CHAPTER 1

BOMBS, FUZES, AND ASSOCIATED COMPONENTS

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 or electrical action to detonate the main booster charge. A mechanical action or an electrical impulse causes the detonator to explode, which fires the primer. The primer-detonator explosion is relayed to the main charge by a booster charge, completing the explosive train.

LEARNING OBJECTIVES

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

1. Describe the operation of mechanical fuzes.
2. Describe the operation of electrical fuzes.
3. Identify the special safety features that are inherent in bomb fuzes.
4. Identify the types of aircraft bombs.
5. Identify the purpose of aircraft bombs.
6. Identify the safety procedures to be followed during bomb shipment
7. Identify the methods used to carry bombs.
8. Identify the function of general-purpose bombs.
9. Identify the parts of general-purpose bombs.
10. Identify the different configurations of general-purpose bombs.
11. Identify the different types of guided bomb units.
12. Identify the purpose of guided bomb units.
13. Identify the different types of air-laid mines.
14. Identify the purpose of air-laid mines.
15. Identify the various configurations of cluster bombs.
16. Identify the purpose of cluster bombs.
17. Identify the different types of practice bombs.
18. Identify the purpose of practice bombs.
19. Recognize the safety precautions to follow while working with fuzes.
20. Recognize the safety precautions to follow while working with bombs.
21. Recognize the safety precautions to follow while working with the associated components of bombs.

FUZE TERMINOLOGY AND BASIC FUZE THEORY

This chapter will introduce you to some of the common terms and acronyms associated with fuzes, basic fuze theory, general classes of fuzes, and the various types of fuzes used in the Navy.

Fuze Terminology

Some of the most common fuze terms that you should know are defined as follows:

- Arming time—is the amount of time or number of 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—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. The two 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 pressure, or long delay. Another classification is their position in the bomb—nose, tail, side, or multi-positioned.

Mechanical Fuzes

All mechanical bomb fuzes are activated by means of an arming wire or lanyard. Pulling the arming wire or lanyard at weapon release frees a vane. Rotation of the vane in the air stream provides mechanical energy to an internal mechanism to arm the fuze or unlock a powered mechanism so that arming can occur. When a fuze is armed, the explosive train is aligned so that the mechanism that determines the mode of fuze functioning is free to operate and the main explosive charge in the weapon can be detonated. The arming time of a fuze can be fixed or variable. In the former case, the arming time is determined at fuze manufacture. In the latter case, the arming time is either pre-flight selected during the weapon build-up operation or aircraft loading sequence, or selected during flight via Serial Data Interface (SDI) from the cockpit. The actual arming time is a function of the delivery tactic employed during weapon delivery. For safe, effective operation, any fuze (mechanical or electrical) must have the following design features:

- It must remain safe in stowage, while it is handled in normal movement, and during loading and downloading 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), which 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. Electrical fuzes can be activated either by means of a lanyard, or by means of electrical energy transferred from aircraft carried equipment to the fuze as the weapon is released from the aircraft. If a fuze is activated by means of a lanyard, its arming time and its function time delay are selected before flight (i.e., at weapon buildup or aircraft loading). With electrical activation, the fuze arming time and functioning characteristics can be determined in-flight to match changing conditions at the target area or conditions at alternate target areas.

If a fuze is electrically activated, the electrical signal can both be a source of energy and contain commands. 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 fuze remains safe until it is energized by the electrical charging system carried in the aircraft. Because of the safety 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 the 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

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; the out of alignment increases safety during shipping, stowing, and handling of the fuze. The arming action of the fuze aligns the firing train.

Shear-Safe

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 normally protrudes from the bomb and it might otherwise 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

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 (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.

MECHANICAL FUZES

There are many fuzes in use by the Navy today. Some of the commonly used fuzes are discussed in this manual. To keep up with current fuzes, the latest information can be found in Aircraft Bombs, Fuzes, and Associated Components, Naval Air Systems Command (NAVAIR) 11-5A-17, and Airborne Bomb and Rocket Fuze Manual, NAVAIR 11-1F-2.

Mark 339 Modification 1 Mechanical Time Fuze

The Mark (Mk) 339 Modification (Mod) 1 mechanical time fuzes (*Figure 1-1*) are used with dispenser weapons and have the following characteristics:

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

The Mk 339 Mod 1 fuze is installed in the bomb clusters during assembly by the manufacturer; therefore, the following information on this fuze is limited.

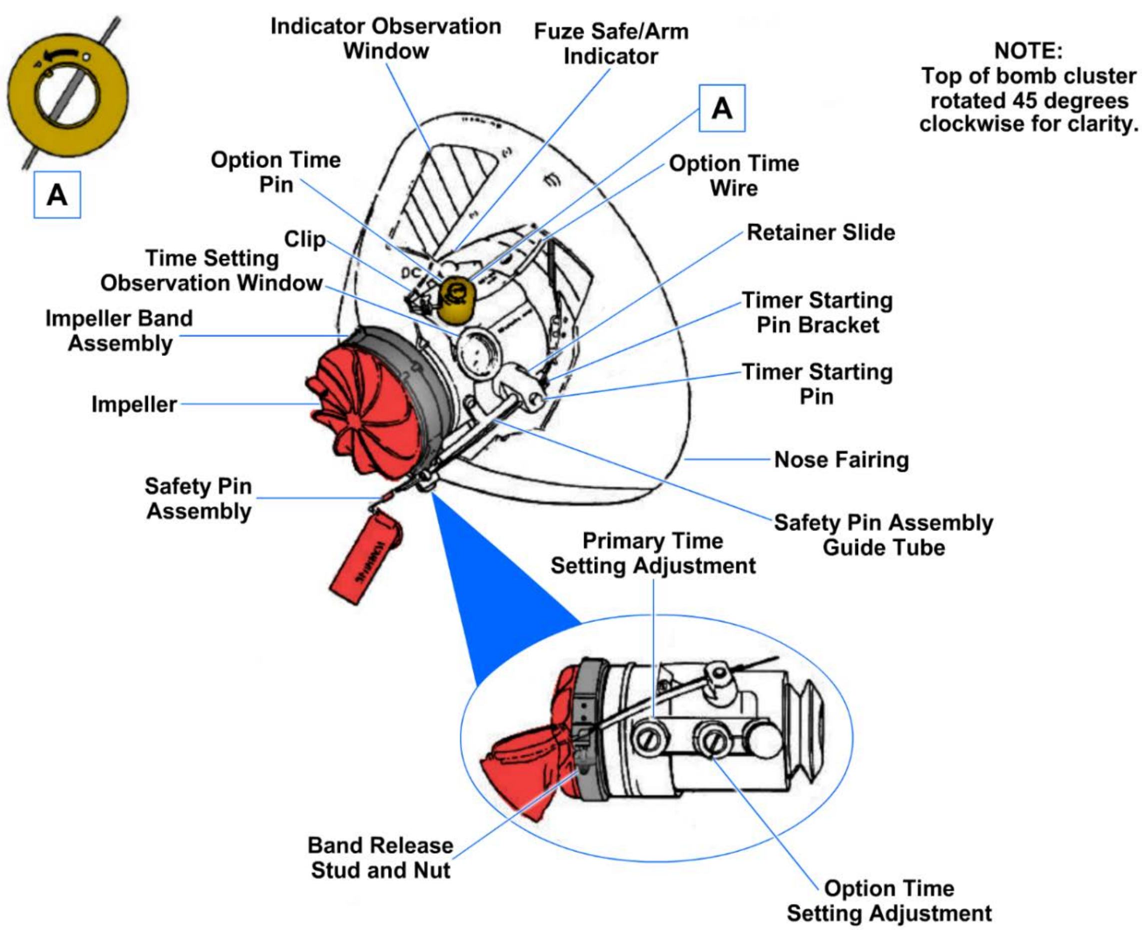

Figure 1-1 — Installed Mk 339 Mod 1 mechanical time fuze.

The purpose of the Mk 339 Mod 1 mechanical time fuze is to initiate the linear-shaped charges located in the cargo section walls. The Mk 339 Mod 1 fuze provides the pilot with in-flight selection of the fuze function time

Physical Description

The primary and option functional delays are preset during assembly at the factory. The fuze is preset at 1.2 seconds for primary delay, and the option delay is preset at 4.0 seconds.

These time delays can be reset during weapon preparation to meet various tactical requirements. The functional delays for both the primary and option modes of the Mk 339 Mod 1 fuze can be adjusted from 1.2 to 100 seconds.

It is possible to tell if the fuze has shifted from the primary to the option mode by checking the time setting in the observation window on the functional mode indicator. If the arming wire has been accidentally pulled during handling, the fuze shifts to the option mode. Once the option wire is pulled, the Mod 1 fuze can be reset to the primary mode by reinstalling the option time wire.

The fuze safe/arm indicator (*Figure 1-2*) provides EEA for the Mk 339 Mod 1 fuze. The fuze safe/arm indicator is viewed through the indicator observation window in the upper nose fairing. 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 (*Figure 1-2*, *view A*), and it is armed when the green foil is pierced by the indicator pin (*Figure 1-2*, *view B*).

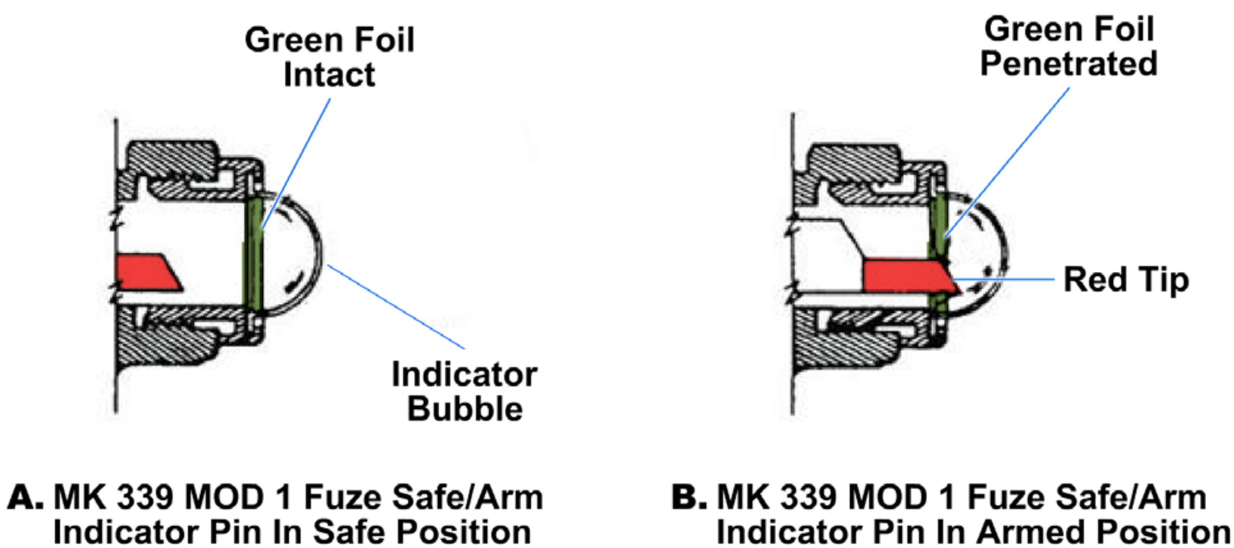

Figure 1-2 — Mechanical time fuze Mk 339 Mod 1 safe/arm indicator pin in safe and armed positions.

Functional Description

The Mk 339 fuze utilizes two arming wires. 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 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.

