A adapter assemblies on the bomb rack (one on either end), the adapter assemblies let you attach the bomb rack to the aircraft pylon assembly. The Aero 1A adapter linkage attaches to the bomb rack. The movement of the Aero 1A

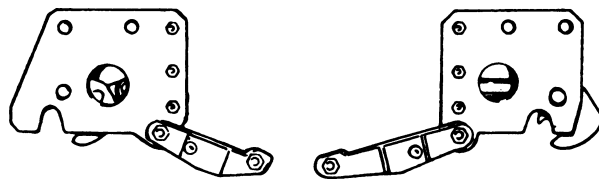


Figure 11-2.—Aero 1A bomb rack adapter assembly.

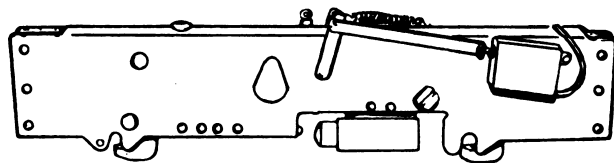


Figure 11-3.—In-flight operable bomb rack lock (IFOBRL).

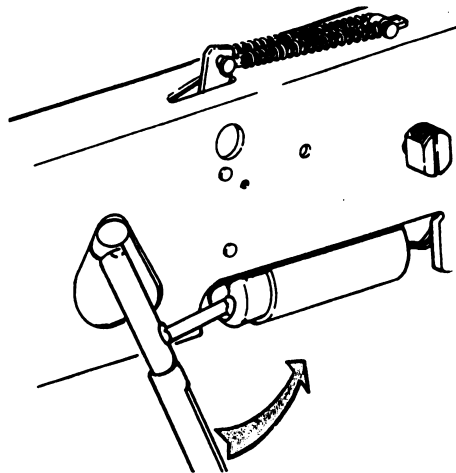


Figure 11-4.—Cocking procedure.

adapter suspension hooks corresponds to the movement of the bomb rack suspension hooks. If you need more information about the Aero 1A adapter assembly, refer to *Bomb Rack Adapter Assembly Aero 1A*, NAVAIR 11-5E-17.

Safety Interlock Mechanism

The safety interlock mechanism is an in-flight, operable bomb-rack lock (IFOBRL) (fig. 11-3).

It provides additional safety when the aircraft carries special stores. The Aero 65A series bomb racks use a special stores conversion kit installation. The safety interlock mechanism has a linear electromechanical actuator. When energized, the actuator unlocks the safety interlock mechanism and permits release of the store. You can find more information on the IFOBRL by referring to the applicable aircraft maintenance manual.

Cocking and Latching

Before you load a weapon on the Aero 65A bomb rack, cock and latch the bomb rack linkage assembly. To cock the bomb rack, you must insert a cocking lever assembly in the hoist bracket mounting hole (fig. 11-4). Pull the assembly back until the release unit plunger compresses. To latch the linkage assembly, turn the latch knob as far as it will go in the direction away from the arrow. (This ensures the linkage is aligned for latching.) Then, turn the latch knob in the direction of the arrow (fig. 11-5). Press the release bell crank forward until the sear roller rises above the sear. Then, return the release bell crank to its normal position. If the sear roller does not rest on the sear or is not visible above the sear, rotate the latch knob in the

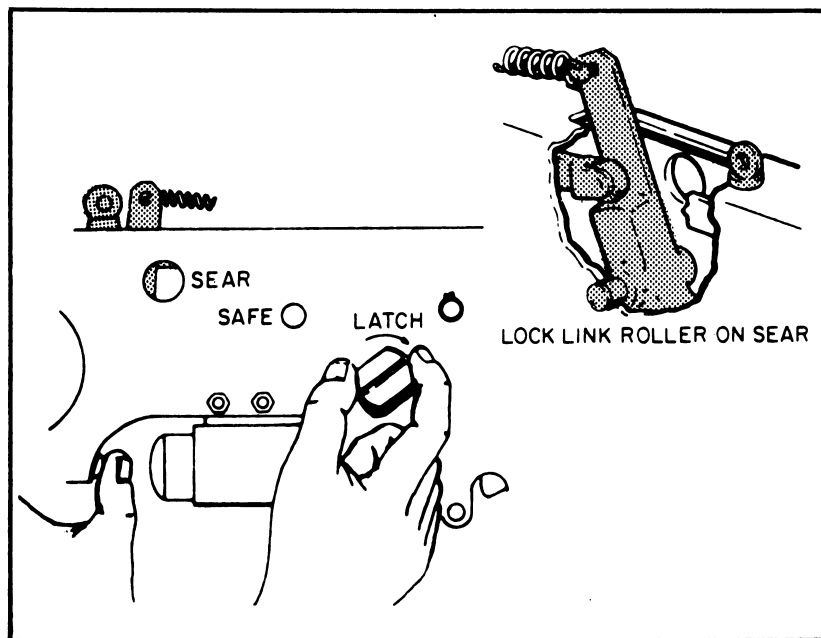


Figure 11-5.—Latching procedure.

direction away from the arrow to force the sear roller down.

The suspension hooks close independently of each other. During loading of a weapon/store, the lugs pivot the hooks on the hook pins to the closed position. You must inspect the hook latch

inspection holes to verify that the hook latch pins are securely held in the hook latches. The hook latches and the ends of the hook latch pins are marked with fluorescent red-orange paint for easy visibility. When the hooks are latched, the painted areas are aligned as shown in figure 11-6.

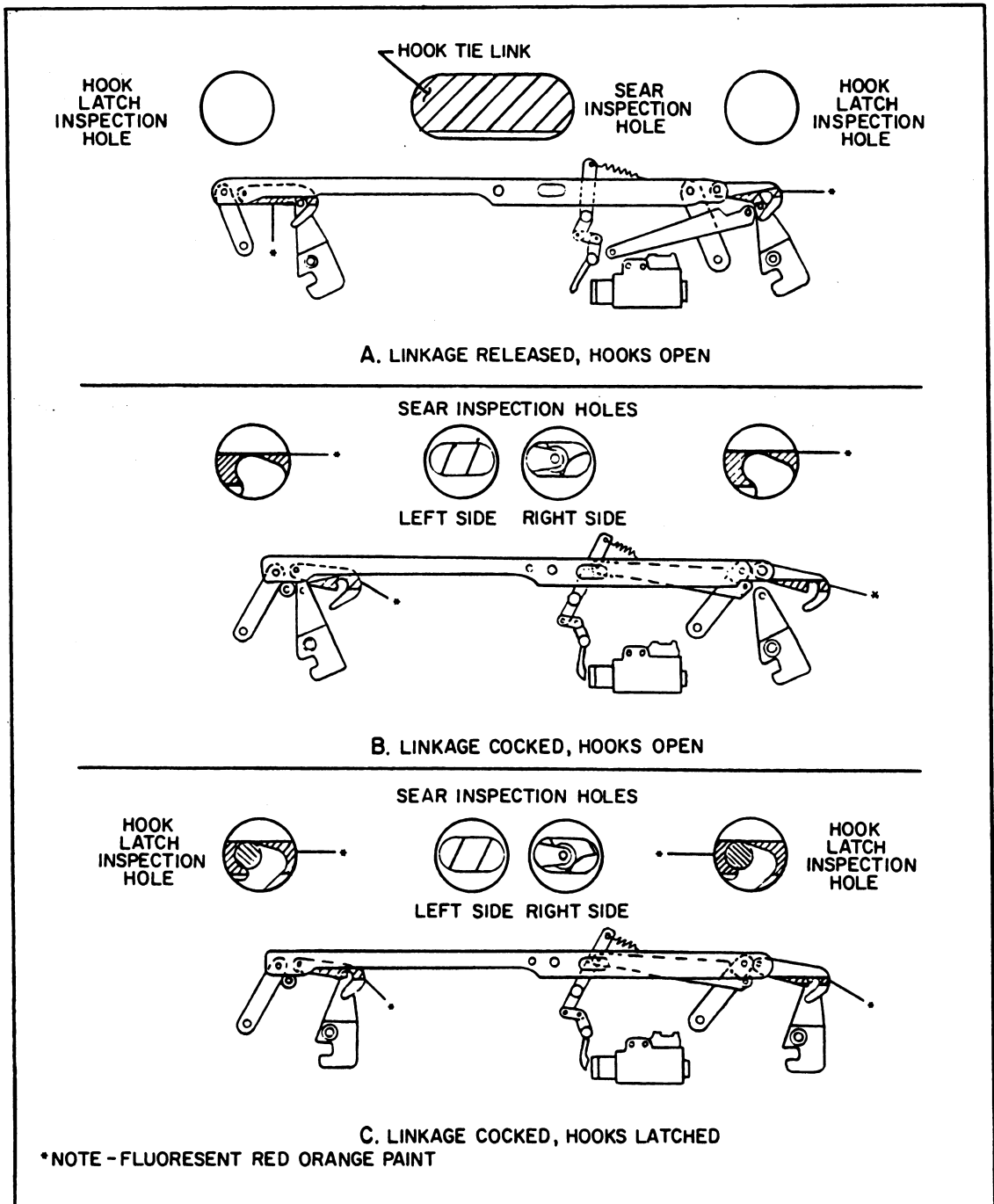


Figure 11-6.—Released, cocked, and latched configuration of the Aero 65A bomb rack.

220.926

Operation

Weapons are armed mechanically and released either electrically or manually.

ELECTRICAL RELEASE.—The electrical release unit is energized by a 28-volt dc power supply from the aircraft's weapons control system by the bomb rack electrical cable assembly. When power is applied, the release unit plunger strikes the release bell crank. Through the connecting link, the sear link rotates to free the lock link. As the hook latches move forward, the hook springs and hook-latch springs pull the suspension hooks open. The front hook comes to rest against the hook stop, and the latches are cammed-up out of engagement. The lock link is held against the aft link by the lock link return spring.

MANUAL RELEASE.—The sequence for manual release is the same as for electrical release, except that the release bell crank is actuated by the manual release cable. The manual release cable is routed from the aircraft and connected to the manual-release cable assembly of the bomb rack.

ARMING.—A 28-volt dc power supply energizes the two arming solenoids. These solenoids electrically control mechanical arming. The arming units are energized individually or simultaneously. When the arming units are energized, the arming wires remain in place. The store is armed as it falls from the bomb rack. When the solenoids are de-energized, the store pulls the wires free of the bomb rack, and it isn't armed.

If you want more information about the Aero 65A series bomb rack, refer to *Bomb Rack Models Aero 65A Series*, NAVAIR 11-5E-50.

MAU-38/A BOMB RACK

The MAU-38/A bomb rack mounts in the bomb bay of P-3 aircraft (all models). The MAU-38/A bomb rack (fig. 11-7) is a major modification of the Aero 65A bomb rack. The frame is modified; there are only two aircraft mounting bolt holes—one on each end of the frame. Also, the release return and manual release linkage are arranged on the right and left side of

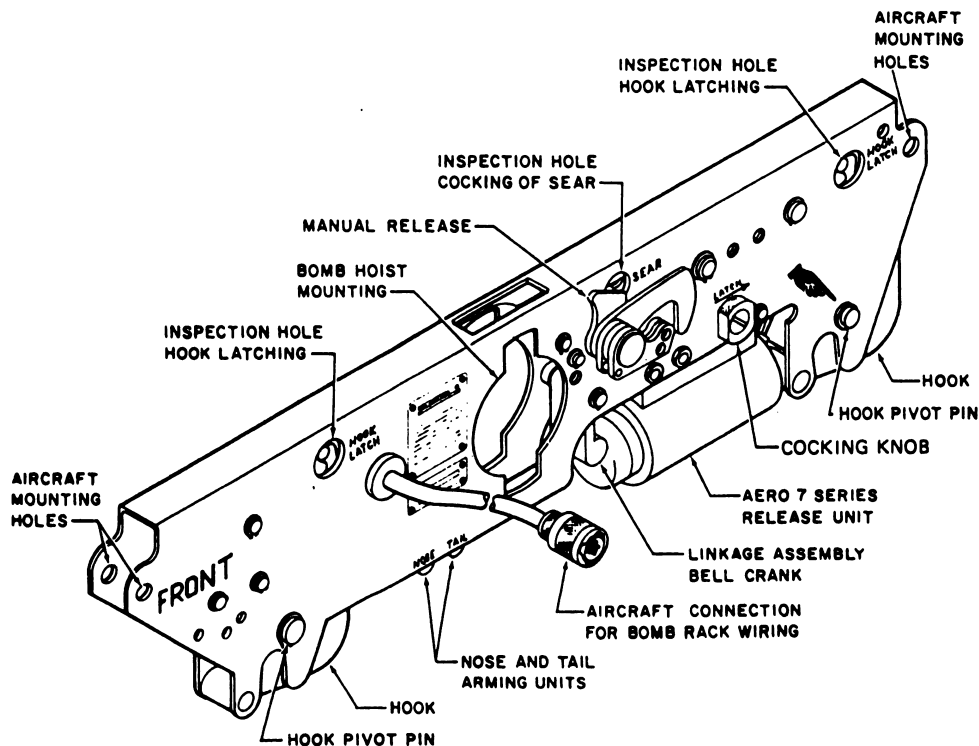


Figure 11-7.—MAU-38A aircraft bomb rack.

220.556

the rack frame, respectively. The operation, suspension, and maximum capacity of the MAU-38/A and Aero 65A bomb racks are the same. However, you can't use the Aero 1A bomb rack adapter assembly on the MAU-38/A.

For further information concerning the MAU-38/A bomb rack, you should refer to *Bomb Rack Model BRU-12/A and MAU-38/A*, NAVAIR 11-5C-23.

BRU-12/A BOMB RACK

The BRU-12/A bomb racks are MAU-38/A bomb racks that incorporate the AAC 571. Part of the change includes the deletion of the remote manual release capability (you can manually open the rack during ground servicing), a double vice a single release return spring, and replacement of the knurled latch knob by a hexagon knob requiring the use of a 3/4-inch wrench. The BRU-12/A is interchangeable with the MAU-38/A. It mounts in the bomb bay of all models of the P-3 aircraft.

BRU-14/A BOMB RACK

The BRU-14/A bomb rack (fig. 11-8) provides suspension and release of conventional and special

weapon/stores up to 2,200 pounds with 14-inch suspension. At times, Aero 1A adapter assemblies are used to increase the bomb rack to 30-inch suspension capacity. The BRU-14/A is a major modification of the Aero 65A-1 bomb rack. You may install it in the bomb bay of the P-3C and S-3A aircraft. The major modifications are discussed in the following paragraphs.

Sway braces are bolted to the rack frame. Installation of an IFOBRL allows remote locking and unlocking of the rack when electrical power is applied to the aircraft.

The BRU-14/A bomb rack has an auxiliary unlock assembly. It releases the IFOBRL if it fails to function in the normal release mode. The auxiliary unlock assembly is a cartridge-actuated device (CAD) that provides a mounting point for the aft end of the IFOBRL. When actuated, the unlock assembly releases the IFOBRL and allows it to move forward. This frees the sear link from restraint and lets the rack linkage function normally.

The BRU-14A bomb rack has a secondary release assembly. It initiates hook release if the LEMA fails to function. The secondary release assembly is a CAD that consists of a housing,

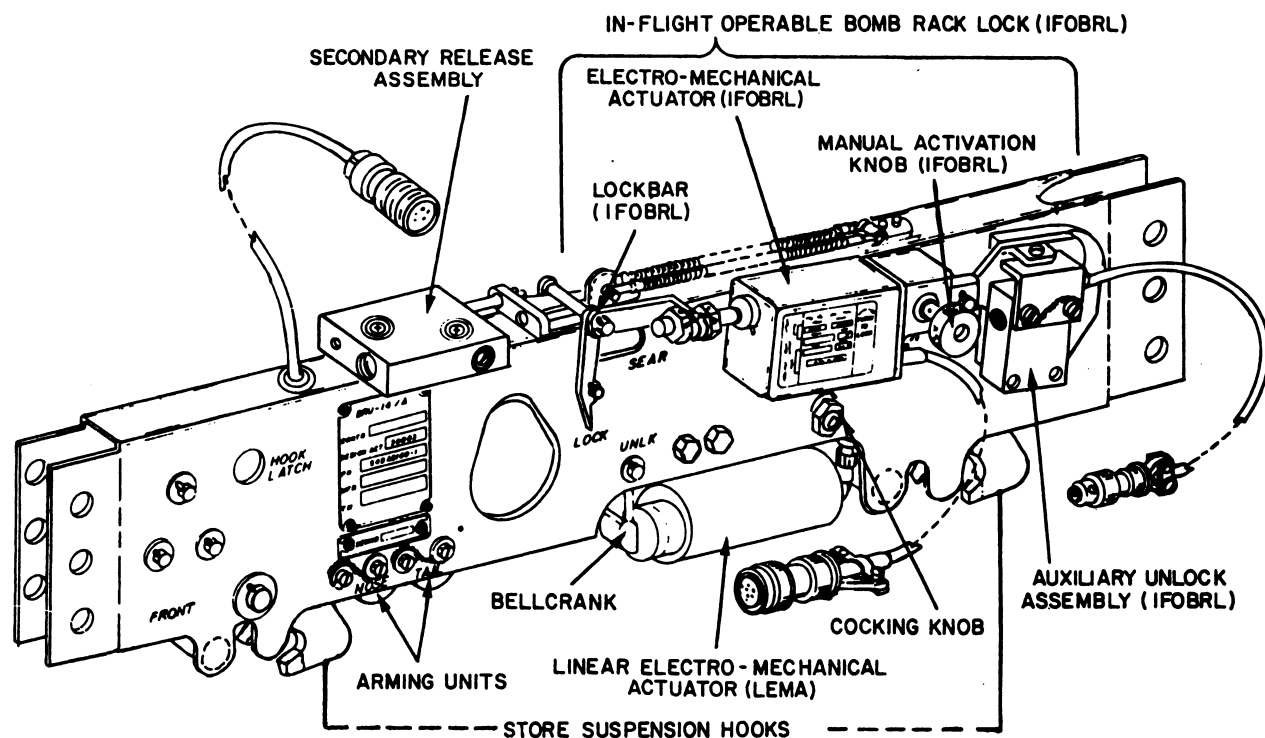


Figure 11-8.—BRU-14A aircraft bomb rack (left-hand configuration).

220.558

piston, and release slider assembly mounted on the top of the bomb rack frame. When actuated, the secondary release moves the sear link forward to release the bomb rack. The BRU-14/A doesn't have remote manual-release capabilities.

If you want more information about the BRU-14/A bomb rack, refer to *Bomb Rack BRU-14/A and BRU-15/A*, NAVAIR 11-5E-18.

BRU-15/A BOMB RACK

The BRU-15/A bomb rack is installed on the wing stations of the P-3B and P-3C aircraft. It is used with the aircraft wing store launcher assembly, which is modified to launch a Harpoon missile. You can attach Aero 1A adapter assemblies to increase the bomb rack to 30-inch suspension capacity. Because of the added Harpoon capabilities, the BRU-15/A replaces the Aero 65A as wing suspension racks for the P-3B and P-3C aircraft.

The BRU-15/A bomb rack is a modification of the BRU-14/A bomb rack. The functional and physical characteristics of the BRU-15/A are shown below.

- The IFOBRL mechanism and associated auxiliary unlock device are not included.
- There is a safety mechanism to positively lock the release mechanism of the bomb rack when a safety pin is installed.
- There is a cable-actuated manual release mechanism that operates the primary release linkage through an added manual release cable and lever.

REVIEW NUMBER 1

- Q1. To suspend stores weighing up to 2,000 pounds on the Aero 65A bomb rack, you would use what adapter assembly?*
- Q2. You are to load a weapon on the Aero 65A bomb rack. What should you do first?*
- Q3. What voltage is required to energize the release unit of the Aero 65A bomb rack?*

Q4. The MAU-38/A bomb rack is mounted on what aircraft?

Q5. If you want to connect a MAU-38/A bomb rack to a BRU-12/A bomb rack, what change would you use?

Q6. The BRU-14/A bomb rack is a major modification of what bomb rack?

Q7. The BRU-14/A bomb rack is installed in what aircraft?

Q8. What bomb rack is used on the wing stations of the P-3B and P-3C aircraft?

BOMB EJECTOR RACKS

Learning Objective: Identify the purpose and use of bomb ejector racks to include their principles of operation, maintenance requirements, and operational description.

When in flight, today's high-speed fighter and attack aircraft create a vacuum under the fuselage and wings. If a weapon/store is released from the bomb rack, this vacuum can prevent the weapon/store from entering the airstream and falling to the target. If this happens, the weapon/store may physically contact the aircraft structure, causing serious damage to or loss of the aircraft.

Bomb ejector racks are different from bomb racks. Bomb ejector racks use electrically fired impulse cartridges to eject the weapon/store free of the bomb racks. Bomb ejector racks eject the weapon/store from the bomb rack with sufficient force to overcome vacuum buildup and ensure a safe weapon/store launching environment.

AERO 7A-5 AND AERO 7B-4 BOMB EJECTOR RACKS

The Aero 7A-5 and Aero 7B-4 bomb ejector racks are mounted externally on the A-6 aircraft. All A-6 aircraft models are equipped with an

Aero 7B-4 ejector bomb rack on the centerline station and an Aero 7A-5 bomb ejector rack on the wing stations. These bomb ejector racks make up the aircraft's basic weapons suspension. They are normally referred to as *parent racks*. Bomb ejector racks are mounted in fairing-enclosed pylons for aerodynamic purposes. The pylons have removable fairings and hinged doors for easy access to the components of the bomb ejector racks.

Aero 7A-5 Bomb Ejector Rack

The Aero 7A-5 bomb ejector rack assembly (fig. 11-9) consists of a housing that contains the following components:

- Four pairs of tandem suspension hooks
- A dual breech assembly
- Mechanical linkage connecting the hook sears to the ejector and manual release assembly
- An electrical junction box connecting the aircraft firing pulses to the breech

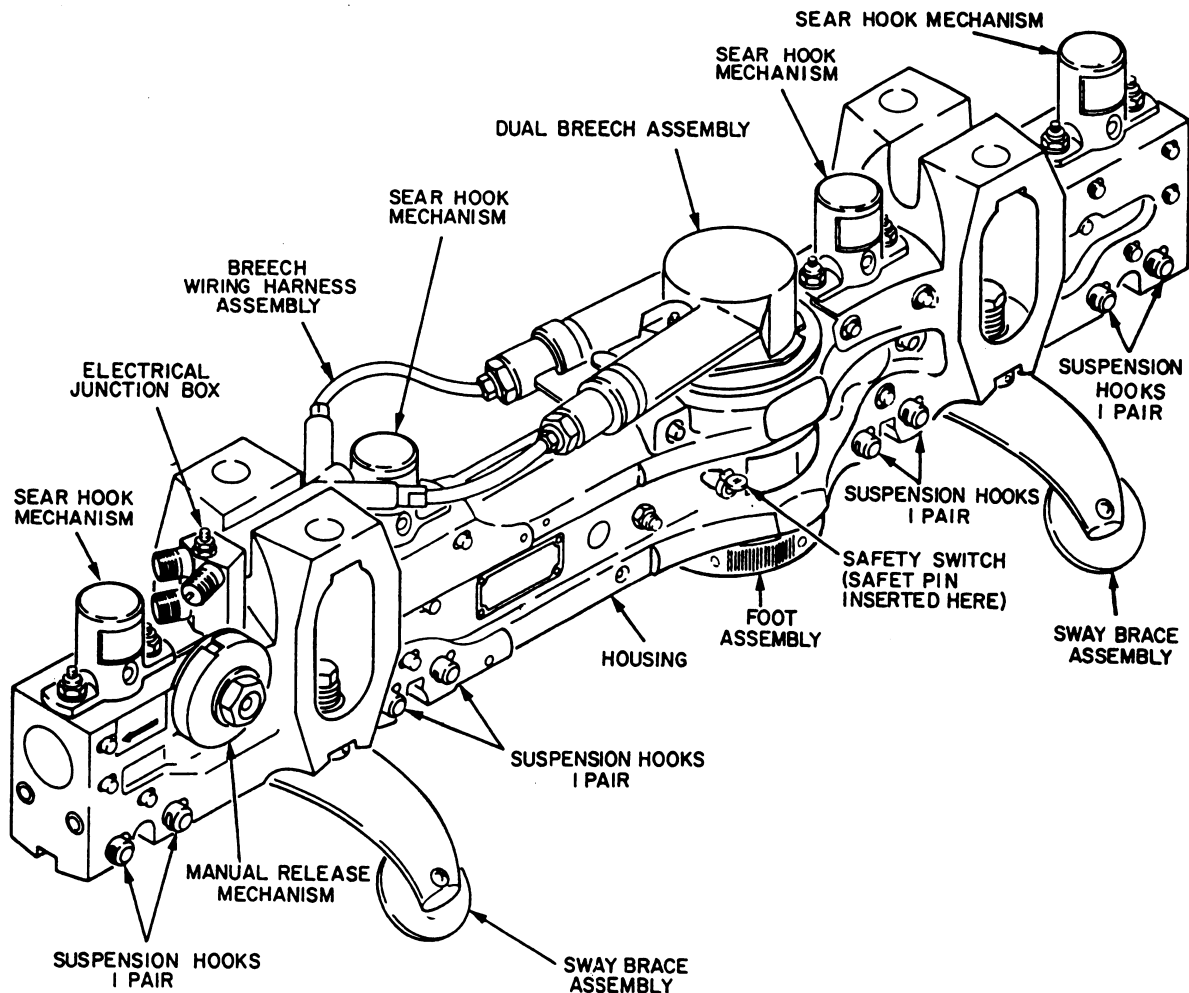
- Two sets of adjustable sway braces
- Mechanical and electrical arming units

There are four separate pairs of suspension hooks on the Aero 7A-5 bomb ejector rack—two pairs for 14-inch suspension and two pairs for 30-inch suspension. The suspension hooks are self-latching, making it easier for you to load the weapon. Inspection windows, one over each pair of suspension hooks, let you visually check sear engagement of the suspension hooks. Before you let go of the weapon or store when loading, check the inspection windows over the suspension hooks; the hooks must be locked. If the suspension hooks aren't properly engaged by the sear, the inspection window is blank. If the suspension hooks are properly engaged by the sear, you will see a horizontal black line (fig. 11-10) in the inspection window. The 14-inch suspension hooks allow a maximum weapon/store capacity of 1,500 pounds. The 30-inch suspension hooks allow a maximum weapon/store capacity of 3,500 pounds.

The dual breech assembly accommodates two impulse cartridges. It consists of a cylinder, piston, foot ejector sleeve, and an ejector foot.

REVIEW NUMBER 1 ANSWERS

- A1. To suspend stores weighing up to 2,000 pounds on the Aero 65A bomb rack, you would use the Aero 1A adapter assembly.
- A2. Before you load a weapon on the Aero 65A bomb rack, you must cock and latch the rack.
- A3. A 28-volt dc is required to energize the release unit of the Aero 65A bomb rack.
- A4. The MAU-38/A bomb rack is mounted on the bomb bays of the P-3 aircraft.
- A5. To connect a MAU-38/A bomb rack to a BRU-12/A bomb rack, you would use the AAC 571 change.
- A6. The BRU-14/A bomb rack is a major modification of the Aero 65A bomb rack.
- A7. The BRU-14/A bomb rack is installed in the P-3B and P-3C aircraft.
- A8. The BRU-15/A bomb rack is used on the wing stations of the P-3B and P-3C aircraft.

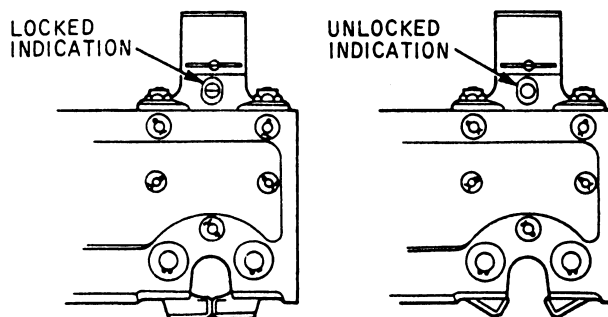


220.559

Figure 11-9.—Aero 7A-5 ejector rack assembly.

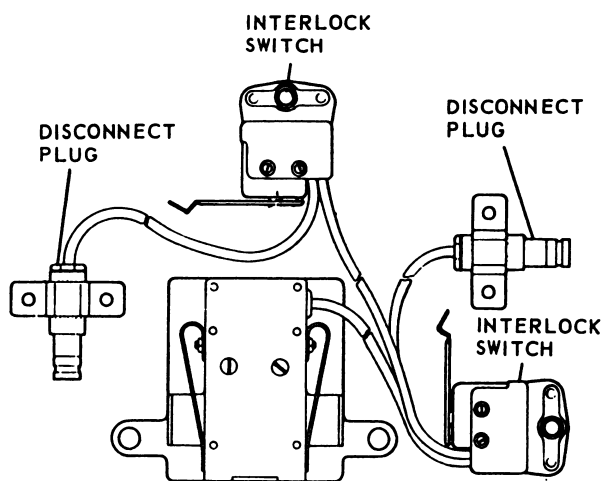
After a weapon or store is loaded, you must adjust the ejector foot flush with the skin of the weapon or store, and then back it off to the first detent. You must **never** adjust the ejector foot lower than the black scribed line on the foot ejector sleeve, or you will damage internal components.

The mechanical linkage allows the locking or releasing of the suspension hooks. You can manually release the suspension hooks by rotating the 3/4-inch manual release nut (located on the forward left-hand side of the bomb ejector rack) counterclockwise. Rotating the manual release nut mechanically actuates the mechanical linkage. This raises the suspension hook sears and opens the suspension hooks. The mechanical linkage is also activated by the dual breech assembly.



220.560

Figure 11-10.—Aero 7A-5 and Aero 7B-4 bomb ejector rack sear indicators.



220.575

Figure 11-11.—Mk-39 electric fuze arming connector used on Aero 7A-5 bomb ejector rack.

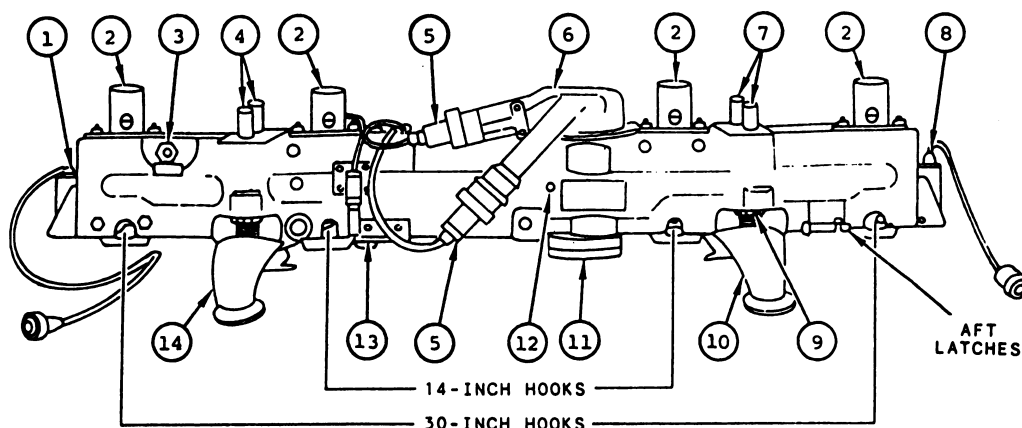
The electrical junction box electrically connects the bomb ejector rack to the aircraft's weapons control system. Electrical power is supplied from the aircraft through the electrical junction box. This operates the mechanical arming solenoids, the dual breech assembly, and provides emergency

operation of the rack. The voltage required for electrical arming doesn't pass through the electrical junction box. A separate connector assembly is located on the side of the bomb ejector rack. It connects the Mk 39 electric fuze connector to the aircraft's fuze function control system.

The Aero 7A-5 has mechanical and electrical arming capabilities. Two electromechanical solenoids are attached to the bomb ejector rack. They give the pilot the in-flight option of selecting nose only, tail only, or nose and tail arming capabilities. When an armed drop of an electrically fuze weapon is desired, the Mk 122 Mod 0 safety arming switch is installed in the weapon. It is electrically connected to the Mk 39 electric fuze arming connector (fig. 11-11) during weapon loading procedures. By using the Mk 122 Mod 0 safety arming switch, the weapon is free of the suspension hooks before forwarding the fuze arming signal to the electric fuze.

Aero 7B-4 Bomb Ejector Rack

The Aero 7B-4 bomb ejector rack (fig. 11-12) is similar in operation to the Aero 7A-5 bomb ejector rack. The Aero 7B-4 bomb ejector rack is 2 inches shorter in height than the Aero 7A-5. This, together with modifications in the aircraft



- | | | |
|-------------------------------|--------------------------------------|----------------------------------|
| 1. Nose arming solenoid | 6. Dual breech | 11. Ejector foot |
| 2. Sear indicator | 7. Aft attaching bolt (2) | 12. Safety pin receptacle |
| 3. Manual release | 8. Tail arming solenoid | 13. Electrical arming receptacle |
| 4. Forward attaching bolt (2) | 9. Aft sway brace adjusting bolt (2) | 14. Forward sway braces |
| 5. Breech cap (2) | 10. Aft sway braces | |

Figure 11-12.—Aero 7B-4 bomb ejector rack.

keel, provides 4 inches of additional deck clearance at the centerline fuselage station on the A-6 aircraft. The side location of the dual breech assembly and the rack mounting method also differs from the Aero 7A-5.

Principles of Operation

Operation of the bomb ejector rack is initiated when 28-volts dc is applied to the two impulse cartridges installed in the dual breech assembly. The two impulse cartridges are fired simultaneously, creating gas pressure in the breech. Gas pressure buildup causes the breech and sleeve assembly, through the mechanical linkage, to raise the hook sears, opening the suspension hooks. At the same time, gas pressure is applied to the piston assembly, driving the ejector foot downward, and ejecting the store from the bomb ejector rack. After ejection, a spring in the sleeve assembly returns the ejector foot to the sleeve housing. Emergency operation of the rack is identical to normal operation, except that completely separate electrical wiring is used for each impulse cartridge to ensure detonation of the two impulse cartridges.

Mechanical arming is done through the electromechanical arming solenoids. It works in the same manner as the Aero 65A series bomb racks. When an armed drop is to be made using electric fuzing, an electrical signal is applied to the Mk 39 electric fuze arming connector. When the hooks open, this signal is transmitted to the Mk 122 Mod 0 safety arming switch, which arms the weapon as it clears the rack suspension hooks. Preventing the arming signal from being transmitted to the weapon before hook release prevents the fuze from becoming armed if a hook-release malfunction occurs.

You don't want the bomb ejector rack to fire during ground operations. To prevent firing, insert a safety pin into the safety switch assembly. The safety pin maintains an open firing circuit, grounds the breech cap assembly electrical circuit, and mechanically blocks the linkage preventing the suspension hooks from opening manually. If the suspension hooks are opened manually, remove the safety pin. If you rotate the manual release nut with the safety pin installed, you will damage the linkage and possibly shear a sear retainer pin. Once the hooks are manually opened, you can reinstall the safety pin to load weapons or stores.

Maintenance Requirements

Organizational-level maintenance for the Aero 7A-5 and the Aero 7B-4 bomb ejector racks is normally performed while the bomb ejector racks are installed on the aircraft. The exception is the 21-day special inspection. In this case, the bomb ejector rack is removed from the aircraft. The bomb ejector racks are also removed from the aircraft and routed to an intermediate-level maintenance activity every 420 days for rework. They are removed from the aircraft every 42 months and routed to a depot-level maintenance activity for overhaul.

Normally, routine maintenance at the organizational level is performed during regularly scheduled servicing intervals. Servicing intervals are classed as daily inspections, loading inspections, turnaround inspections, special inspections, and inspections performed after five firings or at the end of a firing day, whichever occurs first. A few of the more common organizational maintenance requirements are discussed in the following paragraphs.

EJECTOR MECHANISM CLEANING AND INSPECTION.—You must remove the bomb ejector mechanism from the bomb ejector rack for cleaning and inspection after every five shots or at the end of a firing day, whichever occurs first. After removal from the bomb ejector rack, the ejector mechanism is disassembled for cleaning and inspection. You should clean all metal parts with aircraft surface cleaning compound (MIL-C-43616, class 2) and hot fresh water. Use a nonmetallic stiff-bristle brush to remove foreign matter from the threads and areas you can't wipe with a cloth. Then dry the cleaned parts thoroughly with a clean, lint-free cloth (MIL-C-85043) and filtered compressed air or dry nitrogen.

Once the parts have been properly cleaned, you should inspect them for damage or wear and replace or repair the parts as necessary. Before reassembling the ejector mechanism, apply a light coat of general-purpose preservative lubricating oil (VV-L-800). To prevent the piston from locking up, you must wipe off all the excess oil.

BREECH CAP CLEANING AND INSPECTION.—Clean and inspect the breech caps with the bomb rack installed in the aircraft. Unscrew the breech caps from the breech for cleaning and inspection. Clean the electrical insulating and sealing compound located on the inner surface of

the breech cap using a lint-free cloth dipped in dry cleaning solvent (P-D-680, type 2). Clean the ground sleeve assembly using the same method. Inspect the breech caps and breech-cap wiring harness for damage or wear and replace parts as necessary. Apply a light coat of silicone compound (MIL-S-8600) to the outer surface of the ground sleeve assembly. Then reconnect the breech caps to the breech.

SWAY-BRACE ASSEMBLY CLEANING AND INSPECTION.—Clean and inspect sway-brace assemblies with the bomb ejector rack installed in the aircraft. You may clean all sway-brace assemblies with dry cleaning solvent (P-D-680, type 2). Inspect the sway-brace

assemblies for corrosion, distortion, excessive binding, and other physical damage. Also, inspect the sway-brace assemblies for secure attachment to the bomb ejector rack housing assembly and freedom of operation of the adjustment screw, sway braces, and feet. Components that are damaged or excessively worn must be replaced.

For further information concerning the Aero 7A-5 and Aero 7B-4, refer to the publication *Ejector Rack Assembly Model Aero 7A-5*, NAVAIR 11-5D-20.

BRU-10A/A AND BRU-11A/A BOMB EJECTOR RACKS

The BRU-10A/A and BRU-11A/A bomb ejector racks are used to mount and sway brace

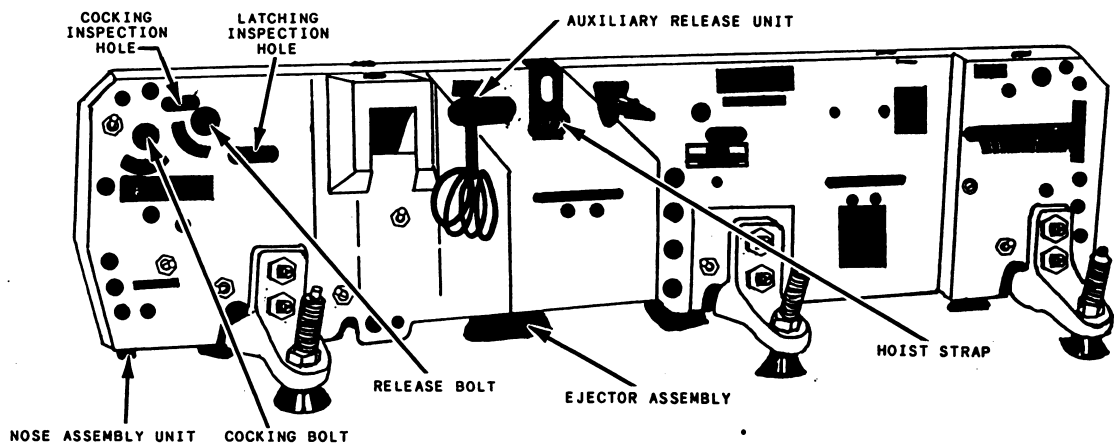


Figure 11-13.—BRU-10A/A bomb ejector rack.

220.563

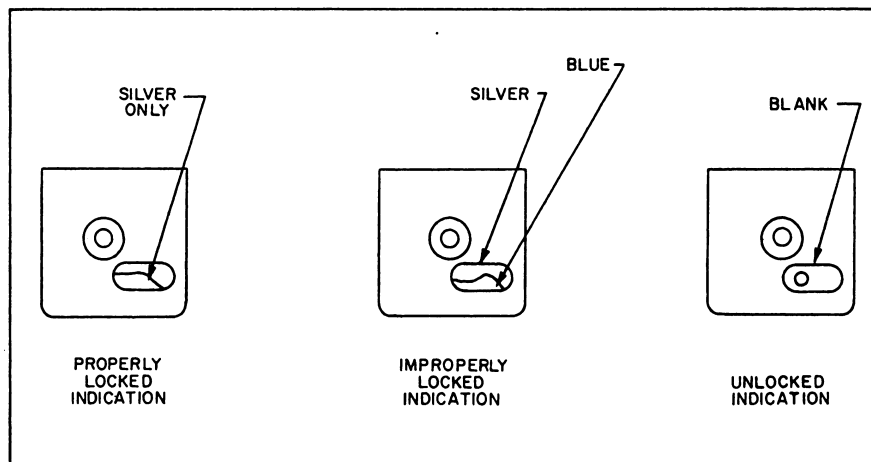
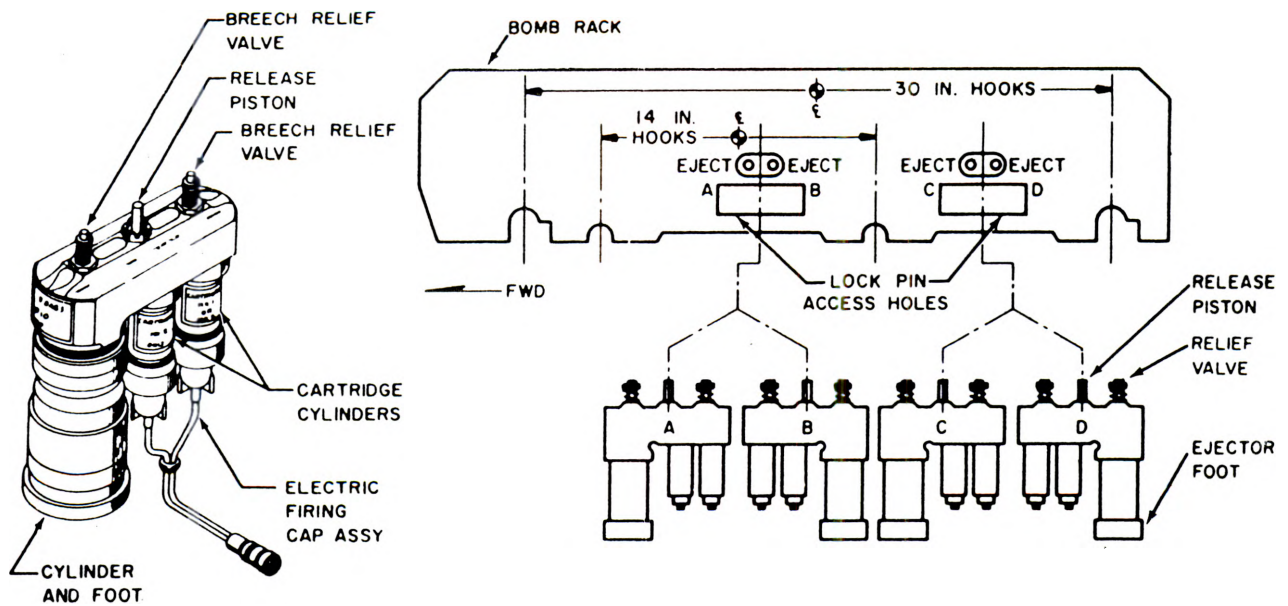


Figure 11-14.—BRU-10A/A bomb ejector rack hook latched indicators.



220.564

Figure 11-15.—BRU-10A/A bomb ejector rack ejector assembly and installation positions.

a single weapon/store or for a variety of multiple weapon/store adapters. The BRU-10A/A bomb ejector rack is pylon mounted on the wing stations of the A-7E aircraft. It is part of the aircraft's basic weapon/store suspension system. It may also be weapons-rail mounted to the F-14 aircraft fuselage. The BRU-11A/A bomb ejector rack is pylon mounted on the wing stations of the S-3A aircraft. It is part of the aircraft's basic weapon/store suspension system.

BRU-10A/A Bomb Ejector Rack

The BRU-10A/A bomb ejector rack (fig. 11-13) has four suspension hooks—two hooks spaced 14 inches apart and two hooks spaced 30 inches apart. It carries weapons/stores weighing up to 4,000 pounds. The bomb ejector rack has the necessary electrical connections, mechanical and electrical arming units, ejection components, and the mechanical linkage for safely suspending and ejecting weapons or stores. Although the BRU-10A/A bomb ejector rack differs from the bomb ejector racks previously discussed, the basic principles of operation are the same, except for the operations discussed in the following paragraphs. As you read them, refer to figure 11-13.

A manual cocking bolt and a manual release bolt are located on the forward left-hand side of

the frame assembly. Before you load a weapon or store, manually cock the mechanical linkage by rotating the cocking bolt. This places the linkage sears in a position to lock the suspension hooks when they are moved to the closed position. The suspension hooks may be released (opened) by manually rotating the manual release bolt. To prevent damage to the mechanical linkage, you must remove the safety flag assembly (safety pin) before you rotate either the cocking bolt or the release bolt.

To find out if the suspension hooks are properly locked, you must visually check the latch inspection holes (fig. 11-14) located in the frame assembly above each hook. If the hook is properly locked, you can see a silver latch indicator through the latching inspection hole. If the hook is **not** locked, you can see a blue/silver latch indicator. If the hooks are unlocked (open), the latching inspection hole will be blank.

The BRU-10A/A bomb ejector rack is designed to hold one ejector assembly that can be inserted in the bomb rack in one of four different positions (fig. 11-15). The position depends on the aircraft and the weapon/store requirements. For ease of removal and installation, the ejector assembly is secured in the bomb rack by a quick-release LOK pin assembly. The

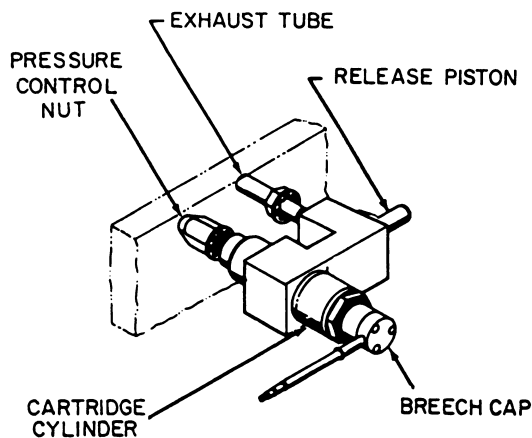


Figure 11-16.—BRU-10A/A bomb ejector rack auxiliary release unit assembly.

release piston (fig. 11-16) is operated by gas pressure. It is used to actuate the mechanical release linkage during cartridge ejection, and to unlock the suspension hooks.

A properly installed safety pin assembly safes the bomb ejector rack mechanically by blocking the mechanical release linkage. Although the safety flag assembly does not safe the rack electrically, it does prevent ejection of loaded weapons/stores if the cartridges are accidentally fired. When the safety flag assembly is inserted in the bomb rack, the safety pin depresses the relief linkage assembly. The relief linkage assembly then depresses one of the two breech relief valves (fig. 11-15) to vent gases if a cartridge is accidentally fired. The relief linkage assembly is arranged so that one of the breech relief valves is depressed regardless of which position the ejector assembly is actually installed in the bomb rack.

The BRU-10A/A bomb ejector rack has an auxiliary release unit assembly. It provides an emergency method of release if the ejector assembly or its electrical system should fail. The BRU-10A/A bomb ejector rack auxiliary release unit assembly (fig. 11-16) consists of a pressure control nut, exhaust tube, release piston, breech cap, and a breech cylinder. When the separation cartridge is fired, the expanding gases supply the force to actuate the release piston. The release piston extends to actuate the mechanical release assembly, releasing the suspension hooks. The suspension hooks release the weapon/store. The auxiliary release unit assembly does not eject the weapon/store. If a cartridge in the auxiliary

release unit assembly is accidentally fired, the installed safety flag assembly prevents movement of the mechanical release mechanism assembly. The gas pressure generated by the ignition of the cartridge vents to the atmosphere through an exhaust tube on the auxiliary release unit assembly.

Organizational-level maintenance is limited to cleaning, replacing, and corrosion control of damaged parts and assemblies that can be replaced without removal of the bomb rack from the aircraft. If a BRU-10A/A bomb ejector rack requires inspection or repair beyond the scope of the organizational maintenance level, route the bomb rack to the intermediate or depot maintenance level. A few of the routine maintenance requirements are discussed in the following paragraphs.

After every five firings or at the end of the day's operation, whichever occurs first, the ejector assembly must be removed from the bomb ejector rack for cleaning and inspection. The actual cleaning and inspection requirements are the same as for the bomb ejector racks previously discussed. After the ejector assembly has been disassembled, cleaned, and inspected, you should lubricate the parts with a thin coat of MIL-L-19701 lubricant prior to reassembly.

The auxiliary release unit must be cleaned whenever a cartridge has been fired or whenever a calendar inspection is being performed. You must disassemble the auxiliary unit for cleaning and inspection. You should clean the breech cap assembly using Trichlorotrifluoromethane (FREON) (MIL-C-81302) or an equivalent product and a soft-bristle brush. Dry the breech cap assembly thoroughly using filtered compressed air or dry nitrogen. Clean the remaining metal parts using a mixture of two parts clean fresh water to one part cleaning solvent (P-D-680), using a soft-bristle brush. Then, thoroughly dry the parts with a clean, lint-free cloth and filtered compressed air. Before you reassemble the part, apply a thin coat of MIL-L-19701 lubricant.

BRU-11A/A Bomb Ejector Rack

The BRU-11A/A bomb ejector rack is a modification of the BRU-10A/A bomb ejector rack. The BRU-11A/A is used on the wing stations of the S-3 aircraft. However, it doesn't operate in exactly the same way. The major difference between the two bomb ejector racks is that the BRU-11A/A is equipped with an

IFOBRL. This mechanism consists of a remote-controlled bomb rack lock and a remote-controlled emergency release for the bomb rack lock. This allows the bomb rack to be locked, using a remote-controlled actuator during loading and during flight. This eliminates the need for the safety pin assembly used on the BRU-10A/A.

There are several different models of the BRU-10A/A and the BRU-11A/A bomb ejector racks currently in use. Part numbers are assigned to identify the differently configured bomb racks and are used during maintenance.

If you need more information about the BRU-10A/A and the BRU-11A/A bomb ejector racks, refer to *Bomb Ejector Rack BRU-11A/A*, NAVAIR 11-10C-24.

REVIEW NUMBER 2

- Q1. *Aero 7A-5 and 7B-4 bomb ejector racks are mounted on _____.*
- Q2. *There are four separate pairs of suspension hooks on the Aero 7A-5 bomb ejector rack—two pairs for _____ suspension and two pairs for _____ suspension.*
- Q3. *What is the maximum store capacity of the 14-inch and 30-inch suspension racks of the Aero 7A-5 bomb ejector rack?*
- Q4. *The Aero 7B-4 bomb ejector rack is mechanically armed through the _____.*
- Q5. *When should you perform organizational-level maintenance on the Aero 7A-5 and 7B-4 bomb ejector racks?*
- Q6. *What is the maximum store capacity of the BRU-10A/A bomb ejector rack?*

Q7. *The BRU-10A/A ejector assembly should be cleaned and inspected _____.*

Q8. *What bomb ejector rack is a modification of the BRU-10A/A bomb ejector rack?*

BRU-32/A BOMB EJECTOR RACK

The BRU-32/A bomb ejector rack (fig. 11-17) is installed on the F/A-18 aircraft. It is used to suspend single stores, BRU-33/A vertical ejector racks (VER), and LAU-115/A, LAU-117/A, and LAU-118/A missile launchers using a 14-inch suspension hook.

The BRU-32/A bomb ejector rack has a safety interlock and automatic sway bracing. The safety interlock mechanically prevents the accidental opening of the suspension hooks. It is also used to lock and unlock the suspension hooks during loading operations. Automatic sway bracing is controlled by the opening and closing of the suspension hooks.

Sensing switches are incorporated within the rack to indicate to the stores management processor (SMP) that a store is loaded. The primary ejection uses two cartridges to generate the required gas pressure for rack operations. If the primary ejection fails, emergency release is provided by the auxiliary release unit. The auxiliary release unit uses one cartridge that opens the hooks only. Nose and tail arming solenoids are used with mechanical fuzing. The Mk 39 electric fuzing receptacle is used for electric

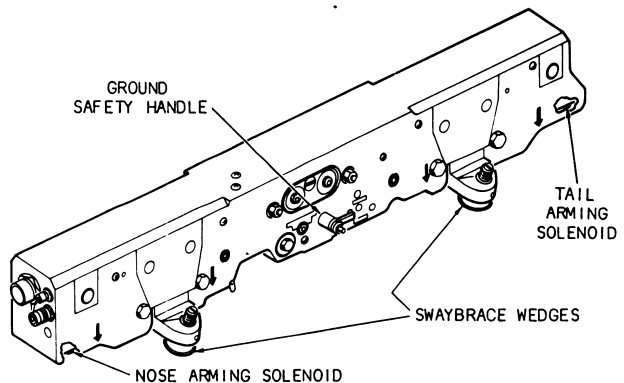


Figure 11-17.—BRU-32/A bomb ejector rack.

fuzing. The bomb rack is interchangeable with the centerline or the inboard and outboard pylons.

BRU-33/A BOMB EJECTOR RACK

The BRU-33/A bomb ejector rack (VER) (fig. 11-18) is suspended by the BRU-32/A bomb ejector rack. It is used to suspend two stores weighing up to 1,000 pounds each by using 14-inch suspension hooks. The VER features a special safety interlock and automatic sway bracing. The safety interlock is electrically controlled by the aircraft and mechanically prevents accidental opening of the suspension hooks.

Sensing switches are incorporated to indicate to the SMP that a store is loaded. The rack has provisions for mechanical and electric fuzing. The ejection unit uses two cartridges to generate the required gas pressure for rack operations.

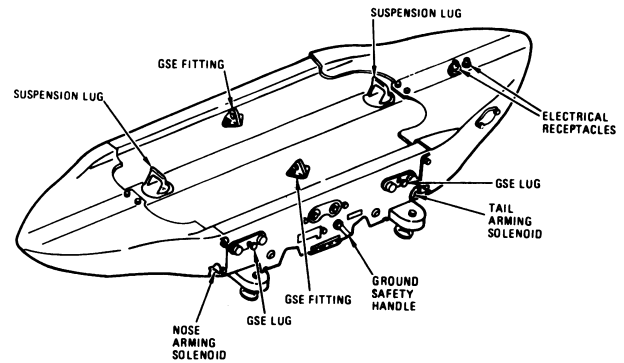


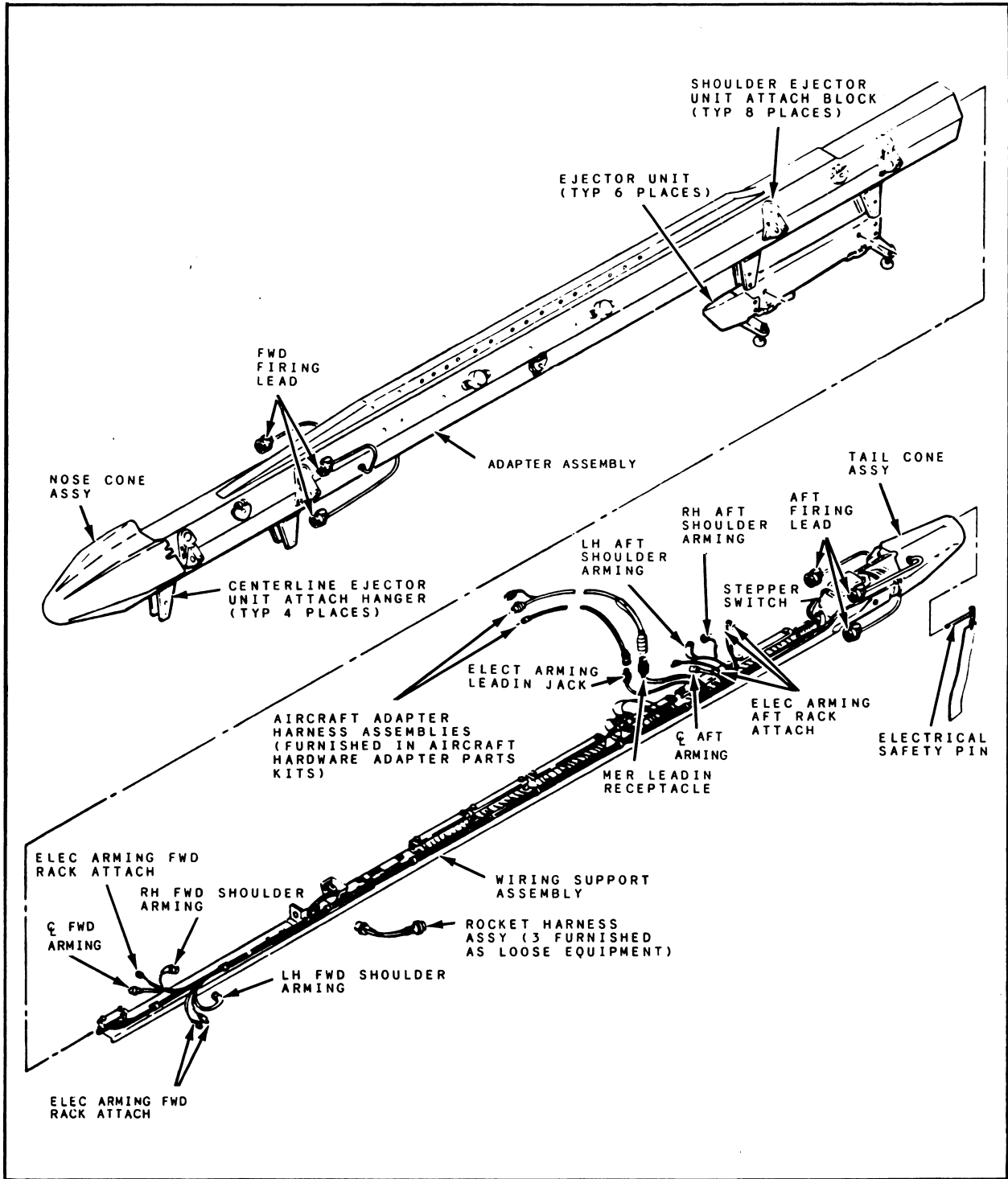
Figure 11-18.—BRU-33/A bomb ejector rack.

A/A37B-6E MULTIPLE EJECTOR RACK (MER) AND A/A37B-5E TRIPLE EJECTOR RACK (TER)

The A/A37B-6E multiple ejector rack (MER) (fig. 11-19) and the A/A37B-5E triple ejector rack

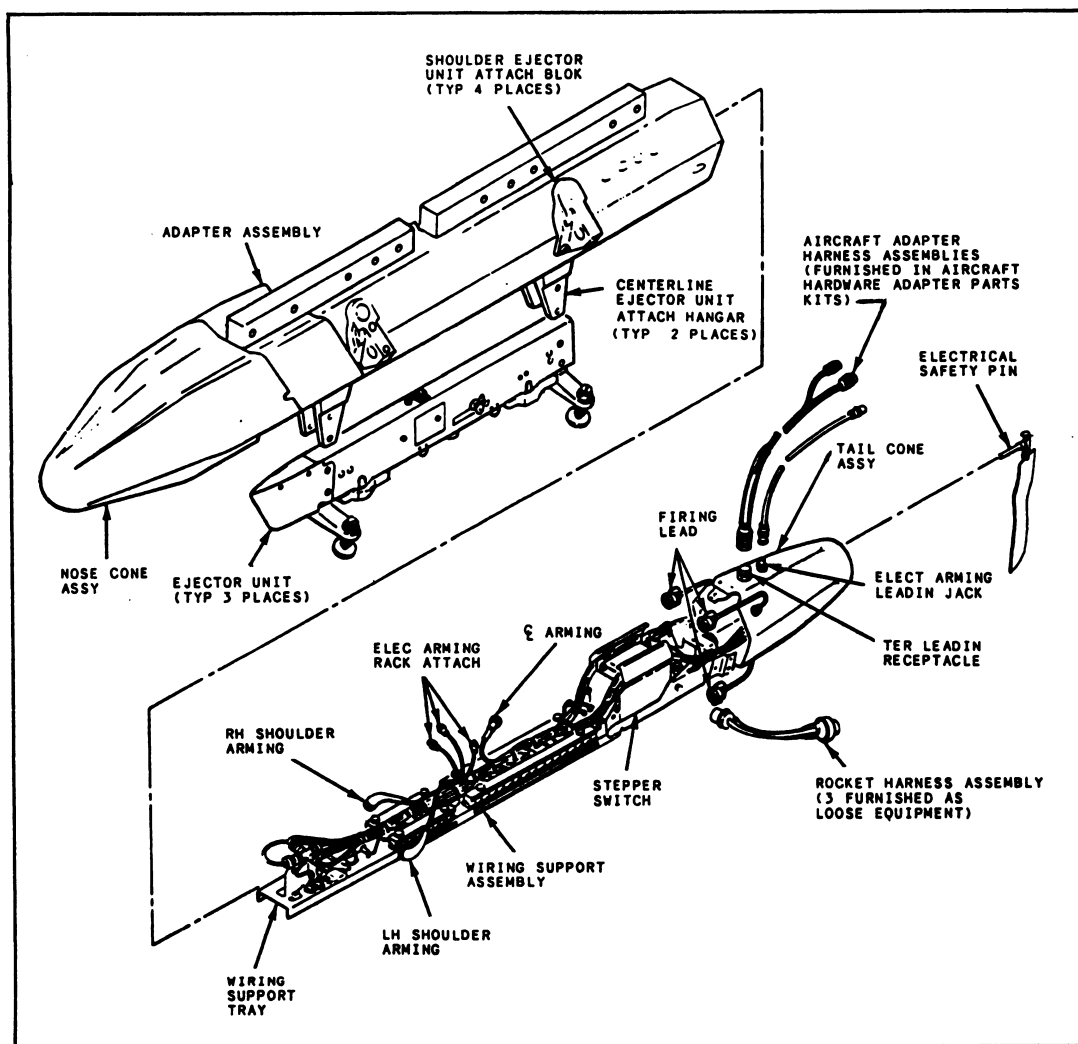
REVIEW NUMBER 2 ANSWERS

- A1. *Aero 7A-5 and 7B-4 bomb ejector racks are mounted on all models of the A-6 aircraft.*
- A2. *There are four separate pairs of suspension hooks on the Aero 7A-5 bomb ejector rack—two pairs for 14-inch suspension and two pairs for 30-inch suspension.*
- A3. *The maximum store capacity of the 14-inch suspension rack is 1,500 pounds and 3,500 pounds for the 30-inch suspension rack on the Aero 7A-5 bomb ejector rack.*
- A4. *The Aero 7B-4 bomb ejector rack is mechanically armed through the electromechanical arming solenoids.*
- A5. *Organizational-level maintenance is performed on the Aero 7A-5 and 7B-4 bomb ejector racks with the racks installed on the aircraft.*
- A6. *The maximum store capacity of the BRU-10A/A bomb ejector rack is 4,000 pounds.*
- A7. *The BRU-10A/A ejector assembly should be cleaned and inspected after every five shots or at the end of the day, whichever comes first.*
- A8. *The BRU-11A/A bomb ejector rack is a modification of the BRU-10A/A bomb ejector rack.*



220.933

Figure 11-19.—Multiple ejector rack, exploded view.



220.934

Figure 11-20.—Triple ejector rack, exploded view.

(TER) (fig. 11-20) are known as a *MER* or *TER*. They are essentially the same assemblies except for structural size and the number of stores they can carry. The *MER* and *TER* are classified as accessory racks. They are installed on parent bomb racks or pylons to increase the number of stores that can be suspended by a particular station.

Both the *MER* and *TER* consist of three major subassemblies—an adapter assembly, a wiring support assembly, and three ejector units for the *TER* and six ejector units for the *MER*.

Adapter Assembly

The adapter assembly is a hollow, hexagonal aluminum extrusion that forms the main support for the rack assembly hardware. Attaching points

on the adapter assembly provide 14-inch or 30-inch spacing of the suspension lugs, which allows installation of the *MER* or *TER* on the various types of aircraft.

The adapter assembly houses the wiring support assembly and provides for attachment of six or three individual ejector units. A nose-cone assembly and a tail-cone assembly enclose the ends of the adapter assembly for aerodynamic purposes.

Wiring Support Assembly

The wiring support assembly combines all of the rack electrical equipment and wiring on a removable tray. The support assembly electrical wiring is coupled to the aircraft normal release and arming systems by adapter harness assemblies.

The adapter harness assemblies are connected between the aircraft receptacles in the aircraft pylon and the two receptacles on the top of the adapter assembly. One of the adapter harness assemblies provides a path for the voltage required for stores release, and the other adapter harness assembly provides a path for electric fuze arming voltages.

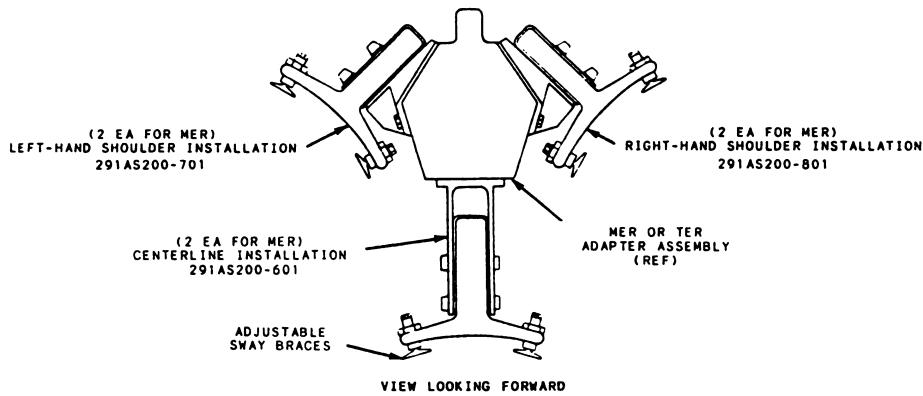
The support assembly electrical wiring harness provides routing of electrical power to the ejector units for sensing, arming, and ejector breech firing. Electrical power is routed to the rocket harness assemblies to provide firing pulses to stores such as rocket launchers and flare dispensers.

The tail-cone assembly houses a home-and-step control switch, a press-to-test homing

indicator light, a release mode selector switch, and an interrupt safety pin switch.

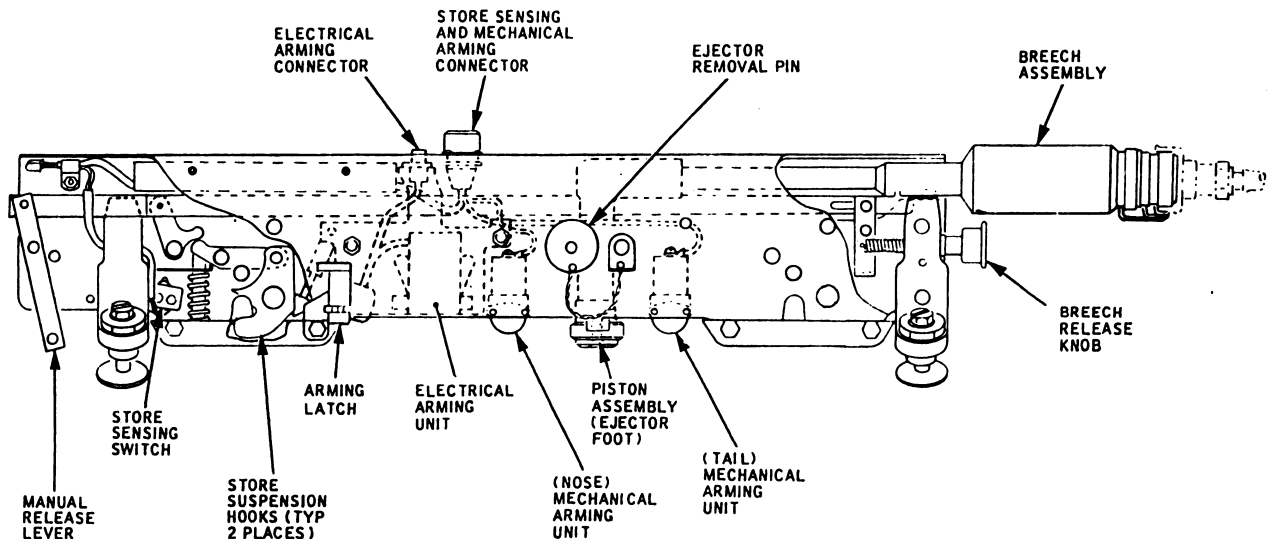
Ejector Unit Assemblies

The ejector unit assemblies used on the MER and TER are identical. The only difference between them is the internal configuration of the release linkage. The ejector units are configured for right-hand shoulder installation, left-hand shoulder installation, or centerline installation (fig. 11-21). They are identified by part number. The shoulder stations are attached to the adapter assembly by ejector unit attach blocks. The centerline stations are attached by ejector unit attach hangars. A MER/TER ejector unit (fig. 11-22) consists of a housing assembly equipped with integral wiring, a breech and



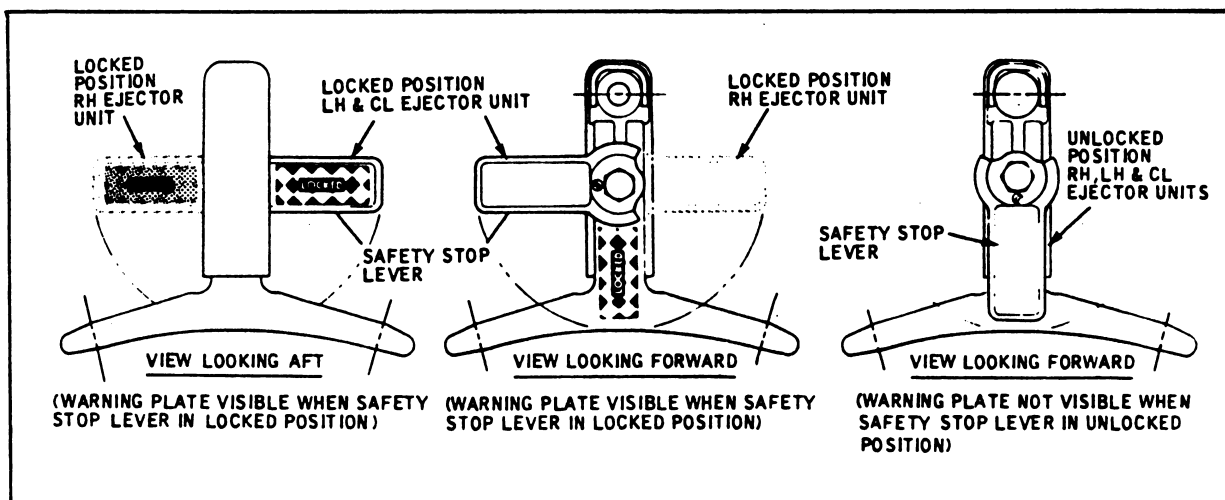
220.430

Figure 11-21.—MER/TER ejector unit locations.



220.567

Figure 11-22.—MER/TER ejector unit.



220.568.1

Figure 11-23.—Ejector unit safety stop lever.

ejector mechanism, store suspension hooks, a store sensing switch, two mechanical arming solenoids, an electrical arming unit, adjustable sway braces, and mechanical linkage driven by the breech or manual release lever to open the suspension hooks.

The suspension hooks are spaced 14 inches apart and are independently self-latching. There is a manual release lever, which is used to open the hooks during ground operation. The safety stop lever is used to safe the ejector unit mechanically. Look at figure 11-23. It shows the locked and unlocked positions of the ejector unit safety stop lever. When the safety lever is in the locked position, the hook release rod is physically blocked from rearward movement and prevents suspension hook release. If the hook release rod is not in the full forward position, the safety stop lever cannot be rotated to the locked position. A store sensing switch is located under the forward suspension hook, and is actuated by the opening and closing of the hook.

MER/TER Operational Description

The functional description of the MER/TER ejector rack is discussed in two categories—ejector unit mechanical operation and MER/TER electrical operation.

EJECTOR UNIT OPERATIONAL DESCRIPTION.—All ejector units on the MER and TER are operationally the same. The ejection

mechanism is actuated by an electrically initiated gas-generating cartridge. As you read this section, look at figure 11-24. It shows the mechanical operation of the ejector unit.

When a store is loaded onto the ejector unit, the store suspension lugs force the suspension hooks to the closed position. The suspension hooks are locked in the closed position by the overcenter position of the hook toggle levers. The link stops, located over each of the hook toggle levers, prevent the suspension hooks from opening until the cartridge is fired or the manual release lever is pulled, even if the safety stop lever is in the unlocked position (fig. 11-24, view A).

When the gas-generating cartridge is fired, the resulting gas pressure moves the breech aft. The aft movement of the breech also moves the hook release rod aft, lifting the toggle hook levers from the overcenter position. The cranks are forced down. This unlocks the suspension hooks (fig. 11-24, view B).

Gas pressure from the cartridge acting against the gun piston, plus the weight of the store, forces the unlocked suspension hooks to open, releasing the store. The hooks are held in the open position by the hook toggle spring and coil spring. The gun piston continues to act against the store to provide positive separation from the ejector unit (fig. 11-24, view C).

MER/TER ELECTRICAL OPERATION.—Before discussing the electrical operation of the MER/TER, you must understand the function of

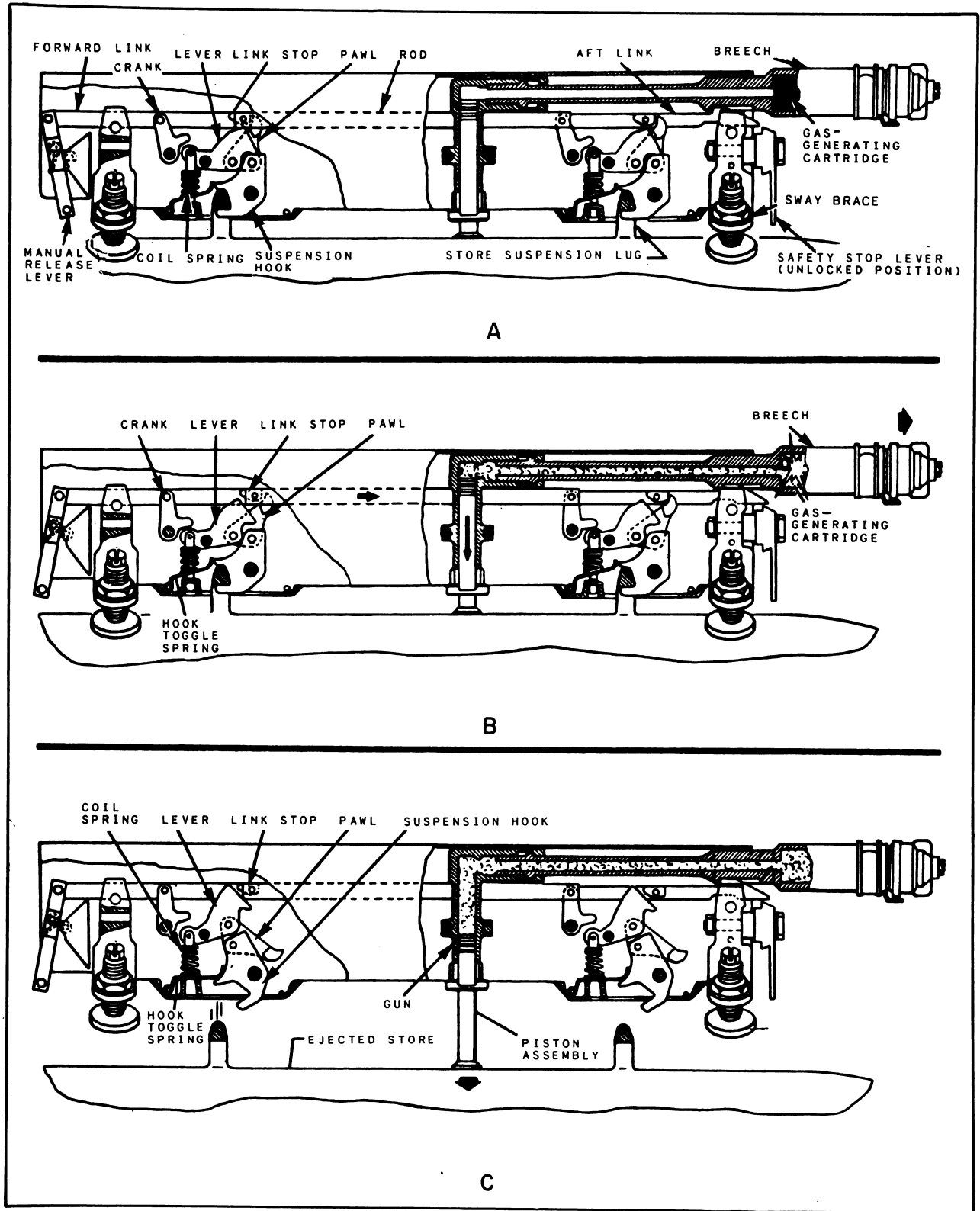
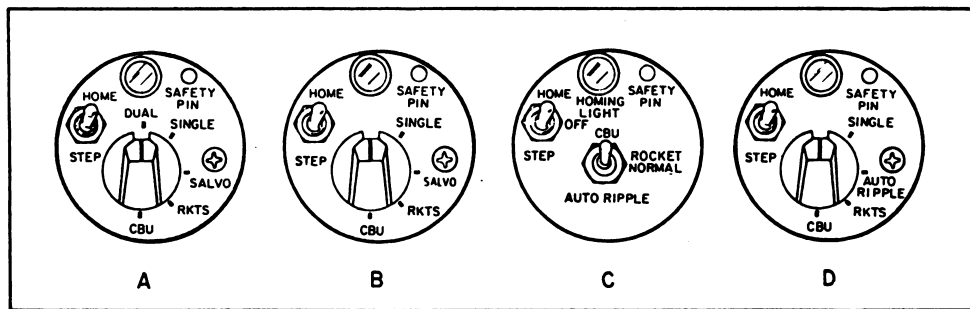


Figure 11-24.—Ejector unit operation.

220.935



220.569.1

Figure 11-25.—MER/TER switches and indicators.

several electrical components. These components are briefly discussed in the following paragraphs. Refer to figure 11-25 for the location of switches and indicators.

NOTE: The CBU setting on the release mode selector switch is used for U.S. Air Force application only.

Figure 11-25, views A through D, shows the different switch and indicator models.

The home/step switch lets you manually control the stepper switch during ground maintenance procedures. The switch is spring-loaded to the center or off position. When in this position (the normal in-flight position), the auto-homing circuit automatically advances the stepper switch to the home position (same as number 1 firing position) when power is applied to the rack.

To manually home the stepper switch, move the home/step switch to the home position and hold. If all forward suspension hooks are closed, the stepper switch advances to the home position. The homing light illuminates and remains on until the home/step switch is released. Moving the home/step switch to the step position lets you manually advance the stepper switch one position each time the switch is actuated to the step position and released.

The release mode selector provides for the release of stores in a single or ripple release mode. The desired release mode must be selected before takeoff. For single release, the release selector switch is positioned to rocket normal or single. In this position, the rack ejects one store each time the cockpit bomb button is depressed and released. If the release mode selector is placed in the auto ripple position, the rack consecutively

ejects all loaded stations automatically as long as the bomb button is depressed. When the electrical safety pin/flag assembly is installed in the safety pin receptacle, the safety switch is opened and the rack electrical circuits are grounded, making the rack electrically safe.

When rockets are to be fired, the release mode selector must be placed in the rocket normal or RKTS position. The cockpit armament control panel switches must be positioned for firing rockets. Firing voltage is then routed through the rocket circuits of the rack, and then through the rocket firing cable to the rocket launcher.

MER and TER ejector units are numbered according to their firing sequence (fig. 11-26). For the purpose of discussion, assume that a MER has stores loaded on stations 1, 2, 4, and 6, and that the release mode selector is set for single release.

When the pilot depresses the cockpit bomb button, a firing pulse is routed from the aircraft through the rack safety switch and the release mode selector switch to energize the necessary rack

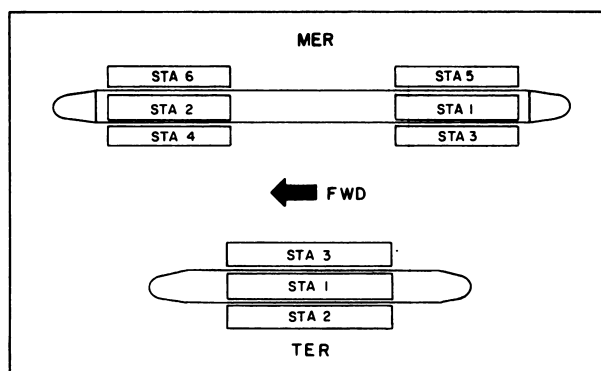
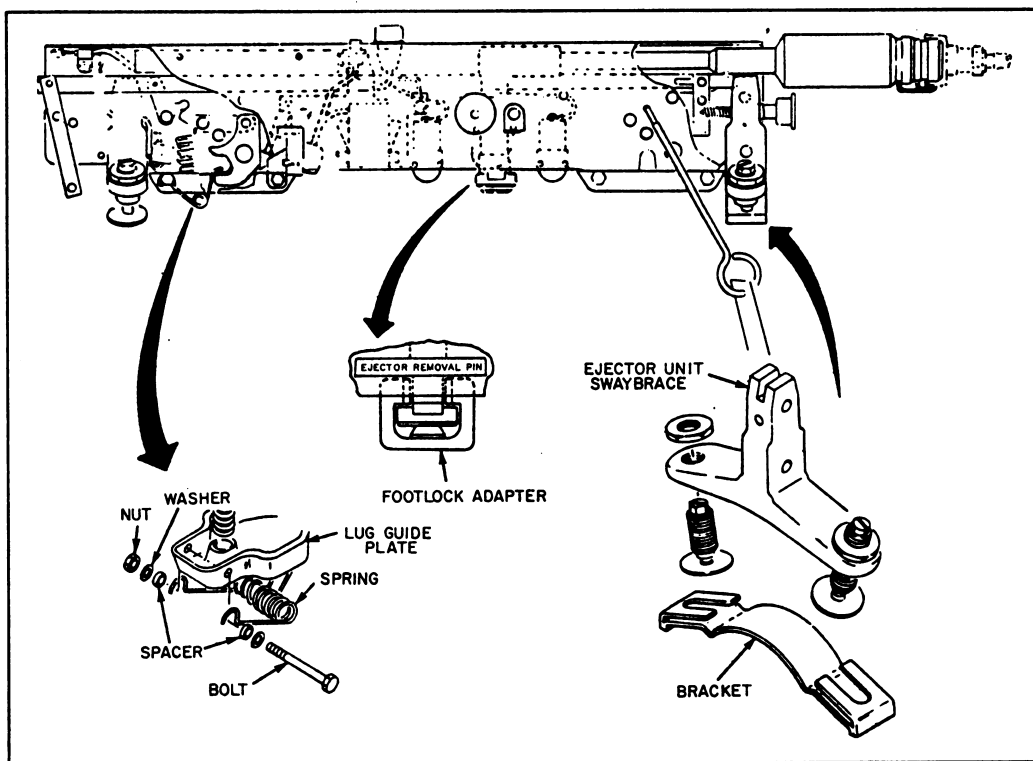


Figure 11-26.—MER/TER firing sequence.



220.571.1

Figure 11-27.—Practice bomb adapter kit.

circuits. With a weapon loaded on station 1, the forward suspension hook is in the closed position, automatically closing the stores sensing switch. The firing voltage is then routed to the firing circuit, firing the cartridge and ejecting the weapon. Ejection of the stores from all remaining loaded stations will occur in sequence each time the pilot presses and releases the bomb button. In this particular load, stations 3 and 5 were not loaded; therefore, make sure the forward hooks are left open. If they are closed, the stores sensing switch signals the rack that a weapon is loaded on that station and will not automatically step to the next station.

If the release mode selector is set for auto ripple, ejection occurs in the same way, with one exception. The weapons release 20-milliseconds apart as long as the bomb button is depressed. The auto ripple mode is normally used only when more than one aircraft station is loaded. The firing pulse is routed through the aircraft computer, which alternates the pulse from one side of the aircraft to the other. This maintains the weight balance of the aircraft.

Hardware Adapter Kits

Hardware adapter kits are used to adapt the MER/TER to various aircraft. The kits include electrical harness assemblies, suspension lugs, sway brace pads and extensions, and attaching hardware required to configure the racks for a desired pylon station on a particular aircraft. Additionally, practice bomb adapters are used to adapt the MER and TER for the attachment of practice bombs or externally carried Mk 45 aircraft parachute flares and Mk 58 marine location markers. The adapter (fig. 11-27) is composed of three separate components—a bracket, an ejector footlock, and a hook actuation spring.

Install the bracket on the ejector unit sway brace by removing one sway brace screw. Then, hook the bracket to the other sway brace screw, and insert the removed screw in the other end of the bracket. The screw is then reinstalled in the sway brace. The brackets provide a suitable mounting surface for the small diameter of a practice bomb.

The ejector footlock fits over the ejector foot to prevent downward movement during ejection. This prevents damage to the foot and also assists in positive unlocking of the suspension hooks.

The hook actuation spring is attached to the ejector unit housing by a bolt and nut with washers and spacers. The actuation spring ensures that the suspension hooks fully open because of the lightweight practice bombs.

Both the hardware adapter kit and practice bomb adapter are considered to be organizational-level equipment, and are to be maintained in the custody of the organizational unit.

For further information concerning the MER and TER, refer to the publication NAVAIR 11-75A-57, *Multiple Ejector Rack (MER) A/A37B-6E and Triple Ejector Rack (TER) A/A37B-5E* (latest revision).

REVIEW NUMBER 3

- Q1. *The BRU-32/A bomb ejector rack is installed on the _____ aircraft.*
- Q2. *What is the maximum capacity of the BRU-33/A bomb ejector rack?*
- Q3. *List the major subassemblies of the MER and TER.*
- Q4. *The adapter assembly of the MER houses the wiring support assembly on which you can attach _____ individual ejector units.*
- Q5. *How many individual ejector units can you attach to the adapter assembly of the TER?*
- Q6. *How are MER and TER ejector units numbered?*

Q7. *What is the purpose of the stores sensing switch located on the forward hook of each station?*

Q8. *At what level is the custody of the MER/TER hardware kit and practice bomb adapter kits maintained?*

BOMB SHACKLES

Learning Objective: Identify the purpose and use of bomb shackles.

The Mk 8 Mod 5 bomb shackle is used on helicopters, such as the SH-3. The Mk 8 Mod 5 bomb shackle (fig. 11-28) is used to suspend and release a mine or torpedo that weighs from a minimum of 100 pounds to a maximum of 1,500 pounds. The bomb shackle incorporates suspension hooks spaced 14 inches apart, center to center. It has no integral provisions for electrical release, electrical arming, or mechanical arming. However, the shackle can be electrically released if you attach an electrical release unit, such as the Aero 7B-1, to the shackle structure. The shackle can be mechanically armed if you attach arming solenoids to the shackle or to the structure on which the shackle is mounted.

The frame of the Mk 8 Mod 5 bomb shackle is an inverted U-shaped member. The frame suspension lugs are also U-shaped. They are attached to the ends of the frame by pivot bolts, which retain the hook link assembly in place within the frame. Inspection holes are located in the frame above each suspension hook so you can visually inspect individual hook latching. There is also a hole in the frame so you can insert a safety pin that mechanically blocks the linkage to prevent the hooks from releasing. Other components of the Mk 8 Mod 5 bomb shackle are the cocking lever, release lever, latching lever, and associated springs.

When you cock the Mk 8 Mod 5 bomb shackle, you move the cocking lever aft until the latching block on the link assembly engages in the slot of the latching lever. The roller on the latching lever rides up and seats on the top of

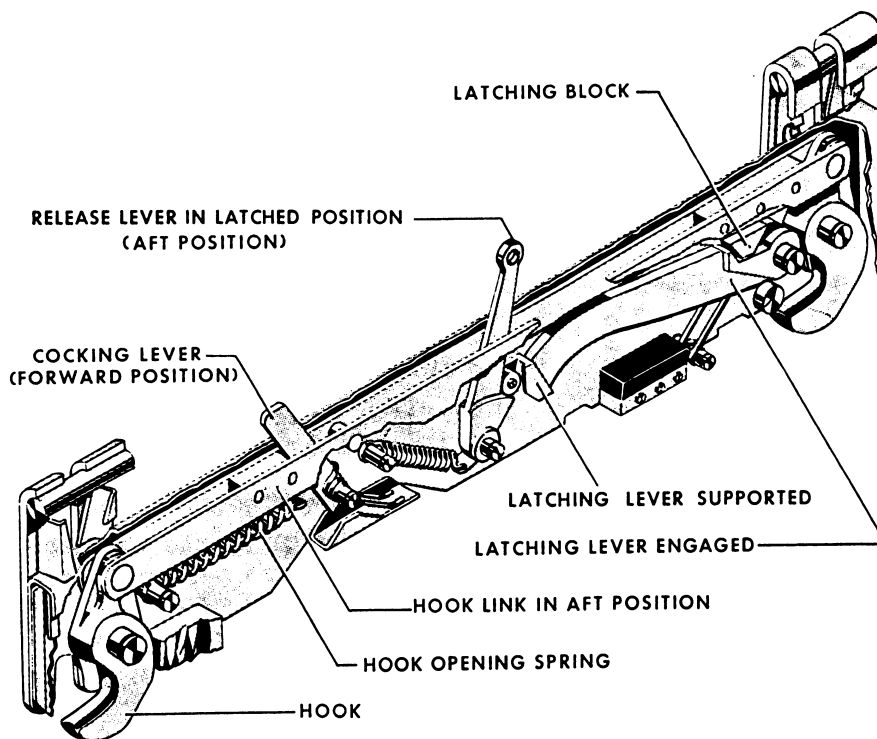


Figure 11-28.—Mk 8 Mod 5 bomb shackle.

220.323

the release lever cam. When the release lever is moved forward, either electrically by the attached release unit or manually, the latching lever moves down and away from the latching block. This action allows the hook-opening spring and the weight of the store to move the hook link assembly forward, releasing the hooks.

Keep the Mk 8 Mod 5 bomb shackle in the released position except when it is actually carrying stores. The shackle is designed to operate without lubrication. Maintenance is limited to cleaning the assembly with dry-cleaning solvent (P-D-680), inspecting the components for wear and operation, and replacing the shackle.

If you want more information about the Mk 8 Mod 5 bomb shackle, refer to *Bomb Shackle Mark 8 Mod 5*, NAVAIR 11-5-114.

REVIEW NUMBER 4

Q1. *The Mk 8 Mod 5 bomb shackle is mounted on what aircraft?*

Q2. *What is the suspension of the Mk 8 Mod 5 bomb shackle?*

DISPENSERS AND EJECTORS

Learning Objective: Identify the purpose and use of dispensers and ejectors.

Dispensers and ejectors are used during tactical situations to provide additional offensive and defensive capabilities to the aircraft. These units are usually detachable. They are suspended from other installed suspension equipment, or they are mounted directly to the aircraft. They are used to suspend and release ordnance items such as aircraft parachute flares, sonobuoys, and photoflash cartridges. In this section of the TRAMAN, you will learn about the basic characteristics of dispensers and ejectors currently in use.

SUU-44 FLARE DISPENSER

The SUU-44 flare dispenser (fig. 11-29) provides the capability for suspending and launching eight Mk 45 aircraft parachute flares equipped with drogue trays. Refer to figure 11-29 as you read this section.

The dispenser has four dispenser tubes. A shear latch (fig. 11-29, view B) is attached to the rear bulkhead to retain the flares in the tube. Each tube holds two flares. After the flares have been inserted into the tubes, rotate the shear latch over the tube opening and fasten it with a shear pin.

Four breeches and breech caps and a spider assembly can be mounted on the forward bulkhead. During dispenser loading and unloading procedures, remove the breech caps and breeches to prevent air pressure buildup when inserting the flares. It also pushes the flares rearward during unloading (fig. 11-29, view A). A reusable nose fairing is installed prior to flight to provide protection to the spider assembly and reduce drag. When installed, the detent safety pin electrically safes the dispenser.

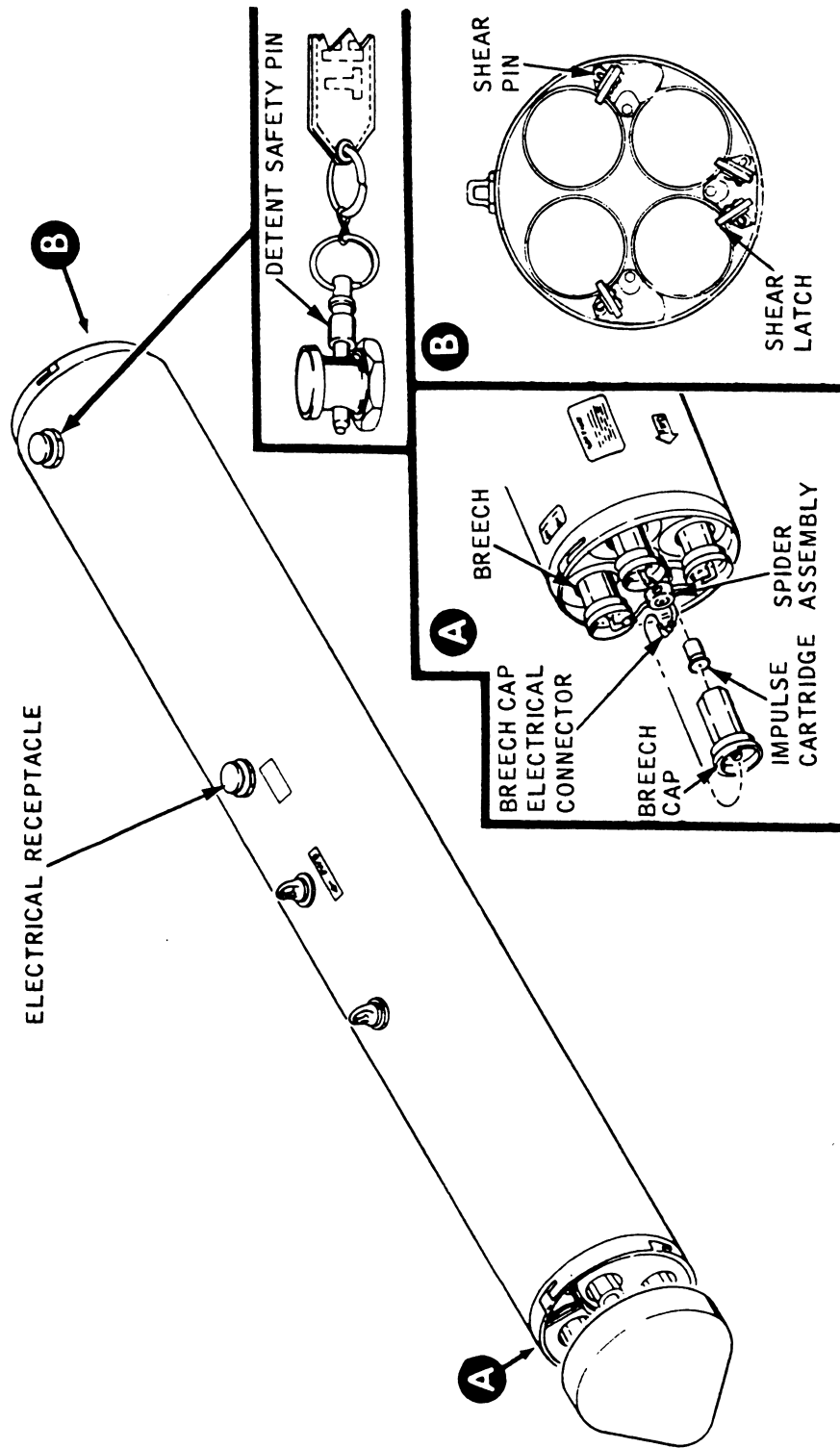
During flight operations, the cartridge is fired by an electrical firing pulse routed from the aircraft to the breech of the dispenser. Gas pressure

REVIEW NUMBER 3 ANSWERS

- A1. *The BRU-32/A bomb ejector rack is installed on the F/A-18 aircraft.*
- A2. *The maximum capacity of the BRU-33/A bomb ejector rack is 2,000 pounds.*
- A3. *The major subassemblies of the MER and TER include an adapter assembly, a wiring support assembly, and ejector units.*
- A4. *The adapter assembly of the MER houses the wiring support assembly on which you can attach six individual ejector units.*
- A5. *You can attach three individual ejector units to the adapter assembly of the TER.*
- A6. *The MER and TER ejector units are numbered according to the firing sequence.*
- A7. *The stores sensing switch located on the forward hook of each station signals the rack whether a weapon is loaded on a particular station or not. If the forward hook is closed, the switch signals the rack that the station is loaded, and will not automatically step to the next station.*
- A8. *Custody of the MER/TER hardware kit and practice bomb adapter kits is maintained at the organizational level.*

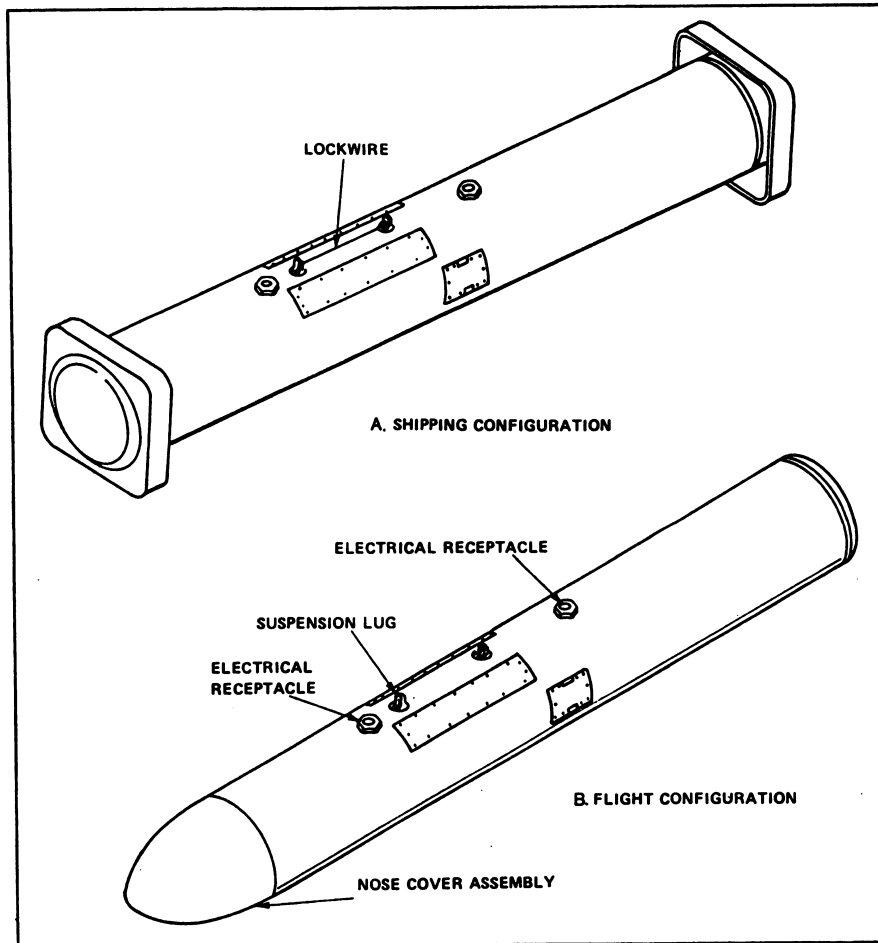
REVIEW NUMBER 4 ANSWERS

- A1. *The Mk 8 Mod 5 bomb shackle is mounted on helicopters such as the SH-3.*
- A2. *The Mk 8 Mod 5 bomb shackle has 14-inch suspension.*



220.573

Figure 11-29.—SUU-44 flare dispenser.



220.937

Figure 11-30.—SUU-25F/A dispenser.

is metered into the forward end of one of the tubes. The expanding gas pressure from the cartridge exerts force against the two flares in the tube. When sufficient force is developed to shear the shear pin off the latch assembly, both flares are ejected into the airstream.

The force of the airstream causes the drogue trays to separate from the flares, pulling the safety pins from the flare fuzes. Further separation pulls the flare lanyard to initiate the flare timing mechanism.

After the cartridge fires, the dispenser intervalometer automatically steps to the next position and is ready for firing the next tube.

Maintenance procedures for the dispenser are concerned with cleaning and inspecting. For further information about the SUU-44 dispenser, refer to *SUU-44 Dispenser*, NAVAIR 11-75AA-44.

SUU-25F/A DISPENSER

The SUU-25F/A dispenser (fig. 11-30) is an airborne, externally mounted, reusable four-tube, rearward ejecting-launching device. The dispenser may be loaded on any aircraft weapons station having a 14-inch suspension and authorized to carry the SUU-25F/A dispenser.

The SUU-25F/A dispenser has two main advantages over the SUU-44 dispenser. It can dispense one store at a time, thus doubling its operational capability. It also has the capability of ejecting eight size A sonobuoys.

The SUU-25F/A has a cylindrically shaped, all-metal body. It has four aluminum tubes that will hold either eight LUU-2B/B aircraft parachute flares or eight size A sonobuoys. The tubes are 5 inches in diameter, clustered together inside an outer skin. There is an

aluminum die-cast bulkhead at each end. When empty, the dispenser weighs 260 pounds. When loaded with eight LUU-2B/B flares, it weighs 490 pounds. When loaded with eight size A sonobuoys, it weighs from 435 to 572 pounds.

The shipping and flight configuration of the dispenser is shown in figure 11-30. The shipping configuration (view A) has shock pan assemblies at either end of the dispenser so it is easier to handle during shipment and storage. A lockwire is attached to the two suspension lugs to prevent

them from becoming lost during shipment or storage. Both the lockwire and shock pan assemblies must be removed before the dispenser is used. When the dispenser is configured for flight (view B), a phenolic or metal cover (nose cone) is mounted on the forward flange. Covers are not shipped with the dispenser; they are ordered as a separate component.

As you read the following section on the SUU-25F/A dispenser, look at figure 11-31 for the location and identification of the components.