ELECTRICAL FUZES

The Navy uses fuze munition unit (FMU), fuzing unit (FZU), and Doppler sensing unit (DSU) fuzes in various tactical situations. For more information on electrical fuzes refer to the Aircraft Bombs, Fuzes, and Associated Components, NAVAIR 11-5A-17, and Airborne Bomb and Rocket Fuze Manual, NAVAIR 11-1F-2.

Figure 1-3 — FMU-143(series) fuze.

FMU-143(Series) Electric Tail Fuze

The FMU-143(series) fuze (*Figure 1-3*) is used with the guided bomb unit- (GBU-) 24(series) and GBU-31(V)4(series) weapons and is initiated by the FZU-32B/B initiator, which is used to generate and supply power to arm the fuze. The safe condition is verified by the presence of a safety pin or arming wire through the pop-out pin (gag rod).

Figure 1-4 — FMU-139(series) electronic bomb fuze.

FMU-139(Series) Electronic Bomb Fuze

The FMU-139(series) electronic bomb fuzes (*Figure 1-4*) are an electronic impact or impact-delay fuze. The fuzes are solid state, micro-computer, multi-option tail or nose fuze used in the Mk 80/bomb live unit (BLU) 100(series) general-purpose bombs, including laser-guided bombs. The fuzes are joint service (Navy and Air Force) with multiple settings. The arming times are in-flight selectable and the functioning delay (high drag arm or delay switch) must be set during weapon assembly. Weapons can be delivered in either high drag (retarded) or low drag (unretarded) mode. There are three arming times (2.6, 5.5, and 10.0 seconds) and four functioning delay settings (10, 25, and 60 milliseconds, and instantaneous). Only 2.6/60, 2.6/25, 2.6/10, and 2.6/INST high drag arm/delay switch positions are authorized for Navy/Marine Corps use.

The low drag arm time (LDAT) rotary switch is positioned at “X” for shipping, storage, and all fuze function control set (FFCS) use. When the FMU-139 is utilized with the Mk 122 safety switch, the LDAT rotary switch must be positioned at the "X" position for all FFCS use. When the FMU-139 is utilized with the FZU-48/B initiator, the LDAT switch must be set to other than "X" position. If the LDAT switch is set to "X" position when the FZU-48/B is utilized the weapon will dud. High drag arm time must be less than low drag arm time in order for fuze to function.

Mk 122 Mod 0 Arming Safety Switch

The Mk 122 Mod 0 arming safety switch (*Figure 1-5*) provides an open circuit and a radiation hazard (RADHAZ) shield to prevent electromagnetic radiation from entering the fuze circuits. When actuated and the lanyard pulled free, the switch connects the bomb fuze control circuits in the aircraft to the electric fuze circuits in the bomb.

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, ensuring 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.

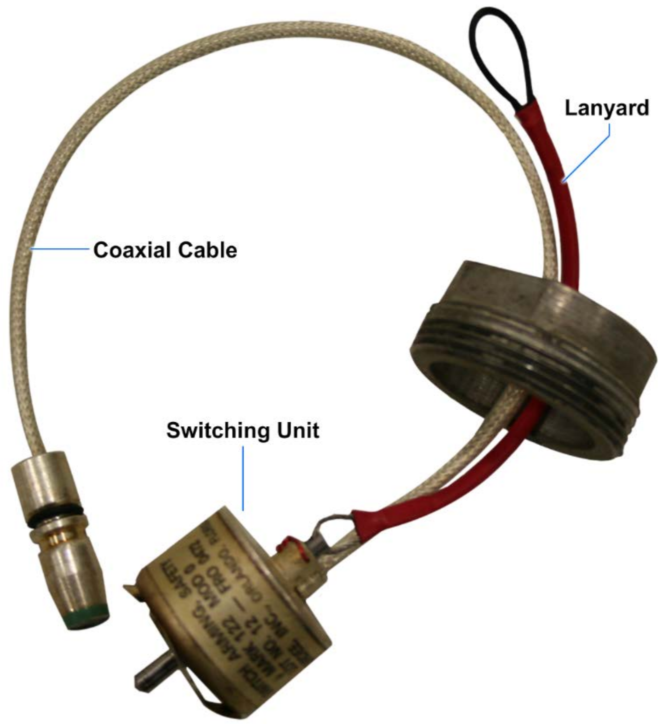

Figure 1-5 — Mk 122 Mod 0 arming safety switch.

NOTE

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

FZU-48/B Initiator

The FZU-48/B initiator (*Figure 1-6*) is a cylindrically shaped metal component that is installed in the bomb charging well. It consists of a main housing with two electrical connectors and a cover assembly with lanyard. The two electrical connectors located in the bottom of the housing are protected during handling and storage by plastic caps. Connectors attach to the electrical cable in the bomb. The cover assembly has an arrow to indicate proper orientation when installed in the bomb and has a flexible lanyard with a swivel break link that attaches to the bomb rack. The power cable assembly routes power from FZU-48/B to FMU-139(series) fuzes. The power cable assembly is a coiled electrical cable with electrical connectors at each end. The appropriate power cable is identified by the white backshell just aft of the fuze connector.

FZU-61/62(Series) Firing Lanyards

The FZU-61/B firing lanyard is a dual-legged lanyard with a pull ring break-link. It is used in conjunction with the FZU-48/B initiator and FMU-139(series) fuze to replace the existing FZU-48/B lanyard with one that will reach the aft arming unit of the BRU-32 bomb ejector rack. The FZU-61/B lanyard eliminates the need for the Mk 3 arming wire for safe jettisons. One of the two legs is removed—depending on what Mk/Mod bomb body is used. The FZU-62/B serves the same purpose as the FZU-61/B for the BRU-33/36/55 racks.

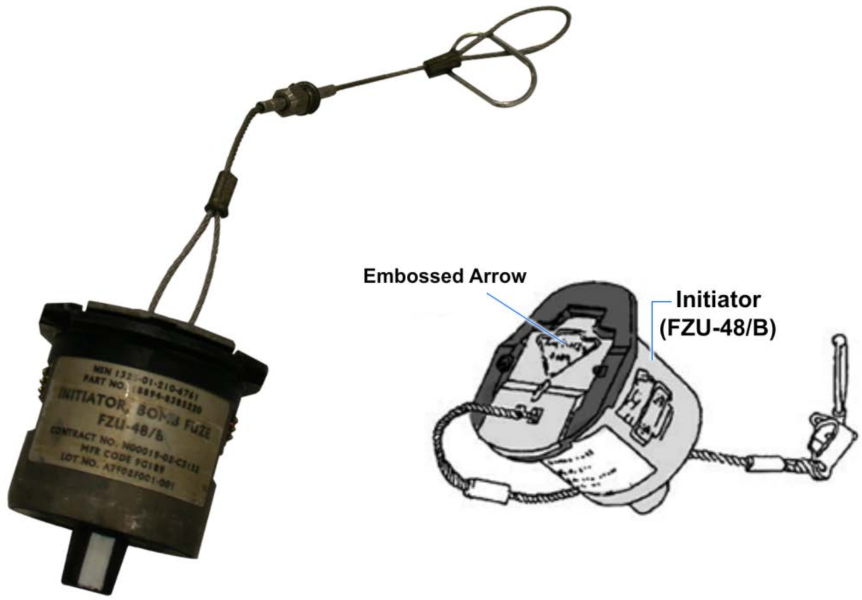

Figure 1-6 — FZU-48/B initiator.

> **NOTE**
>
> The DSU-33(series) and DSU-38(series) are classified CONFIDENTIAL and shall be handled in accordance with DOD 5200.1 R/AFI-31-401.

DSU-33(Series) Proximity Sensor

The DSU-33(series) proximity sensor (*Figure 1-7*) is an adverse-weather, self-powered, active, radio frequency, single mission device capable of operating in an electronic countermeasures (ECM) environment. The sensor interfaces with, and provides a proximity function for, the BLU-110/111/117 and Mk 80(series) general-purpose bombs. It is capable of both high and low drag release and provides a stable height of burst (HOB) above ground level (AGL) over all surfaces, in all projected environments and all meteorological conditions encountered in air attack missions.

Figure 1-7 — DSU-33(series) proximity sensor.

DSU-38(Series) Proximity Sensor

The DSU-38(series) proximity sensor (*Figure 1-8*) will detect, acquire, and track the energy reflected from a laser designated target. The DSU-38A/B integrates an adjustable proximity sensor (APS) which provides selectable height of burst input to the weapon fuze system.

FMU-140A/B Dispenser Proximity Fuze

Figure 1-8 — DSU-38(series) proximity sensor.

The FMU-140A/B dispenser proximity fuze (DPF) (*Figure 1-9*) is a self-powered, active, radio frequency, range-gated radar fuze capable of operating in a high ECM environment. It is used with the cluster bomb unit (CBU)-99 Rockeye and CBU-78 Gator weapons. Fuze electronics are mounted in aluminum support housing with antennas protected by a plastic radome. Height-of-function (HOF) and arming time control switches are easily accessible. Arming times on the FMU-140A/B DPF may be set at 1, 2, 4, 6, 8, and 10 seconds. The fuze also incorporates a 1.2 second arm-and-fire feature that permits the pilot to override the groundset HOF so the fuze functions 1.2 seconds after weapon release. This feature is particularly desirable in Marine Corps close-air-support missions. The Navy's FMU-140A/B DPF initiates a linear-shaped cutting charge. The fuze initiates opening of a dispenser at any one of ten ground-selectable, HOF altitudes between 300 and 3,000 feet. In the proximity mode, the fuze will arm at one of five ground-selectable arming times between 1.2 and 10 seconds. Opening occurs only during the downward trajectory of the munition or, if used in the time mode, 1.2 seconds after release.

Figure 1-9 — FMU-140A/B dispenser proximity fuze.

FMU-167/B Hard Target Void Sensing Fuze

The joint service (Navy/Air Force) FMU-167/B hard target void sensing fuze (HTVSF) electronic bomb fuze system (*Figure 1-10*) consists of an FMU-167/B fuze, a FZU-60/B initiator, retaining ring, and lanyard. The fuze system is designed for mounting only in the tail fuze well of the weapon and is only compatible with the GBU-31. When installed, it is completely enclosed within the weapon and held in place with a locking retaining ring. After installation, the fuze face panel remains accessible for the required weapon interface connections. External interface connections to the FMU-167/B

Figure 1-10 — FMU-167/B HTVSF with FZU-60/B initiator.

fuze are provided by the J1 connector on the aft end face-plate, and the J2 connector on the booster end of the fuze.

The FMU-167/B fuze provides safing, ground setting, and multiple delay time arming and fuzing functions. The fuze differs from other Navy fuzes in that it uses no moving parts and employs only secondary explosives. These secondary explosives are used in a position leading to the initiation of a high explosive main charge without physical interruption. The FMU-167/B fuze provides programmable fuzing logic capable of making active decisions during penetration. These include void detection, layer counting, path length calculation, primary time delay as well as an independent electrically programmable backup time delay of 0 to 255 milliseconds.

The FMU-167/B fuze system uses the FZU-60/B initiator to provide operating power for the fuze. The turbine alternator within the FZU-60/B initiator provides sustained power for all internal safety circuits. FMU-167/B fuze does not have external safety features, such as a safing pin or gag rod; the fuze remains in a safe condition until dropped from aircraft in actual use. The fuze cannot arm unless the fuze receives both a power signal that indicates FZU power and the appropriate arming signal. In the unlikely event that the fuze becomes armed (the high voltage capacitor is charged up) outside of actual use, the charge will bleed down within 30 minutes once power is removed and the fuze will then be safe to handle.

FZU-60/B Initiator

The FZU-60/B initiator is an air-driven, turbine-generator power supply and safety switch configured for installation in the charging well of the bomb. It fits inside the weapon charging well and generates power for the FMU-167/B fuze. The FZU-60/B initiator consists of a cylindrical metal housing with an integral cable on the bottom end. The top end has a hinged cover with a short, attached lanyard. When mounted on the aircraft, the short lanyard is attached to a longer, flexible lanyard with a swivel break-link that attaches to the bomb rack. The cover assembly has an arrow to indicate proper orientation when installed in the bomb. The FZU-60/B initiator connects to the FMU-167/B fuze via an integral cable from the initiator connected to the J2 connector on the fuze.

AIRCRAFT BOMB AMMUNITION AND ASSOCIATED COMPONENTS

Aircraft bombs are released over enemy targets to reduce and neutralize the enemy's war potential. This neutralization is done by destructive explosion, fire, nuclear reaction, and war gases. Aircraft bomb ammunition is used strategically to destroy installations, armament, and personnel. Also, aircraft bomb ammunition is used tactically in direct support of 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.

Bombs are 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.

GENERAL-PURPOSE BOMBS AND FIN ASSEMBLIES

General-purpose (GP) bombs are used in most bombing operations. GP bombs have a slender body made of steel with a well in the nose section for a nose fuze, adapter booster, proximity sensor, or penetrator plug (ogive or MXU-735); a well in the aft section for a tail fuze; and wells centrally located on the top of the bomb body—two for suspension lugs and one for the Mk 122 arming safety switch.

Their cases (bomb body) are aerodynamically designed and relatively light, and approximately 45 percent of their weight is made of explosives. The GP bombs are compatible with proximity sensors, and mechanical and electronic fuzes. These GP bombs may be outfitted with either a conical or retarding fin, laser/Global Positioning System (GPS) guidance airfoil kit, or underwater mine kit.

The GP bombs are olive drab or gray with stenciling on the side for identification. The size and weight of each bomb and other unique information is provided in the following paragraphs. Some bomb bodies have a thermal protective coat applied to the surface to extend the cook-off times (see *Table 1-1*). The nomenclature of the high-explosive filler, such as plastic bonded explosives (PBX) or plastic bonded explosives Navy (PBXN), in the bombs is stenciled on the bomb body, stamped on the base plug, and further identified by a yellow band around the nose. All Mk 80/BLU 100(series) GP bombs currently used aboard ships are required to be thermally protected. Thermally-protected bombs are identified by two yellow bands and the words THERMALLY-PROTECTED in the identification legend. The lot number is stenciled in white on the forward end.

Table 1-1 — Mk 80/BLU 100 Series Cook-Off Times

ORDNANCE	FUZE	AVERAGE REACTION TIME (Minutes & Seconds)	SHORTEST REACTION TIME	BOMB INITIATED REACTION	FUZE INITIATED REACTION (NOTE 1)
Mk 82, 83, 84 non-thermally protected (NTP)	All	3 + 30	2 + 30	Deflagration to explosion	Deflagration to detonation (after 5 minutes)
Mk 82 Mods (NOTE 2) BLU-111 A/B BLU-126/B thermally protected (TP)	FMU-139	10 + 00	8 + 30	Deflagration	Deflagration to detonation (after 12 minutes)
	No fuze	3 + 04	- - -	- - -	Deflagration to detonation (after 5 minutes)
Mk 83 Mods/ BLU-110A/B thermally protected (TP)	FMU-139	10 + 00	8 + 49	Deflagration	Deflagration to detonation (after 12 minutes)
Mk 84 Mods/ BLU-117A/B thermally protected (TP)	FMU-139	10 + 00	8 + 45	Deflagration	Deflagration to detonation (after 12 minutes)
BLU-109 A/B thermally protected (TP) PBXN-109	FMU-143	12 + 18	12 + 00	Deflagration	Deflagration
BLU-116A/B PBXN-109	FMU-143	14 + 15	11 + 58	Deflagration	Deflagration
BLU-110C/B	FMU-139	6 + 07	6 + 07	Burning Reaction	- - -
BLU-111C/B	FMU-139	11 + 30	11 + 30	Burning Reaction	- - -
BLU-117C/B	FMU-139	9 + 17	7 + 55	Burning Reaction	- - -
BLU-126A/B	FMU-139	11 + 30	11 + 30	Burning Reaction	- - -
BLU-129/B	- - -	21 + 10	21 + 10	Burning Reaction	- - -

NOTES

1. Fuze initiated reaction. Frequency of detonation reaction is small.
2. Chips in exterior coating and/or groove for retarding fin cut to bare steel do not change cook-off time.

The GP bombs currently in use are the GP Mk 80/BLU 100(series). The specifications for the individual bombs are listed in *Figure 1-11*. The basic difference between the bombs listed is their size and weight. The following description of the Mk 80/BLU 100(series) bomb is applicable to all bombs within the Mk 80/BLU 100(series) unless otherwise noted.

Physical Characteristics

	MK 82/ BLU-111	MK 83/ BLU-110	MK 84/ BLU-117
Weight			
Conical:	531 lb.	985 lb.	1970 lb.
Retard:	565 lb.	1105 lb.	N/A lb.
Dimensions			
Length:	90 in.	119 in.	154 in.
Diameter:	11 in.	14 in.	18 in.
Suspension Provisions:	14 in.	14 in.	30 in.

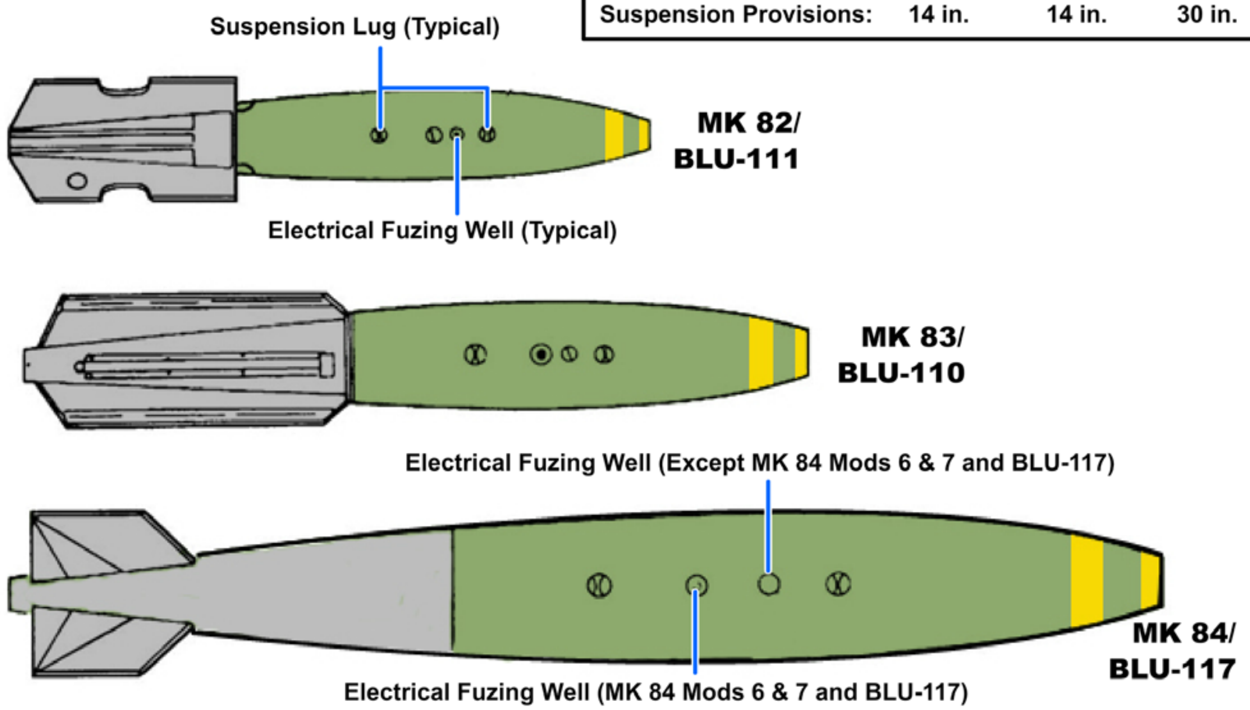

Figure 1-11 — Specifications for GP bombs.

Mk 80/BLU 100(series) GP bombs have two suspension lugs threaded into lug inserts on the bomb body. The high-explosive filler of the bomb is identified by yellow-stenciled nomenclature on the bomb body and yellow bands around the nose.

The BLU-110/111/117A/B bombs are Mk 82/83/84 GP bombs loaded with PBXN-109. The BLU-117C/B utilizes AFX-795 as the explosive filler. The BLU-111 replaces the Mk 82, the BLU-110 replaces the Mk 83 bomb and the BLU-117 replaces the Mk 84. Identification of a PBXN-109 loaded bomb can be made by the stencil on the bomb body (front and rear) and by three yellow bands on the nose. The BLU-110/111/117C/B are vented warheads for better insensitive munition (IM) reaction.

The BLU-126/B low-collateral damage (LOCO) bomb is identical to the BLU-111A/B with the exception of the amount of PBXN-109 explosive filler. The aft end of the bomb is filled with approximately 27 pounds of PBXN-109; the remainder of the bomb is filled with PBXN-109 inert stimulant. There is an extra yellow stripe around the aft end of the bomb body for ease of identification. The BLU-126A/B is a vented warhead for better IM reaction.

The BLU-129/B composite bomb body is a Mk 82 shape with very low collateral damage. The BLU-129 has no thermal protective coating. It uses AFX-1282 as an explosive fill which utilizes tungsten powder to match the mass properties of the Mk 82. It utilizes vented technology for better IM reaction. BLU-129 is restricted to use with guidance kits only.

The BLU-109A/B bomb is a 2,000 pound class bomb designated as a hard target penetrator (HTP). The GBU-24 components convert the bomb from a purely ballistic weapon to a guided weapon. The BLU-109A/B is loaded with PBXN-109, thermally protected, and identified by three yellow bands on the nose. The BLU-109C/B is a vented warhead for better IM reaction.

The BLU-116A/B consists of an explosive filled hardened steel penetrating case loaded with PBXN-109 and surrounded by an aerodynamic airframe, fuzewell, and associated hardware. It has the same external profile as the BLU-109, without thermal coating, with similar mass properties. The bomb consists of two major subassemblies, the airframe subassembly, and the penetrator case subassembly. The BLU-116A/B is identified by three yellow stripes on the nose.

Shipping Configuration

The bomb body (*Figure 1-12*) is shipped with a plastic plug installed in the nose and tail fuze well to prevent damage to the internal threads and 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.