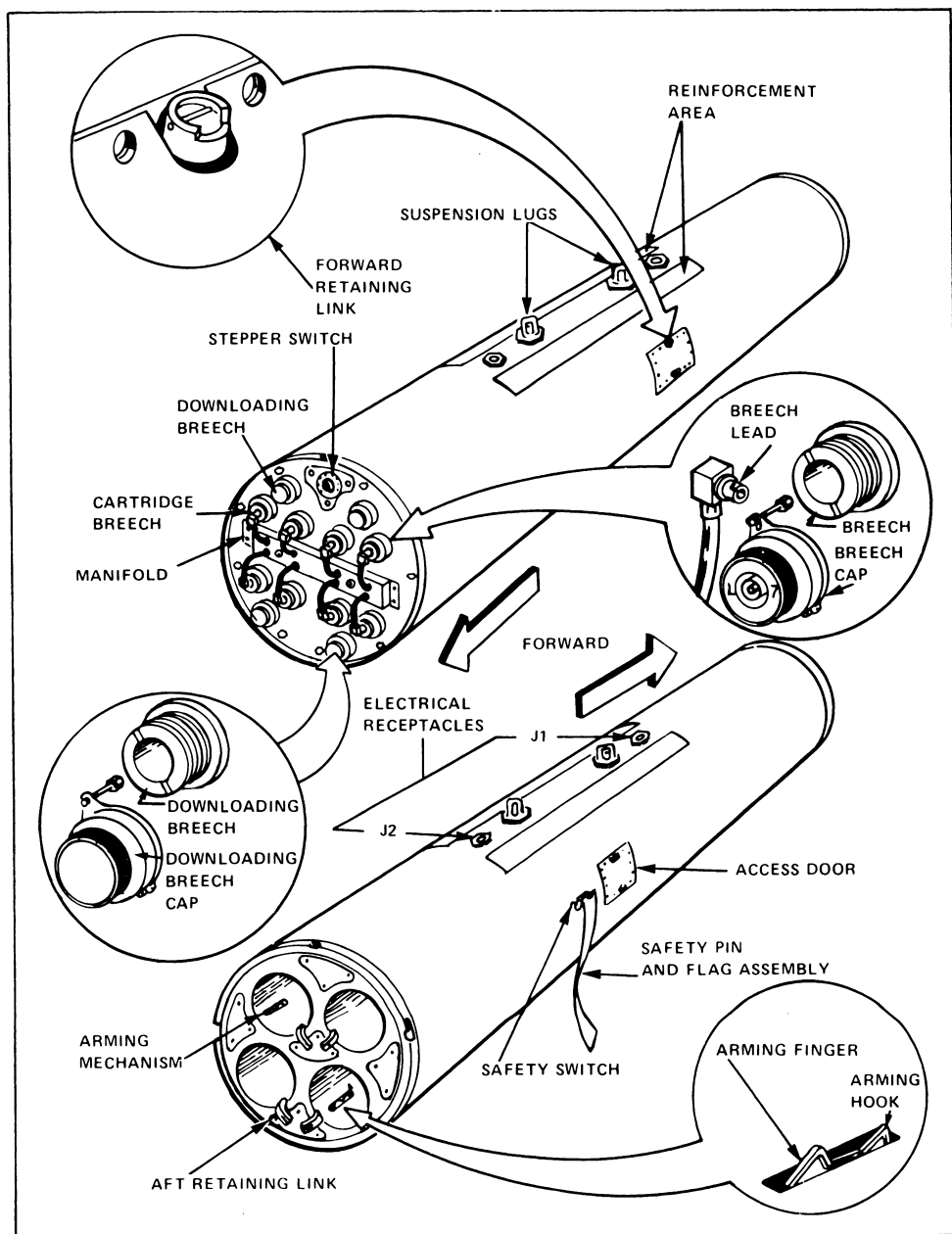


Figure 11-31.—SUU-25F/A dispenser, exploded view.

220.938

The breech, breech cap, breech lead, downloading breech, downloading breech cap, the manifold, and the stepper switch are located on the forward bulkhead.

Breech, Breech Cap, and Breech Lead

There are two breeches, two breech caps, and two breech leads for each tube of the dispenser. The breech is screwed into the bulkhead so a CUU-44 impulse cartridge can be installed. The breech cap, containing the firing pin, screws onto the breech. The breech lead connects to the breech cap and provides a path for the 28-volt dc required to fire the impulse cartridge.

Downloading Breech and Downloading Breech Cap

There is one downloading breech and a downloading breech cap for each tube of the dispenser. The downloading breech mounts to the bulkhead. The downloading breech cap screws onto the downloading breech. With the downloading breech cap removed, the downloading breech lets you insert the loading/unloading/cleaning pushrod tool so the stores can be easily removed during downloading procedures. It also prevents air pressure buildup in the tubes when uploading stores. Reinstall the downloading breech caps after the loading or unloading procedures have been completed.

Manifold

The manifold has eight manifold breech lead receptacles for connection of the breech leads. It also has two test socket assemblies you can use during dispenser electrical test procedures.

Stepper Switch

The stepper switch provides sequential firing of the impulse cartridges. The switch has ten functional settings—one safe setting, one arm setting, and eight firing steps. Always place the stepper switch in the safe position during dispenser loading and unloading. Move the switch to the arm position during aircraft arming procedures just before flight.

Forward and Aft Retaining Lock

Each of the four dispenser tubes contains a forward retaining lock, an aft retaining lock, and an arming mechanism.

The forward and aft retaining locks, when in the locked position, protrude into the dispenser tube. This prevents loaded stores from being inadvertently ejected by g forces during aircraft catapult launches.

The forward retaining lock is located between the dispenser outer skin and the tube near the midpoint of the dispenser. You can move the retainer lock from either the locked or unlocked position through an access door located on either side of the dispenser. Before loading a store, rotate the retaining lock to the unlocked position. This pivots the retainer lock out of the tube. After the store has been loaded, rotate the retaining lock to the locked position, and secure it by installing a shear pin. The forward retaining lock retains the forward loaded store only.

The aft retaining lock is attached to the aft bulkhead and retains the aft loaded store. It is also secured in the locked position by installing a shear pin.

Arming Mechanism

The arming mechanism is located in the aft end of the dispenser tube. The arming mechanism initiates the arming sequence of a store as it is ejected from the tube.

The dispenser is suspended by two screw-type lugs spaced 14 inches apart. The area around the suspension lugs has a hardback reinforcement to permit sway bracing and forced ejection of the dispenser.

Two electrical receptacles, V1 and V2, are located forward and aft of the suspension lugs, respectively. Both receptacles give you a way to electrically connect the dispenser to the aircraft weapons control system. **Only one receptacle is used at a time.** The electrical configuration of the rack determines the receptacle you will use.

An electrical wiring harness is routed internally from electrical connectors V1 and V2 to the stepper switch. The wiring harness is interrupted

by a safety switch that is normally in the closed position. When the safety pin and flag assembly are inserted, the safety switch is held in the open position and the electrical circuits are grounded, making the dispenser electrically safe.

Functional Description

When you load a dispenser tube with munitions, each pair of flares/sonobuoys are

configured with an ADU-381/A flare adapter kit. Also, you should enclose sonobuoys in a mylar sheet (protective sleeve) and install a protective disk (fig. 11-32).

A yellow-colored sealing ring is pressed on each end of the munition as a seal between the munition and the tube body. This prevents gas pressure from escaping during ejection. A green-colored arming cap is installed on the timer end of a flare or on the rotochute end of a sonobuoy.

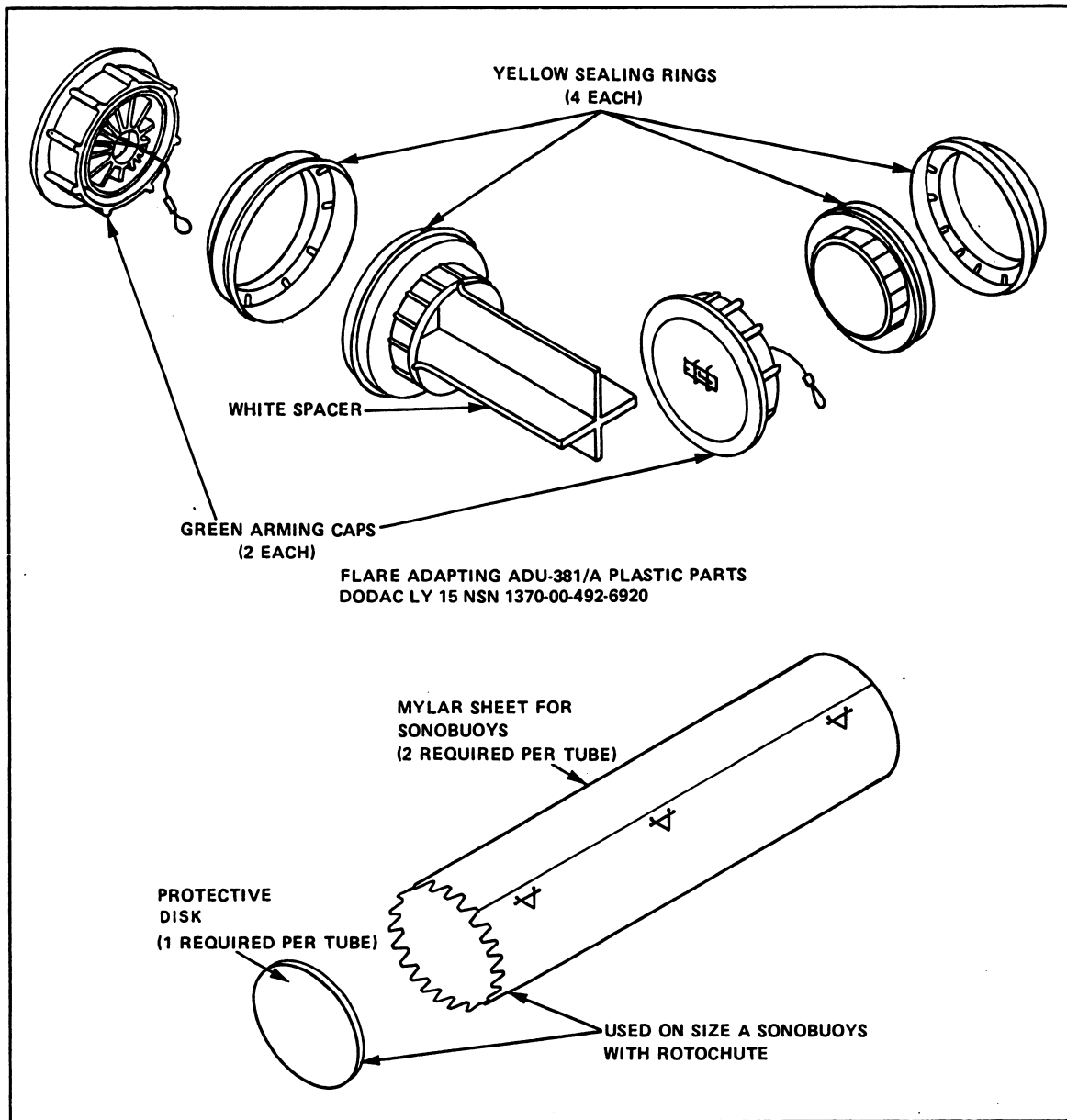


Figure 11-32.—Flare and sonobuoy adapters.

220.939

The green arming cap lanyard is connected to the timer knob of the flare, and then pressed on over the flange of the sealing ring. When you install an arming cap on the sonobuoy, the lanyard is not used. Mount a white cross-shaped plastic spacer on the aft sealing ring of the forward munition. This provides enough space between the forward and aft munition to provide an expansion chamber for ejecting the aft munition.

After you have installed the adapter, install the munitions (fig. 11-33) in the dispenser tube in the following sequence:

1. The first flare is inserted into the tube with the timer end (green arming cap) forward.
2. The second flare is inserted in the same manner.

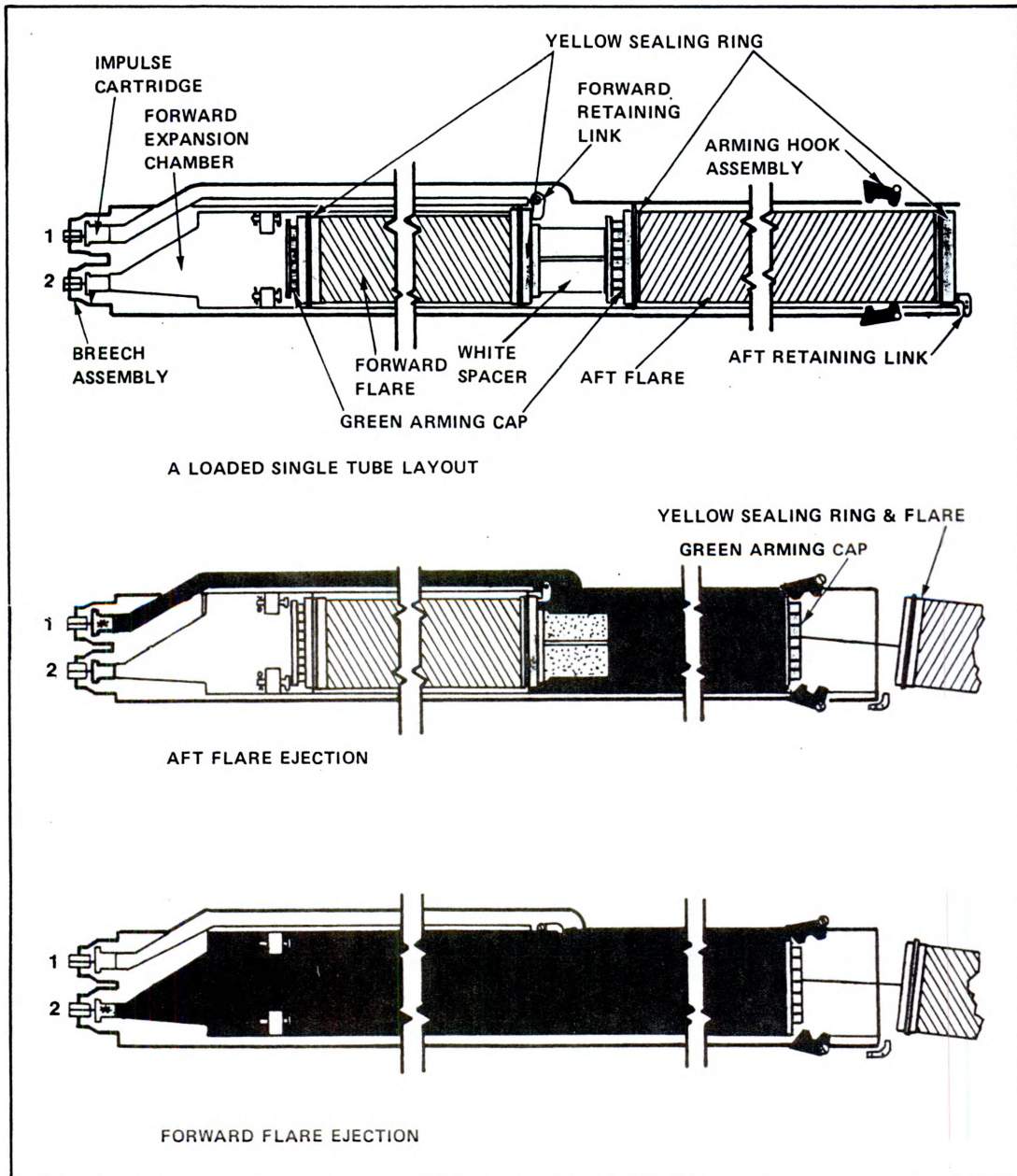


Figure 11-33.—SUU-25F/A ejection sequence.

220.940

3. The first sonobuoy is inserted into the tube with the rotochute end (green arming cap) forward.
4. The second sonobuoy is inserted in the same manner.

As you read about the munition ejection sequence, look at figure 11-33.

When a SUU-25F/A dispenser is fully loaded and uploaded on the aircraft, the pilot may eject flares. First, the aircraft weapon control system must be selected, then the pilot triggers the dispensing switch. A 28-Vdc electrical signal passes through an electrical cable from the aircraft to either receptacle J1 or J2 of the dispenser. The signal is routed from the dispenser receptacle to the stepper switch, causing the stepper switch to step from the preset ARM position to the number 1 position. This fires the number 1 impulse cartridge. The gas pressure, generated by the fired cartridge, is ported through a gas tube, internally along the side of the dispenser, into the aft expansion chamber ahead of the aft flare.

As the gas pressure increases, the aft retaining lock shear pin is cut, allowing the aft flare to eject. As the timer end of the flare approaches the rear of the tube, the arming finger of the arming mechanism engages the yellow sealing ring. The sealing ring cams the arming finger down, which, in turn, cams the arming hook up to engage the green arming cap. This action allows the flare to extend the lanyard. The lanyard extracts the timer knob and arms or starts the flare functioning sequence.

When the pilot triggers the system again, the stepper switch steps to the number 2 position and fires the cartridge. This meters the gas pressure directly into the forward expansion chamber. As the gas pressure increases, the forward retaining lock shear pin is cut. This allows the forward flare to be dispensed in the same manner as the aft flare. If the aft flare failed to eject, the gas pressure generated for ejecting the forward flare produces sufficient gas pressure to purge both flares out of the tube.

The procedure for the remaining three tubes is the same. The firing sequence of the breeches is stamped into the metal of the breech caps, as shown in figure 11-34.

Maintenance Requirements

Organizational-level maintenance is limited to a visual inspection of the dispenser. You need to look for damage such as cracks or breaks in the

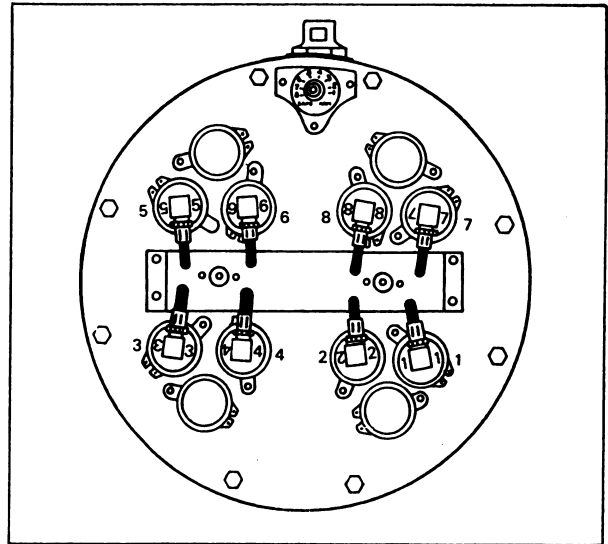


Figure 11-34.—Breech cap identification numbers.

aft retaining locks or suspension lugs, unburned pellets or obstructors in the breech sleeve, and frayed or broken breech leads.

For further information concerning the SUU-25F/A dispenser, you should refer to *Dispenser SUU-25F/A*, NAVAIR 11-75AA-48.

REVIEW NUMBER 5

- Q1. *What is the maximum number of parachute flares you can load in the SUU-44 flare dispenser?*
- Q2. *How many size A sonobuoys can be launched from SUU-25F/A dispensers?*
- Q3. *What impulse cartridge is used to fire the SUU-25F/A impulse cartridge?*
- Q4. *The impulse cartridge is fired by what voltage?*
- Q5. *When performing organizational-level maintenance on the SUU-25F/A, you should look for what types of damage?*

AN/ALE-39A COUNTERMEASURES CHAFF DISPENSING SET

The AN/ALE-39A countermeasure chaff dispensing set, known as the *chaff dispenser*, is an electronic countermeasures device. It may be installed in almost all Navy combat aircraft. The chaff dispensing set includes two dispenser

assemblies, two dispenser housings, two sequencer switches, and a programmer. The cartridge in the chaff dispenser can eject various load 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 fine-shredded metal strips

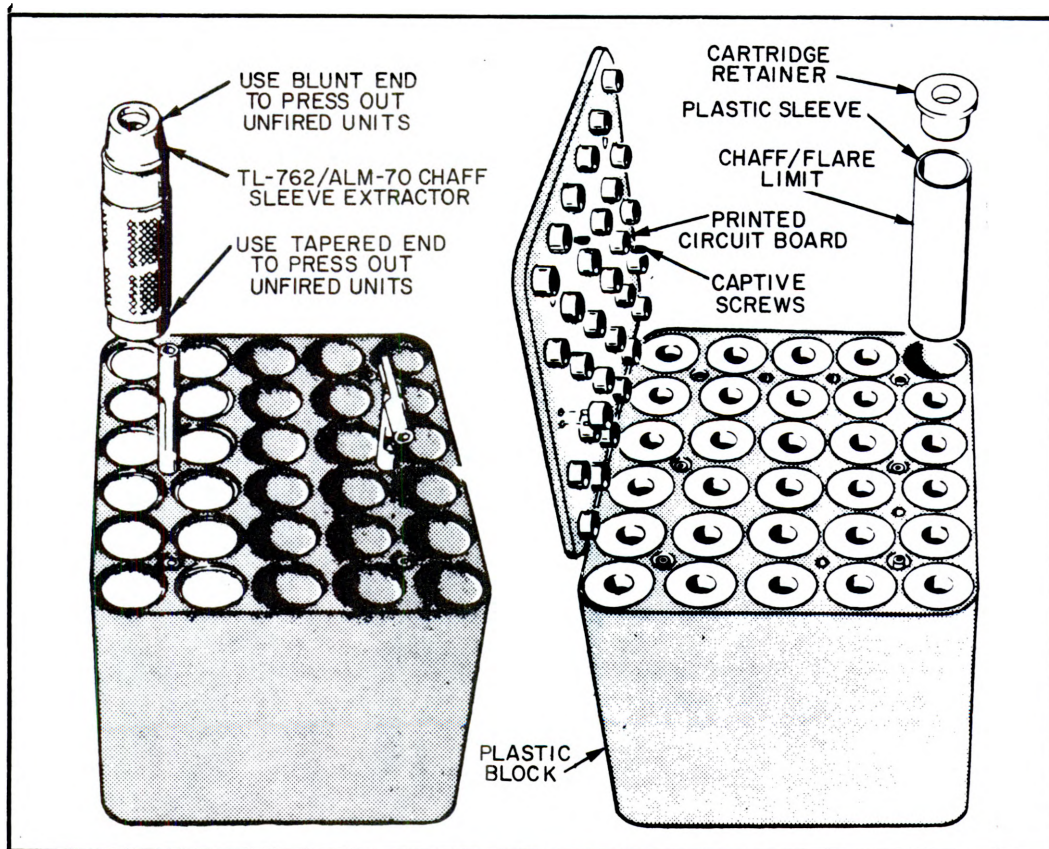


Figure 11-35.—AN/ALE-39A countermeasures chaff dispensing set.

REVIEW NUMBER 5 ANSWERS

- A1. You can load eight parachute flares in the SUU-44 flare dispenser.
- A2. Eight size A sonobuoys can be launched from SUU-25F/A dispensers.
- A3. The CUU-44 impulse cartridge is used to fire the SUU-25F/A impulse cartridge.
- A4. The impulse cartridge is fired by 28 volts dc.
- A5. When performing organizational-level maintenance on the SUU-25F/A, you should look for cracks or breaks in the aft retaining locks or suspension lugs, unburned pellets or obstructors in the breech sleeve, or frayed or broken breech leads.

contained in a cylindrical metal container. When ejected from the chaff dispenser, the metal strips are forced from the cylindrical container and dispersed into the atmosphere. This *jams* ground controlled radar installation or radar-controlled missiles.

Dispenser Assemblies

The dispenser assembly (fig. 11-35) contains two major subassemblies—a glass-reinforced phenolic plastic block and a sandwich-type primed circuit board. The block has 30 holes so you can load the payload units. There are four quick-release positive-lock studs so you can secure the block in the dispenser housing, and two telescoping handles to make it easier to handle.

The sandwich-type printed circuit board contains the circuitry and jacks so you can install 30 electrically initiated Mk 131 impulse cartridges. You must also install a connector to act as an interface between the dispenser assembly and the dispenser housing.

You load the dispenser by putting the 30 payload units (in plastic sleeves with plastic cartridge retainers installed) into the block. Install an impulse cartridge in each of the 30 jacks on the printed circuit board. Then, attach the board to the block by two captive screws.

NOTE: Installation of the impulse cartridges must be accomplished in a designated RF (radio frequency) free area.

Finally, install the loaded dispenser assembly in the dispenser housing. You need to secure it with the four positive-lock studs of the dispenser block. The payload units are forced from the plastic sleeves by the gas pressure generated when the impulse cartridges are fired. The chaff sleeve extractor, shown in figure 11-35, is used during dispenser download procedures.

Dispenser Housings

There are two different housing configurations available, as shown in figure 11-36. You can

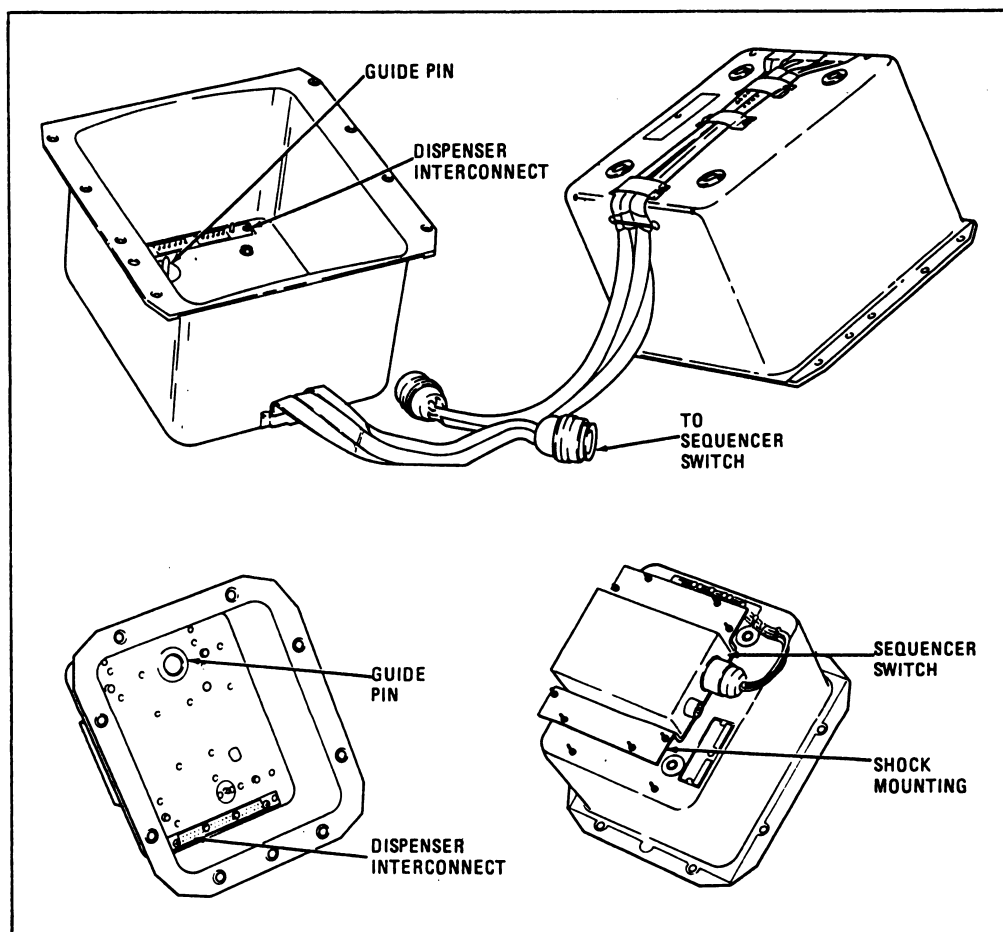


Figure 11-36.—Dispenser housings.

220.572.2

identify the housings by the mounting flange configuration, number and arrangement of mounting fasteners, location of the sequence switch, and the cable arrangement. These configurations are supplied so aircraft manufacturers have flexibility in mounting locations.

You **don't** remove the housing assemblies from the aircraft when loading. You **do** remove the dispenser assembly from the housing assembly by unlocking the four positive-lock studs. Move the dispenser assembly to a designated area and

load it. Then, return it to the aircraft and reinstall it in the dispenser housing. Safety switches, installed in the aircraft near the dispenser housings, make the dispenser's assemblies electrically safe when the safety pin/flag assemblies are installed. When the dispensers are loaded, the safety pin/flag assemblies must remain installed until just before flight.

The rear of the housing assembly has a dispenser interconnect that electrically connects the dispenser assembly to the system. When you

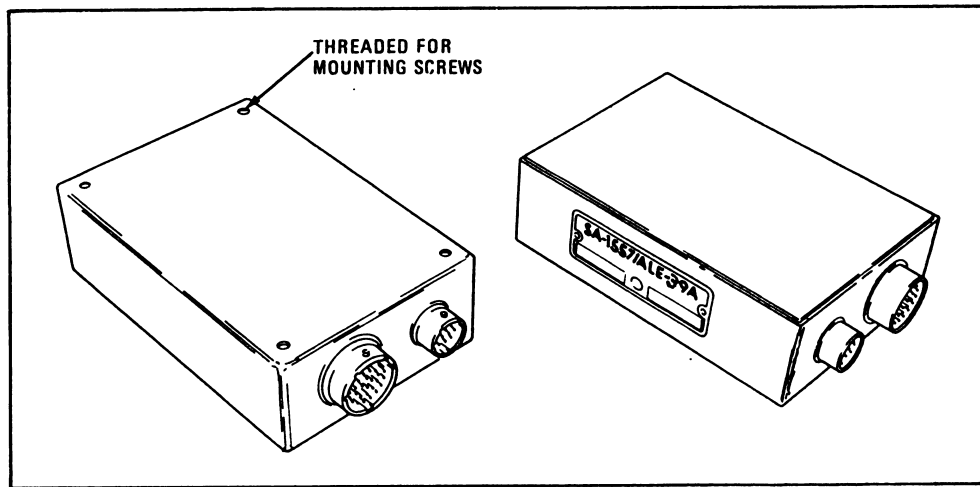


Figure 11-37.—Sequence switch.

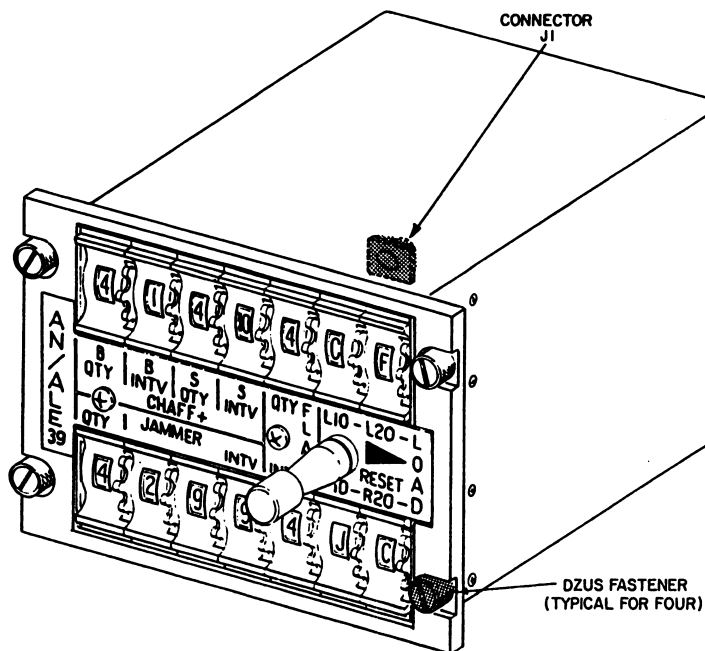


Figure 11-38.—Dispensing set programmer.

are installing the dispenser assembly into the housing assembly, you should use a guide pin to ensure proper alignment of the electrical connectors.

Sequencer Switch

Two sequencer switches (fig. 11-37) are used in a system—one for the right- and left-dispenser assemblies. The sequencer switch is a solenoid-actuated, multideck, rotary stepping switch contained in a hermetically sealed case.

The sequencer switch is actuated by control signals received from the programmer. Each control signal from the programmer actuates a relay in the sequencer switch, which applies 28 volts dc to the rotary switch. As the rotary steps, a firing pulse is supplied directly from the aircraft's 28-volt dc power supply. This firing pulse is directed to the applicable impulse cartridge in the dispenser assembly.

Dispensing starts with the selection of one or both dispensers (right or left) from the cockpit and the initiation of the dispensing switch. When only one dispenser has been selected and is

emptied, the programmer control pulses are automatically transferred to the second sequencer switch. When both dispensers are selected by the cockpit control, simultaneous signals are directed to both sequencer switches. The sequencer switches are connected to the dispenser housing by an electrical cable supplied as part of the dispenser housing.

Dispensing Set Programmer

The dispensing set programmer (fig. 11-38) provides electronic control of the dispensing modes. The AN/ALE-39A programmer generates control signals for the programmed payload ejection sequences. It also generates control signals for single ejection of payloads initiated manually at the CCP. Manual (single) dispensing is performed during a programmed dispensing sequence without disrupting the program.

AN/ALE-37A COUNTERMEASURES CHAFF DISPENSING SET

The AN/ALE-37A countermeasures chaff dispensing set (fig. 11-39) is externally mounted

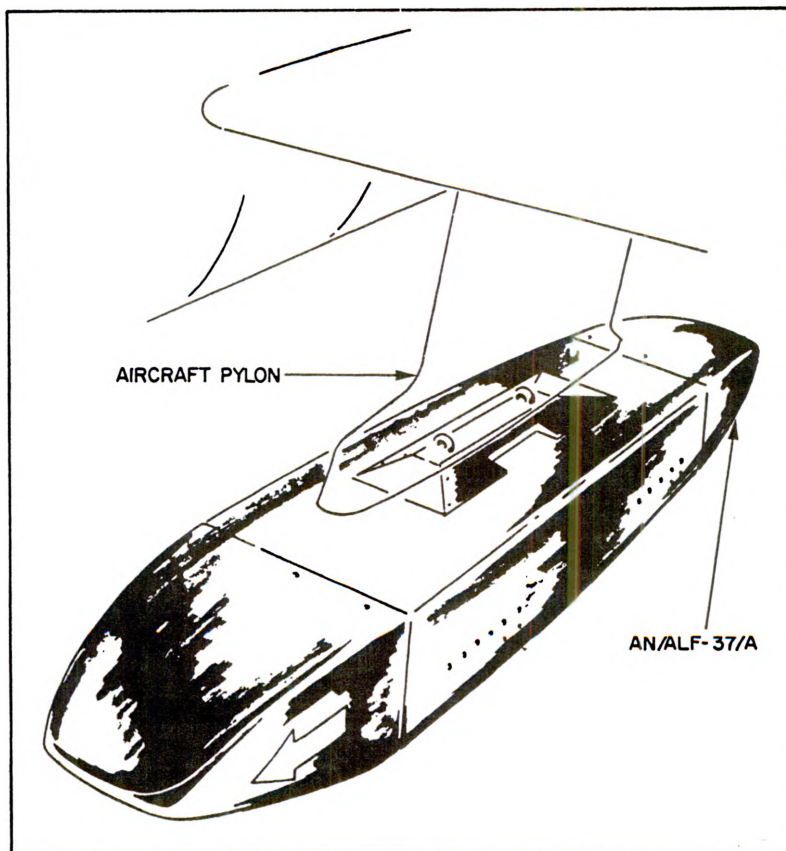
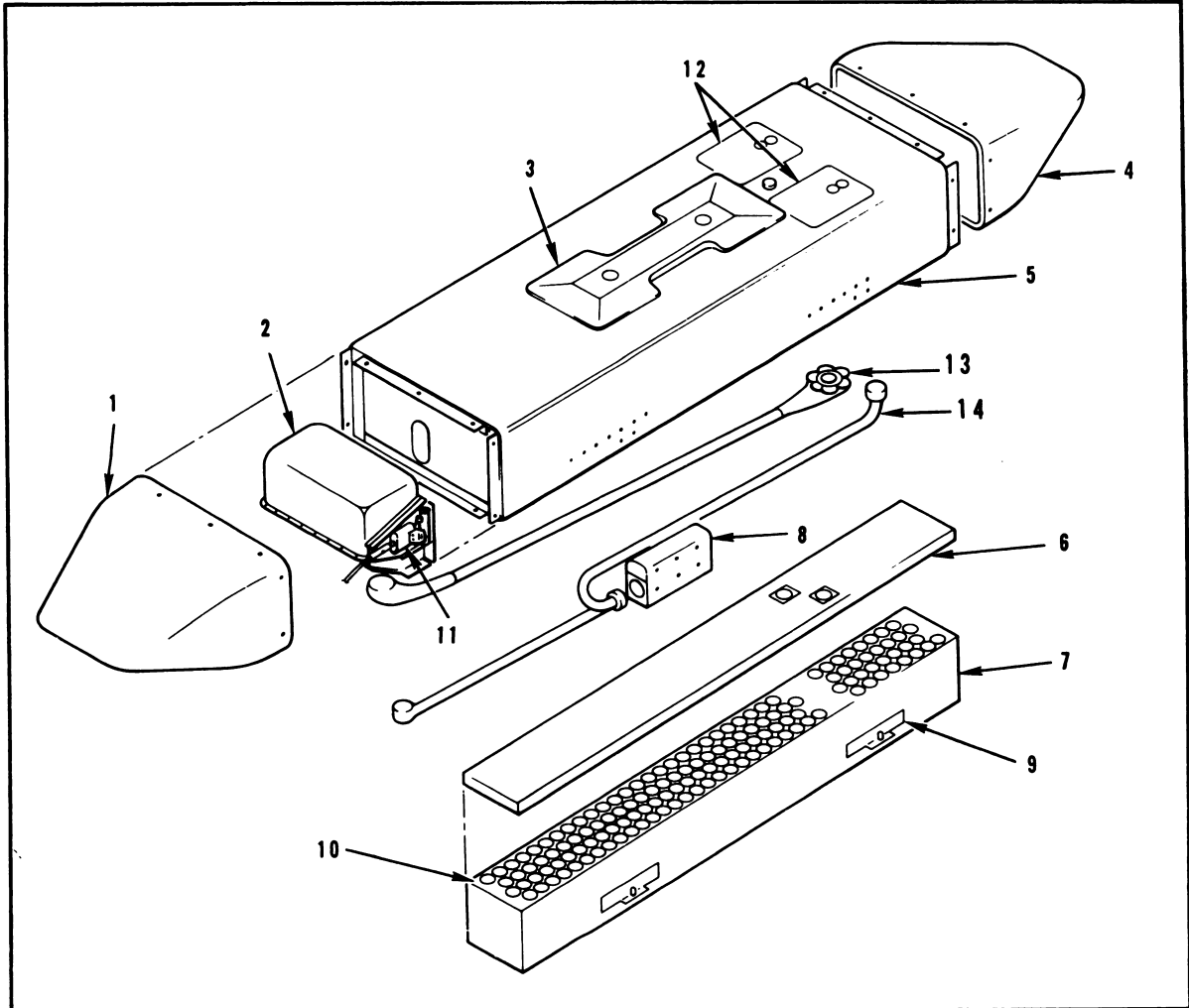


Figure 11-39.—AN/ALE-37A countermeasures dispensing set.



- | | | |
|-------------------|----------------------|-------------------------------|
| 1. Nose cone | 6. Squib board | 11. Lanyard disconnect switch |
| 2. Intervalometer | 7. Chaff module | 12. Access plate |
| 3. Hardback | 8. Control indicator | 13. Squib board harness |
| 4. Tail cone | 9. Module latch | 14. Power wiring |
| 5. Module cavity | 10. Chaff tube | |

220.946

Figure 11-40.—AN/ALE-37A countermeasures dispensing set, exploded view.

on aircraft MER/TER ejector racks that have 14-inch suspension. When mounted on the aircraft, the AN/ALE-37A has various patterns of chaff, decoy flares, or expendable jammers. Dispensing is dependent upon control settings and aircraft speed. Several dispensing pods may be employed on a single aircraft to provide maximum countermeasure capabilities.

The dispensing set is of modular construction, making maintenance easier and reducing turn-around time. Each dispensing pod contains two lightweight payload modules. Each payload module has a capacity of 120 rounds, providing a total capacity of 240 rounds. When empty, the pod weighs 180 pounds. When fully loaded, the pod weighs approximately 277 pounds.

Component Description

The functional theory and a physical description of individual dispensing set components are discussed in the following paragraphs. As you read about the components, look at figure 11-40. It shows their location and identifies them by item number.

Chaff Dispensing Pod

The chaff dispensing pod is constructed of heat-treated aluminum alloy formed sheet metal, extruded shapes, and machined parts. The pod is designed for quick reloading, using the spare loaded modules with squib boards installed. The pod hardback (item 3) has a rigid surface for mounting the pod to the bomb rack. The nose cone (item 1) houses the intervalometer, interlock switch, and provides aerodynamics to the pod. The tail cone (item 4) is identical to the nose cone, except it has extra markings and a hole for the insertion of a lanyard pin. An electrical connector at the aft end of the pod is used to interface with the aircraft's 28-volt dc power supply for pod operation. Power is routed internally, through the electrical wiring (item 14), from the connector to the intervalometer (item 2).

Chaff Module

You load the chaff module (item 7) with chaff, decoy flares, jammers, or a mixture of these payloads and a squib board (item 6). Then, insert it into the module cavity (item 5). Secure the chaff module in the cavity by locking the four positive locking latches (item 9). The 120 chaff tubes (item 10) contain the payloads. Each pod houses two separate modules.

Squib Board

The squib board (item 6) has four layers fastened and bonded together. The top layer is a thin sheet metal cover. The second layer is composed of edge spacers to provide a wire cavity for squib circuits. The remaining layers are composed of electrical insulating and fire-retardant materials. Two 61-pin electrical connectors connect the squib board harness (item 13) to the intervalometer circuitry. Place the

squib board, with 120 Mk 131 impulse cartridges inserted, on top of the chaff module and secure it with eight captive attachment screws.

Intervalometer

The intervalometer (item 2) is used to control the burst rate. The intervalometer circuitry responds to the settings on the pod control indicator or the cockpit control indicator. The intervalometer contains a solid-state component electronic timing pulser to switch the two automatic stepping switches. The stepping switches will operate individually for singles firing or in parallel for doubles firing.

Lanyard Disconnect Switch

The lanyard disconnect switch (item 11) is the main safety feature preventing cartridge detonation during chaff loading and ground maintenance. The switch is normally in the closed position. It is deactivated (opened) by inserting the lanyard pin in the switch socket. With the pin inserted, the lanyard disconnect switch opens the intervalometer circuitry and removes the electrical path to the squib board circuits.

Access Plates

The two access plates (item 12) provide access to the pod electrical connectors.

Pod Control Indicator

The pod control indicator (fig. 11-41) is located on the bottom center of the pod. It provides a means of selecting the burst rate

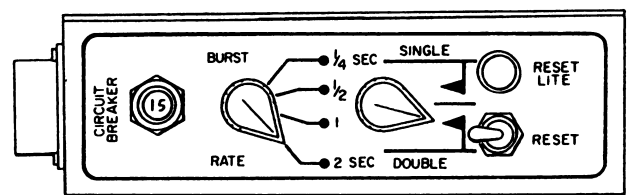


Figure 11-41.—Pod control indicator.

Table 11-1.—Firing Time and Sequence

SINGLE-DOUBLE POSITION	BURST RATE POSITION	TOTAL TIME TO EMPTY
SINGLE	1/4 SEC (0.25 Sec)	1 minute
SINGLE	1/2 SEC (0.5 Sec)	2 minutes
SINGLE	1 SEC	4 minutes
SINGLE	2 SEC	8 minutes
DOUBLE	1/4 SEC (0.25 Sec)	30 seconds
DOUBLE	1/2 SEC (0.5 Sec)	1 minute
DOUBLE	1 SEC	2 minutes
DOUBLE	2 SEC	4 minutes

and firing sequence. The controls are preset before flight to meet expected mission requirements. Table 11-1 lists the eight combinations of firing that can be obtained by positioning of the two rotary selector switches (BURST RATE and SINGLE/DOUBLE) on the pod control indicator. There is also a reset switch and reset light indicator on the pod control indicator so the intervalometer can be recycled to the starting position.

Cockpit Control Indicator

The cockpit control indicator (fig. 11-42) is an optional feature of the dispensing set. The controls on the cockpit control indicator override those on the pod control indicator, letting the operator select the burst rate and dispensing pattern after the aircraft is airborne.

In addition to the burst rate and single/double rotary switches, the cockpit control indicator has four pod select switches, a power ON switch, and four chaff remaining counters. This gives the pilot individual or simultaneous control of four separate dispensing sets while airborne. The cockpit control indicator has no reset feature. When the aircraft doesn't use the cockpit control indicator, any 28-volt dc power source having a cockpit control switch may be used for operation. When the system is used, the burst rate and dispensing pattern are controlled by the preset controls on the pod control indicator.

For further information on the AN/ALE-37A chaff dispensing set, you should refer to *Countermeasures Chaff Dispensing Set, AN/ALE-37A*, NAVAIR 16-30ALE37-1.

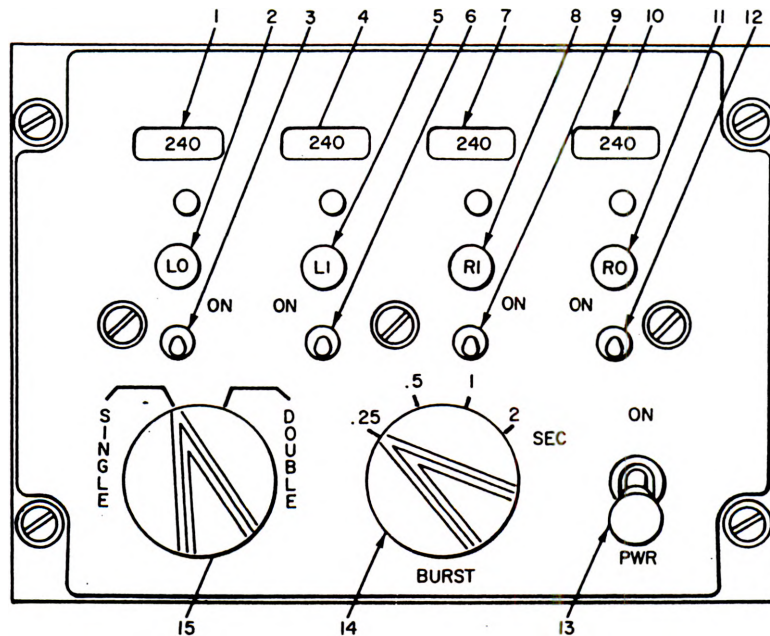
PHOTOFLASH CARTRIDGE EJECTORS

Model 9A and 9B photoflash cartridge ejectors (fig. 11-43) are designed to eject photoflash cartridges for night aerial photography. The basic difference between the two models is the number and size of photoflash cartridges the ejector will handle. The Model 9A ejector holds twenty-six M112 cartridges, and Model 9B holds ten M123 cartridges.

You can install either of these ejectors singly or in side-by-side multiples to form a photographic unit, depending on installation requirements. You can install them at various positions within the fuselage or on the underside of the wing of the carrying aircraft.

Each ejector consists of two major assemblies—cartridge-retainer assembly and breech-block assembly. The breech-block assembly has firing pins, a safety switch, stepping switch, and electrical wiring. The breech-block assembly remains installed on the aircraft. The cartridge retainer is removed for loading or unloading cartridges.

Each ejector model will fire a photoflash cartridge when an electrical pulse is received at the respective ejector firing pin. The pulse is initiated from associated pulsing equipment in the



- | | | |
|---|---|---|
| 1. Left outboard counter | 6. Left inboard pod activate switch | 11. Right outboard pod activate indicator |
| 2. Left outboard pod activate indicator | 7. Right inboard counter | 12. Right outboard pod activate switch |
| 3. Left outboard pod activate switch | 8. Right inboard pod activate indicator | 13. Power switch |
| 4. Left inboard counter | 9. Right inboard pod activate switch | 14. Burst rate selector switch |
| 5. Left inboard pod activate indicator | 10. Right outboard counter | 15. Single double selector switch |

Figure 11-42.—Cockpit control indicator.

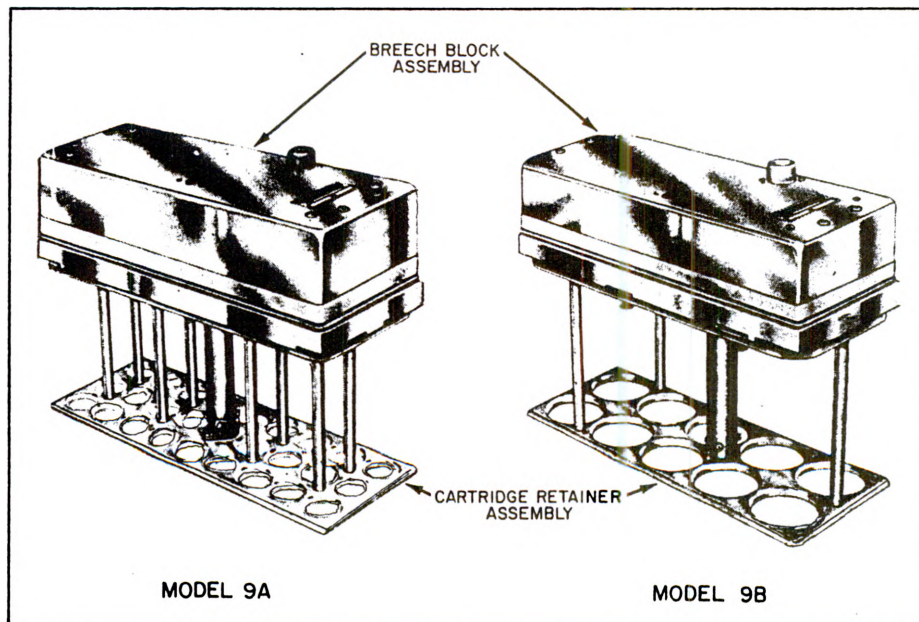


Figure 11-43.—Photoflash cartridge ejectors.

220.949

aircraft. When the last cartridge of the first ejector has been fired, a relay switches the electrical pulse to the next ejector. When used with camera control equipment, the camera is synchronized with each flash by suitable flash-detection equipment or by other electronic means.

If you want more information about the photoflash cartridge ejectors, refer to *Photoflash Cartridge Ejectors Model 9A and Model 9B*, NAVAIR 10-10AJ-15.

REVIEW NUMBER 6

- Q1. *What chaff dispenser is installed in Navy combat aircraft?*
- Q2. *List the two major subassemblies of the AN/ALE-39A countermeasures chaff dispensing set.*
- Q3. *What is the maximum capacity of the AN/ALE-39A?*
- Q4. *When the AN/ALE-37A is fully loaded, what is its weight?*
- Q5. *The AN/ALE-37A chaff dispenser contains _____ modules.*
- Q6. *There are _____ chaff tubes contained in an AN/ALE-37A chaff module.*
- Q7. *The model 9A photoflash cartridge holds _____ M112 cartridges.*
- Q8. *What is the capacity of the 9B photoflash cartridge ejector?*

SAFETY PRECAUTIONS

Learning Objective: *Recognize safety precautions to follow when handling suspension, arming, and releasing equipment.*

As an AO, you need to be concerned with safety when working with suspension, arming, and releasing systems. It is doubtful if there is a petty officer in the Navy who has not witnessed a minor mishap with suspension, arming, and releasing equipment. Accidents can be prevented if safety precautions and maintenance instructions are followed. Accidents can be prevented if personnel are trained and educated to work on the equipment. As a petty officer, following safety precautions and maintenance instructions and training new personnel is a part of your job. A few safety precautions that you need to follow and train your subordinates to follow are shown below.

- Keep all components of the various systems clean, well adjusted, and lubricated as prescribed.
- Make operational checks or periodic inspections of the system under the direct supervision of fully qualified personnel.
- Never insert your fingers or tools into a rack when the rack is cocked.
- Check wiring and electrical fittings regularly. Replace frayed or broken wiring. Check plugs for condition and proper installation.
- Never bypass safety circuits or devices or make them inoperative.
- Don't use any safety pin other than the prescribed one.
- When stores are loaded, install safety pins or other safety devices as prescribed while the aircraft is on the ground.
- Never install or arm an ejector rack unless the safety pin(s) and flag(s) are in place.
- Don't use an ohmmeter to check electrical continuity of an electrically primed cartridge.
- Remove or electrically disconnect all cartridges from the rack firing circuits before removing any component.

- Install only the prescribed cartridges in ejector devices.

- **Never** allow a dual breech ejector unit to be fired without two cartridges or a cartridge and authorized filler plug in the breeches.

- **Never** allow an ejector unit to be fired without a store latched in place.

- When loading stores, inspect all handling gear carefully. **Don't** use doubtful gear.

- When loading stores, make sure that the store is in position and the rack is securely locked before removing hoists.

- **Don't** place any part of your body under stores being loaded or unloaded if it is possible to accomplish the job without doing so.

- When installing suspension equipment, torque all installation bolts or screws to the prescribed torque value.

- Make sure all final work performed on the armament system is inspected by quality assurance personnel familiar with the system. Operational tests should be made on repaired systems where necessary.

REVIEW NUMBER 6 ANSWERS

- A1. The AN/ALE-39A chaff dispenser is installed in Navy combat aircraft.*
- A2. The two major subassemblies of the AN/ALE-39A countermeasures chaff dispensing set are the glass-reinforced phenolic plastic block and a sandwich-type primed circuit board.*
- A3. The maximum capacity of the AN/ALE-39A is 30 payload units.*
- A4. When the AN/ALE-37A is fully loaded, it weighs 277 pounds.*
- A5. The AN/ALE-37A chaff dispenser contains two modules.*
- A6. There are 120 chaff tubes contained in each module of the AN/ALE-37A.*
- A7. The model 9A photoflash cartridge holds 26 M112 cartridges.*
- A8. The 9B photoflash cartridge ejector holds ten M123 cartridges.*

CHAPTER 12

AMMUNITION HANDLING, STORAGE, AND ASSEMBLY

The ammunition used by the U.S. Navy must be maintained in a state of readiness at all times. Improper, rough, and careless handling, storage, and shipping results in malfunctioning ammunition, and it causes accidents that result in material damage or loss of life.

AMMUNITION STOWAGE

Learning Objective: Describe the types of ammunition stowage afloat. Identify the types of stowage spaces afloat to include types of magazines, magazine designations, ammunition stowage requirements, environmental control systems, sprinkler systems and auxiliary equipment, and magazine temperature requirements.

Stowing ammunition aboard ship presents problems you won't find in other types of storage facilities. When ships are underway, they are subjected to random motion. Ammunition is fastened in place firmly and securely when it isn't being handled. Adequate ventilation is a problem. Most ammunition stowage spaces are located below the main deck. Normally, these areas require extensive piping and venting to maintain proper temperature control and to vent hazardous fumes.

Access to stowage spaces often requires specialized equipment for moving ammunition quickly and efficiently. Stowage spaces are located close to other working spaces, which presents hazards to others on the ship, especially if there were a fire or explosion.

AMMUNITION STOWAGE SPACES

NAVSEASYS COM develops and approves the detailed specifications for construction of Navy ships and individual ship's blueprints. Ammunition stowage spaces (magazines) for various types and classes of ships are designated in these specifications. Aircraft or aircraft carriers' ammunition stowage magazines are also approved by NAVAIRSYSCOM.

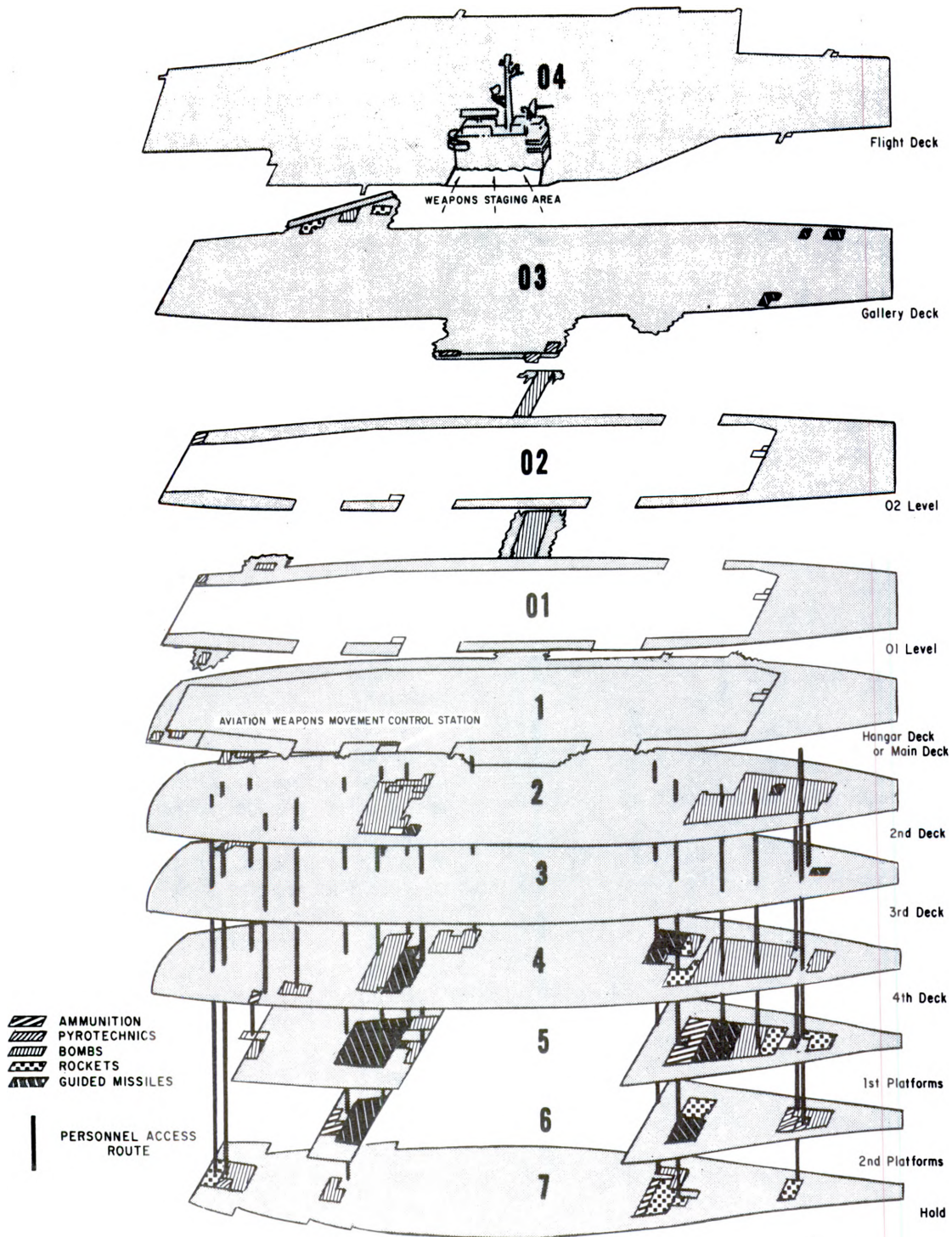
Magazines are arranged so they are close to supply, have the best available protection, and the most favorable stowage conditions. Figure 12-1 shows the magazine locations of a typical CV (aircraft carrier). For safety reasons, various types of explosives and ammunition are stowed in separate magazines or lockers.

The type of stowage varies with the type of ship, the space available, and the amounts of explosive involved. All magazines are marked by label plates that designate the compartment and the types of ammunition stowed in them. Magazines are marked with warnings that apply to specific special hazardous conditions and operations. Additionally, paint-stenciled labels or painted signs are installed on the outside surfaces of ammunition stowage spaces (except where the outside surfaces are visible from the exterior of the ship). The stenciled markings must be located on the bulkheads, overheads, and decks 12 feet apart. The sign or label (fig. 12-2) is a yellow rectangle, 5 inches high by 9 inches wide. The sign has black slanted lines, 1/8-inch thick and 1 inch long, on 3/4-inch centers along the top and bottom edges, with lines slanting from top right to bottom left. The letters are 1/8-inch thick and 3/4-inch high, with the words AMMUNITION FAR SIDE arranged as shown in figure 12-2. Primary and missile magazines aboard CVs are designed to hold a ship's service allowance and the embarked air wing's service allowance of ammunition.

Ships have several different types of magazines. Each magazine is designed for a specific type of ammunition. The magazine types include primary, missile, ready-service, lockers, and chemical.

Primary Magazines

Primary magazines are stowage spaces that are usually located below deck and, if possible, below the waterline. They are adequately equipped with thermal insulation, temperature control, and ventilation. Primary magazines are equipped with adequate sprinkler systems, and they are closed and locked when unattended.



220.454

Figure 12-1.—Typical CV magazine locations.

Missile Magazines

Because of the nature of guided missiles, requirements for their stowage aboard ship differ from those of conventional ammunition. Air-launched missile magazines in aircraft carriers

are usually located below the waterline and within the armor box. Air-launched missile ready-service magazines may be located either above the waterline or within the armor box. Missile magazines contain electrical, hydraulic, and pneumatic power-operated handling equipment.



Figure 12-2.—Example of AMMUNITION FAR SIDE sign or label.

Restraining gear prevents movement of an accidentally ignited motor. Magazines are equipped with specialized detection equipment to make sure that a specific missile hazard isn't present. Take special care of the ventilation system of missile magazines so magazine pressures don't build up to a dangerous level if a missile motor is ignited.

Additional fire-fighting equipment is often provided for missile magazines. This equipment may consist of carbon dioxide, foam, water injection, or a sprinkler system or a combination of these systems. NAVSEASYS COM specifically certifies the magazine for the stowage of hypergolic-fueled missiles, such as the AQM-37 target drone and fuel-air explosive (FAE) weapons. FAE weapons and the AQM-37 are compatible in stowage. FAE weapons require less stringent certified facilities; therefore, FAE weapons can be stowed in hypergolic magazines. However, hypergolic-fueled items cannot be stowed in magazines certified for FAE only.

Ready-Service Magazines

Ready-service magazines (fig. 12-3) are designated spaces located near the weapon or area to be served. Normally, they are equipped with thermal insulation, ventilation, and a sprinkling

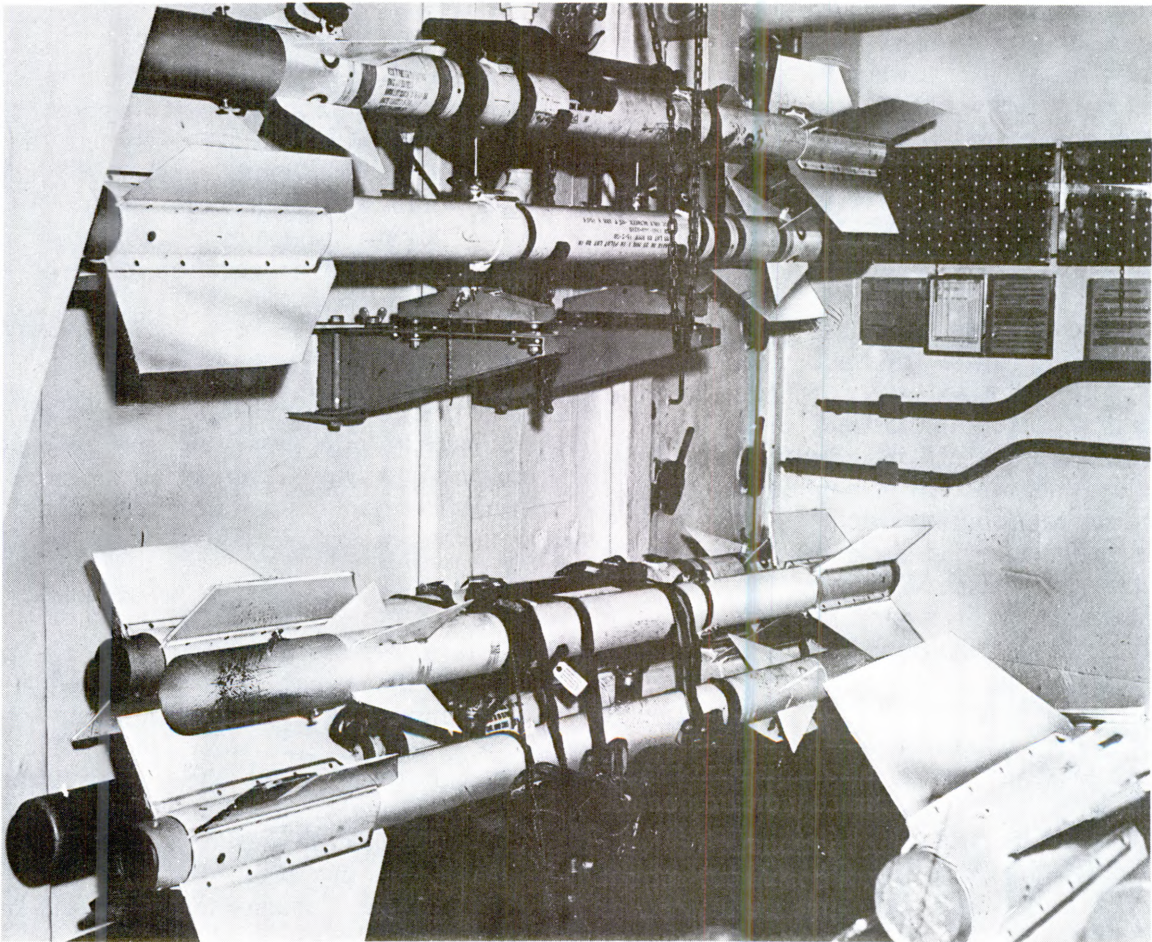


Figure 12-3.—Typical missile ready-service magazine.

system. They are securely locked. Certain magazines located within the armor box of aircraft carriers and used for stowage of completely assembled rounds of weapons and deployable targets are also ready-service magazines.

Lockers

Certain compartments or lockers are used to stow special types of ammunition and ammunition components such as detonators, pyrotechnics, and chemicals. They are frequently located on the weather deck. They are located as conveniently to the weapon or space to be served as possible. They may not be equipped with sprinklers, but they do have locking devices. Special flare ready-service lockers are located at outboard locations on aircraft carriers for short-term stowage of aircraft parachute flares. These flares have either been removed from the primary pyrotechnics magazines and prepared for launching or they have been returned intact after a mission. If necessary, these lockers are manually jettisoned. A label is installed on the locker identifying the type of explosives that are stowed within each locker. Where stowage for ammunition is provided by lockers, chests, or racks that are permanently secured to the ship's structure, don't change their location without prior approval of NAVSEASYSKOM.

Chemical Magazines

Chemical ammunition classified as lethal or incapacitating isn't carried aboard ships unless specifically authorized by NAVSEASYSKOM or higher authority. If authorized, specific stowage instructions are issued by NAVSEASYSKOM, and personnel involved in handling procedures must receive appropriate training. Specific spaces aboard ship may be designated as chemical magazines by NAVSEASYSKOM. The decks and bulkheads of a chemical magazine are coated with an impermeable material, and the magazine contains a provision for sampling its internal atmosphere from an adjacent compartment. Facilities for personnel and gross decontamination are located near the magazine.

IMPROVED REARMING RATE PROGRAM

Modern naval aircraft carriers incorporate a magazine stowage concept called *modular stowage*. The modular stowage concept gives

greater versatility in magazine stowage arrangement and minimizes ammunition handling. It makes it easier to stow ammunition, such as bombs and missiles, as fleet issue loads. Also, it isn't necessary to depalletize or decan loads before they are stowed. The incorporation of modular stowage and the addition of larger weapons elevators to service these areas brought about the Improved Rearming Rate Program (IRRP).

The IRRP allows major handling time improvements in two areas—rearming and weapons assembly. Stowing ammunition as received on pallets lets handling crews rearm the ship's mission load in less time than the old system. In turn, handling time is minimized during weapons assembly.

The installation of larger weapons elevators makes it possible to issue some weapon configurations as **preloaded weapons**. For example, you can assemble and load Mk 80 (series) general-purpose bombs on MER/TER bomb ejector racks in the magazine assembly areas. Then, you can transfer them to ammunition staging areas on the hangar deck or flight deck for issue to the squadron loading crews. These preloaded MERs/TERs let squadron loading crews use the single hoist ordnance loading system (SHOLS) and HLU-196B/E bomb hoist unit to load six or three bombs as a single unit. Aircraft rearming time (turnaround time) is reduced, and the number of personnel required to rearm the aircraft is reduced.

DESIGNATION OF MAGAZINES

Magazines or ammunition spaces afloat are designated with particular reference to the purpose intended. Generally, magazines aboard ship are designated to hold a single type of ammunition.

Single-Purpose Magazine

Magazines are designated as single-purpose stowage magazines whenever practical. The following are single-purpose magazine designations: powder and rocket motor magazine; hypergolic rocket engine magazine; fixed ammunition magazine; small arms magazine; missile magazine; warhead locker or magazine; aircraft bomb magazine; projectile and rocket head magazine; fuze magazine; detonator locker; pyrotechnic magazine or locker; ready-service ammunition room, box, rack, or locker; and chemical magazine.

Multipurpose Magazine

While stowage of a single type of ammunition in an individual magazine is desirable, it isn't always possible. NAVSEASYS COM authorizes certain mixed stowages in magazines that retain a single-purpose designation. Where stowage space is limited and the mission requires carrying various types of ammunition, stowage of more than one type of ammunition in a magazine is an acceptable hazard. Authorization for this type of stowage is at the discretion of the operational commander.

AMMUNITION STOWAGE REQUIREMENTS

Generally, there are magazines for each type of ammunition stowed aboard ship. Ammunition, explosives, and explosive components are stowed in specifically designated stowage spaces. Ammunition stowage spaces aboard ships are limited, and in certain classes of ships, extremely limited. Therefore, ammunition stowed aboard ship should stay within authorized ammunition allowances. It is important for shipboard ammunition to be stowed so maximum effectiveness is achieved. For these reasons, strict compliance with ammunition stowage by compatibility groupings aboard ship, while desirable and observed when practical, may not be feasible. When mixed stowage is used, make sure that it conforms to the stowage tables listed in *Ammunition Afloat*, NAVSEA OP 4.

Table 12-1 is an example of the permissible mixed stowage of ammunition types in shipboard magazines. The different types of ammunition are listed in the first column of table 12-1. The types of magazines are listed across the top of the table. The type of ammunition is stowed only in those magazines indicated by a black box intersecting the horizontal line for the ammunition item and the vertical line for the type of magazine.

REVIEW NUMBER 1

- Q1. *What command develops and approves specifications for construction of Navy ships?*
- Q2. *A ship's primary magazines are usually located _____.*

- Q3. *What type of magazines are located close to the area to be served?*
- Q4. *What is the purpose of modular stowage?*
- Q5. *List the two areas that the IRRP created improved handling.*
- Q6. *Squadron personnel use a _____ hoist for preloaded MERS and TERS.*
- Q7. *Generally, magazines aboard ship are designated to hold _____.*
- Q8. *Authority for stowing mixed types of ammunition in a magazine rest with _____.*

ENVIRONMENTAL CONTROL SYSTEMS

Magazines are fitted with environmental control and safety features to protect ammunition from excessive temperatures and humidity. Most magazines have either mechanical cooling or ventilation systems. However, there are a few magazines that don't have either of these features. If a magazine without controls shows a heat gain in excess of 100°F, use portable ventilation systems to prevent overheating or condensation of moisture.

Supply and Exhaust Ventilation

Ventilation ducts and exhaust ventilation outlets to and from magazines provide forced-air ventilation. Air is forced through the ducts by electric fans installed within the duct work. Standard covers maintain watertightness and prevent the entrance of flames from hits on the ship during combat. Always close these covers during combat (general quarters) conditions, unless otherwise directed. If you inhale fumes from some types of ammunition, you might get slightly intoxicated. However, this should not

appreciably reduce your work efficiency. Generally, there is sufficient air volume in large sealed magazines and handling rooms to provide a safe working atmosphere for approximately 5 hours. Magazines that are continuously occupied by personnel are blown through or ventilated a minimum of once every 5 hours.

Magazine Vent Check Valves

Sometimes, it is necessary to operate the sprinkler system in magazines while the ventilation valves are secured. When this happens, the magazine must be vented by an air escape to ensure that the pressure within the magazine doesn't build up beyond the allowed pressure limits of its watertight boundaries. Magazine check valves allow air and water to escape from the magazine into one of the ventilation ducts or through an independent air escape.

Exhaust Vents

Aboard ship, most magazines, particularly missile magazines, are vented to the atmosphere. When missile motors burn, they rapidly produce large volumes of smoke and gas. To avoid spreading smoke and gas to other areas of the ship if a missile motor in a magazine accidentally ignites, the exhaust ducts are vented to the atmosphere. The area on the weather deck in the vicinity of an exhaust vent is potentially hazardous, and it is marked to warn personnel not to loiter (hang around) in this area.

SPRINKLER SYSTEMS AND AUXILIARY EQUIPMENT

Primary and missile magazines, ammunition handling rooms, and most ready-service magazines are fitted with sprinkler systems. Sprinkler systems consist of spray heads or sprinkler-head valves arranged to dash water directly on the munitions and completely cover the magazine's interior. Sprinkler systems for spaces located below the damage control deck (second deck on aircraft carriers) are arranged for local control at the valve and for remote control from the damage control deck. On aircraft carriers, the remote controls are normally divided into two groups—forward sprinkler control board and aft sprinkler control board. The forward magazine group and the aft magazine group sprinklers can be remotely activated from the two control boards. Sprinkler systems for spaces located on and above the damage control deck are arranged for local control only from a position outside the access entrance to the space.

NOTE: Some magazines are designed without sprinkler systems so water-activated ammunition can be stowed in them. For example, Mk 58 marine location markers cannot be stowed in magazines that can be flooded. Also, weather-deck lockers and 20-mm and 40-mm ready-service rooms do not require sprinkler systems.

REVIEW NUMBER 1 ANSWERS

- A1. NAVSEASYSCOM develops and approves specifications for construction of Navy ships.
- A2. A ship's primary magazines are usually located below the waterline.
- A3. Ready-service magazines are located close to the area to be served.
- A4. The purpose of modular stowage is to give the greatest versatility and to minimize ammunition handling.
- A5. The two areas that the IRRP created improved handling are rearming and weapons assembly.
- A6. Squadron personnel use a HLU-196B/E hoist for preloaded MERS and TERS.
- A7. Generally, magazines aboard ship are designated to hold a single type of ammunition.
- A8. Authority for stowing mixed types of ammunition in a magazine rest with NAVAIRSYSCOM.

Table 12-1.—Permissible Stowage of Ammunition and Explosives

TYPE OF AMMUNITION	TYPE OF MAGAZINE	STOWAGE CATEGORIES													REMARKS			
		PROJECTILES & ROCKET HEADS	FIXED AMMO. GUN & ROCKET	PROPELLANT, GUN, BAG	PROPELLANT, GUN, CASED	PROPELLANT, LIQUID FUEL	PYROTECHNIC	CHEMICAL	BOMB TYPE	SMALL ARMS	WARHEADS	MISSILES (ASSEMBLED)	GRENADE LOCKERS	DETONATOR LOCKERS		READY-SERVICE	DEMOLITION MATERIAL	SPECIAL LOCKERS
Actuator, Torpedo, F/Arming Device Mk 6 Mod 0																		
Arming and Firing Mechanism Mk 1 Mod 1																		
Arming Device, Mks 2 and 3, F/Torpedo																		
Base Couplings, w/primer																		
Bolts, Explosive																		
Bombs, Chemical Agent																		
Bombs, HE Loaded, Depth, Frag, GP, SAP																		
Boosters and Auxiliary Boosters w/o Detonators, HE Loaded, All Types																		
Boosters and Auxiliary Boosters w/Detonators, HE Loaded, All Types																		
Caps, Blasting																		
Cartridges, 40mm, 3" and 5", Blank Saluting																		
Cartridges, Delay, F/AC																		
Cartridges, Engine Starter, MXU-4A/A																		
Cartridges, Explosive, F Torpedo Mk 45																		
Cartridges, Grenade, Rifle and Carbine																		
Cartridges, Impulse, F/AC																		
Cartridges, Impulse, 3" F/SDCP																		
Cartridges, Impulse, F/Gas Gen, 25 Man Life Raft																		
Cartridges, Line Throwing, .45 Cal.																		
Cartridges, 20mm, AP-T, TP, LPT, FCT																		
Cartridges, 20mm, CIWS																		
Cartridges, 20mm, Incend, API, HE Loaded																		
Cartridges, Photoflash																		
Cartridges, Mortar, HE, III, TP, Leaflet and Window																		
Cartridges, Mortar, WP Loaded																		
Cartridges, 40mm Riot Control																		
Cartridges, 3" 50 Cal, 76 mm, Service and Training																		

Separate stowage

Types of Sprinkler Systems

Sprinkler systems are classified by the type or location of the control exercised over the valves that restrain the flow of water. These valves may be operated manually (at the valve) or by remote control (manually or automatically). There are three types of remote operation:

1. Manual, by operating gears
2. Hydraulic, by means of control cocks and water from the fire system or control cocks and oil pressure supplied by hand pumps
3. Automatic, by means of a *rate of rise* or combined *rate of rise* and fixed temperature thermopneumatic control system

The *rate of rise* is indicated in a magazine when the temperature increases rapidly (such as from a fire). The rapid temperature increase activates the sprinkler-alarm device (FH circuit), which, in turn, automatically activates the sprinkler system control valve.

High-Temperature Alarm Systems

High-temperature alarm systems (F circuit) are installed in all of the following magazines or spaces:

- Ammunition and propellant stowage areas
- Ammunition handling spaces
- Ammunition assembly/disassembly/check-out areas
- Cargo ammunition holds to provide a means of determining high temperatures

Don't confuse the F circuit with the FH circuit. The F circuit detects a slow rise in temperature while the FH circuit detects a rapid rise in temperature.

Install a minimum of two thermostats in each space. Install a minimum of one thermostat for each 250 square feet of deck area, or fraction of a deck area. If high temperatures occur in any of the spaces containing thermostats, the high temperature occurrence is indicated on an alarm switchboard installed in an area continuously manned when the ship is underway. Usually, this is damage control central. Audible alarm systems are also installed in the pilot house, officer of the deck (OOD) area, secondary damage control station, and each interior communications room. The audible alarm systems work in conjunction with the F and FH circuits.

Tests and maintenance of the magazine sprinkler systems are performed periodically

according to NAVSEA and applicable preventive maintenance system (PMS) instructions.

MAGAZINE INTERNAL ARRANGEMENT

The internal arrangement of each magazine may vary considerably. The arrangement depends on the stowage space available and the type of ammunition stowed. Figure 12-3 shows a ready-service magazine configured for ready-service missiles. Notice some missiles are stowed in cradles attached to the bulkhead. Other missiles are loaded onto handling equipment and ready for immediate issue. In larger magazines, such as primary missile magazines, stanchions may be installed in sockets provided in the deck and overhead. Cradles are attached to the stanchions to stow a large number of decanned ready-service missiles. Straps are used to secure the missiles in the cradles.

Stanchions are also used to divide a large magazine area into smaller areas or bins to hold various sizes of ammunition with a minimum loss of space. The stanchions are fitted with slots or have other means for receiving battens. The battens (which run horizontally) provide the walls that form the bin.

No matter which stowage method is used, arrange the stowage area so access to as much ammunition and as many containers as possible is provided, and provide adequate space for ventilation and handling operations. Stow ammunition and explosives on dunnage to provide an air space so all parts of the magazine receive maximum ventilation and exposure to the sprinkler system. Mk 3 or Mk 12 metal pallets are used as dunnage aboard aircraft carriers. These have the correct space between the deck and stowed material. They also provide adequate grounding. Additionally, make sure that there is an air space of not less than 2 inches between any ammunition stowage stack and the surface of adjacent plating or sheathing. Stow the stacks of ammunition so sprinkler systems, circuit F sensors, or air escape lines aren't obstructed. When different lots and/or types of ammunition are stored in the same magazine, segregate the ammunition by lot, size, and type. Record this information on magazine cards and post them in the magazine.

Ships at sea move randomly; therefore, securely fasten all hazardous munitions and explosives in place, except when they are actually being handled. In some cases, stanchions and battens provide adequate security. Other types

of ammunition stows, such as palletized bombs or missile containers, are secured by tie-down chains especially designed for this purpose. Connect the tie-down chains to the load and the deck tie-down-points so even the slightest movement of the ammunition is prevented.

MAGAZINE INSPECTION AND VISUAL SURVEILLANCE OF AMMUNITION

The terms *magazine inspection* and *visual surveillance of ammunition* mean the same thing. They apply to the inspection of magazines and their contents. Aboard ship, these inspections are mandatory according to *The Ship's Maintenance and Material Management (3-M) Manual*, OPNAVINST 4790.4 (series), other Navy regulations, and NAVSEASCOM instructions. Magazine inspections are part of the ship's PMS, and they should only be conducted by qualified personnel. These personnel use a check sheet (maintenance requirement card) to ensure that a hazard or abnormal condition is not overlooked.

DAILY VISUAL INSPECTION

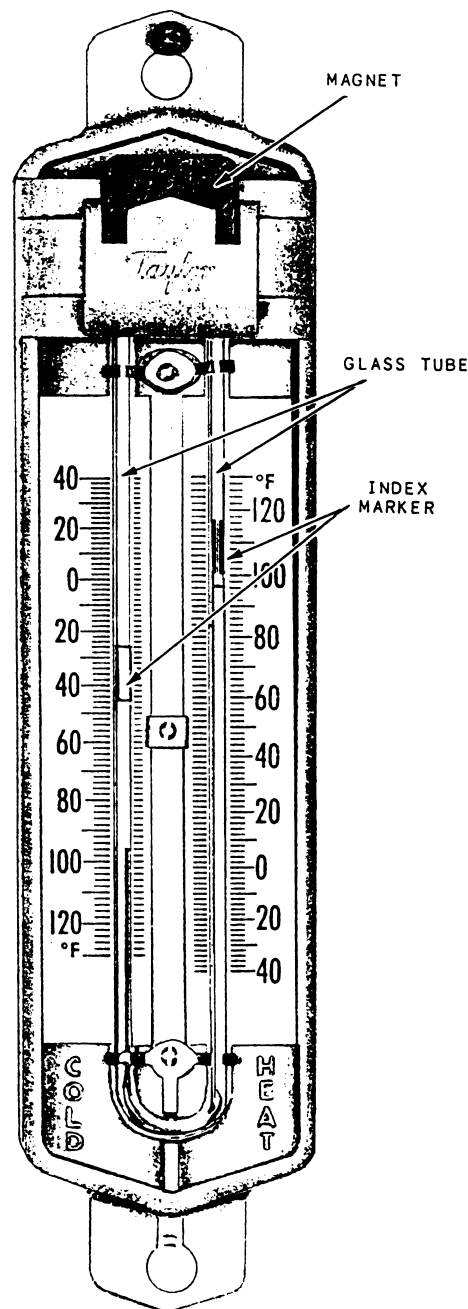
Generally, the daily visual inspection of magazines consists of checking for the following:

- Improperly secured stowage
- Unsatisfactory protective packaging
- Unusual fumes or odors
- Magazine cleanliness
- Other abnormal conditions

Abnormal conditions in a ship's magazine or ammunition stowage space include evidence of tampering to gain access, evidence of theft, evidence of temperature or humidity fluctuations, and the presence of unauthorized materials. Abnormal conditions also include evidence of localized overheating from adjacent compartments on decks, bulkheads, and overheads; indications of leaks from sprinkler or flood pipes, nozzles, or control valves and regulators; and inoperable or damaged reach-rods, linkages, automatic fire alarm devices, and other similar equipment in the specific hazard stowages. Record the results of all magazine inspections on the appropriate PMS schedule.

An important requirement of the daily magazine inspection is observing, recording, and reporting maximum and minimum temperature conditions in each stowage space. A maximum-minimum thermometer (one or more per

magazine) is placed in all magazines when ammunition is stowed in them. The maximum-minimum thermometer (fig. 12-4) is a U-shaped, mercury-filled glass tube with two bulbs. You determine the current temperature by the level of the mercury in either arm of the tube. The current temperature indicated by the thermometer shown



5.65
Figure 12-4.—Maximum-minimum thermometer.

in figure 12-4 is approximately 95°F. The mercury level in each side of the tube should indicate the same temperature reading. If the readings are not the same on both sides of the tube, replace the thermometer.

The maximum and minimum temperatures may be determined by observing the position of the steel index marker located in either side of the glass tube. If the temperature increases, the mercury rises upward in the right-hand scale, forcing the steel index marker upward while the mercury in the left-hand scale decreases downward and the steel index marker remains stationary. If the temperature decreases, the mercury in the left-hand scale rises, forcing the steel index marker upward while the mercury in the right-hand scale decreases downward and the steel index marker remains stationary.

The maximum temperature indicated on the thermometer illustrated is approximately 100°F. The reference point for taking all maximum and minimum readings is always from the bottom edge of the steel index marker. The minimum temperature indicated is approximately 45°F.

After recording the temperature readings on the magazine temperature card, zero the thermometer. You use a horseshoe-shaped magnet to zero the thermometer. Place the magnet against the glass and draw it downward so each steel index marker is drawn down to the level of mercury.

MAGAZINE TEMPERATURE LOG

A Magazine Temperature Record Card (fig. 12-5) is located in each magazine. It is posted near the thermometer for recording daily magazine temperatures. These cards are replaced on the first day of each month. The completed cards are removed from the magazine and the temperatures for each month are posted in a permanent log. The magazine temperature cards are retained on file for a period of 1 year. When recording magazine temperatures in the permanent log, record temperatures in excess of 100°F so they stand out (use red ink). If the temperature exceeds 110°F in smokeless powder, rocket motor, and JATO magazines, check the temperature hourly and record it in a separate notebook. Transfer these recorded temperatures to the permanent log on a daily basis. Any magazine with a temperature consistently above 100°F is reported to NAVSEASYSKOM.

MAGAZINE TEMPERATURE RECORD CARD			
COMP'T. <u>A-304M</u>		THERM. NO. <u>279</u>	
MONTH <u>APRIL</u>		19 <u>70</u>	
DATE	MAX.	MIN.	INITIAL
1	84°	64°	SEH
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			
17			
18			
19			
20			
21			
22			
23			
24			
25			
26			
27			
28			
29			
30			
31			
INDEX	ROUNDS		
INDEX	ROUNDS		
INDEX	ROUNDS		
INDEX	ROUNDS		

Figure 12-5.—Magazine temperature record card.

MAGAZINE SECURITY

Unless work is actually being performed within the space, all ammunition stowage spaces containing ammunition or explosives are secured and locked. This action is required by current directives and instructions. Properly securing an ammunition stowage space includes the following actions:

- Properly set all environmental controls
- Close all hatches, doors, or accesses
- Properly set all dogs on watertight closures
- Lock the space with an adequate locking device

Some ammunition and explosive items such as small arms ammunition, small arms, and pyrotechnics are highly pilferable. Stow them in high-security stowage spaces. These spaces are equipped with an unauthorized entry alarm system and a specially designed high-security locking device.

The ship's gunner maintains and controls the magazine keys, including the high-security keys. The keys are logged out to authorized personnel only. During emergencies, such as fire and flooding, the ship's gunner provides access, as necessary, to locked ammunition spaces. If the ship's gunner is absent, the weapons department duty officer performs this function.

REVIEW NUMBER 2

- Q1. *Missile magazines are vented to _____.*
- Q2. *What item shouldn't be stowed in magazines that are equipped with sprinklers?*
- Q3. *In a shipboard magazine, what alarm circuit indicates a rapid rise in temperature?*
- Q4. *What type of pallets are used as magazine stowage dunnage aboard ship?*
- Q5. *All maximum and minimum readings taken from a magazine thermometer use the _____ as a reference.*
- Q6. *NAVAIRSYSCOM should be notified if the temperature in any magazine is consistently above _____.*
- Q7. *What person controls all magazine keys aboard ship?*

AMMUNITION HANDLING

Learning Objective: Identify ammunition handling equipment used aboard ship. Recognize their purpose and use. Identify the purpose and use of weapons elevators.

Handling ammunition requires detailed planning, precise execution of details, and strict compliance with safety regulations. When handling ammunition aboard a ship, these requirements can't be overemphasized. The working space is limited, and there is a large number of personnel contained within the ship. All personnel (both military and civilian) who handle ammunition must be qualified and certified in their areas of responsibility.

INSTALLED HANDLING EQUIPMENT

Aboard ship, most large magazine and weapons assembly areas are serviced by weapons elevators. These areas have provisions for the use of hoists. A brief description of handling equipment and their purpose are discussed in the following text.

Hoists

You use hoists in magazine stowage areas to stack or relocate ammunition within the magazine. You also use them to decan weapons. Hoists are used during weapons assembly to lift a weapon from the handling equipment or pallets to the assembly stands and from the assembly stand to the handling equipment.

There are three basic types of hoists—manually powered, electrically powered, and pneumatically powered. A hoist may be attached to the overhead by a stationary fitting, or it may be mounted onto an overhead monorail to move the load laterally. You must use the correct sling, hoisting beam, and bomb carrier when connecting the hoisting cable to the load. Hoists have an established SWL that you must consider when selecting a hoist for a particular job. Also, consider the SWL of the interfacing equipment (bomb carrier, sling, etc.). For example, you have selected a hoist with an SWL of 4,000 pounds and a bomb carrier with an SWL of 2,000 pounds. The maximum weight this configuration can safely lift is 2,000 pounds.

Inspect hoists before you use them. Hoist must be periodically load tested. Equipment that has satisfactorily passed periodic load tests is marked to indicate its SWL. As a minimum, the marking includes the following information:

- The name of the testing activity and the name of the person performing the test
- The date the test was performed

- The date of the next required inspection may be included if desired

If the test period has expired or if documentation is not available to verify the latest load test status, the equipment is tested before it is used. If the equipment fails the load test specifications, the equipment is destroyed or, if economically feasible, repaired.

Weapons Elevators

There are currently more than 150 weapons elevators, involving over 55 different designs, installed on aircraft carriers. The size, type, and location of these weapons elevators will vary among the different classes of aircraft carriers.

The Forrestal-class carriers, the USS *Kitty Hawk*, and USS *Constellation* have a combination of 5,500 pound, 2,000 pound, and 1,400 pound special armament stowage space (SASS), and improved weapons handling system (IWHS) elevators installed.

The USS *Enterprise* and USS *America* were designed with pneumatically-operated doors and hatches. The elevators on the USS *America* include five pneumatically operated elevators and three elevators that have hydraulically operated hatches and pneumatically operated doors.

The USS *John F. Kennedy* are designed with platform conveyors and an athwartship shuttle. The elevators have hydraulically operated doors and hatches served from three power plants. Upper-stage elevators, numbers 2, 3, and 4, are raised and lowered by hydraulic ram instead of cables.

The elevators aboard the USS *Nimitz* have two hydraulic power plants that serve 10 high-speed elevators. All the doors and hatches are hydraulically operated. In addition, all of the elevators are rated for a 9,000-pound load capacity, and the elevator trunks have side-loading capabilities at several magazine levels.

Except for minor differences, the elevators aboard the USS *Eisenhower* and the USS *Carl Vinson* are almost identical to those aboard the USS *Nimitz*.

The following text contains a brief description of the two major classifications (lower-stage and upper-stage) of weapons elevators. Regardless of the type of installation, a weapons elevator provides a safe and efficient means for you to handle weapons and weapons components among the magazines and the various assembly, staging, and arming areas within the ship.

LOWER-STAGE WEAPONS ELEVATORS (5,500 POUNDS).—The 5,500-pound lower-stage

REVIEW NUMBER 2 ANSWERS

- A1. *Missile magazines are vented to the atmosphere.*
- A2. *Mk 58 marine location markers shouldn't be stowed in magazines that are equipped with sprinklers.*
- A3. *In a shipboard magazine, the FH circuit indicates a rapid rise in temperature.*
- A4. *Mk 3 or Mk 12 metal pallets are used as magazine stowage dunnage aboard ship.*
- A5. *All maximum and minimum readings taken from a magazine thermometer use the bottom edge of the steel index marker as a reference.*
- A6. *NAVAIRSYSCOM should be notified if the temperature in any magazine is consistently above 100°F.*
- A7. *The ship's gunner controls all magazine keys aboard ship.*

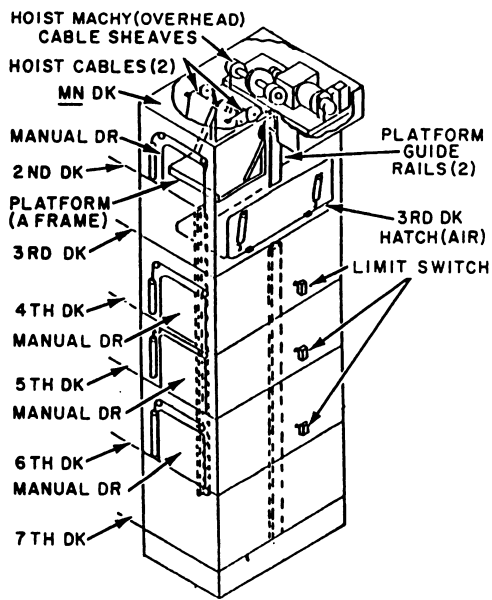


Figure 12-6.—Typical 5,000-pound lower-stage weapons elevator.

weapons elevator (fig. 12-6) services magazines and ammunition handling areas from the 7th-deck level up to and including the 2nd-deck level. The components of the elevator include an electrically powered multiple-drum winch, an elevator platform, an enclosed watertight vertical trunk having doors located at the levels and stations serviced, and a semiautomatic control system.

The platform is suspended, raised, or lowered within the vertical trunk by two wire ropes (steel cables) attached midpoint on either side of the platform. The opposite ends of the wire ropes are attached to the multiple-drum winch and platform-hoist machinery located in the overhead of the trunk. Guide rails are attached to either side of the trunk to maintain positive control of the platform during vertical movement. Rollers attached to the platform ride on tracks, preventing side-to-side or fore-and-aft movement.

To maintain continuity of the ship's armor box, the trunk has a ballistic hatch installed at the 3rd-deck level. Sections of the guide rails are attached to the underside of the hatch. The guide-rail sections align properly with the fixed guide rails when the hatch is opened. When the hatch is in the closed position, it breaks the continuity of the platform guide rails, and the platform is in the stow position above the 3rd-deck level. The ballistic hatch is watertight. It is manually dogged or undogged. It is pneumatically opened

or closed by a remote-dogging station through a series of linkages and gears. The hatch is electrically interlocked with the elevator controller to prevent elevator operation when the hatch has not been opened.

Elevator trunks are equipped with access doors at each deck level serviced by the elevator. In some cases, an elevator services more than one magazine on the same level. If so, more than one access door may be available at that level. Depending on the particular elevator installation, the access doors and dogging mechanisms may be manually or power operated.

Ballistic watertight doors are installed at all 2nd-deck stations. Depending on its location, a door is one of four different operating types—vertical sliding, down-to-open; vertical sliding, up-to-open; horizontal sliding; and overhead. Doors are opened and closed by hydraulic and air cylinders, or manually through an arrangement of pulleys and wire ropes.

Ramps are used to bridge the gaps in the door opening between the elevator platform and the deck. These allow you to load or unload the elevator platform using forklift trucks or wheeled skids.

Each lower-stage elevator is equipped with a broken-rope safety device, a down-speed governor device, and slack cable-sensing devices. The broken-rope safety device is mounted on the elevator platform assembly. If any one of the platform suspension ropes break, a roller-wedging mechanism automatically operates to lock the platform to the guide rails.

A counterweight-type governor device for limiting speed of elevator down travel is located in the upper end of the elevator trunk. The governor is operated by a wire rope connected to a lever of the broken-rope safety device on the elevator platform. Then, the rope is passed over the governor sheave and attached to the governor spooling drum on the hoisting winch. Excessive down speed causes the governor limit switch to shutoff the power to the hoist motor and electric brake. Loss of electric power causes the brake to automatically stop the elevator. If the brake fails to stop the elevator, the governor sheave grips the governor rope, causing the broken-rope safety device to stop the elevator.

A slack cable-sensing safety device is provided for each suspension rope and the governor rope. Located in the area between the winch drums and the overhead sheaves, these devices function by applying a spring-loaded follower roller to the wire rope. Rope slack causes a

proximity switch to shutoff electrical power to the hoisting winch motor and brake, stopping the elevator.

If the elevator overtravels upward beyond the maximum up-stop position, an overtravel-limit switch is actuated. This stops the elevator by shutting off power to the hoisting winch motor and brake.

If the elevator overtravels downward beyond the hold deck loading station level, the platform is stopped by spring bumpers in the bottom of the elevator trunk. The slack-cable switches are actuated to cutoff power to the hoisting winch motor and brake.

An operator-attended control panel is located next to all elevator doors. All operator control panels have a display of selector switches, push buttons, and indicator lamps suited for the control functions required at the station served. All control panels have an emergency stop-run switch from which all operations of the elevator can be stopped.

The main operator control panel and electrical power switch is located at the 2nd-deck level station. An elevator can be dispatched to another level from any operator control panel. The lower-stage elevator control system can dispatch the elevator to another level. However, it can't retrieve the elevator from another level.

SPECIAL ARMAMENT STOWAGE SPACE ELEVATORS (SASS).—The SASS elevators provide service from the special armament stowage spaces to the hangar deck. These elevators are essentially the same as the 5,550-pound lower-stage elevators with two major differences. The operator of the SASS elevator actually rides the platform from one level to another (personnel are strictly prohibited from riding the platform on all other weapons elevators). The SASS elevator also differs from the 5,500-pound elevator in that the trunk is provided with a hangar-deck hatch. When closed, the hatch becomes part of the hangar deck. The hatch is opened mechanically through the elevator control system. The hatch is lifted up into a horizontal position and moved rearward by rollers that ride on rails in the deck.

IWHS LOWER-STAGE WEAPONS ELEVATORS.—The IWHS lower-stage weapons elevator (fig. 12-7) services magazines and ammunition handling areas from the 7th-deck level up to and including the main deck (hangar deck). The IWHS is a highly sophisticated system controlled by a PDP-14 programmable controller that continually tracks the location of the

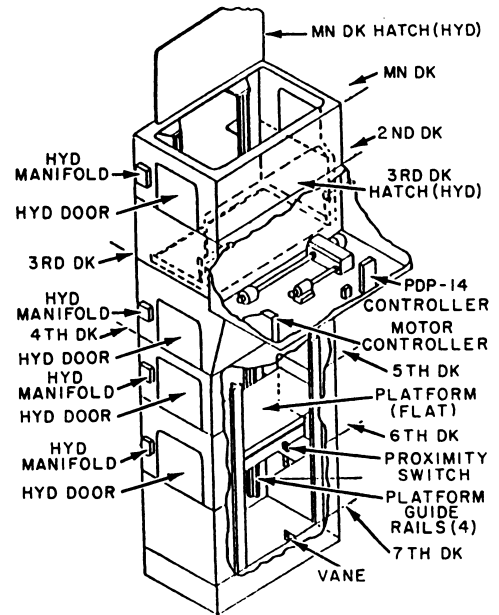


Figure 12-7.—Typical IWHS lower-stage weapons elevator.

platform to within one-twelfth of an inch. Because of the complexity of the IWHS, elevator operators and maintenance personnel are extensively trained in hydraulics, electricity, and electronics.

The platform is lifted by four cables attached at the corners. The platform machinery is located at the 3rd-deck level. The hatches are opened hydraulically. They are designed to automatically undog-open-latch and unlatch-close-dog. The elevator doors are also operated hydraulically.

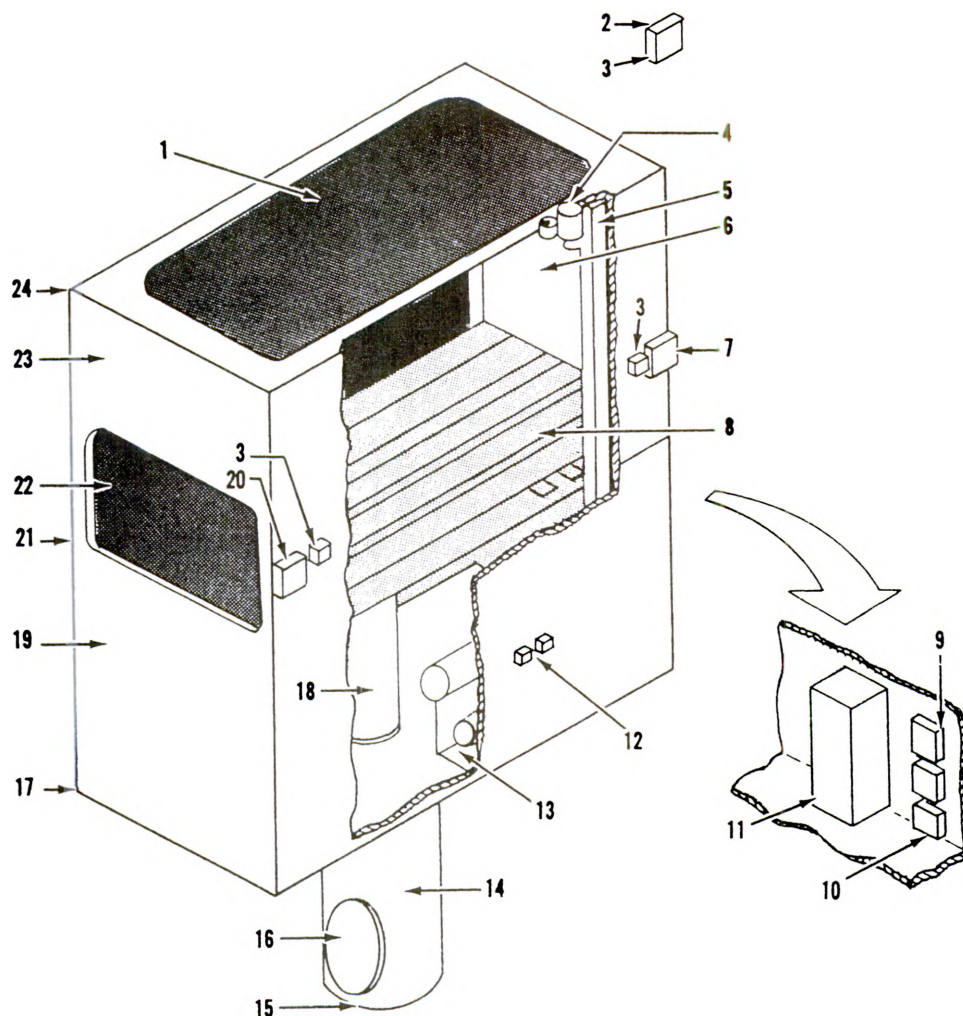
The IWHS incorporates the following safety features:

- An overspeed governor slack-cable device
- An overspeed governor device
- A hydraulic interlock to prevent two hatches from being opened at the same time
- A hydraulic interlock to prevent hatches from closing when dogs are in the dogged position
- An electrical interlock to prevent opening a magazine door unless the platform is at that level
- An electrical interlock to prevent opening more than one magazine door at a time
- A pressure switch to prevent operation of the elevator when the hydraulic pressure is below 1,200 psi

- An electrical interlock to prevent platform high-speed travel beyond the sequence-level slowdown switch
- An electrical interlock to prevent platform travel beyond the sequence level until the main-deck hatch is opened and latched
- An electrical interlock to prevent movement of the platform until the lockbars are fully retracted

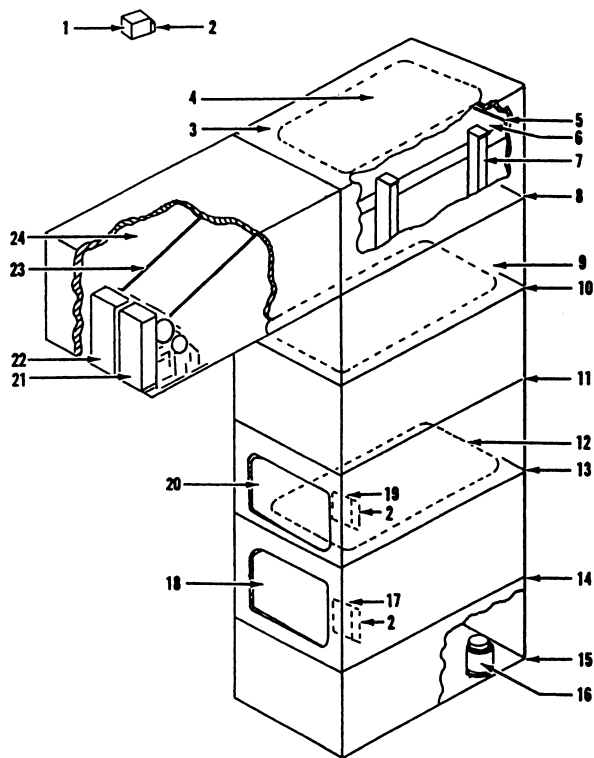
In addition to the operator controllers located at each access door and the 2nd-deck main controller, a portable main controller may be used at the main deck level. Normally, there is one IWHS installed forward to service the forward-magazine group and one installed aft to service the aft-magazine group. These elevators support the IRRP.