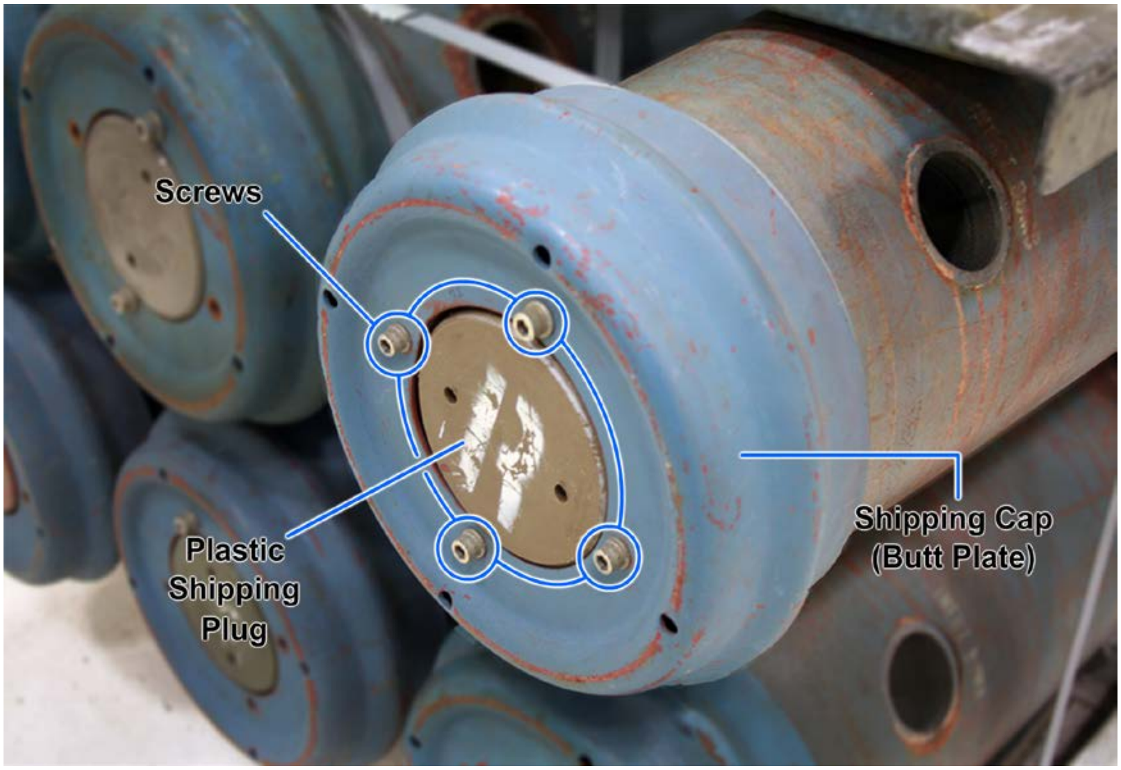

Figure 1-12 — Mk 80/BLU 100(series) bomb shipping configuration.

Bombs are shipped on metal pallets. The number of bombs loaded on each pallet depends on the bomb size. For example, six Mk 82/BLU 111 bombs, three Mk 83/BLU 110 bombs, or two Mk 84/BLU 117 bombs can be shipped on a pallet. Refer to the Transportation and Storage Data for Ammunition, Explosives and Related Hazardous Materials, Naval Sea Systems Command (NAVSEA) SW020-AC-SAF-010 for more information on shipping configurations.

Fuze Wells

The bomb body is designed with a nose and tail fuze well. These wells are internally threaded to receive electrical fuzes and associated components.

Fuze Charging Circuit

The forward and aft charging tubes are installed at the factory and contain the electric fuze wire harness (*Figure 1-13*). 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.

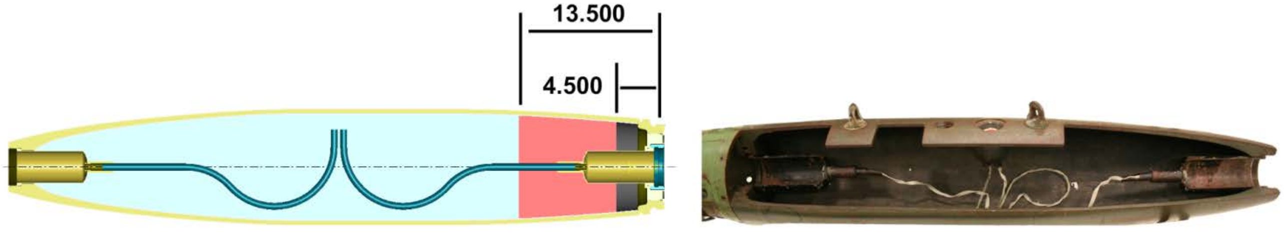

Figure 1-13 — Fuze charging circuit.

Suspension Lugs

There are two suspension lug wells 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 (*Figure 1-14*) 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.

Figure 1-14 — Suspension lug installation.

Nose Plugs

There are two basic nose plugs (*Figure 1-15*) used in GP bombs, the solid nose plug (MXU-735/B and MXU-735A/B) and the ogive nose plug. The ogive nose plug provides a pointed arch. A support cup is used in the nose well with the ogive nose plug to provide a solid structure to the bomb. The MXU-735 solid nose plug is designed to provide better penetration of hard targets, without the likelihood of nose plug shearing during oblique impact. The MXU-735 replaces the ogive nose plug and support cup.

Arming Wire Assemblies

Arming wire, cable, and lanyard assemblies (*Figure 1-16*) 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.

Figure 1-15 — Nose plugs.

> **NOTE**
>
> Dexter safety clips are used vice Fahnestock clips unless otherwise specified.

Normally, the wires consist of one or two brass or steel metal strands attached to a swivel loop. The MAU-166/MAU-182 swivel and ring assembly permits a method for indirect rigging of GP bombs so that no arming wires will remain hanging from the bomb rack after weapon release. Safety Fahnestock clips (*Figure 1-16*) or Dexter safety clips are attached to the ends of the arming wires after installation. They prevent premature or accidental withdrawal of the arming wires from the component.

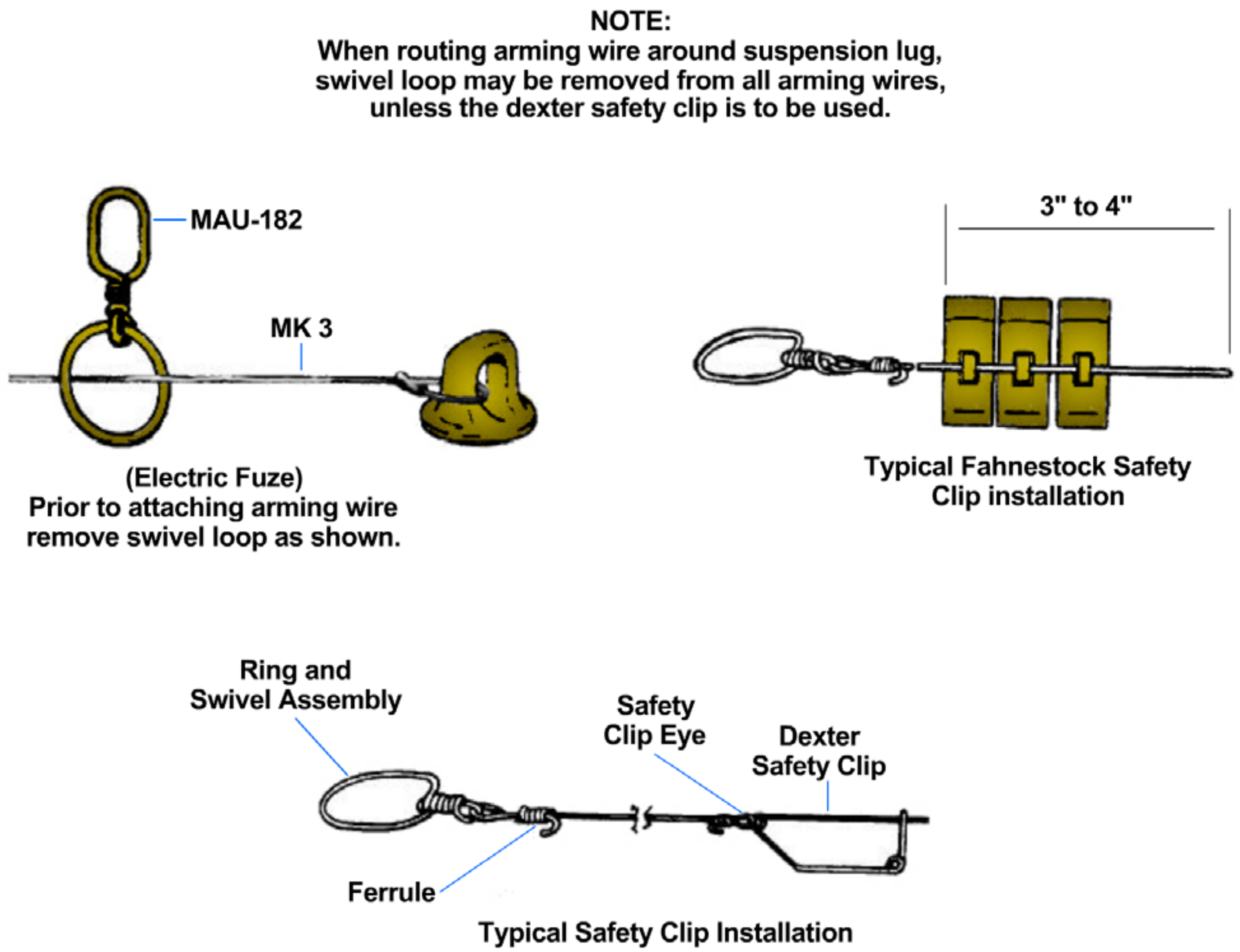

Figure 1-16 — Arming wire assemblies.

Normally, arming wire assemblies are shipped in spiral-wound fiber tubes, over-packed in a wooden box. Generally, the safety Fahnestock clips are packed in the tubes with the arming wires. The most commonly used arming wire assemblies are listed in *Table 1-2*.

Table 1-2 — Arming Wire Data

Arming Wires	Type	Material	Diameter (in.)	Leg Lengths (in.)
Mk 3 Mod 0	Single	Steel	0.032	57.0
Accessory Data				
Description				**Quantity**
Ring and Swivel MAU-182/MAU-166				1 ea
Self-Adjusting Positive Arming Adapter – Reusable				1 ea
Self-Adjusting Positive Arming Adapter, package in M19A1 Ammo Can – Reusable				100 per pkg

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

The F-35 joint strike fighter (JSF) aircraft uses unique lanyards and accessories. A Kevlar lanyard is used in conjunction with the arming wire loop assembly to actuate the air foil group of a GBU-12. One end of the lanyard consists of two lengths of rubber coated Kevlar. One end of the two lengths attaches directly to the weapon lug; the other end attaches to and provides activation of the air foil group.

Fin Assemblies

Fin assemblies, used with the Mk 80/BLU 100(series) GP bombs, provide stability to the bomb. The fin assemblies cause the bomb to fall in a smooth, definite curve to the target, instead of tumbling through the air. Each individual fin is crated in a lightweight, disposable metal crate (*Figure 1-17*) and shipped on metal pallets. Some fin assemblies are shipped with bomb lugs attached to the shipping crate, depending upon the particular Navy Ammunition Logistics Code (NALC)/Department of Defense Identification Code (DODIC).

Figure 1-17 — Fin shipping configurations.

Two types of fins are described in this chapter—conical fins and retarding bomb fin assemblies. The conical fin is used for the nonretard mode of delivery, and the retard/nonretard fin assembly can be used for either the nonretard or retard mode of delivery.

Conical Fin

The typical BSU-33(series) conical fin assembly (*Figure 1-18*) is steel, is 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. An index pin is located on the rim of the conical fin for mating with the index hole in the bomb. 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/BLU 100(series) bombs. The basic difference between the types of conical fins is their physical size and the larger the bomb, the larger the fin.

Figure 1-18 — Typical bomb conical fin assembly.

BSU-85/B Air Inflatable Retarder

The BSU-85/B bomb fin (*Figure 1-19*) attaches to the Mk 83/BLU 110 GP bomb. It is an air-inflatable retarder designed for very low altitudes. It can be dropped in either high-drag (retarded) or low-drag

Figure 1-19 — Typical BSU-85/B air-inflatable retardable fin with high- and low-drag configurations.

(unretarded) mode. The BSU-85/B fin attaches to the bomb body by eight setscrews. It is a self-contained unit that consists of a stabilizer assembly (canister housing) with four fixed fins (X-shaped) and a lanyard assembly. The four fixed fins provide low-drag aerodynamic stability. The wedges installed on the trailing edges provide stabilizing spin during both low-drag and high-drag release.

BSU-86/B Bomb Fin

The BSU-86/B bomb fin (*Figure 1-20*) is used with GP bombs, Mk 82 Mods/BLU 111(series), or the practice bomb BDU-45/B. The fin provides a retarded (high-drag) or unretarded (low-drag) bomb delivery capability for the aircraft. The BSU-86/B fin is attached to the Mk 82/BLU 111 or BDU-45/B bomb by eight setscrews. A 25-degree wedge is located at the tips of each fin to impart spin. The air stream drives the fin open rapidly, when the MAU-199/B spring arming wire (SAW) is activated. The spring load under each fin blade initiates fin opening.

Figure 1-20 — BSU-86(series) bomb fin.

Principles of Operation

There are three modes of delivery available for the 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 slow down 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. Therefore, the retarded mode of delivery is used during low-level bombing to prevent damage to the aircraft.

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 to the full-open position by the air stream, 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 that reads 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 the weapon in the retarded or unretarded mode. This mode is made 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 release allows it to remain in the fin release band, preventing the fins from opening, which results in an unretarded delivery.

GUIDED BOMB UNITS

The Guided Bomb Unit System utilizes bomb bodies of Mk 80 Series low drag general purpose bombs to detect a target illuminated by a laser beam.

GBU-10/12/16

GBU-10/12/16 (*Figure 1-21*) are Mk 80/BLU-110/111/117(series) GP bombs modified to detect a target illuminated by a laser beam. The modification consists of a munition auxiliary unit- (MAU-) 169(series), MAU-209(series) computer control group (CCG), or weapon control unit- (WCU-) 10(series) control section (CS) and the MXU-650, -651, or -667(series) air foil group (AFG). The CCG and guidance fins are mounted on a forward adapter assembly and provide target detection and guidance. The wing assembly is mounted aft.

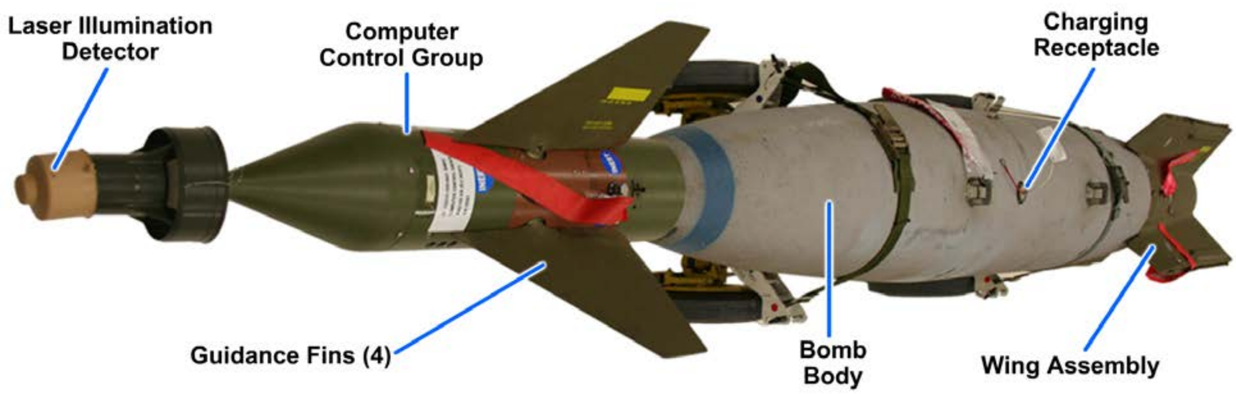

Figure 1-21 — Typical GBU configuration.

The GBU-12F/B is a dual-mode weapon that incorporates GPS guidance using the WGU-53/B vice the MAU-169, MAU-209 or WCU-10. Each AFG contains identical items; although they are different in physical size, they perform identical functions. A typical AFG is composed of a folding wing assembly, forward adapter assembly, guidance fins, and hardware required for assembly of laser-guided weapons.

The CCG mounts on the nose of the bomb body, precluding the use of nose fuzing. The CCG detects a laser-illuminated target and provides weapon guidance signals to the moveable guidance fins (canards). The 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 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 GP markings.

GBU-51/B and GBU-52/B

The GBU-51/B and GBU-52/B GBUs are BLU-126(series) LOCO bombs modified to detect a target illuminated by a laser beam. The GBU-51/B modification consists of a MAU-169(series), MAU-209(series) CCG or WCU-10(series) Control Section and MXU-650(series) AFG. The CCG and guidance fins are mounted on a forward adapter assembly and provide target detection and guidance. The wing assembly is mounted aft. The GBU-52/B is a dual-mode weapon that incorporates GPS guidance using the WGU-53/B vice the MAU-169, MAU-209, or WCU-10.

GBU-24(Series) Paveway III

The GBU-24(series) Paveway III (*Figure 1-22*) is a converted BLU-109A/B or BLU-116A/B 2000-pound-class bomb designated as an HTP. The associated components required for conversion are fuze, airfoil group, FZU initiator, adapter group, and guidance control unit. The heavy-walled case of the bomb provides the penetration capability of 4 to 6 feet of reinforced concrete. The BLU-109A/B and BLU-116A/B have identical characteristics, except the BLU-109A/B has a thermal protective coating applied to the surface to extend the cook-off time. Prior to assembly, verify the BLU-109A/B is not missing more than 20 square inches of thermal coating in a single area or more than 40 square inches total to be acceptable for use.

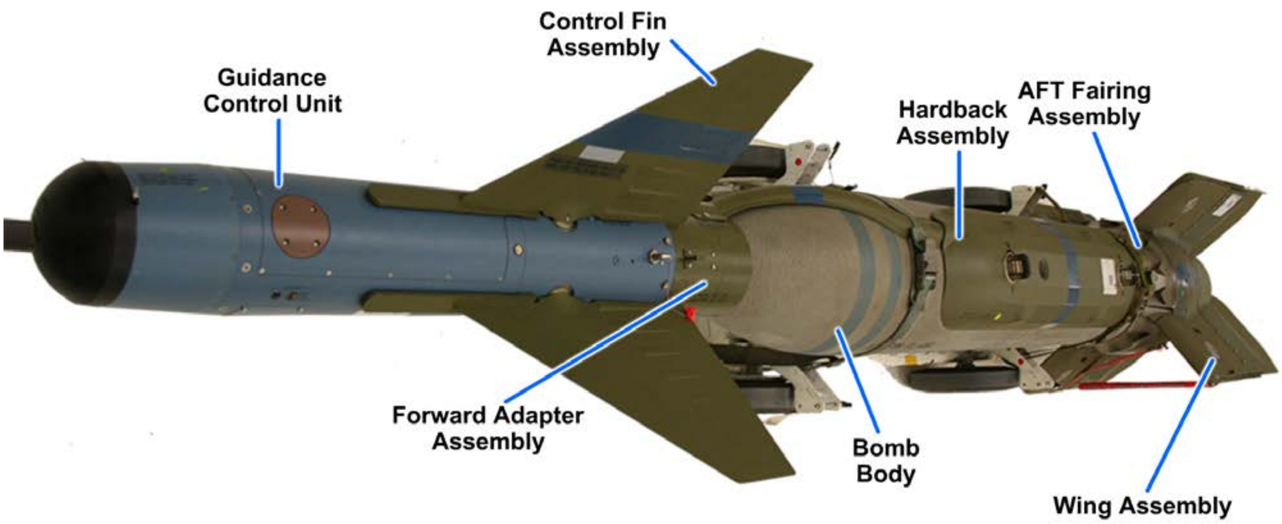

Figure 1-22 — GBU-24(series) Paveway III configuration.

Joint Direct Attack Munition (JDAM)/Laser JDAM Series

The JDAM GBUs (*Figures 1-23 and 1-24*) are Mk 82/83/84, BLU-109, or BLU-110/111/117/126/129 bombs modified with GPS guidance sets. The guidance sets for these weapons are functionally the same but not interchangeable because of the guidance software and physical interface with the warhead. Guidance set control fin actuators contain either electrically released motor “friction” brakes (designated KMU-55X/B) or a fin lock device (designated KMU-55XX/B and KMU-572X/B) that unlock the tail control fins in flight. New production variants of the fin lock device guidance sets will be equipped with either selective availability anti-spoofing module (SAASM) (designated KMU-55XB/B and KMU-572B/B) to provide capability of decoding new GPS cryptography or anti-jamming (AJ) (designated KMU-55XC/B and KMU-572C/B) equipment consisting of a new antenna and associated electronics in the tail assembly. The AJ variant allows the JDAM to navigate with precision using GPS signals in regions containing active GPS jammers. Laser JDAM (LJDAM) adds a laser detector, DSU-38(series), to the GBU-38(series) (500 pound) weapons. With the DSU-38 series, the weapons are redesignated as GBU-54(series).

Physical Characteristics	GBU-32 Series	GBU-38 Series	GBU-54 Series
Weight	1031 lbs.	558 lbs.	580 lbs.
Dimensions:			
Length	119.49 in.	92.64 in.	92.64 in.
Diameter	19.62 in.	17.00 in.	17.00 in.
Suspension Provisions	14 in.	14 in.	14 in.

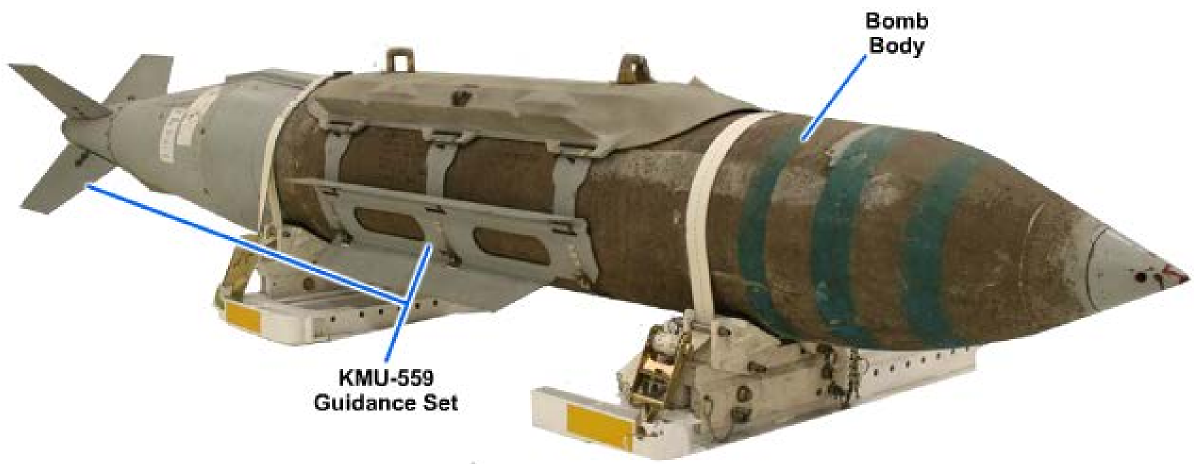

Figure 1-23 — Typical JDAM configuration.

Physical Characteristics	GBU-32 Series	GBU-38 Series	GBU-54 Series
Weight	1031 lbs.	558 lbs.	580 lbs.
Dimensions:			
Length	119.49 in.	92.64 in.	92.64 in.
Diameter	19.62 in.	17.00 in.	17.00 in.
Suspension Provisions	14 in.	14 in.	14 in.

Figure 1-24 — Typical Laser JDAM configuration.

MINES

The Mk 62 mine is a 500-pound weapon and the Mk 63 mine (*Figure 1-25*) is a 1,000-pound weapon. Mk 62 and 63 mines are aircraft-laid and can be utilized as land mines or may be laid in shallow to deep water as bottom mines. The component interchangeability concept of the mine permits defective components to be quickly and easily replaced without greatly affecting the operational readiness of the weapon. This concept also allows the Mk 62 and Mk 63 mines to be identical to their bomb counterpart in appearance, external configuration, weight, CG, ballistics, handling, and loading.