UPPER-STAGE HYDRAULIC ELEVATORS.—Upper-stage hydraulic elevators (fig. 12-8)



- | | | |
|----------------------------|--|--------------------------------|
| 1. Main deck hatch | 9. HYD plant motor magnetic controller | 17. 3rd-deck |
| 2. Main deck control panel | 10. PLATF CONVR motor MAG controller | 18. Hoisting cylinder assembly |
| 3. Call signal station | 11. Static control panel | 19. Machinery space |
| 4. Shock absorbers | 12. HYD plant motor master switch | 20. Remote control panel |
| 5. Guide rail | 13. HYD power unit assembly | 21. 2nd-deck |
| 6. FWD elevator door | 14. Hoisting cylinder enclosure | 22. Aft elevator door |
| 7. Master elevator door | 15. 4th-deck | 23. Elevator trunk |
| 8. Platform conveyor | 16. Hatch | 24. Main deck |

Figure 12-8.—Typical upper-stage hydraulic weapons elevator.



1. FLT DK control panel (gallery walkway)
2. Call signal station
3. Elevator trunk
4. FLT DK hatch
5. Flight deck
6. Elevator platform
7. Guide rail
8. 03 level
9. 02 level
10. 02 level
11. 01 level
12. Main deck aft hatch
13. Main deck
14. 2nd-deck
15. 3rd-deck
16. Shock absorber
17. 2nd-deck control panel
18. 2nd-deck aft elevator door
19. Main deck aft control panel
20. Main deck aft elevator door
21. Elevator hoist motor magnetic controller
22. Elevator static control panel
23. Hoisting machine assembly
24. Machine space

Figure 12-9.—Typical upper-stage wire-rope weapons elevator.

are used to transport weapons between the second deck and the main deck only. The major components of each elevator are an enclosed watertight vertical trunk, an elevator platform assembly, a hydraulic power plant system, and a semiautomatic elevator control system.

If an excessive elevator downspeed occurs, an overspeed valve closes and stops the elevator. The overspeed valve is mounted on the lower end of the lifting ram hydraulic cylinder assembly.

UPPER-STAGE WIRE-ROPE ELEVATORS.—The upper-stage wire-rope elevators (fig. 12-9) are the only weapons elevators in the system that provide weapons transportation to the flight deck. The second deck is the lowest level served by the upper-stage elevators. The equipment of upper-stage wire-rope elevators are either similar or identical to those of lower-stage wire-rope elevators. The following discussion describes the difference between upper- and lower-stage wire-rope elevators.

The elevator trunk enclosure extends from the 3rd deck to the underside of the flight deck. Power-operated ballistic hatches in the main deck, 02 level, and flight deck allow passage of the elevator platform, and they maintain ballistic integrity within the trunk. There are power-operated doors in the trunk for elevator loading and unloading.

So the elevator platform can be raised flush with the flight deck, the wire-rope attachment points are on extensions of the platform structure, placing them below the main hoisting sheaves. An arrangement of hoisting and idler sheaves in the upper end of the elevator trunk allows the platform to be raised flush with the flight deck. Safety devices of upper-stage elevators are essentially identical to those for lower-stage elevators.

Control equipment for upper-stage elevators are essentially identical to those for lower-stage elevators. Operator control panels are located at each station served.

Weapons Elevator Maintenance and Safety

The weapons department is responsible for maintaining all weapons elevators aboard aircraft carriers. As an AO, you will perform preventive maintenance and repair elevator systems. The

SYSTEM COMPONENT IDENTIFICATION		DATE TIME
POSITION OR CONDITION OF ITEM TAGGED		
DANGER		
DO NOT OPERATE		
SERIAL NO.	SIGNATURE OF PERSON ATTACHING TAG	SIGNATURES OF PERSONS CHECKING TAG
	SIGNATURE OF AUTHORIZING OFFICER	SIGNATURE OF REPAIR ACTIVITY REPRESENTATIVE
<small>NAVSHIPS 9000-0-1000 1 IF FRONT 1 IF FORMERLY NAVSHIPS 90001 5 IN 0105-041-0000</small>		

FRONT

DANGER	
DO NOT OPERATE	
OPERATION OF THIS EQUIPMENT WILL ENDANGER PERSONNEL OR HARM THE EQUIPMENT. THIS EQUIPMENT SHALL NOT BE OPERATED UNTIL THIS TAG HAS BEEN REMOVED BY AN AUTHORIZED PERSON.	

BACK

Figure 12-10.—Danger tag.

IWHS elevators are located close to the 5,500-pound elevators. Consequently, the same personnel are required to operate, maintain, and troubleshoot both types of elevators, even though they differ significantly in design and level of sophistication.

Although the primary responsibility of elevator maintenance rests with the AO, some maintenance procedures require the assistance of personnel within other ratings such as Machinist Mate (MM) and Electricians Mate (EM). When this requirement exists, it is noted on the PMS card.

All electrical power requirements for the weapons handling system come from the ship's service 440-volt, three-phase, 60-hertz power supplied throughout the system. Ship's service power is converted to other ac and dc voltages by either the controllers or control panels to meet system equipment requirements.

For the safety of maintenance personnel, the tag-out and tag-in system has been established. The steps within this system are standardized throughout the Navy. The following procedures are general in nature. You should comply

SYSTEM COMPONENT IDENTIFICATION		DATE TIME
SIGNATURE OF PERSON ATTACHING TAG		SIGNATURE OF PERSON CHECKING TAG
CAUTION		
DO NOT OPERATE THIS EQUIPMENT UNTIL SPECIAL INSTRUCTIONS ON REVERSE SIDE ARE THOROUGHLY UNDERSTOOD.		
SERIAL NO.	SIGNATURE OF AUTHORIZING OFFICER	SIGNATURE OF REPAIR ACTIVITY REPRESENTATIVE
	<small>NAVSHIPS 9000-0-1000 1 IF FRONT 1 IF FORMERLY NAVSHIPS 9000</small>	

CAUTION	DO NOT OPERATE THIS EQUIPMENT UNTIL SPECIAL INSTRUCTIONS BELOW ARE THOROUGHLY UNDERSTOOD.	<small>NAVSHIPS 9000-0-1000 1 IF FRONT 1 IF FORMERLY NAVSHIPS 9000</small>
----------------	---	--

Figure 12-11.—Caution tag.

with your ship's tag-out procedure to ensure safety.

1. Identify all components that must be tagged-out. A list of these components is included on your PMS card for the particular maintenance action being performed. If it is a repair action not covered by a PMS card, use the system diagrams and circuit schematics to ensure completeness of the tag-out.

2. Fill out enough DANGER tags (fig. 12-10) and CAUTION tags (fig. 12-11) to completely isolate the equipment being worked on.

3. Fill out the DANGER/CAUTION Tag-out Record Sheet (figs. 12-12 and fig. 12-13). This sheet identifies all tags used in the tag-out procedure.

4. Have a qualified petty officer examine the PMS cards and diagrams or schematics to ensure that the tag-out is complete and correct. The qualified PO signs the tag-out record sheet to certify that an independent check has been made.

5. The authorizing officer signs the tags and the tag-out record sheet. This officer ensures that the tags requested and the persons requesting the tag-out adequately isolate the equipment to be repaired. If the system will be out of commission as a result of the tag-out, the authorizing officer obtains prior permission from the commanding officer and the appropriate department head.

NAVSEA 9210/9 (S-76) (FRONT) **DANGER/CAUTION TAG-OUT RECORD SHEET**
(Formerly NAVSHIPS 9890/9)

SYSTEM OR COMPONENT	LOG SERIAL NUMBER
DATE/TIME TAG-OUT ISSUED	NUMBER OF EFFECTIVE TAGS
REASON FOR TAG-OUT	
PERSONNEL/EQUIPMENT HAZARDS INVOLVED <i>(Mandatory for DANGER Tags)</i>	
AMPLIFYING INSTRUCTIONS <i>(Mandatory for CAUTION Tags)</i>	
WORK NECESSARY TO CLEAR TAG(S) <i>(Including Tests)</i>	

INDEPENDENT TAG COVERAGE CHECKS MADE BY	REPAIR ACTIVITY REPRESENTATIVE <i>(When Appropriate)</i>
PETTY OFFICER IN CHARGE OF WORK _____ <i>(Signature)</i>	_____ <i>(Signature)</i>
SECOND PERSON _____ <i>(Signature)</i>	OFFICER AUTHORIZING TAG(S) <i>(Watch/Duty Officer)</i> _____ <i>(Signature)</i>

OPERATIONS/WORK ITEMS INCLUDED IN TAG-OUT

APPLICABLE DOCUMENTATION <i>(i.e., Job Order, Rip-Out, O/P, etc.)</i> NUMBER & TITLE	ADDITIONAL TAG NUMBERS*	DATE/TIME* ADDED	PETTY OFFICER IN CHARGE*	AUTHORIZING OFFICER*	WORK COMPLETE	DATE
			SECOND PERSON <i>(Signature)*</i>	REPAIR ACTIVITY REP. <i>(when appropriate)*</i>	AUTHORIZING OFFICER REPAIR ACTIVITY REP. <i>(when appropriate)</i>	

Continue on Additional Sheet
(Check Box if Applicable)

**For added work items only, where not applicable fill in "N/A"*

Figure 12-12.—Danger/ Caution tag-out record sheet (front).

Ship's service sound-powered telephones are located at each operator control station. They are used to supplement weapons handling system control indicators and coordinate operations between various deck levels. An elevator must not be dispatched from one deck to another until communications between the sending operator and receiving operator have been established.

In addition to OJT, most commands require that all personnel operating elevators possess a valid operators license. The license should reflect the type(s) of elevator(s) the individual is authorized to operate. For example, an operator may be authorized to operate all elevator systems at any control station, or an individual with less training may only be authorized to operate the 5,500-pound elevator systems at any station except the 2nd-deck main control station.

REVIEW NUMBER 3

- Q1. *What decks are serviced by lower-stage elevators?*
- Q2. *What device is used to bridge the gap in the door opening between an elevator platform and the deck?*
- Q3. *If an elevator suspension rope breaks, what mechanism automatically operates to lock the platform to the guide rails?*
- Q4. *If an elevator overtravels upward beyond the maximum up-stage position, what device actuates, stopping the elevator and shutting off power to the hoisting winch?*
- Q5. *Upper-stage elevators are used _____.*
- Q6. *What decks are serviced by IWHS lower-stage elevators?*

- Q7. *The platform machinery for an IWHS lower-stage elevator is located on the _____ deck.*
- Q8. *The only weapons elevators that provide access to the flight deck are the _____.*
- Q9. *The primary responsibility for maintaining weapons elevators belongs to the _____ rate.*
- Q10. *What electrical power is required to operate the weapons elevators?*

WEAPONS MOVEMENT

The movement of ammunition consists of routine operations such as intramagazine movement and movement of weapons and components in support of flight operations. It may also consist of major evolutions such as ship rearmament or major loading and off-loading operations. Regardless of the size of the operation, anytime weapons or explosives are removed from their proper stowage environment, the opportunity for the occurrence of an ordnance mishap is much greater. Therefore, one of the most important factors of any ordnance evolution is preplanning. Additionally, a safety-first attitude must be paramount.

Weapons Movement in Support of Flight Operations

To enable squadron personnel to meet the short turnaround time of the flight schedule requirements, weapons must be preassembled and located in staging areas on the hangar deck with sufficient lead time.

The area of the hangar deck that is to be used as a weapons staging area must be coordinated with the hangar-deck control officer. The weapons can't interfere with the movement of aircraft or obstruct fire lanes, but they must be positioned so they are protected by the hangar-bay sprinkler system. This area should be located as close as possible to the aircraft elevator doors

to provide a means for jettisoning the weapons overboard in the event of an emergency. Anytime live ordnance is staged on the hangar deck, a security watch must be posted to restrict the area to authorized personnel only and to initiate movement of the weapons in case of an emergency.

The weapons staging area on the flight deck is located outboard of the island structure and inboard of the catwalk or deck edge. This area is commonly called the bomb farm. Anytime live ordnance is present, this area is manned by the bomb-farm watch. Bomb-farm watch personnel maintain direct communication with the aviation ordnance control station (AOCS). In addition to security of the ordnance, the bomb-farm watch issues ordnance to squadron personnel according to the ship's ordnance load plan.

The bomb-farm staging area also incorporates an emergency jettison ramp. The emergency

jettison ramp, when in the rigged position (down), forms a ramp from the flight deck edge to an opening in the outboard bulkhead of the catwalk. This provides a path for jettisoning weapons overboard during an emergency. Additionally, jettison ramps are located fore and aft on the port and starboard sides of the flight deck so weapons can be jettisoned by aircraft loading crews during an emergency. Be careful when the emergency jettison ramps are rigged; they bypass the catwalk and safety net. When the ramps are in the stowed (raised) position, they form part of the catwalk structure.

The bomb farm is routinely replenished with weapons from the hangar deck staging area between the launch and recovery of aircraft. The weapons are transported from the hangar deck to the flight deck by the upper-stage weapons elevators or deck-edge aircraft elevators.

REVIEW NUMBER 3 ANSWERS

- A1. *The 2nd through 7th decks are serviced by lower-stage elevators.*
- A2. *A movable ramp is used to bridge the gap in the door opening between an elevator platform and the deck.*
- A3. *If an elevator suspension rope breaks, a broken-rope safety device automatically operates to lock the platform to the guide rails.*
- A4. *If an elevator overtravels upward beyond the maximum up-stage position, an overtravel limit switch actuates, stopping the elevator and shutting off power to the hoisting winch.*
- A5. *Upper-stage elevators are used to transport weapons between the 2nd and main decks.*
- A6. *The 7th through the main decks are serviced by IWHS lower-stage elevators.*
- A7. *The platform machinery for an IWHS lower-stage elevator is located on the 3rd deck.*
- A8. *The only weapons elevators that provide access to the flight deck are the upper-stage wire-rope elevators.*
- A9. *The primary responsibility for maintaining weapons elevators belongs to the AO rate.*
- A10. *The electrical power required to operate the weapons elevators is 440-volt, three-phase, 60-Hz power.*

Weapons Onload/Offload

There are three situations in which an aircraft carrier normally conducts weapons onload or offload operations—pier side, offshore at anchorage, or at sea. The location of the ship during onload or offload operations affects manpower, equipment, time, and the degree of safety requirements.

PIER SIDE.—Handling large quantities of explosive munitions at piers is limited to those designated by NAVSEASYSKOM as explosive piers. The pier area is restricted during ammunition and explosive loading and offloading operations. Nonessential personnel (visitors) aren't permitted access to the ship or pier area. All privately owned vehicles, ship's vehicles, and assigned government transportation are prohibited on a pier where ammunition is being handled. Before loading or offloading operations, the OOD is notified. The OOD makes sure that a red flag is prominently displayed to indicate that an ordnance evolution is in progress.

Pier-side ammunition handling operations are restricted to daylight hours, except in an emergency. Emergency operations can only be carried out at an adequately lighted pier. An emergency may be dictated by the ship's sailing schedule or by NAVSEASYSKOM. Therefore, ammunition isn't staged on the pier in large quantities. Close coordination is established between the ship's weapons department and the station's weapons department to ensure that the rate of delivery at the pier doesn't exceed the handling rate of the ship's ordnancemen.

EXPLOSIVE ANCHORAGE.—At times, loading or offloading large quantities of ammunition and explosives at the pier is not practical or feasible. For example, a ship may be located at a pier that has a restricted explosive load limit due to the geographical location of other ships or occupied structures. It could also be due to the geographical location of shore-based ammunition-handling facilities. For example, an aircraft carrier may be docked in Norfolk, Virginia, and the activity receiving or issuing the ammunition may be located in Charleston, South Carolina. In this situation, the most practical method would be to locate the aircraft carrier at a designated explosive anchorage (commonly called whiskey anchorage) and transport the ordnance by lighters and/or barges. The transfer of ammunition between the ship and the lighters/barges is

normally accomplished by the use of a floating crane.

Even though a ship is located at an explosive anchorage, transferring ammunition is restricted to daylight hours. Normally, the ship remains at anchorage until the entire evolution is completed, which may vary from 1 to 5 days.

TRANSFER OF AMMUNITION AT SEA.—

The transfer of ammunition at sea (underway) presents problems not met by pier-side or anchorage operations. Normally, replenishment at sea involves the transfer of fuel, supplies, stores, and ammunition simultaneously. Obviously, available deck space, available handling equipment, and manpower is used to the maximum efficiency. Every detail of the entire operation is preplanned and coordinated between the departments involved within the ship and the individuals within the departments.

The transfer of ammunition at sea is accomplished by conventional replenishment (CONREP) and/or vertical replenishment (VERTREP) methods. The CONREP method consists basically of a steel cable rigged between the supply ship and the receiving ship at the hangar-deck level. These points of contact are called conning stations, and there may be more than one conning station in operation at the same time. Cargo is attached to the cable, using approved handling equipment and conveyed from one ship to the other. The AO is only responsible for ammunition items. You position each ammunition load at the conning station for transfer. As the ammunition loads are received at the conning station, you move the load to a designated staging area until it is struck below. The operation of conning equipment is normally performed by the ship's deck department.

In the VERTREP method, helicopters using slings and/or cargo nets transfer the ammunition to or from the supply ship. VERTREP operations are conducted on the flight deck. Aviation ordnancemen are responsible for handling all ammunition and preparing and positioning empty slings and ammunition details for transfer to the supply ship. Ammunition is transferred from the flight deck to the hangar deck by a designated aircraft elevator. This elevator is normally on the port side when CONREP and VERTREP operations are being conducted simultaneously.

REVIEW NUMBER 4

- Q1. The weapons staging area on the flight deck located between the island and the starboard catwalks is known as the _____.*
- Q2. Under what conditions is a pier-side weapons movement of ammunition loaded onto an aircraft carrier?*
- Q3. List the methods used to transfer ammunition at sea.*
- Q4. When VERTREP is being used to transfer ammunition between ships, transfer is accomplished by _____.*

AMMUNITION STORAGE ASHORE

Learning Objective: Identify ammunition magazines used ashore. Recognize the quantity-distance requirements. Recognize the hazards posed by various classes of ammunition. Identify storage capability groups and their use. Identify the facilities used to store ammunition at advanced bases.

All units of the Naval Shore and Marine Corps Establishments that produce, store, ship, or otherwise handle ammunition, explosives, and other hazardous materials are under the management and control of NAVSEASYSKOM. Also, NAVSEASYSKOM manages and controls the technical aspects of assembling, maintaining, surveilling, storing, issuing, shipping, and handling ammunition, explosives, or other hazardous materials.

MAGAZINES

Explosives and ammunition are stowed in magazines or areas designated for the specific

materials. NAVSEASYSKOM designs and designates all magazines or storage areas. The type and amount of material that may be stowed in any magazine depends on the type of magazine in relation to the quantity-distance requirements.

Types of Magazines

Magazines located at naval air stations and other naval installations are of various sizes, types of construction, and classes depending upon the nature of the material to be stowed. Magazines are designated as high-explosive magazines, smokeless-powder magazines, and ready-service magazines according to their intended use. Magazines are further classified by type of design—surface, subsurface, arch-type, earth-covered, or barricaded.

Recently designed magazines used to store smokeless powder, pyrotechnics, loaded projectiles, fixed ammunition, small-arms ammunition, and other fire or missile hazard materials are of two general types—the rectangular earth-covered magazine and the concrete triple-arch, earth-covered magazine.

1. The rectangular earth-covered magazine (50 feet by 100 feet) is constructed of reinforced concrete throughout.

2. The concrete triple-arch, earth-covered magazine has three arches. The combined arches make up a single magazine; however, each arch is separated by a minimum of 10 feet at the door, and the space is filled with dirt. The standard floor size of each arch in the triple-arch construction is 25 feet by 80 feet. Each of the three arches may be used for a different type of compatible material.

Magazines constructed since 1928 used for storing high-explosive, bomb-type ammunition, and other explosive hazard materials are of reinforced concrete, single-arch, earth-covered type construction, and they are barricaded at the entrance end. These magazines have been constructed in three sizes:

1. The 25 feet by 50 feet and the 25 feet by 40 feet sizes are suitable for the stowage of 250,000 pounds net weight of explosives.

2. The 25 feet by 80 feet size is suitable for the stowage of 500,000 pounds net weight of explosives.

Table 12-2.—United Nations Organization Hazard Classes

CLASS	TYPE OF HAZARDOUS MATERIAL
1	Ammunition and explosives, DOT Classes A, B and C; Blasting Agents
2*	Compressed gases, flammable and nonflammable, Poison gases (Poison A)
3	Flammable liquids
4	Flammable solids or substances
5	Oxidizing materials
6*	Poisonous substances (Poison B); Irritating materials; Etiological agents
7	Radioactive materials
8	Corrosive materials
9	Miscellaneous dangerous substances (other regulated materials)

*Includes ammunition without explosive components which contain toxic chemical agents, and containers of toxic chemical agents in bulk. Formerly Q-D Class 8.

Additionally, the following miscellaneous types of magazines may be found at certain establishments.

KEYPORT. The keyport magazine is earth-covered and arch-shaped with a prefabricated concrete construction. It has interior floor dimensions of 6 feet by 8 feet 8 inches. The height of the arch is approximately 6 feet.

BOX. A box magazine is of concrete construction, rectangular shape, and normally measures 12 feet by 17 feet.

CORBETTA. A corbetta magazine is of concrete construction and is shaped like a beehive or dome.

GALLERY. A gallery magazine is a tunnel or cave, and the dimensions will vary.

MISCELLANEOUS OR NONSTANDARD. The physical dimensions of the miscellaneous or nonstandard magazine depends on the type of stowed material and the location of the magazine.

OPEN STORAGE (REVETTED). The type and amount of explosives stowed in open storage (revetted) depends on the size and location of the storage area.

Quantity-Distance (Q-D) Requirements

Quantity-distance (Q-D) requirements apply to the concentration of ammunition, explosives, and other hazardous materials at Naval Shore Establishments for development; manufacturing; test and maintenance; storage, loading and off-loading of vehicles, railcars and aircraft; disposal; and all related handling incidents.

Quantity-distance (Q-D) requirements are based on records of actual fires and explosions involving ammunition and explosives. Q-D requirements safeguard personnel against possible serious injury or equipment destruction from possible fires or explosions. These requirements also protect the inhabitants of nearby communities, private and public property, and the Naval Shore Establishment personnel. These requirements keep the loss of valuable ammunition stores (including inert ordnance items) to a minimum if there were a fire or explosion.

The Department of Defense (DOD) Q-D hazard classification system is based on a system recommended for international use by the United Nations Organization (UNO). The UNO system has nine classes of hazardous material; but, DOD only uses three of the nine classes—Class 1, explosives; Class 2, Division 3, poison A; and Class 6, poisonous (toxic) and infectious substances. Table 12-2 identifies each of the nine classes.

In reviewing table 12-2, you can see that some items are placed in classes other than Class 1. Since DOD uses only Class 1 items for explosives, Class 1 assignments have been made. For example, fuel-air-explosive (FAE) weapons without properly installed explosive components belong in UNO Class 3, while WP M23 igniters belong in UNO Class 4. However, to maintain identity, DOD places these items in Class 1 for storage only until DOD implements other classes. As an AO, you are involved with the storage of Class 1 material; therefore, the information contained in this section only deals with Class 1 classifications.

DOD Hazard Class 1 is subdivided into divisions 1 through 5, based on the character and predominance of the associated hazards and the potential for causing personnel casualties or property damage. These subdivision are not based upon compatibility groups or intended use. The divisions within Class 1 and the expected hazard for each division is listed in table 12-3.

MASS-DETONATING HAZARD MATERIALS (CLASS 1, DIVISION 1).—Damage from mass-detonating hazard materials is caused by concussion or blast or by sympathetic detonation. Prescribed distances between piles of these materials and between magazines containing these materials must be maintained to minimize the possibility of sympathetic detonation or propagation. Ammunition and explosives that are considered mass-detonating hazards are Hazard Class 1, Division 1.

Table 12-3.—Hazard Class 1 Division Designators and Types of Hazards

DIVISION DESIGNATOR	TYPE OF HAZARD
1	MASS DETONATING
2	NON-MASS DETONATING, FRAGMENT PRODUCING
3	MASS FIRE
4	MODERATE FIRE, NO BLAST
5	MASS FIRE

NONMASS-DETONATING HAZARD, FRAGMENT-PRODUCING MATERIALS (CLASS 1, DIVISION 2).—The principal hazards for items within this division are fragment and blast, either individually or in combination, depending on such factors as storage configuration, type of packing, and quantity. The designated minimum distances are based upon the limited range of fragments. These are the distances that must be used for protection of inhabited buildings and public traffic routes. Since fragment-producing materials can be grouped according to the range of the fragments produced, four fragment distance categories have been established. This permits flexibility of storage. Most fragments produced by incidents in this division will fall within one of four specified minimum distances—400, 800, 1,200, and 1,800 feet.

REVIEW NUMBER 4 ANSWERS

- A1. *The weapons staging area on the flight deck located between the island and the starboard catwalks is known as the bomb farm.*
- A2. *A pier-side weapons movement of ammunition loaded onto an aircraft carrier is authorized in emergency situations when authorized by NAVSEASYSKOM or to conform to the ship's sailing schedule.*
- A3. *Conventional replenishment (CONREP) and vertical replenishment (VERTREP) are used to transfer ammunition at sea.*
- A4. *When VERTREP is being used to transfer ammunition between ships, transfer is accomplished by helicopters using slings or cargo nets.*

MASS FIRE HAZARD MATERIALS (CLASS 1, DIVISION 3).—Items in this division burn vigorously. There is little or no possibility for extinguishing them in a storage situation. Normally, explosions will be confined to pressure ruptures of containers and will not produce propagating shock waves or damaging blast overpressure beyond specified distances. A severe fire may result from the tossing about of burning container materials, propellant, or other flaming debris. Toxic effects, such as burning pyrotechnic items, will not normally extend beyond the inhabited building distances specified for this division.

MODERATE FIRE HAZARD, NO BLAST MATERIALS (CLASS 1, DIVISION 4).—Items in this division present a fire hazard with no blast hazard and virtually no fragmentation or toxic hazard beyond the fire hazard clearance specified for high-risk materials. However, separate facilities for storage and handling of this division should not be less than 100 feet from other facilities. However, if the facilities are of fire-resistant construction, they may be 50 feet from each other. If devices containing explosives are such that accidental ignition during storage or transport will not cause external damage to the devices, either by fire, smoke, heat, loud noise, or by visible damage to the outer packaging, they are not considered Class 1 items. These devices may be considered inert for storage purposes and marked **AMMUNITION NON-EXPLOSIVE** for transport purposes. Certain articles within the division that contain one ounce or less of explosives have (based on test results) been classified as Class 1, Division 4S. These articles may be considered inert for storage purposes, and they are not subject to explosive transportation regulations. Articles containing larger quantities of explosives, also classified as Class 1, Division 4S, may be considered inert for storage purposes. However, they must be reviewed on an individual basis to determine whether explosive transportation regulations are applicable.

VERY INSENSITIVE EXPLOSIVE ITEM MATERIALS (CLASS 1, DIVISION 5).—Items in this division are considered very insensitive when not stored or transported with other Class 1 materials. DOD considers these items to be the same as Class 1, Division 1, Compatibility Group D. There is very little probability of accidental explosion or transition from deflagration to detonation. The materials within this division are

shipped as Q-D Hazard Class 1, Division 5. They are stored as Class 1, Division 1, Compatibility Group D.

Normally, technical manuals do not present the hazard class, division, and compatibility group as they are written in previous paragraphs. For example, an item classified as Class 1, Division 5, Compatibility Group D, is written as Class 1.5D; or for an item in Class 1, Division 4, Compatibility Group S is written as Class 1.4S.

Look at figure 12-15. It shows Q-D information about Class 1.1 items. As you read this paragraph, refer to figure 12-15. Col 1 and Col 2 lists the minimum and maximum (respectively) net explosive weight to be stowed. For example, if you are stowing Class 1 Division 1 explosives with a net explosive weight of 13,000 pounds, you find the minimum net explosive weight in Col 1 (10,000 pounds) and the maximum net explosive weight in Col 2 (15,000 pounds); then, read horizontally across the page to obtain the distance requirements. Columns 3, 4, and 5 list the minimum distance, in feet, from the storage site (in this case a standard earth-covered magazine) to an inhabited building. If the net explosive weight is 13,000 pounds, the minimum distance from the front or side of the magazine to the closest inhabited building is 865 feet (Col 3). The minimum distance from the rear of the magazine to an inhabited building is 615 feet (Col 4). The minimum distance from the magazine to other potential explosive sites (PES) is 900 feet. Columns 6, 7, and 8 list the minimum distance, in feet, from the magazine to public traffic routes. It is read in the same manner as Columns 3, 4, and 5.

The Q-D hazard requirements do not apply to ammunition and explosives while in transit. Ammunition and explosives in transit are regulated by the Department of Transportation (DOT). The Q-D hazard classifications do not necessarily mean that all ammunition and explosives within a classification can be stowed in the same magazine. All ammunition and explosives listed as Class 1, Division 1 explosives may not be compatible when stowed together. For example, assembled HE rockets and GP bombs are classified as Class 1, Division 1 explosives, but they aren't compatible when stored together. NAVSEA OP 5, volume 2, contains a listing, by DOD Q-D hazard class, of naval ammunition and explosives.

NEW		Distance in Feet to Inhabited Building			Distance in Feet to Public Traffic Route		
Over	Not Over	From		Other PES	From		Other PES
		Standard Earth-Covered Magazine ⁽⁴⁾			Standard Earth-Covered Magazine ⁽⁴⁾		
		Front or Side	Rear		Front or Side	Rear	
Col 1	Col 2	Col 3	Col 4	Col 5	Col 6	Col 7	Col 8
0	1	35	25	40	21	15	24
1	2	44	32	50	26	19	30
2	5	60	43	69	36	26	40
5	10	75	54	87	45	32	52
10	20	95	68	110	57	41	65
20	30	110	78	125	65	47	75
30	40	120	86	140	72	51	83
40	50 ⁽³⁾	130	92	150	77	55	89
50	100	160	115	190	97	70	115
100	200	205	145	235	125	88	140
200	300	235	165	270	140	100	160
300	400	260	185	295	155	110	175
400	500	280	200	320	165	120	190
500	600	295	210	340	175	125	205
600	700	310	220	355	185	135	215
700	800	325	230	375	195	140	225
800	900	340	240	390	205	145	235
900	1,000	350	250	400	210	150	240
1,000	1,500	400	285	460	240	170	275
1,500	2,000	440	315	505	265	190	305
2,000	3,000	505	360	580	305	215	350
3,000	4,000	555	395	635	335	240	380
4,000	5,000	600	430	685	360	255	410
5,000	6,000	635	455	730	380	275	440
6,000	7,000	670	480	770	400	285	460
7,000	8,000	700	500	800	420	300	480
8,000	9,000	730	520	835	435	310	500
9,000	10,000	755	540	865	450	325	520
10,000	15,000	865	615	990	520	370	595
15,000	20,000	950	680	1,090	570	405	655
20,000	25,000	1,025	730	1,170	615	440	700
25,000	30,000	1,085	775	1,250	650	465	745
30,000	35,000	1,145	820	1,310	685	490	785
35,000	40,000	1,195	855	1,370	720	515	820
40,000	45,000	1,245	890	1,425	745	535	855
45,000	50,000	1,290	920	1,475	775	555	885
50,000	55,000	1,330	950	1,520	800	570	910
55,000	60,000	1,370	980	1,565	820	585	940
60,000	65,000	1,405	1,005	1,610	845	605	965

Figure 12-15.—Quantity-distance requirements for Class 1, Division 1 items (example).

Storage Compatibility Groups

Ammunition and explosives are assigned to one of twelve storage compatibility groups (A through H, J, K, L, and S).

GROUP A. Group A items are initiating explosives. These are bulk initiating explosives that have the necessary sensitivity to heat, friction, or percussion to make them suitable for use as initiating elements in an explosive train.

Wet lead oxide, wet lead styphnate, wet mercury fulminate, wet tetracene, dry RDX, and dry PETN are examples of initiating explosives.

GROUP B. Group B items are detonators and similar initiating devices. These are items containing explosives that are designed to initiate or continue the functioning of an explosive train. Detonators, blasting caps, small arms primers, and fuzes without two or more safing features are examples of Group B items.

GROUP C. Group C items are bulk solid propellants, propelling charges, devices containing propellant with or without a means of ignition, and items that will deflagrate, explode or detonate upon initiation. Examples of Group C items are single-, double-, and triple-base propellants, composite propellants, rocket motors (solid propellant), and ammunition with inert projectiles.

GROUP D. Group D items are black powder, high explosives (HE), ammunition containing HE without its own means of initiation and without propelling charges, and fuzes with two or more safing features. This group includes ammunition and explosives that may explode or detonate when any given item or component is initiated. Also included in this group is ammunition with an initiating device that is packaged to eliminate the risk of ammunition detonation if accidental functioning of the initiating device occurs. The initiating function is confined within the package unless the package has been degraded by fire. In this case, all blast or projection effects are limited to the extent that they will not significantly hinder fire fighting. Examples of these items are thermal batteries, explosive switches or valves, and other ammunition items packaged to meet the criteria established for this group.

GROUP E. Group E items are ammunition that contains HE without its own means of initiation with a propulsive charge (other than one containing a flammable or hypergolic liquid). Examples of these items are artillery ammunition, rockets, and guided missiles.

GROUP F. Group F items are HE ammunition with means of initiation other than described in Group D, with a propelling charge (other than one containing a flammable or hypergolic liquid) or without a propelling charge. This group includes HE ammunition or devices (fuzed) with or without propelling charges. Examples are items initiated by means of a bouchon firing device, grenades, sounding devices, and similar items having an in-line explosive train in the initiator.

GROUP G. Group G items are fireworks, and illuminating, incendiary, smoke (including HC) or tear-producing munitions other than those munitions that are water activated or contain white phosphorus, flammable liquid or gel. This group includes ammunition that, upon functioning, results in an incendiary, illumination,

lachrymatory, smoke, or sound effect. Examples of these items are flares, signals, incendiary or illuminating ammunition, and other smoke or tear-producing devices.

GROUP H. Group H items contain explosives and white phosphorus or other pyrophoric material. Ammunition in this group contains a filler, which is spontaneously flammable when exposed to the atmosphere. Examples of these items are WP, PWP, or other ammunition containing pyrophoric material.

GROUP J. Ammunition in this group contains both explosives and flammable liquids or gels. This ammunition contains flammable liquids or gels other than those that are spontaneously flammable when exposed to water or to the atmosphere. Examples of these items are liquid- or gel-filled incendiary ammunition, FAE devices, flammable-fueled missiles and torpedoes.

GROUP K. Ammunition in group K contains both explosives and toxic chemical agents. Ammunition in this group contains chemicals specifically designed for incapacitating effects that are more severe than lachrymation. Examples of these items are artillery or mortar ammunition (fuzed or unfuzed), grenades, and rockets or bombs filled with a lethal or incapacitating chemical agent.

GROUP L. Ammunition in Group L is not included in other compatibility groups. Ammunition in this group has characteristics that don't permit storage with other types of ammunition, explosives, or dissimilar ammunition within this group. Examples of these items are water-activated devices, prepackaged hypergolic liquid-fueled rocket engines, certain fuel-air-explosive (FAE) devices, TPA (thickened TEA), and damaged or suspect ammunition of any other group. Types of ammunition having similar hazards can be stored together but cannot be mixed with other groups.

GROUP S. Ammunition in this group presents no significant hazard. It is designed or packed so all the accidental functioning hazards are confined within the package, unless the package has been degraded by fire. In this case, all blast or projection effects are limited to the extent they will not significantly hinder fire-fighting operations. Examples of these items are thermal batteries, explosive switches or valves, and other ammunition items that are packaged to meet the criteria established for this group.

GROUPS	A	B	C	D	E	F	G	H	J	K	L	S
A	X	Z										Z
B	Z	X										X
C			X	Z	Z		Z					X
D			Z	X	X							X
E			Z	X	X							X
F						X						X
G			Z				X					X
H								X				X
J									X			X
K										Z		
L												
S	Z	X	X	X	X	X	X	X	X			X

NOTES:

1. The marking "X" at an intersection of the above chart indicates that these groups may be combined in storage. Otherwise, mixing is either prohibited or restricted per note 2 below.
2. The marking "Z" at an intersection of the above chart indicates that, when warranted by operational considerations or magazine non-availability, and when safety is not sacrificed, logical mixed storage of limited quantities of some items of different groups may be combined in storage as approved by NAVSEASYSKOM. Approval is not to be considered a waiver. Combinations that violate the principles of paragraph 2-3.3 require justification by a waiver or exemption. Examples of acceptable combinations of Class 1 are:
 - a. Division 1, Group C bulk propellants with Division 1 bulk HE.
 - b. Division 1, Group C rocket motors with Division 1, Group D bombs (HE) without their own means of initiation.
 - c. Group C rocket motors with Group E complete rocket systems having the same rocket motor.
 - d. Division 3 Group C bulk propellants or bagged propelling charges with Division 3, Group G pyrotechnics without their own means of initiation.
3. Equal numbers of separately packaged components of complete rounds of any single type of ammunition may be stored together. When so stored, compatibility is that of the assembled round, i.e., WP filler in Group H, HE filler in groups D, E, or F, as appropriate.
4. Ammunition designated "Practice" by NSN and nomenclature may be stored with the fully loaded ammunition it simulates.
5. Mixing of compatibility groups (except items in groups A, B, & L) in limited quantities is authorized by NAVSEASYSKOM. Such mixed storage is not to exceed a total of 1,000 pounds net explosive weight and will be considered as the highest hazard division included.
6. Group K requires not only separate storage from other groups, but may also require separate storage within the group. NAVSEASYSKOM shall determine which items in group K may be stored together and those which may be stored separately.
7. Ammunition items without explosives which contain substances properly belonging to another hazard class may be assigned to the same compatibility group as items containing explosives and the same substance, and be stored with them.

Figure 12-16.—Storage compatibility mixture chart.

Ammunition and explosives are assigned to compatibility groups. When stored within their assigned group, ammunition and explosives can be stored together without significantly increasing either the probability of an accident or, for a given quantity, the magnitude of the effects of such an accident. The mixing of storage compatibility groups is permitted by NAVSEA-SYSCOM, as shown in figure 12-16. The mixing of storage compatibility groups other than those shown in figure 12-16 must be approved by NAVSEASYSCOM.

IDENTIFICATION OF FACILITIES

Buildings and magazines, including open storage sites that contain ammunition, explosives, or chemical and inert components, are marked according to a standard system of identification so you can rapidly identify the hazards associated with their contents. This identification and numbering system is used in addition to any other numbers on the buildings. **These standard identification markings are stamped out over other markings, if present.** The standard identification system consists of the magazine designator and the symbol indicator.

The magazine designator is a three-group symbol, composed of numbers and letters. It identifies a magazine by location of the magazine

group, the number of the magazine within the group, and the type of magazine construction. The magazine group number, the type of magazine and capacity letter(s), and the magazine sequence number form the three-group symbol that makes up the magazine designator.

Magazine Group Number

The magazine group number is the first number of the magazine designator symbol. It shows the magazine group in which the magazine is located. Each physically separated group of magazines or, at smaller stations, each non-contiguous magazine area is assigned a number, making it easy to rapidly and easily identify the group. The group numbers begin with 1 and continue in ascending numerical order. If only one magazine group exists, the number 1 is used. For example, the numeral 4 in the first position of the magazine designator 4XTX4 indicates that this magazine is located within magazine group 4.

Magazine Type and Capacity Letter(s)

The magazine type and capacity letter(s) shows the type and capacity of the magazine. For this reason, magazines of certain sizes are assigned a letter designation as indicated in tables 12-4, 12-5, 12-6, and 12-7. To show the type of magazine, for example, the letter T is added if the magazine

Table 12-4.—Magazine Designators for Mass Detonating Hazard of High Explosives (Bulk, Depth Charges, Mines, Warheads, Bombs, etc.), Fuzes, Detonators, Exploders, and Black Powder

DIMENSIONS (nominal)	NORMAL USE	NORMAL EXPLOSIVE LIMIT	LETTER DESIGNATOR
25' × 80' arch type (igloo)	High explosives	500,000 lbs.	A
25' × 50' arch type (igloo)	High explosives	250,000 lbs.	B
25' × 40' arch type (igloo)	High explosives	250,000 lbs.	B
39' × 44' or 32' × 44' (warhead type)	High explosives	500,000 lbs.	W
12' × 17' (box type)	Black powder	20,000 lbs.	E
Miscellaneous or nonstandard size	High explosives	Dependent upon size, location, construction	X
Open storage (revetted)	High explosives	Dependent upon size, location,	R
25' × 20' arch type (igloo)	Fuze and detonator	70,000 lbs.	F
52' dome (Corbetta type)	High explosives	500,000 lbs.	D
Dimensions vary (gallery or tunnel type)	High explosives	250,000 lbs.	G
10' × 14'	Fuze and detonator	15,000 lbs.	H
10' × 7'	Fuze and detonator	7,500 lbs.	H
6' × 8'8" (Keyport type)	High explosives	4,000 lbs.	K

Table 12-5.—Magazine Designators for Fire Hazard of Powder (Bulk or Semifixed Ammunition), Pyrotechnics, Ignition Fuzes and Primers, Small Arms, Smoke Drums, and Explosive-Loaded Chemical Ammunition

DIMENSIONS (nominal)	NORMAL EXPLOSIVE LIMIT	LETTER DESIG- NATOR
50' × 100'	1,000,000 lbs.	L
25' × 80' triple-arch	1,000,000 lbs.	L
52' dome (Corbetta type)	1,000,000 lbs.	D
50' × 60'	300,000 lbs.	M
30' × 50'	125,000 lbs.	N
25' × 48'	125,000 lbs.	N
25' × 40'	125,000 lbs.	N
Miscellaneous or non- standard size	Dependent upon location, size, and construction	Y

Table 12-6.—Magazine Designators for Fragment Hazard of Projectile and Fixed Ammunition

DIMENSIONS (nominal)	MAXIMUM EXPLOSIVE LIMIT	LETTER DESIG- NATOR
50' × 100'	500,000 lbs.	P
25' × 80' triple-arch	500,000 lbs. (total for three arches)	P
25' dome (Corbetta type)	500,000 lbs.	D
Miscellaneous or non- standard size	150,000 lbs.	Z

Table 12-7.—Magazine Designators for Miscellaneous Magazines

DIMENSIONS (nominal)	TYPE	LETTER DESIG- NATOR
	All inert storehouses	SH

is earth-covered and barricaded. If the magazine is earth-covered but not barricaded, the letter C is added. If the magazine is not earth-covered but is barricaded, the letter S is added. Therefore, in the magazine designator 4XTX4, the letter X in the second position indicates that the magazine

size is miscellaneous or nonstandard, and it is normally used for storing high explosives. Also, the normal explosive storage limit depends on the magazine's size, location, and type of construction. The letter T in the third position indicates the magazine is earth-covered and barricaded.

The explosive limits contained in tables 12-4 through 12-7 are maximum capacities. They are based on magazine design and construction characteristics. These limits are further subject to the Q-D considerations discussed previously. Additional limitations are shown in the magazine designator. When the Q-D relationship, as indicated in the tables, doesn't permit using the explosive capacity design of a standard magazine because of insufficient separating distances, the letter X, Y, or Z is added to the designator. These letters indicate the magazine contains mass detonation hazards, mass fire hazards, or fragment-producing hazards, respectively. For example, in the magazine designator 4XTX4, the letter X in the fourth position tells you that the magazine doesn't have a sufficient separating distance from other structures or magazines.

Before 1985, naval facilities used to store or maintain ammunition or explosives used a standard two-part system of identification—a color-hazard indicator and a magazine designator. **The color hazard indicator has been replaced by a system of fire, chemical hazard, and fire-fighting direction symbols.** When possible, mount placards at locations that are visible for a minimum distance of 500 feet in the daytime. Placards are placed on the road at distances of not less than 500 feet to indicate the magazine contents. This is required when visibility is obstructed by vegetation or curves in the road. When the contents of the magazine are changed or removed, the placards are also changed or removed. These placards are displayed to help fire fighters identify, from a safe distance, the type of hazards involved so they can determine the types of equipment and procedures to use.

REVIEW NUMBER 5

Q1. Mandatory regulations governing the storage of ammunition ashore are found in

- Q2. *What prefabricated, concrete-constructed magazine is earth covered and arch shaped?*
- Q3. *What is the normal size of a box-type magazine?*
- Q4. *What concrete-constructed magazine is shaped like a beehive or dome?*
- Q5. *What magazine type consists of a tunnel or cave having varied dimensions?*
- Q6. *WP-M23 igniters belong to what ordnance class?*
- Q7. *How many subdivisions are contained in DOD hazard Class 1?*
- Q8. *What type of items are contained in storage compatibility Group B?*
- Q9. *Black powder belongs in compatibility storage group _____.*
- Q10. *What type of ammunition is found in compatibility Group S?*
- Q11. *The first number in a magazine designator symbol shows the _____.*
- Q12. *The letter T in the third position of a magazine designator indicates that the _____.*

AMMUNITION STORAGE ASHORE FOR ADVANCED BASES

Learning Objective: *Identify ammunition storage ashore for advanced bases to include facilities, magazines, and handling requirements.*

Advanced base is the general term for a temporary base that is in or near a forward area outside the zone of the interior. The primary mission of an advanced base is to support wartime operations of the armed forces. Advanced bases are established to perform one or more of the following functions: to hold threatened strategic areas; to protect, or be part of, a line of communications and supply; to serve as a base for direct offensive operations; or to serve as a base for mounting or supporting further offensives.

If a valid reason for not complying with storage and handling regulations/instructions at advanced bases that are contained in NAVSEA OP 5, volumes 1 and 2, you need to refer to *Ammunition Ashore*, NAVSEA OP 5, volume 3.

AMMUNITION STORING AND HANDLING FACILITIES

When you establish an advanced base, divide the storing and handling facilities into areas. These areas should correspond to the functions required by the mission of the base, to make ordnance handling operations easier and smoother, and to isolate hazards. Areas at advanced bases are designated as magazine, renovation, disposal, pier, enemy ammunition, and administration and personnel areas. These areas are discussed briefly in the following paragraphs.

Magazine Areas. Provide two or more magazine or storage areas for each advanced base. This allows you to disperse ammunition stows, and makes it easier to receive and issue ammunition. The principle objective in the dispersion of ammunition is to prevent the complete loss of a single type of ammunition because of fire, accidental explosion, or hostile action. Ample provision should be made for expansion during the initial planning of magazine areas.

Renovation Areas. Some ammunition received at advanced bases would become unserviceable

if it were improperly handled or exposed to the elements. This would make it require renovation. Since renovation operations may be performed at advanced bases, a suitable area must be provided for segregation, exterior maintenance, and modification operations.

Disposal Areas. Normally, an area unusable for other purposes is chosen for an ammunition disposal area. The disposal site should be at least 800 yards from the nearest ammunition storage site and any inhabited area of the base. The site should be cleared of all vegetation. A powder burning area, detonation pits, and a component popping

pit should be included in the site. Provide a splinter-proof or other suitable shelter to protect personnel during demolition operations. **Where facilities are available, ammunition may be destroyed by dumping at sea. Existing directives should be consulted for disposal procedures.**

Pier Areas. In the initial stages of construction of an ammunition storage area at an advanced base, an isolated and separate ammunition pier should be provided. Such a facility eliminates congestion, delay, and unnecessary hazards when loading and unloading general cargo, fuels, and ammunition.

REVIEW NUMBER 5 ANSWERS

- A1. *Mandatory regulations governing the storage of ammunition ashore are found in OP 5, volumes 1 and 2.*
- A2. *The keyport magazine is a prefabricated, concrete-constructed magazine that is earth covered and arch shaped.*
- A3. *The normal size of a box-type magazine is 12 feet by 17 feet.*
- A4. *The Corbetta magazine is a concrete-constructed magazine shaped like a beehive or dome.*
- A5. *The Gallery magazine consists of a tunnel or cave having varied dimensions.*
- A6. *WP-M23 igniters belong to Class 4 ordnance.*
- A7. *There are five subdivisions contained in DOD hazard Class 1.*
- A8. *Detonators and similar initiating devices are contained in storage compatibility Group B.*
- A9. *Black powder belongs in compatibility storage group D.*
- A10. *Ammunition that doesn't present any significant hazard is found in compatibility Group S.*
- A11. *The first number in a magazine designator symbol shows the magazine group number.*
- A12. *The letter T in the third position of a magazine designator indicates that the magazine is earth covered and barricaded.*

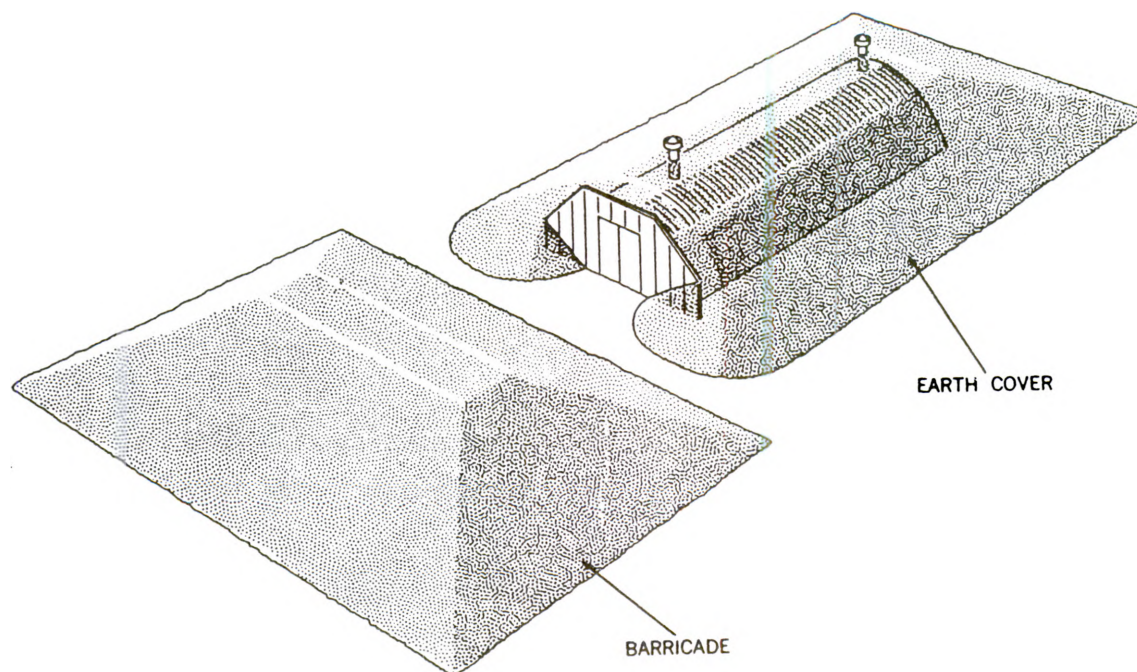


Figure 12-17.—Typical advanced base magazine.

Enemy Ammunition Areas. A separate area should be provided for storing captured enemy ammunition. This area should be **at least 800 yards** from the other storage areas.

Administration and Personnel Areas. Administration and personnel areas must be **at least 800 yards** from the ammunition storage and handling areas.

Ammunition Storage Facilities

Ammunition is stored at advanced bases in approved magazines, existing buildings, and in dry caves and tunnels. Ammunition may also be stored in the open, in quarries, pits, and similar areas. Don't put ammunition in caves, tunnels, quarries, or pits if there isn't adequate drainage. When possible, assign available magazines and buildings for storing the more fragile and perishable ammunition such as pyrotechnics, ammunition containing smokeless powder, fuzes, and similar components. Store the more durable ammunition, such as aircraft bombs and depth charges, in the open, provided it affords maximum

protection against corrosion and deterioration.

PREFABRICATED MAGAZINES.—Advanced base magazines (fig. 12-17) are prefabricated, earth-covered, arch-type structures that are used to provide weatherproof storage for ammunition of all types.

The barrel of each advanced base magazine is an arch made of sheets of corrugated sheet metal bolted together to form a semicircular-arch roof. Two screened, sheet metal ventilators are mounted on top of the arch, one at the front of the magazine and one at the rear. The rear wall is constructed of corrugated sheet metal. The front wall is constructed of wide, heavy-gauge metal plates, which are reinforced with angles and channels. The front wall extends above and to each side of the outer limits of the magazine, providing a retaining wall for the earth fill. The ends of the plates that extend beyond the limits of the magazine are secured to the structure by turnbuckle rods. The magazine floor is a concrete slab placed on compacted gravel or broken stone fill. A pair of 8-foot, double-leaf doors are placed in the front wall of the magazine. Screened louvers are placed

Table 12-8.—Prefabricated Advanced Base Magazines

MAGAZINE SIZE	MAXIMUM CAPACITY	QUANTITY-DISTANCE UNBARRICADED	QUANTITY-DISTANCE BARRICADED
16 × 36	50,000	200 feet	115 feet
25 × 48	150,000	290 feet	165 feet

in each door for ventilation. Table 12-8 lists the available magazine sizes, maximum storage capacities, and the recommended separation distances between the magazines.

A barricade is placed opposite the front wall of each magazine used for the storage of high explosives or fuzes and detonators. The barricade extends to the height of the inside crown of the magazine arch. The barricade must be **at least 3 feet** wide at the crest and slope to a grade on the natural slope of the earth used as fill.

TEMPORARY SHELTERS AND COVERINGS.—If magazines or existing buildings aren't available at advanced bases for the storage of ammunition, temporary shelters or coverings are erected to protect ammunition that is stored in the open.

When tents are used, ventilate them during the heat of the day by raising the sides at the top.

Be careful to prevent the direct rays of the sun from shining through the peaks onto the piles of ammunition. When tents are ventilated properly, air circulates freely around the piles of ammunition in the tents. During the night, and during rainy weather, lace the tents tightly, and keep the sides staked down to prevent moisture from condensing on the ammunition.

In tropical areas where vegetation grows very thick, thatched-roof huts (fig. 12-18) or shelters of woven mats can be erected to protect the ammunition.

Piles of ammunition stored in the open and unprotected by temporary shelters, such as tents or thatched-roof huts, should be covered with a double thickness of serviceable tarpaulin (fig. 12-19). If materials are available, fabricate a wooden roof-type cover like the one shown in figure 12-20, and place it on the top layer of the ammunition pile.

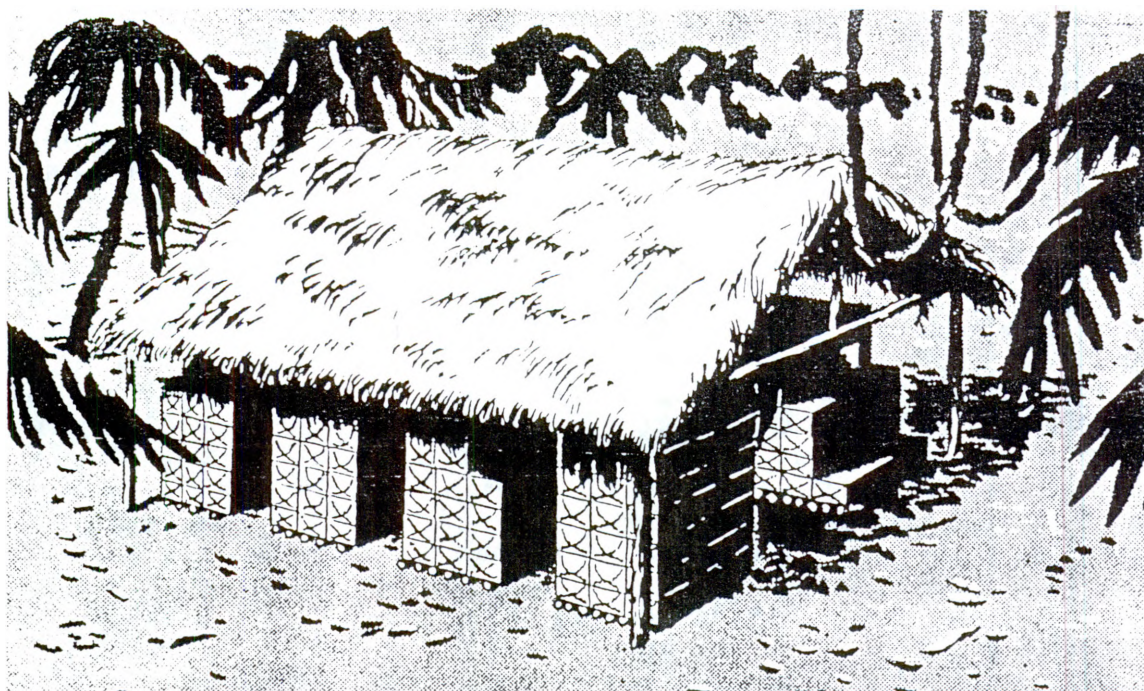


Figure 12-18.—Ammunition protected by a thatched-roof hut.



Figure 12-19.—Ammunition protected by a tarpaulin cover.

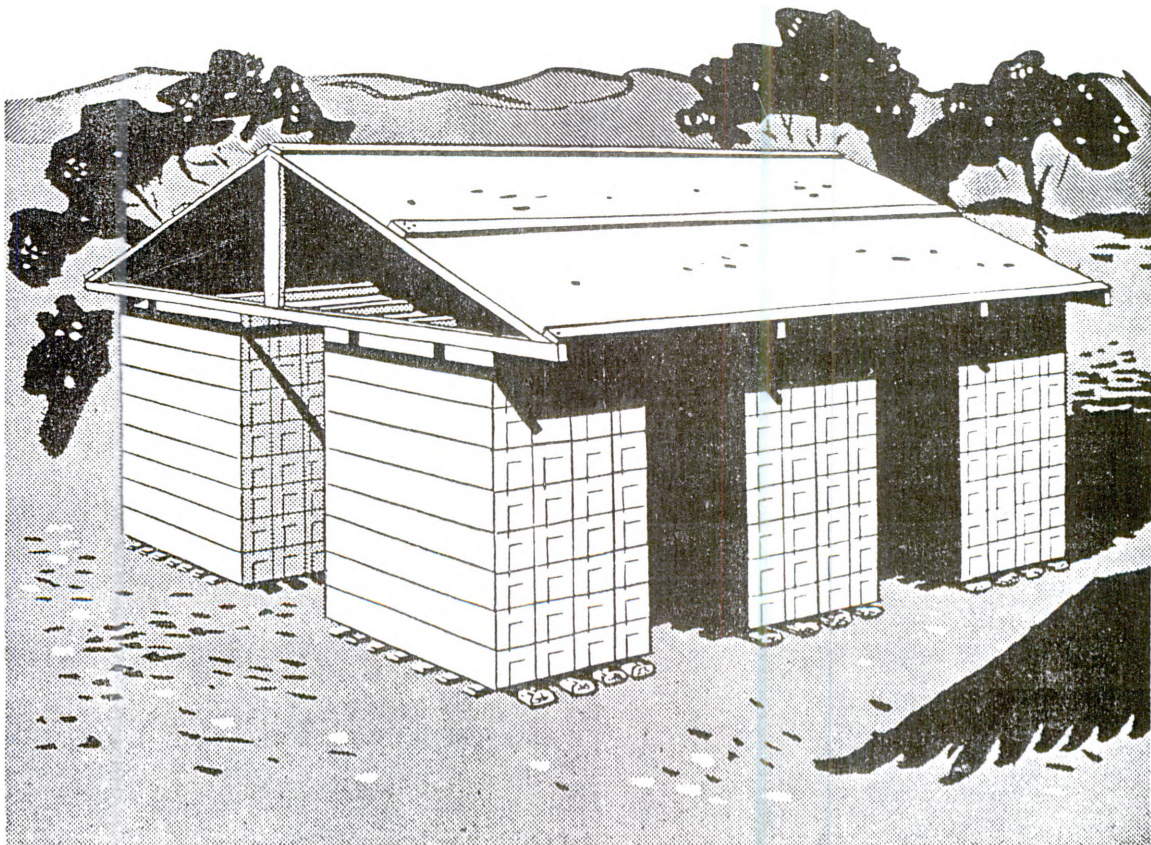


Figure 12-20.—Ammunition protected by a wooden, roof-type cover.

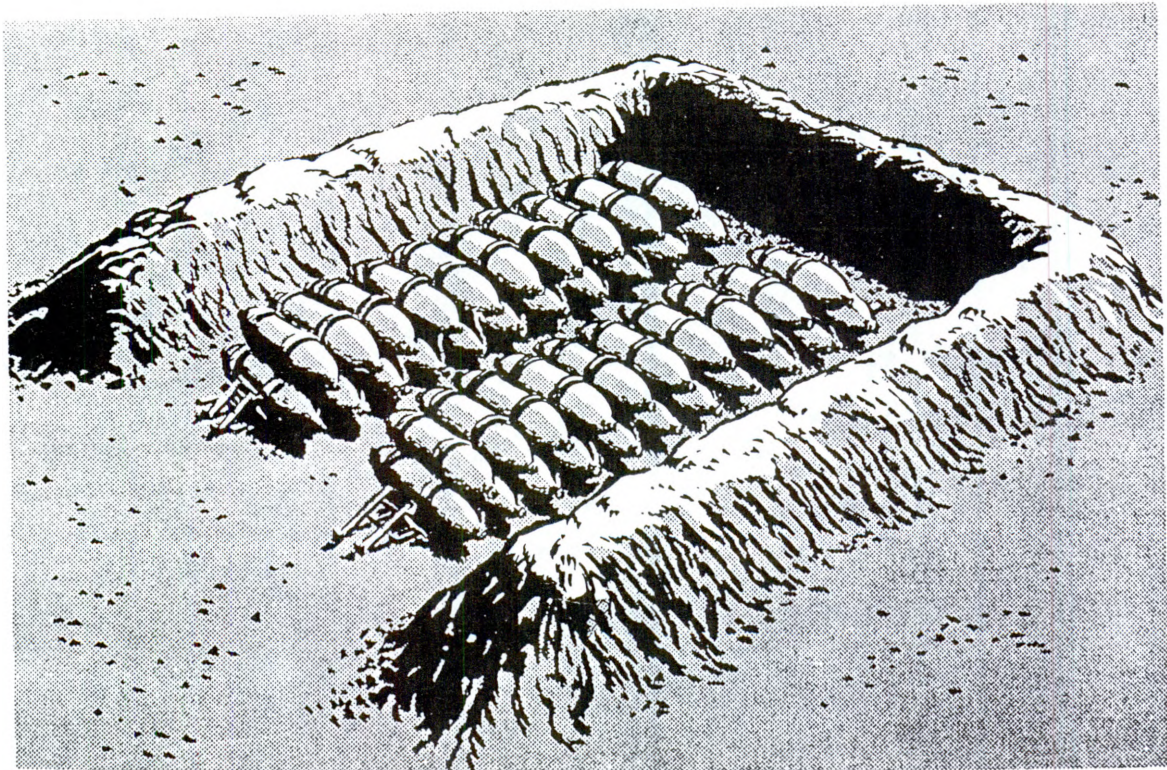


Figure 12-21.—Revetted stowage of aircraft bombs.

BARRICADES AND REVETMENTS.—

Earth barricades or revetments around individual piles of ammunition, similar to that shown in figure 12-21, are easily erected and protect ammunition from fire and explosion. Each barricade should be at least 3 feet wide at the top and 1 foot higher than the ammunition that it protects.

EXISTING BUILDINGS.—Occasionally, existing buildings are used to store ammunition. Each building should be of fire-resistant construction, and it should protect ammunition against moisture and dampness. It should have adequate ventilation and have substantial flooring to support the ammunition. An existing building should afford adequate protection to the ammunition and adjacent areas.

CAVES AND TUNNELS.—Caves and tunnels are used to store ammunition if they are reasonably dry and free of moisture seepage. Most types of ammunition may be stored in caves and tunnels. In very hot climates, however, don't store ammunition that contains smokeless powder in

caves and tunnels unless they are ventilated, either by natural or artificial means, to prevent the accumulation of ether fumes.

OPEN STORAGE.—Ammunition is stored in the open at advanced bases to supplement magazine space. However, when ammunition is stored outdoors, special consideration must be given to protecting it from the elements.

Identification of Magazines and Open Storage Sites

When practicable, magazines, buildings used as magazines, and piles of ammunition stored in the open are marked according to the system of identification you have already read about. At advanced bases, the identification system consists of two parts—a group construction symbol and a symbol hazard indicator.

The group construction symbol is a three-group symbol consisting of the following:

1. A number indicating the group in which the magazine or open storage site is located,

Table 12-9.—Letter Designators for Advanced Base Storage

STORAGE	DESIGNATOR
Advanced base magazine:	
Explosion hazard	X
Fire hazard	Y
Fragment hazard	Z
Open storage (revetted)	R
Caves and tunnels	G

2. A letter or group of letters designating the type and capacity of the magazine, and
3. A number designating the sequence of the magazine within the magazine group or area.

Letter designators for advanced base storage are indicated in table 12-9. To indicate the nature of the construction of the magazine, the letter *T* is added if the magazine is earth-covered and barricaded; the letter *C* is added if the magazine is earth-covered, but the door isn't barricaded. The letter *T* is also used to designate revetted storages. Advanced base magazines, buildings used as magazines, caves, tunnels, and open storage sites do not conform to the standard

magazine sizes prescribed in NAVSEA OP 5, volume 1. Therefore, the letters *X*, *Y*, or *Z* that identify explosion hazard, fire hazard, or fragment hazard, respectively, are used in place of the standard letter designators. Accordingly, *XT* is applied to an earth-covered, barricaded, advanced base magazine that is used for storing high explosives. Also, *RZT* is part of a designator for fragment-hazard material in a revetted storage.

In addition, the following information must be conspicuously posted on one door in each magazine or building that contains ammunition:

1. The hazard classification of ammunition (explosion, fire, or fragment) stored there.
2. The maximum quantities of ammunition in each hazard classification as determined from the quantity-distance (Q-D) tables.
3. Safety precautions and regulations that pertain to the specific material presently stored in the magazine or building.

Post this information at each outside (open) ammunition storage site. Print the information on a card so it is protected from the weather. Then, put the card in a locally manufactured ammunition site sign and card holder, as shown in figure 12-22.

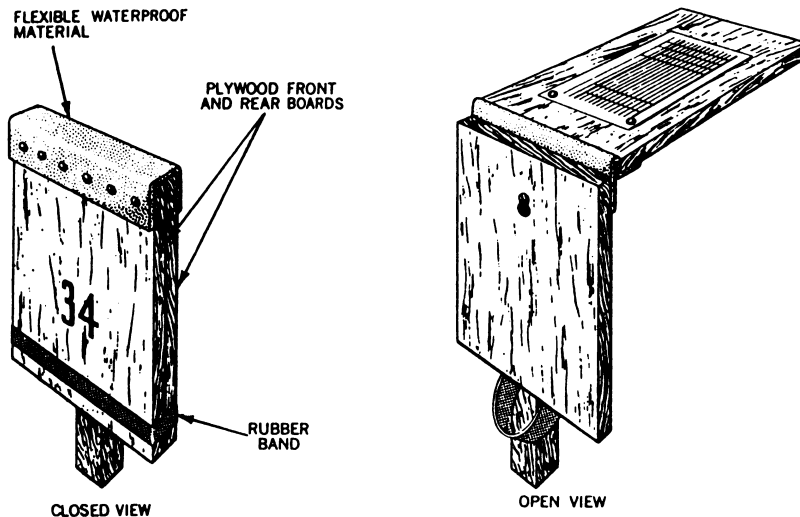


Figure 12-22.—Ammunition site sign and card holder.

Table 12-10.—Quantity-Distance Category A and E

GROSS TONS PER STACK	GROSS TONS PER UNIT	DISTANCE IN FEET BETWEEN—	
		STACKS	UNITS
Less than 10	400	70	350
10 to 20 maximum	400	85	350

Table 12-11.—Quantity-Distance Category B

GROSS TONS PER STACK	GROSS TONS PER UNIT	DISTANCE IN FEET BETWEEN—	
		STACKS	UNITS
Less than 10	400	40	300
10 to 20 maximum	400	50	300

Advanced base magazines are built in the most suitable location for storing one of the three hazard classifications—explosion, fire, or fragment. Since all advanced base magazines are of the same type of construction, all three hazard classifications may be stored in them if they are within Q-D limitations. However, the group construction symbol designates the type of storage for which the magazine is most suitable. Don't change this symbol to show the magazine's present or new use, unless the change is permanent.

DISPERSION OF AMMUNITION

Ammunition dispersement is a main consideration in laying out an ammunition storage area at an advanced base. Each type of ammunition is stored in two widely separated areas. This prevents losing an entire supply of an ammunition item if there is a fire or explosion. Explosive stores are separated from other stores, as specified in the Q-D tables.

Group piles of ammunition stored in the open by categories. These groups are discussed in the following paragraphs. These groupings aren't compatibility groups; they are only used to ensure safe distances are maintained between piles and stacks of ammunition.

CATEGORY A. This category of material presents a fire hazard. It includes propelling charges, bag charges, rocket motors, pyrotechnics, and small arms ammunition. The Q-D criteria for stacks of Category A material is shown in table 12-10. Category A material should be separated from materials in the other categories (B through E) by **at least 400 feet**.

CATEGORY B. This category of material presents fire and fragment or fragment and explosion hazards. It includes fixed ammunition, separate loading projectiles, complete rockets (assembled or unassembled), grenades, and mortars. The Q-D criteria for stacks of Category B material is shown in table 12-11. Category B material should be separated from materials in the other categories by **at least 300 feet**.

CATEGORY C. This category of material presents an explosion hazard. This category includes bombs, warheads, depth charges, mines, demolition material, and bulk explosives. The Q-D criteria for Category C material is shown in table 12-12. Category C material should be separated from materials in the other categories by **at least 695 feet**.

Table 12-12.—Quantity-Distance Category C

GROSS TONS PER STACK	GROSS TONS PER UNIT	DISTANCE IN FEET BETWEEN—		
		STACKS	UNITS	
			BARRICADED	UNBARRICADED
Less than 10	65
10 to 20 maximum	20	85	85	150
	40		105	190
	60		120	215
	80		130	240
	100 maximum		140	255

Table 12-13.—Quantity-Distance Category D

GROSS TONS PER STACK	GROSS TONS PER UNIT	DISTANCE IN FEET BETWEEN—	
		STACKS	UNITS
Less than 5	200	40	200
5 to 10 maximum	200	50	200

CATEGORY D. This category of material includes fuzes and detonators. The Q-D criteria for Category D material is shown in table 12-13. Category D material should be separated from materials in the other categories by **at least 200 feet**.

CATEGORY E. This category of material includes chemical ammunition. The Q-D criteria for Category E material is shown in table 12-10. Category E material should be separated from materials in the other categories by **at least 400 feet**.

REVIEW NUMBER 6

- Q1. Describe the purpose of an advanced base.*
- Q2. What publication governs ammunition storage at advanced bases?*
- Q3. What is the purpose of having at least two storage areas for each type of ammunition at an advanced base?*

Q4. The disposal area at an advanced base should be a minimum of what distance from ammunition storage sites and inhabited areas?

Q5. List the characteristics of a prefabricated magazine at an advanced base.

Q6. At an advanced base, ammunition in Category A poses what sort of hazard?

**MAGAZINE MAINTENANCE,
STORAGE, AND
HANDLING REQUIREMENTS**

Learning Objective: Identify the types of procedures used for magazine maintenance, storage, and handling to include personnel requirements, lightning protection systems, magazine security, and ammunition handling and shipping.

Proper explosives and ammunition storage facilities are only a part of the overall storage system. Among the most important aspects of the storage of ammunition is the proper maintenance of magazines and magazine areas.

PERSONNEL REQUIREMENTS

Normally, all personnel engaged in operations that involve ammunition, explosives, and other hazardous materials are trained and qualified to perform their assigned duties. In addition to being qualified and certified, personnel involved with hazardous explosive operations are certified by a physician as physically qualified. Personnel aren't knowingly permitted or required to work when their ability or alertness is impaired because of fatigue, illness, or other reasons. This would expose them and other personnel to injury.

Occasionally, manpower shortages cause a need for assistance by personnel from other Navy ratings to join working parties to handle or transport ammunition and explosives. These working parties are referred to as augmentation crews. Before using augmentation crews, try to make sure that personnel in the working party are trained so mistakes aren't made or safety factors violated. Furthermore, make sure enough qualified representatives, preferably officers or petty officers that are senior in rank to any

member of the working party, are present to detect or prevent violations of safety orders and other unsafe practices. They should take whatever action is required to correct the situation.

LIGHTNING PROTECTION SYSTEMS

Lightning protection is required for all ordnance handling buildings, storage facilities, and handling areas that have more than 5 days per year when thunderstorms occur.

There are two types of lightning protection systems—primary and secondary. The primary system prevents damage from direct lightning strikes by diverting the strike and providing a low-impedance path to ground. The secondary system maintains all metal objects within its system at the same electrical potential. This prevents the possibility of sparking between the objects.

Primary Systems

There are two types of primary lightning protection systems acceptable to NAVSEASYS-COM—the separately mounted lightning mast system and the separately mounted overhead ground (aerial shield) wire system.

LIGHTNING MAST SYSTEM.—This type of primary system consists of lightning masts

REVIEW NUMBER 6 ANSWERS

- A1. *An advanced base is a temporary base that is in or near a forward area outside the zone of the interior. Its primary mission is to support a wartime operation.*
- A2. *NAVSEA OP 5, Volume 3, governs ammunition storage at advanced bases.*
- A3. *At least two storage areas for each type of ammunition is needed at an advanced base to prevent loss of a particular type of ammunition if there were a fire or explosion.*
- A4. *The disposal area at an advanced base should be a minimum of 800 yards from ammunition storage sites and inhabited areas?*
- A5. *A prefabricated magazine at an advanced base is an earth-covered arch-type structure.*
- A6. *At an advanced base, ammunition in Category A poses a fire hazard.*

(freestanding air terminals) placed around a facility and connected to a buried primary girdle. A sufficient number of masts are used to protect the entire structure within the combined cones of the masts. The number and height of masts required to adequately protect a structure is determined by the dimensions of the structure.

OVERHEAD GROUND (AERIAL SHIELD) WIRE SYSTEM.—This system consists of overhead lightning protection conductors spanned between lightning masts above a facility. The conductors are connected to a buried ground girdle or to ground rods only, depending upon the type of installation.

Secondary System

The secondary lightning protection system consists of a buried girdle to which all metal parts are connected at the lowest point. This implies that electrical access to all reinforced steel must be provided during construction. The normal wire ties are considered sufficient to provide electrical connection between the sections of reinforced steel that are in contact with each other.

MAGAZINE AND MAGAZINE AREA SECURITY

Magazine areas are protected by nonclimbable fences. All the entrances are locked unless guards are posted. Post a sign at all the entrances to restricted areas. The sign indicates that every vehicle must stop, that each person must present proper credentials to the guard, and that all articles prohibited within the area must be given to the guard. The exact wording of the signs are left to the discretion of the commanding officer. However, the word *explosive* doesn't appear on the sign, and the sign isn't attached to the magazines.

Special precautions are taken to guard or patrol the areas that are not protected by suitable fencing. Magazine and explosives areas where ammunition, explosives, and other items of high-security classification are stored must be adequately guarded at all times.

Don't let unauthorized personnel enter or remain in any magazine or explosives area. Personnel involved in ammunition handling operations are authorized in magazines or buildings that contain explosives only as required, and they must enter and leave explosives areas at designated points.

Additional information on the requirements for posting, fencing, unguarded facilities and vehicles, emergency events, and security alarm systems is found in *Department of the Navy Physical Security Instruction for Sensitive Conventional Arms, Ammunitions and Explosives (AA&E)*, OPNAVINST 5530.13.

MAGAZINE/MAGAZINE AREA INSPECTIONS

The commanding officer, or duly authorized representative, requires regular and frequent magazine inspections. These inspections include ready-service lockers, ready-service magazines, and magazine areas. Magazine inspections are conducted to make sure the following conditions are met:

- Ensure magazine repairs are made, if needed.
- Ensure that safety regulations, particularly those that involve cleanliness and elimination of fire hazards, are observed.
- Ensure that magazine contents are not deteriorating into an unsafe condition, and they are stored in an orderly, compatible, and approved manner.

The magazine area inspections are designed to make sure the following actions are being maintained:

- Firebreaks are being maintained.
- Fire protection equipment, when required, is available and serviceable.
- Roads are good and in usable condition.
- Fences are secure.

At times area inspections are performed more often than magazine inspections, particularly during seasons when grass or brush fires are most likely to occur.

General Inspection Requirements

Some of the types of things you look for when conducting general magazine inspections are security, safety, cleanliness, atmosphere (temperature and humidity), identification of

contents, and posting. A checklist covering all safety regulations and requirements of magazine operations is used when you conduct magazine inspections. This helps you make sure you don't overlook violations or hazards. The checklist provides an adequate and full description of any condition that is unsatisfactory and in violation of requirements. Make sure the checklist is properly authenticated and made a part of the magazine log.

Frequency of Inspections

The inspection frequency is determined by the commanding officer or duly authorized representative. The frequency varies, depending on the number of magazines to be inspected, weather conditions, season of the year, number of magazines requiring special attention (for example, environmentally controlled), and security requirements of magazines/magazine areas. Inspections are conducted during daylight hours. Make sure there is enough light to see that any substandard condition that exists is seen and reported to the inspector. The exception to this procedure is security inspections; they are conducted during the day and at night.

Temperature Control Considerations

The majority of the ordnance items in the Navy inventory are designed to withstand temperatures in the range of 130° to 160° Fahrenheit. Temperatures within conventional ordnance storage magazines seldom exceed 105° Fahrenheit. Therefore, you don't have to closely monitor the temperatures within these magazines. However, in the case of *special magazines*, such as certain missile/missile components, torpedoes, and mine magazines that require environmental control, control-system monitoring is still required.

Report of Inspections

You must record the date and hour of each inspection in a magazine inspection log above the signature of the person who made the inspection. Promptly report substandard or abnormal conditions to the officer or supervisor in charge of correcting it. Then annotate the observed conditions in the log. Note satisfactory and

normal conditions in the log by the entry *normal*. Magazine inspection logs may be destroyed 1 year from the date of last entry.

REVIEW NUMBER 7

- Q1. Describe the two types of primary lightning protection systems acceptable to NAVSEA-SYSCOM.
- Q2. Lightning masts are connected to a _____.
- Q3. To what instruction should you refer for specific requirements about the physical security of naval magazines?
- Q4. When are magazine inspections conducted?
- Q5. Describe the information recorded on the magazine inspection log above the signature of the person conducting the inspection.

AMMUNITION HANDLING

The AO must be familiar with handling ammunition. It is a repetitious task, whether at a shore station or aboard ship. Repetitious work, no matter how dangerous, often becomes routine and leads to carelessness. Therefore, pay attention to what you are doing to prevent accidents in operations dealing with ammunition and explosives.

Whenever ammunition or explosives are received, transferred, or stowed, an officer or petty officer that knows the rules governing the care and handling of ammunition supervises the work. The supervisor makes sure that all work personnel are aware of the need to be careful when they handle ammunition and explosives.

Handling equipment is properly maintained and frequently inspected to make sure it is in safe working condition. Also, the handling equipment must be the right equipment for the purpose. Inspections are made before and during loading/unloading operations.

AMMUNITION SHIPPING

Ammunition shipping is a phase of ammunition handling. Instructions for the preparation and shipment of naval ordnance material are contained in *Navy Transportation Safety Handbook for Hazardous Materials*, NAVSEA OP 2165, volumes 1 and 2. The instructions in NAVSEA OP 2165 cover the preparation, flow, and use of all the documents required to ship, receive, and report shipments. Instructions for the use of ordnance transport equipment, materials to be transported, division of responsibility for carrying out inspections, and criteria for accepting or rejecting equipment are also contained in this publication. NAVSEA OP 2165 contains the general information needed for you to efficiently, safely, and economically perform the duties required when shipping ordnance materials.

Department of Transportation Explosive Hazard Classifications

The Department of Transportation (DOT) has established explosive hazard classifications for ammunition and explosives in shipment. DOT defines explosives as *any chemical compound, mixture, or device, the primary or common purpose of which is to function by explosion*. Explosives includes, but are not limited to, individual land mines, demolition charges, blocks of explosives (dynamite, TNT, C-4, and other high explosives), and other explosives (gun powder, nitroguanidine) that have a total weight of 10 pounds or more. All naval explosives fall within three explosive hazard classifications—Class A, Class B, and Class C. These classifications are discussed in the following paragraphs.

CLASS A.—Class A explosives are chemical compounds, mixtures, or devices (mass detonating, spark initiated, or shock sensitive) that constitute a maximum shipping hazard; for example, black

powder, explosive warheads, nitroguanidine, and nitrosoguanidine.

CLASS B.—Class B explosives function by rapid combustion rather than by detonation; for example, rocket ammunition without projectiles, special fireworks, and starter cartridges for jet engines.

CLASS C.—Class C explosive devices contain Class A or Class B explosives, or both, but in restricted quantities. They also have certain types of fireworks. Examples of Class C devices are electric squibs, explosive bolts, common fireworks, and small arms ammunition.

NOTE: Remember, these explosive hazard classifications apply to ammunition and explosives during shipment only. They do not apply to the storage classifications discussed earlier in this chapter.

Explosives Driver

An explosive driver is often an AO with an excellent safe driving record, and a person fully qualified according to *Motor Vehicle's Driver's Handbook Ammunition, Explosives, and Hazardous Materials*, NAVSEA OP 2239. To become a qualified explosives driver, you must meet the qualifications described below. If you meet these qualifications, you are certified to drive motor vehicles that transport hazardous materials (HM).

STATE OPERATOR'S LICENSE.—An explosives driver must hold a valid state operator's license, not necessarily issued by the state in which the activity is located. This applies to operation of vehicles both on- and off-station. This requirement is permanently waived for those personnel stationed outside the 50 states who would otherwise be eligible to obtain an explosives driver's permit.

MEDICAL EXAMINER'S CERTIFICATE.—An explosives driver must undergo an annual physical examination and, on the basis of such an examination, be certified by a licensed doctor of medicine or osteopathy to ensure that he/she meets applicable requirements as stated in the *Federal Motor Carrier Safety Regulations*. Applicants who pass the prescribed annual physical examination are issued a Medical Examiner's Certificate, ATA (American Trucking



MEDICAL EXAMINER'S CERTIFICATE		2-79
(I certify that I have examined)		
John Jackson		
[Driver's name (Print)]		
in accordance with the Motor Carrier Safety Regulations (49 CFR 392.41-391.49) and with the knowledge of his duties, I find him qualified under the regulations.		
<input type="checkbox"/> Qualified only when wearing corrective lenses <input type="checkbox"/> Qualified only when wearing a hearing aid A completed examination form for this person is on file in my office at		
21 Oak St., Jamestown, ARK.		
[Address of examining doctor (Print)]		
2-2-82	M. McKenna	
[Date of examination]	[Name of examining doctor (Print)]	
 [Signature of examining doctor]		
 [Signature of driver]		
42 Penn Rd., Monroe, ARK. 77772		
[Address of driver]		
Reprinted by American Trucking Assns., Inc		

Figure 12-23.—Medical Examiner's Certificate, ATA Form C0750.

Association) Form C0750. (See fig. 12-23.) This certificate, in addition to the explosives driver's permit, must be on the operator's person while driving any vehicle transporting HM.

EXPLOSIVES DRIVER PERMIT.—An explosives driver must hold a U.S. Government

Motor Vehicle Operator's Identification Card, Standard Form 46 (SF 46). (See fig. 12-24.) The card will be noted: "Explosives Driver (Must hold a current medical certificate)." The SF 46 is valid for 3 years and must be renewed prior to expiration. A yearly endorsement is not required. An individual's safety record and physical

REVIEW NUMBER 7 ANSWERS

- A1. *The two types of primary lightning protection systems acceptable to NAVSEASYSKOM are the sequentially mounted lightning system and the separately mounted overhead ground (aerial shield) wire system.*
- A2. *Lightning masts are connected to a buried primary girdle.*
- A3. *For specific requirements about the physical security of naval magazines, you should refer to OPNAVINST 5530.13.*
- A4. *Magazine inspections are conducted only during daylight hours.*
- A5. *The information recorded on the magazine inspection log above the signature of the person conducting the inspection includes the date and hour of each inspection as well as abnormal or substandard conditions of the magazines, or the word "Normal" if conditions were satisfactory.*

Standard Form 46 Revised Jan 1977 USCSC FPM Chapter 910		U.S. Government Motor Vehicle Operator's Identification Card			Card No 1345
Name of Operator J. Doe				Sex M	Date Issued 1/15/80
Height 6'	Weight 180	Date of Birth 7/30/36	Social Security No XXX-XX XXXX	Date Expires 1/15/83	
Color of Hair Br.		Eyes Br.		NOT TRANSFERABLE Card must be carried at all times when operating Govern- ment vehicles	
Signature of Operator (Not valid unless signed)			/s/John Doe		
Name and Location of Issuing Unit NWS Yorktown, VA			Signature and Title of Issuing Official /s/M. T. Smith Qtr - Trans.		
The holder of this card is qualified to operate U.S. Government vehicles and/or equipment specified, subject to any restrictions set forth on the reverse of this card.					
46-105					
SAMPLE					
Restrictions					
QUALIFIED TO OPERATE					
Type Vehicle and/or Equipment	Capacity	Qualifying Official			
Tractor-Trailer	12T	MTS			
Pick-Up	1/2T	OFK			
Van	5T	FMT			
OTHER RECORDS (Optional)					
Explosives Driver					
(Must hold a current medical certificate)					
• GPO : 1978 O - 281-847 (3325)					

Figure 12-24.—U.S. Government Motor Vehicle Operator's Identification Card, SF 46.

requirements will be considered prior to re-certification as an explosives driver.

AGE AND EXPERIENCE.—An explosives driver must be 18 years of age or older to operate motor vehicles transporting HM on-station and 21 years of age or over for off-station motor vehicle HM operations. The explosives driver must also have had considerable and varied driving experience with the type of equipment to be operated and have a safe driving record.

MENTAL REQUIREMENTS.—Applicants, military and civilian, are required to pass a mental examination that is administered by the local command before they can be considered eligible to be explosives drivers.

ALCOHOL AND DRUGS.—An applicant for explosives driver certification found to be addicted to alcohol or drugs is rejected. Certification is revoked for an explosives driver found to be under the influence of alcohol or drugs while on duty or when showing evidence of addiction. Temporary revocation of HM certification may become necessary when the use of physician-prescribed drugs are likely to interfere with the driver's ability to operate a motor vehicle safely.

ABILITY TO READ AND UNDERSTAND REGULATIONS.—An explosives driver must be able to read, write, and understand the English language, and to complete the various forms for which a driver is responsible. The driver is required to read and understand the regulations

that pertain to the duties as prescribed in NAVSEA OP 2239.

In addition to these qualifications, if you apply for certification as an explosives driver, you are required to complete an explosives driver's training course and pass the tests given at the conclusion of the course. All explosives drivers receive at least 12 hours of instruction in the following activities:

- Driving trucks, truck-tractors with semi-trailers, and other vehicles of appropriate types
- Handling and transporting hazardous materials
- Interpreting regulations and procedures pertaining to the transporting of hazardous materials
- Training and use of fire extinguishers
- Completing and filing required reports

When operating Navy-owned vehicles, you, as an operator, must comply with DOD regulations and all state and local traffic laws. You are also subject to fine or imprisonment when you violate these regulations and traffic laws.

REVIEW NUMBER 8

- Q1. To what publication should you refer for information about transporting hazardous materials?*
- Q2. List the three Department of Transportation (DOT) explosives classifications.*
- Q3. In what DOT explosives class does black powder fall?*
- Q4. In what DOT explosives class does small arms ammunition fall?*
- Q5. Explosives drivers must have an _____ physical examination.*

- Q6. What is the minimum age requirement for an explosives driver to transport explosives off-station?*

WEAPONS ASSEMBLY

Learning Objective: *Identify the purpose of conventional weapons assembly to include a description of Mk 80 series bombs and support equipment configurations. Identify common procedures to follow when assembling conventional weapons. Recognize the bomb assembly area arrangement.*

In the following paragraphs, you will read about the assembly procedures for some of the most commonly used weapons. This TRAMAN doesn't include assembly procedures for every available weapon in the Navy. However, the following procedures give you basic information about assembly procedures. Remember, regardless of how well trained an assembly crew may be, there must always be a crew leader. The crew leader is required to use a weapons assembly checklist during all phases of the weapon assembly process.

NOTE: For detailed information on Mk 80 (series) bomb assembly/disassembly, support equipment requirements, and procedures for preloading/downloading accessory suspension equipment, you should refer to the *Airborne Weapons Assembly Manual*, NAVAIR 11-140-5.

MK 80 (SERIES) AIRCRAFT GENERAL PURPOSE BOMBS

The Mk 80 (series) aircraft general-purpose bombs are assembled in a variety of configurations. Mission requirements dictate the way a weapon is to be configured. This information is found in the ordnance load plan. A few of these configurations are discussed in the following paragraphs.

Preparation For Use

When using Mk 80 (series) GP bombs, the following preparations are carried out. As you read this section, refer to figure 12-25.

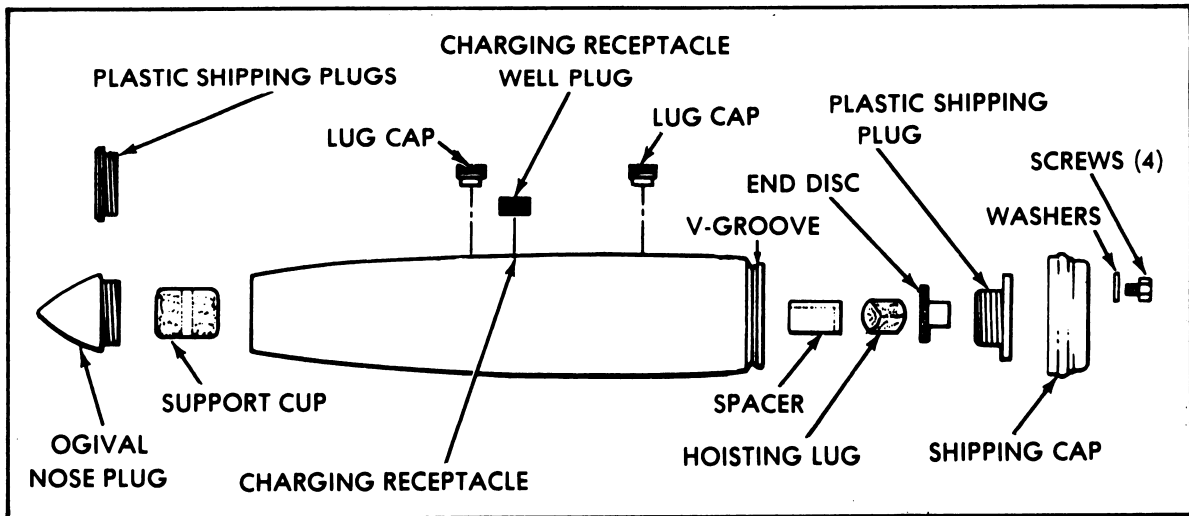


Figure 12-25.—Exploded view of LDGP Mk 80 series bomb in a shipping configuration.

UNPACKING.—You must depalletize the bomb body and place it on the appropriate bomb skid or assembly stand. When depalletizing a bomb body, you need to remove the banding straps and the top section of the metal pallet, the shipping cap on the rear of the bomb body, and the plastic shipping plugs from the nosewell and the tail fuze cavity. Then, install hoisting bars, as necessary, for manual handling of the bombs. Other suitable hoisting equipment may be used when available. Finally, place the bomb on the appropriate bomb skid or assembly stand.

INSPECTION.—You need to inspect the bomb for damage, stripped threads, cracks, or broken welds. Make sure the bottoms of the suspension lug eyes (fig. 12-26) are flush with

the weapon surface. Check to see that the bomb's V-groove is clean and undamaged. Check the fuze wells to ensure they are clean and dry. If VT nose elements and/or electric tail fuzes are to be used, check the electrical connectors to ensure they are not corroded. Press gently on the connectors to see that they are firmly seated. Inspect thermally protected bombs for loose or chipped coating. Bombs with more than 7 square inches of thermal coating missing are not considered thermally protected and are restricted from issue to aircraft carriers. Damaged or otherwise unserviceable bombs should be disposed of by following current directives.

Assembly of Conical Fin and Mechanical Fuzes to the Bomb Body

The conical fin and mechanical fuzes are assembled to the bomb body by using the procedures contained in this section.

WARNING

Fuzing for the thermally protected bomb Mk 82 Mod 2 to obtain cook-off protection is limited to fuze M904E4 with thermally protected adapter-booster M148E1, electric fuzes Mk 344 and Mk 376, and mechanical tail fuze Mk 346. Any other fuzing greatly increases the probability of early detonation of a bomb engulfed in a fuel fire, and it could increase the severity of the explosion after detonation occurs.

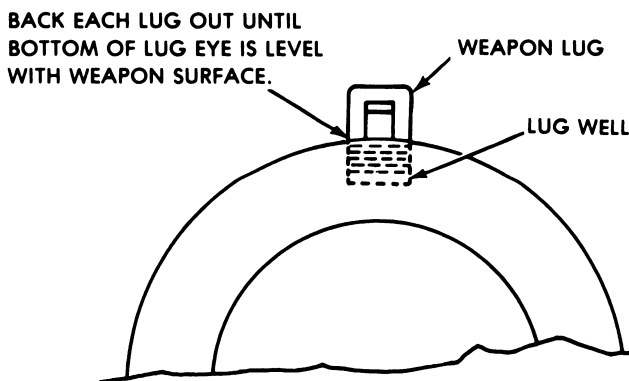


Figure 12-26.—Suspension lug installation.

INSTALLATION OF ADAPTER BOOSTERS.—Remove the fin assembly and suspension lugs (when present) from the fin shipping crate. If a mechanical nose fuzing is used, install an M148 adapter booster. If you use a mechanical tail fuze, then install the M150/T46 adapter booster.

NOTE: The M150 and T46 adapter booster consists of two separate explosive components. The primary adapter booster contains a 2.0-inch diameter tail fuze. The T46 (series) contains a fuze adapter sleeve for use with 1.5-inch diameter fuzes.

Mechanical Nose Fuzing.—When you use mechanical nose fuzing, an M148 adapter booster is installed as follows:

1. Unpack the adapter booster and remove the closing plug.
2. Inspect the adapter booster internally and externally to ensure all parts, including threads, are clean and undamaged.
3. Inspect the bomb nose fuze cavity.
4. Loosen the setscrew in the bomb body.
5. Screw the adapter booster into the bomb and tighten it with a spanner wrench until it is firmly seated.
6. Tighten the setscrew in the bomb body against the adapter-booster threads.

Mechanical Tail Fuzing.—When you use mechanical tail fuzing, install the M150/T46 adapter booster as follows:

1. Remove both components of the adapter booster from the shipping container. Remove the closing plug from the primary adapter booster.
2. Inspect the external and internal threads and the fuze well in the adapter booster for cleanliness and for damage.
3. For a T46 (series) adapter booster, loosen the locking screw and remove the 1.5-inch fuze adapter sleeve. (This sleeve is not used with any currently authorized fuze. Retain the sleeve until the adapter booster is expended, then discard.)
4. Ensure the locking pin holes in the threads of the primary adapter booster are correctly aligned.
5. Ensure the shock absorber is securely attached to the base of the primary adapter booster. If the shock appears loose, attach a strip of tape across the shock absorber and up the sides of the primary adapter booster.
6. Insert the auxiliary booster cup into the bomb fuze well. The outer end of the auxiliary booster cup is marked in large red letters, and is visible after insertion.
7. Screw the primary adapter booster into the bomb and tighten with a spanner wrench until it is firmly seated.

REVIEW NUMBER 8 ANSWERS

- A1. For information about transporting hazardous materials, you should refer to NAVSEA OP 2165, Volumes 1 and 2.
- A2. The three Department of Transportation (DOT) explosives classifications are Class A, Class B, and Class C.
- A3. Black powder is included in Class A of the DOT explosives classes.
- A4. Small arms ammunition is include in Class C of the DOT explosives classes.
- A5. Explosives drivers must have an annual physical examination.
- A6. To transport explosives off-station, the driver must be 21 years of age.

Mk 346 MOD 0 FUZE INSTALLATION.—When mechanical tail fuzeing is used, the Mk 346 Mod 0 mechanical long-delay tail fuze is installed, including appropriate arming assemblies.

Mk 346 Mod 0 Installation Procedures.—You use the following procedures to install the Mk 346 Mod 0 fuze:

1. Remove the fuze from its container.

CAUTION

The Mk 346 fuze should not be unpacked until just before installation in the weapon to provide maximum protection from rough handling.

2. Verify that the 1.5-inch fuze adapter sleeve is removed from the adapter booster.

3. Inspect the fuze for evidence of damage or corrosion. Verify that the antiremoval cam does not extend past the exterior circumference of the fuze base. If the cam faces outward, you can assume the fuze is armed and functioning. Set the fuze aside (away from explosives) and notify EOD personnel immediately.

4. Verify that a green band is visible in the safe-arm window. If a striped band covers any portion of the window, set the fuze aside (away from explosives) and notify EOD personnel immediately.

5. With a screwdriver, check for free rotation of the functioning delay time-setting mechanism. Set the desired delay time in the time observation window by adjusting the setting shaft slot at the outer end of the fuze. The mechanism can be rotated in either direction.

NOTE: Setting the fuze delay sometimes creates backlash in the gear train, which the timer automatically takes up by running. This generally lasts a few seconds. However, it may continue for as long as 2 minutes following the setting procedure. In such cases, the fuze is safe for use after the ticking stops, provided the safe-arm window shows green and the antiremoval cam is not extended.

6. Install the thermal shield (fig. 12-27) on the fuze when a thermally protected bomb Mk 82 Mod 0 is being assembled.

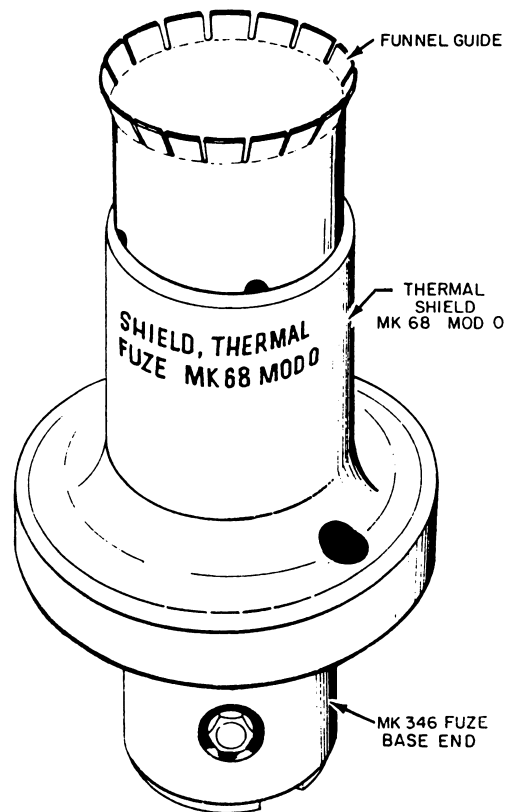


Figure 12-27.—Mk 346 fuze with the Mk 68 thermal shield installed.

7. Place the locking pin that is packed with each fuze into the hole in the threads of the adapter booster. This locks the adapter booster in the fuze well after the fuze is installed.

8. Install the Mk 346 fuze in the booster, and tighten it with a spanner wrench. When a thermal shield is not used, tighten the fuze with the special wrench provided.

Now, you are ready to place the fin assembly over the end of the bomb body, and align the fin for rack compatibility. Butt the fin against the aft end of the bomb and secure it with the setscrews.

NOTE: If nose fuzeing is not used, you need to install a support cup and an ogival nose plug. Secure the nose plug with the setscrew provided in the nose bomb body.

Arming Assembly Installation.—When mechanical tail fuzeing is used, you need to install

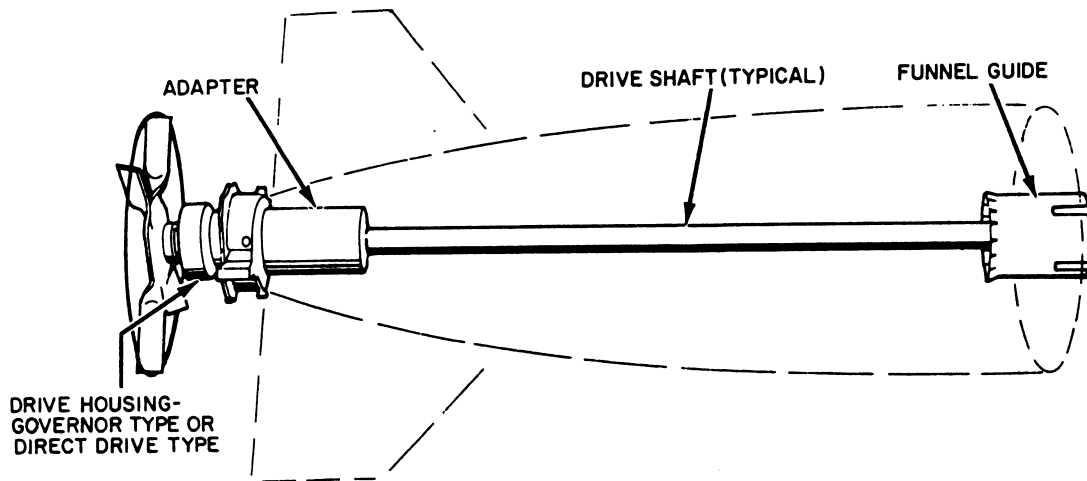


Figure 12-28.—Typical arming assembly.

an appropriate arming assembly, using the following procedures:

NOTE: Mk 3, Mk 4, and Mk 5 arming assemblies are used with the tail assemblies of both low-drag (conical) and retarded (Snakeye) weapons to provide arming action for the long-delay mechanical time fuze Mk 346. The arming assemblies consist of four basic components—fuze drive, adapter, appropriate drive shaft, and funnel guide. Figure 12-28 shows a typical arming assembly.

1. Remove the arming assembly from the container and inspect it for damage.

2. Release the latches on the adapter collar and screw the locknut all the way toward the arming vane end of the fuze drive. Refer to figure 12-29 for identification of parts.

3. Grasp the adapter with one hand and, using evenly applied pressure, press inward on the fuze drive with the other hand. This forces the toothed retaining spring through the adapter sleeve. At the completion of this step, the toothed retaining spring should be protruding through the end of the adapter sleeve.