The Mk 62 mine consist of Mk 82 or BLU-111 bomb body, and the Mk 63 mine consist of Mk 83 or BLU-110 bomb body. A bomb/mine conversion kit, Mk 130 Mod 1, contains the Mk 32 arming device, Mk 59 booster, and the Mk 57 target detecting device (TDD), which requires an Mk 130 battery to be installed. The bomb/mine conversion kit also has the necessary hardware (less battery and fin assembly) to convert a GP bomb to an air-laid mine.

The Mk 65 Mods mines (*Figure 1-26*) are 2,000-pound, aircraft-laid, all modular, influence actuated, bottom mines used against submarines and surface targets. PBXN-103 is used as the explosive payload. Through use of specific components, Mk 65 Mod 0, Mod 1, and Mod 3 mines can each be assembled in two operational assemblies (OAs). The Mk 65 mine consists of a Mk 65 mine case, a Mk 45 safety device arming group with an Mk 2 arming device, a Mk 57 target detecting device, and a Mk 7 tail assembly.

Figure 1-25 — Mk 63 mine.

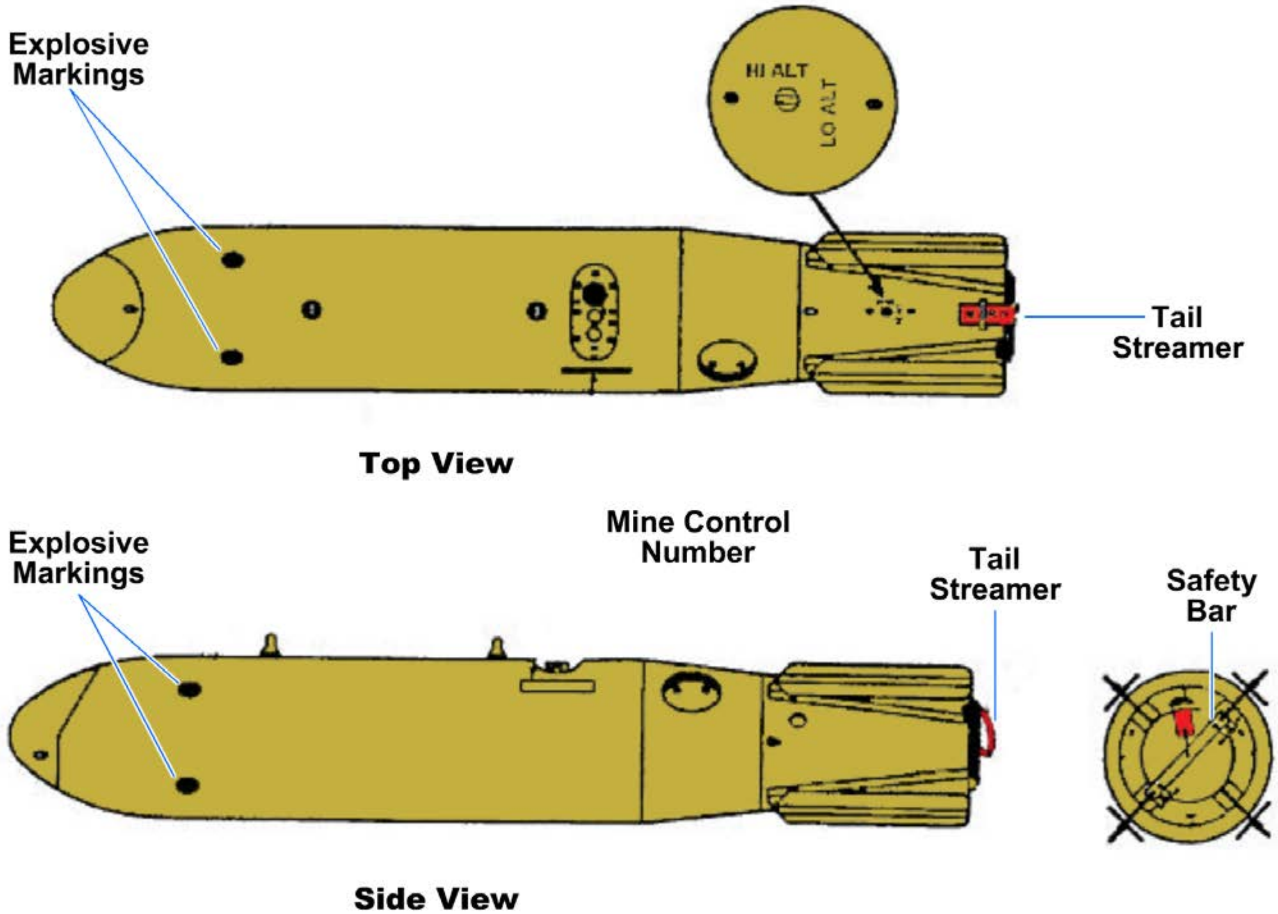

Figure 1-26 — Mk 65 mine.

CLUSTER BOMB UNITS

CBUs are weapons that dispense smaller weapons over a large area. The method of dispensing provides for release of the entire CBU, which separates, by fuzing action, at a prescribed altitude. The smaller weapons are scattered when the CBU separates.

CBU-99B/B Antitank Bomb Cluster (Rockeye) and Dispenser Bomb Stores Suspension and Releasing Unit-76C/B

The antitank bomb cluster is a free-fall, folding fin, airburst weapon. The bomb consists of a Mk 7 Mod 3 bomb dispenser loaded with Mk 118 Mod 0 antitank bombs and a Mk 339 mechanical time fuze or retrofitted with the FMU-140/B DPF. The bomb cluster is delivered to operating activities completely assembled with 14-inch suspension lugs, arming wires, extractors, fuze, and a removable fuze protective cover installed. Fins are held in the folded position with a fin retaining band secured by an arming wire and a ground handling safety pin. When the ground handling safety pin and arming wire are removed, the spring loaded fins open to a 34.2 inch span.

The dispenser bomb stores suspension and releasing unit (SUU)-76C/B is configured as a CBU-100/B (*Figure 1-27*) that has had the Mk 118 bomblets removed and has a payload sleeve and spacers installed. When the payload sleeve is filled with leaflets and inserted into the dispenser, the All-Up-Round (AUR) is redesignated PDU-5/B. Information on decanning, preparation for use, and recanning procedures are found in Airborne Weapons Assembly Manual Cluster Bombs Units, NAVAIR 11-140-9.

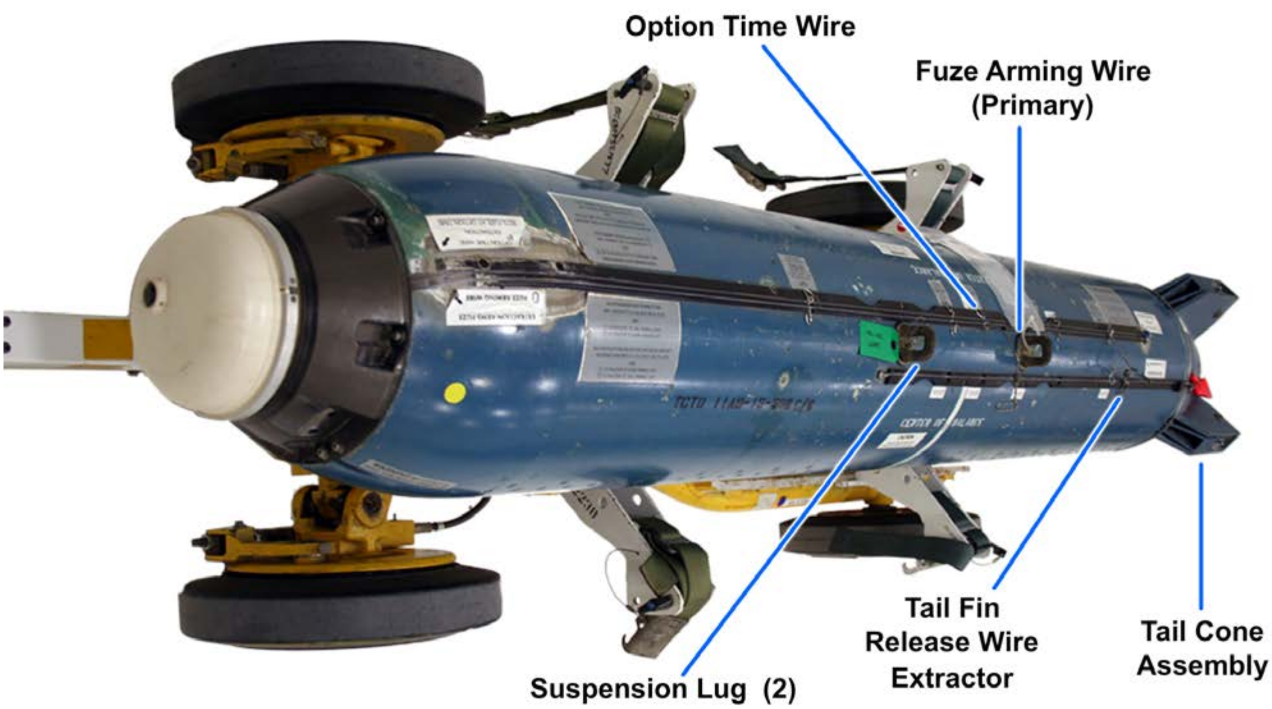

Figure 1-27 — CBU-100/B with FMU-140.

CBU-78C/B Bomb Cluster (GATOR)

The CBU-78C/B bomb cluster is an antipersonnel/antitank, free fall, folding fin, airburst weapon. The weapon consists of an SUU-58/B dispenser, loaded with BLU-91/B and BLU-92/B mines, BRU-42/B kit modification unit, and a FMU-140A/B DPF. The weapon is delivered to operating activities completely assembled with 14-inch suspension lugs, arming wire extractors, and a removable fuze cover installed. Fins are held in the folded position with a fin retaining band secured by an arming wire and a ground handling safety pin.

Mk 7 and Mods Bomb Dispenser

The cargo section of the Mk 7 bomb dispenser 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 dispenser has two linear-shaped charges (LSCs) 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.

A yellow band around the forward end of the cargo section indicates the explosive content of the weapon.

The CBU-99B/B consists of the thermally protected Mk 7 Mod 6 bomb dispenser loaded with 247 Mk 118 bomblets. The LSC is secured to the inner wall of the bomb dispenser. FMU-140A/B DPF initiates the LSC.

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.

SUU-58/B Subsonic Free-Fall Dispenser

The SUU-58/B consists of a cargo section with a nose fairing assembly attached, a tail cone assembly, and fuze arming wires with extractors. There are two observation windows—one for viewing the safe/arm indicator and the other to observe the fuze time-setting dials. The cargo section houses the BLU-91/B and BLU-92/B mines. The tactical weapons have two yellow bands around the nose cone fairing.

SUU-76C/B (PDU-5/B) Dispenser Bomb

The SUU-76C/B (PDU-5/B) dispenser bomb (*Figure 1-30*) consists of the aluminum Mk 7 Mod 3 bomb dispenser. A LSC is secured to the inner wall of the bomb dispenser. A mechanical dispenser fuze, Mk 339, initiates the LSC. The dispenser consists of a SUU-75 bomb dispenser loaded with leaflet material and an Mk 339 mechanical time fuze.