4. Separate the adapter and fuze drive by pulling outward on the drive assembly while holding the sleeve.

5. When the inner ends of the setscrews protrude into the threaded area inside the adapter collar, loosen the setscrews with an Allen wrench.

6. Insert the adapter through the hole in the rear of the fin until it is firmly seated. Then, tighten the setscrews to secure the adapter to the fin.

7. Insert the appropriate drive shaft into the fuze drive barrel until the locking key in the drive shaft engages the output spindle in the fuze drive barrel.

8. With the fuze drive and drive shaft as one unit, orient the fuze drive so the vane strap is aligned with the bomb suspension lugs. Insert the

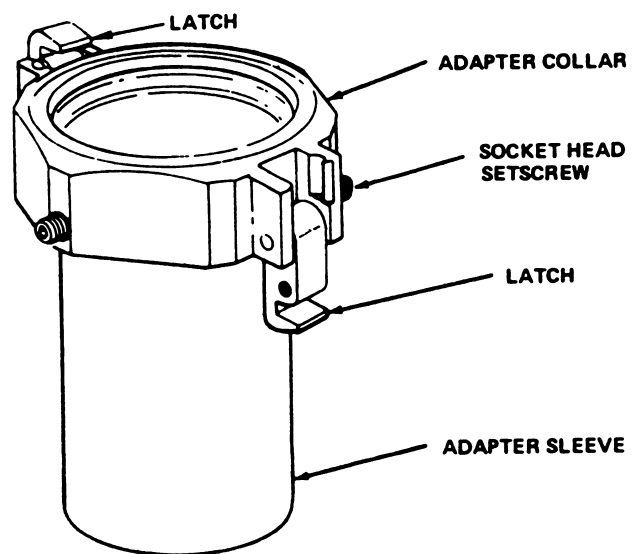


Figure 12-29.—Fuze drive adapter.

drive shaft through the adapter and into the tail assembly of the bomb.

9. On a conical fin assembly, remove the fin access cover. Guide the shaft into the mouth of the funnel guide by slowly and carefully pushing on the outer end of the fuze drive. The drive shaft then engages the input shaft of the fuze and seats firmly against the outer end of the fuze.

10. Handtighten the locknut down the fuze barrel until it contacts the adapter. Back off the locknut as little as necessary so the two latches can be secured to the locknut. Secure the latches over the locknut.

11. Replace the access cover on the conical fin assembly.

12. Install the arming vane.

Arming Wire Installation.—When you have finished loading the weapon on accessory equipment (MER), the arming wire is installed using the following procedures:

1. Route the arming wire through the rear bomb lug, arming vane strap, and the plate holes.
2. Install two Fahnestock clips. Do not cut the arming wire.
3. Ensure the safety pin is installed with the split end pointing aft.

Assembly of Conical Fin and Electric Fuze to the Bomb Body

The conical fin and electric fuze is installed to the bomb. First, remove the fin assembly and suspension lugs (if present) from the shipping crate. Then you install the adapter booster for the mechanical nose fuze using the procedures you have already read about. Now, you are ready to install an electric tail fuze. When installing electric tail fuzes, you should use the following procedures:

NOTE: When the weapon is preloaded on accessory suspension equipment, the TDD Mk 43 (if required) should be installed during the weapon assembly process.

NOTE: Mk 344 and Mk 376 fuzes provide an all electric capability for the Mk 80 (series) bombs with either conical or retarding fin; however, only the Mk 376 may be used for retarded delivery. These fuzes can be used with the TDD Mk 43 to obtain an airburst capability. They can also be used with mechanical nose fuzes

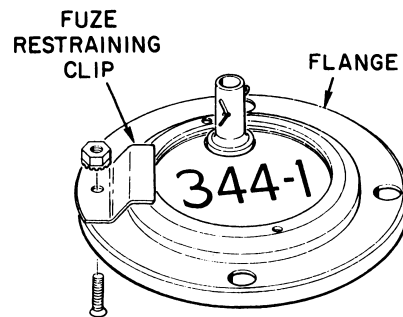


Figure 12-30.—Fuze restraining clip.

to obtain additional fuzing options. A fuze restraining clip (fig. 12-30) must be installed on all Mk 344 and Mk 376 fuzes. This clip may be installed by the manufacturer. If it was not installed by the manufacturer, it must be installed before the fuze is installed in the bomb. This fuze restraining clip is essential for fuze reliability.

WARNING

When the pop-out pin is accidentally popped out, push the pin all the way back in so both sets of holes align. Then, reinstall the safety pin. The buzzing sound emitted when the pop-out pin is reset in the Mk 344 and Mk 376 fuzes is normal. If the pin binds or does not reset, the fuze may be armed. Notify EOD personnel regarding disposition of the fuze.

1. Remove the fuze and the two decals from the shipping container.
2. Verify that the two decals removed from the container match the decals affixed to the fuze body. Set the decals aside for later use.

CAUTION

Mk 344 and Mk 376 electric fuzes that have been removed from their sealed containers and whose shipping caps have been removed and subsequently repacked for more than 30 days (or exposed to excessive moisture for any length of time) must be disposed of by following current directives.

3. When using a fuze whose shipping cap has been removed, check the data marked on the container. Dispose of the fuze when it has been repackaged longer than 30 days.

4. Fuzes Mk 344 and Mk 376 can remain installed in weapons preloaded on accessory suspension equipment in ready-stowage aboard ship for a period of 6 months. Removal of a weapon from stowage voids the 6-month authorization.

WARNING

Never install a fuze when the safety pin is missing from the pop-out pin and the fuze has been removed from its container. Turn the fuze over to EOD personnel for disposal.

5. Verify that the safety pin is installed in the pop-out pin.

6. Verify that the shipping cap is installed. If the cap is missing, dispose of the fuze by following current directives.

7. Remove the shipping cap by twisting. The socket head screw is for depot use only. It does not secure the cap to the fuze.

8. Verify that moisture is not visibly present in the electrical connector at the base of the fuze. When moisture is present, dispose of the fuze by following current directives.

9. Ensure the fuze-restraining clip is installed on the flange of the fuze. If it is not installed, you must install the fuze-restraining clip.

10. Verify that the nose and tail wells of the bomb are clean and dry. Ensure the electrical connector at the base of the well is not corroded. Press on the electrical connector tips with a pencil or wooden dowel. This ensures they are securely seated.

CAUTION

Do not attempt to rotate the fuze by the pop-out pin sleeve. It may break off.

11. Refer to figure 12-31. Insert the fuze into the tail fuze well and handtighten it. With a spanner wrench, tighten the fuze until the flange is seated against the bomb.

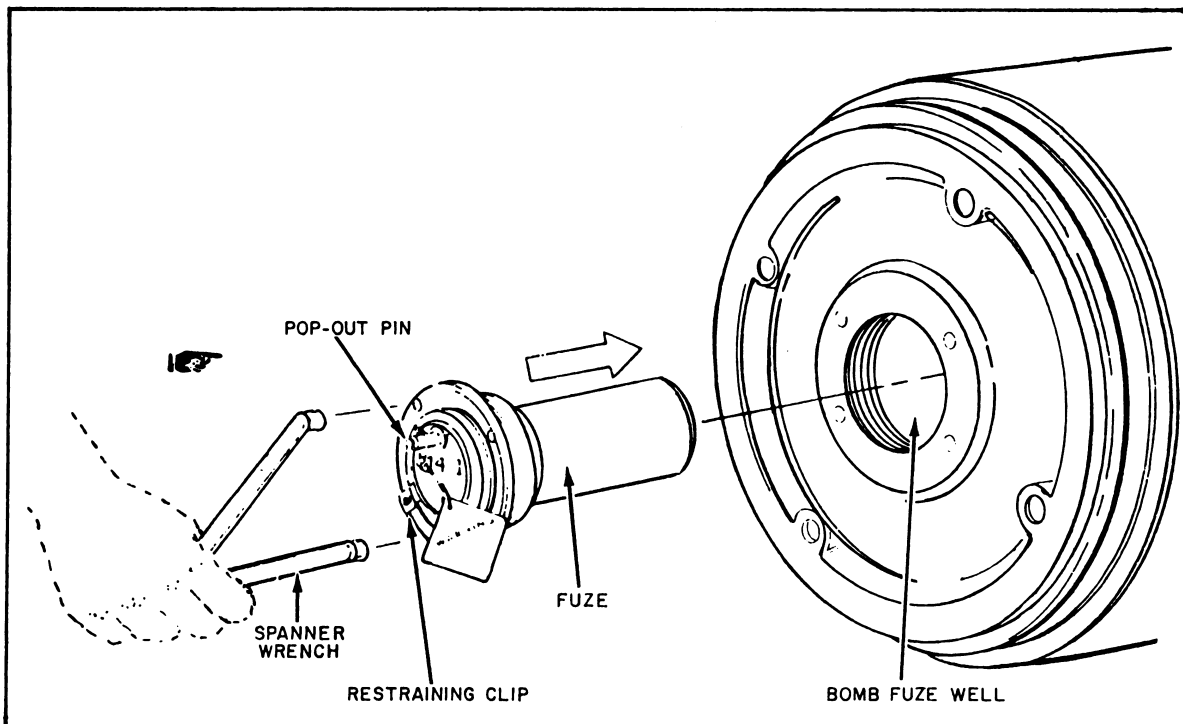


Figure 12-31.—Typical installation of an electric fuze in a Mk 80 series low-drag bomb.

12. Install two fuze-identifying decals, one on the top and one on the bottom of the bomb fin, so they can be easily seen after the fin assembly is installed. Decals are used to identify the bomb/fuzing combination after the bomb is installed on the bomb rack. Also, write the fuze nomenclature on the nose of the bomb with chalk or other suitable means (grease pencil) if decals are not available. If old markings and old decals are evident, remove or deface them.

13. Attach an Mk 3 arming wire to the aft suspension lug using either of the attachments shown in figure 12-32.

NOTE: The preferred method requires the swivel loop to be removed from the arming wire. The wire is passed through the lug, back through the small loop, and drawn taut. The loop must be positioned on the outside of the lug. This is necessary to prevent interference with the movement of the bomb rack hooks, or to prevent damage to the loop during loading.

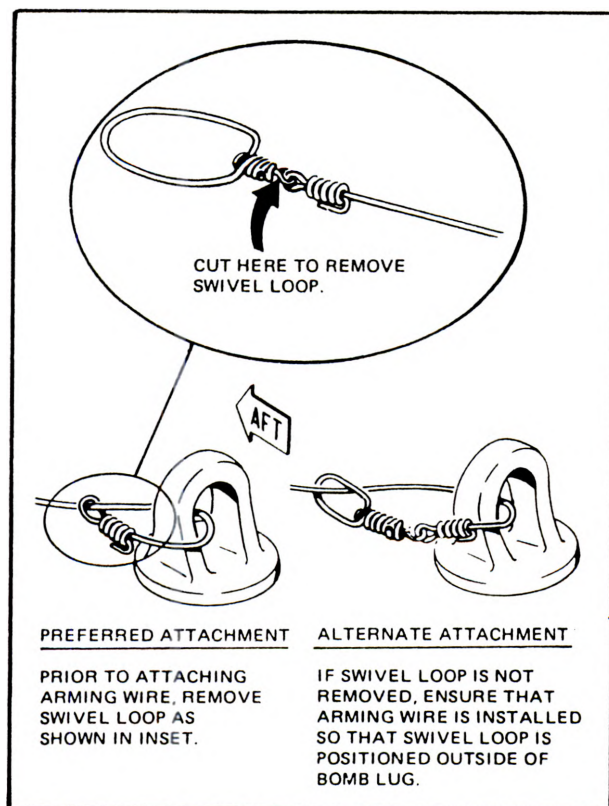


Figure 12-32.—Attachment of Mk 3 arming wire to the aft bomb lug.

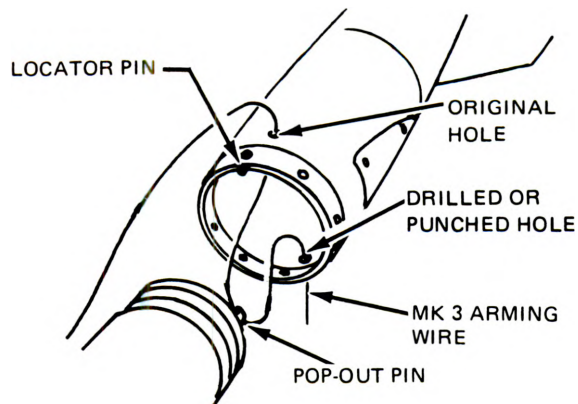


Figure 12-33.—Conical fin arming wire holes.

14. Turn the pop-out pin to align the arming wire holes in the pin with the arming wire holes in the fin.

15. Check the setscrews in the fin. Back off any screws that prevent mating of the bomb and fin.

16. Position the fin close enough to the bomb body to provide working room for installation of the arming wire in the tail fuze. (See fig. 12-33.)

17. Insert the free end of the arming wire through the upper arming wire hole in the fin. Thread the arming wire through the pop-out pin in the fuze and out through the arming wire hole at the bottom of the fin.

WARNING

The safety pin must NOT be removed from the pop-out pin before the arming wire has been installed. Failure to align both sets of holes when installing the safety pin or arming wire dangerously reduces the fuze arming time.

18. Remove the safety pin from the pop-out pin.

19. Align the fin for rack capability.

20. Butt the fin against the aft end of the bomb body and secure it with setscrews.

21. Look through the fin access cover to ensure there are no kinks in the arming wire and that the wire is not looped around the pop-out pin. Alternately pull on the top and bottom portions of the arming wire. This procedure ensures the wire is not jammed and that it does not move too freely.

22. Secure the access cover of the conical fin. Leave the entire wire uncut, and wrap it around the fin. Place the excess wire in the hole at the top of the fin. Do not install Fahnestock clips. The pop-out pin holds the arming wire securely in place.

23. Remove the Mk 122 arming safety switch from its package. Remove the rubber shipping cap (if installed) by peeling (rolling) the cap from the quick-disconnect connector. Be careful not to stress the coaxial cable.

24. Inspect the switch for deformation, corrosion, and damage to the case. Check the contact assembly for cleanliness. Check the coaxial cable for cracks and breaks in the insulation.

25. Install the Mk 122 safety arming switch as follows:

WARNING

The Mk 122 arming safety switch must be installed in a RADHAZ-free environment. Do not pull the lanyard during handling and loading. If the lanyard breaks away from the switch, discard the entire arming safety switch so it will not be used on a bomb. Do not attempt to replace the lanyard.

CAUTION

When installing/removing the weapon carrier and while handling the weapon, be particularly careful to avoid damaging the safety switch. When the weapon is preloaded on accessory suspension equipment, do not install the safety switch until the weapon has been positioned on the skid adapter. Failure to orient the switching unit retaining nut can result in damage to the arming safety switch. Damage could also result to the ejector foot of the BRU-10 bomb ejector rack.

a. Plug the male connector of the switching unit firmly into the bomb charging receptacle, piercing the diaphragm. Then, slide the switching unit retaining nut, threads down, over the cable and lanyard.

b. Secure the arming safety switch in the bomb charging receptacle by screwing the

switching unit retaining nut into the bomb and tightening it with the wrench supplied. When the nut is seated on the top of the switching unit, back it off until the flattened sides of the switching unit retaining nut are at right angles to the length of the bomb. This allows clearance for the ejector foot of the BRU-10 bomb ejector rack.

CAUTION

Take special care of the coaxial cable and the lanyard of the arming safety switch to prevent damage during bomb moving and loading operations.

c. Insert the free end of the cable through the nearest bomb suspension lug to safeguard the cable.

Assembly of Mk 15 Snakeye Fin Assembly to the Mk 82 Aircraft General-Purpose Bomb

The Mk 15 Snakeye fin assembly is available in Mods 1, 1A, 2, 2A, 3, 3A, 4, and 4A. On Mods 1 and 2 fins, the fin attaches to the bomb by means of a retaining ring in the V-groove of the bomb. The retaining ring expands in a semi-circular groove in the flange of the fin support tube. On Mods 3 and 4 fins, attachment is provided by eight setscrews. On Mods 1 and 2 fins, the shock of fin opening is absorbed by a plunger that expands a sleeve. On Mods 3 and 4 fins, the shock of fin opening is absorbed by the crushing of a convoluted steel tube. The fin support tube has a fuze mounting ring for attaching the tail drive of a mechanical tail fuze. A guide tube that reduces fin release wire breakage is supplied with each Mod 1 fin and is installed externally. On Mods 2, 3, and 4 fins, this tube is an integral part of the fin. Mods 2, 3, and 4 fins have a release band clamp that retains the band after fin opening to prevent possible aircraft damage.

The bomb fin modification of the original Mk 15 Mods 1, 2, 3, and 4 fins consists only of a longer (approximately 1/2-inch) bomb fin release band to accommodate the larger diameter of a thermally protected bomb. However, the longer fin release bands can be used on a nonthermally protected bomb when the short fin release bands are not available.

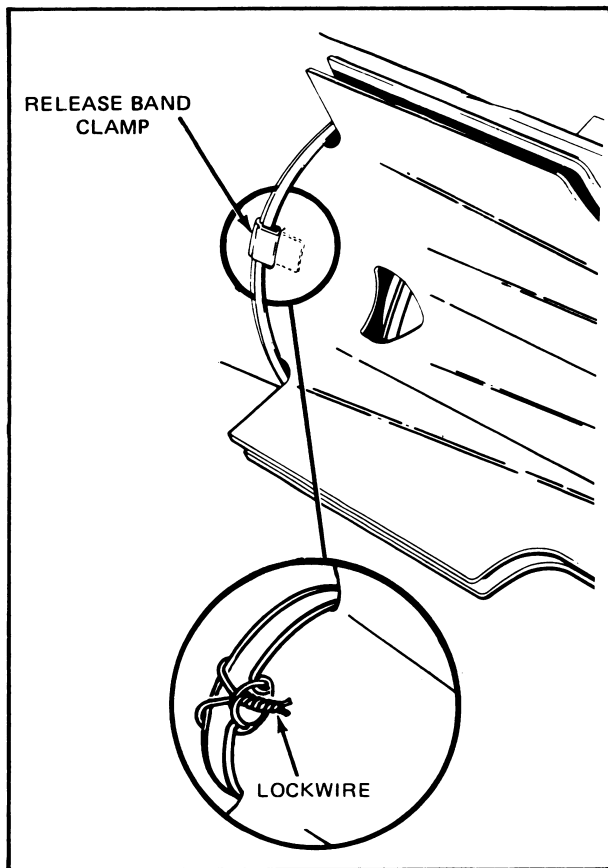


Figure 12-34.—Release band clamp.

GENERAL PROCEDURES.—The Mk 15 Snakeye fin is assembled on the Mk 82 aircraft general-purpose bomb. First, you need to remove the fin assembly and, where present, the guide tube and suspension lugs from the shipping crate. Then, verify that the release band clamp (fig. 12-34) is installed on the fin. When the release band clamp is missing, lockwire the release band to the bottom blade of the fin (fig. 12-34) by winding two turns of the arming or safety wire (minimum of .030-inch diameter) around the release band, and inserting the wire through the adjacent slot in the fin. Then, twist the ends together and bend them back against the fin.

Fin Release Bands.—When interference exists between the Mk 15 fin blades and the thermal coating on the bomb body, you replace the fin release band. You use the following procedures to replace fin release band part number 1568356 (or 341AS109-1)

with the longer fin release band part number 2880289B (or 341AS109-2).

1. Clamp the fins together with vise-grip pliers.

WARNING

The fin release band and fin are spring-loaded. Therefore, to prevent injury or damage release the band with caution.

2. Remove the cotter pin from the fin release band latch. Remove the fin release band and clamp.

3. Install the longer release band and the lockwire, then relatch the release band and insert a tagged cotter pin. Ensure all four ears of the fin release band are inserted in the fin slots.

4. Remove the vise-grip pliers.

Damage and Corrosion Inspection.—Inspect the fin for damage and corrosion. Fins with excessive corrosion or damage must not be used.

1. Ensure the release band is free of Cosmoline preservative.

2. Remove the cotter pin from the fin latch and remove the fin release band. Ensure the latches open freely.

3. When the fins extend automatically (at least 1/2 inch when the release band is removed) and can be extended to contact the shock absorber by hand, the fin is operative. Inoperative fins must not be used.

4. Fin release bands that are damaged or corroded should be replaced.

MK 15 MOD 1 FIN ASSEMBLY.—When the Mk 15 Mod 1 fin assembly is used, ensure the guide tube clamp is installed. If the guide tube clamp is not installed, it may be installed as follows:

1. Mark the location using a center punch. Drill one No. 26 hole (for a No. 8 self-tapping screw) or a No. 23 hole (for a No. 20 self-tapping screw) approximately 15 inches forward of the aft end and 1/2 inch below the top of the round edge

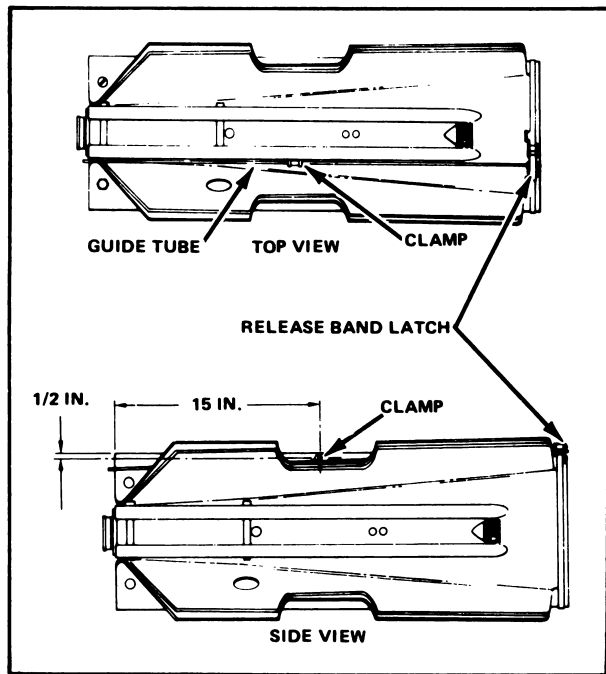


Figure 12-35.—Installation of guide tube clamp (Mod 1 fin).

of the right-hand fin rib. This is for installation of the clamp, as shown in figure 12-35.

NOTE: A sheet metal or plywood template may be constructed to expedite this operation when several fin assemblies are drilled at one time.

2. Fit the release wire guide tube in the clamp. The clamps are available through normal supply channels or from local stock. Secure the clamp to the fin with a No. 8 or a No. 20 self-tapping screw. Tighten the screw while holding the forward end of the tube against the aft side of the release band latch.

MK 15 MOD 1 AND MOD 2 FIN ASSEMBLIES.—The Mk 15 Mods 1 and 2 fin assemblies are installed on an electrically fuzed bomb body as follows:

1. Electric and mechanical fuzes are installed in the same manner discussed earlier for the conical finned bombs.

2. Verify that the safety pin is installed in the pop-out pin.

3. Remove the gold-colored retaining ring (ink stamped 10001-155525) from the fin by squeezing

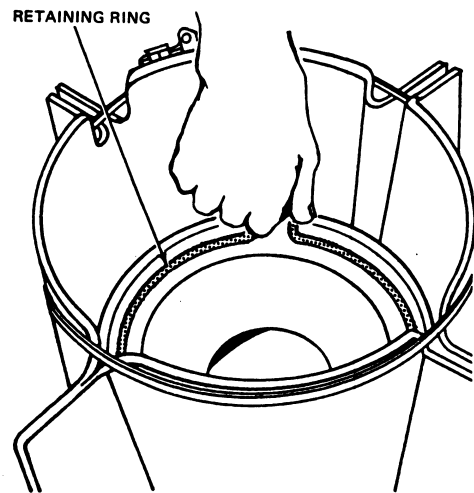


Figure 12-36.—Removal of retaining ring by squeezing ears of ring.

the two projecting ears of the ring together. (See fig. 12-36.) Ensure the garter spring does not unseat.

CAUTION

When installing a retaining ring, be sure that the ears of the retaining ring point forward.

4. Place a silver-colored retaining ring (ink stamped 30003-2602857) in the aft V-groove of the bomb body with the ears pointing forward. (See fig. 12-37.)

NOTE: If a new retaining ring ink-stamped 30003-2602857 is not available, the old ring ink-stamped 10001-155525 may be used when the ring seats fully in the V-groove, the ears are at least 1 3/4 inches apart, and postassembly check points are verified.

5. Squeeze the ears together and lock them in place by means of the small keeper on the ring. (See figure 12-38.)

6. Place the ears so they straddle the 12 o'clock position hole on the bomb. (See figures 12-36 and 12-37.)

7. Attach an Mk 3 arming wire to the aft lug in the manner discussed earlier for the conical finned bomb.

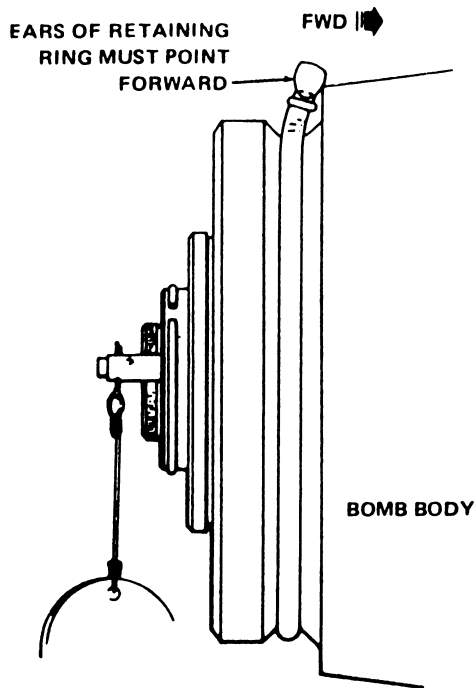


Figure 12-37.—Ears pointing forward at 12 o'clock position hole.

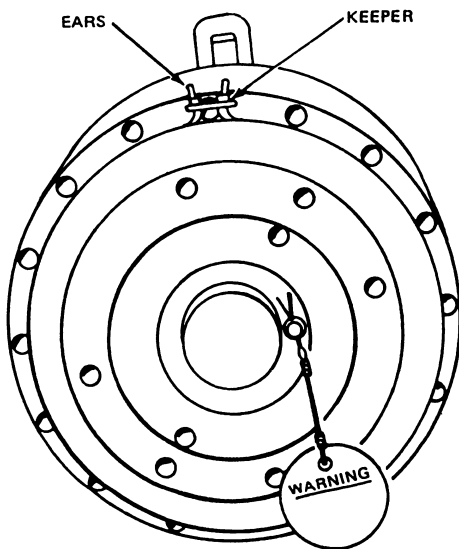


Figure 12-38.—Ears straddling 12 o'clock position hole.

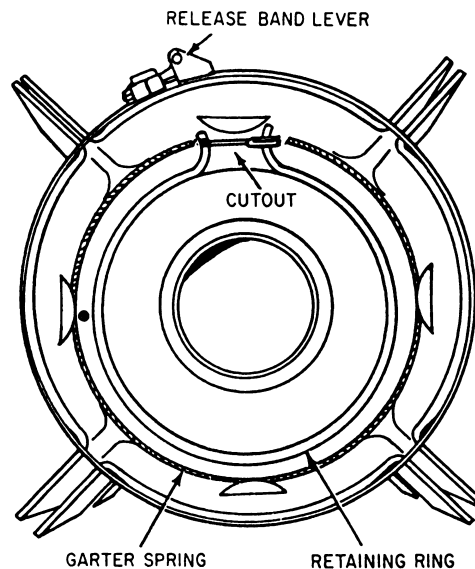


Figure 12-39.—Relationship of cutout in flange to release band lever.

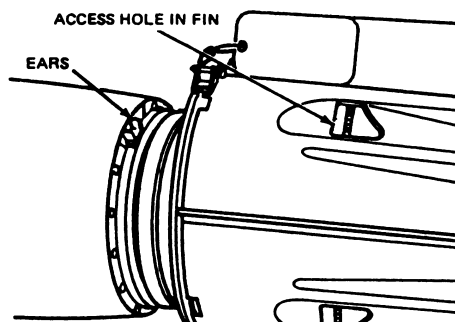


Figure 12-40.—Fin oriented to bomb body.

8. With the ears of the retaining ring in the proper position, orient the fin to the bomb body. The cutout in the fin support must align with the ears of the retaining ring. (See figures 12-39 and 12-40.)

9. Back off the fin just enough to provide working room for installing the arming wire in the tail fuze.

10. Using the access hole in the fin for the arming wire entry, insert the free end of the arming wire into the small hole near the cutout in the fin support.

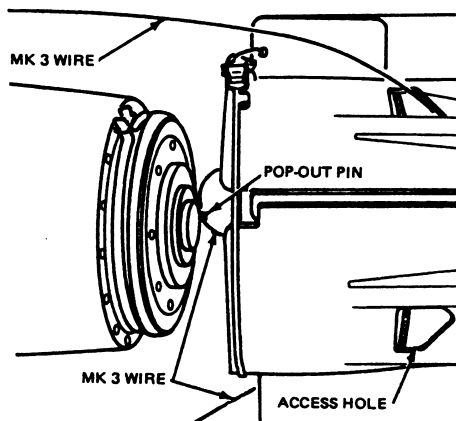


Figure 12-41.—Mk 3 arming wire routed through fin and pop-out pin.

11. Thread the arming wire through the pop-out pin of the tail fuze. (See figure 12-41.) Then pass the arming wire through the small hole at the bottom of the fin support.

12. Remove the safety pin from the pop-out pin.

13. With the cutout in the fin support aligned with the ears of the retaining ring, and while keeping the arming wire taut, press the fin against the bomb body. Make sure that the index pin in the fin support engages the index hole in the bomb body.

14. With a screwdriver, rotate the keeper on the retaining ring to free the ears of the ring. (See figure 12-42.)

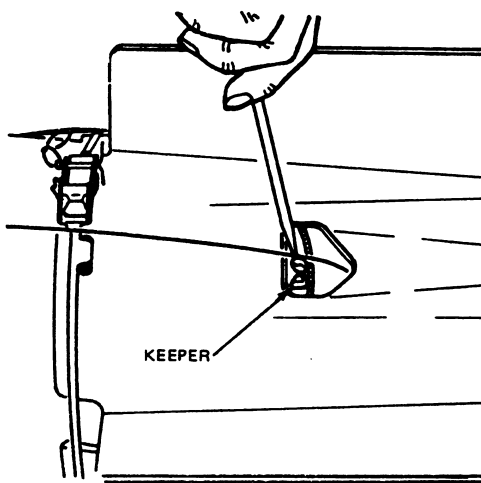


Figure 12-42.—Retaining ring ears feed with screw driver.

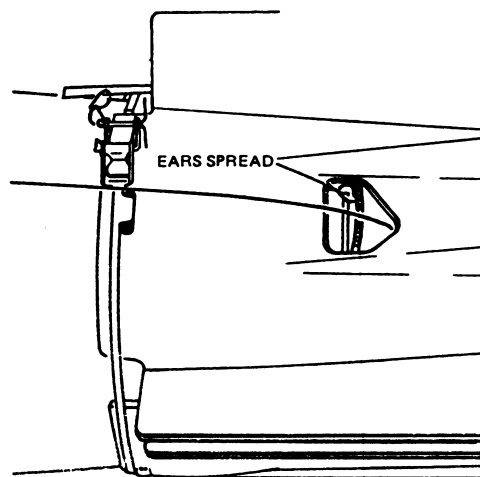


Figure 12-43.—Retaining ring snapped into semicircular groove in fin support.

15. Allow the retaining ring to snap into the semicircular groove in the fin support. (See figure 12-43.) This locks the fin assembly to the bomb body.

WARNING

Ensure that the retaining ring seats. When it is properly seated, the ears must be pointing forward and be 1 1/2 to 1 3/4 inches apart—at least 1 3/4 inches apart for the old ring. When doubt exists about the proper seating, spread the ears by holding one ear and tapping the other with a suitable tool.

16. Check to make sure the ears are 1 1/2 to 1 3/4 inches apart. The ears should be at least 1 3/4 inches apart for the old ring.

17. Keeping the fin pressed against the aft end of the bomb, you should peel the garter spring out of its groove by using a screwdriver or your fingers (fig. 12-44). Then work it through the four access holes in the fins.

18. Feed the spring into the space between the bomb and the fin. After this is done, pull the fin back, allowing the garter spring to contact and seat in the gap between the bomb and the fin support. (See figure 12-45.) A few shakes on the fin aids in seating the spring.

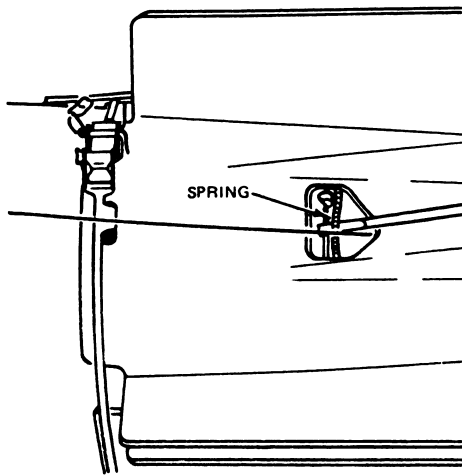


Figure 12-44.—Peeling garter spring out of groove with screwdriver.

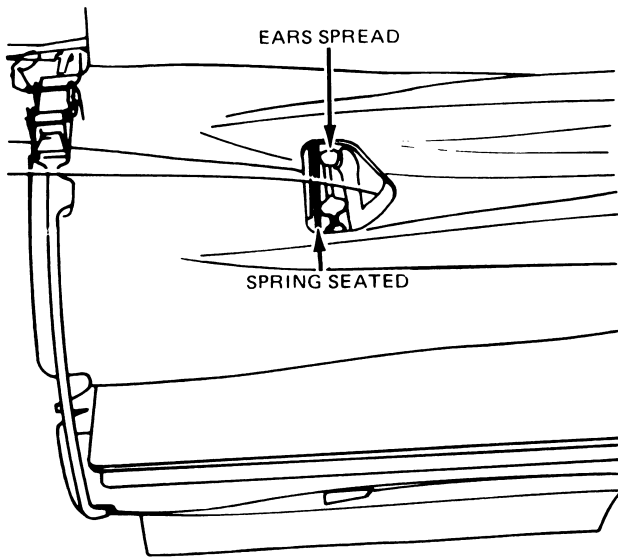


Figure 12-45.—Garter spring seated between bomb and flange.

WARNING

Ensure that the garter spring seats in the gap between the bomb and the fin support. An improperly installed garter spring can result in loss of the fin.

19. Check the seating of the garter spring through the four access holes in the fins. The

spring must seat firmly, but not necessarily equal, all around. The index pin will cause a slight hump in the spring; this is normal.

20. Remove and discard the plastic cap from the aft end of the fin support. Look through the hole in the aft end to ensure the Mk 3 arming wire passes through the pop-out pin and that the safety pin is removed.

21. Alternately pull on the top and bottom of the arming wire to ensure that the wire is free. When the wire is not free, remove the fin, inspect the wire for kinks, and replace the wire if necessary.

22. Leave the entire wire uncut and wrap it around the fin, putting excess wire in the hole at the top of the fin. Do not install any Fahnestock clips. The pop-out pin holds the arming wire securely in place.

23. Install the Mk 122 arming safety switch as discussed earlier for the conical-finned bomb.

24. On the Mk 15 Mod 1 fin only, verify that the arming wire guide tube is secured to the fin with a clamp. (See figure 12-46.) Ensure that the tube aligns with the fin release wire holes in the release band lever. Insert the fin release wire through the guide tube, as shown in

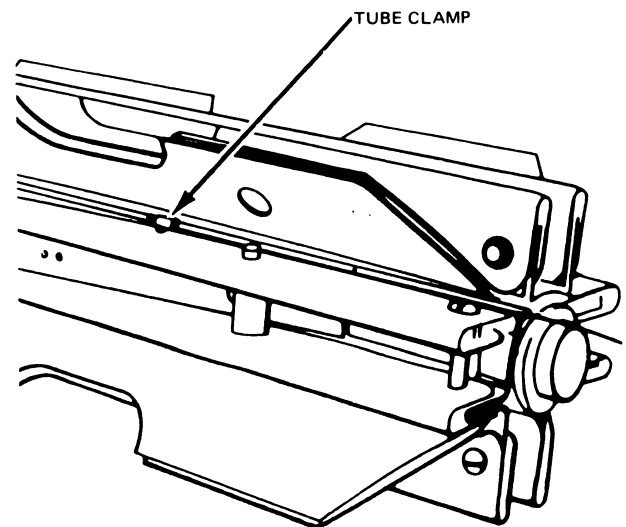


Figure 12-46.—Fin release wire guide tube and clamp installed (Mod 1 fin).

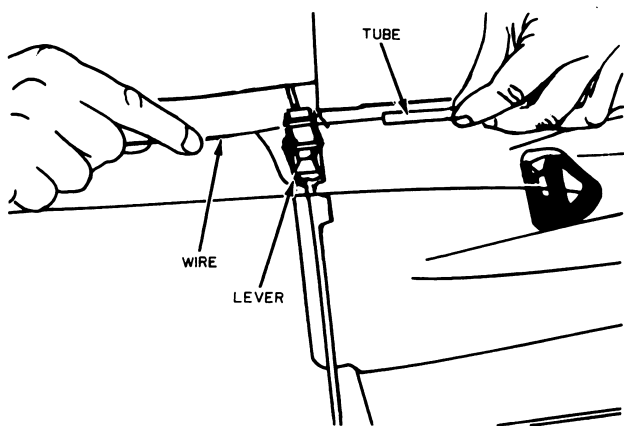


Figure 12-47.—Installing fin release wire in guide tube.

figure 12-47. Disregard all warning decals on the fin concerning Fahnestock clips. When the fin release wire guide tube is not available, use aluminum tubing of 1/4-inch outside diameter and 0.035- to 0.049-inch wall thickness. Cut the tubing to a length of $27 \frac{1}{8} \pm 1/16$ inches.

25. On the Mk 15 Mod 2, install the fin release wire through the release band and into the slot in the top of the fin blade. (See figure 12-48.) Feed the wire into the fin blade until it emerges from the aft end of the fin. Disregard all warning decals on the fin concerning Fahnestock clips.

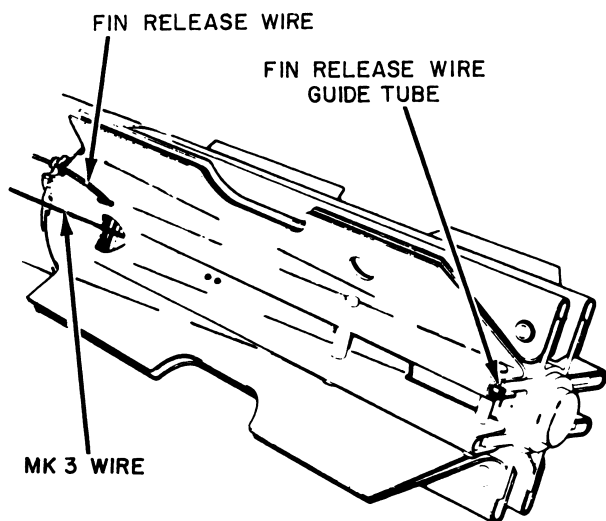


Figure 12-48.—Installing fin release wire in guide tube.

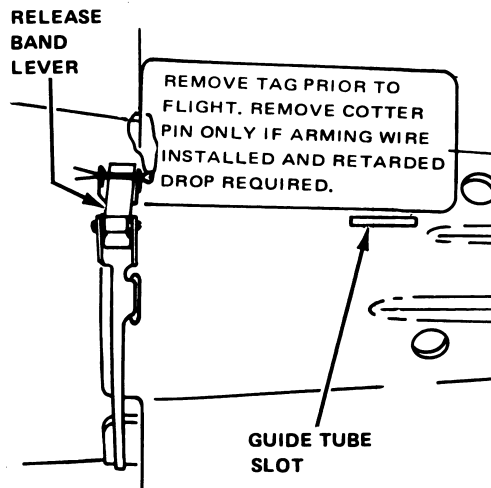


Figure 12-49.—Release band lever aligned with guide tube slot (Mod 3 and Mod 4 fins).

MK 15 MOD 3 AND MOD 4 FIN ASSEMBLIES.—The Mk 15 Mods 3 and 4 fin assemblies are assembled to an electrically fuzed bomb body as follows:

1. Install electric and mechanical fuzes as discussed earlier for the conical-finned bombs.
2. Verify that the release band lever is aligned with the guide tube slot, as shown in figure 12-49.
3. Verify that the setscrews do not protrude beyond the inside surface of the fin support.
4. Attach the Mk 3 arming wire to the aft lug of the bomb, as discussed earlier for the conical-finned bomb.
5. Orient the fin to the bomb body so the index pin in the fin support aligns with the fourth index hole clockwise from the 12 o'clock position hole in the bomb.
6. Hold the fin just far enough from the bomb to provide working room for arming wire installation in the tail fuze.
7. Using the access hole in the fin for wire entry, insert the free end of the arming wire into the small hole in the fin support.
8. Thread the arming wire through the pop-out pin of the tail fuze. (See figure 12-50.) Then pass the wire through the small hole at the bottom of the fin support.
9. Remove the safety pin from the pop-out pin.
10. Keeping the arming wire taut, press the fin against the bomb. Ensure the index pin in the fin support engages the fourth index hole from the 12 o'clock position hole in the bomb.

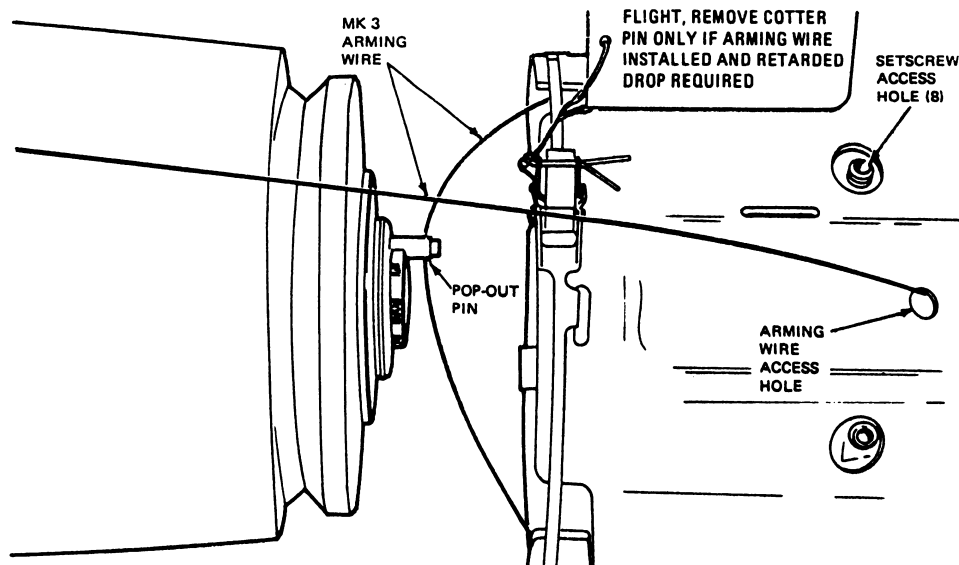


Figure 12-50.—Routing of arming wire Mk 3 (Mod 3 and Mod 4 fins).

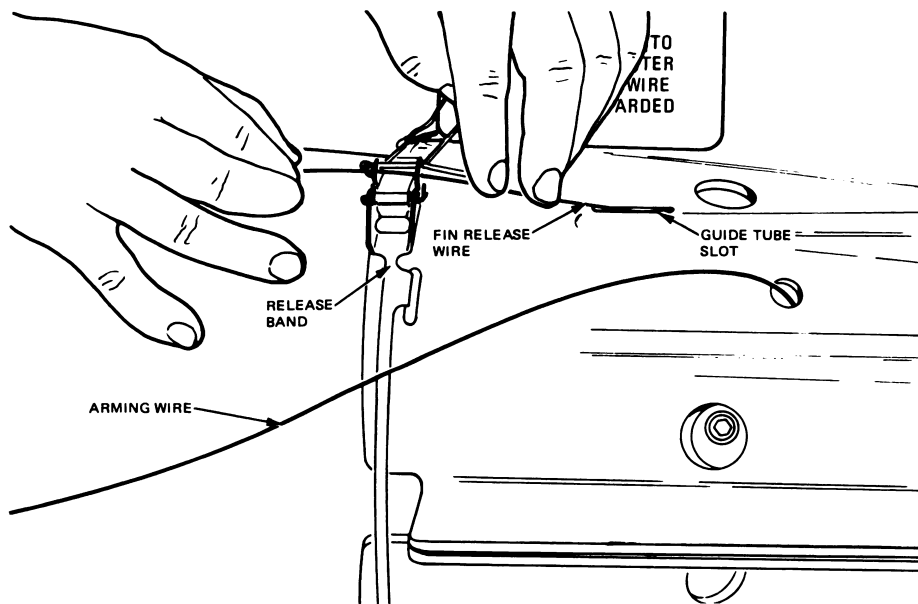


Figure 12-51.—Fin release wire routing (Mod 3 and Mod 4 fins).

11. Tighten the setscrews into the V-groove of the bomb.

12. Remove and discard the plastic cap from the aft end of the fin support. Look through the hole in the aft end to ensure the arming wire passes through the pop-out pin and the safety pin is removed.

13. Alternately pull on the top and bottom of the arming wire to ensure the wire is free. When the wire is not free, remove the fin, inspect the wire for kinks, and replace the wire if necessary.

14. Leave the entire wire uncut and wrap it around the fin, putting the excess wire in the hole in the top of the fin. Do not install any Fahnestock clips. The pop-out pin holds the arming wire securely in place.

15. Install the Mk 122 arming safety switch, discussed earlier in this chapter, for the conical-finned bomb.

16. Install a fin release wire through the release band and into the slot in the top of the fin blade. (See figure 12-51.) Feed the wire into the slot in the fin blade until it emerges from the

aft end of the fin. Disregard all warning decals on the fin concerning Fahnestock clips.

If you want more information about the configuration and assembly procedures for the Mk 80 series aircraft general-purpose bombs, you should refer to *Aircraft General Purpose Bombs, Fire Bombs, Practice Bombs, Fuzes, and Associated Components*, NAVAIR 11-5A-17.

REVIEW NUMBER 9

- Q1. For information about Mk 80 weapons assembly, you should refer to _____.
- Q2. A maximum _____ of thermal coating can be missing from a Mk 80 bomb, and the bomb is still considered thermally protected.
- Q3. What mechanical nose fuze is used with the thermally protected Mk 80 bomb?
- Q4. You should use a _____ diameter fuze with the T46 adapter booster.
- Q5. What tool should you use to tighten a Mk 346 fuze in a Mk 80 bomb?
- Q6. List the arming assemblies that provide arming action for Mk 346 long-delay time fuzes.
- Q7. When using preloaded accessory suspension equipment, you install the Mk 43 TDD in Mk 80 bombs during _____.
- Q8. What electric tail fuze should you use in Mk 80 retarded bombs?
- Q9. To obtain airburst capability, a _____ is used with an electric tail fuze.
- Q10. A Mk 344 or Mk 376 electric tail fuze has a _____ life after removal from their container.
- Q11. Mk 122 arming safety switches are installed in Mk 80 bombs in a _____.
- Q12. Mk 15 Mods 3 and 4 fins are attached to Mk 80 bombs by means of _____.
- Q13. Describe the actions taken if interference exists between Mk 15 blades and the thermal coating on the bomb body.
- Q14. In what position are the ring ears on a Mk 80 bomb with a Mk 15 Mod 1 or Mod 2 fin?

PRACTICE BOMBS

The practice bombs normally used on a routine basis are the Mk 76 Mod 5 and the Mk 106 Mod 5. You don't need to assemble practice bombs. However, you do need to prepare, inspect, and install the signals. These procedures are discussed briefly in the following paragraphs.

Mk 76 Mod 5 Practice Bomb

The Mk 76 Mod 5 practice bomb is prepared for aircraft loading as discussed in the following steps:

WARNING

Be extremely careful when handling a practice bomb loaded with a signal. Jarring or dropping the bomb may detonate the signal. Do not, under any circumstances, point either end of the bomb toward another person. Loading personnel must not place their bodies in line with the nose or tail end of a bomb.

1. Remove the bomb from the cardboard container. The Mk 76 Mod 5 practice bomb is shipped with two bombs to a container.

2. Remove the cotter pin and Mk 1 firing-pin assembly from the nose. Inspect it for rust and deformation. Ensure the firing-pin cup is not

deformed and the firing-pin point is below the lip of its cup.

3. Inspect the blast tube for rust and obstructions. Clean as required. When any obstructions are noted, proceed as follows: Insert a plug gauge SK923AS503 into the center cavity. The gauge should slide into place until the shoulder rests flush against the bomb. When the gauge shoulder does not rest against the bomb, the cavity is not clear. When the obstruction cannot be removed, reject the bomb as unserviceable and dispose of it by following current instructions.

WARNING

A signal cartridge must not be swollen or deformed in any manner. The primer must be flush with or slightly below the base of the cartridge. A signal cartridge that is deformed in any way must not be used. Attempting to install a deformed signal can cause detonation. A signal must not be unpacked before it is required. When a signal cartridge is used, it must be taken from the shipping container and installed directly into the practice bomb. An interim container cannot be used. Extreme care must be used when handling a signal cartridge. When a practice bomb is not used after the signal has been installed, the signal must be gently removed and replaced in the original shipping container. The firing-pin assembly and signal cartridge must slide into place under their own weight. Do not apply pressure to force the signal cartridge or firing-pin assembly into the bomb because the assembly could become deformed and fire the signal.

4. With the firing-pin assembly removed, elevate the nose of the bomb. Insert the Mk 4 or CXU-3A/B practice bomb signal, primer end up, into the nose of the practice bomb. Slide it gently into place. Do not use force. The base flange of the signal cartridge must rest on the bore shoulder, which is about 1 1/4 inches inward from the nose of the bomb.

5. Carefully insert the firing-pin assembly with the firing-pin end toward the signal.

6. Rotate the firing-pin assembly so that the two notches in the lip of the forward cup line up with the cotter pin holes in the nose end of the bomb. Do not apply pressure to the firing pin during this procedure.

7. Insert the cotter pin through the pin holes in the bomb body. Pass it through the notches in the firing-pin assembly. Spread the ends of the cotter pin just enough to retain it in place.

Mk 106 Mod 5 Practice Bomb

The Mk 106 Mod 5 practice bomb is prepared for aircraft loading as discussed in the following steps:

NOTE: The warnings discussed for the Mk 76 Mod 5 also apply to the Mk 106 Mod 5.

1. Remove the bomb assembly from the container. The Mk 106 Mod 5 practice bomb is shipped six bombs to a container.

2. Remove the firing device and sleeve from the nose of the bomb and inspect it for rust or deformation. Refer to figure 12-52 for identification of the components.

3. Inspect the blast tube for rust and deformation. Clean as required.

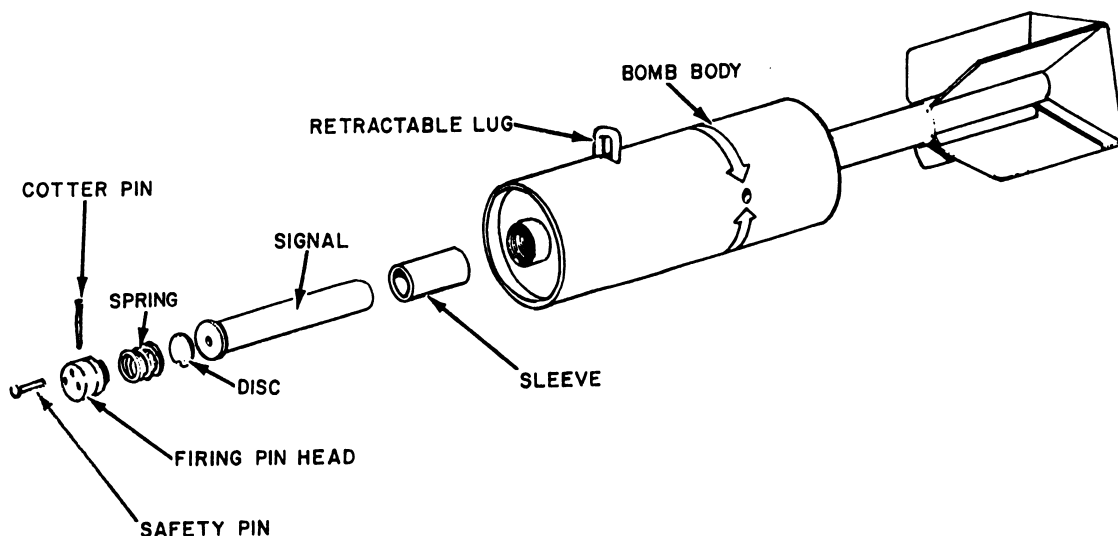


Figure 12-52.—Mk 106 and Mods practice bomb.

4. Insert the signal into the sleeve. With the firing device removed, elevate the nose of the bomb. Insert the Mk 4 or CXU-3A/B practice bomb signal, primer end up, and slide it gently into place. Do not use force. The base flange of the signal cartridge must rest on the bore shoulder.

5. Carefully screw the firing device into the nose of the bomb until it is fully seated with the

safety disc on the end of the spring toward the signal.

6. Verify that the safety pin and the cotter pin are installed in the firing device.

For detailed information concerning the preparation of practice bombs for aircraft loading, refer to the publication NAVAIR 11-5A-17.

REVIEW NUMBER 9 ANSWERS

- A1. *For information about Mk 80 weapons assembly, you should refer to Airborne Weapons Assembly Manual, NAVAIR 11-140-5.*
- A2. *A maximum 7 square inches of thermal coating can be missing from a Mk 80 bomb, and the bomb is still considered thermally protected.*
- A3. *An M904E4 mechanical nose fuze with an M148E1 adapter booster is used with the thermally protected Mk 80 bomb.*
- A4. *You should use a 1.5-inch diameter fuze with the T46 adapter booster.*
- A5. *A spanner wrench is used to tighten a Mk 346 fuze in a Mk 80 bomb.*
- A6. *The arming assemblies used for arming action for Mk 346 long-delay time fuzes include Mk 3, 4, and 5 arming assemblies.*
- A7. *When using preloaded accessory suspension equipment, you install the Mk 43 TDD in Mk 80 bombs during weapons assembly.*
- A8. *Only the Mk 736 electrical tail fuze is used in Mk 80 retarded bombs.*
- A9. *To obtain airburst capability, a Mk 43 TDD is used with an electrical tail fuze.*
- A10. *A Mk 344 or Mk 376 electric tail fuze has a 3-day life after removal from their container.*
- A11. *Mk 122 arming safety switches are installed in Mk 80 bombs in a RADHAZ-free environment.*
- A12. *Mk 15 Mods 3 and 4 fins are attached to Mk 80 bombs by means of eight setscrews.*
- A13. *If interference exists between Mk 15 blades and the thermal coating on the bomb body, you should replace the fin release band with a longer one, part No. 2880289B or 341ASI09-2.*
- A14. *On a Mk 80 bomb with a Mk 15 Mod 1 or Mod 2 fin, fin ears are installed in the 12 o'clock position, pointing forward.*

FIRE BOMBS

The Mk 77 Mod 4 fire bomb allows the Mk 13 initiator (primary fuzing system) to be used on the Mk 273 Mod 0 with the M918 fuze (secondary fuzing system). They are installed in the fire bomb filler holes.

WARNING

Fire bombs are thin-skinned and must be handled with care to avoid puncture.

Prepare the Mk 77 Mod 4 fire bomb for aircraft loading by using the following steps.

1. Remove the bomb body from the shipping crate.
2. Check the bomb and suspension lugs for damage, broken weldments, or cracks that might weaken the suspension or cause leaks in the casing. Dispose of unserviceable bombs and components according to current directives.
3. Verify the presence of filler caps and retainer rings.
4. Check filler caps for presence of sealing gaskets.

WARNING

A bomb must be used or disposed of when it is filled. Tanks must not be emptied and then returned to stowage because of residual explosive vapors. A minimum air space of 3 percent of the capacity of the bomb is required. This prevents it from rupturing due to expansion. Empty bombs should not be loaded on the aircraft and then filled with fire-bomb mix. A partially filled bomb is hazardous to both the aircraft and the pilot.

5. With the filler holes located at the 12 o'clock position, fill the bomb through one of the filling holes to within 1 1/2 inches of the bottom of the filling hole. This leaves a minimum air space of 3 percent of the capacity of the bomb. Both filler caps should be removed, even if the bomb is filled through one hole.
6. When using Mk 273 Mod 0 igniters, install them in the filling holes and secure them into place with the retainer ring by using a spanner wrench.
7. When using Mk 13 initiators, install them into the filler holes immediately after completing

the filling procedures. The filling procedure should be done as follows:

- a. Remove the initiator from the shipping container.

NOTE: When using the Mk 273 Mod 0, the M918 mechanical bomb fuze must not be installed until the fire bomb has been loaded onto the aircraft.

WARNING

In a fire involving the initiator, high temperatures and flying metal particles are present. Avoid prolonged breathing of the fumes.

- b. Inspect the initiator and reject all items that do not satisfy the inspection requirements.
- c. Verify that the date on opened containers indicates that the fuze has been repackaged within the past 30 days.

WARNING

Fuzes with the tear-top torn off and the arming vane popped up are assumed to be armed. Call EOD personnel immediately.

- d. Verify that the tear-top has not been torn off or opened, even slightly.
- e. Inspect for evidence of structural damage and corrosion.
- f. Fill the fire bomb with appropriate gel mixture.
- g. Replace the spare lanyard in the cover; then replace the cover on the initiator.
- h. Immediately after the fire bomb has been filled, verify the presence of the O-ring on the initiator and install it into a filler hole. Ensure the notch in the igniter mates with the key on the filler hole ring. This ensures the proper orientation of the fuze tear-tab.
- i. Use a spanner wrench to secure the initiator with the filler cap retaining ring.

For more information about the preparation of fire bombs, you should refer to *Fire Bombs*, NAVAIR 11-140-18, and *Fueling Gelling Unit Mk 1 Mod 1*, NAVAIR 19-1-112.

5.0-INCH AIRBORNE ROCKET ASSEMBLY PROCEDURES

The following 5.0-inch airborne rocket assembly procedures are used when you load the LAU-10 airborne rocket launcher. The LAU-10 airborne rocket launcher is discussed in chapter 4 of this TRAMAN. If the rocket launcher is being reused, it must be sent to AIMD for electrical checkout prior to loading.

The 5.0-inch rocket components may be received as follows: The rocket motors pre-loaded in the 4-round LAU-10 launcher and the fuze/warhead combinations shipped in separate shipping containers, or all rocket components shipped in separate authorized shipping containers.

Unpacking Rocket Components

Rocket motors and other rocket components are unpacked as discussed in the following steps:

WARNING

Banding straps are under tension. Care must be used in cutting them to prevent injury.

1. Open wooden shipping crates using hand tools such as shears or steel strap cutters. Cut or untwist the securing wires from the metal containers with shears or pliers. Remove the end pans from the launcher shipping containers.

2. When opening containers, use nonsparking tools. Keep all containers in a horizontal position while opening them. During the assembly procedure, keep the rocket warheads and motors in a horizontal position. This decreases the possibility of accidents.

3. All retrograde items such as metal boxes, wooden boxes, spacers, and thread protectors are removed from the components in preparation for assembly. These retrograde items must be disposed of according to current directives.

Inspecting Rocket Components

As the rocket components are removed from their shipping containers, inspect them by performing the steps listed below. Dispose of defective items according to current directives. The components you inspect include warheads,

fuzes, and rocket motors, to include their fins.

WARNING

To avoid personal injury and equipment damage in an operation involving assembly, disassembly, fuzing, defuzing, or cleaning, you must do the work in a designated area. This area must be safely located away from other explosives and vital installations. Only the smallest number of rockets practicable should be exposed. Only authorized personnel essential to the work should be permitted in the vicinity. Refer to the publication NAVAIR 16-1-529/NAVORD OP 3565 for RADHAZ procedures and precautions.

WARHEADS.—Inspect the warheads as follows:

WARNING

Warheads that are cracked or have a gap between the fuze adapter and the warhead are hazardous.

1. Verify that the warhead is not cracked and no gap exists between the fuze adapter and the warhead.

2. On the Mk 32 warhead, verify that the fuze is staked.

3. Verify that the base and fuze cavity threads are not damaged or corroded.

WARNING

Do not use a warhead that does not have the base fuze hole closed by a steel plug or a base fuze. Base fuzes must not protrude more than 1/16 inch. Detonation could occur during handling or firing.

NOTE: Do not disassemble base adapters from the warheads to check for base plugs.

4. Verify that the warhead contains a base fuze or a steel base plug. When installed, ensure the base fuze does not protrude more than 1/16 inch.

5. When the warhead is received without a fuze installed, examine the interior of the fuze cavity to verify there are no obstructions.

FUZES.—Inspect the fuze as follows:

WARNING

Fuzes that are damaged are hazardous. Detonation may occur.

CAUTION

Do not use Mk 93/M414 fuzes with nose cones that are completely penetrated by scratches, cracks, or abrasions. Minor scratches or abrasions do not affect their performance or safety.

1. Verify that the fuze body is not damaged.
2. Check the fuze threads for damage or corrosion.

ROCKET MOTORS.—Inspect the motor as follows:

1. Verify that the motor tube is not dented, deeply scratched, gouged, or corroded.

WARNING

Use a metal shielding band assembly only. Do not substitute the Mk 71 motor plastic fin retainer band because it offers no RADHAZ protection.

NOTE: Rocket motors packaged in individual wooden containers may be received with the old narrow metal shielding band (P/N 1516140) installed. This band is obsolete and must be replaced with shielding band assembly P/N 4902192 when unloaded from the launchers.

2. Verify that the shielding band and the RADHAZ barrier are in place.
3. Verify that the nozzle plug is in place.
4. For rocket motor Mk 16, verify that the fin retainer is in place, the fins are not bent or broken, and the roll pins are intact and do not protrude more than 1/16 inch.
5. For rocket motor Mk 71, verify that the fin retainer is in place, the fins are not bent or broken, and the fin pin is clean and free of foreign matter.
6. The motor contact bands, motor tube threads, and nozzle and fin assembly must be clean and free of grease or other lubricants.

7. Verify that the electrical connector is not broken or the insulation damaged. This is on motors without RADHAZ barriers.
8. Check threads for damage or corrosion.

Assembly of Rocket Components

Rocket components are assembled as discussed in the following steps:

CAUTION

When assembling warheads to motors shipped in the launcher, the motors should be removed from the launcher to prevent damage to the motor fins. Before assembly, the motors should be placed on an appropriate assembly stand.

WARNING

Shielding bands must be in place whenever the rocket motor is out of or protrudes from the launcher. Ensure the shielding band covers the contact band but does not touch it.

1. Slide the rocket motor out of the launcher tube until the contact band is exposed. Install a shielding band (fig. 15-53) on the rocket motor according to instructions on the shielding band. Ensure the latching tabs seat in the launcher detent groove on the motor.
2. Remove the rocket motor from the launcher. For Mk 71 motors, replace the fin

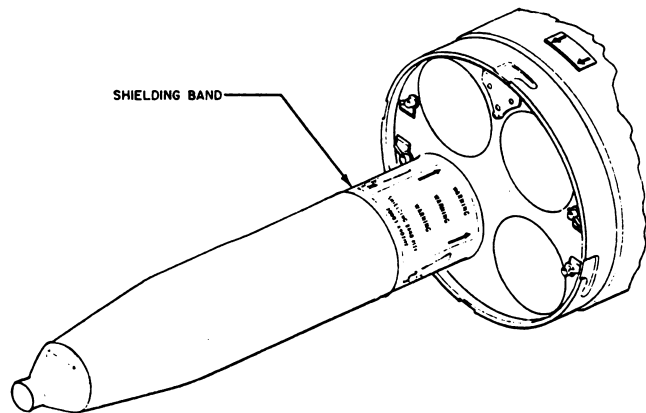


Figure 12-53.—5.0-inch rocket RADHAZ and electrostatic protection.

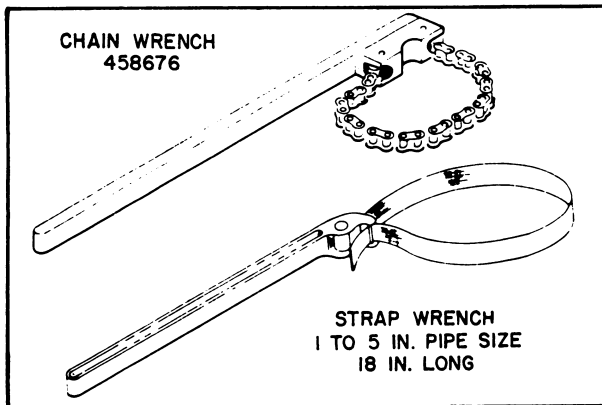


Figure 12-54.—Chain and strap wrenches.

retainer when the fins begin to emerge from the launcher tube.

NOTE: A special chain wrench or strap wrench (fig. 12-54) is used to attach the warhead to the motor.

3. To install the warhead, hold the motor with a strap wrench and screw the warhead into the motor. Tighten the warhead with a chain wrench until it seats on the motor for a full 360 degrees.

WARNING

Do not attempt to remove a base fuze. When removal is attempted, detonation may occur.

CAUTION

When installing Mk 34 and Mk 63 warheads, use the chain wrench only in the area indicated by the decal. This prevents damage to the warhead.

NOTE: Practice warheads Mk 6 Mod 7 and Mk 32 Mod 0 may be found with nylon thread inserts less than 180 degrees apart. In these warheads, a groove may be cut in one insert only. This facilitates assembly of the warhead to the motor.

NOTE: A torque wrench kit consisting of a torque wrench and two crowfoot wrenches is used for tightening the fuze to the warhead.

4. When directed to fuze the warhead, attach the appropriate nose fuze and tighten it with the torque wrench and crowfoot adapter (fig. 12-55) to 55 ± 5 foot-pounds. For this procedure, hold the warhead with either a strap or chain wrench.

For detailed information concerning the assembly procedures of airborne rockets, you should refer to *Airborne Rockets*, NAVAIR 11-85-5.

REVIEW NUMBER 10

Q1. List the two practice bombs normally used.

Q2. List the two practice bomb signals used with the Mk 76 practice bomb.

Q3. You can ship _____ in a container.

Q4. To what publication should you refer for detailed information about practice bombs?

Q5. What tool should you use to install a Mk 274 igniter into a fire bomb filling hole?

Q6. List the publications you should refer to for information about fire bombs.

Q7. A rocket warhead base can protrude a maximum of _____.

Q8. What should you use as a guide when using a chain wrench on Mk 37 and Mk 63 rocket warheads?

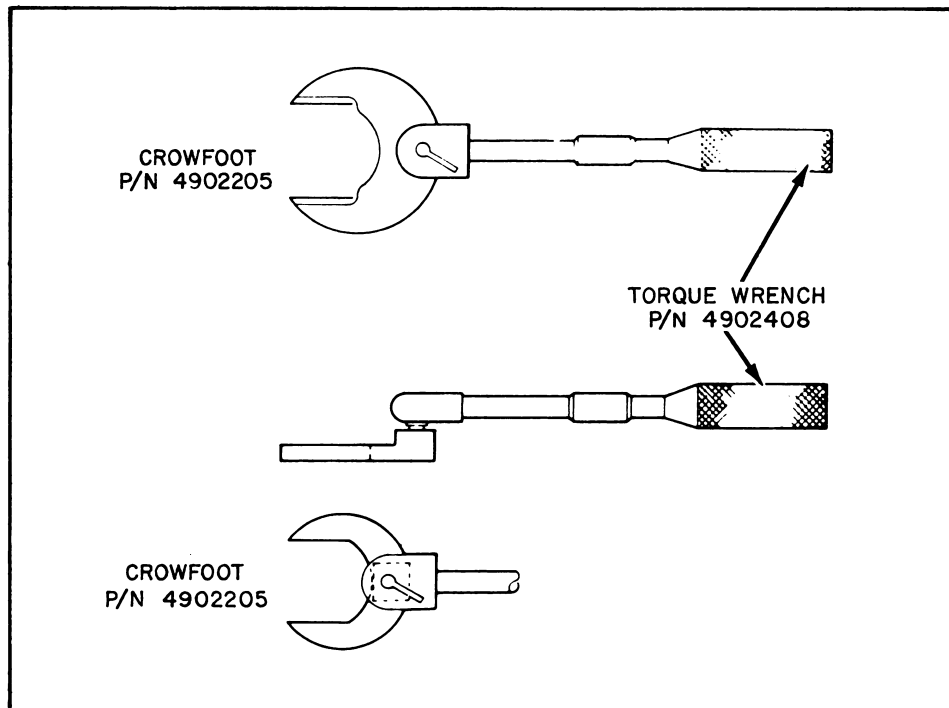


Figure 12-55.—Torque wrench set.

SAFETY PRECAUTIONS

Safety precautions prescribe the minimum requirements and regulations you should observe when handling ammunition. These regulations may be general in nature or step-by-step procedures. Regardless of the situation, safety precautions must NEVER be ignored or bypassed, even during the simplest ammunition-handling evolutions.

The general safety precautions listed below show some of the regulations contained in publications referred to in this chapter.

1. Properly stow all materials within a magazine and keep them in a safe condition. Never let trash resulting from decanning, depalletizing, or unpacking accumulate in a magazine. It presents a fire hazard and unsafe working conditions for personnel.

2. Don't use improvised tools, platforms, or ladders.

3. Before ammunition loading, explosives loading, or offloading operations, either at a shore activity or a ship underway, inspect all fire mains to make sure they operate properly and efficiently. Fire hoses must be laid out ready

for use in the immediate area of operations. The hoses must be laid out so that damage control and fire boundaries are not crossed, using all risers available. Additionally, keep the valves controlling these fire hoses open so that water is readily available.

4. Flame, heat, or spark-producing devices aren't permitted where explosives or flammable materials, batteries, or battery charging lockers are located. Cigarette lighters, heaters, fires, welding tools, soldering irons, cutting torches, and uncovered lights are included in this category. When work requiring the use of flame, heat, or spark-producing devices is urgently required in or adjacent to an ammunition stowage space, follow the procedures outlined in OPNAVINST 8023.2 (series) and OPNAVINST 8023.21 (series).

5. Emphasize safety precautions applicable to inservice ammunition items or equipment by using applicable signs throughout the ship. Signs may be obtained as Cog I material. They are indexed in Section 13 of *Navy Stock List of Forms and Publications—Cognizance Symbol I*, NAVSUP Publication 2002, or when not listed in NAVSUP 2002, you may obtain them from a tender-type ship by submission of a work order.

6. Emergency drills requiring the use of the general alarm system, ship's bell or whistle aren't conducted aboard ship while moored to an ammunition-activity pier, unless specific approval for such drills has been granted by the commanding officer of the ammunition activity.

Similarly, such emergency drills aren't conducted by ships nested together or at a pier where ammunition-handling operations are in progress, or by a ship underway during an ammunition handling evolution.

7. Ammunition evolutions involving direct contact with ammunition components are curtailed during local atmospheric disturbances such as thunderstorms or high winds. Operations aren't resumed until nonhazardous conditions prevail.

8. Stowage of privately owned ammunition and small arms is permitted aboard ship if approved by the commanding officer. This type of stowage is subject to the security requirements of chapter 700 of the Naval Ships Technical Manual, *Ammunition Handling and Stowage*, NAVSEA S9086-XG-STM-000.

9. Ships and craft entering commercial or naval shipyards for periods longer than 6 weeks are completely offloaded of all ammunition, except the small arms ammunition that the commanding officer considers necessary for the maintenance of security aboard ship and inert ordnance items such as bomb fins.

If a ship is expected to remain in the yard for less than 6 weeks, the ship offloads, as a minimum, all ammunition or explosives that can't be stowed in sprinkler-protected or floodable spaces.

10. The number of personnel engaged in ammunition and explosive handling operations is limited to the minimum necessary for safe and efficient performance of the work. Unauthorized personnel aren't permitted in a magazine, missile handling or testing area, or at any handling operation involving explosives or ammunition. Visiting personnel are accompanied by a responsible escort.

11. As a general rule, any pyrotechnic device that is armed and otherwise prepared for launching or activating but hasn't been used may be dearmed, restored to its original packing, and returned to stowage. The exceptions to this rule

REVIEW NUMBER 10 ANSWERS

- A1. *Mk 76 and Mods and Mk 106 and Mods are the two practice bombs normally used.*
- A2. *The CXU-3A/B day use and the Mk 4 night use are the two practice bomb signals used with the Mk 76 practice bomb.*
- A3. *You can ship six Mk 106 practice bombs in a container.*
- A4. *You should refer to NAVAIR 11-5A-17 for detailed information about practice bombs.*
- A5. *You should use a spanner wrench to install a Mk 274 igniter into a fire bomb filling hole.*
- A6. *For information about fire bombs, you should refer to NAVAIR 11-140-8 and NAVAIR 19-1-112.*
- A7. *A rocket warhead base can protrude a maximum of 1/16 inch.*
- A8. *You should use a decal as a guide when using a chain wrench on Mk 37 and Mk 63 rocket warheads.*

are Mk 25 and Mk 58 marine location markers, Mk 48 decoy flares, and aircraft parachute flares. If such devices can't be made safe beyond question, they must be stowed in lockers or disposed of according to current directives.

12. When the temperature in a magazine containing gas generators, propelling charges, or fixed ammunition reaches 110°F or above, certain actions must be taken to preserve safety and stability of the explosives.

When the magazine temperature is between 110°F and 120°F, the magazine should be artificially cooled, as practical. The number of hours and the maximum temperature reached during each hour of exposure above 110°F, but less than 120°F, must be recorded. When the cumulative total number of hours of exposure to these temperatures reaches 500 hours, the ammunition must be expended or turned into an ammunition activity, stating the reason for return. If the ammunition was subjected to these temperatures for less than 500 hours, it should be expended during subsequent firings.

When the magazine temperature is between 120°F and 130°F, the magazine should be artificially cooled, as practical. A special record of the number of hours of exposure and the maximum temperature reached each hour should be made. When a cumulative total of 100 hours of exposure above 120°F is reached, prior to a cumulative total of 500 hours of exposure between 110°F and 130°F, the ammunition must have priority for expenditure or be turned in to an ammunition storage activity at the first opportunity.

At temperatures above 130°F, the ammunition should be removed from the magazine and turned in to the nearest ammunition activity. When there is no storage activity immediately available and the ship is in port, the ammunition may be retained on board in a segregated magazine or in a ready-service room or locker. All possible methods should be used to lower the temperature of the ammunition until the ship is able to turn it in to the nearest ammunition activity.

If you are involved in weapons assembly, always review the applicable safety precautions before beginning the evolution. A few of these general safety precautions are as follows:

1. Fuze or defuze bombs in handling rooms or spaces specifically designed for such purposes.

2. Normally, conventional high-explosive bombs are fuzed after the weapon is loaded on the aircraft. When the aircraft is carrier based, it must be spotted on the flight deck. Exceptions to this rule are authorized when loading bombs that require special fuzing RADHAZ susceptible units, integral fuzing, and all-up-rounds. It also includes those instances where clearances preclude fuzing after the bombs are racked.

3. Detonators, boosters, primers or other firing devices aren't assembled in or removed from bombs unless specifically prescribed for the weapon.

4. Fuzes aren't allowed to accumulate at the fuzing stations. Never stockpile fuzes. They must be withdrawn from stowage on an as needed basis.

5. Never, under any circumstance, try to disassemble or repair a fuze. Also, never try to render inert a live, loaded item of ordnance.

6. Except as authorized by current directives, no attempt should be made to disarm a fuze.

7. Unless specifically authorized, fire bombs aren't fuzed until loaded onto the aircraft.

8. Keep filling areas for fire bombs neat and orderly. Wipe up spilled fire bomb mix immediately. This serves to eliminate a fire hazard.

9. All fire bombs must be expended (or an attempt made to jettison them) from the aircraft before landing.

10. Move assembled rocket ammunition to the designated storage area as soon as practicable after completion of assembly operations.

11. Don't make changes or additions to rockets, launchers, or components without explicit authority from the Naval Air Systems Command.

12. Exercise particular caution when handling rocket motors to avoid propellant grain damage or fracture.

13. Don't connect electrical power or test equipment to a rocket launcher when rockets are installed.

14. Assemble and fuze airborne rockets in a designated assembly area and as close to the time of aircraft rearming as possible.

As a third or second class petty officer, you need to know established safety regulations. If you supervise a handling or assembly crew, you must act in a positive manner to eliminate potential accident hazards that exist in operations under your jurisdiction.

The following safety regulations are only a few of the many regulations you must become familiar with as a supervisor.

1. Explain to all personnel under your immediate supervision the standard safety regulations, industrial hygiene safeguards, and precautions they must follow and enforce. You must explain the characteristics of ammunition, explosives, or other hazardous materials. You must also explain the selection, use, and care of necessary tools, materials, protective equipment, and handling equipment as well as the hazards of fire, explosion, and other catastrophes that the safety regulations and industrial hygiene requirements are intended to eliminate or reduce.

2. Instruct and train each individual under your immediate supervision in the work that he/she is to perform. You need to be satisfied the individual is capable of performing the work safely. Instruction must also provide complete information concerning magazine location, identification, and the location and use of shelters, first-aid kits, fire-fighting apparatus, guards, personal protective equipment, showers, and neutralizing solutions.

3. Identify all persons entering or approaching the magazine area in your charge. Determine by whose authority they were permitted to enter and/or to remain in the area. You must eject any person whose presence and/or actions, in your opinion, is/are detrimental to safety.

4. Maintain cleanliness of the magazine and magazine area. You must maintain all safeguards and prevent the blocking of safety exits, aisles, and accesses to fire-fighting equipment.

5. Ensure that all conditions in the magazine and magazine area under your jurisdiction comply with orders relating to operation

shutdown before you leave at the close of work. When the operation isn't relieved by an incoming shift, make sure that windows and doors are closed and locked, and any master power and light switches outside the magazine are in the OFF position. When an incoming shift relieves the operation, or is relieved for any other reason, make a complete status report to the relieving supervisor. This report should contain detailed information about any situation that requires immediate attention or that should be kept under observation.

6. Alert the immediate supervisor of the need for explosive ordnance disposal (EOD) personnel to remove defective or suspect ammunition from the work area.

REVIEW NUMBER 11

- Q1. Under what atmospheric conditions are ammunition evolutions curtailed?*
- Q2. A ship can stay in a naval shipyard for _____ without completely offloading ammunition.*
- Q3. Magazines are artificially cooled when they reach what temperature?*
- Q4. At what temperature range should all ammunition be removed from a magazine?*

(THIS PAGE IS INTENTIONALLY LEFT BLANK.)

REVIEW NUMBER 11 ANSWERS

- A1. Ammunition evolutions are curtailed during thunderstorms or high winds.*
- A2. A ship can stay in a naval shipyard for a maximum period of 6 weeks without completely offloading ammunition.*
- A3. Magazines are artificially cooled when they reach a temperature between 120°F and 130°F.*
- A4. All ammunition is removed from a magazine if the temperature is 130°F or above.*

CHAPTER 13

AIRCRAFT LOADING/UNLOADING PROCEDURES

After aircraft ordnance and ordnance accessories have been tested, they are approved for carriage and release by a particular model aircraft. Information about ordnance and ordnance accessories can be found in the aircraft's NATOPS flight/tactical manual. This manual is the basic authority for the types of ordnance and ordnance load combinations on each model aircraft. Deviation (change) from the basic authority must be approved before it can be made. The authority that approves deviations is the Naval Air Systems Command (NAVAIR).

The types of aircraft ammunition and armament equipment that you handle has been covered in previous chapters. In this chapter, you will learn about loading/unloading ammunition and other armament equipment onto the aircraft.

AIRBORNE WEAPONS/STORES LOADING MANUAL

Learning Objective: Identify requirements in airborne weapons/stores loading manuals as they pertain to loading and unloading aircraft.

The airborne weapons/stores loading manual, known as the *loading manual*, standardizes loading procedures used throughout the Navy. It improves safety and reliability in the loading of conventional weapons, special weapons, and airborne stores. You must follow the loading procedures in the loading manual. If there is a conflict between the loading manual and another publication, follow the procedures in the loading manual until NAVAIRSYSCOM solves the conflict.

The procedures in the loading manual are followed during aircraft loading. However, the physical size of the manual makes it impractical for use on the flight line. Therefore, the actual aircraft loading procedures for a weapon/store are condensed into an airborne weapons/stores

checklist. An individual checklist is provided for each type of weapon/store to be loaded. This includes release and control system checks, retarded/nonretarded bombs, fire bombs, pyrotechnics, and laser-guided bombs. Each member of the loading crew does **not** need a copy of a checklist during loading operations. However, crew leaders **MUST** use a checklist for the particular weapon/store being loaded. Each checklist contains a required reading section that each member of the loading crew must read before starting loading operations.

When high-tempo operations make the use of a checklist impractical, the type commander (TYCOM) can authorize the use of a stores reliability card (SRC). The SRC has condensed procedures from the checklist. The card is laminated and pocket size. When authorized, trained and certified personnel use an SRC instead of the airborne weapons/stores checklist.

CV NATOPS MANUAL

Learning Objective: Identify the requirements in airborne weapons/stores loading manuals and the CV NATOPS manuals.

The *CV NATOPS Manual* is issued by the authority of the Chief of Naval Operations (CNO) in conjunction with the Naval Air Training and Operating Procedures Standardization (NATOPS) program. The *CV NATOPS Manual* contains the best available operating instructions, and it is regulatory in nature. In this section of the TRAMAN, you will read about the weapons handling procedures covered in the *CV NATOPS Manual* that you will use aboard ship.

TERMS

When you are involved in weapons loading and flight deck operations, there are certain

weapons terms that you must know. Some of the more common terms are discussed in the following paragraphs.

Airborne Stores. Airborne stores include tanks (fuel and spray), pods (refueling, photo, ECM, etc.), nonexpendable training weapons, and targets. Also, items intended for carriage by aircraft, either internally or externally are considered aircraft stores; for example, racks, launchers, adapters, and detachable pylons. **This definition applies to items not normally separated from the aircraft during flight.**

Arming. Arming is an operation that changes a weapon from a safe condition to a state of readiness.

Arming area. The arming area is a designated area of the flight deck where a weapon is armed for initiation. When forward-firing weapons are involved, you must ensure the area ahead of the aircraft is clear and remains clear until after the aircraft is launched. Aboard ship, this is normally the same area as the catapult area.

Dearming area. The dearming area is a designated area of the flight deck where a weapon is changed from an armed state to a safe condition. When forward-firing weapons are involved, the area ahead of the aircraft must remain clear until completion of weapon safing.

Downloading. Downloading is an operation that removes airborne weapons/stores from an aircraft.

Hung weapons. Hung weapons are weapons that cannot be fired or dropped from an aircraft because of a weapon, rack, or circuit malfunction.

Loading (rearming). Loading or rearming is an operation that installs airborne weapons/stores on or into an aircraft.

Rearming area. The rearming area is a designated area of the flight deck where a replenishment operation for prescribed airborne weapons/stores and other armament items on or into an aircraft is being conducted. When handling weapons in a rearming area, you should ensure all fuzes/initiators are safe and all gun chambers clear. This operation may include fuzing (bombs) and stray-voltage checks.

Safing (dearming). Safing or dearming is an operation whereby a weapon is changed from an armed state to a safe condition.

Unexpended weapons. Unexpended weapons include those weapons that were not subjected to attempts to fire or drop from the aircraft. They are presumed to be in a normal operating condition and can be fired or jettisoned, as necessary.

WEAPONS HANDLING PROCEDURES

Airborne weapons handling evolutions (loading/unloading) introduce a degree of risk into carrier operations. They require careful planning and preparation. The necessity to train for and conduct combat operations creates risks that cannot be avoided when explosive weapons are handled.

Weapons Loading/Downloading

The flight deck is the preferred area to load or download an aircraft. Normally, the rearming area on an aircraft carrier is adjacent to and aft of the island structure on the flight deck. When operationally necessary, however, the ship's commanding officer (CO) may authorize loading/downloading on the ship's bow while cyclic flight operations are in progress. Only a minimum quantity of weapons should be moved toward the ship's bow.

Loading limited amounts of weapons on the hangar deck may be authorized by the CO when operationally necessary. However, this adds an additional risk of fire because there is both fuel and explosives in a confined area. Only aircraft scheduled for the next launch or on an alert condition are authorized for loading on the hangar deck. Authorization is also restricted to the particular weapons shown in table 13-1.

According to the *CV NATOPS Manual*, fueling, loading/downloading weapons (including preloaded MERs/TERs), and installing fuzes and arming wires simultaneously are authorized. However, you **can't** load forward-firing ordnance that requires simultaneous and/or prior electrical connections for loading while aircraft fueling is in progress. **Don't** make other electrical connections to weapons or remove/install impulse cartridges while aircraft are being fueled.

Table 13-1.—Weapons Loading/Strikedown/Downloading and Recovery Guide

WEAPON	HANGAR DECK		RECOVERY (8)	
	LOAD	STRIKEDOWN/ DOWNLOAD	UNEXPENDED	HUNG
General Purpose Bombs/LGB	YES (1) (5)	YES (6)	YES (2)	YES (2)
DST	YES (5)	YES (6)	YES (2)	YES (2)
Mk 77 Fire Bomb	NO	NO	NO	NO
FAE	NO	NO	NO	NO
2.75/5.0 Rocker Launchers	NO	NO (3)	YES	YES
Aircraft Parachute Flare	NO	NO	NO	NO
Tube Loaded Flare Dispenser	NO	NO	YES	YES
20mm Guns/Mk 4 Gun Pod (7)	YES	YES (7)	YES	YES
Rockeye 11/APAM	YES (5)	YES (6)	YES	YES
Sidewinders (all)	NO (4)	YES	YES	YES
Sparrow III	NO (4) (5)	YES (6)	YES	YES
Shrike AGM-45	NO (4)	YES (6)	YES	YES
Walleye Weapon	YES (5)	YES (6)	YES	YES
Standard Arm AGM-78	NO (4) (5)	YES (6)	YES	YES
Phoenix Arm AGM-54	NO (4)	YES (6)	YES	YES
Harpoon AGM-54	NO (4) (5)	YES (6)	YES	YES
Decoy Flare	NO	NO	YES	YES
Mines (all)	YES (5)	YES (6)	YES	YES
Torpedoes (all)	YES (5)	YES (6)	YES	YES
SUS Charge	YES	YES	YES	YES
Photoflash Cartridges	NO	NO	YES	YES
Marine Marker	YES	YES	YES	YES
Practice Bombs	YES (5)	YES (6)	YES	YES
JAU-1B Cartridge	YES	YES (9) (10)	YES	YES
Target Missile AQM-37	NO	NO	YES	NO

Notes:

- (1) No mechanical nose fuzes will be installed on the hanger deck.
- (2) Arming wires intact.
- (3) CVs with centerline elevators may lower aircraft to the hangar deck only if downloading on the flight deck will delay the launch. Hangar deck downloading must be performed immediately after the aircraft is in spot and tied down.

Don't position the fuel hoses under the weapons/stores being loaded/downloaded.

When required, you may apply electrical power to the aircraft during a loading/downloading evolution. However, it should be held to a minimum, and it should be consistent with operational requirements. **Don't** apply electrical power to the armament or weapon release-and-control circuitry while weapons are being loaded/downloaded. Conduct loading/downloading

weapons and oxygen servicing (other than the converter replacement at the aircraft) as separate evolutions.

Arming/Dearming

Arm airborne weapons in the designated rearming area or the arming area. Generally, all weapons (except for forward-firing ordnance) are armed in the rearming area. This is done after

engine turnup but before the aircraft is taxied. Weapons that are armed in the rearining area include retard/nonretard bombs, CBUs, and fire bombs. These arming functions are normally performed by the squadron's ordnance loading crew.

Aircraft loaded with forward-firing ordnance, such as aircraft guns, rockets, and missiles, are

positioned in the arming area to arm the weapons. When the aircraft is located in the arming area, optimum safety is provided because the area directly in front of the aircraft is unobstructed by structures or personnel.

Arming functions are normally performed by the CVW arm/dearm crew in the arming area under the supervision of the CVW ordnance

Table 13-2.—Aircraft Arming Signals








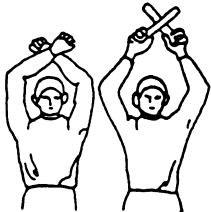
SIGNAL		MEANING	RESPONSE
DAY	NIGHT		
<p>① ARMING SUPERVISOR: HANDS OVER HEAD WITH FINGER TIPS TOUCHING.</p> 	<p>RED BANDED WANDS OVERHEAD WITH TIPS TOUCHING.</p>	<p>PILOT/COPILOT/NFO: CHECK ALL ARMAMENT SWITCHES OFF OR SAFE.</p>	<p>PILOT/COPILOT/NFO: RAISE BOTH HANDS INTO VIEW OF ARM- ING SUPERVISOR AFTER CHECKING SWITCH POSITIONS. (HANDS REMAIN IN VIEW DURING CHECK AND HOOKUP).</p>
<p>② ARMING SUPERVISOR: ONE HAND OVER HEAD; POINT TO ARMING CREWMEMBERS WITH OTHER HAND.</p> 	<p>SAME AS DAY BUT WITH RED BANDED WANDS.</p>	<p>ARMING CREW: PERFORM STRAY VOLTAGE CHECKS.</p>	<p>ARMING CREW: GIVE "THUMBS UP" TO ARMING SUPER- VISOR IF NO STRAY VOLTAGE EXISTS. "THUMBS DOWN" INDI- CATES STRAY VOLTAGE PROBLEMS. NIGHT: VERTICAL SWEEP WITH FLASH- LIGHT INDICATES NO STRAY VOLTAGE. HORIZONTAL SWEEP INDICATES STRAY VOLTAGE.</p>
<p>③ ARMING SUPERVISOR: RAISE FIST, EXTENDED UPWARD TO MEET HORIZONTAL PALM OF OTHER HAND.</p> 	<p>FORM A TEE WITH RED BANDED WANDS.</p>	<p>ARMING CREW: ARM WEAPONS (AS APPLICABLE).</p>	<p>ARMING CREW: GIVE ARMING SUPER- VISOR "THUMBS UP" WHEN ARMING COM- PLETED AND CLEAR IMMEDIATE AREA. "THUMBS DOWN" IF MALFUNCTION EXISTS. NIGHT: VERTICAL SWEEP WITH FLASH- LIGHT INDICATES ARMING COMPLETED. HORIZONTAL SWEEP INDICATES MALFUNCTION.</p>
<p>④ ARMING SUPERVISOR: RAISE BOTH HANDS WITH FINGERS POINTING TO SOUND ATTENUATORS.</p> 	<p>SAME AS DAY. TIPS OF RED BANDED WANDS TOUCHING SOUND ATTENUATORS.</p>	<p>ARMING CREW: PERFORM MISSILE CHECK.</p>	<p>PILOT: GIVE ARMING SUPERVISOR "THUMBS UP" IF TONE IS HEARD. "THUMBS DOWN" IF NO TONE. NIGHT: SAME AS SIGNAL 3 ABOVE.</p>

Table 13-2.—Aircraft Arming Signals—Continued

SIGNAL		MEANING	RESPONSE
DAY	NIGHT		
<p>5</p> <p>ARMING SUPERVISOR: INSERT FINGER OF ONE HAND INTO CLENCHED FIST OF OTHER HAND AND GIVE EXTRACTING MOTION.</p> 	<p>TOUCH TIPS OF RED BANDED WANDS IN FRONT OF BODY. THEN MOVE ONE WAND LATERALLY IN A SWEEPING MOTION.</p>	<p>ARMING CREW: REMOVE BOMB RACK/PYLON SAFETY PINS.</p>	<p>ARMING CREW: SHOWS PINS TO ARMING SUPERVISOR AND CLEAR IMMEDIATE AREA.</p> <p>NIGHT: SAME AS SIGNAL 3 ABOVE.</p>
<p>6</p> <p>ARMING SUPERVISOR: GIVE PILOT</p> <p>(A) THUMBS UP.</p>  <p>(B) THUMBS DOWN.</p> 	<p>(A) VERTICAL SWEEP WITH RED BANDED WAND.</p> <p>(B) HORIZONTAL SWEEP WITH RED BANDED WAND.</p>	<p>PILOT:</p> <p>(A) AIRCRAFT ARMED AND ALL PERSONNEL AND EQUIPMENT CLEAR.</p> <p>(B) AIRCRAFT DOWN FOR WEAPONS.</p>	<p>PILOT:</p> <p>(A) ACKNOWLEDGE WITH SIMILAR SIGNAL.</p> <p>(B) ACKNOWLEDGE WITH SIMILAR SIGNAL.</p>
<p>7</p> <p>ARMING SUPERVISOR/OBSERVER: CROSSED ARMS OVERHEAD, FISTS CLENCHED.</p> 	<p>CROSSED STANDARD RED WANDS HELD OVERHEAD.</p>	<p>SUSPEND ALL ARMING/SAFETY OPERATIONS ON AIRCRAFT.</p>	<p>SUSPEND ARMING AND AWAIT FURTHER INSTRUCTIONS.</p>

220.734.1A

officer. The crew is composed of ordnancemen from each squadron within the CVW. They are cross-trained and certified to arm/dearm all types of aircraft aboard the ship. The crew members work in their respective squadrons except during actual aircraft launch and recovery operations.



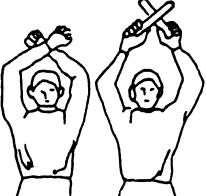
Airborne weapons are dearmed in the designated dearming area before or immediately after engine shutdown. All forward-firing ordnance is dearmed by the CVW arm/dearm crew before engine shutdown. All other ordnance is safed or dearmed by squadron ordnancemen in the dearming or rearming area after engine shutdown.

When arming or dearming an aircraft, aircraft arming and safing signals (tables 13-2 and 13-3) are used when crew members perform the arm/dearm procedures. These signals are used by both the squadron and CVW arm/dearm crews. Arming or dearming aircraft is conducted only when the aircraft is at a complete stop, and control of the aircraft has been turned over to the arming crew supervisor.

Hung/Unexpended Weapons

The CVW aircraft dearming supervisor is always on the flight deck during recovery operations. By being there, he makes sure that the aircraft directors and the dearming crew

Table 13-3.—Aircraft Safing Signals

SIGNAL		MEANING	RESPONSE
DAY	NIGHT		
<p>① SAFING SUPERVISOR: HANDS OVER HEAD WITH FINGER TIPS TOUCHING.</p> 	<p>RED BANDED WANDS OVERHEAD WITH TIPS TOUCHING.</p>	<p>PILOT/COPILOT/NFO: CHECK ALL ARMAMENT SWITCHES OFF OR SAFE.</p>	<p>PILOT/COPILOT/NFO: RAISE BOTH HANDS INTO VIEW OF SAFING SUPERVISOR AFTER CHECKING SWITCH POSITION. (HANDS REMAIN IN VIEW DURING SAFING.)</p>
<p>② SAFING SUPERVISOR: ONE HAND OVER HEAD, POINT TO SAFING CREWMEMBER WITH OTHER HAND.</p> 	<p>SAME AS DAY BUT WITH RED BANDED WANDS.</p>	<p>SAFING CREW: SAFE WEAPONS (AS APPLICABLE).</p>	<p>SAFING CREW: AFTER SAFING, GIVE SAFING SUPERVISOR "THUMBS UP" AND MOVE CLEAR OF AIRCRAFT. NIGHT: VERTICAL SWEEP WITH FLASHLIGHT WHEN SAFING IS COMPLETE.</p>
<p>③ SAFING SUPERVISOR/OBSERVER: CROSSED ARMS OVERHEAD, FISTS CLENCHED.</p> 	<p>CROSSED STANDARD RED WANDS HELD OVERHEAD.</p>	<p>SUSPEND ALL ARMING/ SAFETY OPERATIONS ON AIRCRAFT.</p>	<p>SUSPEND SAFING AND AWAIT FURTHER INSTRUCTIONS.</p>

220.735.1

coordinate their actions. The dearming supervisor tells the aircraft director which aircraft require safing before the aircraft is taxied to the recovery spot.

At times, aircraft return to the ship with hung or unexpended weapons. When this happens, the flight leader advises cognizant personnel aboard ship of the total quantity and type of hung or unexpended weapons on aircraft in that flight. As each of these aircraft approaches the ship, the air officer announces the model and type of weapon problem over the flight-deck announcing system.

After landing with hung weapons and/or forward-firing weapons, the aircraft is normally safed after taxiing clear of the landing area. However, at the discretion of the air officer, it may be safed in the landing area. Aircraft

returning with unexpended weapons should be safed according to normal procedures.

REVIEW NUMBER 1

Q1. If you want to find information on aircraft ordnance and ordnance accessories, you should refer to _____.

Q2. To what authority should you submit a change to or request a deviation from a NATOPS flight or tactical manual?

Q3. What command resolves conflicts between weapons/stores loading manuals and other publications?

Q4. In high-tempo operations, what person can authorize the use of stores reliability cards?

Q5. CV NATOPS manuals are issued by the _____.

Q6. Except for forward-firing ordnance, where are weapons armed?

Q7. At sea, the responsibility for dearming forward-firing ordnance belongs to the _____.

AIRCRAFT LOADING/ UNLOADING PROCEDURES

Learning Objective: *Identify the procedures used to load and unload bombs.*

As an AO, you will load ammunition on many different models of aircraft. However, the general loading/unloading procedures for most aircraft are similar. The procedures contained in this chapter don't cover every step of weapon preparation and loading. These procedures will give you basic information about representative types of ordnance that you might load in an operating squadron. The aircraft loading/unloading procedures covered in this section are general, and they are limited to aircraft bombs. When loading practice bombs, you should handle them just like live ordnance, and you should use the appropriate checklist.

Before loading bombs onto an aircraft, you must prepare and inspect the aircraft. Step-by-step procedures must be carefully followed. These procedures are found in the applicable manuals.

AIRCRAFT PREPARATION AND INSPECTION

The aircraft preparation and inspection procedures contained in this section are for

loading bombs onto the parent racks and onto MERs/TERs. When a procedure is applicable to the MERs/TERs only, it is shown as a note just before the action you perform.

The first step you should take when loading bombs onto parent racks and MERs/TERs is to make sure that the preloading release and control checks have been performed. Then make sure the aircraft is in the rearming area, and all flight stations you are to load are accessible from the flight deck. You need to make sure that the aircraft is properly grounded.

NOTE: Electrical power may be applied to the aircraft during loading/unloading evolutions, but power is to be held to a minimum. The step "if applicable, power removed" may be omitted when operational requirements dictate that a power requirement is necessary. However, unless a step procedure in the checklist calls for power, don't energize the armament circuits. Remove power from the aircraft if the step "power removed" is not preceded by "if applicable."

If applicable, make sure that electrical power is removed from the aircraft. Also, make sure the aircraft is properly grounded. To ground the aircraft, use a command-approved ground strap or wire attached to the aircraft and to a certified grounding station. Static check grounding straps/wire (fig. 13-1) for 25 ohms or less every 6 months.

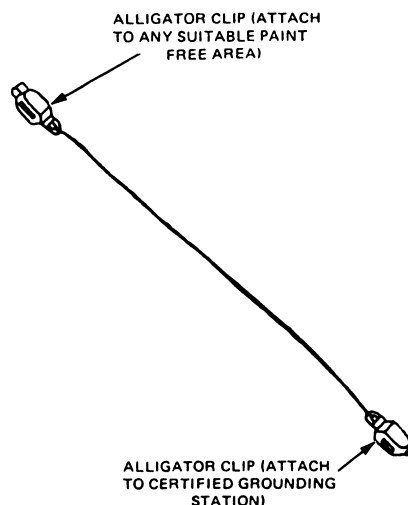


Figure 13-1.—Typical aircraft ground strap.

You need to make sure safety pins are installed in all loaded parent racks (BRU-10). When loading a MER/TER, verify that an electrical safety pin is installed, and that the safety stop lever is locked on each loaded ejector unit. You need to verify that all cockpit armament selectors on the left and right cowlings are in the out position (deselected). Make sure the control switches are in OFF or SAFE position.

Next, open the pylon access doors on all parent stations to be loaded. Check that the ejector unit breech cap harness and auxiliary release unit breech cap aren't connected. Then, you can remove the breech caps from the ejector unit. Verify that the cartridges are removed from the breech chambers and the auxiliary release unit. Retract the sway braces to the full up position (fig. 13-2).

Once you have retracted the sway braces to the full up position, retract the ejector foot to the full up position. Then, open all suspension hooks. To cock the parent rack, you need to remove the rack safety pin and rotate the cocking bolt about 45 degrees (clockwise for the left side, counterclockwise for the right side), using a

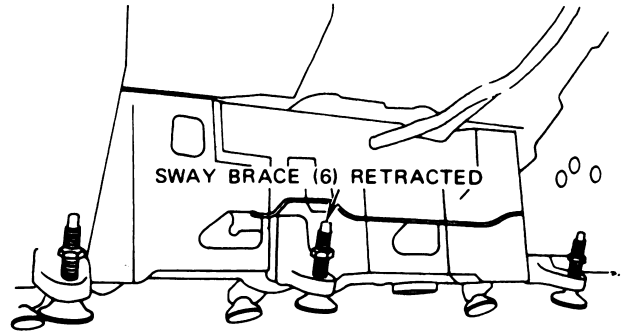


Figure 13-2.—Parent rack sway brace retraction.

3/4-inch socket wrench. You can make sure the rack is cocked by making sure—

- the bearing is seated in the sear notch,
- the blue dot is positioned aft of the silver indicator above all hooks except the aft 30-inch hook,
- the blue dot is positioned forward of the fully exposed silver indicator above the aft 30-inch hook, and

REVIEW NUMBER 1 ANSWERS

- A1. To find information on aircraft ordnance and ordnance accessories, you should refer to the applicable NATOPS flight/tactical manuals.
- A2. A change to or request for a deviation from a NATOPS flight or tactical manual should be submitted to the Naval Air Systems Command (NAVAIR).
- A3. NAVAIRSYSCOM resolves conflicts between weapons/stores loading manuals and other publications.
- A4. In high-tempo operations, the type commander (TYCOM) authorizes the use of stores reliability cards.
- A5. CV NATOPS manuals are issued by the Chief of Naval Operations (CNO).
- A6. Except for forward-firing ordnance, weapons are armed in the arming area.
- A7. At sea, the responsibility for dearming forward-firing ordnance belongs to the CVW arm/dearm crew.

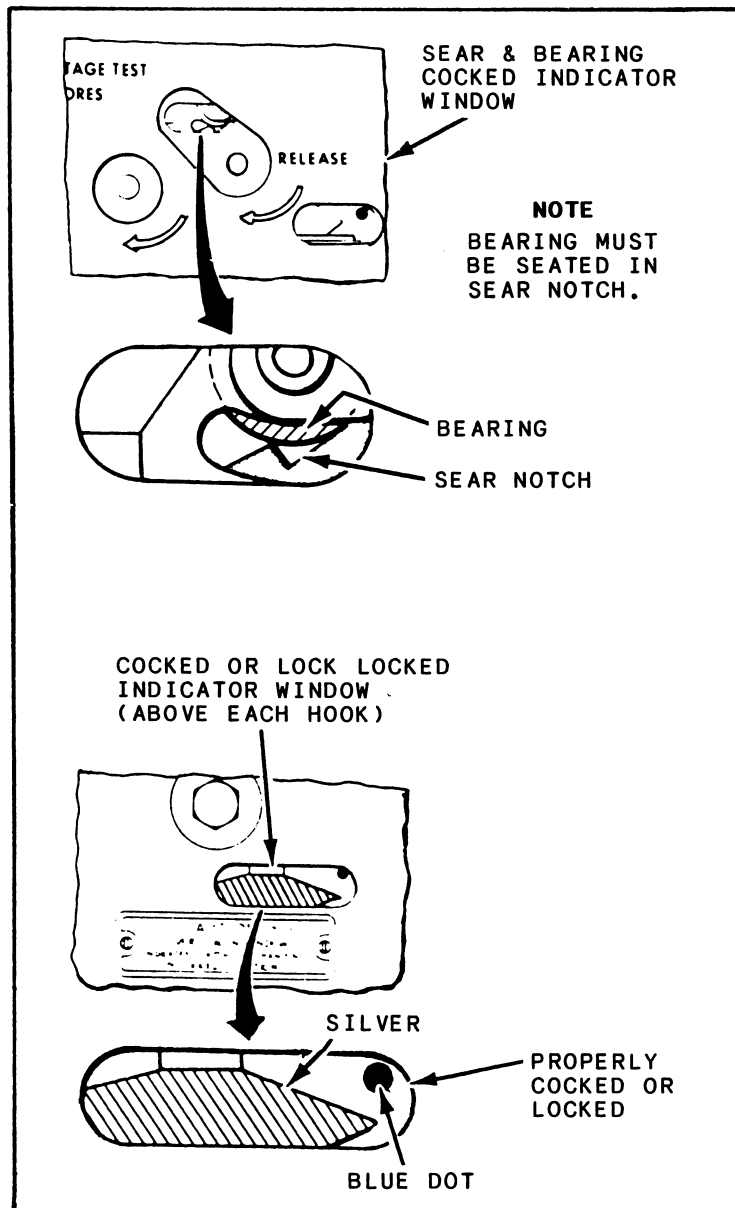


Figure 13-3.—Parent rack cocked and hook locked indication.

- the silver diamond covers the blue diamond field on the latch bar above each hook (fig. 13-3).

After making sure the parent rack is cocked, reinstall the rack safety pin.

If you are going to load a preloaded MER/TER, verify that an adapter connector and an electric fuze adapter harness (if applicable) are installed. Also, make sure the pullout bails are attached to the bail bar.

The following information will give you some idea of the steps you would follow to prepare/inspect a MER/TER for loading. Visually inspect the parent rack to ensure a safety pin is installed and the rack is locked. Make sure the ejector unit and unit lockpin are installed in position A, and the parent rack cartridges are installed. Check to make sure the ejector unit breech cap harness and auxiliary release unit breech cap aren't connected. You need to make sure that the parent rack sway braces and ejector foot are properly adjusted/positioned. Also, there should be an adapter

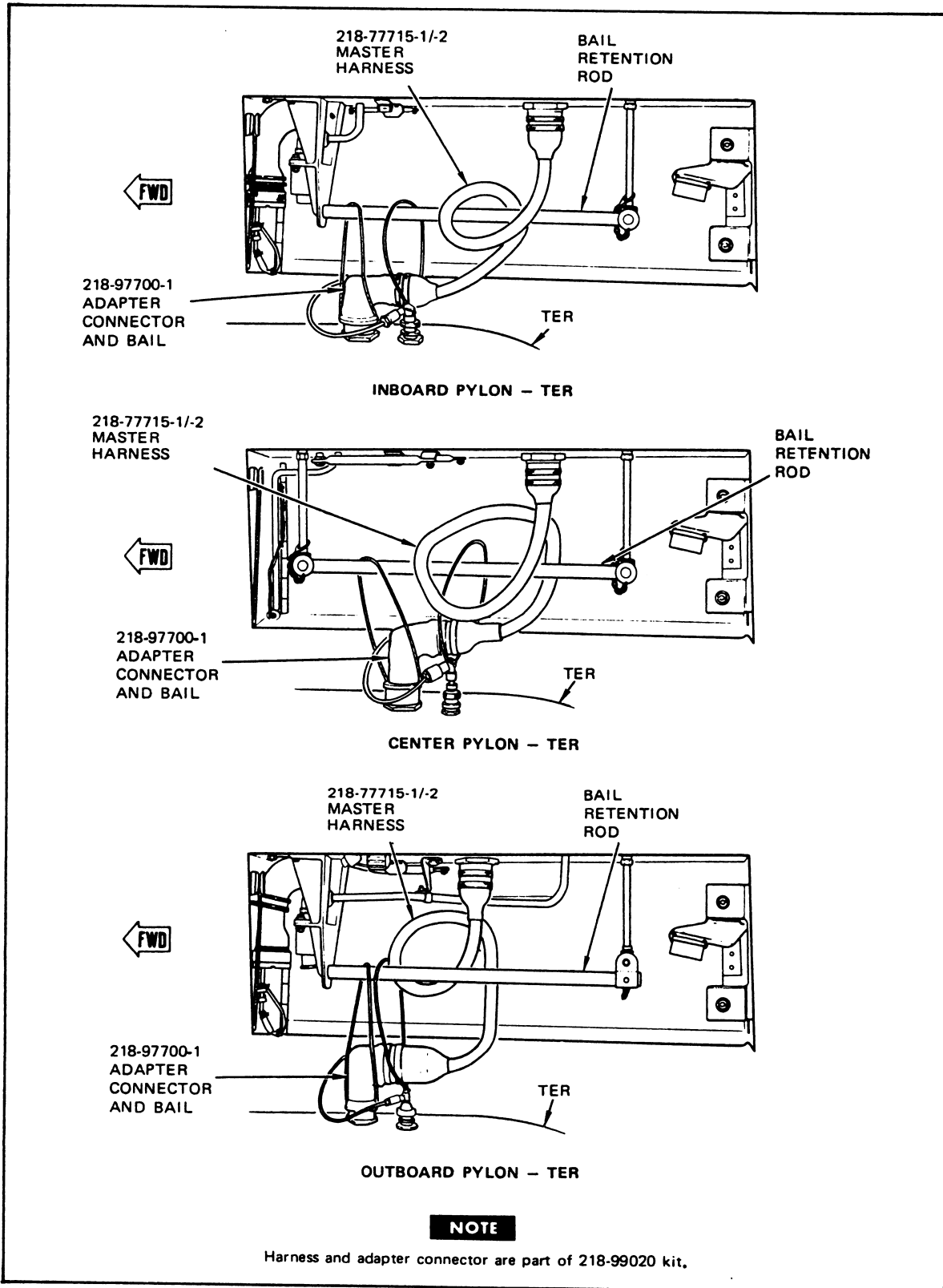


Figure 13-4.—MER/TER harness configuration.

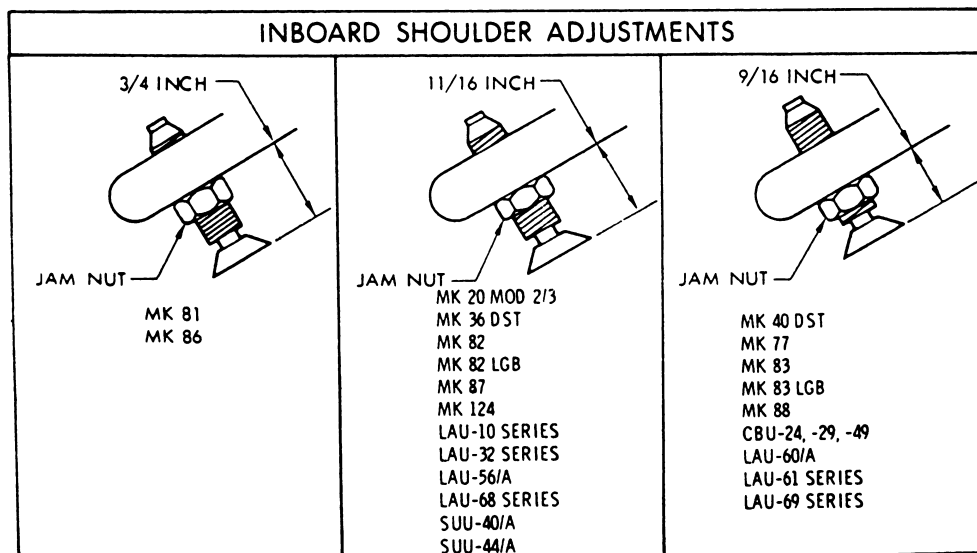
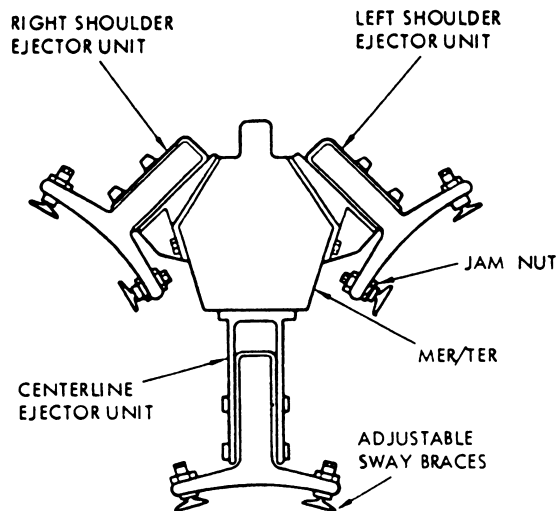


Figure 13-5.—MER/TER sway brace preset adjustment.

220.711

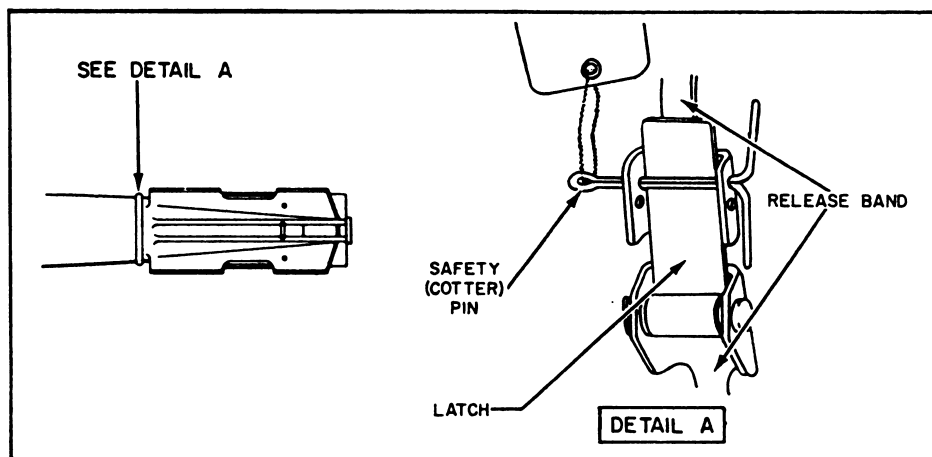
connector installed in the aircraft and connected to the MER/TER with the pullout bail attached to the bail bar (fig. 13-4).

If electric fuzing is used, you need to check that an electric fuze adapter harness is installed and connected to the MER/TER. If applicable, make sure the pullout bail is attached to the bail bar, as shown in figure 13-4. Next, install the electrical safety pin. Then, disconnect the breech caps and verify that the cartridges are removed from all ejector units. Make sure the breech caps are positioned to prevent damage during weapons loading. Then, open all suspension hooks. Adjust the inboard sway braces to the diameter

of the weapon, as shown in figure 13-5. Adjust all other sway braces to the full up position. Finally, retract the ejector feet to the full up position, and set the mode selector switch to the proper position.

WEAPON INSPECTION

All weapons must be inspected before you can load them. If they don't meet the inspection criteria, you must reject them and notify the proper authority. Some of the things you should look for are described in this section.



220.714.1

Figure 13-6.—Release band safety pin.

The first thing you should do is make sure that the weapon is assembled correctly and not damaged. Then, inspect the lugs and tail fins. They should be aligned and securely installed.

Mk 15 fin. The Mk 15 fin can be used for both retard and nonretard release. You can determine the mode of delivery by referring to the ordnance load plan. If an Mk 15 fin is installed for nonretard release, you need to make sure that the safety (cotter) pin is installed in the fin release band latch. The split ends should be spread 180 degrees apart, as shown in figure 13-6. If the Mk 15 fin is installed for retard release, you need to make sure the fin release wire is installed in the fin release band latch, through the guide tube, and the safety (cotter) pin is removed.

Electric fuze. If an electric fuze (fig. 13-7) is installed in the bomb, you should check to ensure the following actions have been taken:

- That an Mk 122 arming safety switch is installed in the charging receptacle, and the lanyard and cable are taped to the weapon.

- That the Mk 3 arming wire is connected to the aft bomb lug and routed through the top hole in the fin, through the pop-out pin of the fuze. It should extend through the hole in the bottom of the fin. Make sure Fahnestock clips aren't installed.

- That the safety cotter pin and warning tag have been removed from the fuze pop-out pin, and the fuze restraining clip has been installed.

- That a decal or other appropriate marking is affixed to the bomb to indicate the type of fuze installed.

Mechanical fuze. If a mechanical fuze is to be installed, you need to make sure an adapter booster is installed. Check to make sure that the fuze cavity is free of foreign matter and isn't damaged.

Mk 43 target detecting device. If an Mk 43 target detecting device (TDD) is to be installed, you need to remove the adapter booster. Use a pencil or wooden dowel and lightly press on the electrical connector in the bomb nose well. This action ensures the connector is locked in place.

Fuzes. When you inspect fuzes, you need to pay particular attention to the warnings and cautions contained in the inspection procedures. Warnings and cautions that should be followed are contained in this section. **Remember, though, for exact procedures, you must follow the applicable publications.** Some of the things you need to look for when inspecting fuzes are found in this section.

NOTE: Refer to the preface of this TRAMAN for the meaning of WARNINGS and CAUTIONS.

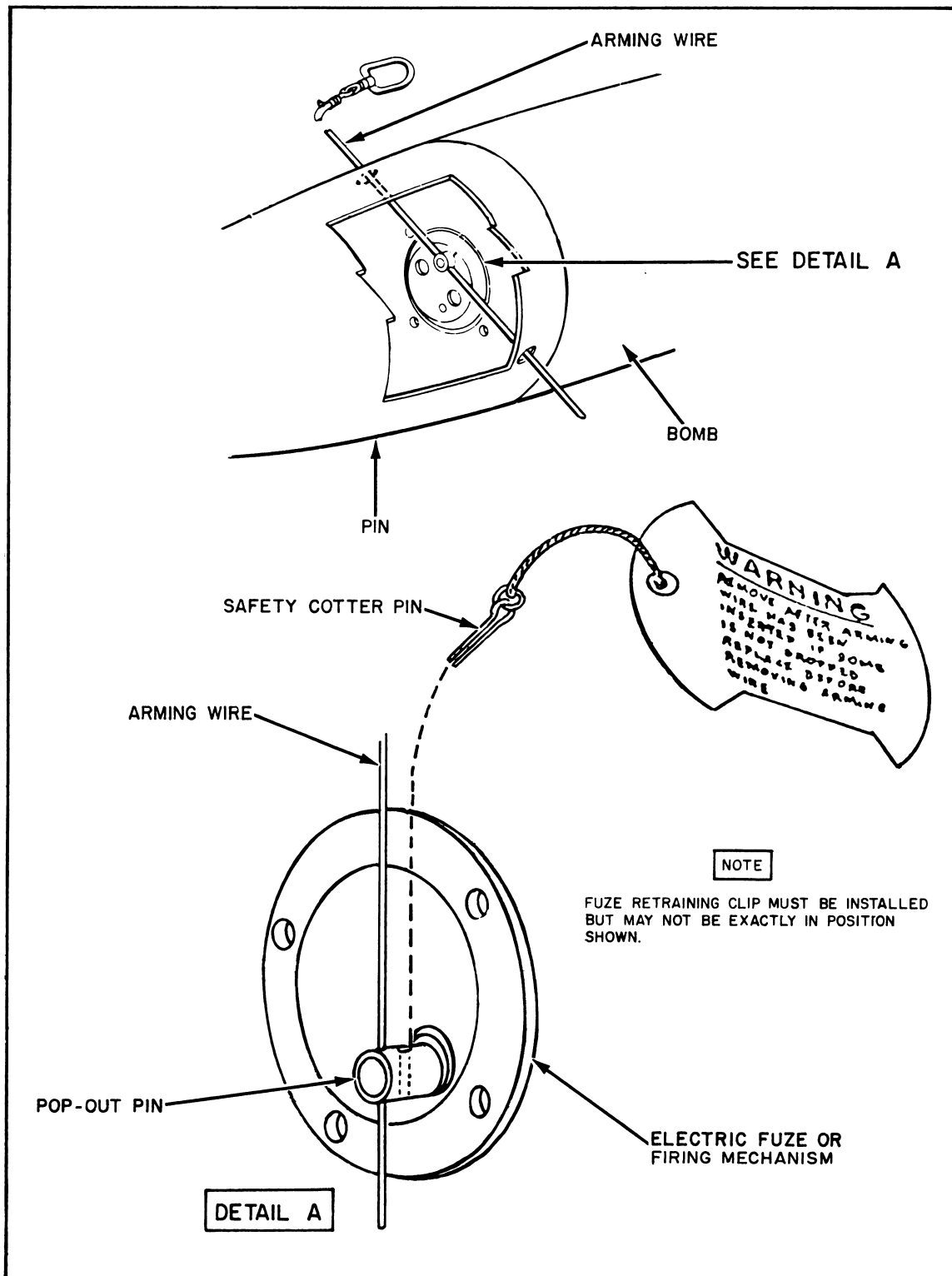


Figure 13-7.—Typical electric fuze/firing mechanism installation.

WARNING

Do not attempt to disarm a partially or fully armed fuze by rotating the arming vane. Notify the proper authority if a partially or fully armed condition is indicated.

As you read about the M904E3/E4 mechanical fuze, look at figure 13-8. When inspecting the M904E3/E4 mechanical fuze, look for the following conditions and/or take the indicated actions:

- That the safety wire is installed through the arming vane and the arming wire guide.

WARNING

A black letter A against a red background in the upper or lower window indicates a fully armed fuze. Notify the proper authority when an armed or partially armed condition is indicated.

- That the upper and lower windows do not show a black letter A against a red background.

WARNING

If a green background without the number 6 or 18 appears in the upper window when the arming delay is set on 6 or 18, or if the number in the upper window does not match the arming delay setting number, the fuze is partially armed. If the arming delay setting cannot be changed, you should consider the fuze to be armed. Discontinue the inspection and notify the proper authority.

NOTE: When removed from its individual container, each fuze must be inspected at the 6- and 18-second settings. Subsequent inspections may be made at either the 6- or 18-second setting.

- Set the arming delay to the 6- and 18-second settings. Make sure a green background with a white number 6 or 18 appears in the upper window. The lower window should be vacant or dark in color.

CAUTION

Do not reinstall the stopscrew if the delay is set at the 2- or 4-second setting or a dud may result.

NOTE: The arming delay may be set before or during fuze installation in the bomb. The stopscrew must be removed to obtain the 2- or 4-second delay setting.

- Set the arming delay, if applicable. The arming delay setting knob is locked at the desired setting when the index locking pin is released.

If an M9 delay element is **not** installed, make the following checks and/or take the indicated actions:

- That the delay element well is clean and not damaged.

- That the correct delay element is being used. (Check the delay time printed on the outer end of the element.) You can determine the delay requirements by referring to the ordnance load plan.

- That the delay element is clean and not damaged.

- Depress the delay locking pin on the fuze.

- Align the keyway in the delay element with the small pin in the delay element well.

- Insert the delay element into the delay element well.

- Release the delay element locking pin and make sure the element is fully seated and locked.

A preloaded MER/TER is inspected for the following:

- That the MER/TER is configured for 30-inch suspension. The rack should be marked for its designated loading station.

- That the MER/TER electrical safety pin is installed.

- That the safety stop levers are locked on each loaded ejector unit.

- That the breech caps are disconnected and the cartridges removed.

- That the sway braces are adjusted against the weapons and the jam nuts tight.

- That the fins do not overlap, if applicable.

- That the ejector feet are positioned against the weapons.

- That the manual release levers are fully aft.

- That empty station suspension hooks are open.

- That the mode selector switch is set.

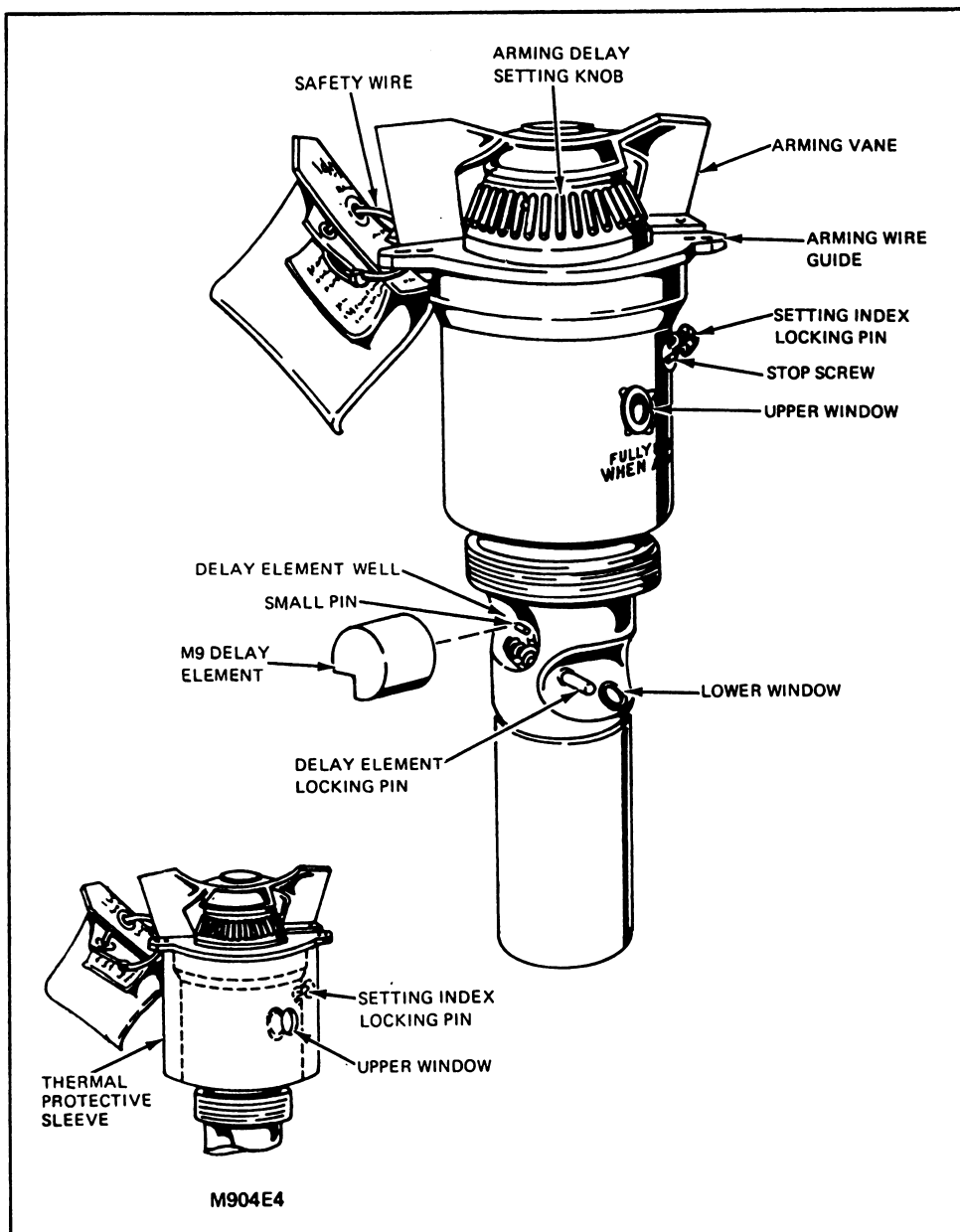


Figure 13-8.—M904 (series) fuze.

Inspect retard/nonretard bombs to make sure the fuze cavities aren't damaged and are free of foreign material. Check to see that the Mk 122 arming safety switch lanyard tab is connected to the spring latch on the side of the ejector unit. Then, make sure the arming wires and fin release wires are installed and taped to the bomb for handling. Make sure the Mk 3 arming wire is connected to the aft bomb lug and routed through the aft arming latch and the top hole in the fin,

through the pop-out pin of the fuze, and then extended through the hole in the bottom of the fin. Make sure Fahnestock clips aren't installed. The tagged safety pin should be removed from the fuze pop-out pin and the fuze retaining clip installed. The arming wire/safety clip is installed in the striker rod of the Mk 43 TDD. If an Mk 15 fin is installed for retard release, make sure the fin release wire is installed in the fin release band latch, through the guide tube, and the safety

(cotter) pin is removed. If an Mk 15 fin is installed for nonretard release, the safety (cotter) pin should be installed in the fin release band latch, and the split ends spread 180 degrees apart.

WEAPON LOADING

The method you use to load retard/nonretard bombs depends on the weight and configuration of the bombs and the operational commitments. For example, you can load a 500-pound bomb onto the parent rack, a MER/TER, using the HLU-196/E bomb hoisting unit. But remember, you are authorized to manually load weapons or stores weighing 1,000 pounds or less with manual hoisting bars. To meet rearming requirements of high-tempo cyclic operations, you would normally use manual hoisting bars to load individual retard/nonretard bombs that weigh 1,000 pounds or less. Preloaded MERs/TERs and bombs weighing over 1,000 pounds are normally loaded with the HLU-196/E bomb hoisting unit. Both loading methods are discussed in the following text.

To get the parent rack ready for loading a single weapon or a preloaded MER/TER, you would first verify that the aircraft preparation/inspection and weapon inspection have been completed. Then, make sure electrical power is removed from the aircraft, and it is electrically grounded. Make sure that all cockpit armament selectors on the left and right cowlings are in the out position (deselected), and the control switches are OFF or SAFE. All other armament switches should be set to OFF or SAFE. Now, open the left-hand avionics bay access door. For each station being loaded, set the armament station control unit (ASCU) store switches (settings are shown in the tactical manual). Make sure the rack is cocked and the safety pin is installed.

WARNING

The ejector breech cap and auxiliary release unit breech cap must not be connected until directed.

Install a cartridge in the auxiliary release unit breech. Don't connect the breech cap. Install cartridges in the ejector unit breech chambers and attach the breech caps. Tighten the caps firmly

by hand. Install the ejector unit and unit lockpin in position **B** for single bombs, or position **A** for a preloaded MER/TER.

When the parent rack is ready to be loaded, position the weapon and the handling/loading equipment under the loading station. If applicable, prepare the weapon for bomb hoist loading by installing a hoisting sling on the bomb for single store hoisting, or trolleys for hoisting a preloaded MER/TER. Then, you can install the bomb hoist on the parent rack and attach the hoist cable to the hoisting sling or to the MER/TER trolleys. Remove slack from the cable by operating the hoist. (Remember, one person is positioned at the front and one at the tail of the weapon to steady it while it is being hoisted.) Remove the tie-down straps that secure the weapon to the handling equipment.

If applicable, install a manual hoisting bar for manual loading by installing the HLU-256/E manual hoisting bar in the fuze well. Then, remove the weapon tie-down straps that secure the weapon to the handling equipment.

NOTE: If the Mk 3 arming wire is pulled from the Mk 344/376 fuze, it may be reinstalled. If the quick-disconnect connector is damaged on the Mk 122 arming safety switch or if the lanyard has been pulled, the switch must be replaced.

Now, the bomb hoist can be used to load the weapon.

WARNING

Hoist-loading MERs with three 1,000-pound stores is prohibited because of the longitudinal unbalance.

If using an electric fuze, hoist the weapon to about 10 inches below the rack. Connect the Mk 122 arming safety switch quick-disconnect connector (fig. 13-9) to the parent rack arming receptacle. Then, continue to hoist the weapon until both suspension lugs enter the parent rack suspension hooks, and the hooks latch. Make sure you visually inspect the hook lock indicators for a hook locked indication above each set of hooks being used. Slack the hoist cable and shake the weapon gently to make sure it is supported by the suspension hooks.

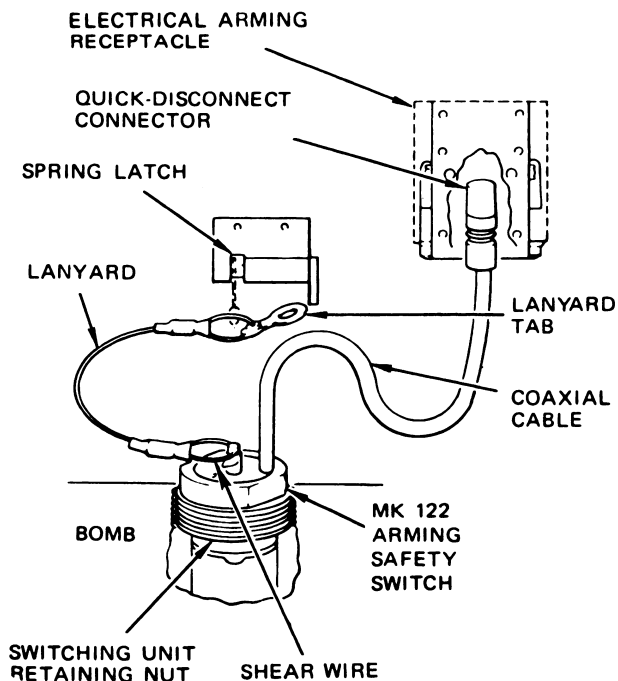


Figure 13-9.—Mk 122 arming safety switch.

After the parent rack check, you can manually hoist the bar. If using an electric fuze, lift the weapon to about 10 inches below the rack. Then, connect the Mk 122 arming safety switch quick-disconnect connector to the parent rack arming receptacle. Continue to lift the weapon until both lugs enter the parent rack suspension hooks, and the hooks latch.

WARNING

Maintain lifting pressure on the weapon until it has been verified that the weapon is supported by the suspension hooks.

Next, visually inspect the hook lock indicators for a hook locked indication above each set of hooks used. Maintain lifting pressure on the weapon and shake it gently to make sure the weapon is supported by the suspension hooks.

When you have finished loading the weapon on the parent rack, remove the manual hoisting bar or the bomb hoisting unit. Then you can

adjust the sway braces by taking the following actions:

NOTE: Unused sway braces should remain in the full up position with the jam nuts tightened.

- Adjusting the sway brace adjusting screws until the sway brace pads contact the weapon.

- Simultaneously tightening the forward right and aft left sway brace screws one-quarter turn, using a suitable wrench.

- Simultaneously tightening the forward left and aft right sway brace screws one-quarter turn.

NOTE: If all sway brace screws cannot be tightened one-quarter turn on final tightening, ensure the same amount of turn is applied to each sway brace screw. The total tightening of each sway brace screw should not exceed one-half turn.

- Tightening the jam nuts using a suitable wrench.

Next, you should adjust the ejector foot down until it makes contact with the weapon. Then back off to the first detent.

If the MER/TER is preloaded, you can connect the adapter connector to the MER/TER. If electric fuzing is used on the preloaded MER/TER, connect the electric fuze adapter harness to the MER/TER. Then, if applicable, install the fuzes.

To install the M904E3/E4 fuze, make sure there is a nose adapter booster installed in the bomb. The adapter booster threads need to be clean and undamaged. As applicable, check to see that an arming delay is set and the arming delay setting knob is locked. Also, make sure the correct delay element is fully seated and locked. Then, screw the fuze into the adapter booster, making sure it is hand tight.

WARNING

Do not remove the fuze arming vane safety wire until directed to do so.

You install the fuze arming wire by connecting the swivel end to the arming solenoid. Then

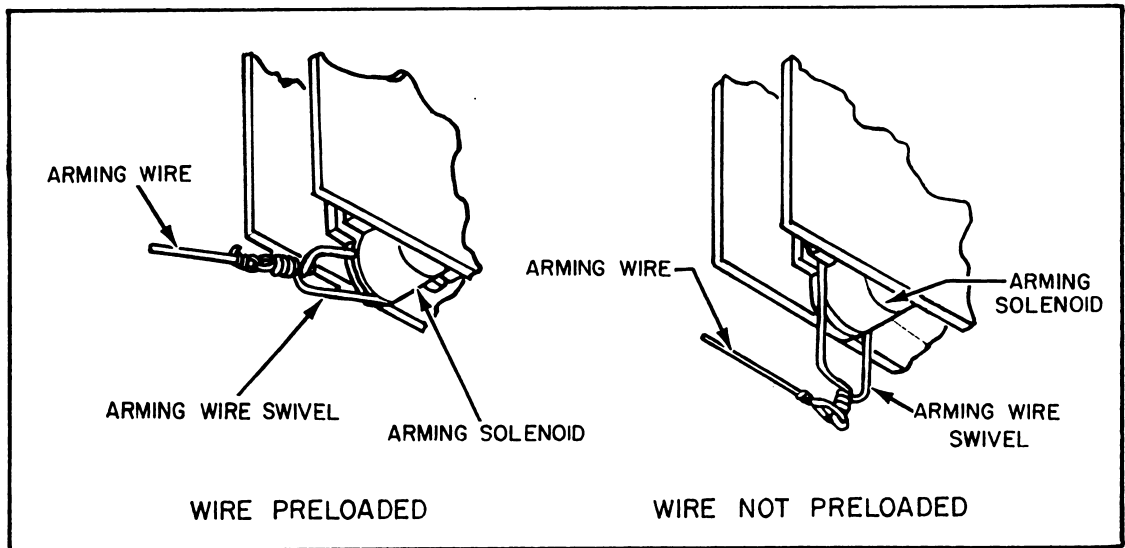


Figure 13-10.—Arming wire rigging.

route the other safety clip end through the fuze arming vane. When adjusting slack, be careful to avoid preloading the arming wire, as shown in figure 13-10. Before trimming off the excess wire protruding from the fuze arming vane, you should install the appropriate number of Fahnstock clips. After the Fahnstock clips are installed, you should trim the arming wire to within 3 or 4 inches of the fuze arming vane.

NOTE: When possible, you should use safety clips instead of Fahnstock clips.

To install the Mk 344/376 fuze, make sure the Mk 3 arming wire is positive armed. Then, trim the excess Mk 3 arming wire to about 6 inches below the bottom of the fin. Make sure that Fahnstock clips **aren't** installed. Attach the Mk 122 arming safety switch lanyard tab to the spring latch on the rack.

Once fuzes are installed, install cartridges in all loaded MER/TER breech chambers. Screw the breech caps on all MER/TER breech chambers and hand tighten the breech caps. Then, connect the ejector unit breech cap harness and auxiliary release unit breech cap. Verify that unloaded MER/TER suspension hooks are open. Place a WEAPON LOADED sign in the cockpit. Remove tools and handling/loading equipment from the area.

Weapons are loaded on a MER/TER in much the same way as on a parent station. The major differences are as follows:

- When using hoisting equipment, a MER/TER hoisting trolley must be used.
- After the weapon lugs have engaged the rack suspension hooks, the safety stop lever must be locked.
- The ejector foot must be positioned down against the weapon.

POSTLOADING QUALITY ASSURANCE INSPECTION

A certified quality assurance inspector (QAR) performs the postloading quality assurance inspection after loading is complete. A postloading quality assurance inspection makes sure that weapons are properly loaded and no procedural steps were omitted.

REARMING AREA (BEFORE ENGINE TURNUP)

There aren't many procedures for you to carry out in the rearming area (before engine turnup). You will remove the WEAPON LOADED sign from the cockpit, and close and secure access doors. Normally, these procedures are performed at the same time as the pilot's aircraft walkaround inspection before manning the aircraft.

REARMING OR ARMING AREA (AFTER ENGINE TURNUP)

The procedures performed in the rearming area or arming area (after engine turnup) are done after the engine start and normally after the plane captain completes the pretaxi signals. Bomb-type ammunition is normally armed in the arming area. All forward-firing ordnance **must** be armed in the arming area. Final arming of bomb-type ammunition requires that a safety person be positioned in view of the pilot. The safety person notifies the pilot of the intention to remove safety pins. When this is done, a member of the arming crew removes the MER/TER electrical safety pins, and another crew member removes the safety pins from the parent racks. Finally, a crew member unlocks the MER/TER safety stop levers.

DEARMING OR REARMING AREA (IMMEDIATELY AFTER ENGINE SHUTDOWN)

Dearming procedures are performed after aircraft landing or ground abort. Aircraft bombs are normally dearmed in the rearming area. However, if the aircraft has missiles or rockets aboard, they are safed in the designated dearming area.

WARNING

Do not attempt to disarm a partially or fully armed fuze. Notify the proper authority. If any component is missing, loose, or damaged, notify proper authority. If an arming wire is not installed in the fuze/arming device, the fuze/arming device may be partially armed. You should notify the proper authority.

NOTE: The only means of determining the safe condition of an electric fuze/firing mechanism is by verifying that the arming wire is installed through the pop-out pin.

The first step you take when dearming an aircraft is to make sure the fuzes/arming devices or firing mechanisms are safe and arming wires are installed through fuze vanes and pop-out pins, as applicable. Then, inspect the weapons for missing, loose, or damaged components. If a MER/TER is involved, position the safety stop

levers to lock on loaded racks. Install the safety pins in loaded stations; if a MER/TER is involved, install the electrical safety pins. When you have finished installing the safety pins, indicate to the pilot that the safety pins are installed, and the MER/TER safety stop levers are locked.

NOTE: If an aircraft returns with unexpended ordnance, a **WEAPON LOADED** sign must be placed in the cockpit.

Check that all cockpit armament switches are OFF, SAFE, or NORM. As applicable, remove arming wires, lanyards, or lanyard tabs from empty stations. Finally, report the status of the aircraft to the proper authority.

UNLOADING PROCEDURES

Before you unload a weapon from the parent rack, the aircraft should be in the rearming area. Make sure that electrical power to the aircraft is removed, and the aircraft is properly grounded. Verify the following: verify that all cockpit armament selectors on the left and right cowlings are in the out position (deselected), and the control switches are OFF or SAFE; that all other armament switches are OFF or SAFE; that safety pins are installed in all loaded parent racks. Finally, if a MER/TER is being unloaded, verify that the electrical safety pin is installed, and the safety stop lever is locked on each loaded ejector unit.

Now you can open the pylon access doors. For a parent rack, disconnect the ejector unit breech cap harness and auxiliary release unit breech cap. If unloading a MER/TER (with a weapon) from the parent rack, remove the breech caps from the breech chambers, the cartridges from the breech chambers, position the breech caps to prevent damage during unloading, and disconnect the adapter connector, and, if applicable, the electric fuze adapter harness from the MER/TER.

WARNING

Do not remove a fuze or arming wire that was not installed during loading procedures. Do not remove an arming wire unless the fuze safety pin/device is installed.

Ensure that the M904E3/E4 fuze is safe by verifying the installation of the arming wire in the arming wire guide and the arming vane. Make sure you can't see a black letter *A* against a red background in the upper (external) window. If the arming delay isn't set on 6 or 18 seconds, the upper (external) window should be vacant. If the arming delay is set on 6 or 18, you should see matching numbers on a green background in the window. Then you can install a safety wire through the arming wire guide and the arming vane.

WARNING

If the arming wire is not in place or if the upper (external) window indication is a black letter *A* against a red background, consider the fuze to be armed. Do not attempt to change the arming delay settings to disarm the fuze, or to remove the fuze from the bomb. Notify the proper authority when an armed or partially armed condition is indicated.

WARNING

If a green background without the number 6 or 18 appears in the upper (external) window when the arming delay is set on 6 or 18, or if the number in the upper (external) window does not match the arming delay setting number, the fuze is partially armed. Notify the proper authority.

Other actions you should take when unloading weapons include checking to see that the arming wire is installed in the pop-out pin for Mk 344 and Mk 376 electric fuzes. If an electric fuze was used, you need to disconnect the Mk 122 arming safety switch lanyard tab from the spring latch. Then, if applicable, install the fin release band safety (cotter) pin. Disconnect the fin release wires, lanyards, and arming wires from the aircraft.

If applicable, you can remove the M904E3/E4 fuzes by removing the arming wire and removing the fuze from the bomb. After you have removed the fuze, make sure the lower window is vacant or dark colored. Set the arming delay to 6 or 18 seconds. Then, make sure a green background with a white number 6 or 18, depending on the

arming delay setting, appears in the upper window. The lower window must remain vacant or dark colored.

WARNING

If the lower window is red or has a black letter *A* against a red background, consider the fuze armed. Notify the proper authority.

NOTE: Each fuze must be checked for safety on the 6- or 18-second arming delay setting before being placed in storage.

Now you're ready to position the handling/loading equipment under the station you want to unload. As applicable, install a manual hoisting bar or a bomb hoisting unit. Retract the ejector foot to the full up position. Then, retract the sway braces to the full up position. Position one person at the front and one person at the tail of the weapon to steady and guide the weapon onto the bomb handling equipment. Raise the weapon until the suspension lugs float in the hooks. Remove the parent rack safety pin, or move the MER/TER safety lock lever from lock to unlock, as appropriate. Operate the manual release to open the suspension hooks and lower the weapon onto the handling/loading equipment. If an electrically fuzed bomb is being unloaded, lower the weapon approximately 4 inches, and then disconnect the Mk 122 arming safety switch quick-disconnect connector from the rack. Then, you can lower the weapon to the handling/loading equipment. Properly secure the weapon to the handling/loading equipment.

When all weapons have been unloaded, remove the WEAPON LOADED sign from the cockpit. Then, remove all weapons and handling/loading equipment from the area. Finally, report the status of the aircraft to the proper authority.

REVIEW NUMBER 2

- Q1. What is the grounding strap static check requirement for naval squadrons?*
- Q2. During a weapons inspection, you find a weapon or component that doesn't meet inspection criteria. What is the first step you should take?*

- Q3. *What fin is used with Mk 82 bombs for both retard and nonretard release configurations?*
- Q4. *When using electrical fuzes, where should you secure the swivel end of the arming wire?*
- Q5. *During an inspection, you see a black letter A against a red background on an M904 fuze. What is the condition of the fuze?*
- Q6. *During an inspection, you see a green background and the number 6 or 18 doesn't show in the upper window when the arming delay is set at 6 or 18. What is the condition of the M904 fuze?*
- Q7. *What is the maximum weight you are authorized to manually load?*
- Q8. *When manually loading Mk 80 bombs, what hoisting bar should you use?*
- Q9. *If a sway brace on a bomb rack isn't being used, it should remain in what position?*
- Q10. *What is the maximum tightening range of a sway brace screw?*
- Q11. *What arming wire should you use when using electric fuzes?*
- Q12. *When you begin dearming an aircraft, what is the first step you should take?*

SAFETY PRECAUTIONS

Learning Objective: *Recognize the safety precautions to follow when loading/unloading aircraft.*

Safety precautions were given in this chapter as **WARNINGS**, **CAUTIONS**, and **NOTES**. However, there are other safety precautions that you should observe when loading or handling aircraft bombs and practice bombs. A few of these safety precautions are as follows:

- Before removing aircraft bombs from the bomb farm area, verify that the bombs are properly secured to the handling equipment.

- When the bombs are delivered to the aircraft for loading, they must be positioned fore and aft to help prevent inadvertent movement of the handling equipment by the side-to-side roll of the ship.

- Once bombs have been delivered to the aircraft, a person must remain in the immediate area. Bombs must not be left on the flight deck unattended.

- Never attempt to load bombs without sufficient personnel.

- When installing practice bomb signals in Mk 76 or Mk 106 practice bombs, never assemble more bombs than are needed for the next event. When the day's flight schedule has been completed, practice bomb signals must be removed from practice bombs before returning them to storage.

- Because of the nonexplosive nature of practice bombs, AOs have a tendency to be lax when handling and loading practice bombs. Remember, an Mk 76 practice bomb weighs 25 pounds and could cause severe injury if dropped on a person's foot or hand. Additionally, when a practice bomb signal is installed and the bomb is accidentally dropped, sufficient fire and metal fragments can be ejected from the tube to cause severe personal injury.

For further information concerning flight deck operational procedures, you should refer to the *CV NATOPS Manual*, NAVAIR 00-80T-105.

REVIEW NUMBER 3

- Q1. *What maximum amount of Mk 76 and/or Mk 106 practice bombs should be assembled at any one time?*
- Q2. *When loading certain bombs, AOs tend to be careless and get injured. What type of bombs usually cause this attitude?*

REVIEW NUMBER 2 ANSWERS

- A1. *The grounding strap static check requirement for naval squadrons is 25 ohms or less, conducted at least every 6 months.*
- A2. *During a weapons inspection, you find a weapon or component that doesn't meet inspection criteria. You should reject the weapon, and notify the proper authority.*
- A3. *The Mk 15 Snakeye fin is used with Mk 82 bombs for both retard and nonretard release configurations.*
- A4. *When using electrical fuzes, secure the swivel end of the arming wire to the aft bomb lug.*
- A5. *During an inspection, you see a black letter A against a red background on an M904 fuze. When you see this, you know the fuze is fully armed.*
- A6. *During an inspection, you see a green background and the number 6 or 18 doesn't show in the upper window when the arming delay is set at 6 or 18. When you see this, you know the fuze is partially armed.*
- A7. *You are authorized to manually load 1,000 pounds.*
- A8. *When manually loading Mk 80 bombs, you should use the HLU-256/E hoisting bar.*
- A9. *If a sway brace on a bomb rack isn't being used, it should remain in the fully up position with the jam nuts tightened.*
- A10. *The maximum tightening range of a sway brace screw is not to exceed one-half turn.*
- A11. *When using electric fuzes, you should use Mk 3 arming wire.*
- A12. *When you begin dearming an aircraft, the first step you should take is to make sure fuzes/arming devices or firing mechanisms are in a safe condition. Also, install arming wires through the fuze vanes and pop-out pins.*

REVIEW NUMBER 3 ANSWERS

- A1. *Only assemble the amount of practice bombs needed for the next event at any one time.*
- A2. *When loading certain bombs, AOs tend to be careless and get injured. Practice bombs usually cause this attitude.*

CHAPTER 14

AIRCRAFT WEAPONS SYSTEMS

Modern supersonic fighter and attack aircraft attack a target automatically and accurately. These aircraft are designed and built as a completely integrated weapons system. The weapons subsystems are interconnected and dependent on each other or on other aircraft systems. For example, the bomb release system in some modes of operation depends on the aircraft's flight control system; the missile system is interconnected with the aircraft's radar system for missile guidance. In addition to delivering weapons more accurately, the use of computer-controlled weapons systems provide a higher degree of safety by reducing human error.

The Navy currently uses the F-14 and F/A-18 fighter aircraft, the A-6 attack aircraft, the P-3C and S-3A aircraft, and the SH-3 helicopter antisubmarine warfare weapons systems. The F/A-18 is a dual-mission aircraft (fighter/attack), and is discussed under fighter aircraft. The weapons systems used in modern aircraft are complex. The information on fighter, attack, and antisubmarine warfare weapons systems in this chapter is basic. As you work in your rating, you will learn more about specific systems, and you will be trained in their operation.

FIGHTER AIRCRAFT WEAPONS SYSTEMS

Learning Objective: Identify fighter aircraft weapons systems to include those used in the F-14 and F/A-18 aircraft.

The following discussion of the F-14 and F/A-18 aircraft introduces you to information on the available aircraft armament systems and the basic controls and components common to these systems.

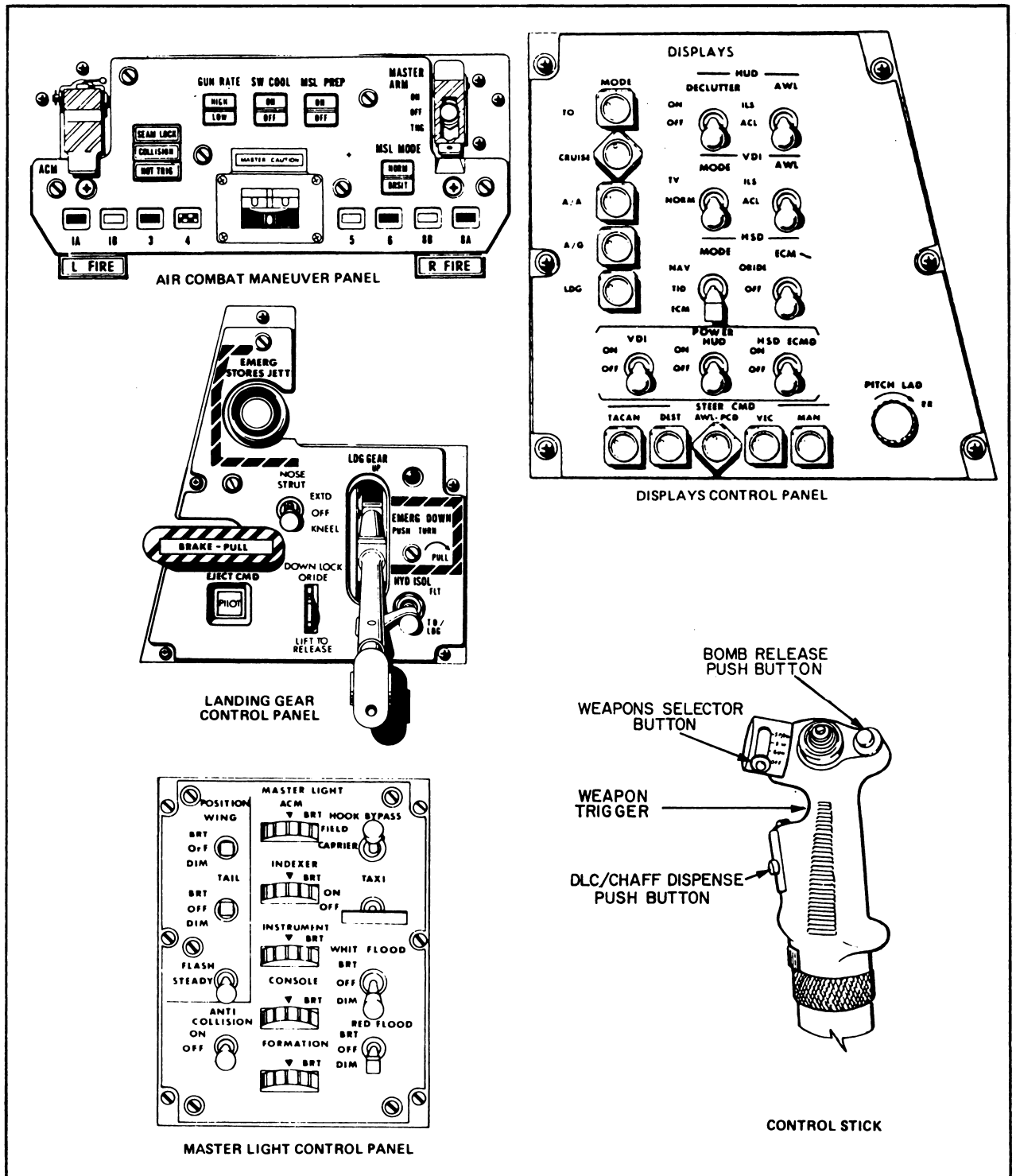
F-14 AIRCRAFT WEAPONS SYSTEMS

The F-14 aircraft is a two-seat (in-line), supersonic, fighter aircraft. It has a servo air fitting and ground cooling air inlet fitting. The servo air fitting provides air to operate servo valves in the environmental control system during built-in-test (BIT) checks and to pressurize the AWG-9 waveguide and gun gas purge valve operation during aircraft ground checks. The ground cooling air inlet fitting provides cooling air to electronic equipment during ground operation.

External power can be applied to all F-14 (series) aircraft. You can use mobile ac power plants, carrier, or hangar ac power cables to apply electrical power to the aircraft when the engines are not operating.

The aircraft armament system consists of a missile control system, multiple weapons release system, M61A1 20-mm automatic gun fire control system, AN/AWW-4 fuze function control system, AN/ALE-39 decoy dispensing system, and jettison system. The F-14 armament system consists of the following basic controls and components common to all systems:

- Air combat maneuver (ACM) panel
- Armament control indicator panel
- Displays control panel
- Control stick
- Master light control panel
- Landing gear handle
- Armament safety override switch



220.991

Figure 14-1.—F-14 control panels.

Air Combat Maneuver (ACM) Panel

The ACM panel (fig. 14-1) is located on the forward cockpit center console. It contains switches for missile preparation, missile operating

mode selection, and for arming the system. Indicators inform the pilot of weapon status, when the missile is locked on the target, and when the missile is ready to be launched. When the ACM encounter mode is selected, gun high-firing

rate and the AIM-9 missile cooling are automatically selected. The ACM panel switches are discussed in the following paragraphs.

MASTER ARM SWITCH. The MASTER ARM switch is a three-position (ON/OFF/TNG) guarded toggle switch. When the guard is raised and the switch is set to ON, a master arm signal is sent to the ARMAMENT panel to enable the master arm logic circuitry. When the switch is set to TNG, it initiates the in-flight training mode.

ACM SWITCH. The ACM switch is a cam-type switch. It is activated when the switch guard is moved up to select the ACM encounter mode. Once the system enters the ACM encounter mode, the normal missile mode is automatically selected. If the weapon control system loses track of the target, the system is automatically switched to the boresight mode. Target data is displayed by the vertical display indicator system when the computer pilot attack mode is selected.

ACM JETT SWITCH. The ACM JETT switch is a push-button switch located under the ACM switch guard. When the switch is pressed, the stores on the stations that were selected on the ARMAMENT panel are jettisoned. The ACM JETT switch can't jettison Sidewinder missiles even when their stations are selected.

HOT TRIG (TRIGGER) WARNING INDICATOR LIGHT. The HOT TRIG warning indicator lamp lights to notify the pilot that missiles are ready for launching, the gun is ready to fire, or the weapons selected are ready for firing.

WEAPON STATUS INDICATORS. The weapons status indicators (stations 1A, 1B, 3, 4, 5, 6, 8B, and 8A) notify the pilot of weapon status when the LDG GEAR handle is in the UP position.

Armament Control Indicator Panel

The armament control indicator panel (fig. 14-2) is located in the aft cockpit left vertical console. It contains the attack mode (ATTK MODE) selector switch, weapon-type (WEP TYPE) thumb-wheel switch, electric fuze (ELECT FUZE) selector switch, delivery (DLVY MODE) switches, delivery options (DLVY OPTNS) switches, station set (STA SET) switches, missile option (MSL OPTION) switches, missile speed gate (MSL SPD GATE) selector switch, and select jettison (SEL JETT), tank jettison (TANK JETT), and jettison options (JETT OPTIONS) switches.

Displays Control Panel

The displays control panel (fig. 14-1) is located on the forward cockpit right vertical console. It contains the air/ground mode (A/G MODE) push-button switch for air-to-ground mode selection, the air/air mode (A/A MODE) push-button switch for air-to-air mode selection, and the all-weather landing/precision course direction (AWL/PCD) push-button switch for air-to-air mode selection. This panel also contains the all-weather landing/precision course direction (AWL/PCD) push-button switch for the all-weather landing/precision course direction mode. The AWL/PCD switch is used when bombs are to be released using the data link system.

Control Stick

The control stick (fig. 14-1), located in the forward cockpit, contains the weapons selector button, weapon trigger, bomb-release push button, and the DLC/CHAFF DISPENSE push button.

WEAPON SELECTOR BUTTON. The weapon selector is a four-position rotary push-button switch. When set in the Sparrow/Phoenix (SP/PH) position, it selects AIM-7 missiles automatically. Selection of AIM-54 missiles is done by pressing and releasing the push button once. The SW position selects an AIM-9 Sidewinder missile, the GUN position selects the gun for operation, and the OFF position de-energizes all systems.

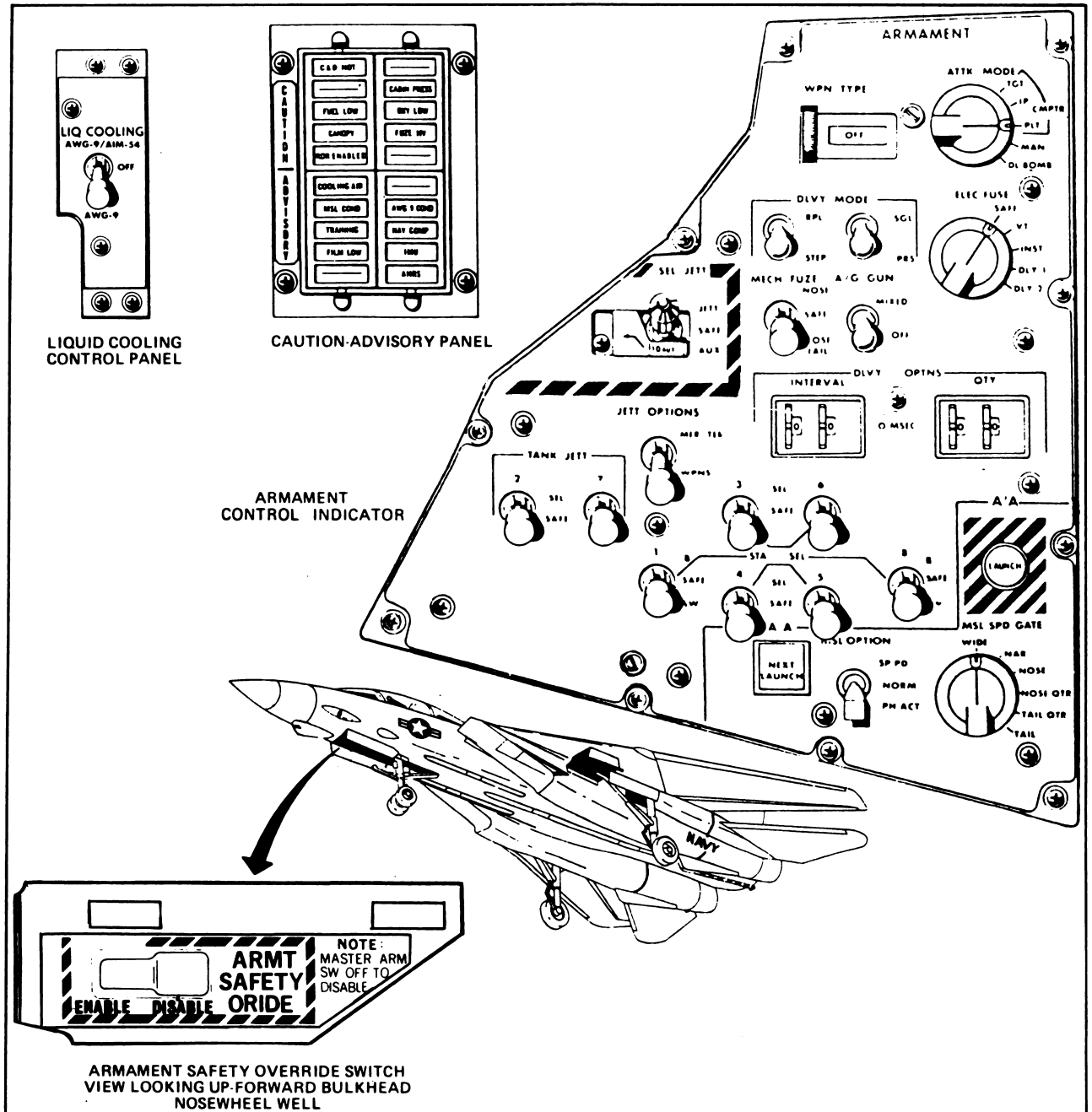
WEAPON TRIGGER. When squeezed, the weapon trigger generates a missile launch initiate command when all the missile launch requirements are met. It fires the gun when all the gun firing requirements are met, and it fires rockets when all the rocket firing requirements are met.

BOMB RELEASE PUSH BUTTON. When the bomb release PUSH button is depressed, it generates a bomb-release signal that releases loaded stores.

DLC/CHAFF DISPENSE PUSH BUTTON. When depressed, the DCL/CHAFF DISPENSE PUSH BUTTON generates a CHAFF/FLARE release signal that dispenses CHAFF/FLARE rounds.

Master Light Control Panel

The master light control panel (fig. 14-1) is located on the right side console of the forward cockpit. It contains the ACM thumb-wheel



220.992

Figure 14-2.—F-14 weapons control panels.

control, which controls the 26 volts ac to the ACM panel indicator lights.

Landing Gear Handle

The landing gear handle (LDG GEAR) handle (fig.14-1) is located on the left vertical console of the forward cockpit. It operates a switch assembly that functions as an armament safety device. As such, it prevents accidental missile launching, bomb release, rocket firing, and ACM encounter

jettison of external weapons/stores when the aircraft is on the ground. Master arm power is prevented when the LDG GEAR handle is in the down (DN) position. When the LDG GEAR handle is in the UP position, the fire control system master arm power is available.

Armament Safety Override Switch

The armament safety override (ARM SAFETY ORIDE) switch (fig. 14-2) is located in the

nosewheel well. It is a magnetically held closed switch. The switch is used as an armament safety override to bypass the open landing gear safety circuit when the LDG GEAR handle is in the DN position. This lets you make functional checks of the system during ground maintenance.

Missile Control System

The missile control system consists of the controls and components you have already read about. It also contains the following missile system controls and components:

- Weapons status indicators
- Liquid (LIQ) cooling control panel
- Aft cockpit caution advisory panel

The AIM-54 and AIM-7 missile fire control systems help to select, prepare, and launch AIM-54 and AIM-7 missiles. The AIM-54 is a long-range, semiactive radar midcourse guided and active radar terminal guided missile. It operates in either the normal or boresight mode. The F-14 holds a maximum of six AIM-54 missiles—two are suspended from multipurpose pylons on stations 1B and 8B and the remaining four at weapons rail stations 3R, 4R, 5R, and 6R. The AIM-7 is a medium-range, semiactive radar-guided missile. It also operates in either the normal or boresight mode. The F-14 holds a maximum of six AIM-7 missiles—two are suspended from multipurpose pylons on stations 1B and 8B and four at semisubmerged fuselage stations 3, 4, 5, and 6.

With the LDG GEAR handle in the UP position, the weapon status indicators (on the ACM panel) notify the pilot of the AIM-54 and AIM-7 missile status. When a missile station is ready, the weapon status indicator is white. When a missile station is selected and ready, the weapon status indicator shows a checkerboard. Only one weapon status indicator has a checkerboard indication at any one time. When a station has no weapon, or when the weapon is not ready, the weapon status indicator is black.

The liquid cooling control panel (fig. 14-2) is located in the left side console of the aft cockpit. It contains the LIQ COOLING toggle switch to control application of liquid coolant. When the LIQ COOLING switch is OFF, it deactivates the cooling systems and shuts down the AWG-9 and AIM-54 cooling pumps. When the LIQ COOLING switch is set to AWG-9/AIM-54, it activates both the AWG-9 cooling pump motor and the AIM-54 cooling pump motor. This provides ground and airborne thermal conditioning

for the AWG-9 and Phoenix missiles. When the LIQ COOLING switch is set to AWG-9, it activates the AWG-9 cooling thermal conditioning.

The aft cockpit caution advisory panel (fig. 14-2) is located on the right knee panel. It contains the missile condition (MSL COND) advisory indicator lamps, which light when liquid coolant is applied to the AIM-54 missile.

The missile preparation (MSL PREP) switch (fig. 14-1) is a two-position push-button indicator switch located on the ACM panel. When the switch is set to ON, the weapon control system prepares all AIM-7 and AIM-54 missiles for launch.

The missile mode (MSL MODE) switch (fig. 14-1) is a two-position push-button switch located on the ACM panel. It is used to select the missile mode of operation. The boresight (BRSIT) position is only active when the system is not in the ACM encounter mode (ACM switch OFF). With the BRSIT mode selected, the pilot steers the aircraft on a collision course with the target. The normal (NORM) position notifies the weapon control system to launch missiles in a normal configuration. Target data is displayed by the vertical display indicator system, and a launch enable is generated by the weapon control system. The AIM-9 missile operates in one of two modes—the slave scan mode when the radar subsystem is tracking a target, or the boresight scan mode when the radar subsystem isn't tracking a target.

When the selected missile is ready to be launched, the LAUNCH push-button indicator, located on the armament control indicator (fig. 14-2), lights. Pressing the LAUNCH push-button indicator generates a missile launch initiate command that launches the selected missile. The NEXT LAUNCH push-button indicator, also located on the armament control indicator (fig. 14-2), lets the naval flight officer (NFO) select an alternate target. Once selected, the weapons control system is instructed to track the alternate target.

The missile options (MSL OPTIONS) switch is located on the armament control indicator (fig. 14-2). It is a three-position switch that is used to select the radar track configuration of the selected missile. The SP PD position is used only with the AIM-7F missiles. This position causes the selected missile to operate in the pulse Doppler mode. The NORM position is used with the AIM-7 and AIM-54 missiles. This position causes the weapon control system to direct the selected missile radar system to operate in the continuous wave (CW) mode. When an AIM-54 missile is selected for

launch, the missile is instructed to operate in the semiactive guidance mode. The PH ACT position is used only with AIM-54 missiles. This position causes the weapon control system to switch from semiactive guidance to active guidance and command the AIM-54 missile radar system to operate in a short-range mode.

The MSL SPD GATE selector is a six-position rotary switch located on the armament control indicator (fig. 14-2). This switch is used to prepare the selected missile for launch. The WIDE position is used only with the AIM-7 missile when there is no radar lock with the target. The pulse Doppler frequency is forced to sweep the entire missile radar frequency range. The NAR position is used only with the AIM-7 missile radar frequency range. The NAR position is used only with the AIM-7 missile when there is radar lock with the target, and only the narrow portion of the pulse Doppler frequency is swept. The NOSE, NOSE QTR, TAIL QTR, and TAIL positions are used to inform the weapon control system that the selected missile radar system is to lock on the target corresponding to the switch position. These switch positions relate to the physical segments of the aircraft.

The AIM-9 fire control system enables selecting, preparing, and firing of the AIM-9 (series) missiles. The AIM-9 missile is a supersonic, short-range, air-to-air intercept missile that uses passive infrared for target detection and guidance. When using multipurpose pylons not modified by AAC 618, AIM-9 missiles are carried on stations 1A and 8A. When using multipurpose pylons modified by AAC 618, the F-14 holds a maximum of four AIM-9 missiles—one missile each on stations 1A, 1B, 8A, and 8B.

The weapons status indicators are located on the ACM panel. They notify the pilot of the weapon status of the AIM-9 missiles on stations 1A, 1B, 8A, and 8B.

The Sidewinder cool (SW COOL) switch (fig. 14-1) is a two-position push-button switch on the ACM panel. This switch is used to generate the AIM-9 missile cool signal to cool the missiles. When in the ACM encounter mode, AIM-9 missile cooling is automatically selected, regardless of the SW COOL switch position.

The throttle quadrant, located on the left side console of the forward cockpit, contains the CAGE/SEAM push-button switch for initiating the Sidewinder expanded acquisition mode (SEAM) lock-on command. The pilot presses the CAGE/SEAM push-button switch when the missile is locked on the target as indicated by the

AIM-9 tone in the pilot headset. The SEAM LOCK advisory indicator, located on the ACM panel, lights to notify the pilot that the AIM-9 missile selected is locked on the target. A tone volume control panel with an SW potentiometer, located on the pilot's left side console, controls the AIM-9 tone to the pilot's headset.

The station select (STA SEL) switches, located on the armament control indicator panel, are three-position lever-lock toggle switches. These switches enable the jettisoning of weapons or stores loaded on multipurpose pylon stations 1B and 8B. The B position enables jettisoning of weapons or stores from multipurpose pylon stations 1B and 8B. The SAFE position inhibits jettisoning. The SW position enables jettisoning of AIM-9 missiles from stations 1A and 8A. This capability isn't possible when LAU-7 launchers using AAC 688 are installed.

Multiple Weapons Release System

The multiple weapons release system has basic controls and components and multiple weapons system controls and components. They are discussed in the following paragraphs.

The bomb release and rocket control systems enable selecting, preparing, and delivering of the air-to-ground stores. Weapons that can be carried on stations 3R, 4R, 5R, and 6R range from general-purpose bombs of various sizes to CBU, LAU-10, and fire bombs. Rocket launchers can only be carried on stations 3R and 6R. System operation is computer or data-link controlled. A manual (backup) mode having a manually controlled sight reticle can also be selected.

WEAPON-TYPE THUMB-WHEEL SWITCH. The weapon-type (WPN TYPE) thumb-wheel switch (fig. 14-2), located on the armament control indicator panel, is an ON-OFF thumb-wheel switch for use in weapon selection. The weapon is selected by rotating the switch until the type of weapon is displayed in the associated window.

ATTACK MODE SELECTOR SWITCH. The attack mode (ATTK MODE) switch is a five-position rotary switch located on the armament control indicator panel (fig. 14-2). This switch is used to select the attack mode for bomb release and rocket firing. The COMPTR PLT and MAN positions are used for the gun fire control system. With the WPN TYPE thumb-wheel switch set to OFF, the COMPTR PLT position provides target data to the vertical display indicator system

regardless of the mode (A/G, A/A, or ACM encounter) selected. With the ATTK MODE switch set to MAN, and WPN TYPE set to OFF, target information is not displayed in any of the three modes.

The computer target (COMPTR TGT) position permits bomb release or rocket firing against weapon control system designated targets. The computer identification point (COMPTR IP) position permits bomb release against weapon control system designated targets only. The computer pilot (COMPTR PLT) position permits bomb release or rocket firing without the weapon control system. The manual (MAN) position permits bomb release or rocket firing on a visual course to the target without the weapon control system. The data link bomb (D/L BOMB) position permits bomb release under control of the data link system only.

DELIVERY MODE SWITCHES. The two delivery mode (DLVY MODE) switches (fig. 14-2) are located on the armament control indicator panel. They are used to select the delivery sequence of the A/G weapons. The single pairs (SGL PRS) switch is a two-position toggle switch that selects the release of one weapon at a time (SGL position), or the release of two weapons at a time (PRS POSITION). The step ripple (STP RPPL) switch is a two-position toggle switch. The STP position provides for the release of one (SGL) or two (PRS) weapons each time the weapon trigger or bomb-release push button on the control stick is actuated. The RPPL position allows the release of a selected quantity of weapons at a selected interval release in singles or pairs.

DELIVERY OPTIONS CONTROLS. The delivery options (DLVY OPTIONS) controls (fig. 14-2) are located on the armament control indicator panel. They consist of two thumb-wheel incremental stepping controls for selecting the interval and quantity of weapons to be delivered. The interval control allows for a release interval selection up to 990 milliseconds in 10-millisecond increments. The QTY control switch allows for selection of weapons for release from 0 to 29 in single unit increments.

STATION SELECT SWITCHES. The station select (STA SEL) switches for stations 3R, 4R, 5R, and 6R (fig. 14-2) are located on the armament control indicator panel. These are two-position lever-lock toggle switches that enable

A/G weapon delivery. The select (SEL) position selects the associated station for weapon release or firing. The SAFE position inhibits release or firing.

M61A1 20-MM Automatic Gun Fire Control System

The M61A1 20-mm automatic gun fire control system enables selecting, arming, and firing of the gun. Depending upon the mission objective, the gun fire control system can be operated in an air-to-ground (A/G), air-to-air (A/A), or air combat maneuver (ACM encounter) mode. Two attack modes of operation are available—computer pilot attack mode and manual attack mode. The computer pilot attack mode operates with the weapon control system, CSDC, and the vertical display indicator system to display target data. The manual attack mode is used primarily as a backup mode to provide a manually controlled sight reticle if a system malfunction occurs.

GUN RATE SWITCH. The GUN RATE switch (fig. 14-1) is located on the ACM panel. It is a two-position push-button indicator switch that selects HIGH (6,000 rounds per minute) or LOW (4,000 rounds per minute) rate of fire. This switch is only active in the A/G and A/A modes.

A/G GUN SWITCH. The A/G GUN switch (fig. 14-2) is located on the armament control indicator panel. It is a two-position toggle switch that enables or inhibits a mixed bomb and gun mode operation. The MIXED position enables bomb and gun mode operation while the OFF position inhibits it.

GUN CONTROL UNIT. The gun control unit, located above the gun barrels, contains the BURST selector switch. This switch limits the number of rounds that can be fired per burst (50, 100, or 200), or it permits unrestricted firing (MAN position).

HOOK/GUN PANEL. The HOOK/GUN panel, located on the forward cockpit vertical console, contains the gun rounds counter. This counter provides a digital countdown readout of the rounds remaining.

Decoy Dispensing Systems

The F-14 aircraft uses the AN/ALE-39 decoy dispensing system. The CHAFF/FLARE

DISPENSE panel is located on the aft cockpit right side console. The MANUAL DISPENSE switch on the CHAFF/FLARE DISPENSE panel is used to initiate rounds from the aft cockpit. Rounds can also be initiated from the forward cockpit by the decoy dispense push button on the control stick.

Jettison System

The jettison system allows jettison of certain external stores. There are four jettison modes:

1. Emergency, which is pilot controlled
2. ACM encounter, which is NFO selected and pilot controlled
3. Selective, which is NFO controlled
4. Auxiliary, which is NFO controlled

In all modes, arming and fuzing is disabled during jettison operations. The landing gear handle must be UP for ACM encounter, selective, and auxiliary jettison modes.

EMERGENCY JETTISON MODE.—The emergency jettison mode is interlocked with the weight-on-wheels logic. It jettisons all external stores except the AIM-9 missiles. Jettison controls are shown in figure 14-3. The ACM panel has indicators that notify the pilot of weapons station status of all stations that have jettisoned weapons or stores. A black indication appears in the window for each station when the weapons or stores have been jettisoned.

ACM ENCOUNTER JETTISON MODE.—The ACM encounter jettison mode jettisons all external stores except the AIM-9 missiles already selected by the NFO. The ACM panel has switches for the ACM encounter mode. The ACM switch is a cam-type switch that is activated when the switch guard is set to the UP position. When pressed, it selects the ACM encounter mode. The ACM JETT switch is a push-button switch located under the ACM switch guard. When it is pressed, the stores on the stations selected on the armament control indicator panel are jettisoned.

The STA SEL switches (stations 3, 4, 5, and 6) are two-position lever-lock toggle switches that enable jettisoning of loaded station stores. The SEL position enables jettisoning of the associated station weapons or stores. The SAFE position inhibits jettisoning. STA SEL switches (stations 1 and 8) are three-position lever-lock toggle switches that enable the jettisoning of Sparrow or Phoenix missiles loaded on multipurpose pylon stations 1B and 8B. The B position enables jettisoning of Sparrow or Phoenix missiles from

multipurpose pylon stations 1B and 8B. The safe position inhibits jettisoning. The SW position is inhibited when in the ACM encounter jettison mode. The TANK JETTISON switch, when in the SAFE position, inhibits jettisoning; and when in the SEL position, it enables jettisoning of the fuel tanks on the associated stations.

SELECTIVE JETTISON MODE.—The selective jettison mode jettisons only selected external weapons or stores. With the MASTER ARM switch set to ON, a master arm signal is applied to the armament control indicator panel to enable the master arm logic circuitry. The armament control indicator panel contains the switches for selecting the selective jettison mode, jettison options, and station selection.

The SEL JETT switch is a three-position, lever-lock toggle switch used for enabling the selective jettison mode. The JETT position enables the selective jettison mode, the SAFE position inhibits selective jettisoning, and the AUX position selects the auxiliary jettison mode.

The JETT OPTIONS switch is a two-position, lever-lock toggle switch that permits the NFO to jettison the weapons and stores only.

The STA SEL switches for stations 3, 4, 5, and 6 are used in the selective jettison mode function in the same manner as the ACM encounter jettison mode. The STA SEL switches for stations 1 and 8 are three-position, lever-lock toggle switches that enable jettisoning of AIM-9 missiles (loaded on LAU-7 launchers not modified by AAC 688) from stations 1A and 8A. The switches enable jettisoning of AIM-7 or AIM-54 missiles from stations 1B and 8B. These STA SEL switches also enable jettisoning from multipurpose pylons not modified by AAC 618, or AIM-9 missiles (loaded on LAU-7 launchers not modified by AAC 688) from stations 1A and 8A. These switches can be used for jettisoning AIM-9, AIM-7, or AIM-54 missiles from stations 1B and 8B on multipurpose pylons that are modified by ACC 618. The B position enables jettisoning of weapons from multipurpose pylon stations 1B and 8B. The SAFE position inhibits jettisoning. The SW position enables jettisoning of AIM-9 missiles (loaded on LAU-7 launchers not modified by AAC 688) from stations 1A and 8A.

The TANK JETTISON switches function in the same manner as the ACM encounter mode.

AUXILIARY JETTISON MODE.—The auxiliary jettison mode is used as a backup in case equipment malfunctions or cartridges misfire. Use of this mode causes a free-fall release of weapons or stores. All selected stations fire auxiliary

jettison cartridges simultaneously when the SEL JETT switch on the armament control indicator panel is held in the AUX position.

Aircraft Armament Configuration Capabilities

The basic armament configuration (fig. 14-4) of the F-14 aircraft consists of four fuselage-mounted LAU-92 missile launchers and an internally mounted M61A1 20-mm gun. However, the aircraft has a total of eight weapons stations

that hold a variety of missile launchers and weapons rails. Figure 14-5 shows the location of weapons stations 1 through 8. Figures 14-6 through 14-12 show the various station and equipment configurations.

For more information on the authorized configurations of aircraft, you should refer to *F-14 Tactical Manual*, NAVAIR 01-F14AAA-1T. If you want more information on F-14 weapons systems, refer to *Airborne Weapons/Stores Loading Manual*, NAVAIR 01-F14AAA-75.

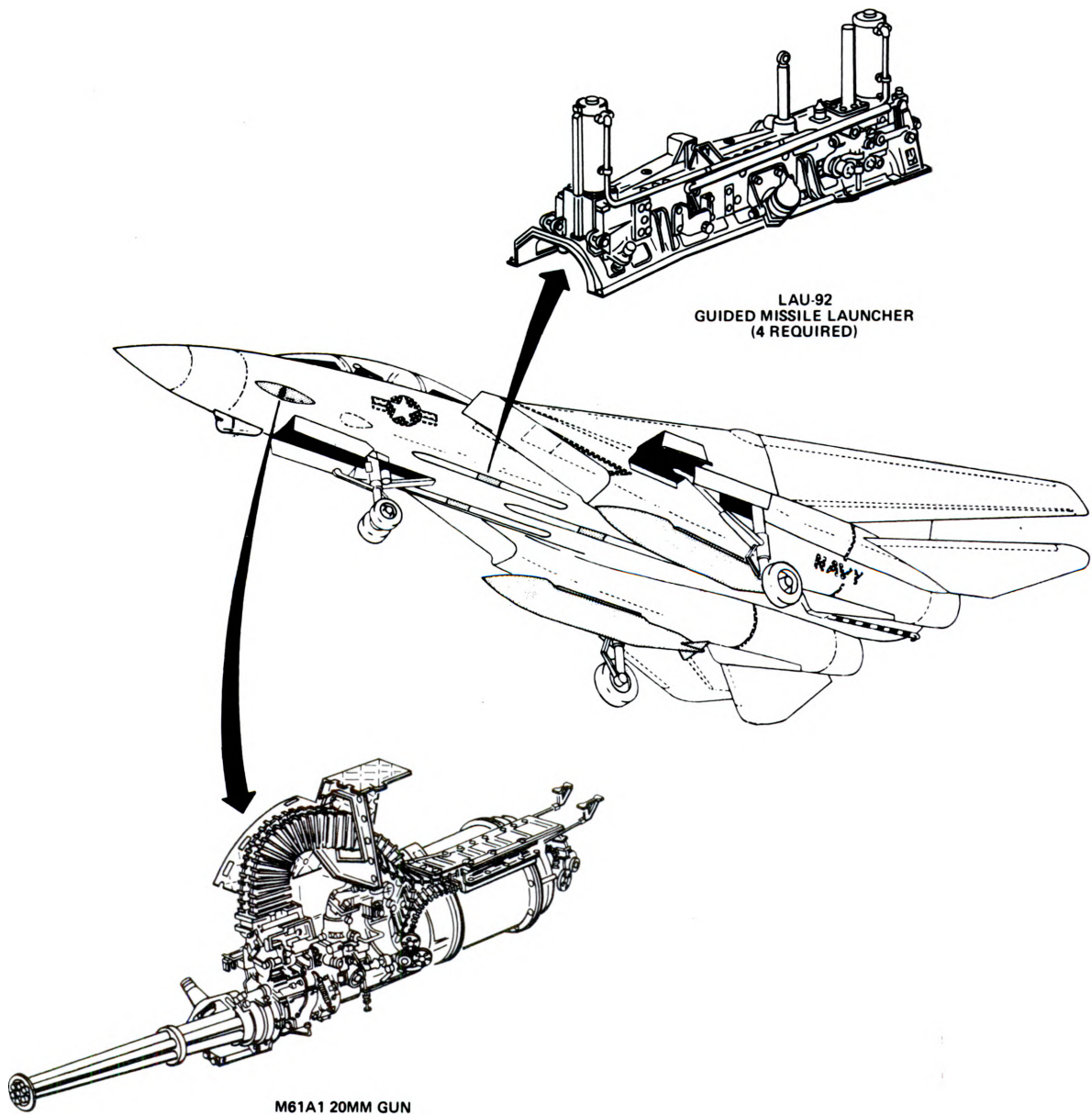
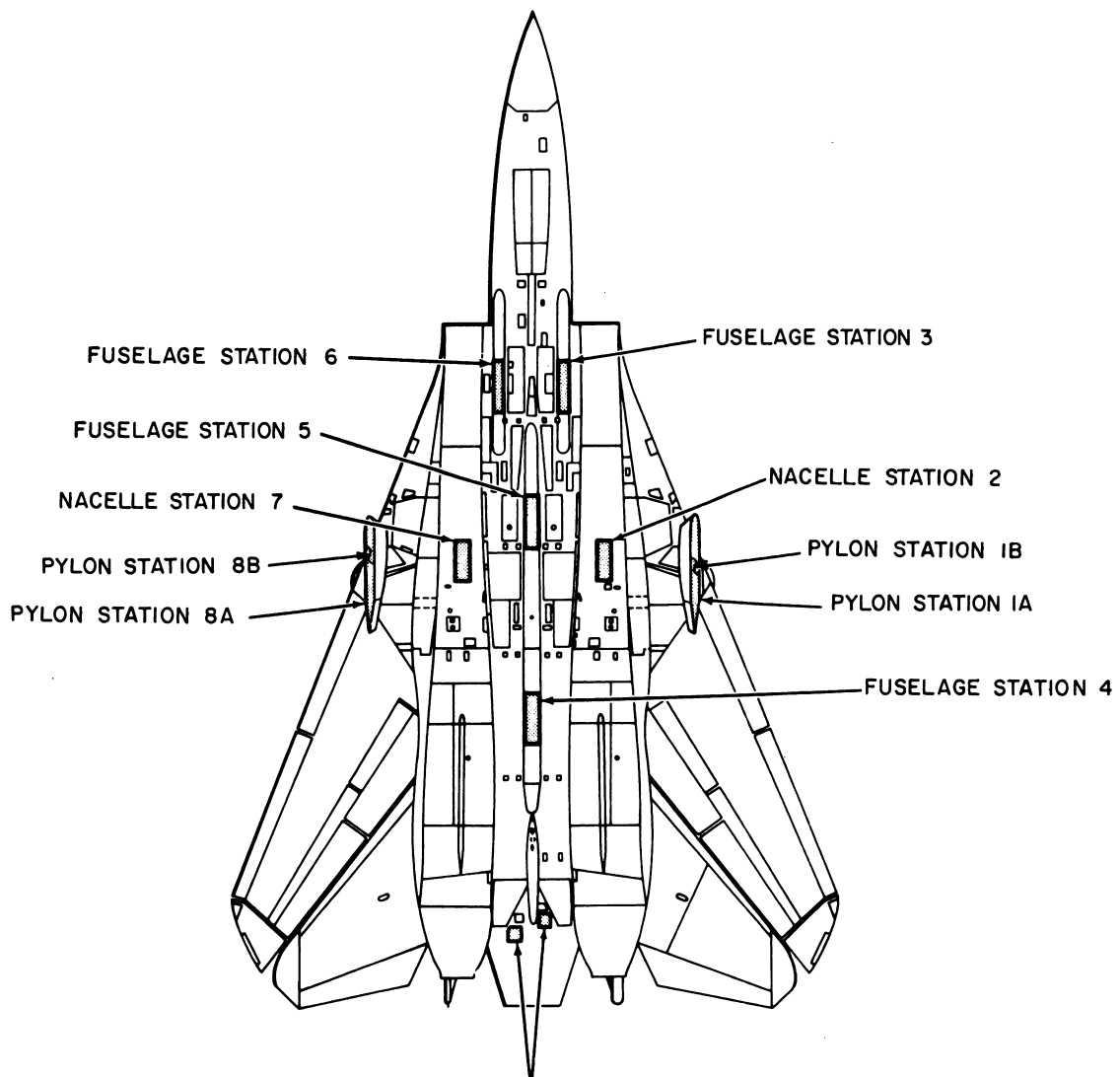


Figure 14-4.—Basic armament configuration.

220.994

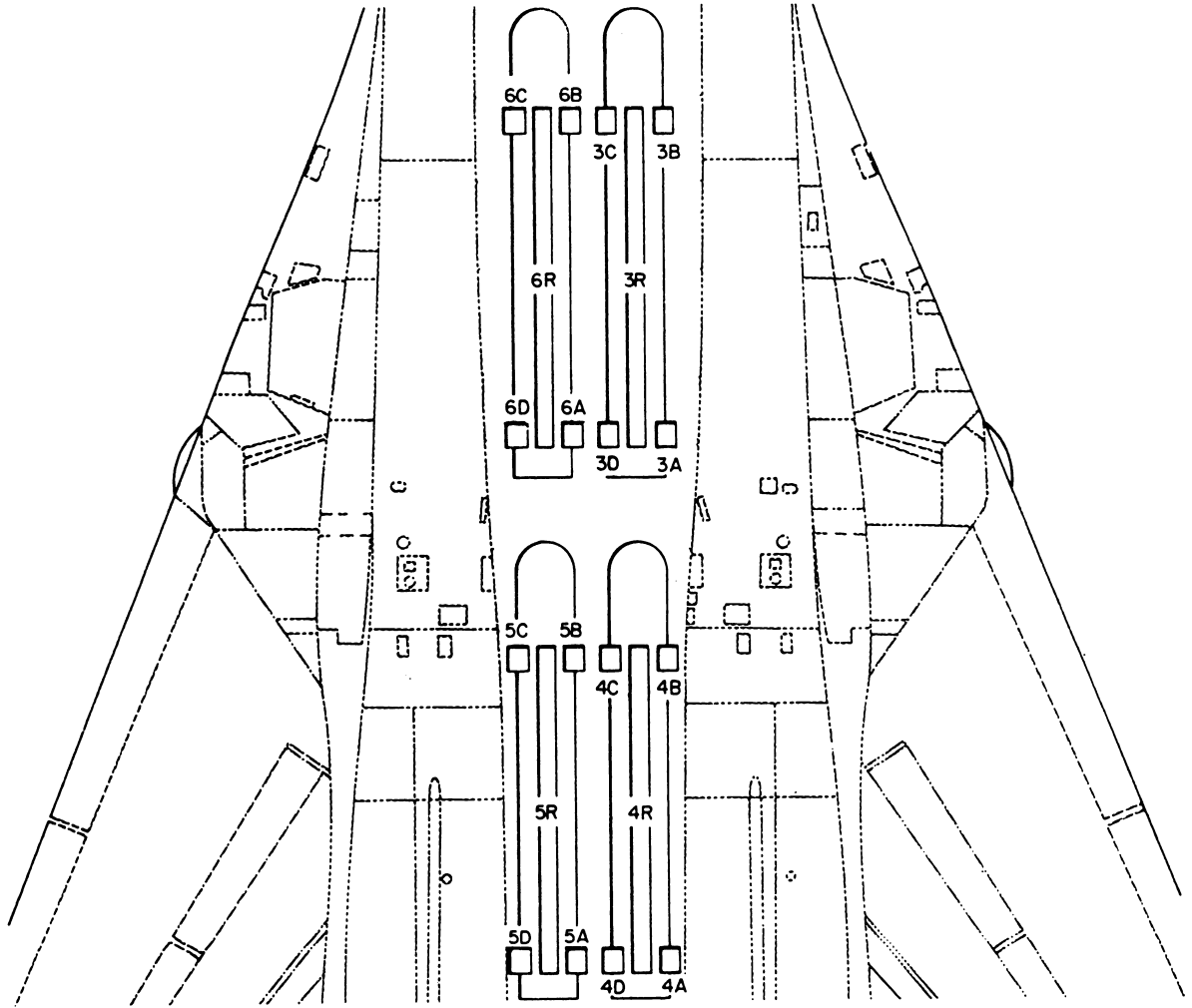


DECOY DISPENSERS (TYPICAL)

VIEW LOOKING UP

EQUIPMENT	FUSELAGE, NACELLE, AND PYLON STATIONS									
	1A	1B	2	3	4	5	6	7	8B	8A
LAU-7 Guided Missile Launcher	X	X							X	X
LAU-92 Guided Missile Launcher		X		X	X	X	X		X	
LAU-93 Guided Missile Launcher		X							X	
MXU-611 Fuel Tank Release Mechanism			X					X		

Figure 14-5.—Location of weapons stations.



VIEW LOOKING UP

EQUIPMENT	WEAPONS RAIL STATION																			
	3R	3A	3B	3C	3D	4R	4A	4B	4C	4D	5R	5A	5B	5C	5D	6R	6A	6B	6C	6D
LAU-93 GUIDED MISSILE LAUNCHER	X					X					X					X				
BRU-24/25 BOMB RACK		X	X	X	X		X	X	X	①		①	X	X	X		X	X	X	X

① USED FOR PRACTICE BOMBS ONLY

Figure 14-6.—Station configuration capabilities.

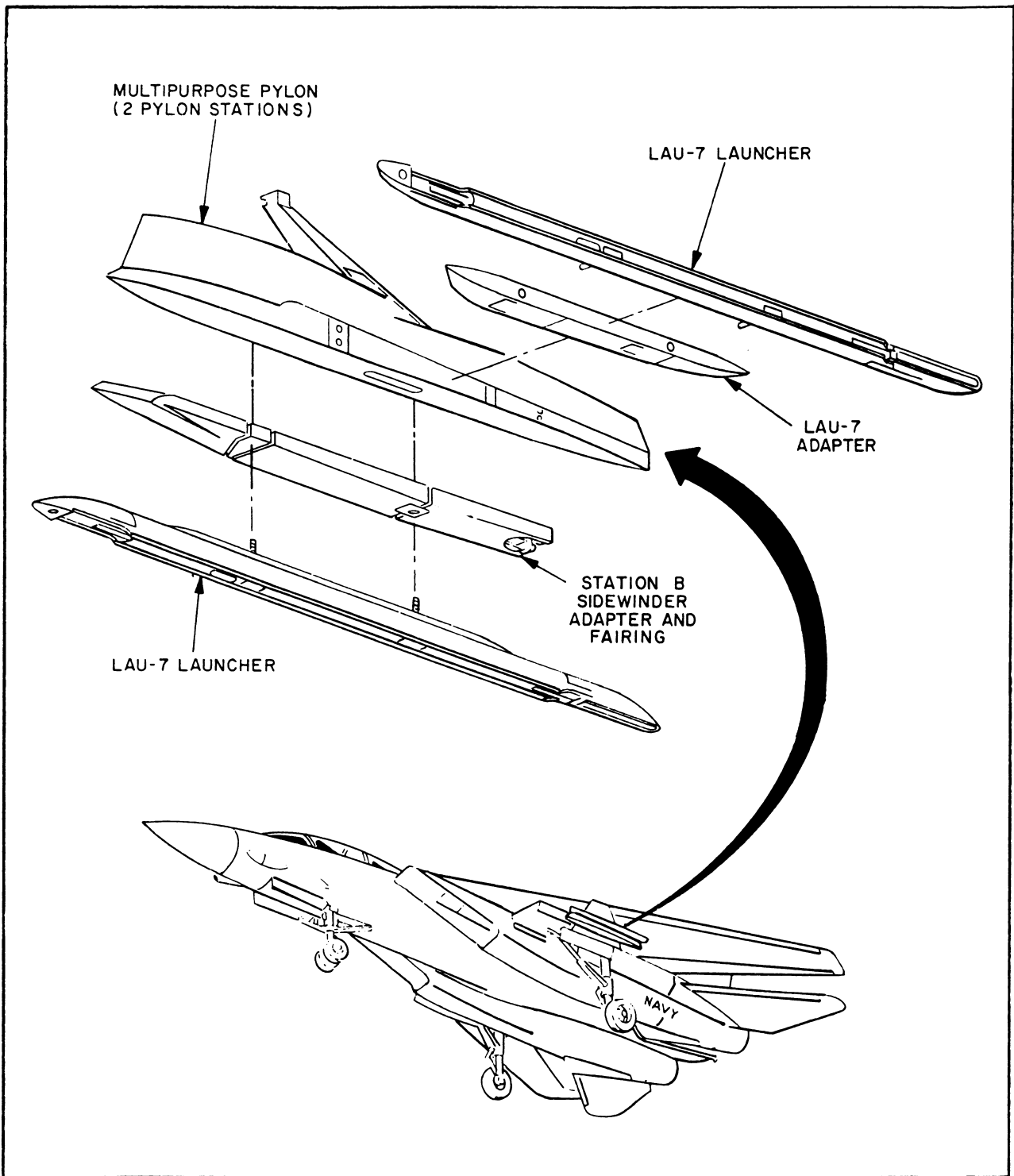


Figure 14-7.—LAU-7 configuration on aircraft.

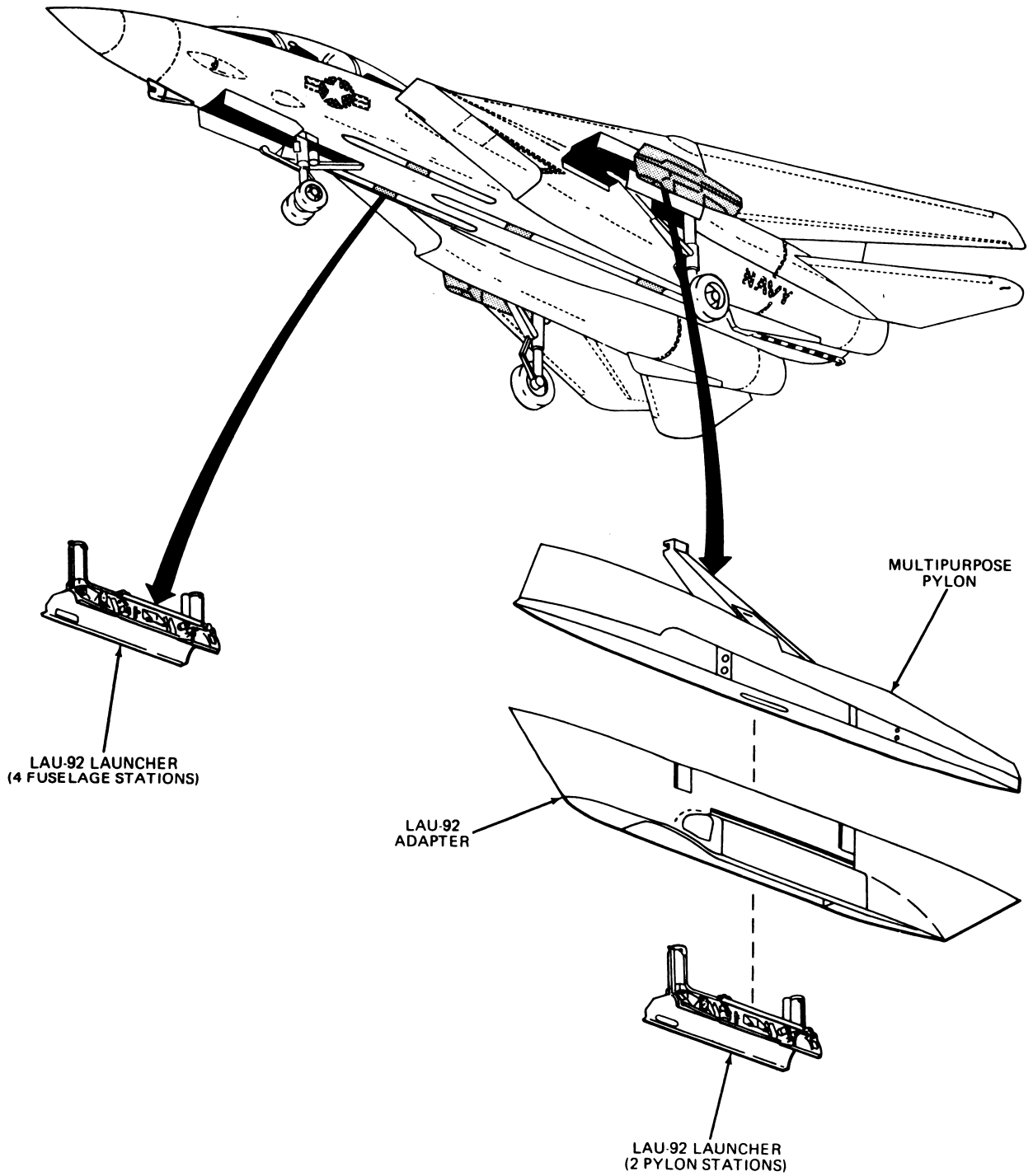


Figure 14-8.—LAU-92 configuration on aircraft.

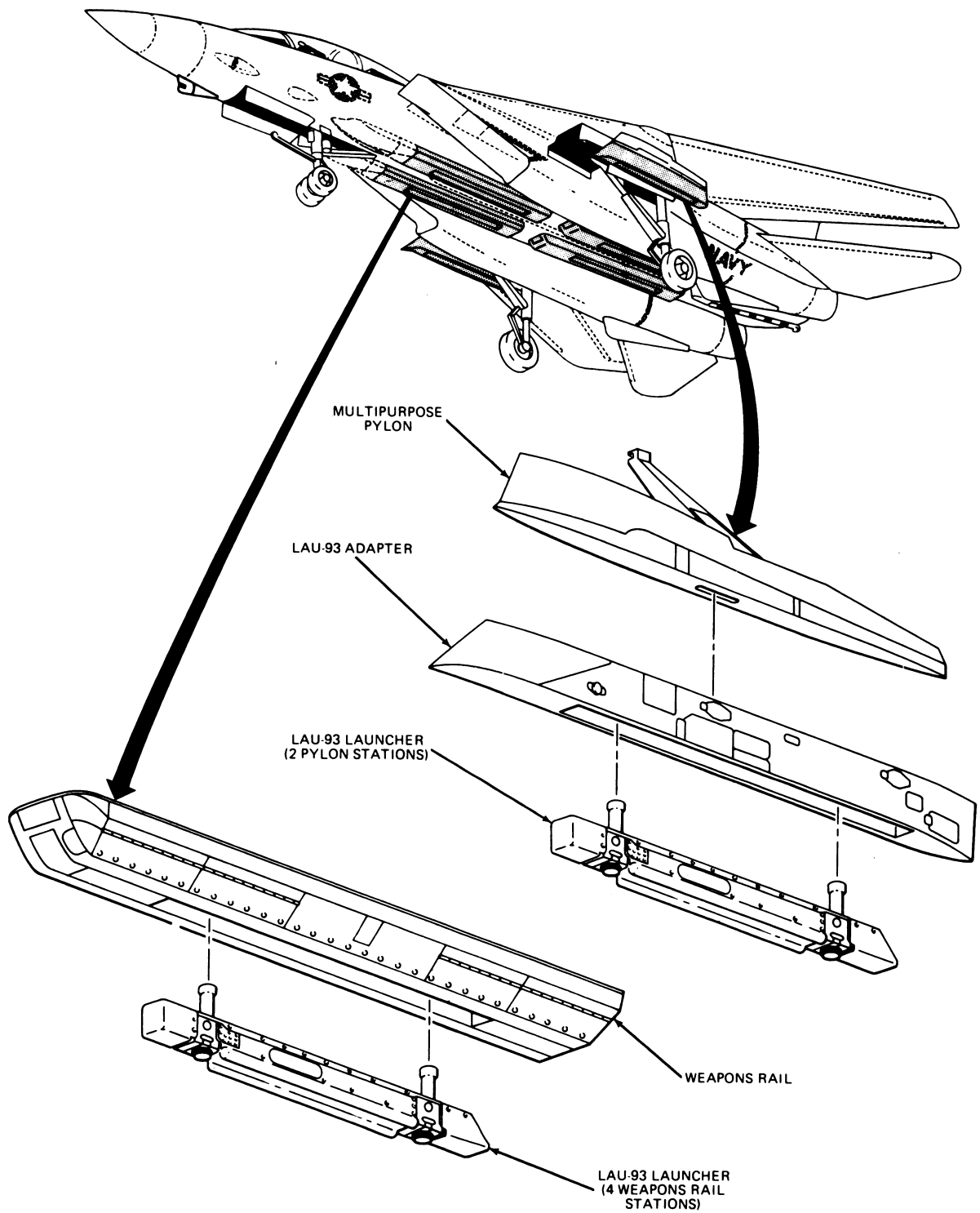


Figure 14-9.—LAU-93 configuration on aircraft.

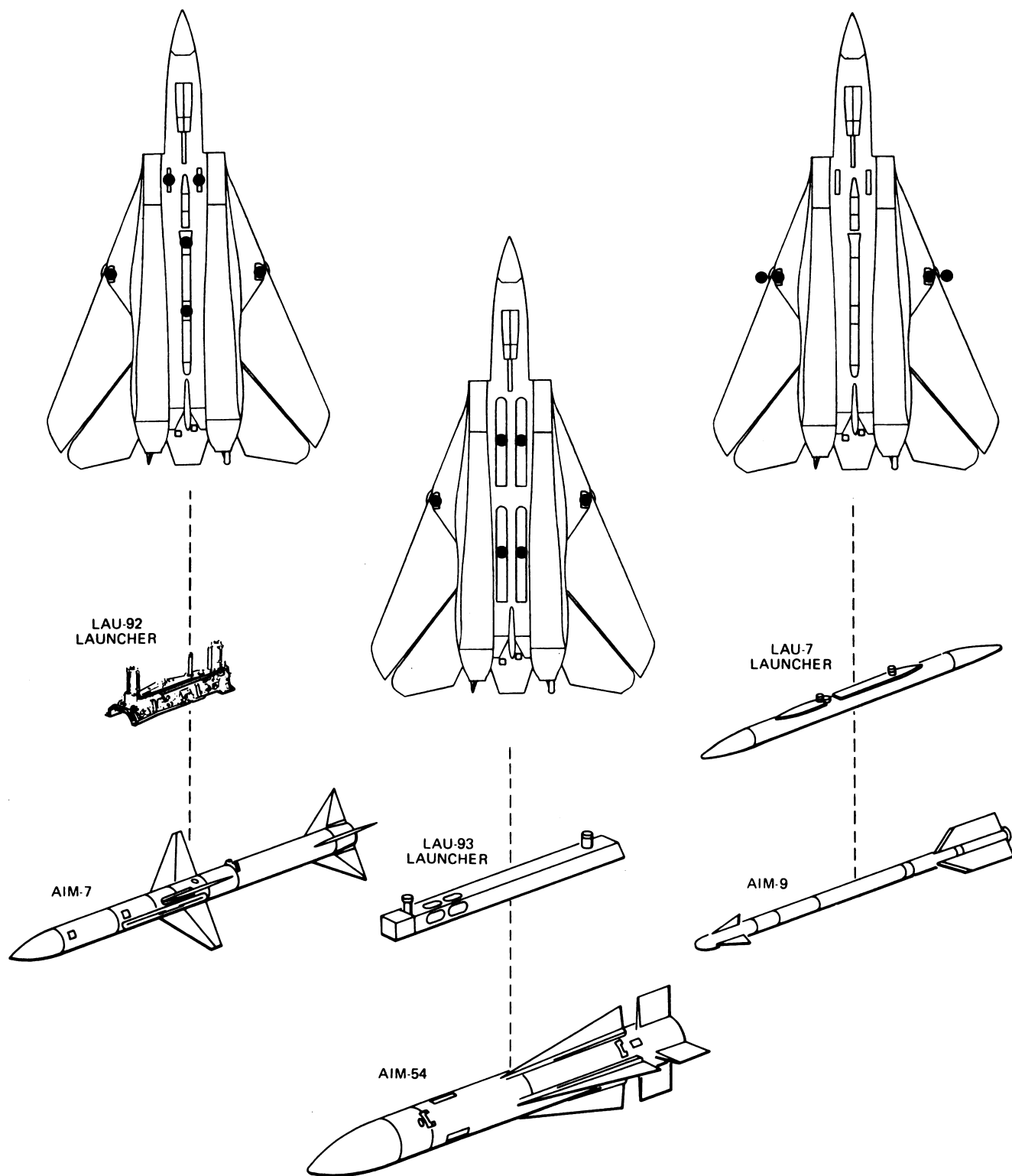


Figure 14-10.—Air intercept missiles configuration on aircraft.