The SUU-76C/B (PDU-5/B) is delivered to operating activities completely assembled with 14-inch suspension lugs, arming wires, extractors, fuze, and a removable fuze protective cover. Fins are held in the folded position with a fin retaining band secured by an arming wire and a ground handling safety pin. When the ground handling safety pin and arming wire are removed, the spring loaded fins open to a 34.2 inch span. The leaflet dispenser contains an in-flight fuze option that requires the use of an option time wire and extractor, and has a fuze observation window for verifying settings and safety. The dispenser has fin and fuze tethers incorporated to retain release bands when the dispenser is released.

BLU-91/B and BLU-92/B Mines

The target sensors are the primary difference between the two mines. The BLU-91/B uses an armor-piercing warhead and a magnetometer type of sensor; the BLU-92/B has a fragment type of warhead with trip wires as the primary target sensor.

Mk 118 Mod 0 and Mod 1 Antitank Bomblets

The antitank bomblets Mk 118 Mod 0 (*Figure 1-28*) consists of an Mk 1 Mod 0 fuzing system, a shaped-charge warhead, and fixed stabilizing fins.

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 sandbags, the bomb penetrates the targets until deceleration lets the inertia firing pin strike and initiate the stab detonator, causing warhead denotation.

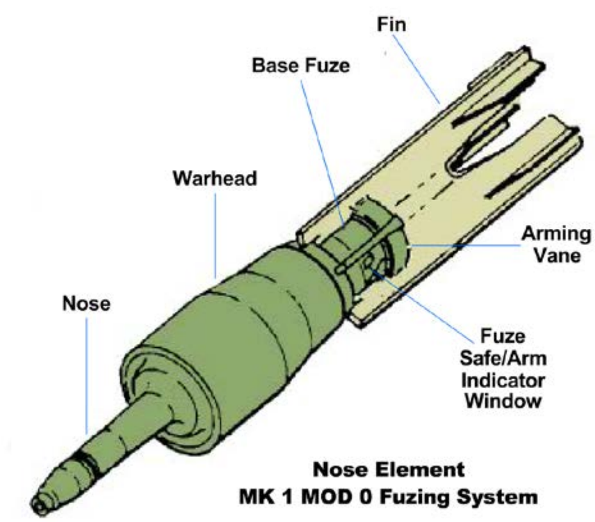

Figure 1-28 — Antitank bomblets Mk 118 Mod 0/Mod 1.

Functional Description

When the bomb cluster is released from the aircraft, the arming wires (primary and/or optional arming) are pulled sufficiently to arm the Mk 339 mechanical fuze or FMU-140A/B DPF and release the fins. After the positive armed fin release arming wire frees the fin release band, the movable fins snap open by spring force.

Functioning of the fuze initiates the linear-shaped charges in the dispenser cuts the dispenser case in half and disperses the bombs/bomblets. When the Mk 339 Mod 1 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.

SHIPPING AND STORAGE CONTAINERS

Shipping containers store and ship various thermally protected weapons. The configuration of each container is unique for each weapon. The containers have customized shipping cushions, bracing, carrying handles, and lifting rings to facilitate handling and protection of the weapon.

CNU-319/E Shipping and Storage Container

The shipping and storage container, CNU-319/E, is used to ship and store two each CBU-78, CBU-99, or SUU-76C/B bomb clusters. The container, made of welded steel, consists of a cover and lower body assemblies. The container is free-breathing with holes in the bottom. The cover assembly has four stacking angles—one at each corner—that allow air circulation (when stacked as many as five high) as well as protection from container scrapes and gouges. Two stationary handles on each end of the cover are provided to lift off the cover.

CNU-238/E Multipurpose Shipping and Storage container

The multipurpose shipping and storage container, CNU-238/E, is used to ship and store two each CBU-78, CBU-99, or SUU-76C/B bomb clusters. The container consists of a welded steel cover assembly and a lower body. The cover assembly has four stacking lugs and four lifting handles for removing the cover assembly.

PRACTICE BOMBS

Practice bombs are used to simulate the ballistic properties of service bombs. Practice bombs are manufactured as either solid or cast-metal bodies. 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, GP bombs are used for full-scale practice bombing. These bombs are physically the same as the Mk 80(series) GP 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 BDU-48/B. The two types are used for practice and are quite different in design and appearance from each other.

Mk 76 Mod 5

The Mk 76 Mod 5 is a 25-pound, solid, metal-cast, practice bomb (*Figure 1-29*). 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 tail fins. The bomb is designed with single-lug suspension, using the Mk 14 suspension lug.

Figure 1-29 — Mk 76 Mod 5 practice bomb.

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 and the identification nomenclature is stenciled in white letters on the bomb body.

BDU-48/B

The BDU-48/B is a 10-pound practice bomb (*Figure 1-30*). 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 assembly, and box-type conical fins. The firing device consists of a firing pin assembly and a cotter pin. The BDU-48/B is painted blue. Identification nomenclature is stenciled in white letters on the bomb body. The bomb can use signal cartridge Mk 4 Mod 3, or CXU-3A/B. While handling or transporting bombs, loaders should avoid placing their bodies in line with either end of the bomb.

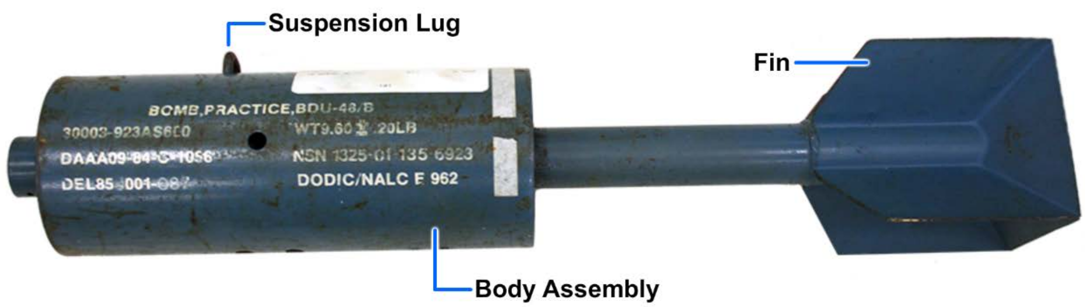

Figure 1-30 — BDU-48/B practice bomb.

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.

The full-scale practice bombs currently in use are the Mk 80(series) inert bombs and BDU-45(series) practice bomb (*Figure 1-31*). They include the Mk 82 inert, Mk 83 inert, and Mk 84 inert GP bombs. These bombs are assigned a different NALC/DODIC 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.

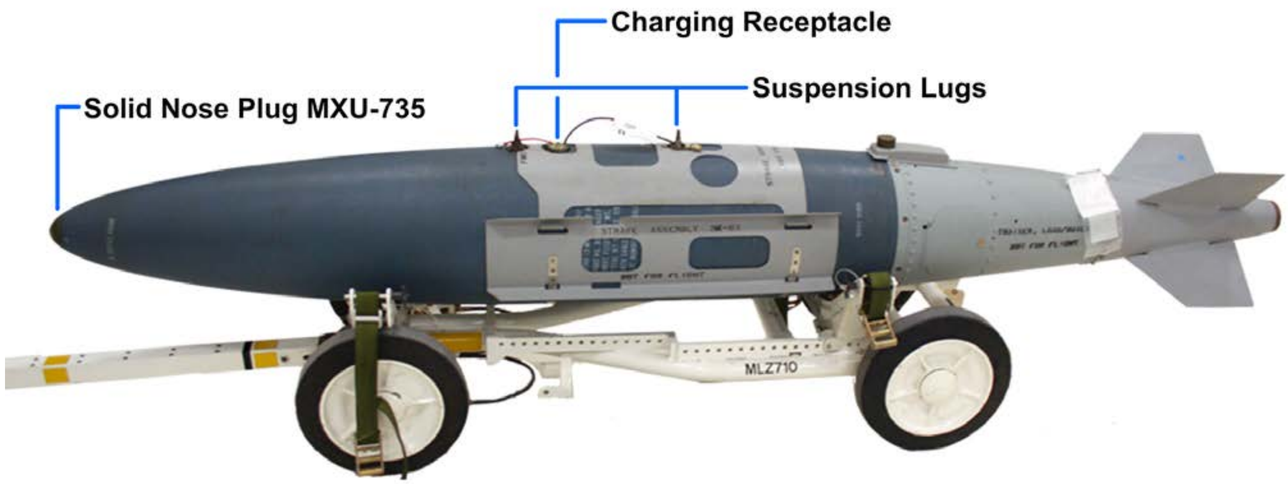

Figure 1-31 — BDU-45/B practice bomb.

The Mk 80(series) inert GP bombs are painted blue. The new Mk 80(series) inert GP 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 (*Figure 1-32*) is designed for use in the tail fuze well of the Mk 80(series) inert GP bombs. A practice bomb signal cartridge is installed in the Mk 89 Mod 0, which provides visual observation (smoke) of weapon-target impact. 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.

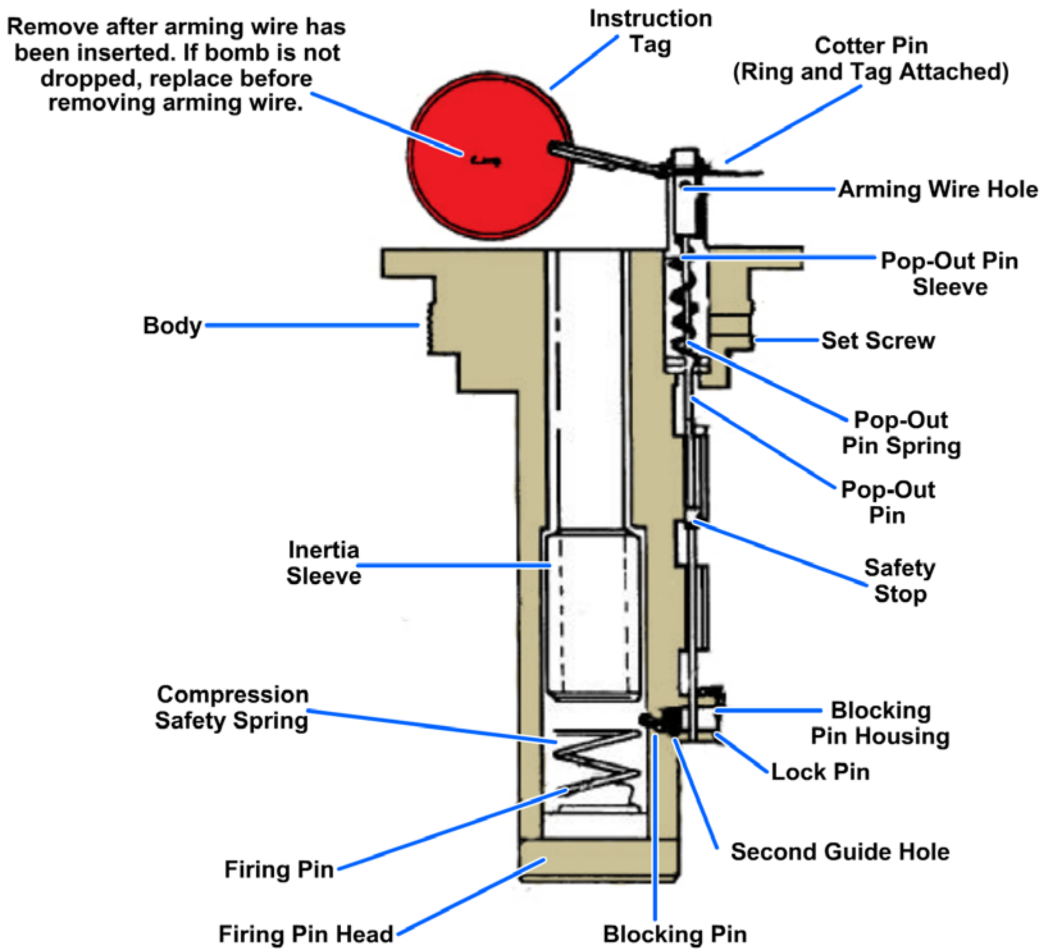

Figure 1-32 — Mk 89 Mod 0 bomb-spotting charge adapter.