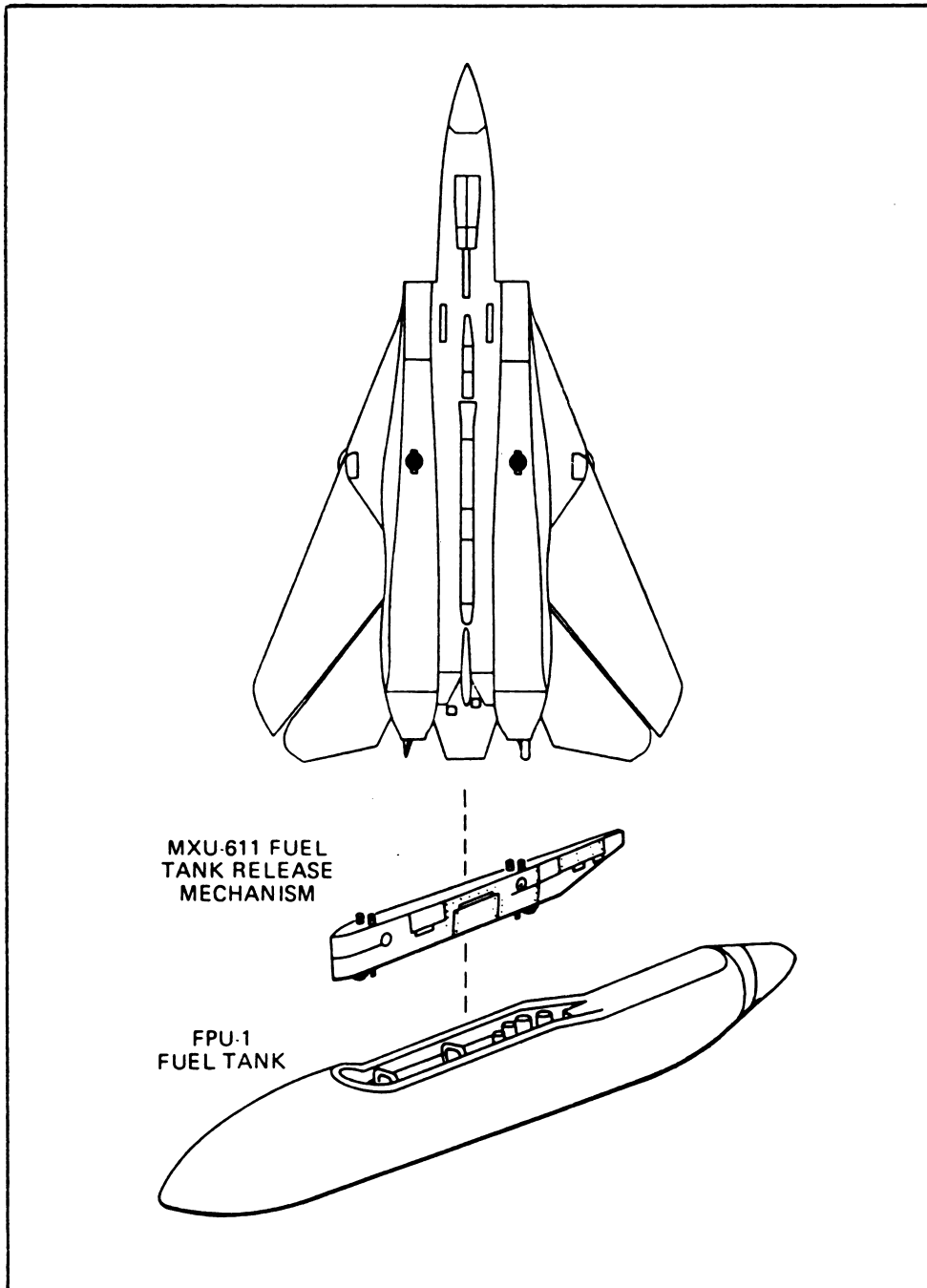


Figure 14-11.—Fuel tank configuration on aircraft.

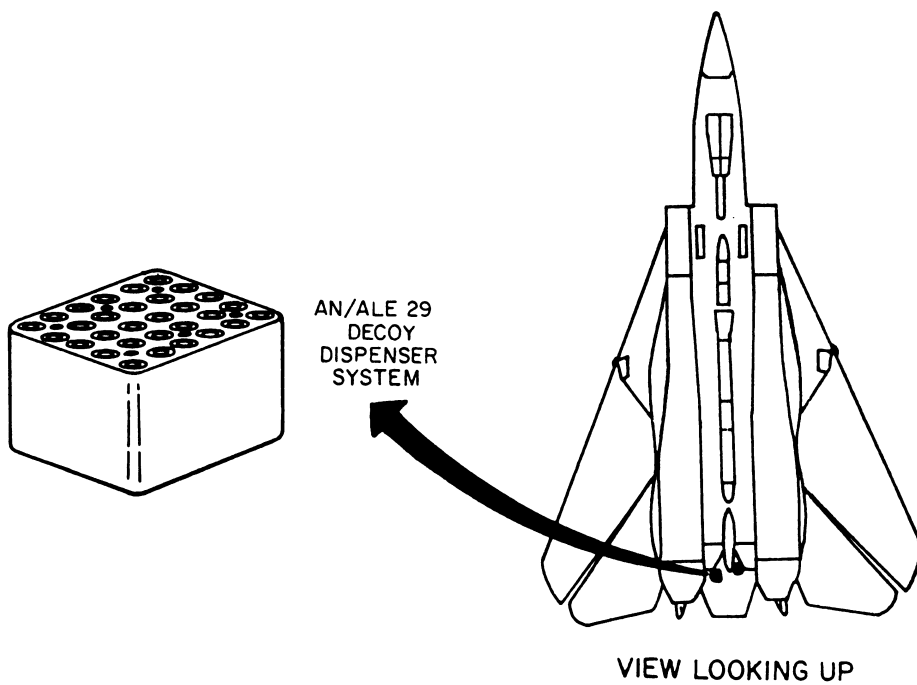
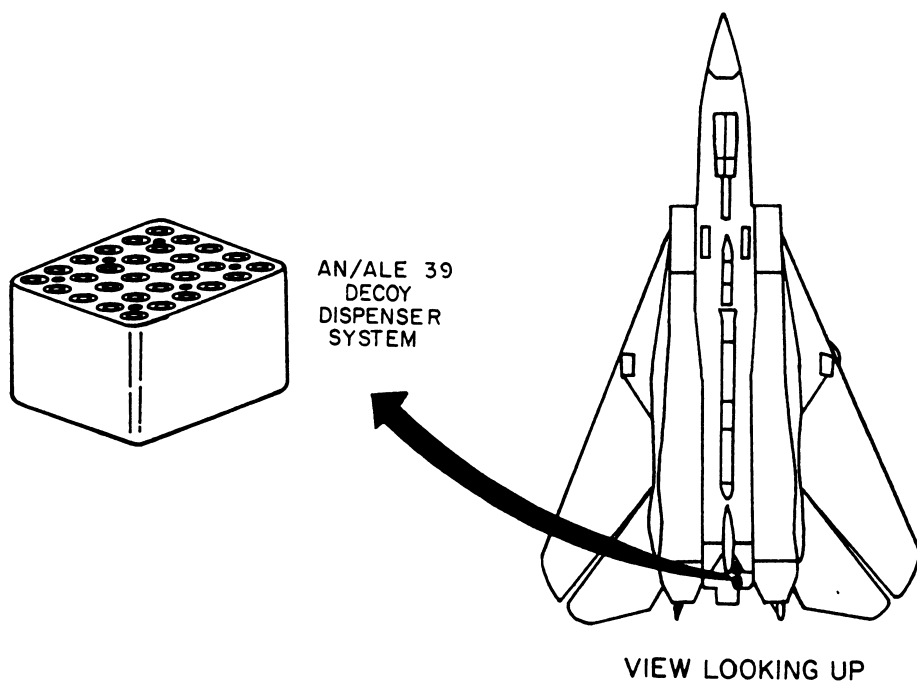


Figure 14-12.—Decoy dispenser configuration on aircraft.

REVIEW NUMBER 1

- Q1. What naval aircraft is a dual-mission, fighter bomber?
- Q2. The F-14 aircraft incorporates the _____ chaff dispensing system.
- Q3. List the conditions that are given to the pilot when the HOT TRIG (trigger) indicator lights.
- Q4. When the landing gear handle is in the down position on the F-14 aircraft, what switch is used to bypass the open loading gear safety circuit?
- Q5. The F-14 aircraft can hold a maximum of _____ AIM-54 missiles.
- Q6. List the fuselage stations of the F-14 aircraft that are used to suspend AIM-7 missiles.
- Q7. The F-14 aircraft can hold a maximum of _____ AIM-9 missiles?
- Q8. List the fuselage stations of the F-14 aircraft that are used to carry Sidewinder missiles.
- Q9. What are the HIGH and LOW rates of fire for the M61A1 gun when it is mounted in the F-14 aircraft?

Q10. What switch on the F-14 aircraft limits the number of rounds that are fired per burst?

Q11. List the four jettison modes of the F-14 aircraft.

Q12. What jettison mode is the only one controlled by the pilot?

F/A-18 AIRCRAFT

The F/A-18 aircraft is a two-seat, dual-role (fighter/bomber), supersonic aircraft. External electrical power can be applied at the external power receptacle on the left side of the forward fuselage. This is easily accessible from the deck level. The external power connector connects 115/208-volt, three-phase, 400-hertz ac external power to the ac bus. When external power is not available, the aircraft has an auxiliary power unit (APU) to drive either of the aircraft generators for functional checkout of the aircraft system.

The systems and subsystems of the F/A-18 aircraft armament system are discussed in the following text. The aircraft armament system, basic controls, and components all function in relation to each other.

Ground Power Control Panel Assembly

The ground power control panel assembly has four toggle switches. Three of these switches control the application of external power to avionic and instrument systems. This prevents excessive equipment operating time because of other unassociated ground operations.

The EXT PWR (external power) switch is a three-position switch used to apply electrical power to the aircraft. In the NORM (normal) position, electrical power is supplied to the aircraft. In the OFF position, no power is supplied to the aircraft. The RESET position resets power for the external monitoring circuit when there is a temporary overload. Switch 1 is a three-position switch with B ON to provide enabling power to the mission computers. Switch 2 is a three-position switch with B ON to provide enabling power to the DDIs. The B ON switch also enables power to the aircraft radar. Switch

3 is a three-position switch with B ON to provide enabling power to the armament computer (SMP), AN/AWW-4 system, HARM system, and the AN/ALE-39 system.

Landing Gear Control Handle

In the DN position, the LDG GEAR control (fig. 14-13) disables normal weapon release, launch, and fire signals. In the UP position, 28-volt dc power is applied from the main landing gear weight-off-wheels relay to the master arm circuit breaker.

Armament Safety Override Switch

The armament safety override switch (fig. 14-14) is in the maintenance panel located in the nosewheel well. In the override position, it overrides the landing gear handle DN position so ground operational maintenance can be pulled on the weapon systems.

Master Arm Control Panel Assembly

The master arm control panel assembly (fig. 14-15) is located in the forward cockpit. It

REVIEW NUMBER 1 ANSWERS

- A1. The F/A-18 is a dual-mission, fighter bomber naval aircraft.
- A2. The F-14 aircraft incorporates the AN/ALE-39 chaff dispensing system.
- A3. The conditions that are given to the pilot when the HOT TRIG (trigger) indicator lights include the following:
 - a. Missiles are reading for launch.
 - b. The gun is ready to fire.
 - c. Weapons are reading to be fired.
- A4. When the landing gear handle is in the down position on the F-14 aircraft, the armament safety override switch is used to bypass the open loading gear safety circuit.
- A5. The F-14 aircraft can hold a maximum of six AIM-54 missiles.
- A6. The fuselage stations of the F-14 aircraft used to suspend AIM-7 missiles include stations 3, 4, 5, and 6.
- A7. The F-14 aircraft can hold a maximum of four AIM-9 missiles?
- A8. The fuselage stations of the F-14 aircraft that are used to carry Sidewinder missiles include stations 1A, 1B, 8A, and 8B.
- A9. The HIGH and LOW rates of fire for the M61A1 gun when it is mounted in the F-14 aircraft are HIGH—6,000 and LOW—4,000.
- A10. The burst selector switch on the F-14 aircraft limits the number of rounds that are fired per burst.
- A11. The four jettison modes of the F-14 aircraft are as follows: (1) emergency, (2) ACM encounter, (3) selective, and (4) auxiliary.
- A12. The emergency jettison mode is the only one controlled by the pilot.

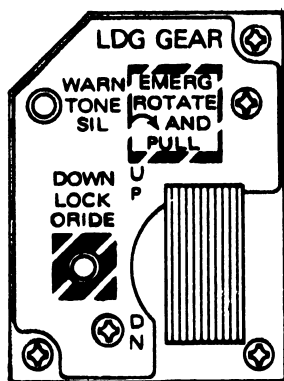


Figure 14-13.—Landing gear control handle.

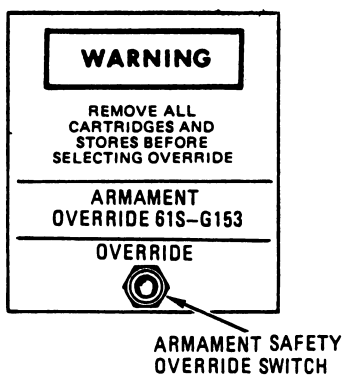


Figure 14-14.—Armament safety override switch.

contains the A/A, A/G, and MASTER switches. The A/A and the A/G are push-button switches that provide a ground to the SMP. They select the air-to-air or air-to-ground computer modes, respectively. The MASTER switch is used with the LDG GEAR handle or the armament safety override switch. In the SAFE position, weapons cannot be released or fired, although emergency jettison can be initiated. The ARM position provides an input to the SMP and power for weapon release, fire, or jettison. The switch position (SAFE/ARM) is displayed on the DDIs in the wing-form display.

Aircraft Controller Grip Assembly

The aircraft controller grip assembly (fig. 14-16) contains the A/G weapons release switch

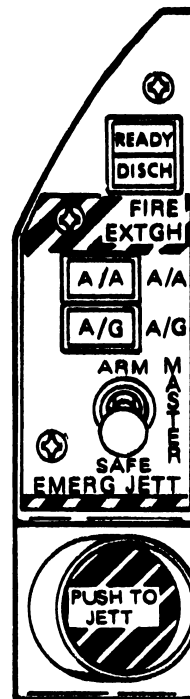


Figure 14-15.—Master arm control panel assembly.



Figure 14-16.—Aircraft controller grip assembly.

(bomb release switch). The switch is spring-loaded to the OFF position. When the switch is pressed, it completes a circuit from the SMP and provides an input back to the SMP. The aircraft grip controller assembly also contains an A/A switch and the trigger switch, which is discussed later in this chapter.

Digital Display Indicators

The digital display indicators (DDIs) (fig. 14-17) are located on the main instrument panel vertical consoles. The DDIs monitor the SMP and display that information. The information is coded into the SMP and displayed on the DDIs. The DDIs always have a wing-form display, and when in the air-to-ground mode, a program list. The wing-form display, program list, and switches/controls on the DDIs are discussed in the following paragraphs.

The wing-form display is displayed in the air-to-air or air-to-ground computer modes. It identifies what is loaded on all stations except the wing tip AIM-9 stations, which are always

displayed. The weapon loaded is displayed on the DDI by the appropriate acronym. When weapons are loaded on the stations (except for the AIM-9 and AIM-7 stations), the type of weapon loaded is coded into the SMP during loading procedures. Thus, when selected, the DDIs display the appropriate abbreviated acronym. For example, the abbreviated acronym 1 82B indicates that one Mk 82 blunt-nose bomb is loaded.

The push-button switches around the DDIs are used to select weapons, various functions, and mode options of a function. For example, mechanical fuzing (MFUZ) is one function, and nose/tail fuzing (NOSE, N/T) and LDLY (long-delay fuzing) are the selectable options.

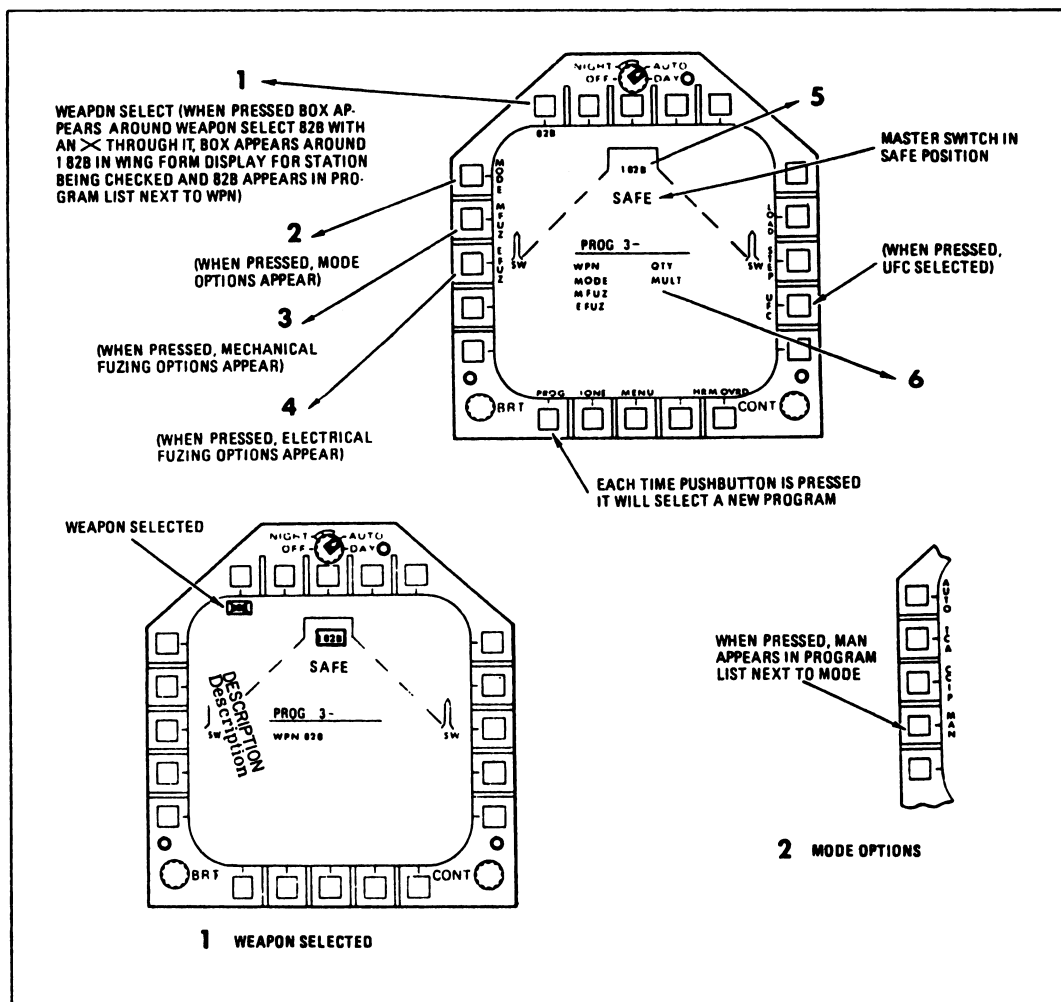
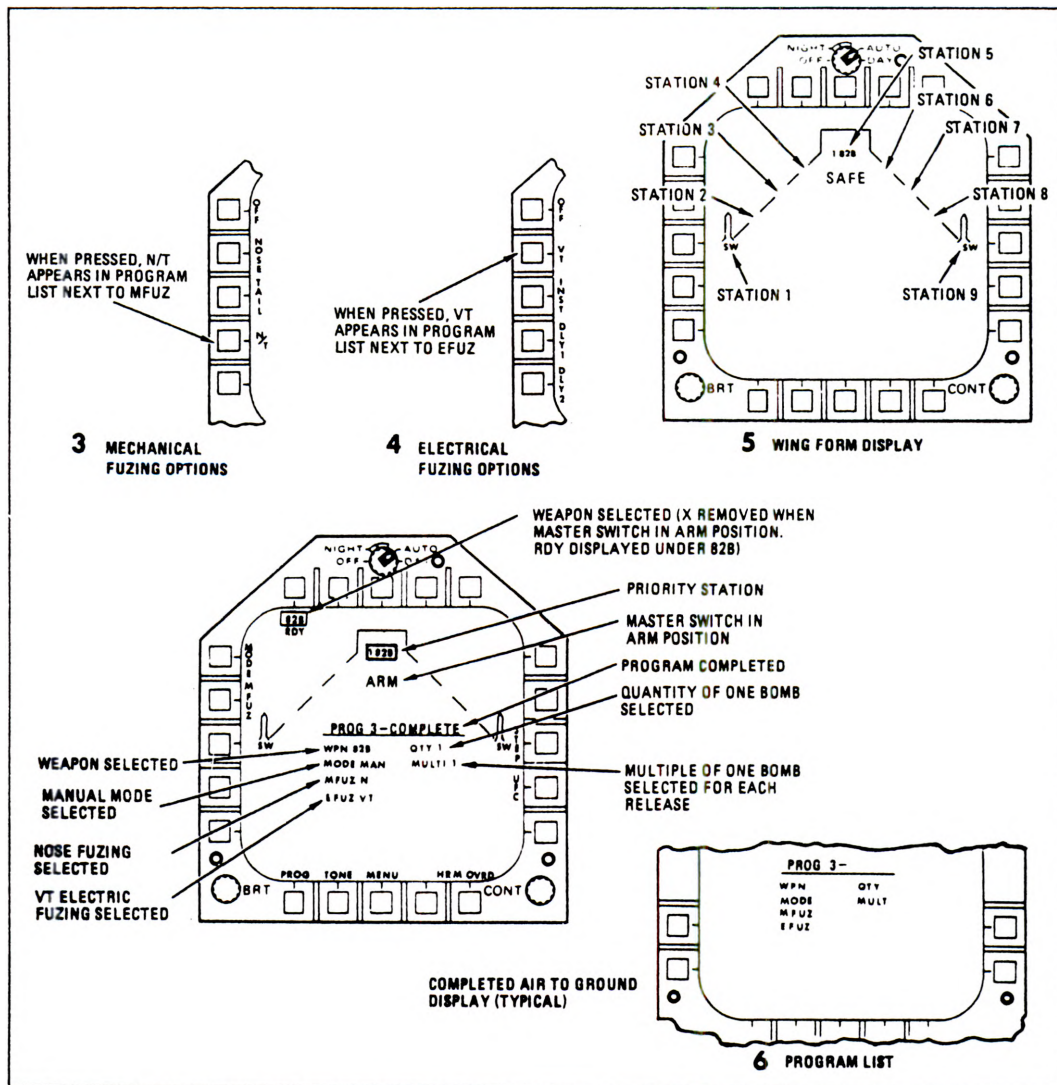


Figure 14-17.—Digital display indicators.

220.1011



220.1011.1

Figure 14-17.—Digital display indicators—Continued.

Weapon selection for air-to-ground weapons is done by pressing the push-button switch located next to the acronym of the selected weapon. When the weapon is selected, a box lights around the acronym. When the master switch is in the SAFE position, an X appears superimposed through the acronym. A box also appears around the acronym of the weapon in the wing-form display for the first priority (first station in firing sequence) station having this particular weapon loaded. Also, this weapon acronym is displayed next to WPN in the program list.

Function selection is done by pressing the push-button switch next to the acronym of the

function desired. When the push-button next to LOAD is pressed, the number next to the acronym of the weapons loaded on TERs in the wing-form display changes. **This happens only when a TER with less than three weapons loaded on it is on the aircraft.** Each time the push button is pressed, the number decreases. When only two weapons are loaded, pressing the push button once allows the SMP to program for only two weapons. When the push button next to STEP is pressed, the next loaded priority station is selected, provided it is loaded with the weapon selected. Each time the push button is pressed, it selects the next priority station.

When the push button next to PROG (program) is pressed, the next program is selected and displayed above the program list. Each time the push button is pressed, it selects a new program. When the push button next to Up-front control (UFC) is pressed, the UFC is selected. It is used to select quantity (QTY) and multiples (MULT) of the weapon selected for release. When the push button next to mechanical fuzing (MFUZ) is pressed, mechanical fuzing is selected. After the push button is pressed, the mechanical fuzing options for the weapon selected are displayed. When the push button next to electric fuzing (EFUZ) is pressed, electric fuzing is selected. After the push button is pressed, the electric fuzing options for the weapon selected are displayed.

Option selection is done by pressing the push-button switch next to the acronym of the option desired. When the push button next to MFUZ is pressed, the mechanical fuzing options (OFF, NOSE, TAIL, N/T, LDLY) are displayed. Pressing the push button next to the option desired selects and displays that option in the program list. When the push button next to EFUZ is pressed, the electric fuzing options (OFF, BT, INST, DLY 1, DLY 2), if any, are displayed. Pressing the push button next to the option desired selects and displays that option in the program list.

The program list is **only** displayed in the air-to-ground computer mode with GP bombs loaded. At the top of the program list, the acronym PROG 1, PROG 2, or PROG 3 is displayed. Since PROG 3 is the manual program, it is used for release and control checks. Selection of PROG 3 is accomplished on the DDIs by pressing the PROG push-button switch. When PROG 3 COMPLETE is displayed, all conditions for release have been met, as shown in figure 14-17.

The up-front control (UFC) is used with the DDIs. When the DDI UFC push button is pressed, power is supplied to the UFC to select QTY and MULT of weapons to be released. QTY and MULT are displayed on the option display. Pressing the option select switches selects either QTY or MULT. Once a selection is made, pressing the number desired on the keyboard and pressing the ENT (enter) key selects the number. The number is displayed on the program list on the DDIs next to the applicable acronym.

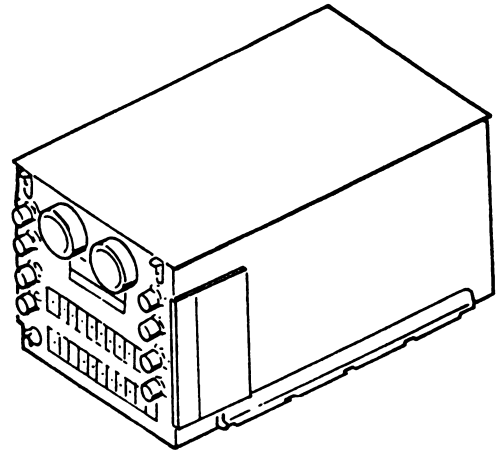


Figure 14-18.—Armament computer—stores management processor (SMP).

Armament Computer

The armament computer, stores management processor (SMP), (fig. 14-18) is interfaced with and controlled by the digital computers. The SMP is also interfaced with and controls the weapon station command encoders-decoders. The SMP has a weapon insertion panel with code wheels. These code wheels are used to enter the code into the weapon-type (ARMAMENT) and nose/tail fuzes (FUZING). The weapon-type code **must** match the weapon loaded, and the nose/tail fuzes code **must be** compatible with the weapon or the SMP won't allow it to release normally. For weapons without nose/tail fuzes, the codes must still match the weapon loaded. AIM-7 missiles loaded on fuselage stations 4 and 6 do not require a weapon code.

Digital Computers

Digital computers make up the mission computer system and control the avionics systems. They interface with the SMP and allow the SMP to route power to the encoders-decoders for weapon release. The digital computers are controlled by the MC switch on the MC/AYD ISOL panel. When the MC switch is in the 1 OFF position, power is removed from mission computer one. When in the NORM position, power is applied to mission computers one and two. When in the 2 OFF position, power is removed from mission computer two. The command encoders-decoders provide an interface

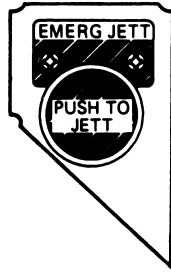


Figure 14-19.—Emergency jettison control panel assembly.

with the SMP and the weapon loaded. When the SMP supplies power to the encoders-decoders, they allow weapon release.

Jettison System

The jettison system gives the pilot/crew a way to jettison weapons, stores, launchers, and fuel tanks. The jettison system has three modes of release—emergency jettison, selective jettison, and auxiliary jettison.

The emergency jettison mode jettisons all weapons from the five pylon stations. Conditions for jettisoning are weight-off-wheels or landing gear control handle in the UP position, and the EMERG JETT PUSH-TO-JETT switch pressed. The PUSH-TO-JETT switch (fig. 14-19) is on the emergency jettison control panel assembly. When pressed, this push-button switch completes a circuit from the SMP to the BRU-32/A breech and fires the primary cartridges.

The selective jettison mode individually jettisons the left fuselage missile, the right fuselage missile, racks, launchers, and stores. The conditions for using the selective jettison mode are the landing gear control handle in the UP position, all gear up and locked, MASTER switch to ARM, stations selected by the JETT STATION SELECT switches, the SELECT JETT switch in the desired position, and the JETT push button pressed. The JETT STATION SELECT switches (fig. 14-20) are on the flaps, landing gear, and stores indicator panel. When the switches are pressed, a ground is provided to the SMP and the station is selected. The SELECT JETT switch is located on the left-hand vertical control panel assembly. The rotary portion of the switch selects the fuselage missile stations (L FUS, MSL/R FUS, MSL/RACK, LCHR/STORES) to be jettisoned.

The auxiliary jettison mode is a gravity mode to jettison the five pylon stations when emergency

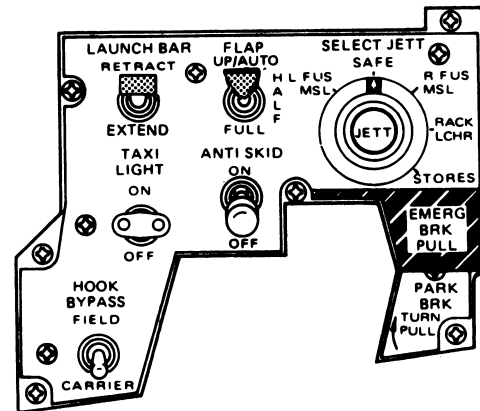


Figure 14-20.—Jettison station select switches.

and/or selective jettison fails. The conditions for using the auxiliary jettison mode are as follows: the landing gear handle in the UP position, all gear up and locked, MASTER switch to ARM, stations selected by the JETT STATION SELECT switches, AUX REL switch to ENABLE, and the bomb release switch pressed. The AUX REL switch is located on the ECM control panel assembly. When the switch is positioned to ENABLE, it provides a ground to the SMP, and allows the auxiliary cartridge to fire when the bomb release switch is pressed.

Bomb Release System

The bomb release system provides the aircraft with capabilities for release of conventional weapons. The system uses the BRU-32/A and BRU-33/A gas ejector bomb racks for suspension and release of weapons. Normal release is provided in four electrically controlled modes of operation. Release is accomplished by electrically firing two gas generating cartridges in the breech housing unit in the bomb rack. The system consists of the armament system basic controls and components.

AN/AWW-4 Fuze Function Control System

The AN/AWW-4 fuze function control system gives the aircraft the capability of using electric fuzes. The system uses the Mk 39 bomb arming unit in the BRU-32/A and BRU-33/A bomb racks. The Mk 39 bomb arming unit denies all voltage to the weapon until it has actually separated from the bomb rack. Voltage is

supplied by the PP-6419 power supply to the bomb arming unit through the aircraft wiring. There are four voltages selected on the DDIs. When release is initiated, voltage is supplied through an inter-connecting cable to the weapon during the first few inches of fall of the weapon. No voltage is supplied to the bomb rack until the bomb release switch is pressed. The system consists of the PP-6419 power supply and the armament system basic controls and components.

Rocket Firing System

The rocket firing system gives the aircraft the capability to fire rockets. The system uses the BRU-32/A and BRU-33/A bomb racks for suspension of the rocket launchers. When the bomb release switch is pressed, voltage is supplied through aircraft wiring to the VER. Wiring within the VER allows the rocket to fire. The system consists of the armament system basic controls and components.

Walleye Guided Weapon System

The Walleye guided weapon system gives the aircraft the capability for release and guidance of a Walleye weapon. The system uses the BRU-32/A bomb rack, bomb release system, and the AN/AWW-4 fuze function control system for fuzing. Video is supplied from the weapon through the aircraft wiring to the DDIs. No voltage is supplied to the bomb rack until the bomb release switch is pressed. The system consists of the CAGE/UNCAGE switch and the armament system basic controls and components. The CAGE/UNCAGE switch is on the throttle. When the switch is pressed, it cages/uncages the weapon selected.

The AN/AWW-7B data link system is used with the Mk 21 and Mk 27 Walleye weapons and with the Walleye guided weapon system. The data link system provides control and guidance to these weapons using a data pod externally mounted to the aircraft. The system uses the BRU-32/A bomb rack. Video is supplied from the weapons and pod to the DDIs through the aircraft wiring. The system consists of the armament system basic controls and components.

AGM-65 Maverick System

The AGM-65 Maverick system gives the aircraft the capability for firing a Maverick missile.

The system uses the BRU-32/A bomb rack and the LAU-117/A launcher for suspension and firing of the Maverick missile. Control of the missile is supplied through the missile control system; the AN/AWW-4 fuze function control system provides fuze arming. Video is supplied from the weapon through the aircraft wiring to the DDIs. No voltage is supplied to fire the missile until the trigger switch is pulled. The system consists of the trigger switch (located on the aircraft controller grip assembly) and the armament system basic controls and components. The trigger switch is a two-position detent switch. The first detent initiates camera operation, and the second detent initiates missile launch.

AGM-88 HARM System

The AGM-88 HARM system gives an aircraft the capability for firing a HARM missile. The system incorporates the BRU-32/A bomb rack and the LAU-118/A launcher for suspension and firing. Control of the missile is supplied through the SMP. No voltage is supplied to fire the missile until the trigger switch is pulled. The system consists of the trigger switch and armament system basic controls and components.

AIM-7 Sparrow Fire Control System

The AIM-7 Sparrow fire control system gives the aircraft the capability for firing an AIM-7 missile. The system incorporates the LAU-116/A launcher for fuselage stations and the BRU-32/A bomb rack with a LAU-115/A launcher on wing pylon stations for suspension and firing. Control of the missile is supplied through the SMP and the radar system. No voltage is supplied to fire the missile until the trigger switch is pulled and all landing gear is up and locked. Weapon selection is accomplished by the A/A weapon select switch on the aircraft controller grip assembly. The system consists of the RADAR switch, CAGE/UNCAGE switch, and the armament system basic controls and components.

The A/A weapon select switch in the FWD position selects the Sparrow missile on the priority station. Each time the switch is pressed, the priority station changes. SEL is displayed on the DDI underneath the SP acronym of the station selected. An X is superimposed through the SP when the missile is not tuned. The X is removed when the missile tunes. The RADAR switch is

located on the sensor control panel. When the switch is positioned to STBY or OPR position, power is supplied to the radar system.

AIM-9 Sidewinder Fire Control System

The Sidewinder fire control system gives an aircraft the capability for firing an AIM-9 missile. The system uses the LAU-7/A-4 launcher for wing tip stations and the BRU-32/A bomb rack with a LAU-115/A launcher configured with LAU-7/A-4 launchers on wing pylon stations for suspension and firing. Control of the missile is supplied through the SMP. No voltage is supplied to fire the missile until the trigger switch is pulled and all landing gear is up and locked. Weapon selection is done by the A/A weapon select switch on the aircraft controller stick grip. Tone volume is controlled by the WPN VOL switch. The system consists of the IR COOL switch, trigger switch, and the armament system basic controls and components.

In the DOWN position, the A/A weapon select switch selects the Sidewinder missile on the priority station. Each time the switch is pressed, the priority station changes. SEL is displayed on the DDI underneath the SW acronym of the station selected. The WPN VOL switch is on the intercommunication amplifier control panel assembly. The outside control varies the volume of the Sidewinder tone.

The IR COOL switch is a three-position switch on the map gain control panel assembly. When the switch is in the OFF position, coolant is disabled to the seeker heads unless weight is off of the wheels, the MASTER switch is in the ARM position, and the station is selected. In the NORM position, coolant is enabled to all seeker heads when weight is off of the wheels. In the ORIDE position, coolant is enabled to all seeker heads when power is applied to the aircraft.

M61A1 20-MM Gun System

The M61A1 20-mm gun system gives an aircraft the capability for firing of this gun. The system enables selecting, arming, and firing. Depending on the mission objective, the gun can be operated in the air-to-air (A/A) or air-to-ground (A/G) computer mode. There are two A/G modes—continuously computed impact point (CCIP) and manual (MAN). There are three

A/A modes—director, disturbed, and cage. Control of the gun is supplied through the SMP. No voltage is supplied to fire the gun until the trigger switch is pulled and all landing gear is up and locked. The gun fire control system consists of four subsystems—the gun and associated ammunition feed, hydraulics, gun gas purging and ammunition cooling, and gun electronics.

Gun selection in the A/G mode is accomplished by pressing the push button next to the GUN acronym on the DDI. A box around GUN lights and GUN is displayed in the wing-form display above the rounds-remaining indication. If another weapon is selected with a box around it and the gun is selected with a box around it, hot gun is selected.

The gun selection in the A/A mode is accomplished by positioning the A/A weapon select switch to the AFT position. When selected, GUN is displayed in the wing-form display above the rounds-remaining indication. The gun encoder-decoder provides an interface with the SMP and the gun. When the SMP supplies power to the encoder-decoder, it fires the gun.

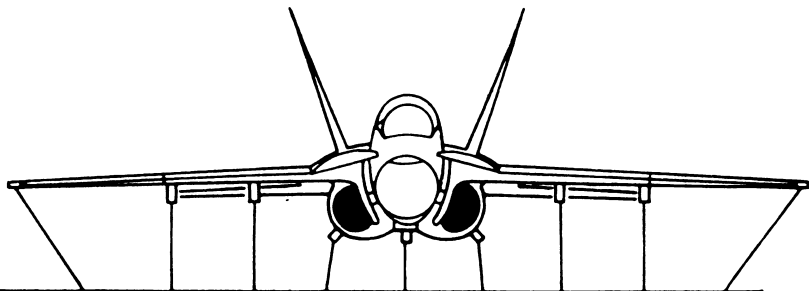
AN/ALE-39 Decoy Dispensing System

The AN/ALE-39 decoy dispensing system gives an aircraft the capability to dispense chaff/flares. The decoy rounds are contained in two dispensers at the fuselage underside area. Control is supplied through the SMP. The system consists of the dispenser/ECM control panel, engine throttle lever grip assembly, left console DISP switch, AN/ALE-39 programmer, two AN/ALE-39A dispensers, MX-7721/ALE-39A dispenser housings, two 1874/ALE-39 sequencer switches, and the armament system basic controls and components.

Aircraft Armament Configuration Capabilities

The basic armament configuration of the F/A-18 aircraft consists of LAU-116/A missile launchers, LAU-7/A-4 missile launchers, SUU-63/A pylons, SUU-62/A pylon, BRU-32/A bomb racks, and an M61A1 20-mm gun.

The F/A-18 basic armament configuration can be reconfigured to accommodate a variety of



EQUIPMENT	9	8	7	6	5	4	3	2	1
SUU-62/A Pylon					X				
Latch Assembly				X		X			
LAU-116/A Launcher				X		X			
BRU-33/A (VER)		X	X		X		X	X	
BHU-32/A Bomb Rack		X	X		X		X	X	
SUU-63/A Pylon		X	X				X	X	
LAU-117/A Launcher		X	X				X	X	
LAU-118/A Launcher		X	X				X	X	
LAU-115/A Launcher		X						X	
LAU-115/A Launcher with LAU-7/A Launcher		X						X	
LAU-7/A Launcher	X								X

220.1015

Figure 14-21.—F/A-18 aircraft station configuration capabilities.

weapons. Figure 14-21 shows the station configuration capabilities.

If you want more information about authorized aircraft configurations and weapons loading, refer to *A1-F18AA-TAC-000*, volume 1, and *A1-F18AA-TAC-100*, volume 2, *NATOPS Tactical Manual*. A general description of the F/A-18 armament systems and suspension/releasing equipment is contained in the *Airborne Weapons/Stores Loading Manual*, A1-F18AA-LWS-000.

REVIEW NUMBER 2

Q1. In the F/A-18 aircraft, the armament safety override switch is located on the _____.

Q2. List the jettison modes of the F/A-18 aircraft.

Q3. If the emergency jettison is selected on the F/A-18 aircraft, what weapons are released?

Q4. Under what condition would the auxiliary jettison mode be used in the F/A-18 aircraft?

Q5. What fuze function control system gives the F/A-18 aircraft the capability of using electric fuzes?

Q6. To suspend and fire the Maverick missile from the F/A-18 aircraft, you should use what bomb rack and launcher combination?

Q7. What missile launcher should you use to suspend the AGM-88 HARM missile on the F/A-18 aircraft?

Q8. What missile launcher is used on the wing pylon stations of the F/A-18 aircraft to suspend and launch an AIM-7 Sparrow missile?

ATTACK AIRCRAFT WEAPONS SYSTEMS

Learning Objective: *Identify the attack aircraft weapons systems to include those used in A-6 aircraft.*

The following discussion of the A-6 aircraft includes the available aircraft armament systems and the basic controls and components that are common to these systems.

The A-6 (series) aircraft includes the A-6E, EA-6A, EA-6B, and the KA-6D models. The EA-6B is a four-seat aircraft used in electronic warfare operations. The KA-6D is a two-seat aircraft that functions as a tanker for air-to-air refueling operations. In this section of the chapter, you will learn about the A-6E aircraft.

The A-6 is a two-seat aircraft capable of suspending, arming, and launching conventional ordnance as well as missiles and special weapons. External electrical power and air-cooling requirements for ground operation are like those discussed earlier in this chapter.

The aircraft armament systems consist of systems and subsystems that provide the common circuits, basic controls, and components necessary to release weapons/stores or fire rockets/missiles. These systems/subsystems include weapons release system, AGM-78 (series) missile system, mechanical arming system, AGM-45 (Shrike) missile system, AGM-53A (Condor) missile system, AIM-9 (Sidewinder) missile system, AN/ALE-39 chaff dispensing system, T-375 aircraft monitor and control system (AMAC), jettison system, optical sight system, rocket system, and AN/AWW fuze function control system.

ARMAMENT CONTROL UNIT

The armament control unit (fig. 14-22) contains the controls and indicators to monitor and control the selection of stores and the attack and release modes. This panel is on the left side of the bombardier/navigator main instrument panel.

Look at the top section of the armament control panel (fig. 14-22). There are seven tape-setting indicators, with seven corresponding station select switches, and a MASTER ARM switch. Now, look at the lower section of the panel. It has the ATTACK and RELEASE switches; a RESELECT and COMPLETE indicator; a MECH ARM switch; ROCKET switch; GUNS switch; INTERVAL, QUANTITY, and TIME thumb-wheel switches; and MISSILE PWR, CONTROL, and COOLING switches. The switches found on the armament control panel are described in the following paragraphs.

ARMAMENT TAPE. Each armament tape can display 64 separate lines of characters. The tape is continuous and indexed to the armament digital readout. This digital readout provides six BITS for each of the seven stations to interface with the central digital computer. This readout identifies the store loaded on the station.

RELEASE INDICATOR. Each of the seven stations has a separate release indicator to visually indicate that a release has been directed to that station. The indicator rotates when a pulse voltage is applied. Each indicator remains in the set condition until it is manually released by pushing the reset button below the indicator.

STATION SELECT SWITCHES. The armament control unit can interface with seven external store stations. The five three-position, lever-lock station switches are used to select the station from which weapons are to be released and the type of weapons to be released (BOMB/GUNS or ROCKET/MISSILES). By placing the switch in the desired position, the circuit is ready for a release pulse to the station selected for release of the store. The station select switches are bypassed for emergency jettisoning of the stores.

MASTER ARMAMENT SWITCH. The MASTER ARMT switch is a three-position, lever-lock toggle switch that provides power for release

and selective jettisoning of weapons. In the OFF position, no electrical power is available to the release circuitry. With the landing gear up and locked and the MASTER ARMT switch ON, electrical power is supplied to the store release circuitry. **The MASTER ARMT switch must be in the ON position before operational release of weapons.** The PRAC position is used to simulate actual operation during practice missions. When the switch is positioned to PRAC, the release pulses generated by the armament control unit are restricted from the pylons, and the preselected weapons are not released.

ATTACK MODE SWITCHES. The ATTACK mode switches are lighted push-button switches used to select any one of the eight different attack modes. These switches determine what external equipment is used to initiate weapons release. The eight attack modes are GENERAL, STRAIGHT, HI LOFT, ROCKET, LAB TGT, LAB IP, DELAY, and GCB.

If either push-button is depressed when in the LAB TGT and LAB IP mode, the INS sends a

release signal to the armament control unit when the aircraft reaches a set pitch angle. This mode operates with the pilot's commit switch, armament control unit, timer, intervalometer, and QUANTITY thumb-wheel settings.

When the DELAY mode is depressed, the pilot's commit switch activates the armament control unit timer, which, in turn, activates the intervalometer when the timer countback reaches 0.

The GCB mode switch, when depressed, allows the ground-controlled bombing system to perform automatic release. The pilot's commit switch must be depressed for this mode.

RELEASE MODE SWITCHES. The RELEASE MODE switches are interlocked push-button switches used to select any one of eight different release modes. These switches determine whether the selected stations are driven sequentially or simultaneously. The RELEASE modes are STEP, BOMB-TRAIN, BOMB SALVO, ROCKET-TRAIN, ROCKET-SALVO, MISSILE, GUNS, and SEL JETT.

REVIEW NUMBER 2 ANSWERS

- A1. *In the F/A-18 aircraft, the armament safety override switch is located on the maintenance panel in the nosewheel well.*
- A2. *The jettison modes of the F/A-18 aircraft include (1) emergency, (2) selective, and (3) auxiliary.*
- A3. *If the emergency jettison is selected on the F/A-18 aircraft, all weapons from the five pylon stations are released.*
- A4. *The auxiliary jettison mode is used in the F/A-18 aircraft when emergency and/or selective jettison fails. It is a gravity jettison mode.*
- A5. *The AN/AWW-4 fuze function control system gives the F/A-18 aircraft the capability of using electric fuzes.*
- A6. *To suspend and fire the Maverick missile from the F/A-18 aircraft, you should use the BRU-32A and the LAU-117/A combination.*
- A7. *You should use the LAU-118/A to suspend the AGM-88 HARM missile on the F/A-18 aircraft.*
- A8. *The LAU-115/A missile launcher is used on the wing pylon stations of the F/A-18 aircraft to suspend and launch an AIM-7 Sparrow missile.*

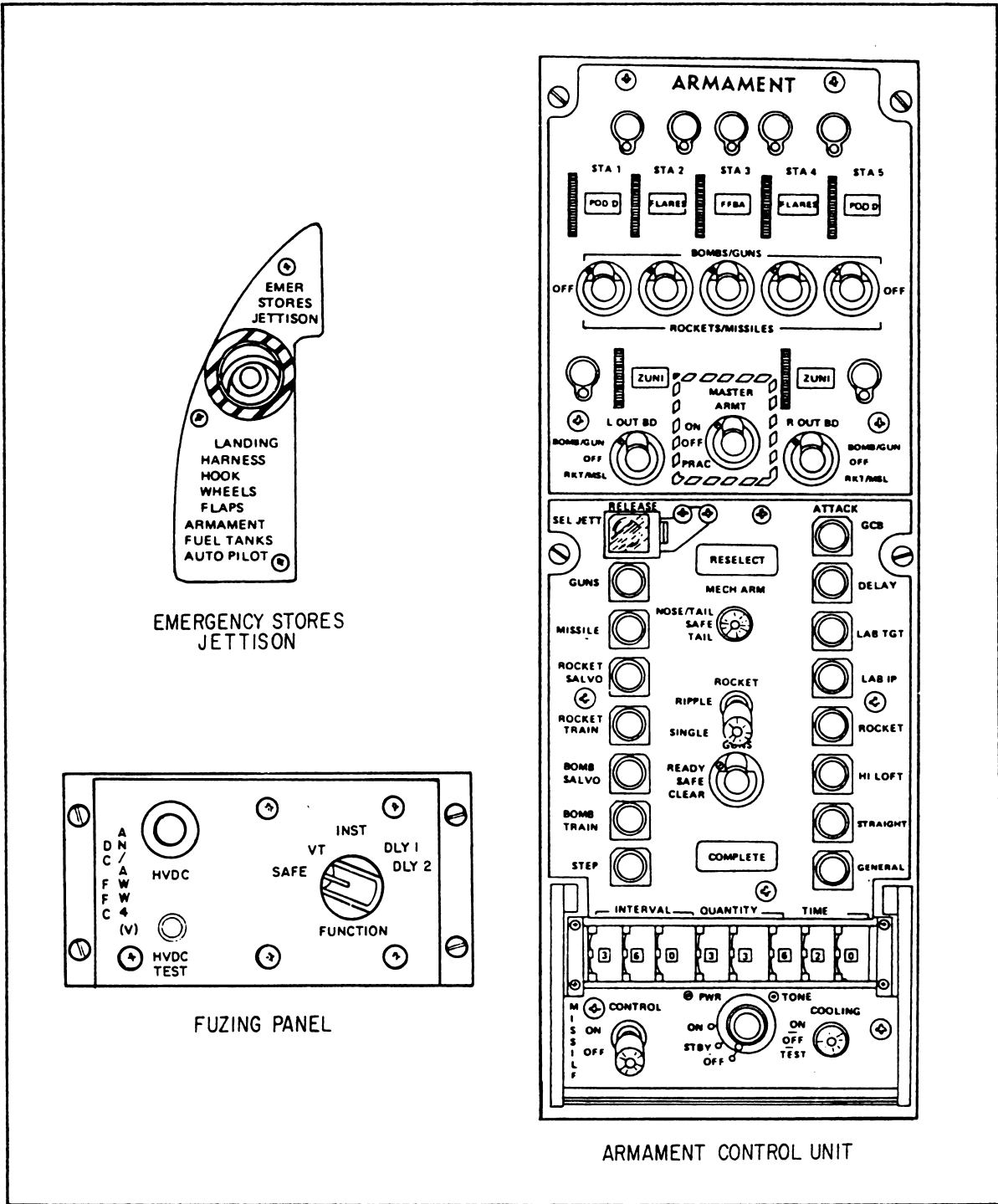


Figure 14-22.—A-6E armament system controls.

220.1028

The STEP switch allows for the sequential release of bombs, rockets, and missiles. This is based upon a manual rate of release signals generated by the weapons release switch.

In the BOMB-TRAIN position, the stores are sequentially released from the selected stations. One store is released each time a release signal is directed to the station select logic. The spacing between these sequential releases is based on the predetermined setting on the INTERVAL thumb-wheel switch, except when using an automatic computer release mode. In the GENERAL, STRAIGHT, or HI LOFT attack mode, the sequential spacing is based upon the TIMER thumb-wheel switch setting.

In the BOMB SALVO position, the stores are released simultaneously from all selected stations. One store is released from each selected station each time a release signal is directed to the station select logic. The spacing between these simultaneous releases (a train of salvos) is generated in the same manner as BOMB-TRAIN.

The ROCKET-TRAIN position allows for the sequential firing of rockets from selected stations. The spacing between the sequential firing is based on the predetermined setting on the TIME thumb-wheel switch, except when using an automatic computer release mode. In the ROCKET attack mode, the sequential spacing is based upon the INTERVAL thumb-wheel switch setting.

The ROCKET SALVO position allows for simultaneous firing of rockets for selected stations. The spacing between these simultaneous firings (a train of salvos) is generated in the same manner as ROCKET-TRAIN.

The MISSILE position allows for the sequential release of a single missile from each selected station. The spacing between these sequential releases is based upon the predetermined setting on the armament control unit TIME thumb-wheel switch.

The GUNS position allows for the simultaneous manual firing of the gun pods on selected stations.

The SEL JETT position allows for the simultaneous jettisoning of stores from selected stations. This position is protected from accidental

operation by a clear plastic guard. To move the switch to this position, the guard must be held back and the push button depressed.

MECH ARM SWITCH. The MECH ARM switch is a three-position, lever-lock toggle switch that controls nose and tail arming of conventional weapons.

ROCKET SWITCH. The ROCKET switch is a two-position toggle switch marked RIPPLE and SINGLE. Use of this switch permits selection of stick centering for BOMB-SALVO or BOMB-TRAIN releases. When the switch is at RIPPLE, release timing is adjusted to place the first bomb on the target. When SINGLE is selected, the middle bomb is placed on the target.

GUNS SWITCH. The GUNS switch is a three-position, lever-lock toggle switch. This switch controls the charging and clearing of guns in the gun pod. In the READY position, all guns are simultaneously charged and made ready for firing. Placing the switch in the CLEAR position empties the gun chambers of live rounds. This renders all guns inoperative. With the switch in the SAFE position, no electrical power is available for firing.

RESELECT INDICATOR. The RESELECT indicator is activated by the reselect relay in the armament control unit. Both leads to the circuit are brought out separately to an input/output connector so the light can be tested and dimmed externally. The reselect relay is energized by a signal from the ballistics computer when there is an incompatibility in the armament control unit setting. The indicator goes out when the correct setting is made. The reselect relay, when energized, inhibits intervalometer and CDC pulses from the station select logic, but it does not inhibit the manual STEP pulses. Since the RESELECT indicator is driven by the CDC, it is inoperable when the CDC is OFF or not in the aircraft.

QUANTITY COMPLETE INDICATOR. The quantity COMPLETE indicator is controlled by the multiple release counter circuitry. It is also capable of being tested and dimmed externally. When the armament control unit generates the required number of release pulses as set on the QUANTITY select thumb-wheel switch, the quantity COMPLETE indicator is activated. This indicates the desired number of pulses

were sent to selected stations. The quantity COMPLETE indicator goes out when either the commit switch or weapons release switch is released.

INTERVAL THUMB-WHEEL SWITCH.

The INTERVAL thumb-wheel switch is a three-digit switch that performs two functions. In the LAB IP, LAB TGT, and DELAY attack modes, the true BDC poles of the switch set the TIMER so correct countback is obtained in each time. In the GENERAL, STRAIGHT, HI LOFT, and ROCKET attack modes, the complement BCD poles of the switch control the digital computer release pulses to the armament control unit so the correct spacing distance is obtained in feet.

QUANTITY THUMB-WHEEL SWITCH.

The QUANTITY thumb-wheel switch is a two-digit switch that performs two functions. In the manual release mode and three of the automatic release modes, the true poles of the switch control (by way of the multiple release counter) the number of pulses generated by the intervalometer. For this function, the switch has a range from 99 to 1, and it is variable in single-increment discrete steps. In the GENERAL, STRAIGHT, HI LOFT, and ROCKET attack modes, the complement BCD poles of the switch control the number of automatic release pulses generated by the digital computer.

TIME THUMB-WHEEL SWITCH. The TIME thumb-wheel switch is a three-digit switch that performs two functions. In the manual release mode and three of the automatic release modes (LAB IP/TGT, GCB, DELAY), the true BCD poles of the switch set the intervalometer so correct station-to-station release spacing is obtained in real time. In the GENERAL, STRAIGHT, HI LOFT, and ROCKET attack modes, the THUMB-WHEEL switch controls the digital computer release pulses so the weapon isn't released from the aircraft before the minimum safe time.

MISSILE POWER/TONE SWITCH. The MISSILE PWR/TONE switch is a three-position rotary switch that controls the audio level of the missile tones. The three positions used on the MISSILE PWR/TONE rotary switch are OFF, STBY, and ON.

MISSILE COOLING SWITCH. The MISSILE COOLING switch is a three-position

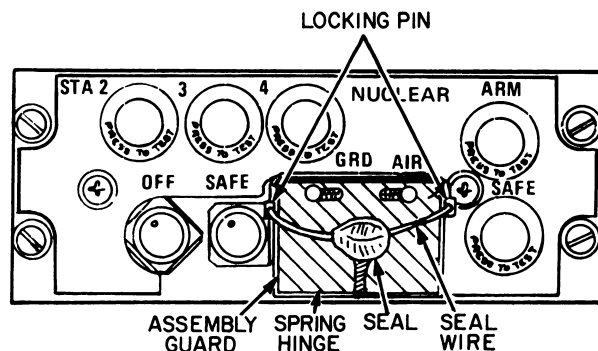


Figure 14-23.—A-6E DCU-186/A aircraft control monitor.

toggle switch (TEST/OFF/ON). In the ON position, it controls the power to the Sidewinder missile cooling system. In the TEST position, it controls the power to the Shrike guidance system for ground test. In the OFF position, no power is applied.

CONTROL MONITOR DCU-186/A

The control monitor DCU-186/A (fig. 14-23) has all the controls and indicators to monitor and control the arming and safing of special weapons. The panel contains three functional press-to-test STA disagreement lamps and four switches—OFF, SAFE, GRD, and AIR. The three press-to-test STA disagreement lamps (2, 3, and 4) monitor the weapons and the T-375 circuits. The numerals 2, 3, and 4 above the lamps refer to the respective weapons location. These locations are left inboard wing, centerline, and right inboard wing, respectively. The disagreement lamps are designed on the light-off principle. Thus, the normal condition for any setting of the switches is indicated by the disagreement lamp remaining off. When a lamp lights, a malfunction exists. The GRD and AIR switches are protected by a spring-loaded shield and are normally lockwired and sealed.

ELECTRICAL FUZING

The A-6 has an AN/AWW fuze function control system that is controlled by the AN/AWW-4 fuze function control panel (fig. 14-22) in the cockpit. The AN/AWW-4 provides the pilot with the same electrical fuze function option times as discussed earlier in this chapter.

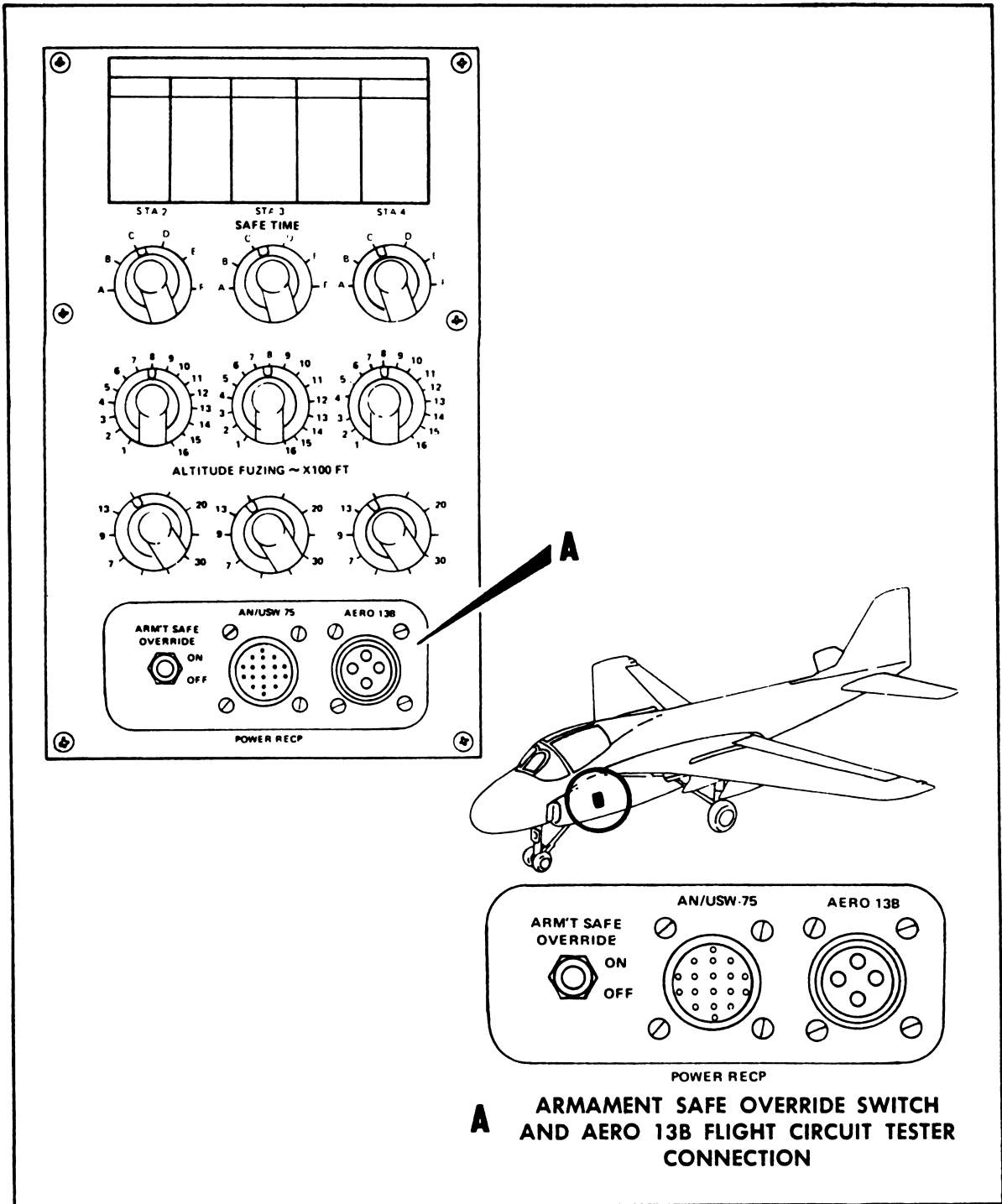


Figure 14-24.—Ballistic control panel.

220.1030

BALLISTIC CONTROL PANEL

The ballistic control panel is located on the left engine inlet duct (fig. 14-24). It selects the safe escape times of the aircraft when both free-fall and drogue-retarded weapons are being released. After the settings are made on the panel, the required safe aircraft escape time and the altitude fuzing set in the weapons are fed into the ballistics computer. The computer calculates weapon release to accommodate safe escape by the aircraft.

The armament safe override switch is also located on the ballistic control panel. This switch is an ON/OFF switch, spring-loaded to the OFF position. Armament systems checks are performed during ground tests when the armament safe override switch is momentarily set to the ON position.

PILOT'S CONTROL STICK GRIP

The pilot's control stick grip (fig. 14-25) contains the commit switch, gun trigger switch, and the weapon release button.

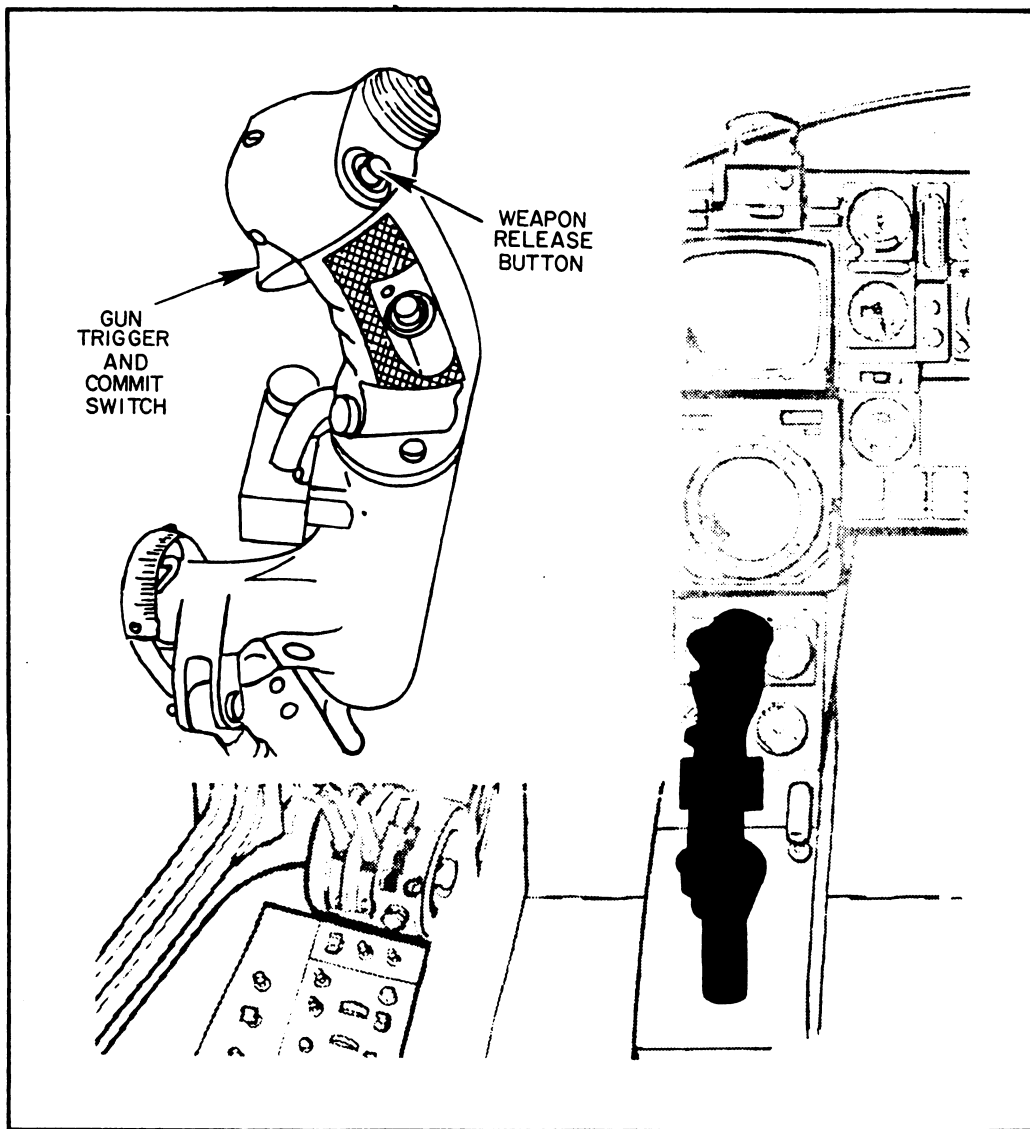


Figure 14-25.—Pilot's control stick grip.

220.1031

The commit switch initiates an automatic mode of attack. During the LAB IP attack mode, the pilot depresses the commit switch to start the ordnance intervalometer countdown to the pull-up. During a LAB TGT attack, the commit switch programs the inertial navigation system for an over-the-shoulder release maneuver. When installed, the gun trigger switch fires the Mk 4 gun pod.

The weapon release button allows the manual release of a store. When depressed, the manual release button releases the selected store.

A commit release switch is located on the forward end of the pilot's canopy. It is mounted on a bracket that moves forward and aft when the canopy is opened. The commit release switch buttons are electrically parallel and operate in exactly the same way as the corresponding commit switch and weapon release switch button on the pilot's control stick grip.

AN/AWG-21 WEAPON CONTROL SYSTEM

An A-6 aircraft with the AN/AWG-21 (fig. 14-26) weapon control system can launch AGM-78 Standard Arm missiles toward many types of enemy radar. The AN/AWG-21 system receives and processes characteristics of threat radars. It displays information that lets the bombardier/navigator launch any of four missiles at a designated target.

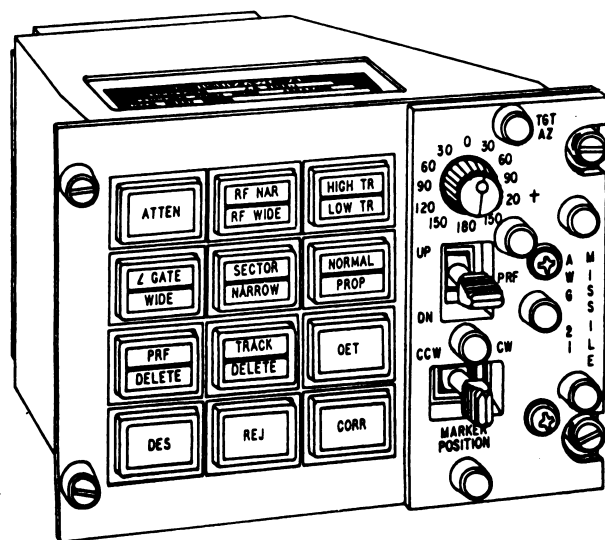


Figure 14-26.—AWG-21 missile control panel.

AIM-9 MISSILE SYSTEM

The AIM-9 missile is carried and launched from the LAU-7 (series) guided missile launcher at each wing station. When the MASTER ARMT switch is set to PRAC or ON, and the left main gear door is closed (in-flight) or the ARMT SAFE OVERRIDE switch is actuated (ground test), power is available for station-select logic. Then, the missile servo and thermionic cathode heaters are turned on by setting the PWR switch to STBY or ON. After a short interval, the missile tone is checked by selecting an appropriate station.

AGM-45A SHRIKE MISSILE SYSTEM

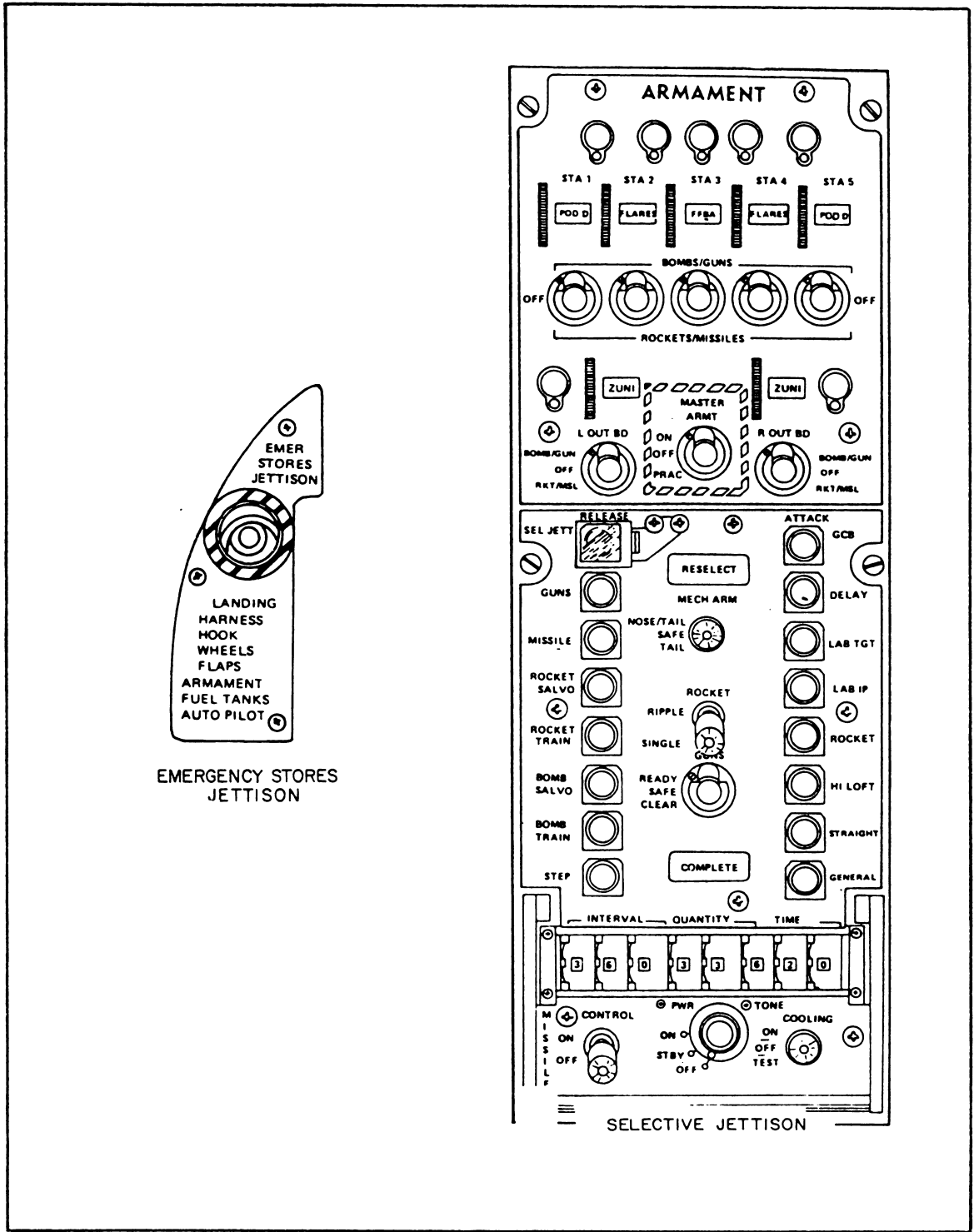
The Shrike release system allows a single or double launch of an AGM-45A Shrike missile from stations 1, 2, 4, and 5. When an AGM-45A missile is loaded and the armament power is ON, missile circuits are still not available. The MASTER ARMT switch must be set to PRAC or ON, and the left main gear door closed, or the ARMT SAFE OVERRIDE switch actuated. Controls on the armament control unit that must be actuated for control and launching of the Shrike missile are the MASTER ARMT switch, STA 1, 2, 4, and 5 select switches, MISSILE PWR switch, MISSILE TONE control, COOLING switch, RELEASE switch, MISSILE button, and Shrike setting on the ARMAMENT tape readout.

GROUND-CONTROLLED BOMBING SYSTEM

The ground-controlled bombing system (GCBS) operates with the TPG-10 remote bombing system. It provides ground-controlled steering and weapon release for close-support bombing attacks. The system components in the aircraft include the GCBS control panel on the bombardier/navigator right console, the GCBS address panel on the pilot instrument panel, and the necessary receiver and antenna assemblies throughout the aircraft. The ground station tracks the aircraft relative to the target coordinates, computes altitude, velocity and heading error, and transmits coded signals to the airborne system.

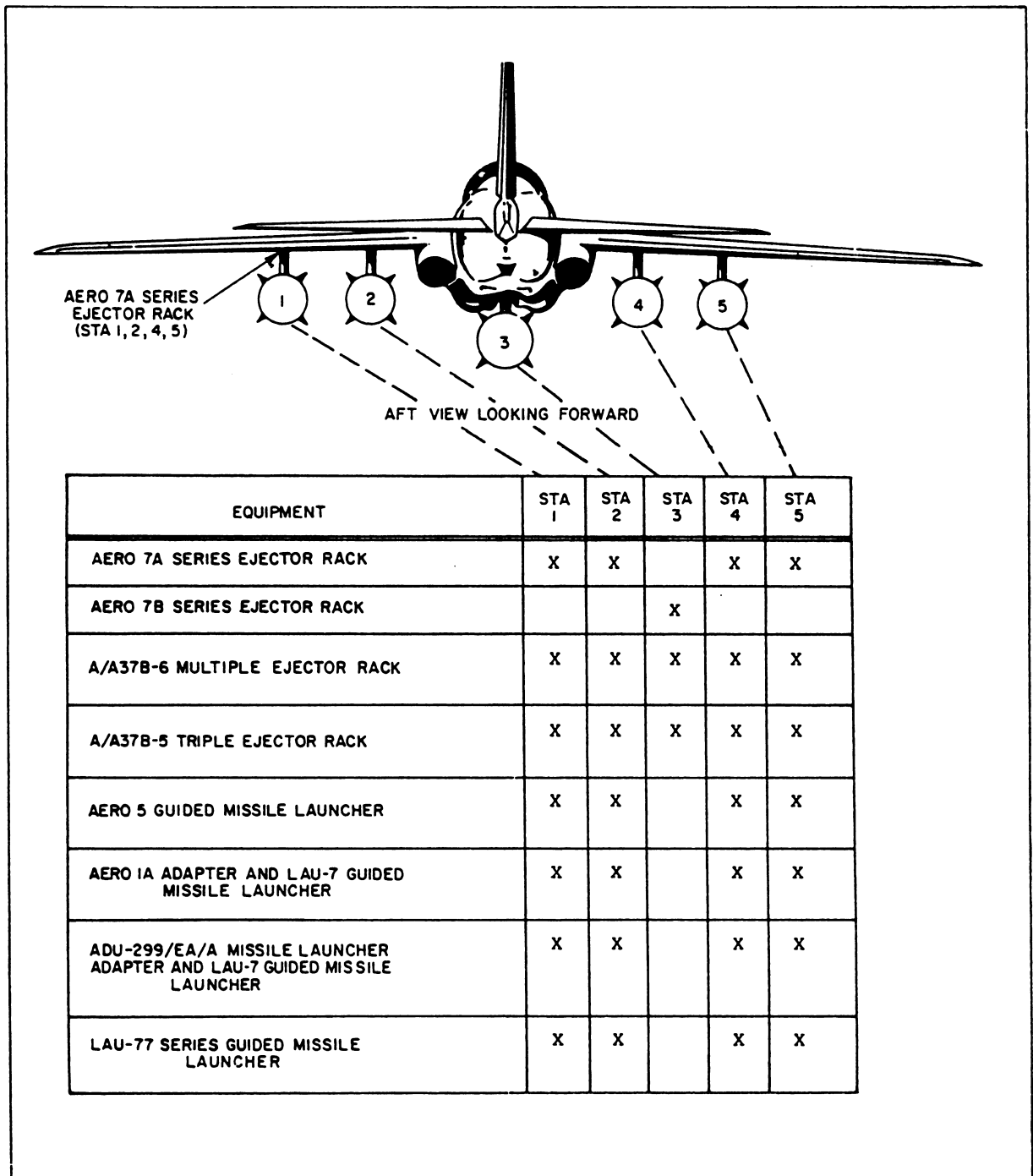
JETTISON SYSTEM

The jettison system (fig. 14-27) permits selective and emergency jettisoning of stores on the Aero 7 (series) ejector racks. Selective jettisoning is used to drop empty fuel tanks, rocket



EMERGENCY STORES JETTISON

Figure 14-27.—A-6E selective and emergency stores jettison switches. 220.1033



220.1034

Figure 14-28.—A-6E aircraft station configuration capabilities.

launchers, or stores that weren't released through normal release circuits, and are a potential hazard to the aircraft. Emergency jettison is used to simultaneously jettison all stores. In either selective jettison or emergency jettison, all power is interrupted to the fuzing circuits and stores are jettisoned in the safe condition.

AIRCRAFT ARMAMENT CONFIGURATION CAPABILITIES

The basic aircraft configuration consists of five parent racks, one Aero 7B ejector on the centerline station, and four Aero 7A ejector racks on the wing stations. The aircraft configuration capabilities for the A-6 are shown in figure 4-28.

If you want more information about authorized aircraft configurations and loading, refer to *A-6 Aircraft Tactical Manual*, NWP 55-3-A6; *A-6 Aircraft Tactical Manual (Supplement)*, NWP 55-3-A6; and *Airborne Weapons/Stores Loading Manual Navy Models A-6 Series, EA-6 and KA-6 Aircraft*, NAVAIR 01-85AD-75. When using these manuals, make sure you use the most recent revision.

REVIEW NUMBER 3

- Q1. Describe the primary mission of the KA-6D aircraft.*
- Q2. List the conditions to be met for power to be supplied to the stores release circuitry on the A-6 aircraft.*
- Q3. What component of the A-6 has the controls and indicators to monitor and control the arming and safing of special weapons?*
- Q4. What fuze function control system gives the A-6 aircraft electrical fuzing capability?*

Q5. What weapon control system is required to launch the AGM-78 missile from the A-6 aircraft?

Q6. Describe the purpose of the emergency jettison system of the A-6 aircraft.

Q7. What bomb rack should be used on the centerline station of the A-6 aircraft?

Q8. What bomb ejector racks should you mount on the four A-6 wing stations?

ANTISUBMARINE WARFARE WEAPONS SYSTEMS

Learning Objective: Identify antisubmarine warfare weapons systems to include the basic system, the kill store system, the release and control system, the release and control systems checks, and weapons system maintenance.

Antisubmarine warfare (ASW) is becoming a broad field. New developments are being made in submarine detection as well as in the tactical deployment of the equipment. AOs are interested in antisubmarine warfare because of the improvement of the capabilities for the in-flight launching of search and kill stores. The search stores (primarily sonobuoys), launched at precise intervals and locations and with the airborne electronics equipment, give accurate information in the detection of submarines. The kill stores consist mainly of torpedoes, mines, bombs, rockets, and guided missiles. The basic ASW search and kill store system and its associated equipment are currently used in the P-3C and S-3A aircraft and the SH-3 helicopter.

BASIC SYSTEM

The basic ASW weapons system consists of the equipment and accessories necessary for carrying and releasing weapons and search stores.

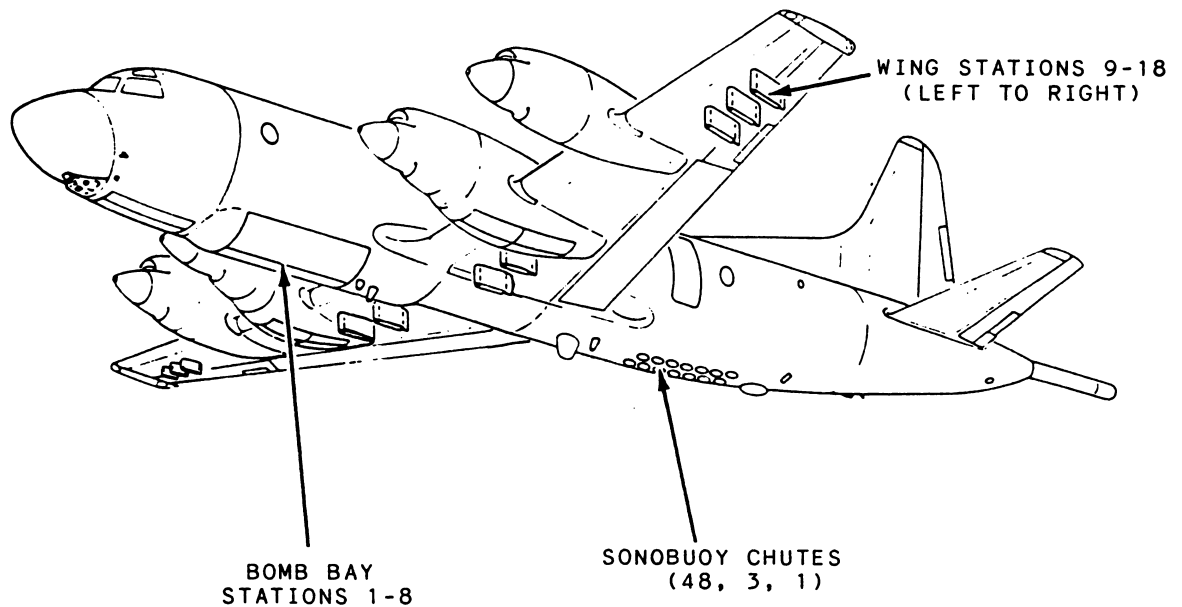
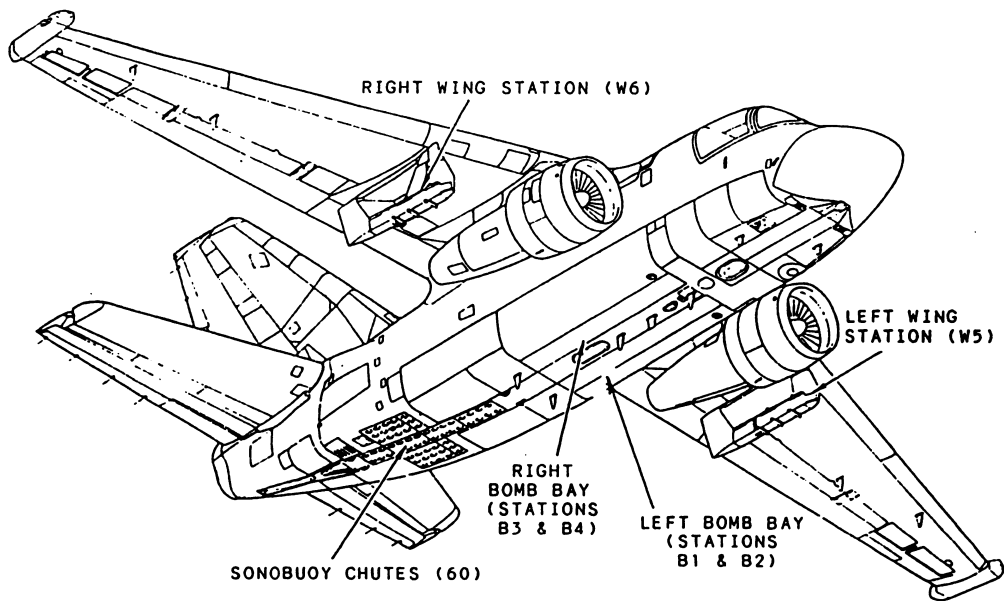


Figure 14-29.—P-3C ordnance stations.

220.643

REVIEW NUMBER 3 ANSWERS

- A1. The primary mission of the KA7-6D aircraft is as a tanker for air-to-air refueling operations.
- A2. The landing gear must be up and locked and the MASTER ARM switch set to ON for power to be supplied to the stores release circuitry on the A-6 aircraft.
- A3. The DCU-186/A control monitor of the A-6 has the controls and indicators to monitor and control the arming and safing of special weapons.
- A4. The AN/AWW-4 fuze function control system gives the A-6 aircraft electrical fuzing capability.
- A5. The AN/AWG-21 weapon control system is required to launch the AGM-78 missile from the A-6 aircraft.
- A6. The emergency jettison system of the A-6 aircraft is used to simultaneously jettison all stores from the A-6 aircraft in a safe condition.
- A7. The Aero 7B bomb ejector racks should be used on the centerline station of the A-6 aircraft.
- A8. The Aero 7A bomb ejector racks should be mounted on the four A-6 wing stations.



220.644

Figure 14-30.—S-3A ordnance stations.

In the P-3C (fig. 14-29), there are 8 bomb bay stations and 10 wing stations that can carry a variety of stores. Forty-eight unpressurized, three pressurized, and one free-fall launch chutes are used in the search store system. In the S-3A (fig. 14-30), two bomb bays with two stations each and two wing stations are available for store carriage. Sixty unpressurized launch chutes are used in the S-3A search store system.

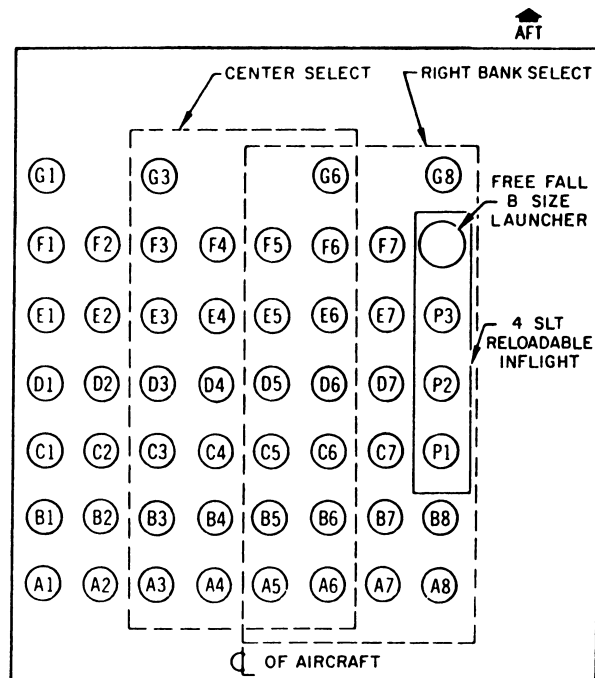
The weapon control system of each aircraft has the units, panels, switches, logic circuits, interfaces, computer, and controls necessary for selecting, arming, and releasing the kill or search stores. Status lights indicate store selection errors and store go or no-go status. Electrical jettison release systems are used to release or eject all kill stores of the P-3C aircraft and the wing stores and all search stores of the S-3A aircraft.

Search Store System

The search store systems of the P-3C and S-3A aircraft have the necessary equipment and accessories to carry and release sonobuoys. Also, the sono systems can carry and release several other search-related stores.

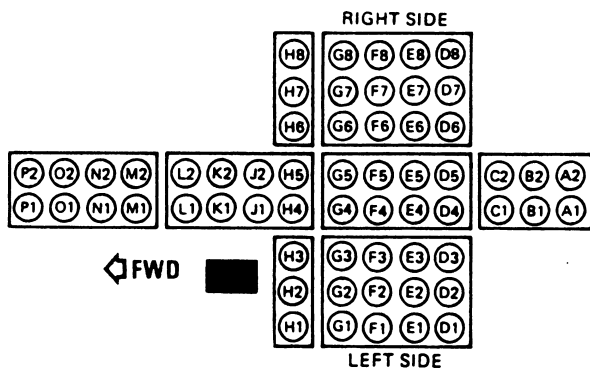
Part of the search store system consists of unpressurized size A sonobuoy launch tubes (SLTs). These are installed in the underside of the aircraft fuselage. There are 48 SLTs on the P-3C and 60 SLTs on the S-3A. The SLTs are not accessible from the pressurized aircraft cabin (flight station), therefore, the

designation unpressurized. The SLTs may be reloaded only from the outside of the aircraft. Look at figures 14-31 and 14-32. They show the arrangement of the SLTs as you look up at the lower fuselage.



220.645

Figure 14-31.—P-3C sonobuoy launch tube arrangement.



220.646

Figure 14-32.—S-3A sonobuoy launch tube arrangement.

The P-3C has three pressurized size A SLTs (fig. 14-33) and one unpressurized size B free-fall chute. They are all accessible from the flight station and reloadable in flight. Size A chutes are about 5 inches in diameter, and the size B chute is about 7 inches in diameter.

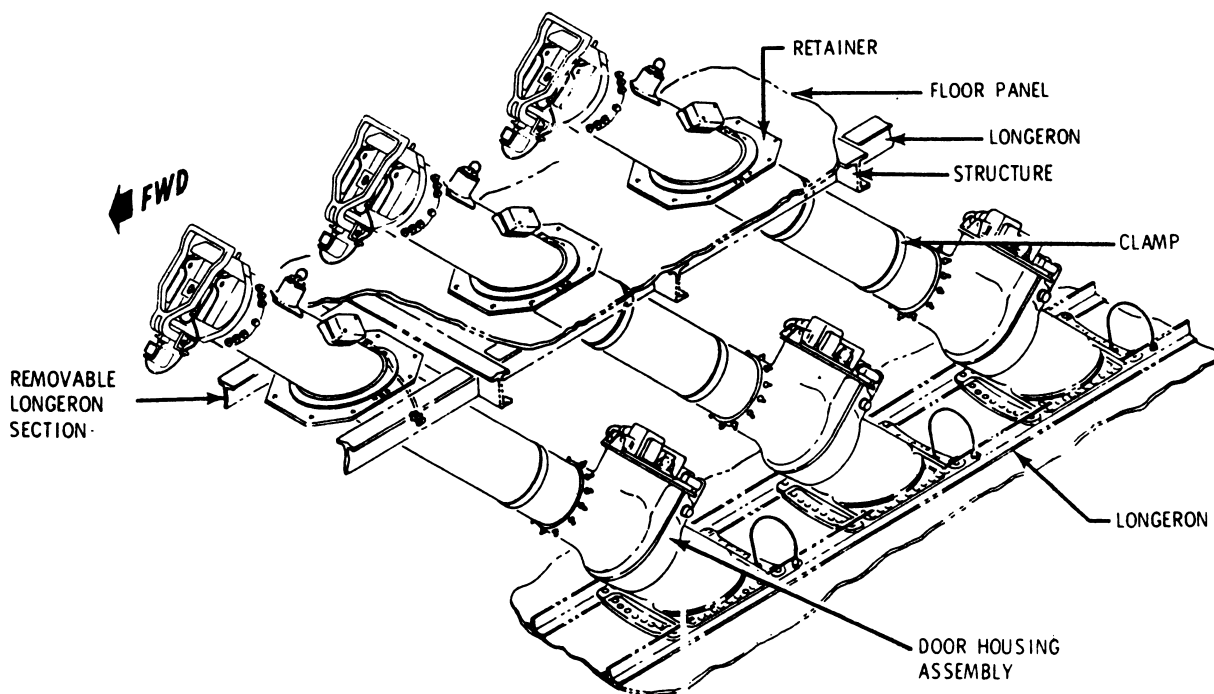
The size B chute is a tube with a pressure sealing cover at the flight station (top) end. If it is pressurized, the cabin of the aircraft must be

depressurized before opening the sealing door of the chute. The chute is then used for manually expending miscellaneous items less than 7 inches in diameter. The size B chute has no connecting electrical circuits.

All of the size A SLTs in both aircraft have electrical interconnections to the aircraft computer and manual mode control circuits for sonobuoy inventory and launching.

Sonobuoys, Mk 58 and/or Mk 25 marine location markers (MLMs) and, at times, signal underwater sounds (SUSs) are loaded into sonobuoy launch containers (SLCs). The Mk 25 MLMs and SUSs may be dropped from the size B chute of the P-3C. After you load a store into the SLC, with the appropriate pads and spacers, install an end cap at the open end and mark it with information about the enclosed store. The end cap has two protruding pin lugs that mate with slots on the SLC to lock the store in place. The lugs shear when the CAD is fired, and everything in the SLC is ejected.

NOTE: Some sonobuoys are received prepackaged in disposable SLCs. This deletes the need for loading SLCs at the organizational maintenance level.



220.647

Figure 14-33.—Pressurized size A sonobuoy launch tubes.

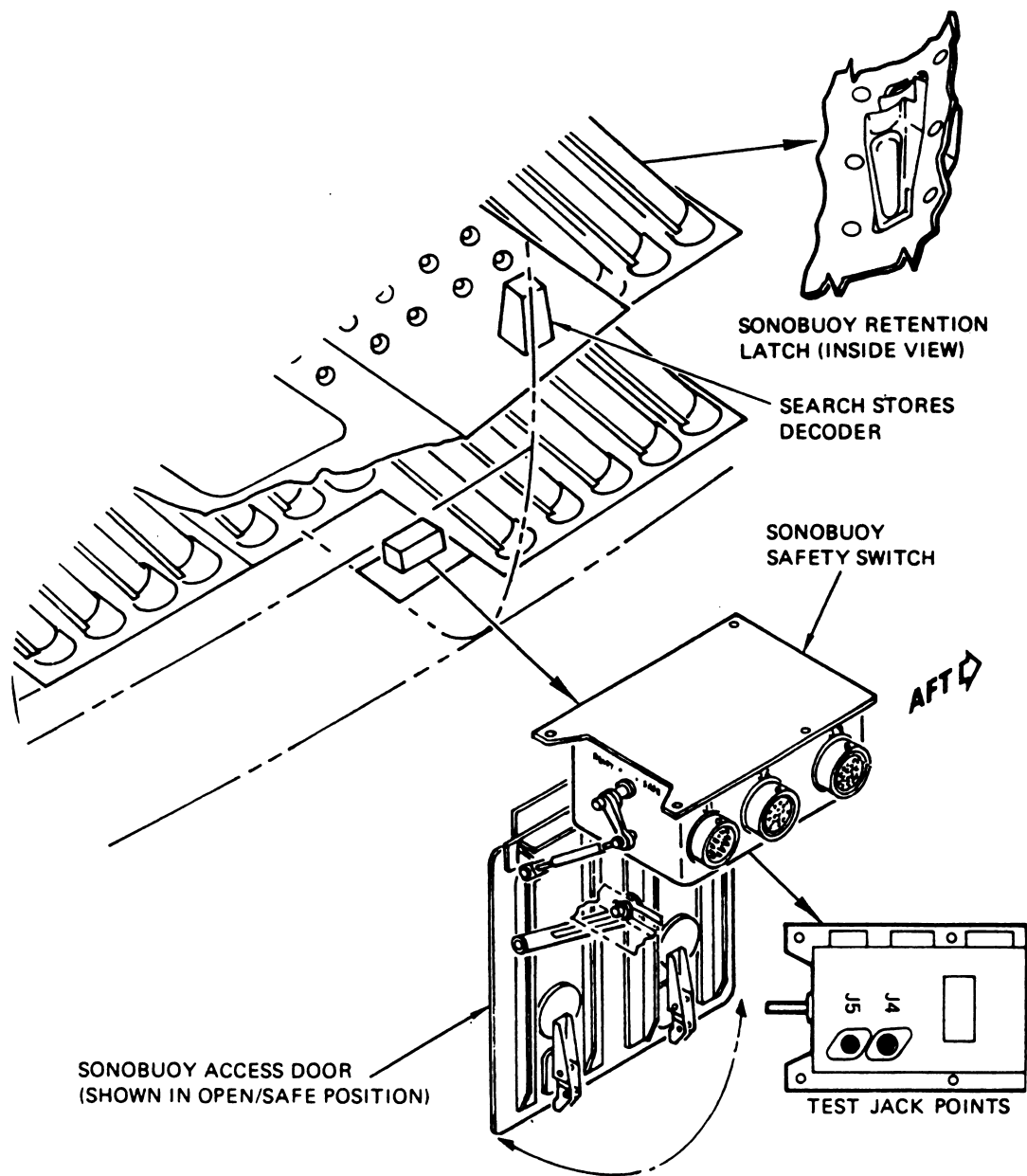


Figure 14-34.—S-3A sonobuoy safety switch.

220.649

Before you load the SLCs into the SLTs, perform a no-voltage and stray-voltage check on the sono circuits at the sonobuoy safety switch (fig. 14-34) for the S-3A and on the sono launch circuit tester in the P-3C. The safety switch (on both aircraft) is located next to the SLTs. It is actuated to the safe position when the switch access door is open. Apply electrical power and air conditioning to the aircraft, and perform the

checks with the AN/AWM-54 test set and W4 adapter. During these checks, a sono disabled indication is displayed on the pilot's armament control panel.

The SLC, with a CAD installed, is loaded into a designated SLT according to a load plan. Turn the SLC as you place it in the SLT until it is fully inserted. The locking lugs at the CAD cap mate with the locking lugs of the SLT, and the

CAD is pressed against the electrical firing pin in the SLT breech assembly. In the S-3A, always load tube P2 with an SLC containing a search and rescue (SAR) sonobuoy. The P-3C also has a stowage rack inside the aircraft for 36 SLCs for use in the pressurized SLTs.

When the SLC is loaded, clear the area beneath the loaded SLTs and close the safety switch door. When the door is closed, the cockpit sono disabled indication is extinguished. A continuity check is performed by the aircraft circuits on the CADs, and the load status is verified by using the sono select switches of the particular aircraft. The switch door is opened again, and the system is disabled until just before takeoff. The load plan is given to the tactical coordinator (TACO or TACCO) for computer programming of the specific store in each SLT, and in the case of the P-3C, the stowage rack.

Release of SLT stores in flight is activated by the aircraft computer (auto mode). The computer is programmed by the TACO and controlled by the pilot's or TACO's keyset in the P-3C, and the TACO's keyset in the S-3A. The manual release mode is used only during maintenance testing and system checks, and as an emergency backup for the auto mode. Emergency jettison of SLTs is **not** included in the P-3C system. In the S-3A, emergency jettison is part of the jettison circuit and, when activated, it jettisons 59 of the 60 SLTs in less than 10 seconds. Until the pilot initiates circuit activation, the SAR buoy remains in chute P2.

Photographic System (P-3C)

The P-3C photographic system consists of two separate and independently operated camera installations. The system has a forward camera (KA-74) for surveillance and an aft camera (KB-18) for damage assessment. Both are day/night cameras; however, only the day capability is used. The forward camera is pitch/roll gimbal-mounted. It is positioned in flight by controls located on the copilot's side console. The pilot or copilot can manually operate the camera by using the forward camera control located on the control pedestal. The aft camera is fixed-mounted. It is manually operated by controls located on the copilot's side console or triggered automatically by a weapon release. The joint photographic system is the joint responsibility of personnel in the PH and AO ratings.

Helicopter Search Store System

The search store system of helicopters is less complex than that of the P-3C and S-3A aircraft, but it serves the same purpose. Look at figure 14-35. It shows some of the basic search store equipments of the SH-3 series helicopter and the location of the four kill store stations. The various models of the SH-3 helicopter (A, D, G, H) have different configurations and capabilities. The discussion of the helicopter search store system is general, and it doesn't apply to a specific SH-3 model helicopter.

SONOBUOY LAUNCHER SYSTEM.—The sonobuoy launcher system allows free-fall launching of sonobuoys. The system consists of a control panel and 12 launcher tubes (size A), which are incorporated as an integral part of the airframe. Each tube contains a retention gate that is electrically or manually released to launch individual sonobuoys. A tube-loaded microswitch operates a panel light when the selected tube is loaded.

MK 25 MARINE LOCATION MARKER LAUNCHER SYSTEM.—Two box-like launcher containers can carry 12 Mk 25 MLMs with Mk 34 adapter kits. They are suspended in the left-hand sponson from a single Mk 8 bomb shackle. The markers are loaded from the bottom into the 24 chutes. An electrical release actuator, similar to the sono release, opens a gate at the bottom of each chute. A spring in each chute forces the marker out of the chute when the gate is opened.

MAD REELING MACHINE/TOWED BODY SYSTEM.—The reeling machine/towed body, a part of the AN/ASQ-81(V)-2 magnetic anomaly detector (MAD) system, is suspended in the right-hand sponson by an Mk 8 bomb shackle. The reeling machine contains a towed body cable, cable reel, motor, latching mechanism, cable cutter, and associated electronic circuitry. The reeling machine limit switches, electrohydraulic switches, relays, and mechanical linkages control and monitor the reeling machine cable operation to make sure there is positive control of the towed body. The towed body is constructed of fiber glass and houses the magnetic detector. The magnetic detector is monitored by instruments in the helicopter aircrew flight station.

KILL STORE SYSTEM

The kill store system includes all equipment necessary to select, arm, and release weapons

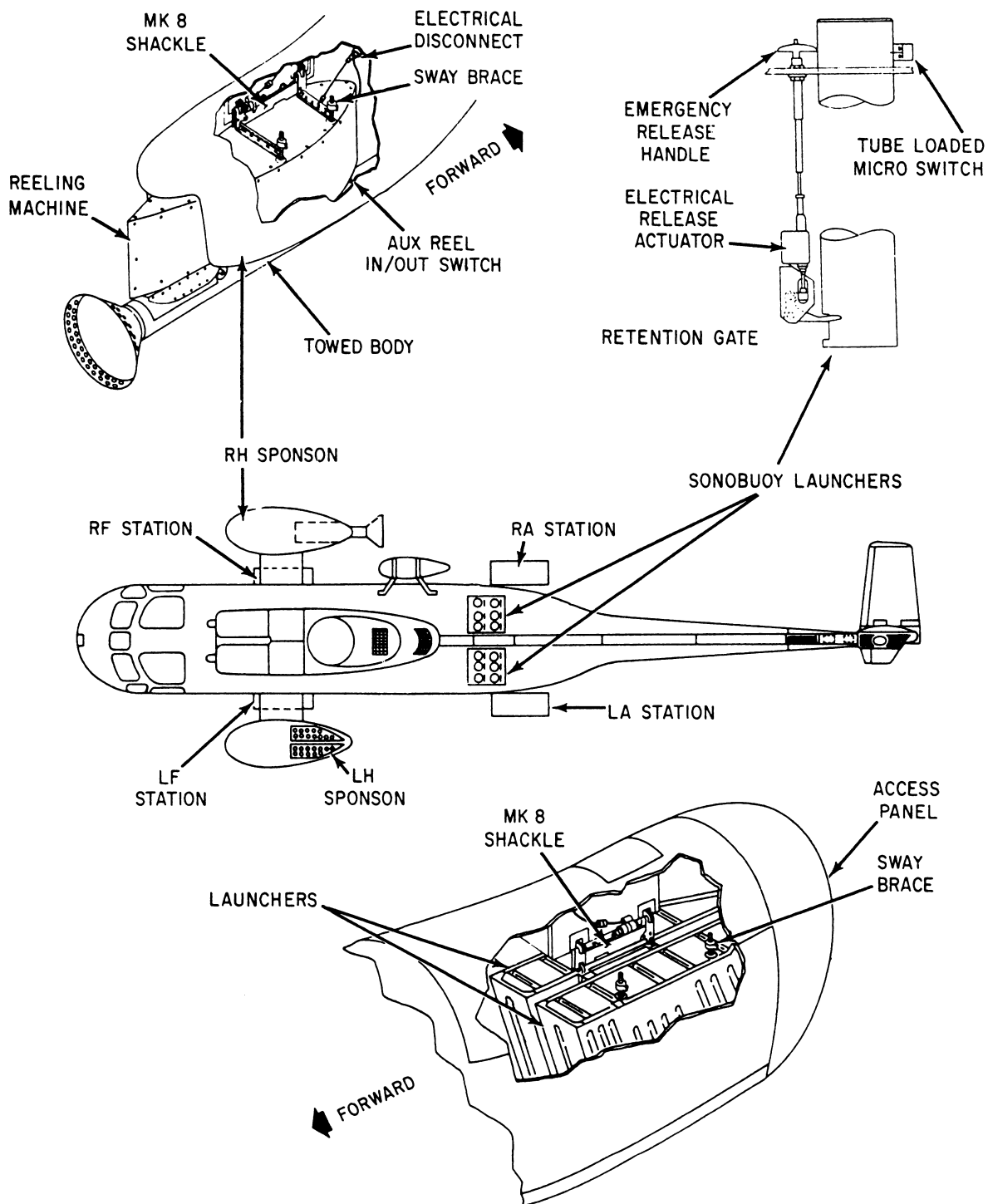
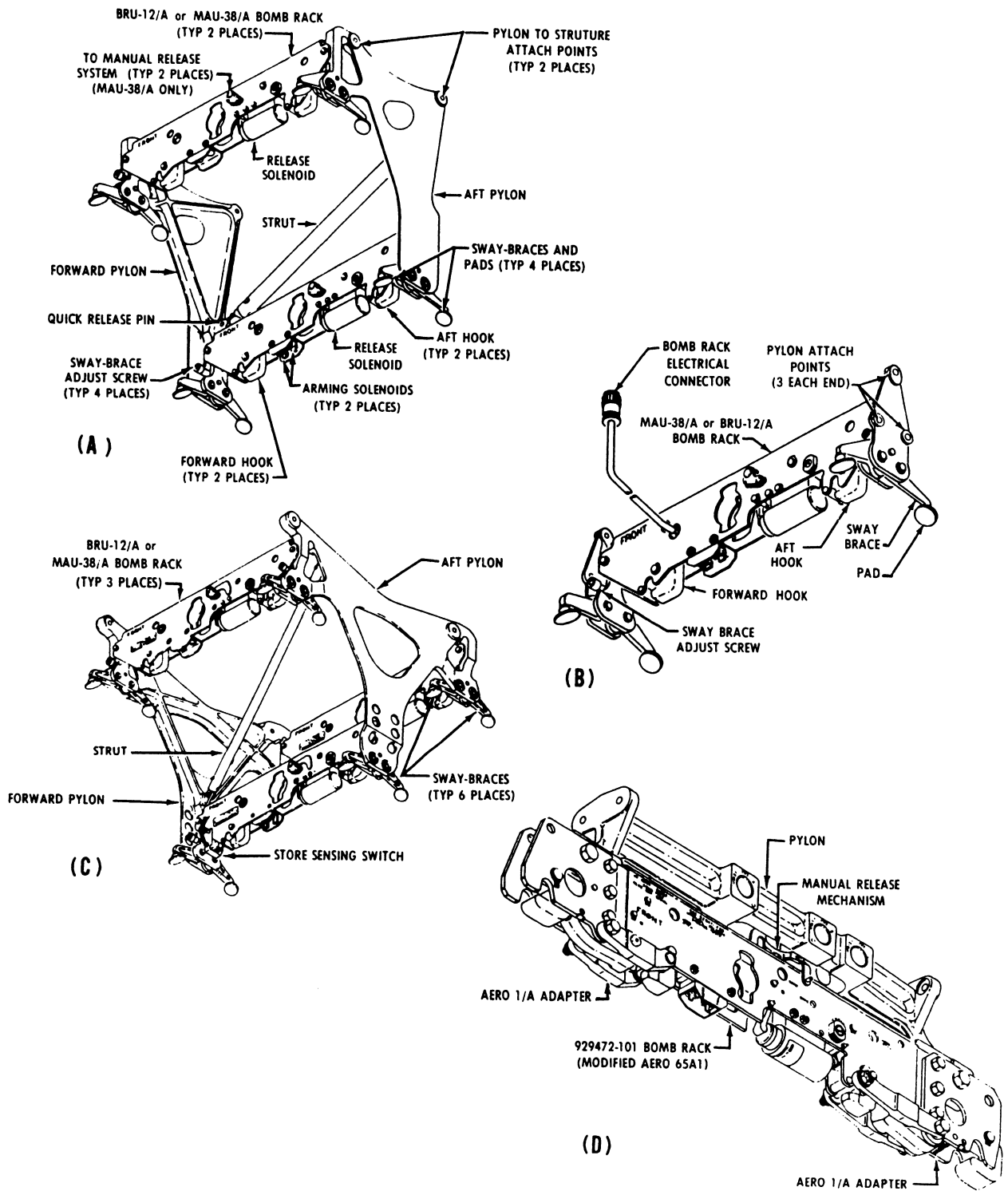


Figure 14-35.—SH-3 (series) search and kill stores.

220.650



220.411
Figure 14-36.—Bomb bay pylons. (A) primary pylon; (B) alternate pylon; (C) 500-pound mine pylon; (D) 1,000/2,000-pound mine pylon.

from the bomb bays and wing stations of aircraft. The system, especially on the P-3C, is divided into two subsystems—the bomb bay system and the wing store system.

Bomb Bay System

The bomb bay system consists of the units and components needed to carry, arm, and release stores. On the P-3C, stores are installed on bomb racks suspended from removable pylon assemblies, which are mounted across the center of the bomb bay. On the S-3A, the racks are attached to brackets mounted to the aircraft in a cruciform pattern. Each of these basic installations is assigned a station number. Numbers followed by a letter (such as A or B) designate these stations for special capacities or types of stores. These stations are arranged in pairs, such as stations 1 and 2, 3 and 4, etc. Additionally, the P-3C stations are grouped into two layers—odd-numbered stations in the upper layer and even-numbered stations in the lower layer. **When the bomb bay is loaded with mixed stores, each pair of stations must be loaded with the same type of store. This is to ensure proper clearance between the stores.** The S-3A has only one layer of stations because of its smaller bomb bays.

The bomb bay doors are electrically controlled and hydraulically operated. For ground maintenance without power, you can close or open the doors internally on the P-3C by using a manual control valve and hand pump. For ground

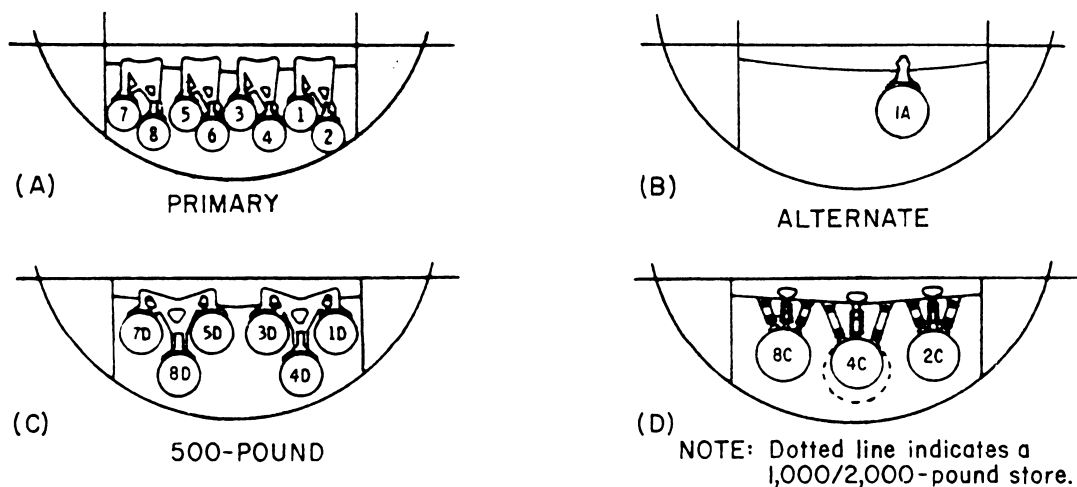
maintenance without power on the S-3A, you need to use a 3/8-inch drive crank to open or close the doors. Both aircraft have a ground safety pin to disable the door mechanism in the open position. **The door safety pin must be inserted when you are working in the bomb bays.**

The release of bomb bay stores is normally accomplished by the computer, as programmed by the TACO and controlled by the pilot and TACO in the P-3C, and the TACO with copilot backup in the S-3A. The pilots have final control because they must activate the master arm switch.

NOTE: Release of a special store requires action by both the pilot and TACO in all modes. Store jettison is accomplished through a pilot-controlled electrical circuit.

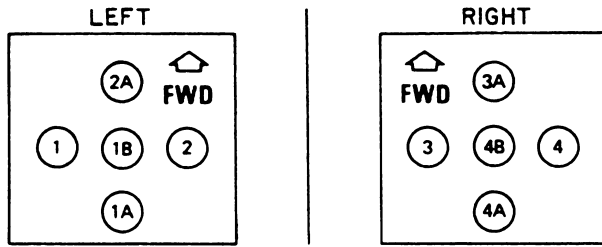
P-3C CONFIGURATION.—The P-3C aircraft bomb bay suspension system has eight MAU-38/A or BRU-12/A bomb racks and three Aero 1A adapted Aero 65A1 bomb racks. These bomb racks are suspended from removable pylon assemblies mounted at various locations across the center of the bomb bay. Different configurations of the bomb bay are made by varying the arrangement of the pylons.

As you read the following paragraphs, refer to figure 14-36, views A through D. This figure shows the four pylon assemblies used to support the bomb racks. The bomb bay configured with the four primary pylon assemblies is shown in figure 14-37, views A through D.



VIEWS LOOKING FORWARD

Figure 14-37.—P-3C bomb bay configurations.



220.651

Figure 14-38.—S-3A bomb bay configurations.

The primary pylon assembly (fig. 14-36, view A) has two MAU-38/A bomb racks or one BRU-12/A bomb rack mounted between two pylon ends. A diagonal strut is attached between the pylon ends to maintain a rigid structure. Four sway brace assemblies are an integral part of the pylon. When the bomb bay is configured like this, the bomb stations retain their numerical identity (1 through 8).

The alternate pylon assembly (fig. 14-36, view B) has a single MAU-38/A or BRU-12/A bomb rack mounted between two pylon ends. The pylon is designed to carry an engine starting unit or, in special instances, a special weapon. Figure 14-36, view B, shows a configuration of one alternate pylon assembly with a store on station A.

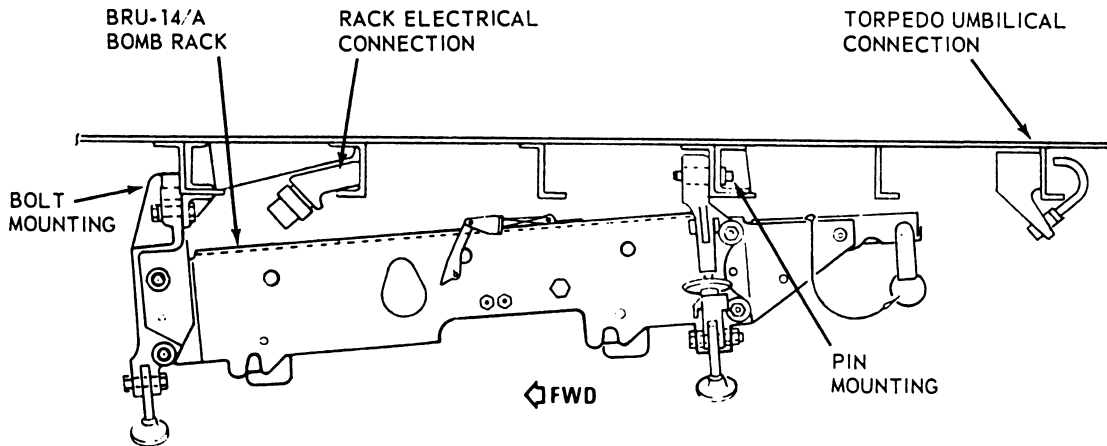
The 500-pound mine pylon assembly (fig. 14-36, view C) has three MAU-38/A or BRU-12/A bomb racks mounted between two pylon ends. Three mines or other comparable stores (not exceeding 500 pounds) can be suspended and released from this pylon. Figure

14-36, view C, shows two 500-pound pylons installed in the bomb bay.

The 1,000/2,000-pound mine pylon assembly (fig. 14-36, view D) has a bomb rack mounted on a one-piece pylon. The bomb rack is essentially an Aero 65A1, modified with Aero 1A adapter mechanisms. A maximum of three of these assemblies can be installed in the bomb bay. The sway braces for steadying the loaded store on this pylon assembly are attached to the bomb bay overhead. Figure 14-36, view D, shows a bomb bay configured with three of these pylon assemblies.

A bomb bay remote safety pin system is used in the bomb bay to safety the upper bomb racks during ground operations. This function is done by manual remote retraction and insertion of a safety pin in the MAU-38/A or BRU-12/A bomb rack. The system consists of an insertion/retraction device mounted on each of the upper bomb racks, a torque tube with universal joints, and a lever on the forward end of the torque tube. The lever for each rack is located near the forward bulkhead of the bomb bay. When you rotate the lever, the insertion/retraction device actuates. The matching holes in the lever and the front support bracket let you use an Aero 65 bomb rack safety pin and streamer to retain the lever in the normal or safe position. A retract spring on the insertion/retraction device returns the safety pin to the retract position when the remote lever is in the normal position.

S-3A CONFIGURATION.—The S-3A bomb bay suspension has two BRU-14/A bomb racks. The racks are suspended from the bomb bay



220.652

Figure 14-39.—S-3A bomb bay rack mounting.

overhead support braces. Different configurations are made by arranging the racks in various locations on the support braces. Figure 14-38 shows the configurations available for each bomb bay.

The basic configuration of the S-3A consists of dual stations—stations 1 and 2 and stations 3 and 4 across the bays. The station A configuration consists of dual tandem stations in each bay—1A and 2A, 3A and 4A. These two configurations are used, as necessary, to provide store clearance, depending on the shape and size of the store. The single store configuration consists of one station per bay—1B and 4B. This

configuration is used for special purposes, such as special weapons.

The BRU-14/A rack (fig. 14-39) is held in position by two mounting bolts through the forward mount. Mounting pins secured to the aircraft braces restrain the rear of the rack assembly. Electrical receptacles at each mounting position provide connection for the rack to the aircraft circuits.

Foldable scrub rails, or guides, secured to the bomb bay centerline bulkhead are used with some stores to prevent damage to the aircraft structure as the store falls away. Figure 14-40

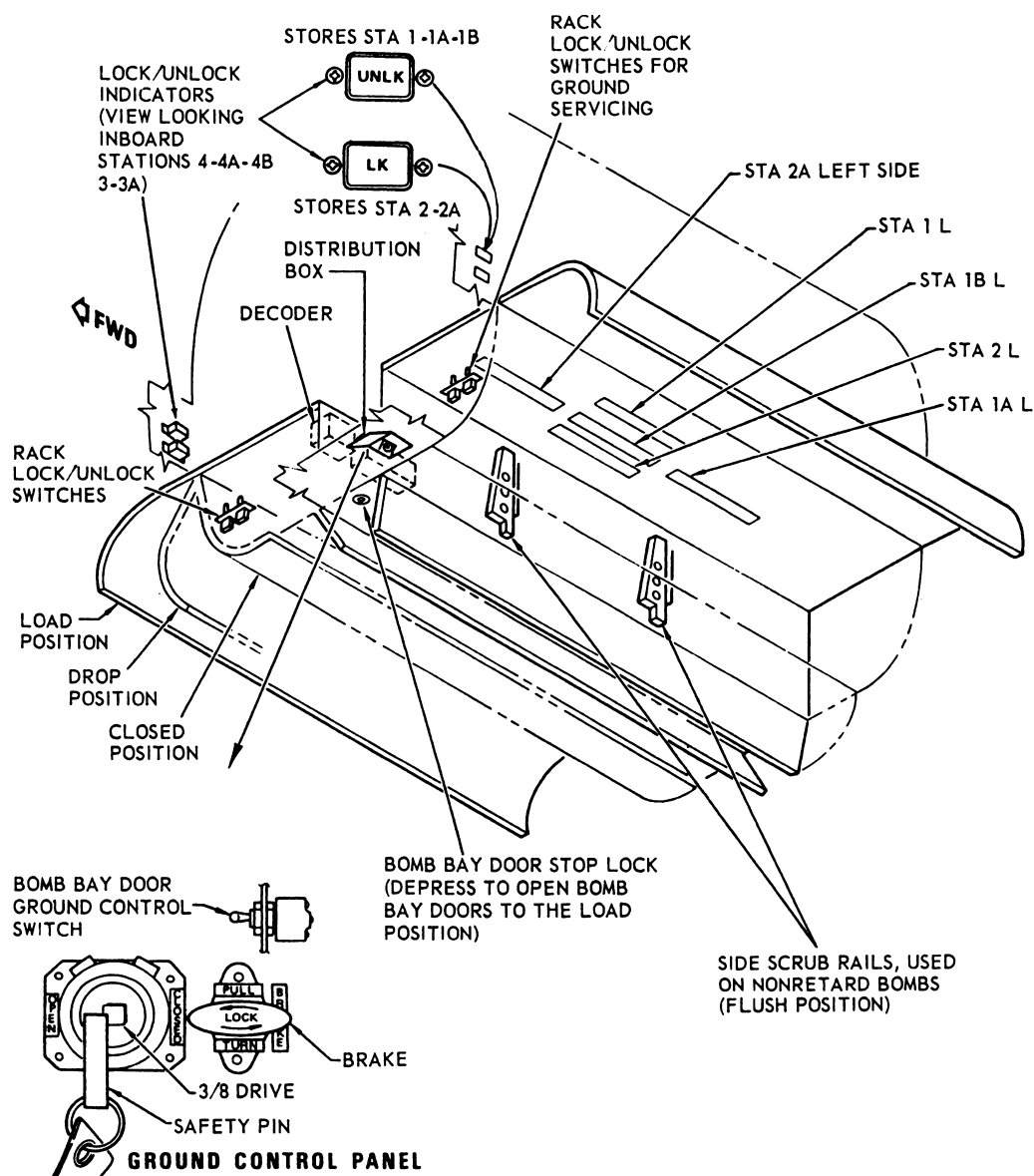
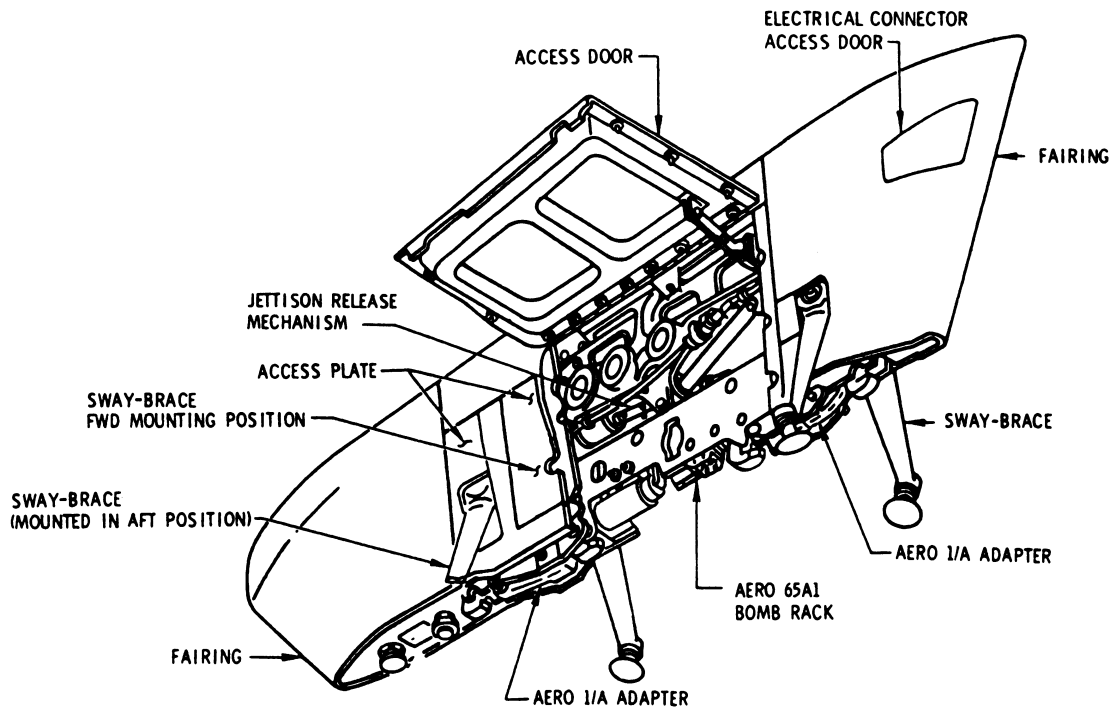


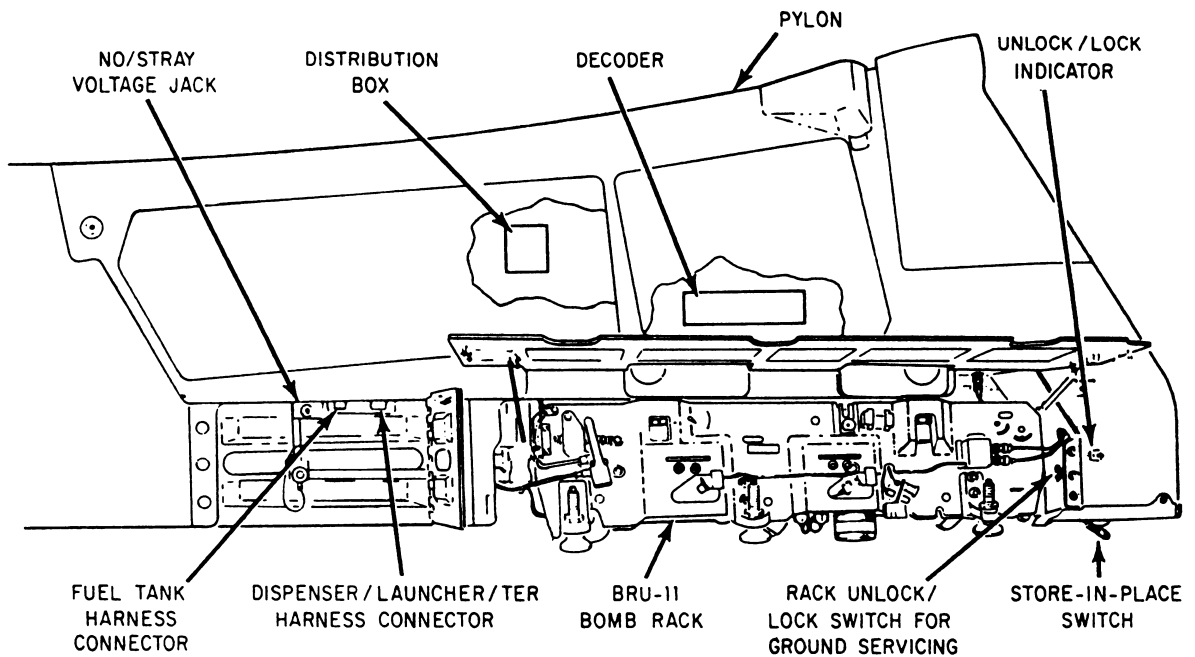
Figure 14-40.—S-3A bomb bay and components.

220.653



220.413

Figure 14-41.—Wing launcher assembly all-purpose universal pylon.



220.654

Figure 14-42.—Pylon/rack assembly.

shows the relative location of components of the S-3A bomb bay.

The distribution box provides the necessary interface between the decoder and the bomb racks in both auto (computer) and manual modes. The decoder contains the necessary electronics for receiving commands from the armament control panel for arming and releasing bomb bay stations and transmitting station status information.

Wing Store System

The wing store system consists of the units and components necessary for carrying, arming, and releasing external stores. On the P-3C, these stores are suspended from 10 wing stations—9 through 18, from left to right. On the S-3A, the stores are suspended from two wing stations—W5 (left) and W6 (right).

P-3C WING LAUNCHER ASSEMBLY.—The P-3C wing launcher assembly universal pylon (fig. 14-41) consists of a pylon assembly supporting an Aero 65A-1 bomb rack with two Aero 1A adapters, four sway brace assemblies, and an emergency release jettison mechanism. The three hoist positions are identified by decals—hoist position A, B, and C. Their use is determined by the relationship of the store suspension lugs to the center of gravity (CG) of the weapon. The rear sway braces are positioned at a forward or aft mounting position, depending

on weapon length and contour. The forward position is used with 500- and 1,000-pound mines; the aft position is used with 2,000-pound mines. The wing launcher fairing is trimmed to fit the wing contour at one station, and it isn't interchangeable between stations after trimming. Weapons are jettisoned when the jettison solenoid in the wing launcher is energized. The solenoid-actuated linkage connects to the Aero 65A-1 manual release cable. **The jettison solenoid and linkage must be cocked before loading.**

S-3A PYLON/RACK ASSEMBLY.—The S-3A pylon/rack assembly (fig. 14-42) consists of a pylon supporting a BRU-11A/A ejector rack. The rack is a self-contained unit that performs all the functions of carrying, arming, and releasing the stores. It is controlled by the aircraft armament circuits. The pylon provides structural attachment between the aircraft wing and the rack. It also contains the necessary wiring and components to connect the rack to release and status indicating circuits.

HELICOPTER KILL STORE SYSTEM.—The kill store system of the SH-3 series helicopter consists of control panels, interconnecting electrical units, and four launchers. Each launcher is made up of an Mk 8 Mods bomb shackle, an Aero 7 series release unit, mechanical arming units, and accessories varied by location (forward or aft) for a particular helicopter model. Look at figure 14-43. It shows one configuration

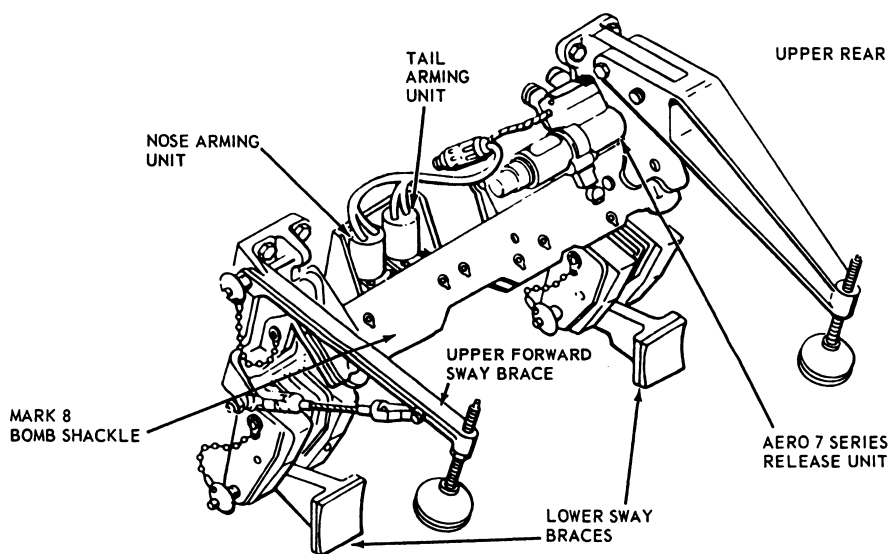


Figure 14-43.—SH-3 stores launcher.

of a forward, left-hand station. Electrical receptacles in the fuselage connect the launcher and adapter cables for the carrying stores at that particular station, such as fuel tanks, torpedoes, and special weapons. These stations are released and jettisoned electrically through normal and jettison-release circuits.

REVIEW NUMBER 4

- Q1. List the three basic aircraft used by the Navy for ASW operations.
- Q2. The P-3C aircraft has _____ bomb bay stations.
- Q3. What is the total number of unpressurized sonobuoy launch chutes in a P-3C aircraft?
- Q4. Three pressurize SLTs are used in P-3C aircraft. What size SLTs are used?
- Q5. No-voltage and stray voltage checks on the S-3A sono launch circuits are made using _____ the test set and adapter.
- Q6. What is the capacity of the SLC stowage rack inside a P-3C aircraft?
- Q7. What type of camera is mounted as the forward camera in the P-3C photographic system?
- Q8. What ratings have joint responsibility for the photographic system in the P-3C aircraft?
- Q9. There are _____ SLTs in the SH-3 helicopter.

Q10. Describe the numbering system of the P-3C bomb bay stations.

Q11. You can mount _____ MAU7-38 racks on the primary pylon assembly of a P-3C aircraft.

Q12. What rack/adapters are found in the P-3C aircraft wing launcher assembly?

Q13. Before the Aero 65A-1 can be loaded, the jettison solenoid and linkage associated with it must be in the _____ position.

Q14. What bomb shackle or release unit is used with the SH-3 helicopter kill store system?

RELEASE AND CONTROL SYSTEMS

The release and control systems of the P-3C and S-3A provide the necessary controls and circuitry for controlling and releasing search-and-kill stores from the aircraft. Look at figures 14-44 through 14-49. These figures show armament system controls, indicators, and information panels of the P-3C and S-3A aircraft.

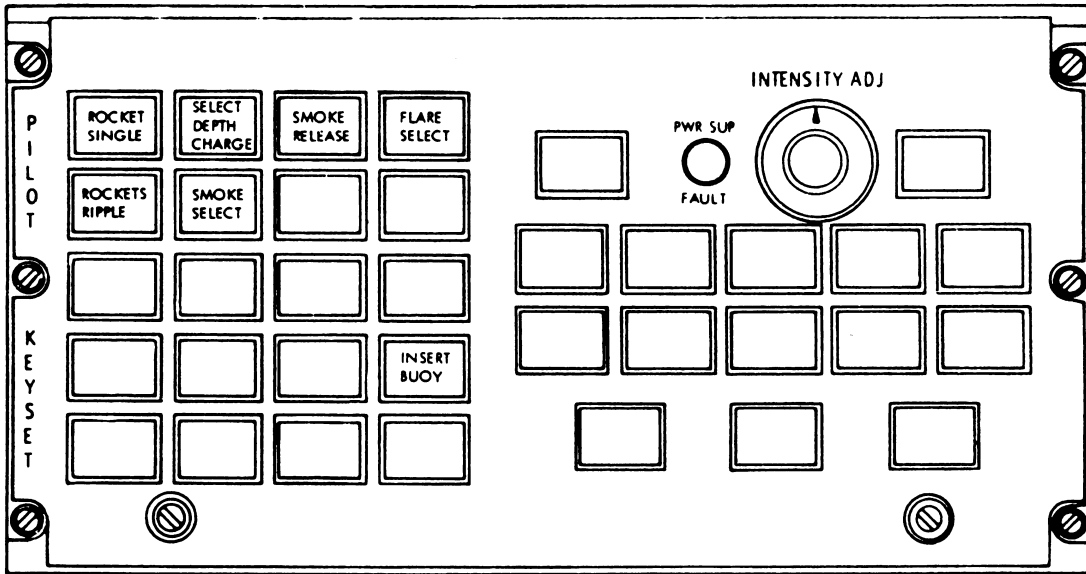
NOTE: P-3C aircraft manuals refer to the armament system for kill stores and the ordnance system for search stores. No distinction is made between them in this section of the training manual.

If you compare the figures, you can see that the controls are similar, even though the arrangement on particular panels is different. In the P-3C aircraft, system control is concentrated between the TACO and pilot, with the copilot and other crew members having minor control functions. In the S-3A aircraft, this control is concentrated between the TACO and copilot; however, the pilot and, to a lesser extent, the sensor operator (SENSO) have control functions available. Both pilots retain final command over stores release through the master arm and search power switches.

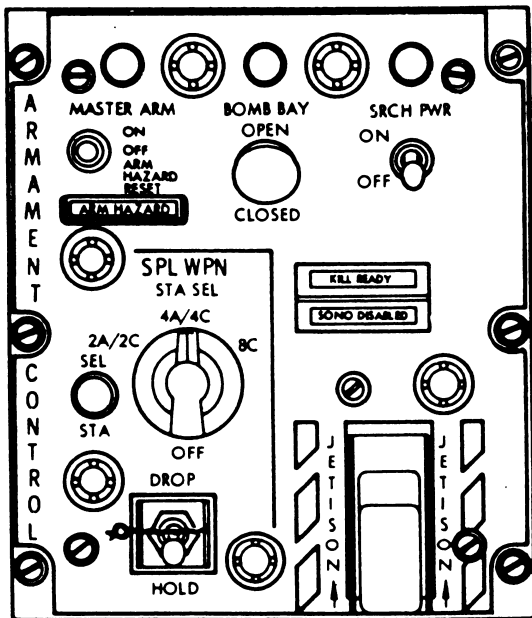
Operation

The system's primary mode system operation is the automatic (on-line) mode. This mode uses the computer, logic units (subprograms), crew

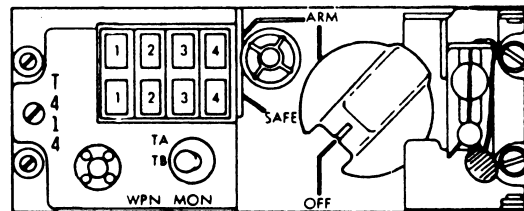
member keysets, bomb bay rack lock panel (P-3C), multipurpose data displays (MPDs), pilot's armament control panel (ACP), and other displays and panels to control and monitor the system. The manual (off-line) mode is used as a



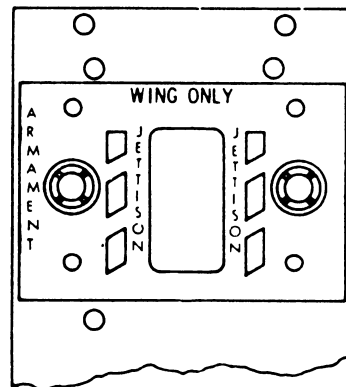
PILOTS KEYSSET



ARMAMENT CONTROL PANEL



AMAC PANEL (SPECIAL WEAPON)



WING ONLY JETTISON SWITCH

Figure 14-44.—P-3C pilot armament panels.

220.656

backup system for the automatic mode and for maintenance. The manual mode uses the same components, less the computer and logic units, through the TACO's manual weapon control box (P-3C) and the main auto key select on the pilot's ACP (S-3A).

AUTOMATIC MODE.—The automatic mode is a search and kill store management method that allows maximum flexibility and

control of the system. It minimizes the amount of necessary manual action required by the aircraft crew. In the automatic mode, the computer and its subsystems function as follows:

- Maintain an up-to-date inventory of all stores on the aircraft. They provide a weapon inventory that can be displayed on the TACO auxiliary readout (P-3C) or any crew member MPD (S-3A).

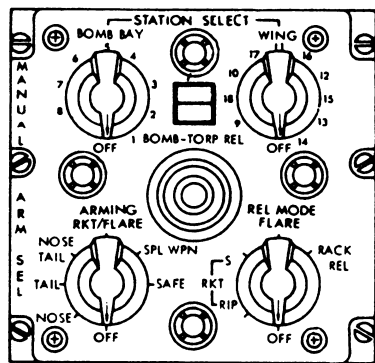
REVIEW NUMBER 4 ANSWERS

- A1. The three basic aircraft used by the Navy for ASW operations include the P-3 and S-3 aircraft and SH-3 helicopter.*
- A2. The P-3C aircraft has eight bomb bay stations.*
- A3. There are 48 unpressurized sonobuoy launch chutes in a P-3C aircraft.*
- A4. Three pressurized size A SLTs are used in P-3C aircraft.*
- A5. No-voltage and stray voltage checks on the S-3A sono launch circuits are made using the AN/AWM-54 and W-4 test set and adapter.*
- A6. The SLC stowage rack inside a P-3C aircraft will hold 36 SLCs.*
- A7. The KA-74 camera is mounted as the forward camera in the P-3C photographic system.*
- A8. The AO and PH ratings have joint responsibility for the photographic system in the P-3C aircraft.*
- A9. There are 12 SLTs in the SH-3 helicopter.*
- A10. P-3C bomb bay stations are numbered as follows: odd-numbered stations in the upper level and even-numbered stations on the lower level.*
- A11. You can mount two MAU7-38 racks on the primary pylon assembly of a P-3C aircraft.*
- A12. One Aero 65A-1 rack with two Aero 1A adapters are found in P-3C aircraft wing launcher assembly.*
- A13. Before the Aero 65A-1 can be loaded, the jettison solenoid and linkage associated with it must be in the cocked position.*
- A14. The Mk 8 bomb shackle or Aero 7 release unit is used with the SH-3 helicopter kill store system.*

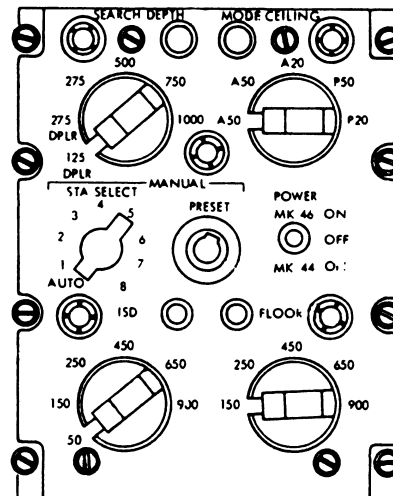
- Determine the availability of a selected weapon and select the weapon station from which the weapon is to be released (station priority).
- Energize the armament system relays at the proper time, in the proper sequence, and for the

proper time duration to accomplish a store release under joint computer and operator control.

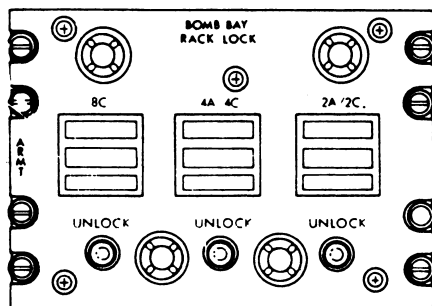
- Instruct the operator (pilot, copilot, or TACO), by cuing (light display or readout on MPD), to perform a required manual operation.



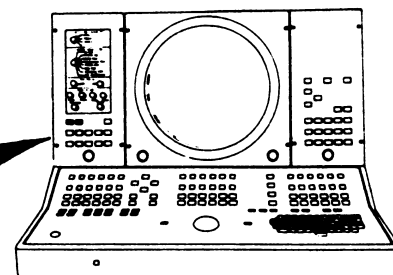
TACO MANUAL WEAPON CONTROL BOX



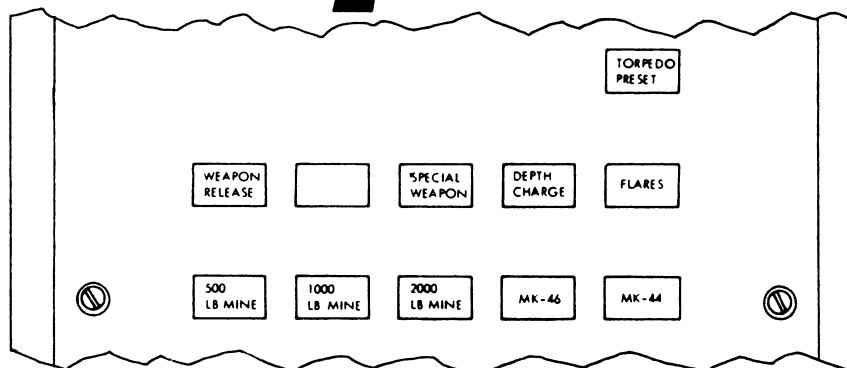
TORPEDO PRESETTER CONTROL PANEL



BOMB BAY RACK LOCK CONTROL PANEL (SPECIAL WEAPON)



MULTIPURPOSE DATA DISPLAY



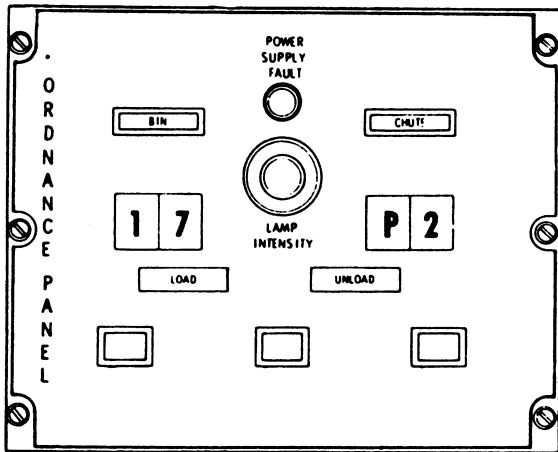
TACO KEYSSET

Figure 14-45.—P-3C TACO armament controls and displays.

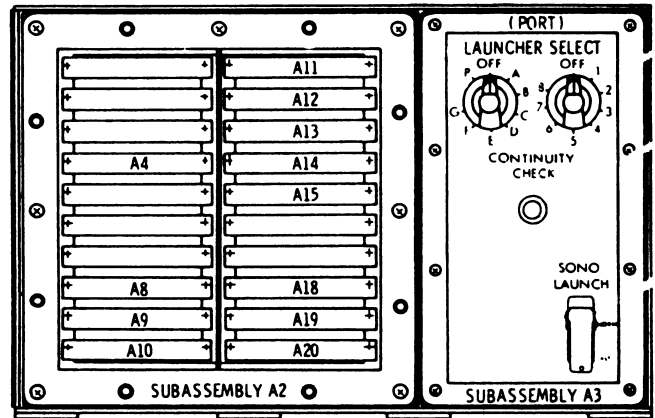
220.657

For example, the computer may cue the operator to turn on the bomb bay door switch and the master arm switch. The P-3C computer also uses the ordnance panel to instruct the ordnance crew member on how

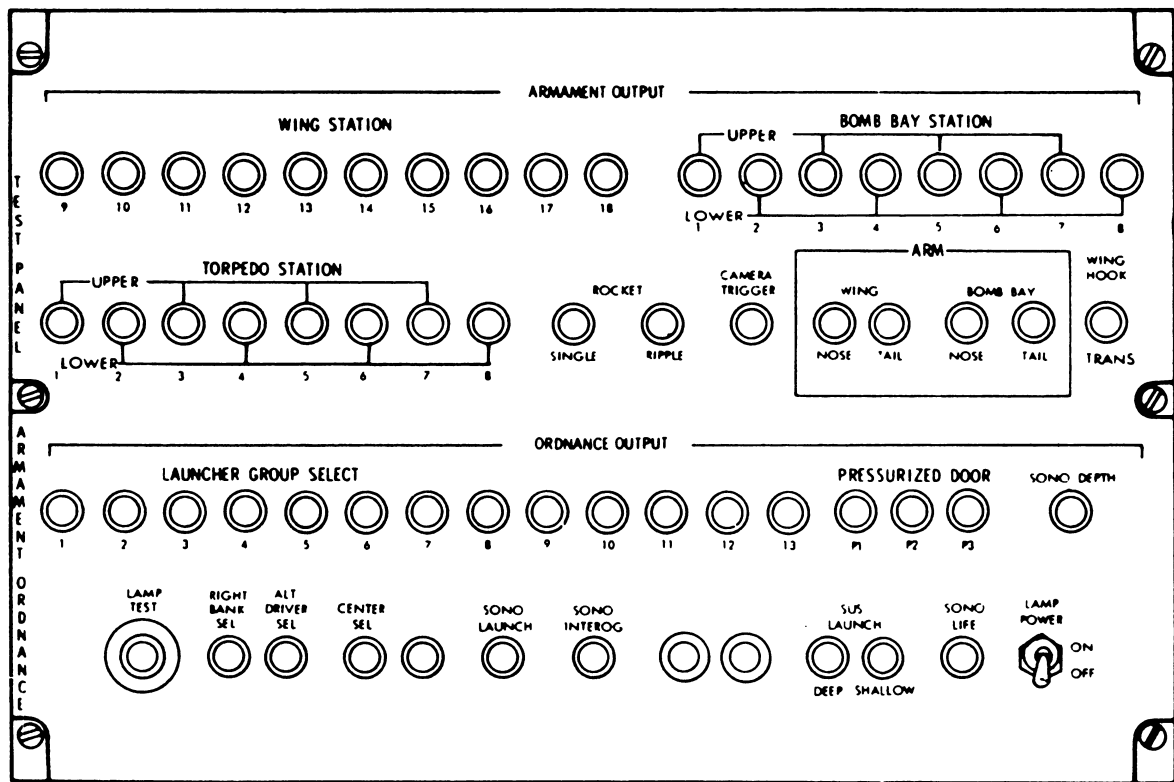
to perform certain pressurized SLT loading or unloading operations (exchange between stowage rack and SLTs). This lets the ordnance crew member make the available search store requested by the TACO.



ORDNANCE PANEL (CONTROL INDICATOR)



SEARCH STORES INTERCONNECT



ELECTRICAL (ARM/ORD) TEST PANEL

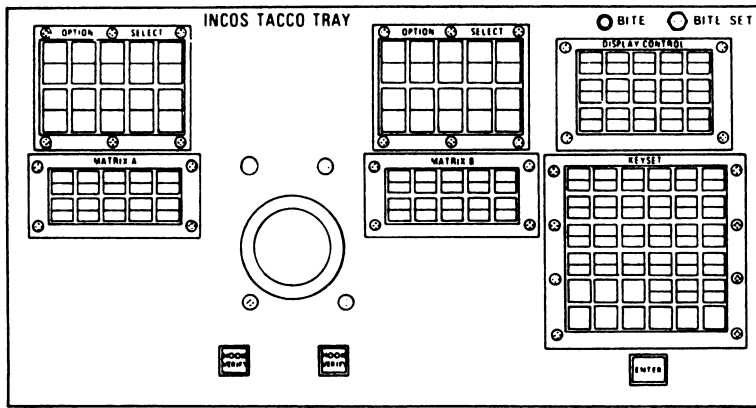
Figure 14-46.—Ordnance aircrew information panels and manual sonobuoy launch switches.

releases, and furnish system release commands in response to crew member release commands.

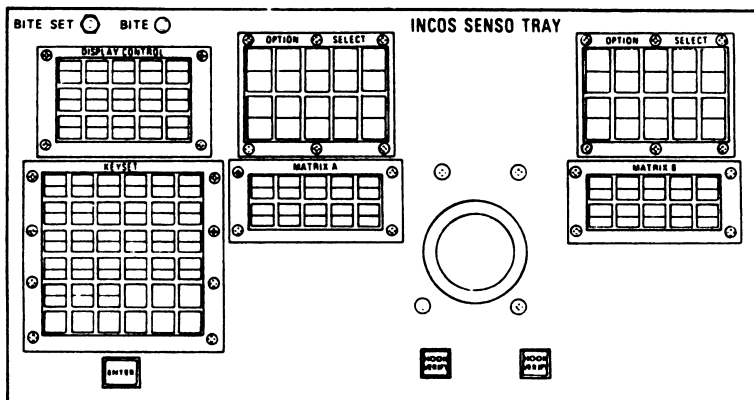
inventory, and prepare the system for the next store selection.

- Secure the system following each weapon release, check store-in-place status, update the

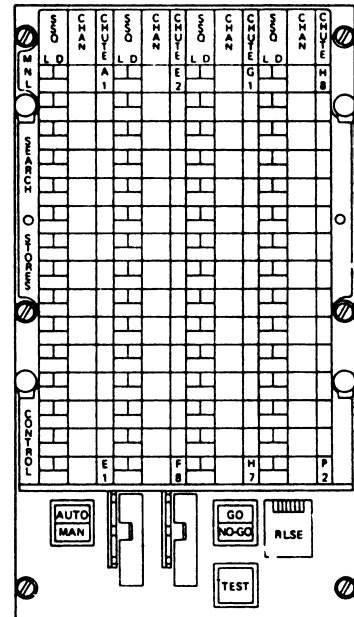
MANUAL MODE.—In the P-3C, the manual mode provides the TACO with management



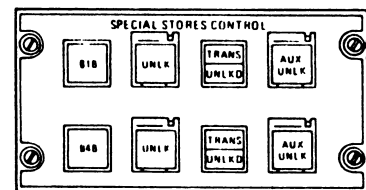
TACCO INCOS TRAY



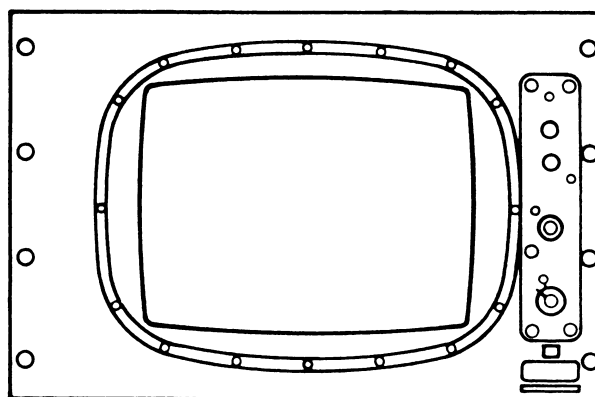
SENSO INCOS TRAY



SEARCH STORES CONTROL PANEL (TACO ONLY)



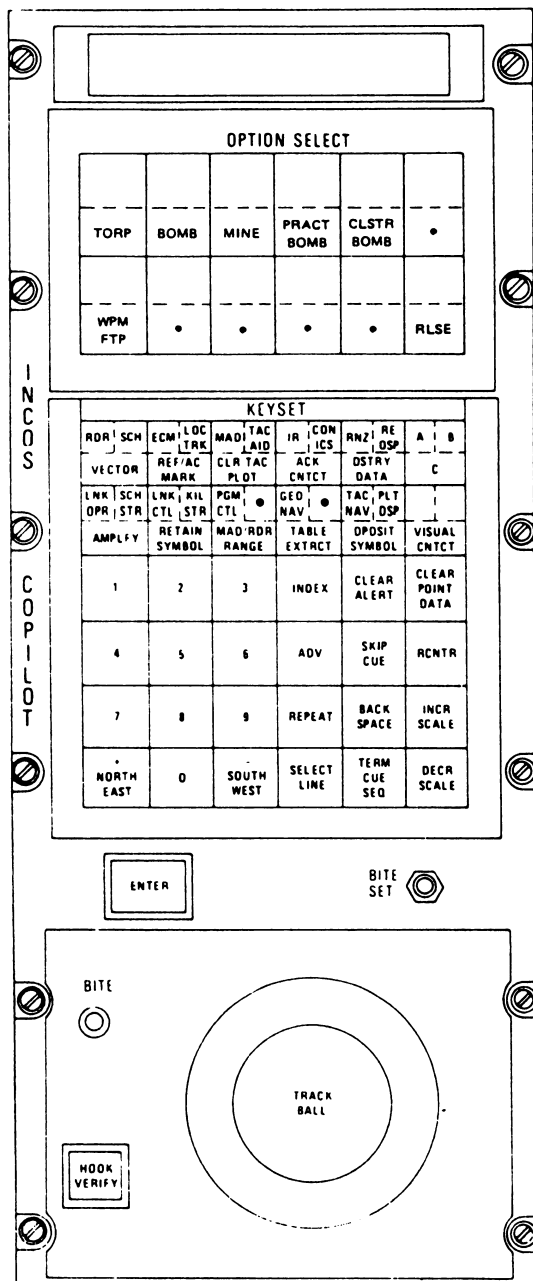
SPECIAL STORES CONTROL PANEL (TACO ONLY)



MPD

Figure 14-48.—S-3A TACO and SENSO panels, displays, and INCOS trays.

220.660



220.661

Figure 14-49.—S-3A copilot INCOS panel and tactical display (track ball); kill store options shown on option select.

control of all kill and search stores. In the S-3A, each crew member controls kill and search stores, under the joint management of the pilot and TACO.

In the manual mode, the P-3C TACO/S-3A pilot selects the bomb bay or wing station for

release and the arming and release mode of the selected weapon. These actions are executed by using the control on the weapons control panel. If required, the pilot is cued to turn on the master arm switch and open the bomb bay doors.

When the station, arming, and release modes have been selected, the master arm power is on, the bomb bay doors open, and the kill ready lights on the ACP and TACO manual weapons control panel illuminate (P-3C). If the selected station is loaded, the station select keys on the ACP light amber (S-3A). Then, the store may be released by the pilot, copilot, or TACO (also SENSO in the S-3A) by using their release switches.

The P-3C search store release and control in the manual mode is completed by the ordnance crew member using the controls on the search stores interconnection box. The desired SLT is selected using the letter and number switches. This cues the pilot to turn on the search power switch. When the SLT has been selected and search power is on, a launch is made by actuating the sono launch switch on the search stores interconnection box.

Special weapon release requires additional operations by the pilot. The pilot selects the station for release and positions the drop/hold switch to drop. The TACO must unlock the selected station rack lock in sequence. Release of special weapons is then completed in the same manner as conventional weapons.

Jettison

Store jettison of both aircraft is somewhat similar in operation and control. Manual actuation of the jettison or the external jettison switch by the pilot disables the arming circuit and initiates jettison.

In the P-3C, the jettison programmer is energized and sends sequential release and bomb bay door open/close signals. Wing stations are released in pairs (one from each wing) from outboard stations to inboard stations at 2-second intervals. At this same time, the bomb bay doors are opening. Then, the lower stations are released, the upper stations are released, and the doors close.

A separate switch on the pilot's console starts the jettison function for wing stations only. Selective jettison from any station is done through normal manual release with the arming select (TACO weapons panel) set on safe.

In the S-3A, the wings and SLTs receive jettison commands from the wing and search store

Table 14-1.—Preloading Checks

STORE	AIRCRAFT	SYSTEM CHECK
Bombs on parent racks	P-3, S-3	Jettison, wing and/or bomb bay release, mechanical arming.
Mines	P-3, S-3	Jettison, wing and/or bomb bay release, mechanical arming.
Torpedoes	P-3, S-3	Jettison, bomb bay release, mechanical arming, torpedo presetter.
TER	S-3	Jettison (TER and BRU-11), multiple release, mechanical arming.
Rockets or flare dispensers on parent racks	P-3, S-3	Jettison, wing release, rocket firing.
Missiles	P-3	Jettison, AGM-12B release and control.
Fuel tanks	S-3	Jettison.
Nuclear weapons	P-3, S-3	AMAC wiring and release (includes or refers to jettison and bomb bay release check).

decoders to release all wing stores and 59 SLTs. In the P-3C, the SAR chute remains loaded.

Bomb bay stores, wing stores only, and wing stores from auxiliary devices (such as TERs and flare launchers) are released by using the ACP AUX rotary switch. This is done according to the load to be jettisoned. In this situation, the mechanical arm thumb-wheel selector must be set to safe and the arm set switch depressed. Armed store releases may also be initiated in the above manner.

When the aircraft is on the ground, the jettison circuits of both aircraft are disabled by the weight-on-wheels switches. These switches are located on the right and left main landing gear (main mounts).

RELEASE AND CONTROL SYSTEM CHECKS

Release and control system checks are performed before stores are loaded, after reconfiguration of the aircraft where electrical connections are unmated and mated, after any

malfunction in the release and/or control system, and before placing the aircraft on alert status. Some of the stores and system checks performed on the P-3C and S-3A aircraft are listed in table 14-1. All the checks need not be performed by the operator prior to every loading. Only the checks that apply to the store being loaded are normally performed. Notice that the jettison system check applies to all stores listed in table 14-1.

Preparation

Before performing system checks, you must prepare the aircraft to make sure it is ready for the performance of the required checks. The aircraft loading manual outlines step-by-step preparation procedures, up to the actual performance of the particular check. Some of the steps you should do to prepare an aircraft for systems checks are as follows:

- Ensure the aircraft is parked in a designated area, secured, and electrically grounded.

- Ensure electrical power and air conditioning are available, as designated. Air conditioning must be applied to the avionics equipment to prevent damage from overheating. The electric power required is 115 Vac, 400 hertz, three phase. Additionally, the P-3C also requires 28 Vdc, usually received from the same power source as the ac.

Both aircraft have a turbine engine auxiliary power unit (APU) integral to the aircraft. The APU supplies the electrical power requirements for air conditioning and auxiliary hydraulic services required for aircraft ground maintenance and engine starting.

- Ensure the cockpit control, cockpit switches, and all armament switches, controls, and circuit breakers remain in the designated off/hold/open/closed position.

- Ensure all ejector cartridges are removed.

- Ensure all harnesses are disconnected from explosive devices, such as ejector units, auxiliary unlocks, and auxiliary releases.

- Ensure, as applicable, that the bomb bay safety pin, sonobuoy safety switch door, and other safety devices are installed/open/in place or available.

- Do not perform checks with weapons loaded on the aircraft.

Inspection

After the aircraft is prepared and the electrical power and air conditioning is applied, you can begin the inspection or checks of the system.

When the aircraft landing gear lever is in the down position, the weapon system is disabled, or safed, by a switch in the lever mechanism assembly. When the aircraft is on the ground, the jettison system is disabled by the weight-on-wheels switches on the main mounts. For ground maintenance of the weapons system, the safing switches may be bypassed or safety disabled.

In the P-3C, the landing gear lever switch is bypassed by momentary actuation of an armament safety circuit disable switch on the

armament circuit breaker panel (kill stores) or a search power safety disable switch on electronics rack G2 search store. The weight-on-wheels switches are bypassed by installing a jumper cable between terminal A5 and ground on terminal board (TB) 419.

In the S-3A, the gear lever switch is bypassed by momentary actuation of the safety disable kill or safety disable search switches on the right hinged circuit breaker panel. The weight-on-wheels switches are bypassed by a safety disable SAR and jettison switch on the same circuit breaker panel mentioned above.

Before disabling the gear lever switch safety circuit, the master arm or search power switch, or both, must be turned on. Holding power for the disabling relays is supplied through the energized contacts of these switches. When either switch is turned off, the disabling relay for that system opens and the system returns to the safe condition.

For jettison checks, the jumper wire holds the circuit closed on the P-3C. The disabling switch on the S-3A must be held in the disable position. Safety disabling is accomplished as directed in the step-by-step procedures for the particular check. Some items of the check criteria, as designated by the loading manuals, are discussed below.

The arming solenoid armed and unarmed retention force check must be performed before loading mines and after any suspected failure of the arming system. Procedures for the retention force check are included in applicable MIMs.

If any malfunction occurs during a check, you should report it to the maintenance supervisor immediately. Don't proceed to any other check. After the malfunction is corrected, the check must be repeated.

The aircraft monitor and control (AMAC) wiring and release checks must be performed within 24 hours of or after the last flight prior to weapons loading, whichever occurs last. You do **not** have to perform the AMAC check for a logistic movement if the weapon is not electrically mated to the aircraft system. However, the release check **must** be performed.

Any visual or test equipment indications, other than those specified in the check tables, are considered to be malfunctions.

As the required system checks are being performed, you should visually inspect aircraft components such as racks, pylons, mechanical, and electrical connections to prevent possible malfunctions. This is a preventive action rather than a corrective maintenance action.

Postcheck

After preparation and inspection of the release and control system, postcheck procedures are performed according to instructions in the loading manual. A postcheck consists of returning the aircraft and armament controls to the safe or normal condition. Electrical power and air conditioning are removed from the aircraft, unless they are required by other maintenance personnel to perform their tasks. If an AMAC wiring check was performed, sealing wires are installed on the AMAC panel off/safe/arm switch and the ACP drop/hold switch. The seal wire is for one-time use only. It is a breakable, single strand copper wire with a lead slug on one end that can be crushed. The wire is routed through small holes in the armament panels and back through the lead slug. The wire is pulled taut and the lead slug crushed to hold the wire. When the seal is properly installed, the switches cannot be moved to the arm or drop position without breaking the wire, which indicates the switches were used.

Completion of all the steps in the postcheck procedure phases the aircraft into the preparation-for-loading sequence. This means you can load the aircraft.

WEAPONS SYSTEM MAINTENANCE

Aircraft weapons system maintenance is divided and subdivided into categories—preventive (planned or scheduled) and corrective (unscheduled) maintenance.

Preventive Maintenance

Preventive maintenance is the care and servicing needed to maintain equipment and facilities in satisfactory operating condition. This is done by systematically inspecting, detecting, and correcting incipient failures, either before they occur or before they develop into major

defects. Systematically inspecting, detecting, and correcting beginning failures in a weapons system are major parts of your job. Some preventive maintenance is done during preflight by the flight crew using computer system readiness tests. During these tests, the computer evaluates the weapons system (and other systems) for flight readiness and indicates faulty areas.

Corrective Maintenance

Corrective maintenance is the actions performed, as a result of failure, to restore an item to a specified condition. Unforeseen failures can occur in any part of the weapons system. Experience, on-the-job training, and education eases some of these problems and/or reduces system downtime to a minimum.

Corrective maintenance of the P-3C and S-3A weapons systems includes automatic and manual system tests, fault isolation, and component removal and installation. The aircraft systems are designed so that computer functions may be used in some testing (troubleshooting) for fault isolation.

Normally, troubleshooting for system faults starts with the simplest tests (manual) and proceeds, if necessary, to complex procedures (automatic on-line). When you are performing fault isolation testing, whether simple or complex, use the MIM.

The weapons system for the P-3C and S-3A aircraft is divided into two subsystems.

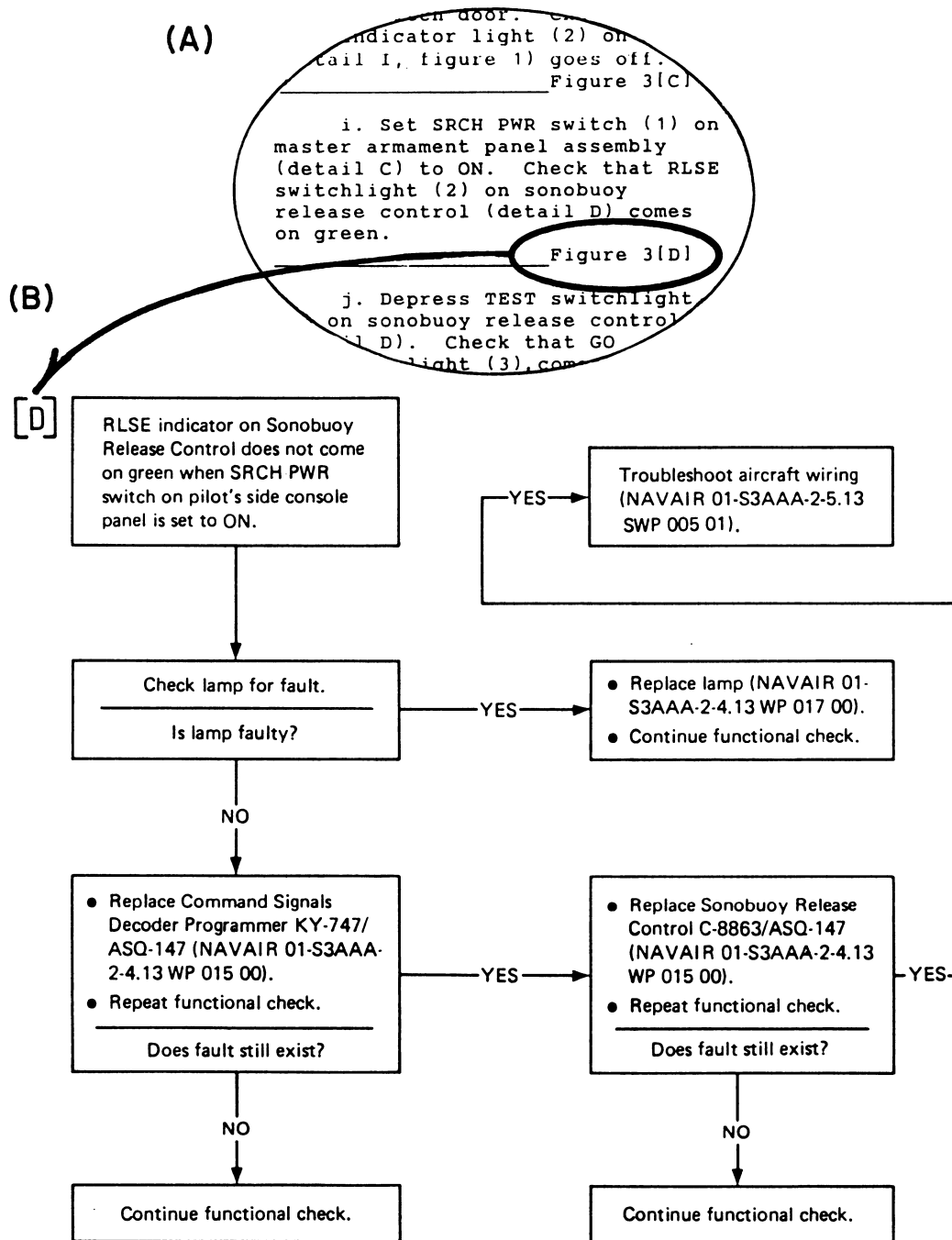
1. The armament system—kill stores in the P-3C and armament control subsystem (ARM-COS) in the S-3A.
2. The ordnance system—search stores in the P-3C and search store control group (SESCOS) in the S-3A.

Troubleshooting procedures for the particular system are indexed in the MIMs.

MANUAL TESTS.—Manual test procedures are used to isolate a malfunction to a portion of the system external to the computer. By using the procedures outlined in the MIM, a manual release is attempted. If the malfunction exists in the manual mode, the MIM lists probable causes for

the particular fault and corrective actions. Figure 14-50 shows a portion of the S-3A MIM search stores fault isolation and corrective actions. The S-3A MIM is arranged with the functional checkout procedures listed in columns

on separate pages. If the required indication (a green light in this example) does not occur (fig. 14-50, view A), the AO is referred to a particular part of the foldout troubleshooting diagram (fig. 14-50, view B) for corrective actions.



220.667

Figure 14-50.—S-3A search stores control group testing and troubleshooting. (A) portion of functional checkout; (B) portion of troubleshooting diagram.

FAULT SYMPTOM	PROBABLE CAUSE	ISOLATION PROCEDURE	CORRECTIVE ACTION
9. Single station rack releases prior to KILL READY condition (may be any station)	Shorted station release relay	Substitute subassembly 5A1 for port wing stations. Substitute subassembly 5A2 for starboard wing stations	Replace defective subassembly
10. No rocket/flare single release. Rack release normal	1. Defective rocket select single relay	Substitute subassembly 5A1 in aft armament interconnection box for stations 9 and 10. Substitute subassembly 5A2 in aft armament interconnection box for stations 17 and 18	Replace defective subassembly
	2. Defective switch on TACO manual weapons control panel	Substitute TACO manual weapons control panel	Replace defective TACO manual weapons control panel
	3. Defective bomb rack	Substitute bomb rack	Replace defective bomb rack
11. No rocket ripple re-	1. Defective rocket select	Substitute subassembly 5A1 in aft armament	Replace defective subassembly

220.668

Figure 14-51.—P-3C wing station fault isolation and corrective action example.

Figure 14-51 shows a portion of the P-3C MIM wing station fault isolation and corrective actions, which are all on the same page.

AUTOMATIC OFF-LINE TESTS.—Automatic off-line test procedures check the logic circuits and the release system without the computer, using logic unit 2 (P-3C) or the right and left control logic units (S-3A) to simulate the computer.

AUTOMATIC ON-LINE TESTS.—Automatic on-line tests are done by using a test program computer tape to provide a gross evaluation of the computerized avionics systems. A special diagnostic test program (part of the tape) provides a critical evaluation of the weapons release system from the computer to the release units. As the test progresses, the computer cues, or displays on the MPD, a digital readout indicating the defective

components. If more than one component is at fault, the computer cues the probable defective components in a priority sequence or one probable defective component of the highest priority. Replacement or substitution of the defective component(s) and rerun of the test program will verify the system or further isolate faults.

SAFETY PRECAUTIONS

Learning Objective: Recognize safety precautions to follow when handling aircraft weapons systems.

The safety precautions you should follow when dealing with aircraft, systems, and their maintenance are outlined in various publications. The repetition of safety precautions in the

manuals makes sure they are widely distributed and read. A few of the safety precautions applicable to the aircraft discussed in this chapter are listed below.

- Do not open or close the bomb bay doors when personnel or equipment are in the vicinity of the bomb bay. Also, do not enter the bomb bay until the door safety pin is installed.

- Beware of APU noise. It can cause permanent ear damage to the unprotected ear. Wear ear protection devices when working in the vicinity of an operating APU.

- Provide adequate interphone communications between personnel inside and outside the aircraft to ensure safety between personnel and to compensate for the size of the aircraft.

- Before you apply external power to the aircraft, make sure that personnel are not performing maintenance on electrical or electronic systems.

- Make sure that personnel working with or near high voltage are familiar with modern methods of resuscitation.

- Observe the aircraft external danger areas shown in the particular loading manual.

- Be extremely careful near breakaway suspension bands. They can release with enough force to cause serious injury.

REVIEW NUMBER 5

Q1. What is the primary mode of operations in the P-3C release system?

Q2. Describe the purpose of the P-3C manual mode of operation.

Q3. What electrical power is required to operate the air-conditioning unit of a P-3C aircraft?

Q4. A MOAT is performed on an aircraft within what maximum time before a weapons loading evolution?

Q5. What type of maintenance is used to keep equipment in satisfactory operating condition?

Q6. What type of maintenance is performed as a result of a failure or to restore an item to a specified condition?

Q7. What is the function of the automatic off-line tests on P-3C aircraft?

REVIEW NUMBER 5 ANSWERS

- A1. The automatic (on-line) mode is the primary mode of operations in the P-3C release system.
- A2. The purpose of the P-3C manual mode of operation is to provide the TACO with management control of all kill and search stores.
- A3. The air-conditioning unit of the P-3C aircraft requires 115-Vac, 400-hertz, three-phase electrical power to operate.
- A4. A MOAT is performed on an aircraft within a maximum of 24 hours or after the last flight before weapons loading, whichever occurs last before a weapons loading evolution.
- A5. Preventive maintenance is used to keep equipment in satisfactory operating condition.
- A6. Corrective maintenance is performed as a result of a failure or to restore an item to a specified condition.
- A7. The automatic off-line tests on P-3C aircraft are used to check the logic circuits and release system without the computer using logic unit 2 to simulate the computer.

CHAPTER 15

AIRCRAFT WEAPONS SYSTEMS TEST EQUIPMENT

Aviation ordnancemen use test equipment in all phases of electrical testing of weapons systems. The testing procedures you use are required at specific maintenance levels, such as depot, intermediate, or organizational. Test equipment varies in complexity, from a small pocket tester to a very large and complex unit. No matter the size or complexity, the purpose of the test equipment is to make sure that the weapon and the launching platform (aircraft) function correctly when used.

TEST EQUIPMENT

Learning Objective: Identify the test equipment used with aircraft weapons systems. Recognize the purpose and use of each.

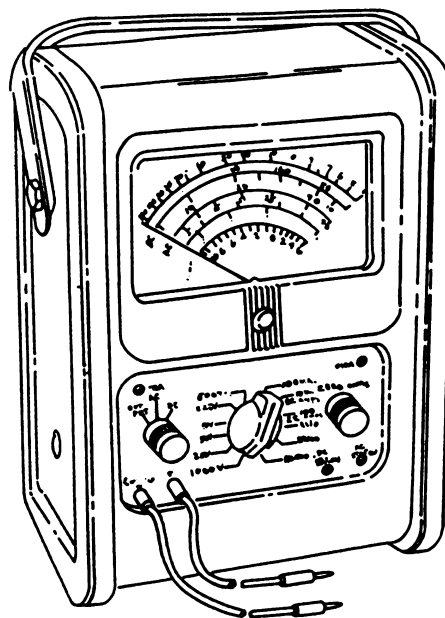
All the test equipment you will use isn't described in this chapter. Also, the step-by-step procedures required to operate the test equipment aren't listed. To do your job, you need to be able to identify the equipment, know what it is used for, and how it is used. The specific step-by-step procedures you follow when using test equipment can be found in applicable publications.

AN/PSM-4 MULTIMETER

The AN/PSM-4 multimeter (fig. 15-1) is used to measure resistance (ohms), amperage (ac or dc), and voltage (ac or dc) in an electrical circuit. You use it to test aircraft circuits when no special test equipment is available, or when reasonably accurate measurements are required. Although other types of multimeters are available, the AN/PSM-4 is the Navy's standard-issue multimeter.

AN/AWM-54 AIRCRAFT FIRING CIRCUIT TEST SET

The AN/AWM-54 aircraft firing circuit test set (fig. 15-2) is a portable, battery-operated, flight



220.665

Figure 15-1.—AN/PSM-4 multimeter.

line test set used at duty stations ashore or afloat. You use this test set to check for stray voltages and various aircraft firing circuits, such as rocket firing, bomb release, missile firing, and JATO.

The complete AN/AWM-54 test set includes the following components:

- TS-3021/AWM-54 test set
- Transit case
- Spare battery pack
- Spare extension cable
- Adapter retainer assembly
- Technical manual

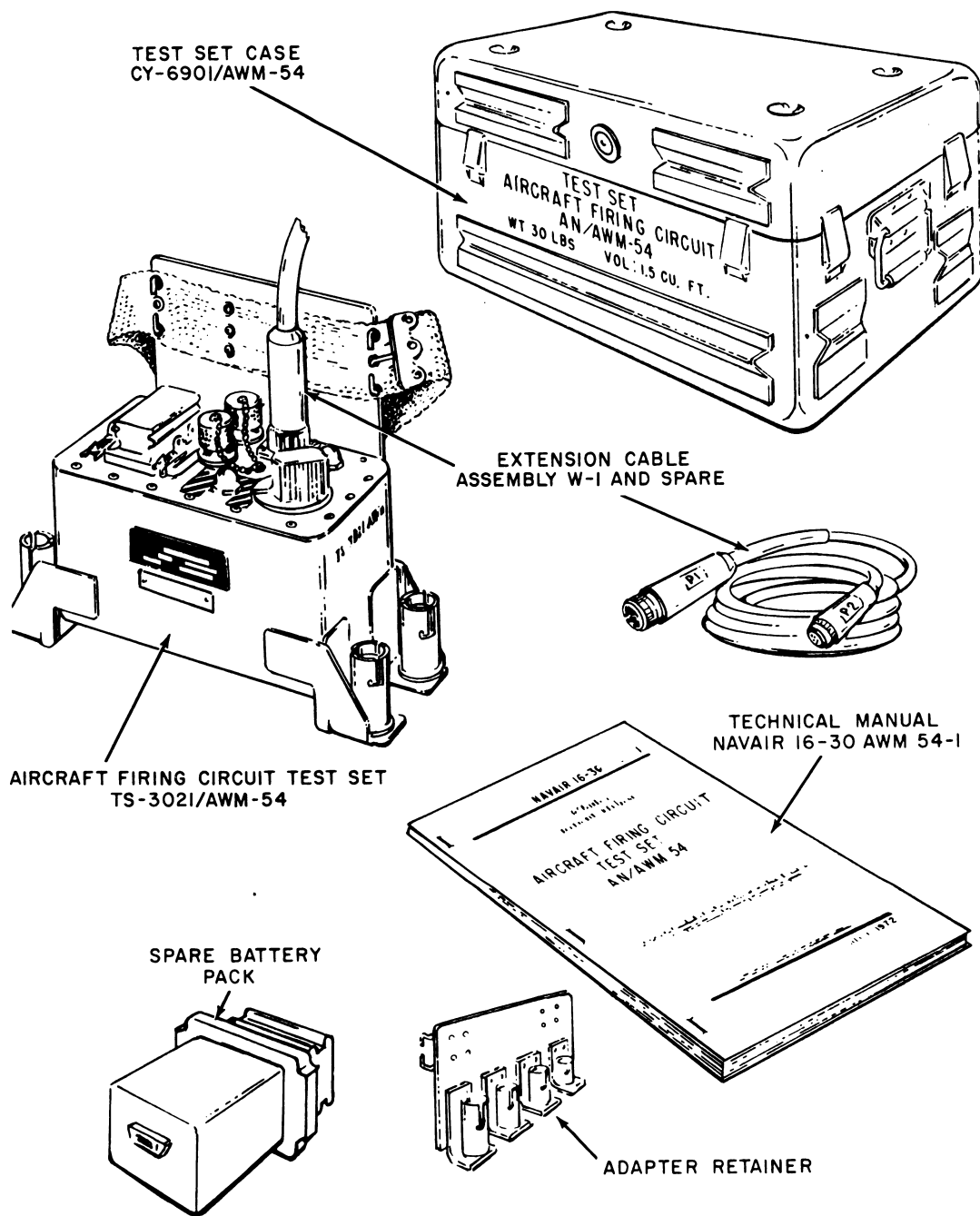


Figure 15-2.—AN/AWM-54 aircraft firing circuit test set.

220.510

A battery charger (not shown) is also available, but you need to order it separately. The TS-3021/AWM-54 test set weighs about 7.5 pounds. It has a strap you can place around your waist for carrying the set.

Several accessory adapter assemblies are available for the test set. These adapters

allow you to connect the test set to various armament configurations found on different aircraft. Some aircraft require only one or two adapter assemblies while others require five or six. These adapters are not furnished with the test set; they must be ordered separately.

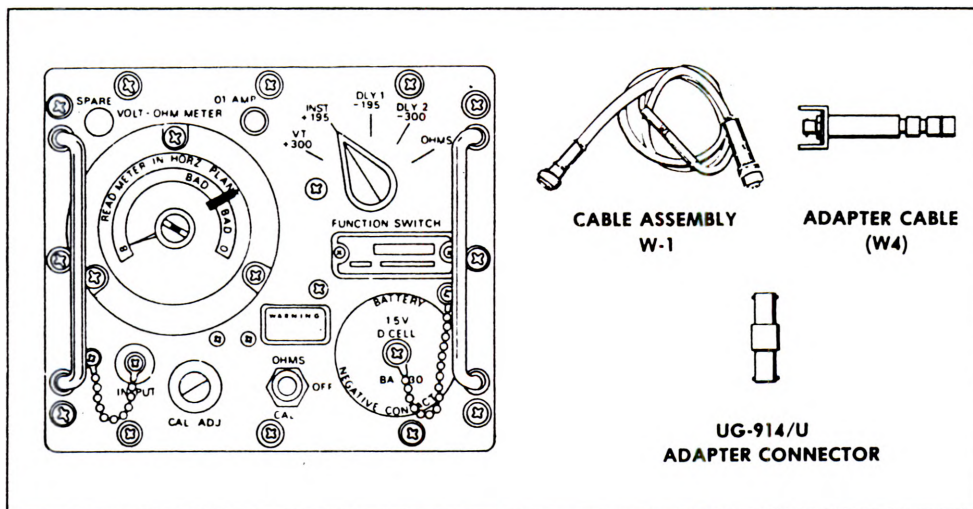


Figure 15-3.—AN/AWM-42A fuze function control test set.

220.973

AN/AWM-42A FUZE FUNCTION CONTROL TEST SET

The AN/AWM-42A fuze function control test set (fig. 15-3) is used to check the dc fuzing capabilities of fuze function control circuits. You use it to check for continuity and resistance in the electric fuzing. The test set has its own power

source. The AN/AWM-42A fuze function control test set is used on all Navy aircraft having electric fuzing capabilities.

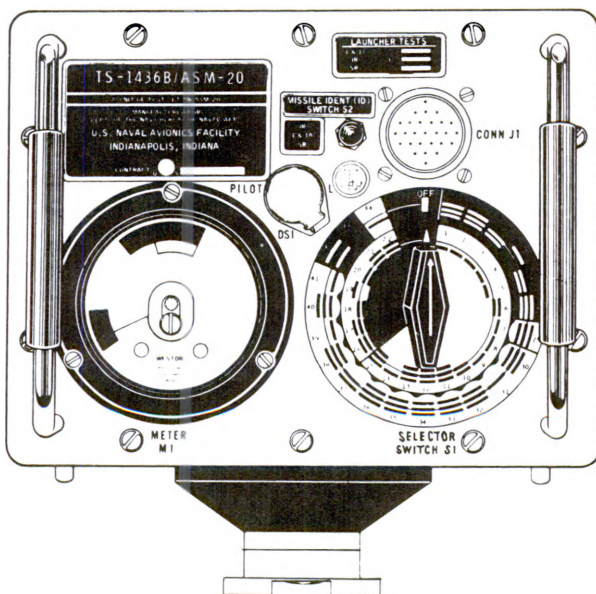
AN/ASM-20B GUIDED MISSILE LAUNCHER TEST SET

The AN/ASM-20B guided missile launcher test set (fig. 15-4) gives three GO/NO GO indications:

1. that power supplied by the LAU-7A launcher to the AIM-9 missiles is within voltage tolerance,
2. that the launcher firing sequence is correct, and
3. that the firing circuits are safe.

A gas pressure tester (MX-3298/ASM-20) is included to test the nitrogen gas system of LAU-7A launchers. The tester also simulates missile tone signals to the launcher and the aircraft tone circuits. You can use the test set to perform stray voltage checks on the missile arming and motor firing circuits.

An igniter contact block, mounted on the bottom of the tester case, supports the tester on the launcher rail in the forward detent. The striker points provide electrical connections between the test set and the fuze and motor igniter circuits in the aircraft and in the launcher. The test set is made up of a tester, a stowage/shipping case, cables/adapters common to all aircraft, and a pressure gauge.



220.626

Figure 15-4.—AN/ASM-20B guided missile launcher test set.

The test set controls and indicators consist of a selector switch S1, missile identification switch S2, meter M1, and pilot light DS1. The selector switch S1 is a two-section (upper and lower knobs) switch having 48 test positions. The OFF position is an off and a transfer position. When the upper knob is in any position other than OFF, only the upper knob switch positions 1 through 28 are connected. To use the lower knob, you must set the upper knob in the OFF position. The selector switch positions are color-coded to match the color on the meter.

The meter determines GO/NO GO by comparing the colored area under the pointer to the colored area of the selector switch. The meter is connected to the circuits in all selector positions except OFF.

The three-position missile identification (ID) switch is used to energize identification relays in the missile launcher system.

The pilot light is energized in all positions except OFF, 23, and 42. The AN/ASM-20B guided missile launcher test set is used on all Navy aircraft having Sidewinder (series) launching capabilities.

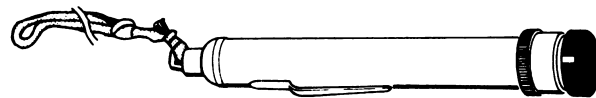
TTU-304/E GUIDED MISSILE TESTER

The TTU-304/E guided missile tester set (fig. 15-5) is used during prior-to-launch procedures for checking the tone operability of the guidance control group of the Sidewinder missile. The TTU-304/E guided missile tester is used on all Navy aircraft that have Sidewinder missile capabilities.

AN/ASM-149C GUIDED MISSILE LAUNCHER AND AIRCRAFT ELECTRICAL CIRCUIT TEST SET

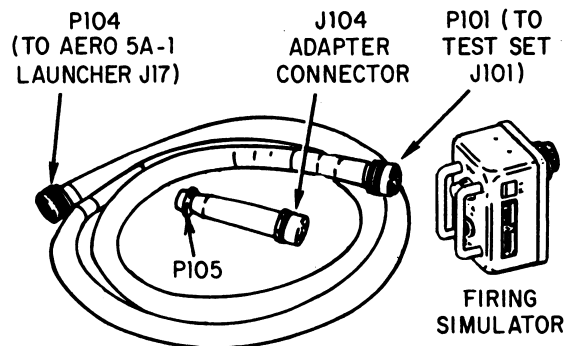
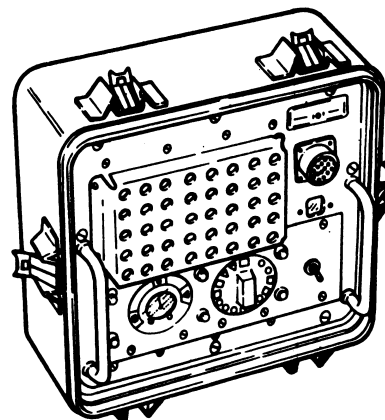
The AN/ASM-149C guided missile launcher and aircraft electrical circuit test set (fig. 15-6) is used to determine the operational capability and safety of an aircraft and the missile launcher circuits used with the AGM-45 Shrike missile. The test set is used with aircraft that have a Shrike missile system.

When you connect the ASM-149C test set to the Aero 5 missile launcher, the aircraft wiring



220.616

Figure 15-5.—TTU-304/E guided missile test set.



220.629

Figure 15-6.—AN/ASM-149C guided missile launcher and aircraft electrical/circuit test set.

is checked through the launcher to complete release and control checks. You can use an adapter plug with the cable to check the aircraft wiring. A check through the ejector rack is conducted **only** when the system malfunctions. You need to isolate the malfunctions either to the aircraft or the Aero 5 launcher.

The test function switch numbers are shape coded (square, circle, or triangle) to match

the indications that should appear on the quality indicator meter. During some steps of the check, the tester (simulating the missile) sends aural (sound) signals to the aircraft audio circuit. It also sends other types of signals to aircraft visual indicators such as lights and scopes. After a station has been checked, a firing simulator may be used with the AN/ASM-149C test set to check the firing circuit for simulation of launching Shrike missiles in pairs. This check makes sure the firing sequence is correct and within time tolerance.

AN/ALM-70A COUNTERMEASURE DISPENSER TEST SET

The AN/ALM-70A countermeasure dispenser test set (fig. 15-7) is used to check the AN/ALE-39 decoy dispensing system and the AN/ALE-37A dispenser. You connect the test set to the system being checked by test set cables or test set adapters. The test set uses aircraft power for its operation. The AN/ALM-70A test set is used on the A-6, F/A-18, and F-14 aircraft.

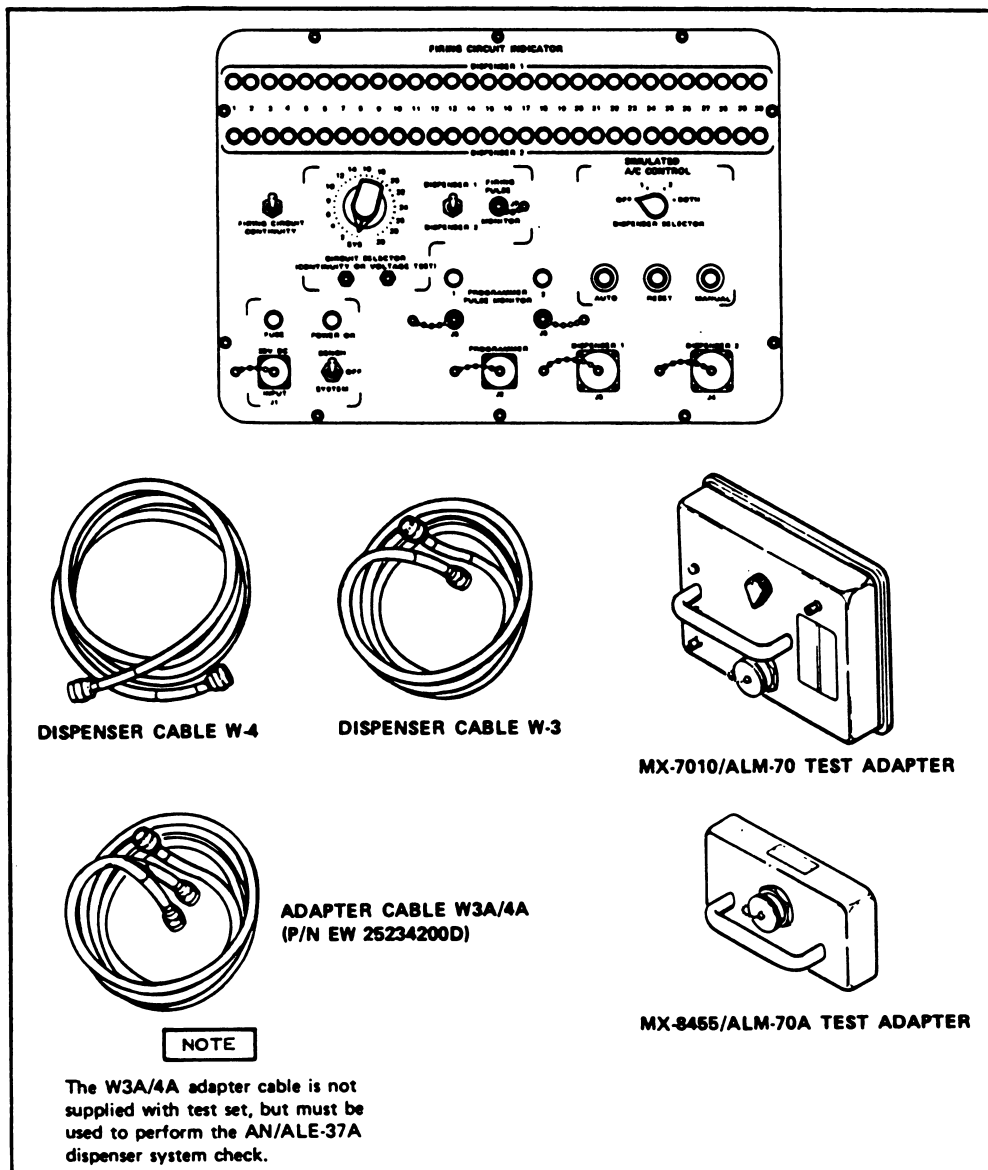
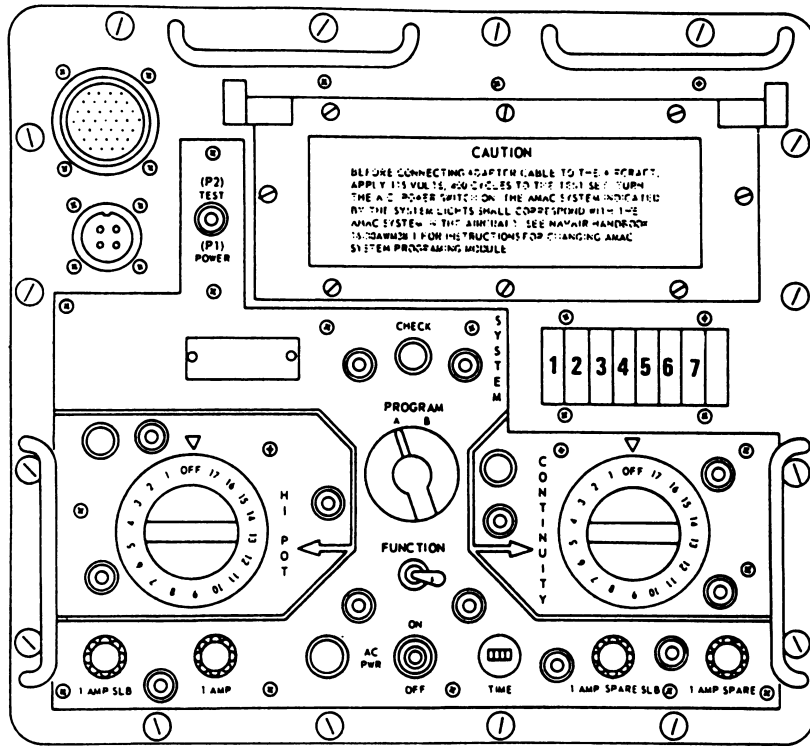


Figure 15-7.—AN/ALM-70A countermeasure dispenser test set.



220.666

Figure 15-8.—AN/AWM-38 armament wiring test set.

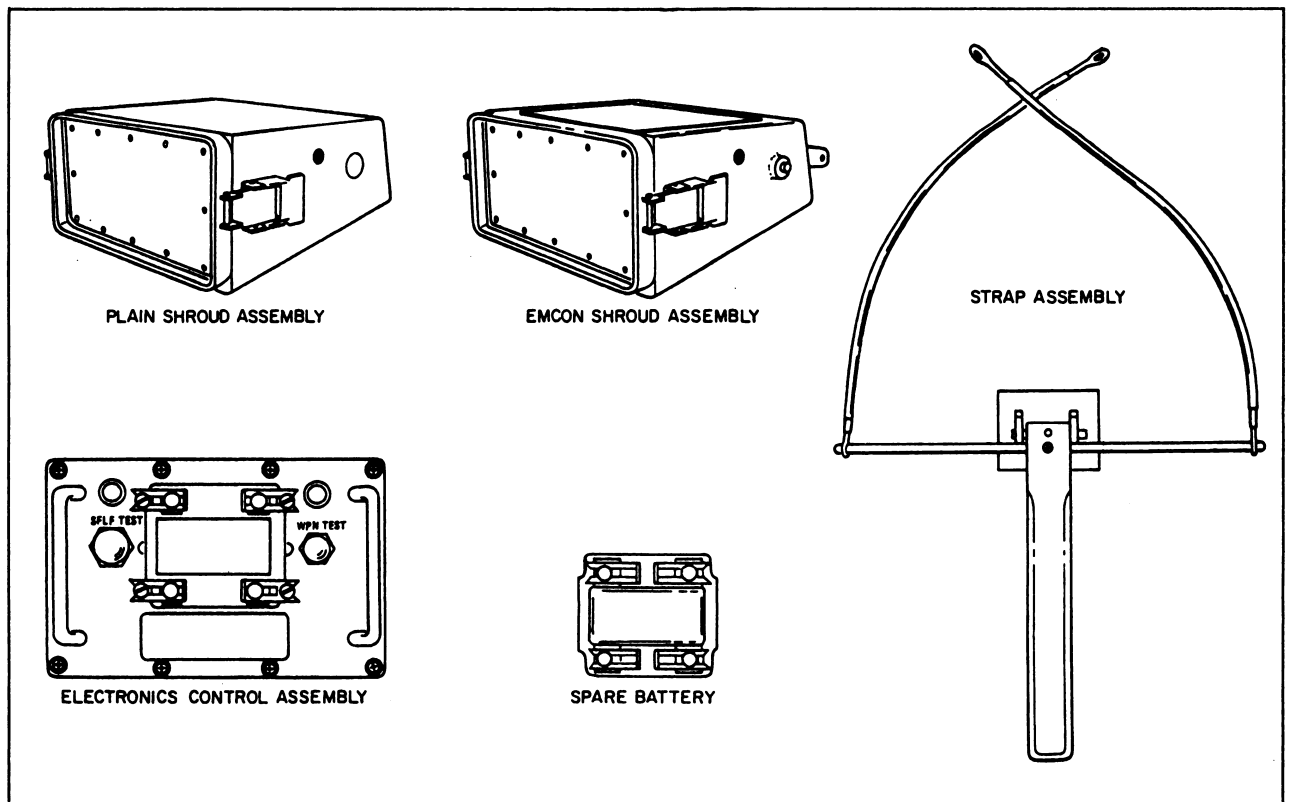
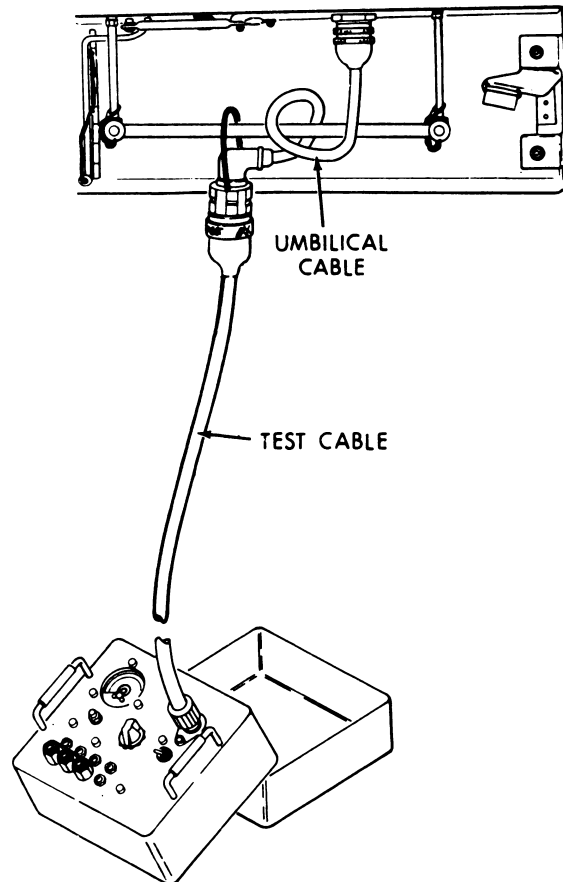


Figure 15-9.—AN/DSM-139 guided weapon test set.

AN/AWM-38 ARMAMENT WIRING TEST SET

The AN/AWM-38 armament wiring test set (fig. 15-8) is used to check the wiring of an aircraft's AMAC circuits for isolation resistance and circuit continuity. The test set has two cables—a CA-1 power cable and a CA-2 extension cable. Additional accessory cable adapters are required to adapt the CA-2 extension cable to a particular aircraft's AMAC system. These accessory cable adapters are ordered through normal supply channels.

The AN/AWM-38 test set performs two test functions—the HI-POT and CONTINUITY checks. The HI-POT function checks the AMAC circuits for wiring insulation defects by applying 615 Vdc to selected circuits. In the CONTINUITY check, the 28-Vdc power supply in the AMAC system is activated, and a wiring continuity indication on the tester lamp is made. The AN/AWM-38 armament wiring test set is used on all aircraft that have the AMAC control system.

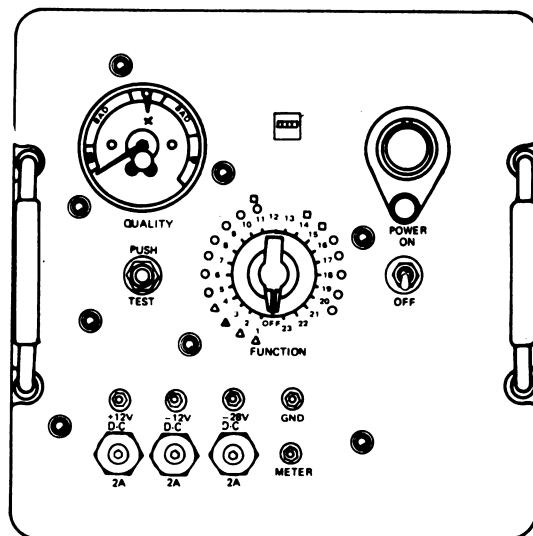


AN/DSM-139 GUIDED WEAPON TEST SET

The AN/DSM-139 guided weapon test set (fig. 15-9) is used to check the operation of the data link antenna on the Mk 21, Mk 23, and Mk 27 Walleye extended-range, data link weapons. The test set has its own power source and built-in self-test features. The test set ensures the weapon antenna transmits at high power within a prescribed frequency after the weapon has been loaded on the aircraft. The AN/DSM-139 test set is used with the F/A-18 aircraft.

AN/ASM-184B(V)-1 AIRCRAFT WEAPON CONTROL TEST SET

The AN/ASM-184B(V)-1 aircraft weapon control test set (fig. 15-10) is a GO/NO GO test set designed to check the aircraft's Walleye weapon system at the pylon umbilical connection. The test set is used to check signals from the aircraft control system to the rack umbilical connection. It lets you check fuze function system power inputs to the weapon, and it simulates signal output from the weapon to the aircraft. The AN/ASM-184B(V)-1 test set is used with the F/A-18 aircraft.



220.631

Figure 15-10.—AN/ASM-184B(V)-1 aircraft weapon control test set.

REVIEW NUMBER 1

TO ANSWER QUESTIONS 1 THROUGH 9, MATCH THE TEST SET WITH ITS DESCRIPTION.

<u>DESCRIPTION</u>	<u>TEST SET</u>
Q1. <i>The standard Navy-issue multimeter</i>	A. <i>MX-3298/ASM-20</i>
Q2. <i>Used to make stray voltage checks on Navy aircraft</i>	B. <i>TTU-304/E</i>
Q3. <i>Used to check the dc fuzing capabilities of fuze function control circuits</i>	C. <i>AN/ALM-70A countermeasures dispenser test set</i>
Q4. <i>Used to check Sidewinder missile systems</i>	D. <i>AN/AWN-38 armament wiring test set</i>
Q5. <i>Used to check the tone operability of the Sidewinder missile during prior-to-launch procedures</i>	E. <i>AN/PSN-4</i>
Q6. <i>Used to check the launcher circuits of the AGM-Shrike missile</i>	F. <i>AN/ASM-20B</i>
Q7. <i>Used to check the AN/ALE-39A and AN/ALE-37 chaff dispensers</i>	G. <i>AN/ASM-149C</i>
Q8. <i>Used to check the wiring of an aircraft's AMAC circuits for isolation resistance and circuit continuity</i>	H. <i>AN/AWM-54</i>
Q9. <i>Used to check the nitrogen gas pressure of the LAU-7A launcher</i>	I. <i>AN/AWM-42A</i>

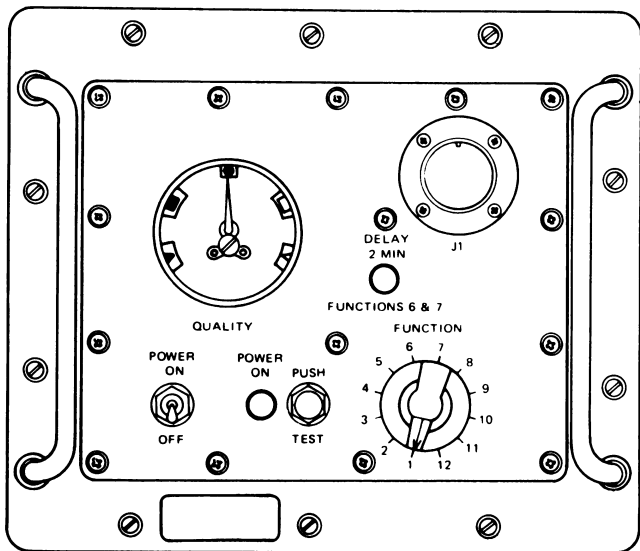
Q10. *Describe the purpose of the AN/DSM-139 guided weapon test set.*

Q11. *What test set simulates signal output from the Walleye weapon to the aircraft?*

AN/ASM-496 DATA LINK CONTROLLER TEST SET

The AN/ASM-496 data link controller test set (fig. 15-11) is a small, portable flight-line test

device that you use to perform preflight and periodic performance evaluations of the guided weapons controller. The controller initiates certain data link commands and proportional signals for the AN/AWW-7B guided weapons



220.976

Figure 15-11.—AN/ASM-496 data link controller test set.

monitor control set. The test set is used with the AN/ASM-184B(V)-1 aircraft weapon control test set to completely evaluate the aircraft interface for the AN/AWW-7B guided weapons monitor control set. Operation, output frequencies, and certain voltage levels are evaluated by the test set. The test set results are displayed on a quality meter mounted on the front panel. A total of 11 test results are resolved into a quality meter readout. The AN/ASM-496 test set is used with the F/A-18 aircraft.