BDU-59(Series) Laser Guided Training Round

The laser guided training round (LGTR) (*Figure 1-33*) provides a low cost training device permitting aircrews to realistically practice the employment of Paveway II LGTRs. The LGTR duplicates the release envelope and terminal guidance, and closely matches the time of flight characteristics of the GBU-10/12/16.

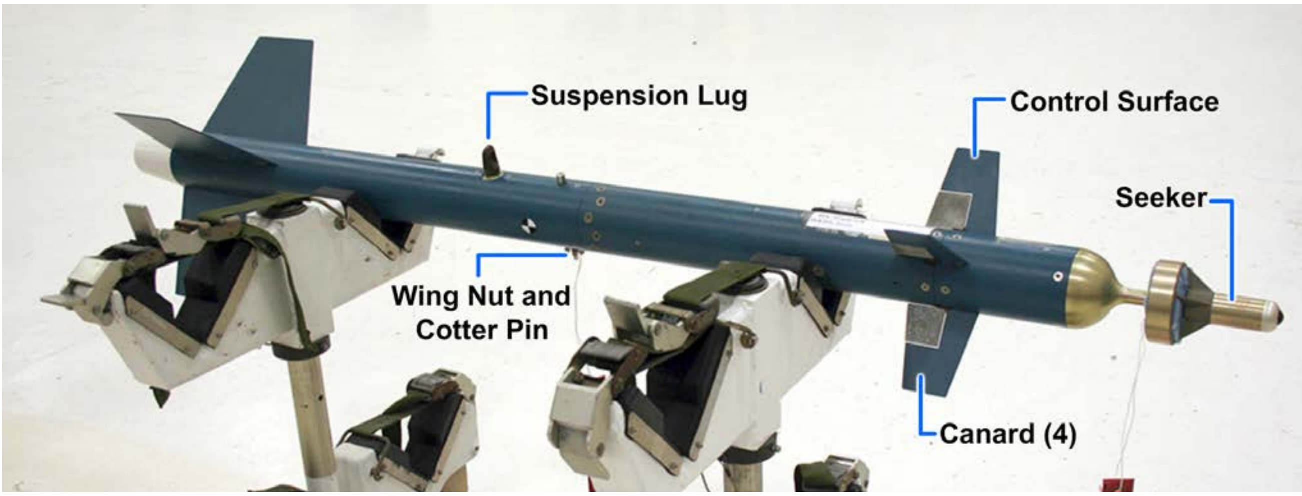

Figure 1-33 — Laser guided training round.

The AUR LGTR has an aero-stabilized seeker to align the seeker to the LGTR velocity vector. The seeker can detect laser energy transmitted on one of twelve laser frequencies (*Figure 1-34*). A screwdriver-operated switch is provided to select one of the four to twelve prebriefed laser code settings. The LGTR is 4 inches in diameter and 75 inches long. The LGTR has a weight of 89 pounds. The AUR shall not be disassembled for any maintenance inspection.

The guidance and control system uses pursuit navigation logic to null out the line of sight errors observed by the detector. Steering commands are provided to a pneumatic actuator driven by stored, compressed gas to deflect the canards.

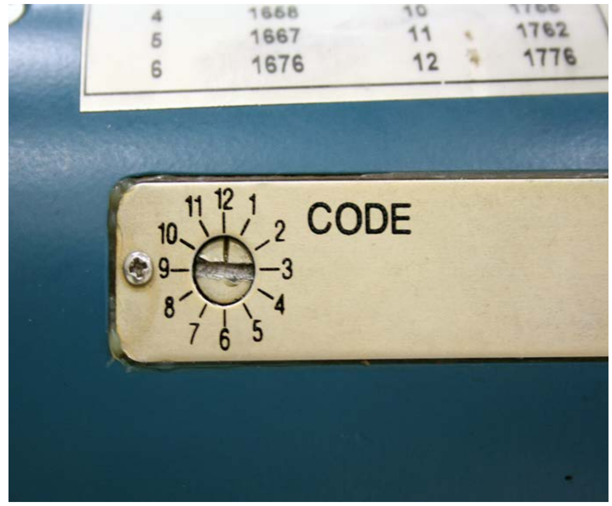

Figure 1-34 — LGTR laser code frequency.

The LGTRs single Mk 14 suspension lug interfaces with the multiple-carriage bomb rack ejector unit's aft hook. Two LGTR adapter brackets must be used to secure the LGTR to the ejector unit. The LGTR adapter brackets are attached to the multiple-carriage bomb rack ejector units forward and aft sway brace assemblies. The adapter brackets are sway-braced to secure the LGTR to the ejector unit.

SAFETY PRECAUTIONS

The following are general precautions that are not related to any specific procedures. These are recommended precautions that personnel must understand and apply during many phases of aircraft rearming.

- The hazards of bomb ammunition will vary, depending on the types and quantities of explosives involved regardless of the particular weapons being handled, potential hazards are always present; explosive bomb ammunition is hazardous because of its tendency, when detonated, to set off all explosive material that is near it
- Most fuzes contain a charge of high explosives and must be handled carefully; when compared to the booster charge, the amount of explosives is small; however, the explosives in fuzes are much more sensitive; fuzes are manufactured to meet all safety requirements when used properly, but the safety features designed in any weapon or explosive component are only as reliable as the person using them
- Fuzes are packed in sealed, moisture-proof containers, and should not be unsealed until they are required for use; fuzes that are 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
- 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
- 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

- 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, and newly assigned personnel—still in training—are assigned as crewmembers and never permitted to work alone until they are fully qualified and certified

For specific safety precautions regarding bomb ammunition refer to the specific ammunition and the aircraft loading manuals.

End of Chapter 1

Bombs, Fuzes, and Associated Components

Review Questions

1-1. What term describes the time or number of arming vane revolutions needed for the firing train to align after a bomb is released?

A. Arming time
B. Delay time
C. Nondelay time
D. Safe air travel time

1-2. What means is used to initiate an electrical fuze?

A. Bomb release
B. Electrical impulse
C. Equipment release
D. Mechanical action

1-3. What mechanical time fuze is used with dispenser weapons?

A. FMU-139
B. FMU-143
C. Mk 1 Mod 1
D. Mk 339 Mod 1

1-4. By what means, if any, can the factory set primary and optional functioning delay of the Mark 339 be changed for tactical requirements?

A. Adjusting the primary and option time-setting dials
B. Pulling both the arming wire and option wire
C. The pilot selecting the option mode of delivery
D. None; the settings cannot be changed

1-5. What method is used to determine if the Mark 339 fuze has shifted from the primary to the option delay?

A. By checking the time setting observation window of the fuze
B. By looking for the indicator pin
C. The arming wire has been pulled during handling
D. The fuze is in a safe condition

1-6. Which of the following weapons uses a fuzing munition unit (FMU)-143(series) tail fuze?

A. CBU-100
B. CBU-78
C. GBU-12
D. GBU-24(series)

1-7. What electronic bomb fuze is used in Mark 80/bomb live unit-100(series) general purpose bombs?

A. FMU-139
B. FMU-140
C. FMU-143
D. FMU-152

1-8. What electronic bomb fuze is used for retarded delivery of the Mark 80/bomb live unit-100(series) bomb?

A. FMU-139
B. FMU-140
C. FMU-143
D. FMU-152

1-9. What type of bomb is used in most routine bombing operations?

A. Cluster bombs (CBU)
B. General-purpose (GP) bombs
C. Low-collateral damage (LOCO) bombs
D. Special purpose bombs

1-10. What total number of yellow bands identifies a bomb live unit (BLU)-110/111/117A/B bomb loaded with plastic bonded explosives Navy-109?

A. One
B. Two
C. Three
D. Four

1-11. A bomb body is shipped with a plastic plug installed in the nose and tail fuze wells to prevent what occurrence?

A. Accidental arming
B. Damage to the internal threads and moisture from entering the fuze wells
C. Static charge build-up
D. The explosive filler from spilling out

1-12. When shipping bombs, what type of pallet is used?

A. Metal
B. Plastic
C. Shipping
D. Wood

1-13. When shipping, what factor determines the number of bombs that are loaded on each metal pallet?

A. Quantity of bombs ordered
B. Size of the bombs
C. Size of the pallet
D. Type of bomb hoist used

1-14. Arming wire assemblies are used for what purpose?

A. Actuate the fin assembly
B. Initiate the arming sequence of electrical fuzes
C. Initiate the arming sequence of mechanical fuzes
D. Maintain ordnance components in a safe condition until the actual release of a weapon from an aircraft

1-15. Premature or accidental withdrawal of an arming wire from a component is prevented by the installation of which of the following devices?

A. C-clamps
B. Dexter safety clips
C. Metal crimps
D. Plastic retainers

1-16. What items are used to attach a conical fin assembly to the aft end of a bomb body?

A. Quick-release adapters
B. Quick-release clamps
C. Cam locks
D. Setscrews

1-17. What bomb fin is used with the Mark-82/bomb live unit-111 bomb to provide a retarded (high-drag) bomb delivery for the aircraft?

A. BSU-33
B. BSU-45
C. BSU-85
D. BSU-86

1-18. What general-purpose bomb, if any, is used with the bomb stabilizer unit (BSU)-85/B Air Inflatable Retarder?

A. Mk-82/BLU-111
B. Mk-83/BLU-110
C. Mk-84/BLU-117
D. General-purpose bombs do not use the BSU-85

1-19. If applicable, how do laser-guided bombs detect a target?

A. Laser beam illumination
B. Laser-guided bombs do not detect targets
C. Programmed target data
D. Remote guidance

1-20. In what location is the wing assembly mounted on the guided bomb units?

A. The aft end of the bomb body
B. The centerline of the bomb body
C. The nose of the bomb body
D. The right side nose and the left side aft of the bomb body

1-21. The computer-control group of a laser guidance kit is used for what purpose?

A. To detect laser-illuminated targets and to provide an attachment point for the guidance fins
B. To laser-illuminate targets
C. To provide an attachment point for the guidance wings
D. To provide an attachment point for the wing assemblies

1-22. What modification kit is used to convert general purpose bombs into mines?

A. Mk 130 Mod 1 bomb/mine conversion kit
B. Mk 12 bomb conversion kit
C. Mk 32 arming device
D. Mk 9 mine conversion kit

1-23. What bomb body, if any, is used to make the Mark 63 mine?

A. Mk 82/BLU-111
B. Mk 83/BLU-110
C. Mk 84/BLU-117
D. Bomb bodies are not used to make mines

1-24. What is the purpose of the Mark 339 Modification 1 mechanical time fuze?

A. Initiate the linear-shaped charges in the cargo section wall
B. Provide movable fins
C. Provide the arming wires
D. Stabilize weapon during delivery

1-25. Which of the following items are components of the Mark 118 Modifications 0 and 1 antitank bombs?

A. Laser guided seeker
B. Mk 10 Mod 0 fuzing system
C. Shaped-charge warhead
D. Variable stabilizing fins

1-26. Practice bombs are used for what purpose?

A. Provide full-scale bombing
B. Provide safety when training new or inexperienced pilots and ground-handling crews
C. Represent service bombs in their size and tumbling effect
D. Simulate bombing runs

1-27. What type of ammunition causes the most injuries to personnel?

A. Aircraft bombs
B. Missiles
C. Practice bombs
D. Rockets

RATE TRAINING MANUAL – USER UPDATE

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