AN/DSM-77B TEST SET

The AN/DSM-77B test set (fig. 15-12) is used to evaluate the operational readiness of the Walleye weapon guidance section and aircraft cockpit television display. You use the test set to check the television camera and guidance section in the weapon, the lock-on control in the aircraft, and the video display. The AN/DSM-77B test set is used with the F/A-18 aircraft.

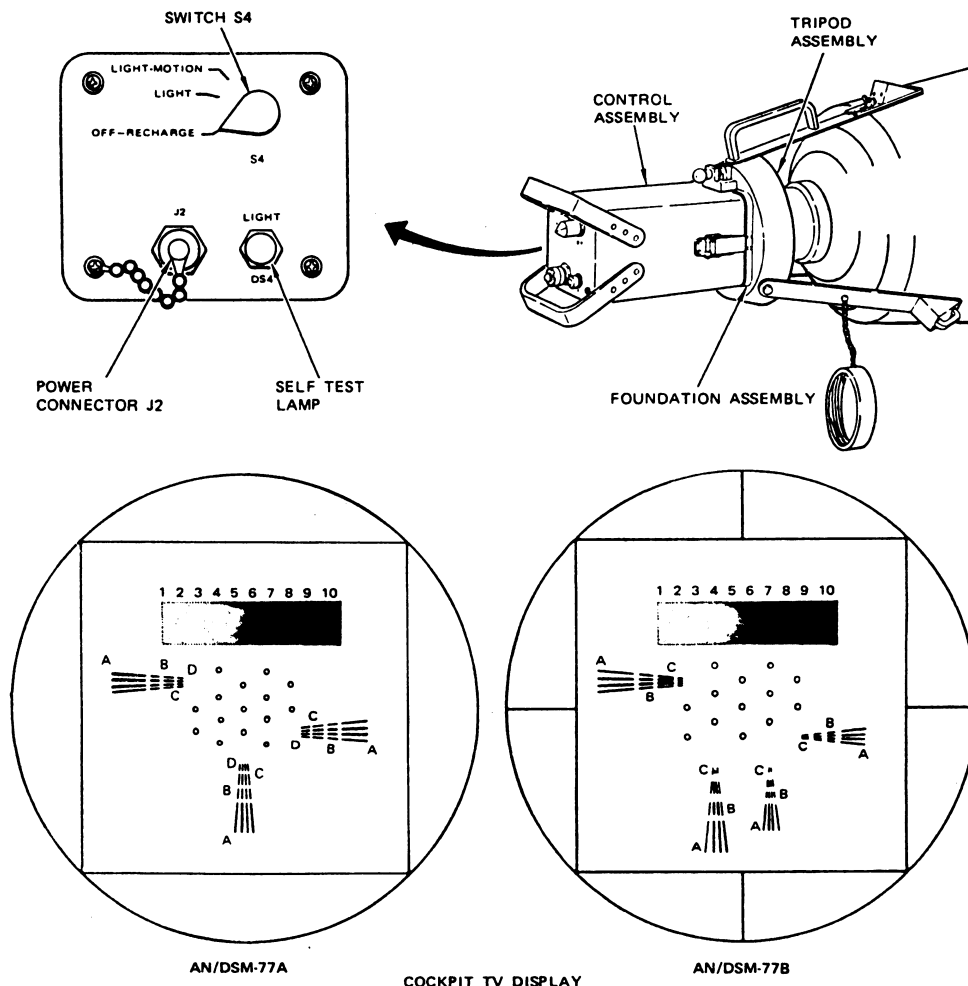


Figure 15-12.—DSM-77C series test set.

220.617

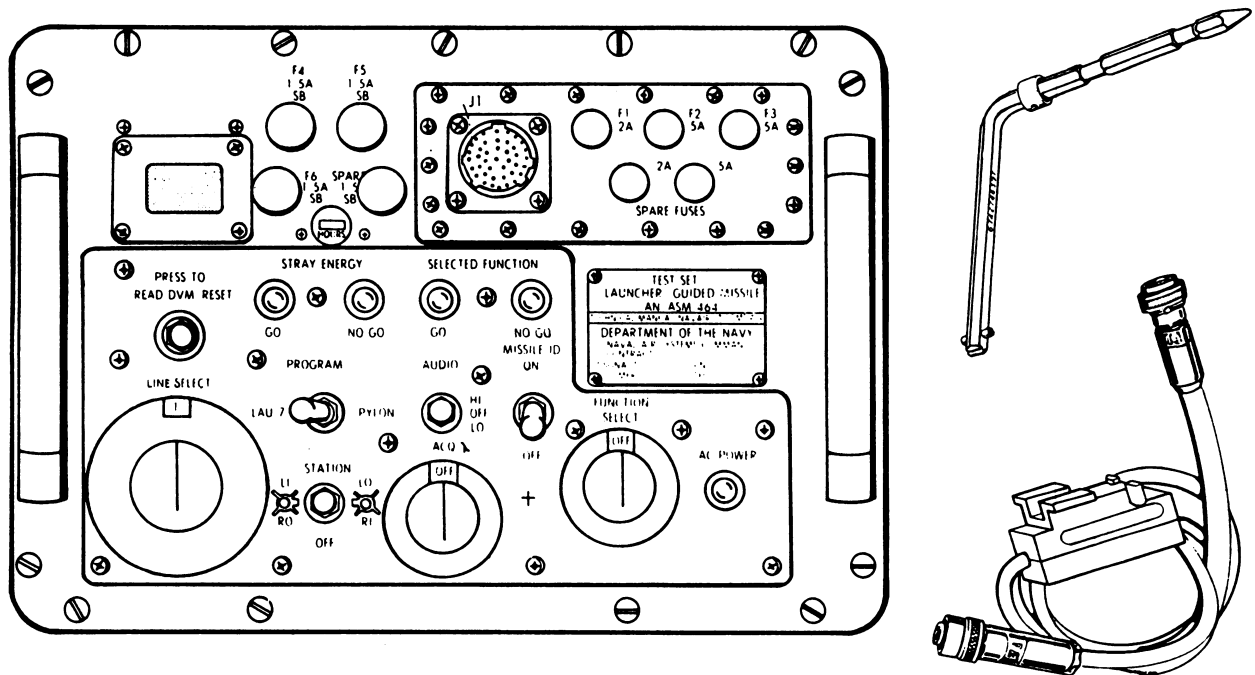
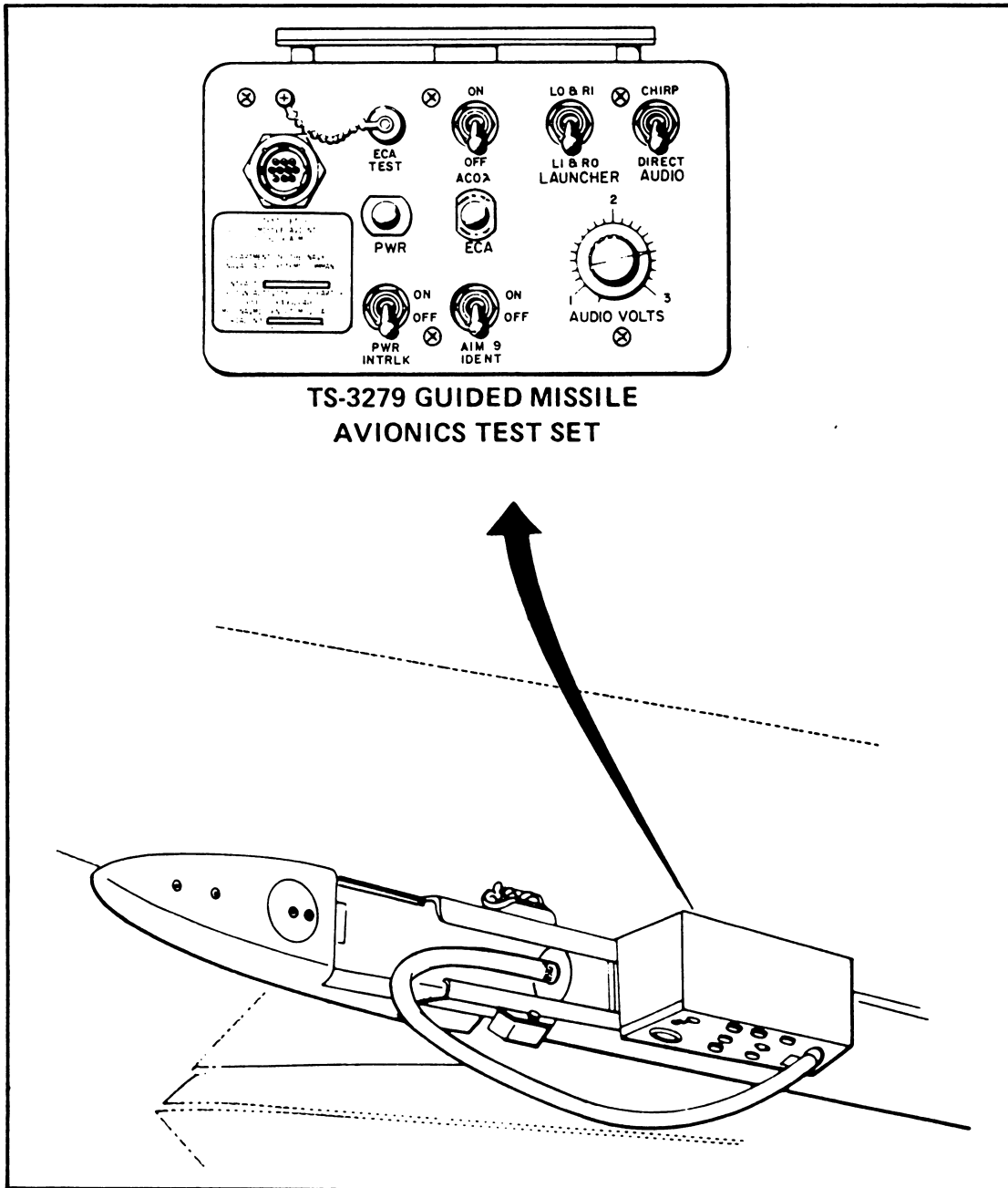


Figure 15-13.—AN/ASM-464 guided missile launcher test set.

220.977

REVIEW NUMBER 1 ANSWERS

- | | |
|--|--|
| A1. The standard Navy-issue multimeter | E. AN/PSN-4 |
| A2. Used to make stray voltage checks on Navy aircraft | H. AN/AWM-54 |
| A3. Used to check the dc fuzing capabilities of fuze function control circuits | I. AN/AWM-42A |
| A4. Used to check Sidewinder missile systems | F. AN/ASM-20B |
| A5. Used to check the tone operability of the Sidewinder missile during prior-to-launch procedures | B. TTU-304/E |
| A6. Used to check the launcher circuits of the AGM-Shrike missile | G. AN/ASM-149C |
| A7. Used to check the AN/ALE-39A and AN/ALE-37 chaff dispensers | C. AN/ALM-70A countermeasures dispenser test set |
| A8. Used to check the wiring of an aircraft's AMAC circuits for isolation resistance and circuit continuity | D. AN/AWN-38 armament wiring test set |
| A9. Used to check the nitrogen gas pressure of the LAU-7A launcher | A. MX-3298/ASM-20 |
| A10. The AN/DSM-139 guided weapon test set is used to check the operation of the data link antenna on the Mk 21, Mk 23, and Mk 27 Walleye extended range, data link weapons. | |
| A11. the AN/ASM-184B(V)-1 aircraft weapon control test set simulates signal output from the Walleye weapon to the aircraft. | |



**TS-3279 GUIDED MISSILE
AVIONICS TEST SET**

220.978

Figure 15-14.—AIM-9 SEAM system check.

**AN/ASM-464 GUIDED MISSILE
LAUNCHER TEST SET**

The AN/ASM-464 guided missile launcher test set (fig. 15-13) is a portable flight line test device that you use to perform the operational checks of AIM-9 missile launching, visual target acquisition system (VTAS) and Sidewinder expanded acquisition mode (SEAM)

circuits associated with the guided missile launcher LAU-7/A-4. The AN/ASM-464 test set is used with the F/A-18 aircraft.

**TS-3279/ASM GUIDED
MISSILE AVIONICS TEST SET**

The TS-3279/ASM guided missile avionics test set (fig. 15-14) is used to test the VTAS/SEAM

aircraft system applicable to AIM-9 missiles. The TS-3279/ASM test set is used with the F-14 aircraft.

TS-3479/AWM-23 MISSILE AUXILIARIES TEST SET

The TS-3479/AWM-23 missile auxiliaries test set (MATS) (fig. 15-15) is used to verify the operational status and functions of the AIM-54 Phoenix missile control system. The test set gives

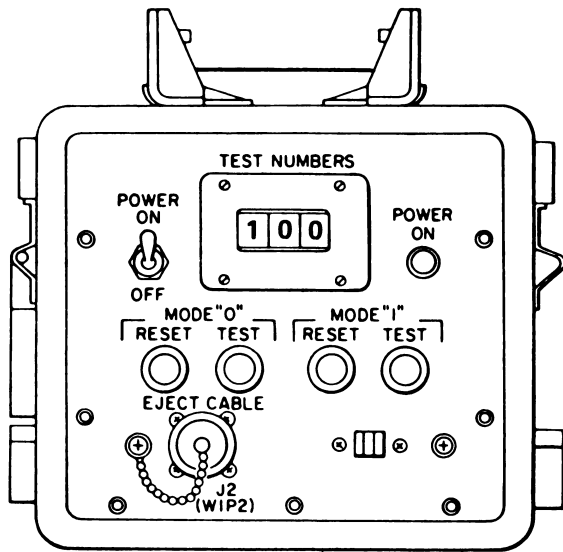


Figure 15-15.—TS-3479/AWM-23 missile auxiliaries test set.

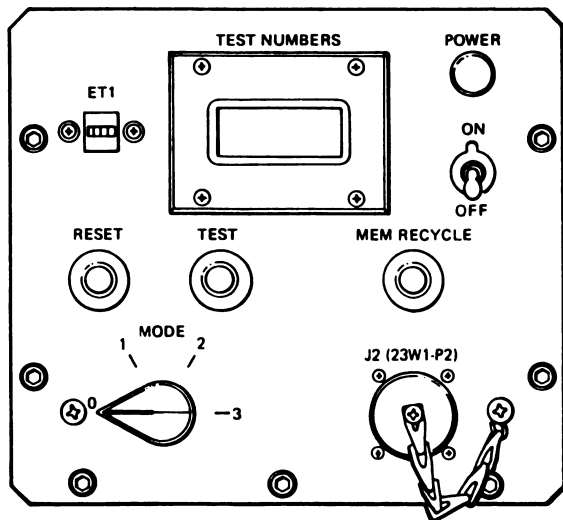
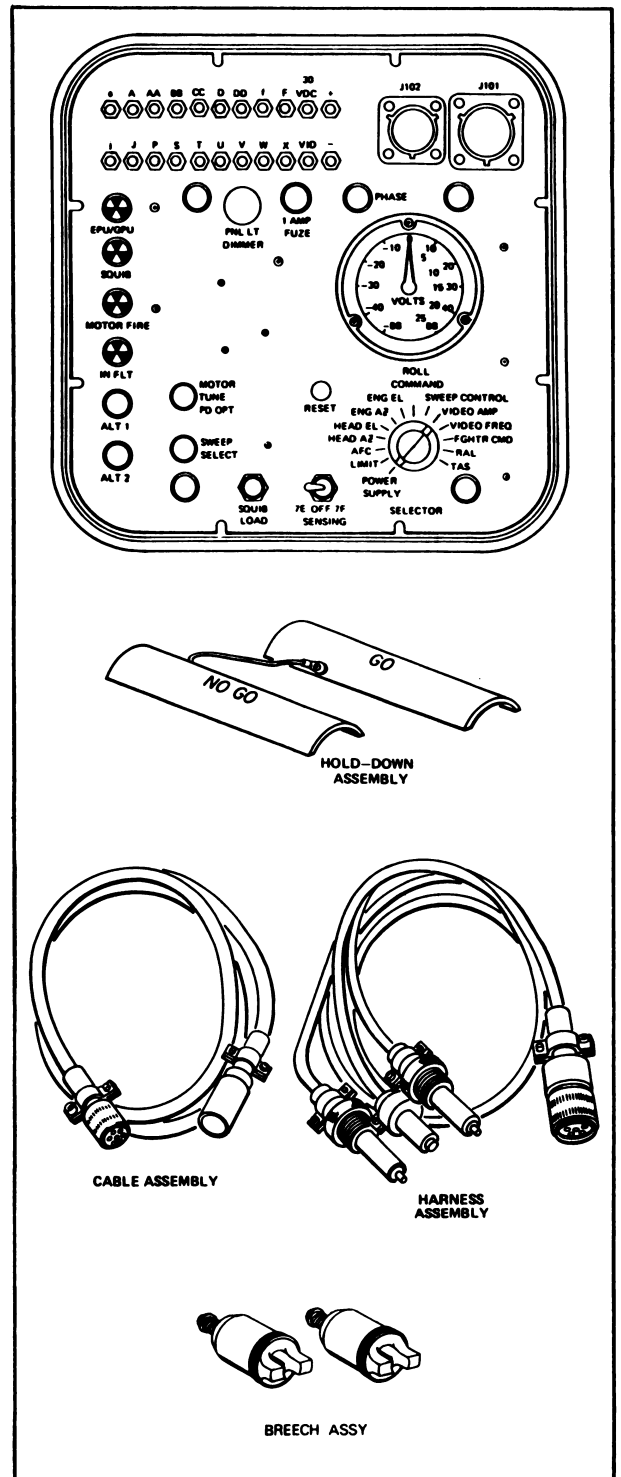


Figure 15-16.—TS-3561/AWM-23 missile interface test set.



220.981

Figure 15-17.—MSTS W104057-3 missile station test set.

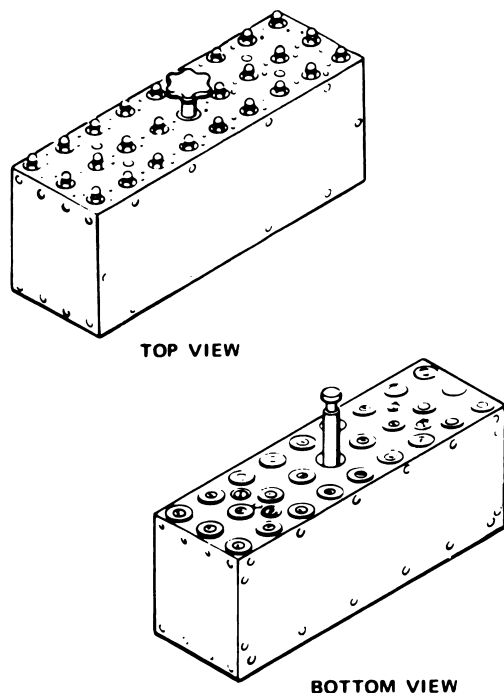


Figure 15-18.—LE-1620 photoflash cartridge ejector tester.

a GO/NO GO indication for circuit continuity and signal presence. The TS-3479/AWM-23 is used with the F-14 aircraft.

TS-3561/AWM-23 MISSILE INTERFACE TEST SET

The TS-3561/AWM-23 missile interface test set (MITS) (fig. 15-16) is used to perform the AIM-54 missile station (LAU-93) checks. The

TS-3561/AWM-23 test set is used with the F-14 aircraft.

W104057-3 MISSILE STATION TEST SET

The W104057-3 missile station test set (MSTS) (fig. 15-17) is used to verify the operational status and functions of the AIM-7 Sparrow missile control system. When connected to the aircraft, the MSTS simulates the missile and provides visual indications of received inputs. The MSTS consists of a chassis assembly, a harness assembly, and a connector assembly. The chassis assembly is contained in an aluminum case with a detachable cover. The hold-down assembly, cable, and connector assemblies are stored behind a hinged lid in the detachable cover. The W104057-3 missile station test set is used with the F-14 aircraft.

LE-1620 PHOTOFLASH CARTRIDGE EJECTOR TESTER

The LE-1620 photoflash cartridge ejector tester (fig. 15-18) is used to test the Model 9A photoflash cartridge ejectors. It has 26 indicating lamps. Each lamp simulates a cartridge.

LE-2125 PHOTOFLASH CARTRIDGE EJECTOR TESTER

The LE-2125 photoflash cartridge ejector tester (fig. 15-19) is used to test the Model 9B

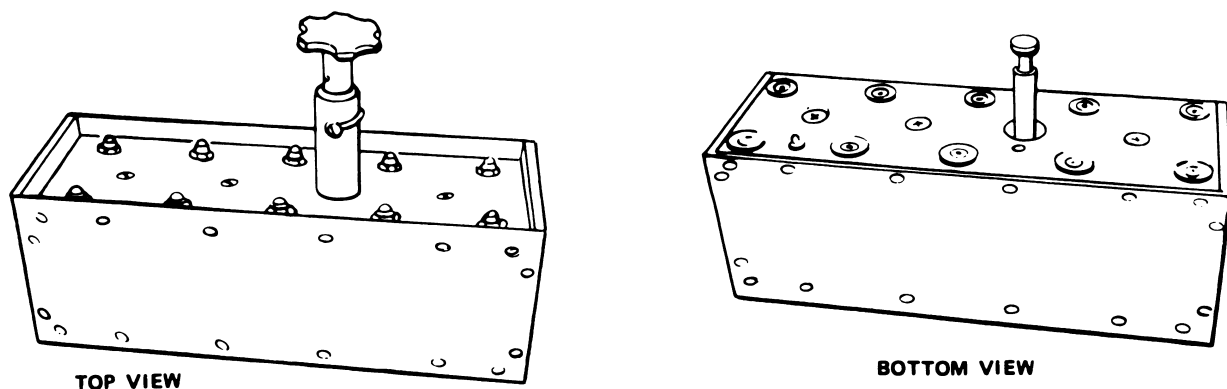
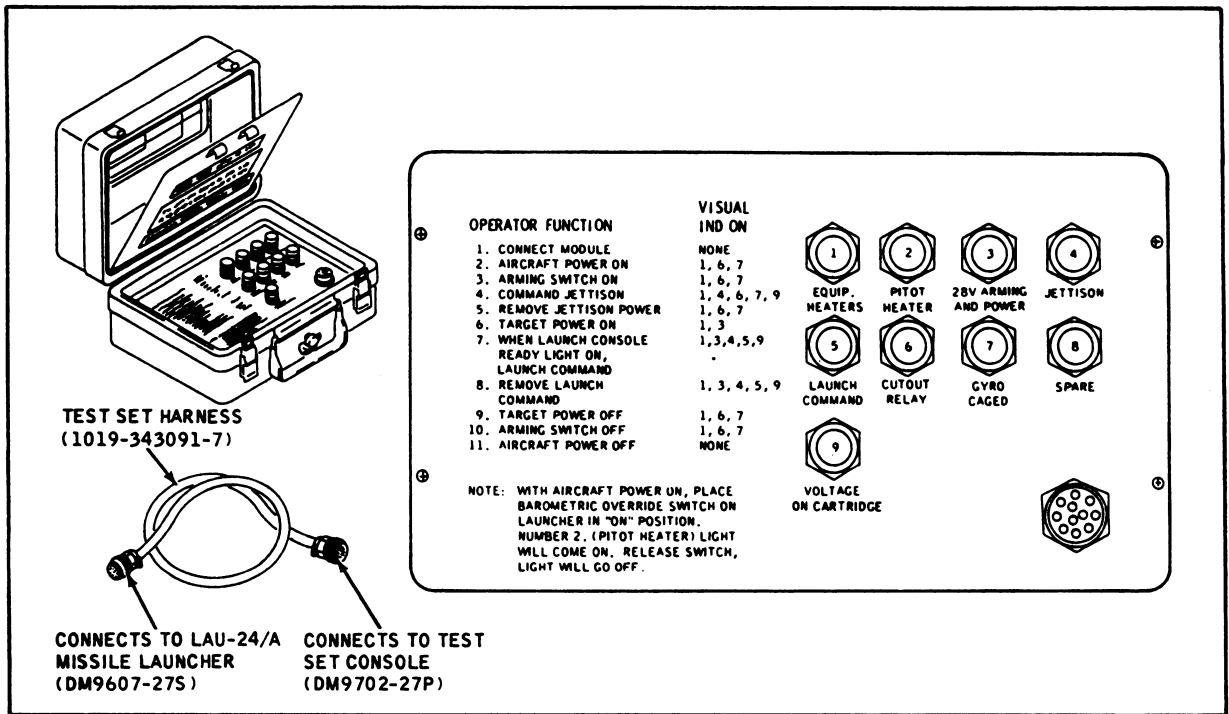


Figure 15-19.—LE-2125 photoflash cartridge ejector tester.



220.985

Figure 15-20.—TTU-183/F test set.

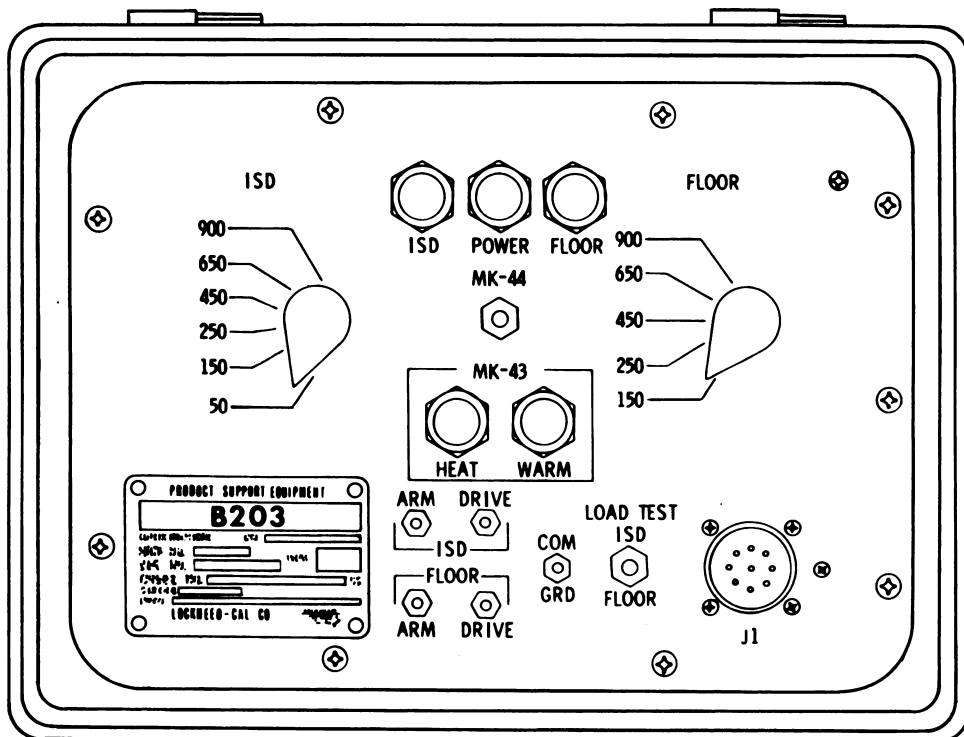


Figure 15-21.—B203 torpedo heat and control system test set.

photoflash cartridge ejectors. It has 10 indicating lamps. Each lamp simulates a cartridge.

TTU-183/F TEST SET

The TTU-183/F test set (fig. 15-20) is used to check operation of the aircraft's single-station launching system before loading the AQM-37/A missile target on the center line LAU-24/A launcher. Electrical power for operating the test set is furnished by the aircraft's electrical system.

B203 TORPEDO HEAT AND CONTROL SYSTEM TEST SET

The B203 torpedo heat and control system test set (fig. 15-21) is used to perform circuit continuity tests on Mk 46 torpedo preset circuits. The B203 test set is used with the P-3 aircraft.

B473 TEST SET OVERLAY

The B473 test set (fig. 15-22) consists of an overlay and an adapter cable. It is used with the

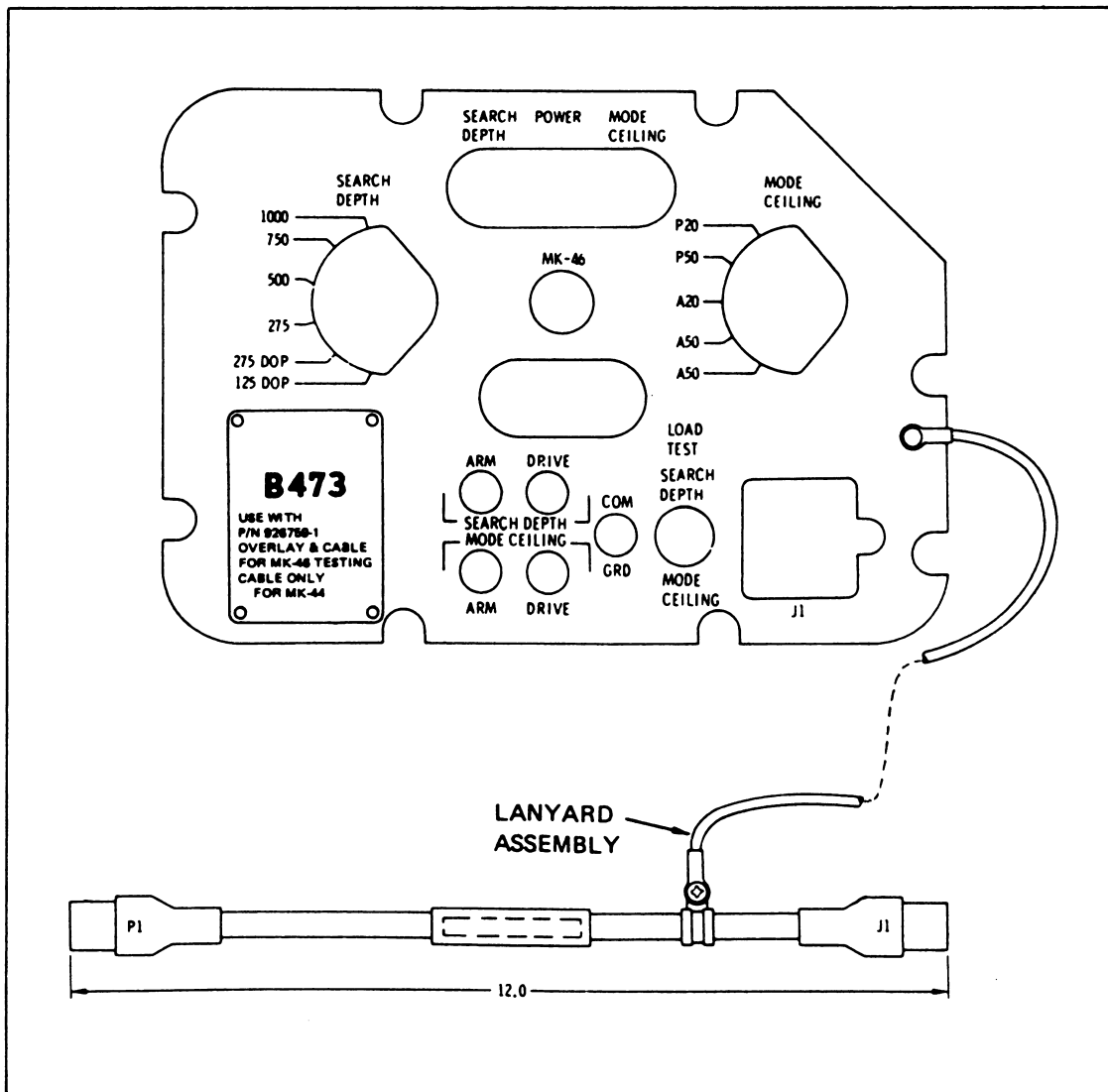
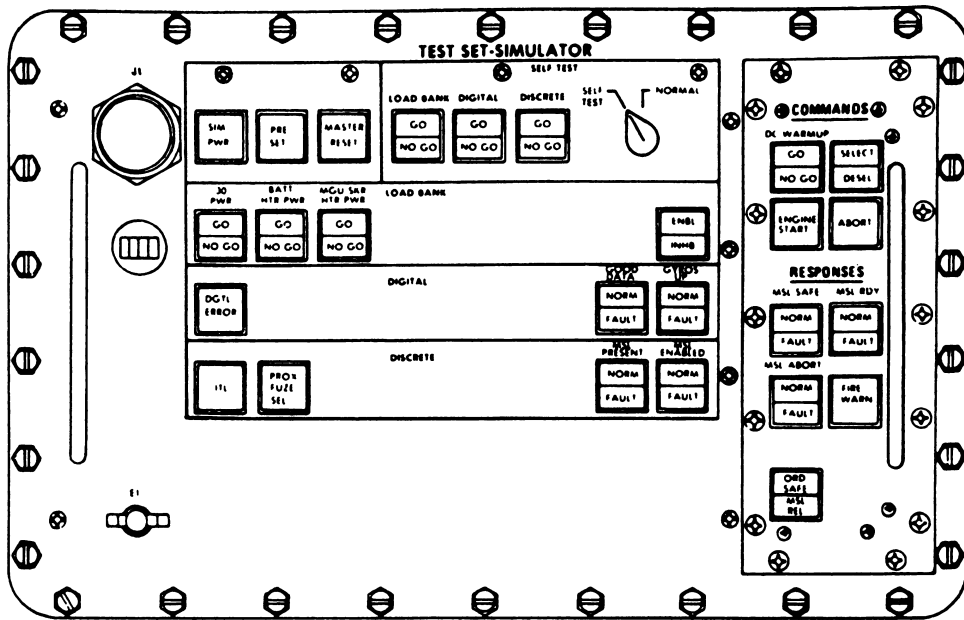


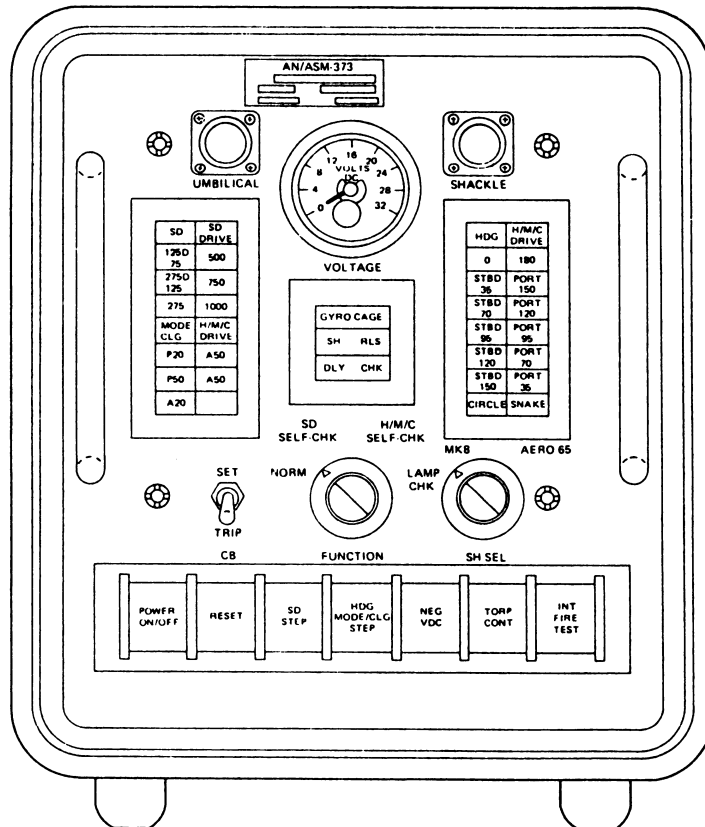
Figure 15-22.—B473 test set overlay.

220.987



220.988

Figure 15-23.—TS-3519/DSM test set simulator.



220.664

Figure 15-24.—AN/ASM-373A airborne torpedo presetter test set.

B203 torpedo heat and control test set to perform circuit continuity tests on Mk 46 torpedo preset circuits.

TS-3519/DSM TEST SET SIMULATOR

The TS-3519/DSM test set simulator (fig. 15-23) is a portable test set. It is used to simulate a Harpoon missile for wing station checkout, power-on functional testing, and fault isolation. The TS-3519/DSM is used with the P-3 aircraft.

AN/ASM-373A AIRBORNE TORPEDO PRESETTER TEST SET

The AN/ASM-373A airborne torpedo pre-setter test set (fig. 15-24) has capabilities for functionally testing the pre-setter portion of the armament control panel subassembly in the aircraft. It can also be used to check aircraft wiring and the torpedo umbilical connector. The AN/ASM-373A test set is used with the S-3 aircraft.

REVIEW NUMBER 2

IN ANSWERING QUESTIONS 1 THROUGH 6, MATCH THE DESCRIPTION WITH THE TEST SET.

<u>DESCRIPTION</u>	<u>TEST SET</u>
<i>Q1. Used to evaluate the operational readiness of the Walleye weapon guidance section cockpit television display of the F/A-18 aircraft</i>	<i>A. TS-3279</i>
	<i>B. B203 torpedo heat and control system test set</i>
<i>Q2. Used with the F/A-18 to perform the operational checks of the AIM-9 missile launching, visual target acquisition system (VTAS), and Sidewinder expanded acquisition mode (SEAM)</i>	<i>C. AN/DSM-77B</i>
	<i>D. ALE-1620 photoflash cartridge ejector tester</i>
<i>Q3. Used to check the VTAS/SEAM system on AIM-9 missiles on F/A-18 aircraft</i>	<i>E. W104057-3 missile station test set</i>
<i>Q4. Used to verify the operational status and function of the AIM-7 Sparrow missile on the F-14 aircraft</i>	<i>F. AN/ASM-464</i>
<i>Q5. Used to test the Model 9A photoflash cartridge ejectors</i>	
<i>Q6. Used to perform circuit continuity tests on Mk 46 torpedo preset circuits</i>	

TEST EQUIPMENT SAFETY SUMMARY

Learning Objective: *Recognize the safety precautions to follow when working with aircraft weapons systems test equipment.*

The test equipment discussed in this chapter is designed to perform two functions—

1. to ensure the correct firing voltage is available at the appropriate station when the cockpit switches are properly set, and
2. to ensure that voltage or stray voltage is not present before electrical connection of certain launchers, such as rocket launchers, is made.

These two functions are called *aircraft release and system control checks*. Normally, you perform aircraft release and system control checks

before the weapons are installed on the aircraft. However, some checks require the weapons to be loaded on the aircraft. As part of the loading process, the Sparrow, Phoenix, Walleye, and Sidewinder (on some aircraft) weapons are electrically mated to the aircraft. Then, the external power is applied to the aircraft, and a missile-on-aircraft test (MOAT) is performed. This test is normally performed during the prior-to-launch sequence.

You conduct the Sparrow and Phoenix MOAT by activating the circuits within the aircraft. Then, you observe the indications as they are received in the cockpit. No test equipment is required to perform this test.

The Sidewinder MOAT is performed by at least two persons (one in the cockpit and one at the missile station) using an audio headset and a TTU-304/E tester. The TTU-304/E tester is basically a pencil flashlight with an infrared filter lens.

REVIEW NUMBER 2 ANSWERS

<u>DESCRIPTION</u>	<u>TEST SET</u>
<i>A1. Used to evaluate the operational readiness of the Walleye weapon guidance section cockpit television display of the F/A-18 aircraft</i>	<i>C. AN/DSM-77B</i>
<i>A2. Used with the F/A-18 to perform the operational checks of the AIM-9 missile launching, visual target acquisition system (VTAS), and Sidewinder expanded acquisition mode (SEAM)</i>	<i>F. AN/ASM-464</i>
<i>A3. Used to check the VTAS/SEAM system on AIM-9 missiles on F/A-18 aircraft</i>	<i>A. TS-3279</i>
<i>A4. Used to verify the operational status and function of the AIM-7 Sparrow missile on the F-14 aircraft</i>	<i>E. W104057-3 missile station test set</i>
<i>A5. Used to test the Model 9A photoflash cartridge ejectors</i>	<i>D. ALE-1620 photoflash cartridge ejector tester</i>
<i>A6. Used to perform circuit continuity tests on Mk 46 torpedo preset circuits</i>	<i>B. B203 torpedo heat and control system test set</i>

The person in the cockpit plugs the headset into the audio connection and turns on the switches indicated in the checklist. These switches are Sidewinder COOL, STATION SELECT, and AUDIO CONTROL. The person at the missile station removes the missile protective dome cover. Then, with the tester turned ON, the beam of the tester is moved across the nose of the missile from a distance of 1 to 2 feet. As the missile senses radiation from the tester through the launcher's audio amplifier, a tone is heard in the headset. If more than one missile is loaded, each missile should be tested and the dome covers replaced. Sidewinder MOAT may also be performed during pretaxi arming signals with the pilot as the person in the cockpit.

The Walleye MOAT also requires at least two persons and a DSM-77 test set. The DSM-77 test set projects a test image to be received by the Walleye. The test image is displayed on the aircraft cockpit monitor. (See figure 15-12.)

With the cockpit switches ON, as listed in the checklist, the Walleye dome cover removed, and the tester mounted on the weapon and switched to LIGHT, a display appears on the aircraft monitor. When the tester is switched to LIGHT-MOTION, the image moves from side to side, diagonally, or up and down, depending upon the position of the tester. The tester control assembly is rotated around the foundation assembly during the testing process. During each position test, the person in the cockpit pulls the trigger switch and the weapon's television camera will lock on to one of the target dots and follow it as it moves. As each test is completed for each weapon loaded, the dome cover should be replaced.

CAUTION

During MOAT, or any other test being performed after weapons have been loaded on the aircraft, the MASTER ARMAMENT switch must NEVER be placed in the ON position.

When performing aircraft release and system control checks, you should always use the step-by-step procedures (checklist) provided in the aircraft loading manual. A few safety precautions must be observed when performing

aircraft release and system control checks. These are listed below.

1. Before you begin an aircraft release and system control check, make sure the aircraft is parked in a designated area, secured, and electrically grounded.

2. Before you apply external electrical power to the aircraft, make sure all cockpit switches have been positioned to OFF, NORMAL, or HOLD. If required, apply external air conditioning.

3. Before you begin an aircraft release and system control check, make sure all breech caps are disconnected and all safety pins are installed in the loaded parent racks. If applicable, MER/TER loaded stations must have all safety stop levers in the locked position. **Failure to perform this procedure could result in the firing of installed ejector cartridges, which, in turn, would cause the loaded weapon/store to eject. This could result in the injury of personnel.**

4. Test equipment should only be used by personnel who have become qualified through an established qualification and certification program.

Stray voltage checks are normally performed with the weapon loaded on the aircraft, but they are made before making an electrical connection between the weapon and the aircraft. Additionally, this check is normally performed after the aircraft's engines have been started and all aircraft preflight checks have been completed. The stray voltage check is performed at the last possible moment before the aircraft takes off. This is to ensure that no voltage has been induced in the aircraft firing circuitry from external sources, such as the ship's radar. The launcher electrical safety pin must not be removed until the aircraft is positioned on the catapult for takeoff.

REVIEW NUMBER 3

Q1. How many persons are required to perform a MOAT on a Sidewinder missile?

Q2. In what position should the MASTER ARM switch be set when a MOAT is being conducted on a naval aircraft?

REVIEW NUMBER 3 ANSWERS

A1. At least two persons are required to perform a MOAT on a Sidewinder missile.

A2. The MASTER ARM switch should be set in the OFF or SAFE position when a MOAT is being conducted on a naval aircraft.

APPENDIX I

GLOSSARY

A/A—Air to air.

AAB—Aviation armament bulletin.

AAC—Aviation armament change.

ABSLA—Approved basic stock level of ammunition.

ACM—Air combat maneuver.

AFB—Airframe bulletin.

AFC—Airframe change.

AFTER ENGINE TURNUP—That time in the prior-to-launch phase when the pilot has completed his pretaxi checklist.

AFTER LANDING/GROUND ABORT—That time after landing or ground abort phase when the pilot has completed his after landing checklist.

A/G—Air to ground.

AGM—Air-launched, surface attack, guided missile.

AIM—Air-launched, aerial intercept, guided missile.

AIMD—Aviation intermediate maintenance department.

AIRBORNE STORE—Fuel and spray tanks, nonexpendable training weapons, pods (refueling, gun, ECM, etc.). This includes all similar items intended for carriage by aircraft, including racks, launchers, and detachable pylons that do not normally separate from the aircraft in flight.

AIRBORNE WEAPON—All missiles, rockets, bombs, mines, torpedoes, and all similar items

intended for carriage by aircraft that are normally separated from the aircraft in flight.

AIRCRAFT ARMAMENT SYSTEM—Aircraft armament subsystems that, when interconnected, give the aircraft its airborne weapons/stores capability.

AIRCRAFT CONFIGURATION—The system and components required to carry or deliver a specific airborne weapon/store.

AIRCRAFT LOAD PLAN—A chart/form used to assign weapons to a particular bomb rack/station for loading.

AMAC—Aircraft monitor and control. A functional test of the aircraft monitor and control system, release system, and jettison system for nuclear weapons.

AOCS—Aviation ordnance control station.

ARM—Antiradiation missile.

ARM, ARMING—The action that changes ammunition from a safe condition to a state of readiness for initiation.

ASW—Antisubmarine warfare.

AT—Arming time.

ATM—Air-launched, training, guided missile.

AT/PERS—High-explosive antitank/anti-personnel.

ATR—Ammunition transaction report.

AUR—All-up-round. The complete assembly of a weapon normally shipped to the operating forces. The weapon requires no assembly or functional checks before loading on the aircraft for delivery to the target.

AVB—Avionics bulletin.

AVC—Avionics change.

AWB—Airborne weapons bulletin.

AWC—Airborne weapons change.

AYB—Accessory bulletin.

AYC—Accessory change.

BD—Base detonating.

BDU—Bomb dummy unit.

BEFORE ENGINE TURNUP—That time in the prior-to-launch evolution when the pilot is commencing general aircraft ground inspection or checks and extending until the inspections or checks are complete.

BIT, BITE—Built-in test.

BPDSMS—Basic Point Defense Surface Missile System.

CAD—Cartridge-actuated device.

CAIMS—Conventional Ammunition Integrated Management System.

CARTRIDGE—A complete assembly consisting of an initiator and a pressure-producing propellant in a suitable case. Impulse cartridges have no projectiles. A cartridge may be electrically or mechanically fired.

CAUTION—An operating procedure, practice, or condition that, if not strictly observed, could result in damage to or destruction of equipment.

CBU—Cluster bomb unit. It consists of a number of bombs contained in a dispenser or clustering device and suspended from a bomb rack. A CBU may function while on the rack or after release.

CCG—Computer control group.

CG—Center of gravity.

CHAFF—A radar reflective material used to deceive or counteract unfriendly radar or destructive offensive ordnance.

CHECKLIST—An individual sequence of procedures bearing a title and constituting a part of a publication designated as the loading checklist.

CINCLANTFLT—Commander-in-Chief Atlantic Fleet.

CINCPACFLT—Commander-in-Chief Pacific Fleet.

CNO—Chief of Naval Operations.

CO—Commanding Officer.

COG—Cognizance symbol. Indicates the command, bureau, or office that has control over supply and/or distribution of the material.

CONVENTIONAL WEAPONS—Nonnuclear weapons. This excludes all biological weapons and generally excludes chemical weapons except for existing smoke, incendiary agents, and agents of riot-control weapons.

CV—Aircraft carrier.

DAAS—Defense Automatic Addressing System.

DEARMING AREA—That area where a weapon is changed from a state of readiness for initiation to a safe condition. When forward firing weapons are involved, the area ahead of the aircraft must be clear and kept clear until weapon safing procedures are completed.

DODIC—Department of Defense Identification Code.

DOT—Department of Transportation.

DOWNLOADING—An operation that removes airborne weapons/stores from aircraft.

DROPPING SAFE—Releasing an airborne weapon/store in a safe or unarmed condition so that it will not function upon impact.

DST—Destructor.

DTRM—Dual-thrust rocket motor.

DUD—Explosive ammunition that has failed to function.

ECCM—Electronic counter-countermeasures.

ECM—Electronic countermeasures.

EEA—External evidence of arming.

EED—Electroexplosive device.

EMCON—Emission control.

EOD—Explosive ordnance disposal.

ERDL—Extended range data link.

EXPLOSIVE ORDNANCE DISPOSAL UNIT—Personnel with special training and equipment who render explosive ordnance safe, make intelligence reports, and supervise the safe removal of ordnance.

FAE—Fuel-air explosive.

FFAR—Folding-fin aircraft rocket.

FFT—For further transfer.

FORWARD-FIRING WEAPONS—Weapons such as missiles, rockets, and guns that are propelled in a forward direction.

FSC—Federal supply class.

FUZE—A term used for the mechanical or electrical device that initiates detonation of an explosive at a desired time.

GBI—Gains by inventory.

GCBS—Ground controlled bombing system. Weapons are released from the aircraft by a controller on the ground.

GCG—Guidance control group.

GCU—Gun control unit.

GP—General purpose.

GUIDED WEAPON—A weapon that has no propulsion but does have guidance control capability.

HARM—High-speed antiradiation missile.

HE—High explosive.

HEAT—High-explosive antitank.

HE-FRAG—High-explosive fragmentation.

HEI—High-explosive incendiary.

HERO—Hazardous electromagnetic radiation to ordnance.

HTW—Helicopter trap weapon.

HUD—Head-up display.

HUNG WEAPON—A weapon that accidentally remains attached to an aircraft after an attempt to release it from the rack.

IF APPLICABLE—Used to preface a step/procedure meaning that, when required, must be performed. When the step/procedure is not required, it may be omitted.

IFOBRL—In-flight operable bomb rack lock.

INTERVALOMETER—An electrical or electromechanical device that controls the release or firing of airborne weapons/stores at a specified interval or sequence.

IPDSMS—Improved Point Defense Surface Missile System.

IPB—Illustrated parts breakdown.

IRRP—Improved Rearming Rate Program.

IWHS—Improved Weapons Handling System.

JATO—Jet-assist takeoff.

JETTISON—Releasing of an airborne weapon or store by an emergency or secondary release system.

LABS—Low altitude bombing system.

LALS—Linkless Ammunition Loading System.

LBI—Loss by inventory.

LDGP—Low-drag general purpose.

LEMA—Linear electromechanical actuator.

LGB—Laser-guided bomb.

LSFFAR—Low-spin folding-fin aircraft rocket.

MACH—A measurement of sonic speed under standard atmospheric conditions. Mach 1.0 is about 766 miles per hour.

MDD—Maintenance due date.

MER—Multiple ejector rack.

MIARS—Maintenance Information Automated Retrieval System.

MILSTRIP—Military Standard Requisitioning and Issue Procedures.

MIM—Maintenance instruction manual.

MMMU—Mobile missile maintenance unit.

MOAT—Missile on aircraft test.

MOD—Modification.

MOMAT—Mobile mine assembly team.

MRC—Maintenance requirement card.

NADEP—Naval ammunition depot.

NALC—Naval ammunition logistics code.

NAPI—Naval Aeronautic Publications Index.

NAR—Naval ammunition reclassification.

NATO—North Atlantic Treaty Organization.

NATOPS—Naval air training and operating procedures standardization.

NATSF—Naval Air Technical Services Facility.

NAVAIR—Naval air.

NAVAIRSYSCOM—Naval Air Systems Command.

NAVSEA—Naval sea.

NAVSEASYSKOM—Naval Sea Systems Command.

NAVSUP—Naval supply.

NIIN—National item identification number.

NOTE—An operating procedure, practice, or condition that is essential to highlight.

NSN—National stock number.

NWS—Naval weapons station.

OD—Ordnance data.

OIC—Officer in charge.

OHO—Ordnance handling officer.

OJT—On-the-job training.

OP—Ordnance publication.

PD—Point detonating.

PMIC—Periodic maintenance inspection cards.

PMS—Preventive Maintenance System.

PWP—Plasticized white phosphorus.

Q-D—Quantity-distance.

RAC—Rapid action change. Issued to provide timely information of changes to manuals.

RADHAZ—Radiation Hazards to Ordnance.

RAT—Ram air turbine.

RDD—Required delivery date.

REARMING AREA—That area where an operation that replenishes the prescribed airborne weapons/stores, ammunition, bombs, and other armament items for an aircraft is conducted. This operation may include fuzing and any stray voltage checks, as applicable.

RELEASE AND CONTROL SYSTEM CHECK—Functional test of an aircraft electrical/mechanical conventional weapon release and/or control subsystem.

RF—Radio frequency.

RIM—Ship-launched intercept-aerial guided missile.

RPM—Rounds per minute.

S&A—Safety and arming device.

SASS—Special armament stowage space.

SAT—Safe air travel.

SATS—Short airfield tactical site.

SEAM—Sidewinder expanded acquisition mode. A means of slaving the AIM-9 optics to the air intercept radar to enhance tactical employment.

SEB—Support equipment bulletin.

SEC—Support equipment change.

SHOLS—Single Hoist Ordnance Loading System.

SLC—Sonobuoy launch tube.

SPCC—Ships Parts Control Center.

SRC—Stores reliability card.

STRAY VOLTAGE—An undesired voltage existing between two specified points of a weapon system that is capable of producing a flow of current when a designated electrical measuring device is connected between the two points.

SWL—Safe working load.

SWP—Subordinate work package.

TACO or TACCO—Tactical coordinator.

TCB—Target control system bulletin.

TDD—Target control system change.

TDD—Target detecting device.

TER—Triple ejector rack.

TMDC—Type maintenance due code.

TMINS—Technical Manual Identification Numbering System.

TPDR—Technical Publication Deficiency Report.

TRAMAN—Training manual.

UNO—United Nations Organization.

UIC—Unit identification code.

VER—Vertical ejector rack.

VT—Proximity fuze, so called because the original devices contained one or more vacuum tubes.

WARNING—An operating procedure, practice, or condition that, if not correctly followed, could result in personal injury or loss of life.

APPENDIX II

REFERENCES

Aviation Ordnanceman 3 & 2, NAVEDTRA 10345-E, Naval Education and Training Program Management Support Activity, Pensacola, Florida, December 1985.

INDEX

A

- A-7E gun system installation, 8-21 to 8-23
- Adapter boosters, 3-20 to 3-22
- Aerial targets and associated equipment, 9-1 to 9-14
 - powered targets, 9-9 to 9-14
 - AQM-37A missile target, 9-10 to 9-12
 - aerodynamic destruct system, 9-12
 - scoring system, 9-10 to 9-11
 - BQM-34A/S target system, 9-13
 - BQM-74C target drone, 9-12 to 9-13
 - safety precautions, 9-13 to 9-14
 - target towing systems and associated towing equipment, 9-3 to 9-9
 - A/A37U-15A external gunnery tow system, 9-4 to 9-6
 - description, 9-4 to 9-5
 - theory of operation, 9-5 to 9-6
 - A/A47U-3A and A/A47U-4 tow target reeling machine-launcher system, 9-6
 - tow cables and associated equipment, 9-7 to 9-9
 - Klein "Chicago" grip, 9-8 to 9-9
 - Mk 1 target leader, 9-7 to 9-8
 - Mk 8 target release ring, 9-8
- towed targets, 9-1 to 9-3
 - rigid tow targets, 9-2 to 9-3
 - TDU-10/B tow target, 9-2
 - TDU-34/A aerial tow target, 9-2 to 9-3
 - textile tow targets, 9-1 to 9-2
- Aircraft bomb ammunition and associated components, 2-1 to 2-42
 - antitank bomb cluster Mk 20 Mods and anti-personnel/antimaterial bomb cluster CBU-59/B, 2-27 to 2-33
 - functional description, 2-31 to 2-32
 - BLU-77/B bomblet, 2-32
 - Mk 118 Mods 0 and 1 antitank bomb, 2-32
 - Aircraft bomb ammunition and associated components—Continued
 - antitank bomb cluster Mk 20 Mods and anti-personnel/antimaterial bomb cluster CBU-59/B—Continued
 - Mk 20 Mods 2, 3, 4, and 6 bomb cluster and CBU-59/B configurations, 2-27 to 2-31
 - BLU-77/B target discriminating shaped-charge airburst bomblet, 2-31
 - Mk 7 and Mods bomb dispenser, 2-28 to 2-31
 - Mk 118 Mod 0 and Mod 1 antitank bomb, 2-31
 - Mk 339 Mods 0 and 1 mechanical time fuze, 2-31
 - shipping and storage containers, 2-32 to 2-33
 - bomb dummy units, 2-38 to 2-40
 - BDU-8A/B, 2-38
 - BDU-11A/E, 2-38
 - BDU-12A/B, 2-38 to 2-40
 - BDU-20/C, 2-40
 - BDU-24/C, 2-38
 - BDU-36/C, 2-40
 - destructors, 2-12 to 2-14
 - fire bombs, 2-14 to 2-27
 - fuel-air explosive bomb cluster CBU-55A/B and CBU-72/B, 2-18 components, 2-18 to 2-22
 - functional description, 2-22 to 2-24
 - handling and shipping, 2-24 to 2-27
 - Mk 77 Mod 4 fire bomb, 2-14 to 2-17
 - fuel gel mixture, 2-16
 - functional description, 2-14 to 2-15
 - Mark 1 Mod 0 fuel gelling unit, 2-17

- Aircraft bomb ammunition and associated components—Continued
 - general-purpose bombs and fin assemblies, 2-1 to 2-11
 - arming wire assemblies, 2-3 to 2-4
 - fin assemblies, 2-4 to 2-11
 - principles of operation, 2-9 to 2-11
 - snakeye fin assemblies, 2-4 to 2-9
 - fuze charging circuit, 2-3
 - fuze wells, 2-3
 - identification, 2-3
 - shipping configuration, 2-2 to 2-3
 - suspension lugs, 2-3
 - helicopter trap weapon (HTW) Mk 115 Mod 0, 2-34 to 2-35
 - laser guided bombs, 2-11
 - practice bombs, 2-35 to 2-38
 - full-scale practice bombs, 2-36 to 2-38
 - subcaliber practice bombs, 2-35 to 2-36
 - Mk 76 Mod 5, 2-36
 - Mk 106 Mod 4, 2-36
 - safety precautions, 2-40 to 2-42
- Aircraft gun systems, loading/downloading, 8-29 to 8-31
- Aircraft-laid mines, 7-6 to 7-16
- Aircraft-launched torpedo configurations, 7-2 to 7-5
- Aircraft loading/unloading procedures, 13-1 to 13-22
 - airborne weapons/stores loading manual, 13-1
 - CV NATOPS Manual, 13-1 to 13-7
 - terms, 13-1 to 13-2
 - weapons handling procedures, 13-2 to 13-7
 - arming/dearming, 13-3 to 13-5
 - hung/unexpected weapons, 13-5 to 13-7
 - weapons loading/downloading, 13-2
 - loading/unloading procedures, aircraft, 13-7 to 13-21
 - aircraft preparation and inspection, 13-7 to 13-11
 - dearming or rearming area immediately after engine shutdown), 13-19
 - postloading quality assurance inspection, 13-18
 - rearming area (before engine turnup), 13-18
- Aircraft loading/unloading procedures—Continued
 - loading/unloading procedures, aircraft—Continued
 - rearming or arming area (after engine turnup), 13-19
 - unloading procedures, 13-19 to 13-21
 - weapon inspection, 13-11 to 13-16
 - weapon loading, 13-16 to 13-18
 - safety precautions, 13-21 to 13-22
 - Aircraft mines, operational, 7-12 to 7-16
 - Mk 55 mine, 7-12 to 7-15
 - Mk 56 mine, 7-15
 - Mk 60 mine (captor), 7-15 to 7-16
 - Aircraft rockets and rocket launchers, 4-1 to 4-30
 - aircraft rocket launchers, 4-20 to 4-27
 - 2.75-inch (series) launchers, 4-26 to 4-27
 - 5.0-inch (series) launchers, 4-26
 - common components, 4-23 to 4-25
 - breaker switch, 4-24
 - fairings, 4-23 to 4-24
 - intervalometer, 4-24 to 4-25
 - mode selector switch, 4-24
 - shipping configuration, 4-22 to 4-23
 - center section, 4-22
 - RF barriers, 4-23
 - shipping ends, 4-22 to 4-23
 - aircraft rockets, 4-1 to 4-20
 - principles of rocket propulsion, 4-1 to 4-2
 - rocket and rocket fuze terminology, 4-1
 - rocket components, 4-2 to 4-18
 - fuzes, 4-15 to 4-18
 - motors, 4-2 to 4-9
 - warheads, 4-9 to 4-15
 - service rocket assemblies, 4-18 to 4-20
 - 2.75-inch FFAR and LSFFAR, 4-18 to 4-19
 - 5.0-inch FFAR, 4-19 to 4-20
 - rocket safety precautions, 4-27 to 4-30
- Aircraft weapons systems, 14-1 to 14-66
 - antisubmarine warfare weapons systems, 14-39 to 14-64
 - basic system, 14-39 to 14-44
 - helicopter search store system, 14-44
 - photographic system (P-3C), 14-44
 - search store system, 14-41 to 14-44

Aircraft weapons systems—Continued

- antisubmarine warfare weapons systems—Continued
 - kill store system, 14-44 to 14-52
 - bomb bay system, 14-47 to 14-51
 - wing store system, 14-51 to 14-52
 - release and control system checks, 14-60 to 14-62
 - inspection, 14-61 to 14-62
 - preparation, 14-60 to 14-61
 - release and control systems, 14-52 to 14-60
 - jettison, 14-59 to 14-60
 - operation, 14-53 to 14-59
 - weapons system maintenance, 14-62 to 14-64
 - corrective maintenance, 14-62 to 14-64
 - preventive maintenance, 14-62
- attack aircraft weapons systems, 14-29 to 14-39
 - AGM-45A Shrike missile system, 14-36
 - AIM-9 missile system, 14-36
 - aircraft armament configuration capabilities, 14-39
 - AN/AWG-21 weapon control system, 14-36
 - armament control unit, 14-29 to 14-33
 - ballistic control panel, 14-35
 - control monitor DCU-186/A, 14-33
 - electrical fuzing, 14-33 to 14-34
 - ground-controlled bombing system, 14-36
 - jettison system, 14-36 to 14-39
 - pilot's control stick grip, 14-35 to 14-36
- fighter aircraft weapons systems, 14-1 to 14-29
 - F-14 aircraft weapons systems, 14-1 to 14-19
 - air combat maneuver (ACM) panel, 14-2 to 14-3
 - aircraft armament configuration capabilities, 14-10 to 14-19
 - armament control indicator panel, 14-3
 - armament safety override switch, 14-4 to 14-5
 - control stick, 14-3
 - decoy dispensing systems, 14-7 to 14-9
 - displays control panel, 14-3

Aircraft weapons systems—Continued

- fighter aircraft weapons systems—Continued
 - F-14 aircraft weapons systems—Continued
 - jettison system, 14-9 to 14-10
 - landing gear handle, 14-4
 - M61A1 20-mm automatic gun fire control system, 14-7
 - master light control panel, 14-3 to 14-4
 - missile control system, 14-5 to 14-6
 - multiple weapons release system, 14-6 to 14-7
 - F/A-18 aircraft, 14-19 to 14-29
 - AGM-65 Maverick system, 14-26
 - AGM-88 HARM system, 14-26
 - AIM-7 Sparrow fire control system, 14-26 to 14-27
 - AIM-9 Sidewinder fire control system, 14-27
 - aircraft armament configuration capabilities, 14-27 to 14-29
 - aircraft controller grip assembly, 14-21
 - AN/ALE-39 decoy dispensing system, 14-27
 - AN/AWW-4 fuze function control system, 14-25 to 14-26
 - armament computer, 14-24
 - armament safety override switch, 14-20
 - bomb release system, 14-25
 - digital computers, 14-24 to 14-25
 - digital display indicators, 14-22 to 14-24
 - ground power control panel assembly, 14-19 to 14-20
 - jettison system, 14-25
 - landing gear control handle, 14-20
 - M61A1 20-mm gun system, 14-27
 - master arm control panel assembly, 14-20 to 14-21
 - rocket firing system, 14-26
 - Walleye guided weapon system, 14-26
 - safety precautions, 14-64 to 14-66

- Aircraft weapons systems test equipment, 15-1 to 15-20
- test equipment, 15-1 to 15-17
 - AN/ALM-70A countermeasure dispenser test set, 15-5 to 15-6
 - AN/ASM-20B guided missile launcher test set, 15-3 to 15-4
 - AN/ASM-149C guided missile launcher and aircraft electrical circuit test set, 15-4 to 15-5
 - AN/ASM-184B(V)-1 aircraft weapon control test set, 15-7
 - AN/ASM-373A airborne torpedo presetter test set, 15-17
 - AN/ASM-464 guided missile launcher test set, 15-11
 - AN/ASM-496 data link controller test set, 15-8 to 15-9
 - AN/AWM-38 armament wiring test set, 15-7
 - AN/AWM-42A fuze function control test set, 15-3
 - AN/AWM-54 aircraft firing circuit test set, 15-1 to 15-2
 - AN/DSM-77B test set, 15-9 to 15-10
 - AN/DSM-139 guided weapon test set, 15-7
 - AN/PSM-4 multimeter, 15-1
 - B203 torpedo heat and control system test set, 15-15
 - B473 test set overlay, 15-15 to 15-17
 - LE-1620 photoflash cartridge ejector tester, 15-13
 - LE-2125 photoflash cartridge ejector tester, 15-13 to 15-15
 - TS-3279/ASM guided missile avionics test set, 15-11 to 15-12
 - TS-3479/AWM-23 missile auxiliaries test set, 15-12 to 15-13
 - TS-3519/DSM test set simulator, 15-17
 - TS-3561/AWM-23 missile interface test set, 15-13
 - TTU-183/F test set, 15-15
 - TTU-304/E guided missile tester, 15-4
 - W104057-3 missile station test set, 15-13
 - test equipment safety summary, 15-18 to 15-20
- Air-launched guided missiles, guided missile launchers, and guided missile handling, 5-1 to 5-42
- air-launched guided missiles, 5-1 to 5-25
 - missile classification, 5-1 to 5-2
 - range, 5-1
 - speed, 5-1 to 5-2
 - types of guided missiles, 5-2
 - missile components, 5-4 to 5-11
 - armament section, 5-6 to 5-8
 - guidance and control section, 5-4 to 5-6
 - propulsion section, 5-8 to 5-11
 - missile designation, 5-2
 - missile identification, 5-2 to 5-4
 - service guided missiles, 5-11 to 5-25
 - HARM missile, 5-23
 - Harpoon guided missile, 5-12 to 5-14
 - Maverick missile, 5-20 to 5-21
 - Phoenix missile, 5-20
 - Shrike missile, 5-24 to 5-25
 - Sidewinder guided missile, 5-14 to 5-17
 - Sparrow III guided missile, 5-11 to 5-12
 - standard ARM missile, 5-22 to 5-23
 - Walleye guided weapon, 5-17 to 5-20
 - guided missile handling, 5-37 to 5-40
 - afloat, 5-38 to 5-39
 - ashore, 5-39 to 5-40
 - NAD/NWS/MMMUs, 5-38
 - guided missile launchers, 5-25 to 5-37
 - ADU-299/E missile launcher adapter, 5-36 to 5-37
 - AERO 5B-1 guided missile launcher, 5-29
 - LAU-7/A (series) guided missile launcher, 5-25 to 5-28
 - fin retainer assemblies, 5-27
 - forward fairing assembly, 5-27
 - functional description, 5-27
 - housing assembly, 5-26
 - mechanism assembly, 5-27
 - nitrogen receiver assembly, 5-26
 - power supply, 5-27
 - snubber mount fitting assembly, aft fairing latch assembly, and aft fairing assembly, 5-27
 - umbilical hook support assembly, 5-27

Air-launched guided missiles, guided missile launchers, and guided missile handling—Continued

guided missile launchers—Continued

- LAU-17/A wing missile pylon, 5-29 to 5-30
- LAU-77A/A guided missile launcher, 5-36
- LAU-92/A guided missile launcher, 5-35
- LAU-93/A guided missile launcher, 5-35
- LAU-115/A guided missile launcher, 5-30 to 5-32
- LAU-116/A guided missile launcher, 5-32 to 5-33
- LAU-117/A guided missile launcher, 5-33 to 5-34
- LAU-118/A guided missile launcher, 5-35

safety precautions, 5-40 to 5-42

Ammunition, 1-8 to 1-27

Ammunition container M548, 1-26 to 1-27

Ammunition handling and gun drive systems, 8-11 to 8-18

Ammunition handling equipment, 10-1 to 10-48

beams, 10-8 to 10-10

- ADU-399/E guided missile hoisting beam, 10-8 to 10-9
- MHU-129/E guided missile hoisting beam, 10-9 to 10-10
- Mk 37 Mod 0 lift beam, 10-10
- HLU-210/E hoisting beam, 10-8

bomb hoists, 10-10 to 10-14

- Aero 14C bomb hoist, 10-11 to 10-12
- HLU-196B/E bomb hoisting unit, 10-12

hoisting bands, 10-12 to 10-14

carriers, 10-3 to 10-4

- Mk 49 Mod 1 weapons carrier, 10-3 to 10-4
- Mk 51 Mod 1 weapons carrier, 10-4

hoisting bars, 10-6 to 10-8

- Aero 64A hoisting bar, 10-6
- Aero 68A hoisting bar, 10-6
- HLU-256/E manual hoisting bar, 10-6 to 10-8

loaders, 10-43 to 10-48

- Aero 47A, Aero 47A-1, and MJ-7 weapons loaders, 10-44 to 10-45
- A/S 32K-1A/1B/1C SATS weapon loaders, 10-43

Ammunition handling equipment—Continued pallets, 10-1 to 10-3

- ammunition pallet crate, 10-2 to 10-3
- Mk 3 Mod 0 pallet, 10-2
- Mk 12 Mod 1 pallet, 10-2
- standard four-way wood pallet, 10-1

safety precautions for handling equipment, 10-45 to 10-48

skids, weapons transporters, and associated adapters, 10-14 to 10-31

Aero 12C bomb skid, 10-15 to 10-18

Aero 9B/C bomb skid adapter, 10-16

Aero 39B bomb skid adapter, 10-17

Aero 64B soft-belt adapter, 10-17 to 10-18

Aero 21C weapon skid and MHK-128/M32K-5(V) munitions transporter, 10-18 to 13-31

ADK-362/A/B/M32K-5(V) multiple weapon adapter, 10-27 to 10-29

ADU-353-1 skid adapter, 10-24 to 10-25

ADU-400/E weapon skid loading lift adapter, 10-29 to 10-30

ADU-475/E guided missile adapter, 10-23 to 10-24

Aero 36A bomb truck adapter, 10-30 to 10-31

Aero 58A skid adapter, 10-19 to 10-23

Aero 67A small bomb and missile adapter, 10-25 to 10-26

stands, 10-4 to 10-6

A/E32M-4 maintenance and reconfiguration stand, 10-5

A/F 32K-1/1A bomb assembly stand, 10-5 to 10-6

trailers, 10-38 to 10-43

Aero 51B munitions trailer, 10-42 to 10-43

A/M 32K-4A SATS rough terrain trailer, 10-40 to 10-42

MHU-126/M small munitions trailer, 10-40

Mk 7 and Mods bomb trailer, 10-39

trucks, 10-31 to 10-38

Aero 33D/E bomb truck, 10-36 to 10-38

ammunition handling truck, 10-31

Ammunition handling equipment—Continued trucks—Continued

- forklift trucks, 10-32 to 10-35
 - diesel engine forklift trucks, 10-33
 - electric forklift trucks, 10-33 to 10-35
- pallet trucks, 10-35
 - electric pallet truck (low lift), 10-35
 - hand pallet truck (low lift), 10-35 to 10-36

Ammunition handling, storage, and assembly, 12-1 to 12-76

- ammunition handling, 12-11 to 12-24
 - installed handling equipment, 12-11 to 12-21
 - hoists, 12-11 to 12-12
 - weapons elevator maintenance and safety, 12-16 to 12-21
 - weapons elevators, 12-12 to 12-16
 - weapons movement, 12-21 to 12-24
 - weapons movement in support of flight operations, 12-21 to 12-22
 - weapons onload/offload, 12-23 to 12-24
- ammunition storage ashore, 12-24 to 12-33
 - identification of facilities, 12-31 to 12-33
 - magazine group number, 12-31
 - magazine type and capacity letter(s), 12-31 to 12-33
 - magazines, 12-24 to 12-31
 - quantity-distance (Q-D) requirements, 12-25 to 12-27
 - storage compatibility groups, 12-28 to 12-31
 - types of magazines, 12-24 to 12-25
- ammunition storage ashore for advanced bases, 12-33 to 12-41
 - ammunition storing and handling facilities, 12-33 to 12-40
 - ammunition storage facilities, 12-35 to 12-38
 - identification of magazines and open storage sites, 12-38 to 12-40
 - dispersion of ammunition, 12-40 to 12-41

Ammunition handling, storage, and assembly—Continued

- ammunition stowage, 12-1 to 12-11
 - ammunition stowage requirements, 12-5
 - ammunition stowage spaces, 12-1 to 12-4
 - chemical magazines, 12-4
 - lockers, 12-4
 - missile magazines, 12-2 to 12-3
 - primary magazines, 12-1
 - ready-service magazines, 12-3 to 12-4
- daily visual inspection, 12-9 to 12-10
- designation of magazines, 12-4 to 12-5
 - multipurpose magazine, 12-5
 - single-purpose magazine, 12-4
- environmental control systems, 12-5 to 12-6
 - exhaust vents, 12-6
 - magazine vent check valves, 12-6
 - supply and exhaust ventilation, 12-5 to 12-6
- improved rearming rate program, 12-4
- magazine inspection and visual surveillance of ammunition, 12-9
- magazine internal arrangement, 12-8 to 12-9
- magazine security, 12-10 to 12-11
- magazine temperature log, 12-10
- sprinkler systems and auxiliary equipment, 12-6 to 12-8
 - high-temperature alarm systems, 12-8
 - types of sprinkler systems, 12-8
- magazine maintenance storage and handling requirements, 12-41 to 12-48
 - ammunition handling, 12-44 to 12-45
 - ammunition shipping, 12-45 to 12-48
 - Department of Transportation explosive hazard classifications, 12-45
 - explosives driver, 12-45 to 12-48
 - frequency of inspections, 12-44
 - general inspection requirements, 12-43 to 12-44
 - report of inspections, 12-44
 - temperature control considerations, 12-44
- lightning protection systems, 12-42 to 12-43
 - primary systems, 12-42 to 12-43
 - secondary system, 12-43

Ammunition handling, storage, and assembly—Continued
 magazine maintenance storage and handling requirements—Continued
 magazine and magazine area security, 12-43
 magazine/magazine area inspections, 12-43 to 12-44
 personnel requirements, 12-42
 safety precautions, 12-71 to 12-76
 weapons assembly, 12-48 to 12-71
 5.0-inch airborne rocket assembly procedures, 12-68 to 12-71
 assembly of rocket components, 12-69 to 12-71
 inspecting rocket components, 12-68 to 12-69
 unpacking rocket components, 12-68
 fire bombs, 12-67
 Mk 80 (series) aircraft general purpose bombs, 12-48 to 12-64
 assembly of conical fin and electric fuze to the bomb body, 12-53 to 12-64
 assembly of conical fin and mechanical fuzes to the bomb body, 12-49 to 12-53
 preparation for use, 12-48 to 12-49
 practice bombs, 12-64 to 12-66
 Mk 76 Mod 5 practice bomb, 12-64 to 12-65
 Mk 106 Mod 5 practice bomb, 12-65 to 12-66
 Ammunition identification, 1-9 to 1-13
 Ammunition lot number, 1-12 to 1-13
 AN-M173A1 mechanical impact fuze, 3-16 to 3-18
 Arming safety switch Mk 122 Mod 0, 3-24
 Arming wire assemblies, 2-3 to 2-4

B

Ballistic control panel, 14-35
 Beams, 10-8 to 10-10
 ADU-399/E guided missile hoisting beam, 10-8 to 10-9
 HLU-210/E hoisting beam, 10-8
 MHU-129/E guided missile hoisting beam, 10-9 to 10-10
 Mk 37 Mod 0 lift beam, 10-10
 BLU-77/B target discriminating shaped-charge airburst bomblet, 2-31

Bomb ammunition, 1-9
 Bomb bay system, 14-47 to 14-51
 Bomb dummy units, 2-38 to 2-40
 BDU-8A/B, 2-38
 BDU-11A/E, 2-38
 BDU-12A/B, 2-38 to 2-40
 BDU-20/C, 2-40
 BDU-24/C, 2-38
 BDU-36/C, 2-40
 Bomb ejector racks, 11-7 to 11-24
 A/A37B-6E multiple ejector rack (MER) and A/A37B-5E triple ejector rack (TER), 11-16 to 11-24
 Aero 7A-5 and Aero 7B-4 bomb ejector racks, 11-7 to 11-12
 BRU-10A/A and BRU-11A/A bomb ejector racks, 11-12 to 11-15
 BRU-32/A bomb ejector rack, 11-15 to 11-16
 BRU-33/A bomb ejector rack, 11-16
 Bomb fuzes and associated components, 3-1 to 3-28
 electrical fuzes, 3-22 to 3-26
 arming safety switch Mk 122 Mod 0, 3-24
 description, 3-22
 functional operation, 3-23 to 3-24
 Mk 31 safety device, 3-22 to 3-23
 Mk 43 Mod 0 target detecting device, 3-24 to 3-26
 fuse terminology and basic fuze theory, 3-1 to 3-3
 basic fuze theory, 3-1 to 3-2
 electrical fuzes, 3-2
 mechanical fuzes, 3-1 to 3-2
 fuze terminology, 3-1
 special safety features, 3-2 to 3-3
 mechanical fuzes, 3-3 to 3-22
 adapter boosters, 3-20 to 3-22
 adapter booster M150/T46 (series), 3-21 to 3-22
 M148/M148E1/T45 (series) adapter booster, 3-21
 M904E2/E3/E4 mechanical impact nose fuze, 3-3 to 3-7
 functional description, 3-6 to 3-7
 physical description, 3-4 to 3-6
 Mk 339 Mod 0 and Mod 1 mechanical time fuze, 3-7 to 3-12
 functional description, 3-11 to 3-12
 physical description, 3-8 to 3-11

Bomb fuzes and associated components—Continued

mechanical fuzes—Continued

- Mk 346 Mod 0 mechanical long-delay tail fuze, 3-12 to 3-16
 - arming assemblies Mk 3, 4, and 5 Mods, 3-13 to 3-16
 - description, 3-12 to 3-13
 - identification of a fully or partially armed fuze, 3-16
 - operation, 3-13
- mechanical fuze Mk 343 Mod 0, 3-19 to 3-20
 - igniter Mk 273 Mod 1, 3-20
 - initiator Mk 13 Mod 0, 3-20
 - operation, 3-20
 - self-dud, 3-20
- mechanical impact fuze AN-M173A1, 3-16 to 3-18
 - description, 3-17
 - operation, 3-17 to 3-18
- mechanical impact fuze M918, 3-18 to 3-19
- safety precautions, 3-26

Bomb hoists, 10-10 to 10-14

- Aero 14C bomb hoist, 10-11 to 10-12
- HLU-196B/E bomb hoisting unit, 10-12
- hoisting bands, 10-12 to 10-14

Bomb racks, 11-1 to 11-7

- Aero 65A series bomb rack, 11-1 to 11-5
- BRU-12/A bomb rack, 11-6
- BRU-14/A bomb rack, 11-6 to 11-7
- BRU-15/A bomb rack, 11-7
- MAU-38/A bomb rack, 11-5 to 11-6

Bomb release system, 14-25

Bomb shackles, 11-24 to 11-25

Bomb signal cartridges, practice, 6-17 to 6-19

Bombs and fin assemblies, general-purpose, 2-1 to 2-11

Bombs, practice, 2-35 to 2-38, 12-64 to 12-66

BQM-34A/S target system, 9-13

BQM-74C target drone, 9-12 to 9-13

Breech, breech cap and breech lead, 11-30

C

Carriers, 10-3 to 10-4

- Mk 49 Mod 1 weapons carrier, 10-3 to 10-4

- Mk 51 Mod 1 weapons carrier, 10-4

Cartridges and cartridge-actuated devices, 1-13 to 1-19

Cartridges, photoflash, 6-14 to 6-16

- M112A1 (series) photoflash cartridge, 6-14 to 6-15

- M123A1 (series) photoflash cartridge, 6-15 to 6-16

CBU-55A/B and CBU-72/B fuel-air explosive bomb cluster, 2-18

Chaff dispensing pod, 11-39

Chaff module, 11-39

Chemical agents, 1-3

- incendiaries, 1-3
- military gases, 1-3
- screening smoke, 1-3
- simulated military gases, 1-3

Chemical ammunition, 1-9

Control monitor DCU-186/A, 14-33

Craft gun ammunition 20-mm M50 configuration, 1-19 to 1-27

CV NATOPS Manual, 13-1 to 13-7

D

Decoy dispensing systems, 14-7 to 14-9

Decoying devices, 6-16 to 6-17

Demolition ammunition, 1-9

Destructors, 2-12 to 2-14

Digital computers, 14-24 to 14-25

Digital display indicators, 14-22 to 14-24

Dispensers and ejectors, 11-25 to 11-42

- AN/ALE-39A countermeasures chaff dispensing set, 11-34 to 11-37

- photoflash cartridge ejectors, 11-40 to 11-42

- SUU-25F/A dispenser, 11-28 to 11-33

- SUU-44 flare dispenser, 11-26 to 11-28

E

Electrical fuzes, 3-22 to 3-26

Electrical fuzing, 14-33 to 14-34

Elevators, weapons, 12-12 to 12-16

Environmental control systems, 12-5 to 12-6

Explosive hazard classifications, Department of Transportation, 12-45

Explosives and ammunition, 1-1 to 1-30
 ammunition, 1-8 to 1-27
 ammunition identification, 1-9 to 1-13
 ammunition lot number, 1-12 to 1-13
 Department of Defense Identification Code (DODIC) and Navy Ammunition Logistic Code (NALC), 1-12
 lettering, 1-12
 mark and modification designation, 1-12
 marking, 1-11
 nonservice ammunition, 1-9 to 1-11
 painting, 1-11
 service ammunition, 1-9
 cartridges and cartridge-actuated devices, 1-13 to 1-19
 aircraft logbook entries, 1-18 to 1-19
 miscellaneous cartridges, 1-15 to 1-17
 personnel escape devices, 1-13 to 1-15
 racks, launchers, and dispensers, 1-15
 service life, 1-17 to 1-18
 craft gun ammunition 20-mm M50 configuration, 1-19 to 1-27
 ammunition container M548, 1-26 to 1-27
 cartridge components, general description, 1-19 to 1-20
 classification, 1-19
 identification, 1-23 to 1-25
 M220 target practice-tracer cartridge, 1-23
 M242 high-explosive incendiary-tracer cartridge, 1-23
 M254 dummy cartridge, 1-23
 M51A1B1/M51A2 dummy cartridges, 1-20
 M54A1 high-pressure test cartridge, 1-20
 M55A2 target practice cartridge, 1-20 to 1-23
 M56A3 high-explosive incendiary cartridge, 1-23

Explosives and ammunition—Continued
 ammunition—Continued
 types of ammunition, 1-8 to 1-9
 bomb ammunition, 1-9
 chemical ammunition, 1-9
 demolition ammunition, 1-9
 guided missile ammunition, 1-9
 gun ammunition, 1-9
 pyrotechnic ammunition, 1-9
 rocket ammunition, 1-9
 explosives, 1-1 to 1-7
 chemical agents, 1-3
 incendiaries, 1-3
 military gases, 1-3
 screening smoke, 1-3
 simulated military gases, 1-3
 classification of explosives, 1-2 to 1-3
 classification by composition, 1-2
 classification by reaction, 1-2
 classification by service use, 1-2 to 1-3
 explosive terminology, 1-1 to 1-2
 types and applications explosives, 1-3 to 1-7
 auxiliary explosives, 1-6
 bursting explosives, 1-6 to 1-7
 initiating explosives, 1-5 to 1-6
 propellants, 1-4 to 1-5
 hazards of electromagnetic radiation to ordnance (HERO), 1-27 to 1-29
 HERO emission control (EMCON) bill, 1-29
 HERO ordnance classifications, 1-27 to 1-29
 HERO safe ordnance, 1-27 to 1-28
 HERO susceptible ordnance, 1-28
 HERO unsafe ordnance, 1-28 to 1-29
 safety precautions, 1-30
 Explosives driver, 12-45 to 12-48

F

F-14 aircraft weapons systems, 14-1 to 14-19
 F-14 gun system installation, 8-21
 F/A-18 aircraft, 14-19 to 14-29
 F/A-18 gun system installation, 8-18 to 8-20
 Fighter aircraft weapons systems, 14-1 to 14-29
 Fin assemblies, 2-4 to 2-11
 Fire bombs, 2-14 to 2-27, 12-67

Fuze charging circuit, 2-3
Fuze terminology, 3-1
Fuze theory, basic, 3-1 to 3-2
Fuze wells, 2-3

G

Glossary, AI-1 to AI-5
Ground-controlled bombing system, 14-36
Guided missile ammunition, 1-9
Guided missile handling, 5-37 to 5-40
Gun ammunition, 1-9
Gun drive and drum drive systems, 8-16 to 8-17
Gun gas purge system, 8-17 to 8-18
Gun, M61A1 automatic, 8-1 to 8-11
 gun components, 8-2 to 8-7
 M61A1 gun principles of operation, 8-7 to 8-11
Gun system installations, M61A1, 8-18 to 8-23

H

HARM missile, 5-23
Harpoon guided missile, 5-12 to 5-14
Helicopter search store system, 14-44
Helicopter trap weapon (HTW) Mk 115 Mod 0, 2-34 to 2-35
HERO emission control (EMCON) bill, 1-29
HERO (Hazards of electromagnetic radiation to ordnance), 1-27 to 1-29
HERO ordnance classifications, 1-27 to 1-29
Hoisting bars, 10-6 to 10-8
 Aero 64A hoisting bar, 10-6
 Aero 68A hoisting bar, 10-6
 HLU-256/E manual hoisting bar, 10-6 to 10-8

I

Illuminating devices, area and target, 6-4 to 6-8
 LUU-2B/B aircraft parachute flare, 6-6 to 6-8
 Mk 45 Mod 0 aircraft parachute flare, 6-4 to 6-6
Inspections, magazine/magazine area, 12-43 to 12-44
Intervalometer, 4-24 to 4-25

K

Kill store system, 14-44 to 14-52
Klein "Chicago" grip, 9-8 to 9-9

L

Lanyard disconnect switch, 11-39
Laser guided bombs, 2-11
Launchers, aircraft rocket, 4-20 to 4-27
Launchers, guided missile, 5-25 to 5-37
 ADU-299/E missile launcher adapter, 5-36 to 5-37
 AERO 5B-1 guided missile launcher, 5-29
 LAU-7/A (series) guided missile launcher, 5-25 to 5-28
 LAU-17/A wing missile pylon, 5-29 to 5-30
 LAU-77/A guided missile launcher, 5-36
 LAU-92/A guided missile launcher, 5-35
 LAU-93/A guided missile launcher, 5-35
 LAU-115/A guided missile launcher, 5-30 to 5-32
 LAU-116/A guided missile launcher, 5-32 to 5-33
 LAU-117/A guided missile launcher, 5-33 to 5-34
 LAU-118/A guided missile launcher, 5-35
Lightning protection systems, 12-42 to 12-43
Linkless ammunition loading system, 8-23 to 8-31
Loaders, 10-43 to 10-48
 Aero 47A, Aero 47A-1, and MJ-7 weapons loaders, 10-44 to 10-45
 A/S 32K-1A/1B/1C SATS weapon loaders, 10-43
Loading/unloading procedures, aircraft, 13-7 to 13-21

M

M220 target practice-tracer cartridge, 1-23
M242 high-explosive incendiary-tracer cartridge, 1-23
M254 dummy cartridge, 1-23
M918 mechanical impact fuze, 3-18 to 3-19
M51A1B1/M51A2 dummy cartridges, 1-20
M54A1 high-pressure test cartridge, 1-20
M55A2 target practice cartridge, 1-20 to 1-23
M56A3 High-explosive incendiary cartridge, 1-23
M61A1 20-mm automatic gun fire control system, 14-7

- M61A1 automatic gun installation and loading equipment, 8-1 to 8-36
 - ammunition handling and gun drive systems, 8-11 to 8-18
 - chute assemblies, 8-15
 - conveyor assembly, 8-15 to 8-16
 - drum unit assembly, 8-11 to 8-12
 - entrance unit, 8-14
 - exit unit, 8-12 to 8-14
 - gun drive and drum drive systems, 8-16 to 8-17
 - gun gas purge system, 8-17 to 8-18
 - transfer unit and adapter assembly, 8-14 to 8-15
 - adapter assembly, 8-14 to 8-15
 - transfer unit, 8-14
 - linkless ammunition loading system, 8-23 to 8-31
 - components, 8-24 to 8-28
 - conveyor system, 8-27 to 8-28
 - drum loader assembly, 8-26 to 8-27
 - drum unload assembly, 8-27
 - loader ammunition transporter, 8-24 to 8-25
 - operation, 8-28 to 8-31
 - loading/downloading aircraft gun systems, 8-29 to 8-31
 - loading/downloading transporter, 8-28 to 8-29
- M61A1 automatic gun, 8-1 to 8-11
 - gun components, 8-2 to 8-7
 - M61A1 gun principles of operation, 8-7 to 8-11
 - clearing cycle, 8-10 to 8-11
 - firing cycle, 8-7 to 8-10
- M61A1 gun system installations, 8-18 to 8-23
 - A-7E gun system installation, 8-21 to 8-23
 - F-14 gun system installation, 8-21
 - F/A-18 gun system installation, 8-18 to 8-20
- maintenance and testing, 8-31 to 8-33
 - intermediate maintenance, 8-32 to 8-33
 - scheduled maintenance, 8-32 to 8-33
 - unscheduled maintenance, 8-33
 - organizational maintenance, 8-32
 - safety precautions, 8-33 to 8-36
- M904E2/E3/E4 mechanical impact nose fuze, 3-3 to 3-7
- Magazine group number, 12-31
- Magazine inspection and visual surveillance of ammunition, 12-9
- Magazine security, 12-10 to 12-11
- Magazine temperature log, 12-10
- Magazine type and capacity letter(s), 12-31 to 12-33
- Magazines and open storage sites, identification of, 12-38 to 12-40
- Magazines, designation of, 12-4 to 12-5
- Magazines, types of, 12-24 to 12-25
- Maintenance and testing (LALS), 8-31 to 8-33
 - intermediate maintenance, 8-32 to 8-33
 - organizational maintenance, 8-32
- Mark 1 Mod 0 fuel gelling unit, 2-17
- Maverick missile, 5-20 to 5-21
- Mechanical fuzes, 3-3 to 3-22
- Mine components, 7-9 to 7-12
 - arming components, 7-10 to 7-11
 - explosive components, 7-10
 - firing components, 7-11 to 7-12
 - mine case, 7-9 to 7-10
- Mine handling, 7-16 to 7-17
- Missile components, 5-4 to 5-6
 - armament section, 5-6 to 5-8
 - guidance and control section, 5-4 to 5-6
 - propulsion section, 5-8 to 5-11
- Missile control system, 14-5 to 14-6
- Missile designation, 5-2
- Missile target AQM-37A, 9-10 to 9-12
- Missiles, types of guided, 5-2
- Mk 1 target leader, 9-7 to 9-8
- Mk 7 and Mods bomb dispenser, 2-28 to 2-31
- Mk 8 target release ring, 9-8
- Mk 20 Mods 2, 3, 4, and 6 bomb cluster and CBU-59/B configurations, 2-27 to 2-31
- Mk 31 safety device, 3-22 to 3-23
- Mk 46 and Mods torpedoes, 7-1 to 7-6
- Mk 77 Mod 4 fire bomb, 2-14 to 2-17
- Mk 80 (series) aircraft general purpose bombs, 12-48 to 12-64
- Mk 118 Mod 0 and Mod 1 antitank bomb, 2-31
- Mk 339 Mods 0 and 1 mechanical time fuze, 2-31, 3-7 to 3-12
- Mk 343 Mod 0 mechanical fuze, 3-19 to 3-20
- Mk 346 Mod 0 mechanical long-delay tail fuze, 3-12 to 3-16

N

NAD/NWS/MMMUs, 5-38

O

Otto Fuel II, 7-6

P

Pallets, 10-1 to 10-3
 ammunition pallet crate, 10-2 to 10-3
 Mk 3 Mod 0 pallet, 10-2
 Mk 12 Mod 1 pallet, 10-2
 standard four-way wood pallet, 10-1
 Phoenix missile, 5-20
 Photoflash cartridge ejectors, 11-40 to 11-42
 Photographic system (P-3C), 14-44
 Propellants, 1-4 to 1-5
 Pyrotechnic ammunition, 1-9
 Pyrotechnics, 6-1 to 6-20
 aircraft-launched smoke and flame marking devices, 6-8 to 6-14
 Mk 25 Mods 2 and 3 marine location marker, 6-9 to 6-12
 functional description, 6-11
 launching methods, 6-11 to 6-12
 physical description, 6-10 to 6-11
 Mk 58 Mod 1 marine location marker, 6-12 to 6-14
 launching methods, 6-13 to 6-14
 physical description, 6-13
 area and target illuminating devices, 6-4 to 6-8
 LUU-2B/B aircraft parachute flare, 6-6 to 6-8
 components, 6-6 to 6-7
 operation, 6-7 to 6-8
 Mk 45 Mod 0 aircraft parachute flare, 6-4 to 6-6
 decoying devices, 6-16 to 6-17
 handling and safety precautions, 6-19 to 6-20
 hand-manipulated signaling devices, 6-1 to 6-4
 Mk 13 Mod 0 marine smoke and illumination signal, 6-1
 Mk 79 Mod 0 illumination signal kit, 6-1 to 6-4
 photoflash cartridges, 6-14 to 6-16
 M112A1 (series) photoflash cartridge, 6-14 to 6-15
 M123A1 (series) photoflash cartridge, 6-15 to 6-16
 practice bomb signal cartridges, 6-17 to 6-19

Q

Quality assurance inspection, postloading, 13-18

R

References, AII-1
 Release and control systems, 14-52 to 14-60
 Rocket ammunition, 1-9
 Rocket and rocket fuze terminology, 4-1
 Rocket assembly procedures, 5.0-inch airborne, 12-68 to 12-71
 Rocket components, 4-2 to 4-18
 fuzes, 4-15 to 4-18
 motors, 4-2 to 4-9
 warheads, 4-9 to 4-15
 Rocket components, inspecting, 12-68 to 12-69
 Rocket firing system, 14-26
 Rocket propulsion, principles of, 4-1 to 4-2
 Rockets, aircraft, 4-1 to 4-20

S

Safety and handling precautions, 6-19 to 6-20
 Safety precautions, 1-30, 2-40 to 2-42, 3-26, 5-40 to 5-42, 7-17 to 7-18, 8-33 to 8-36, 9-13 to 9-14, 11-42 to 11-44, 12-71 to 12-76, 13-21 to 13-22, 14-64 to 14-66
 Safety precautions for handling equipment, 10-45 to 10-48
 Safety precautions, rocket, 4-27 to 4-30
 Search store system, 14-41 to 14-44
 Security, magazine and magazine area, 12-43
 Shrike missile, 5-24 to 5-25
 Sidewinder guided missile, 5-14 to 5-17
 Signaling devices, hand-manipulated, 6-1 to 6-4
 Mk 13 Mod 0 marine smoke and illumination signal, 6-1
 Mk 79 Mod 0 illumination signal kit, 6-1 to 6-4
 Skids, weapons transporters, and associated adapters, 10-14 to 10-31
 Aero 12C bomb skid, 10-15 to 10-18
 Aero 21C weapon skid and MHK-128/M32K-5(V) munitions transporter, 10-18 to 10-31
 Smoke and flame marking devices, aircraft-launcher, 6-8 to 6-14
 Mk 25 Mods 2 and 3 marine location marker, 6-9 to 6-12
 Mk 58 Mod 1 marine location marker, 6-12 to 6-14

- Snakeye fin assemblies, 2-4 to 2-9
- Sparrow III guided missile, 5-11 to 5-12
- Sprinkler systems and auxiliary equipment, 12-6 to 12-8
- Squib board, 11-39
- Stands, 10-4 to 10-6
 - A/E32M-4 maintenance and reconfigurations stand, 10-5
 - A/F 32K-1/1A bomb assembly stand, 10-5 to 10-6
- Stepper switch, 11-30
- Storing and handling facilities, ammunition, 12-33 to 12-40
- Stowage requirements, ammunition, 12-5
- Stowage spaces, ammunition, 12-1 to 12-4
 - chemical magazines, 12-4
 - lockers, 12-4
 - missile magazines, 12-2 to 12-3
 - primary magazines, 12-1
 - ready-service magazines, 12-3 to 12-4
- Suspension, arming, and releasing equipment, 11-1 to 11-44
 - bomb ejector racks, 11-7 to 11-24
 - A/A37B-6E multiple ejector rack (MER) and A/A37B-5E triple ejector rack (TER), 11-16 to 11-24
 - adapter assembly, 11-18
 - ejector unit assemblies, 11-19 to 11-20
 - hardware adapter kits, 11-23 to 11-24
 - MER/TER operational description, 11-20 to 11-23
 - wiring support assembly, 11-18 to 11-19
 - Aero 7A-5 and Aero 7B-4 bomb ejector racks, 11-7 to 11-12
 - Aero 7A-5 bomb ejector rack, 11-8 to 11-10
 - Aero 7B-4 bomb ejector rack, 11-10 to 11-11
 - maintenance requirements, 11-11 to 11-12
 - principles of operation, 11-11
 - BRU-10A/A and BRU-11A/A bomb ejector racks, 11-12 to 11-15
 - BRU-10A/A bomb ejector rack, 11-13 to 11-14
 - BRU-11A/A bomb ejector rack, 11-14 to 11-15
 - BRU-32/A bomb ejector rack, 11-15 to 11-16
 - BRU-33/A bomb ejector rack, 11-16
 - Suspension, arming, and releasing equipment—Continued
 - bomb racks, 11-1 to 11-7
 - Aero 65A series bomb rack, 11-1 to 11-5
 - Aero 1A adapter assembly, 11-2 to 11-3
 - cocking and latching, 11-3 to 11-4
 - operation, 11-5
 - safety interlock mechanism, 11-3
 - BRU-12/A bomb rack, 11-6
 - BRU-14/A bomb rack, 11-6 to 11-7
 - BRU-15/A bomb rack, 11-7
 - MAU-38/A bomb rack, 11-5 to 11-6
 - bomb shackles, 11-24 to 11-25
 - dispensers and ejectors, 11-25 to 11-42
 - AN/ALE-37A countermeasures chaff dispensing set, 11-37 to 11-40
 - access plates, 11-39
 - chaff dispensing pod, 11-39
 - chaff module, 11-39
 - cockpit control indicator, 11-40
 - component description, 11-39
 - intervalometer, 11-39
 - lanyard disconnect switch, 11-39
 - pod control indicator, 11-39 to 11-40
 - squib board, 11-39
 - AN/ALE-39A countermeasures chaff dispensing set, 11-34 to 11-37
 - dispenser assemblies, 11-35
 - dispenser housings, 11-35 to 11-37
 - dispensing set programmer, 11-37
 - sequencer switch, 11-37
 - photoflash cartridge ejectors, 11-40 to 11-42
 - SUU-25F/A dispenser, 11-28 to 11-33
 - arming mechanism, 11-30 to 11-31
 - breech, breech cap, and breech lead, 11-30
 - downloading breech and downloading breech cap, 11-30
 - forward and aft retaining lock, 11-30
 - functional description, 11-31 to 11-33
 - maintenance requirements, 11-33
 - manifold, 11-30
 - stepper switch, 11-30
 - SUU-44 flare dispenser, 11-26 to 11-28
 - safety precautions, 11-42 to 11-44
 - Suspension lugs, 2-3

T

Target detecting device, Mk 43 Mod 0, 3-24 to 3-26
Target towing systems and associated towing equipment, 9-3 to 9-9
Targets, powered, 9-9 to 9-14
Targets, towed, 9-1 to 9-3
 rigid tow targets, 9-2 to 9-3
 textile tow targets, 9-1 to 9-2
TDU-10/B tow target, 9-2
TDU-34/A aerial tow target, 9-2 to 9-3
Test equipment, 15-1 to 15-17
Test equipment safety summary, 15-18 to 15-20
Torpedo configurations, 7-1 to 7-2
 exercise configuration, 7-2
 warshot configuration, 7-1
Tow cables and associated equipment, 9-7 to 9-9
Trailers, 10-38 to 10-43
 Aero 51B munitions trailer, 10-42 to 10-43
 A/M 32K-4A SATS rough terrain trailer, 10-40 to 10-42
 MHU-126/M small munitions trailer, 10-40
 Mk 7 and Mods bomb trailer, 10-39
Transporter, landing/downloading, 8-28 to 8-29
Trucks, 10-31 to 10-38
 Aero 33D/E bomb truck, 10-36 to 10-38
 ammunition handling truck, 10-31
 forklift trucks, 10-32 to 10-35
 pallet trucks, 10-35

U

Underwater weapons, 7-1 to 7-18
 aircraft-laid mines, 7-6 to 7-16
 classifications, 7-7 to 7-9
 mine components, 7-9 to 7-12
 arming components, 7-10 to 7-11
 explosive components, 7-10
 firing components, 7-11 to 7-12
 mine case, 7-9 to 7-10
 operational aircraft mines, 7-12 to 7-16
 Mk 55 mine, 7-12 to 7-15
 Mk 56 mine, 7-15
 Mk 60 mine (captor), 7-15 to 7-16
 mine handling, 7-16 to 7-17
 Mk 46 and Mods torpedoes, 7-1 to 7-6
 aircraft-launched torpedo configurations, 7-2 to 7-5
 Otto Fuel II, 7-6
 torpedo configurations, 7-1 to 7-2
 exercise configuration, 7-2
 warshot configuration, 7-1
 safety precautions, 7-17 to 7-18

W

Walleye guided weapon, 5-17 to 5-20
Walleye guided weapon system, 14-26
Weapon loading, 13-16 to 13-18
Weapons assembly, 12-48 to 12-71
Weapons elevator maintenance and safety, 12-16 to 12-21
Weapons handling procedures, 13-2 to 13-7
Weapons movement, 12-21 to 12-24
Weapons system maintenance, 14-62 to 14-64
Wing store system, 14-51 to 14-52

UNIVERSITY OF ILLINOIS-URBANA



3 0112 101044292