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/electrical action to detonate the main burster charge. A mechanical action or an electrical impulse, which causes the detonator to explode, fires the primer. 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.*

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

FUZE TERMINOLOGY

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

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 multi-positioned.

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) 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). 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. 1-1) is a mechanical impact nose fuze used in the Mk 80 (series) low-drag general-purpose (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 it 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 an 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, 0.1, or 0.25 second.

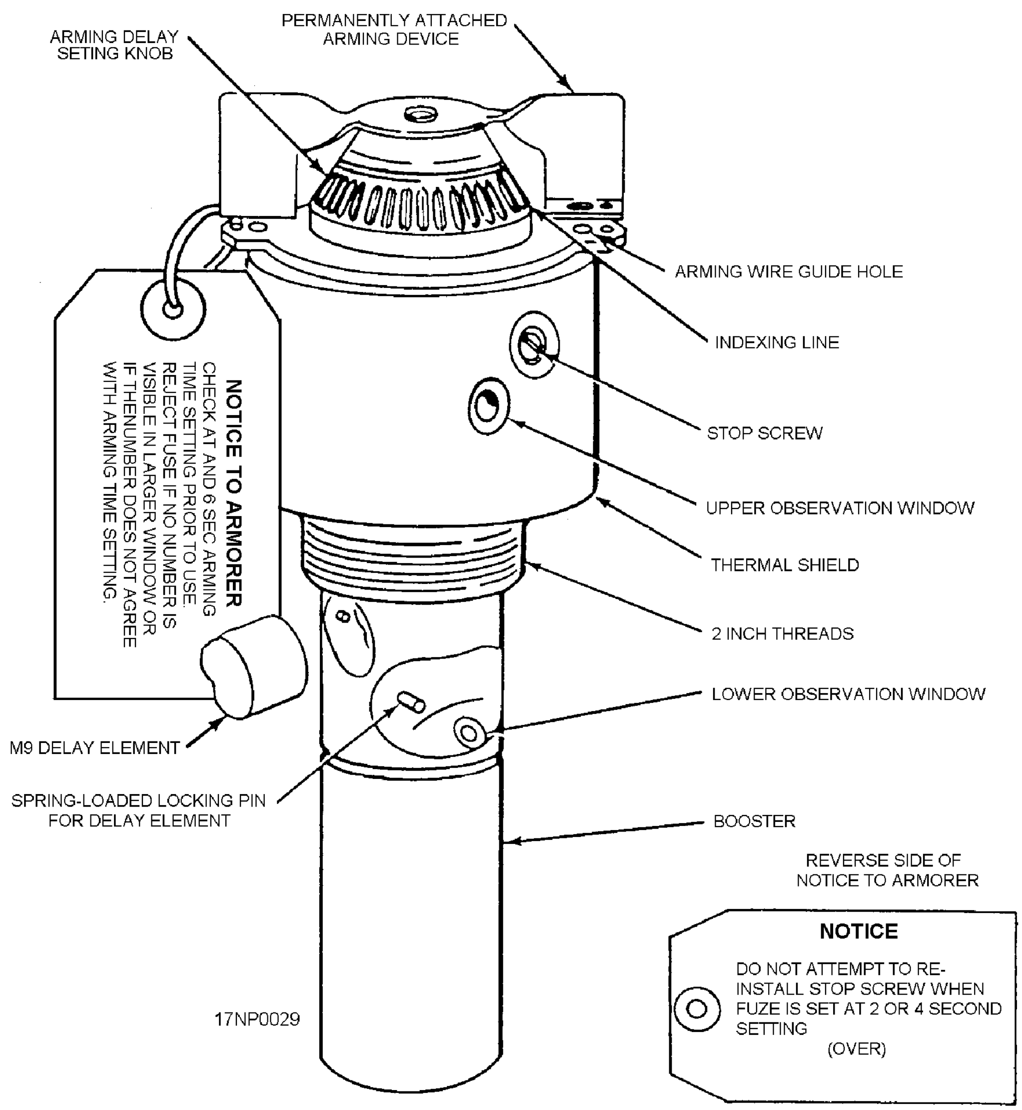


Figure 1-1.—Mechanical impact nose fuze M904 (series).

Physical Description

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

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 (table 1-1) of the bombs subjected to intense heat or flame.

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.*

Table 1-1.—MK 80/BLU Series Cook-Off Times

Item	Ordnance	Fuze/Adapter Booster	Average Reaction Time (Min & Sec)	Shortest Reaction Time	Bomb Initiated Reaction	Fuze Booster Initiated Reaction*
Bomb H6 and PBXN 109 filled	Mk 82, 83, 84 unprotected	All	3 + 30	2 + 30	Deflagration to explosion	Deflagration to detonation (after 5 minutes)
	Mk 82 Mods/ BLU-111	M904E4 with M148E1 Adapter, FMU-152, FMU-139	10 + 00	8 + 00	Deflagration	Deflagration to detonation (after 12 minutes)
		M904E2/E3 with M148/T45	6 + 00	5 + 00		Deflagration to detonation
		M148T45 (no fuze)	3 + 04			Deflagration to detonation (denotation may occur after 5 minutes)
	Mk 83 Mods/ BLU-110 thermally protected	M904E4 with M148E1 Adapter, FMU-139/B, FMU-152	10 + 00	8 + 49	Deflagration	Deflagration to detonation (after 12 minutes)
	Mk 84 Mods/ BLU-117 thermally protected	M904E4 with M148E1 Adapter, FMU-139/B, FMU-152	10 + 00	8 + 45	Deflagration to detonation (after 12 minutes)	

* Fuze or booster initiated reaction. Frequency of detonation reaction is small.

** Chips in exterior coating and/or groove for retarding fin cut to bare steel do not change cook-off 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.*

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. 1-1). To check the fuze condition, hold the fuze vertically and look through the windows perpendicular to the fuze body. Look at table 1-2. It shows you what you would see through the observation windows of the M904E3/4 fuze at various time settings and fuze conditions.

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.

Table 1-2.—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." (Some green may show at top of window.)	*Red with black Letter "A."

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 preselected 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?

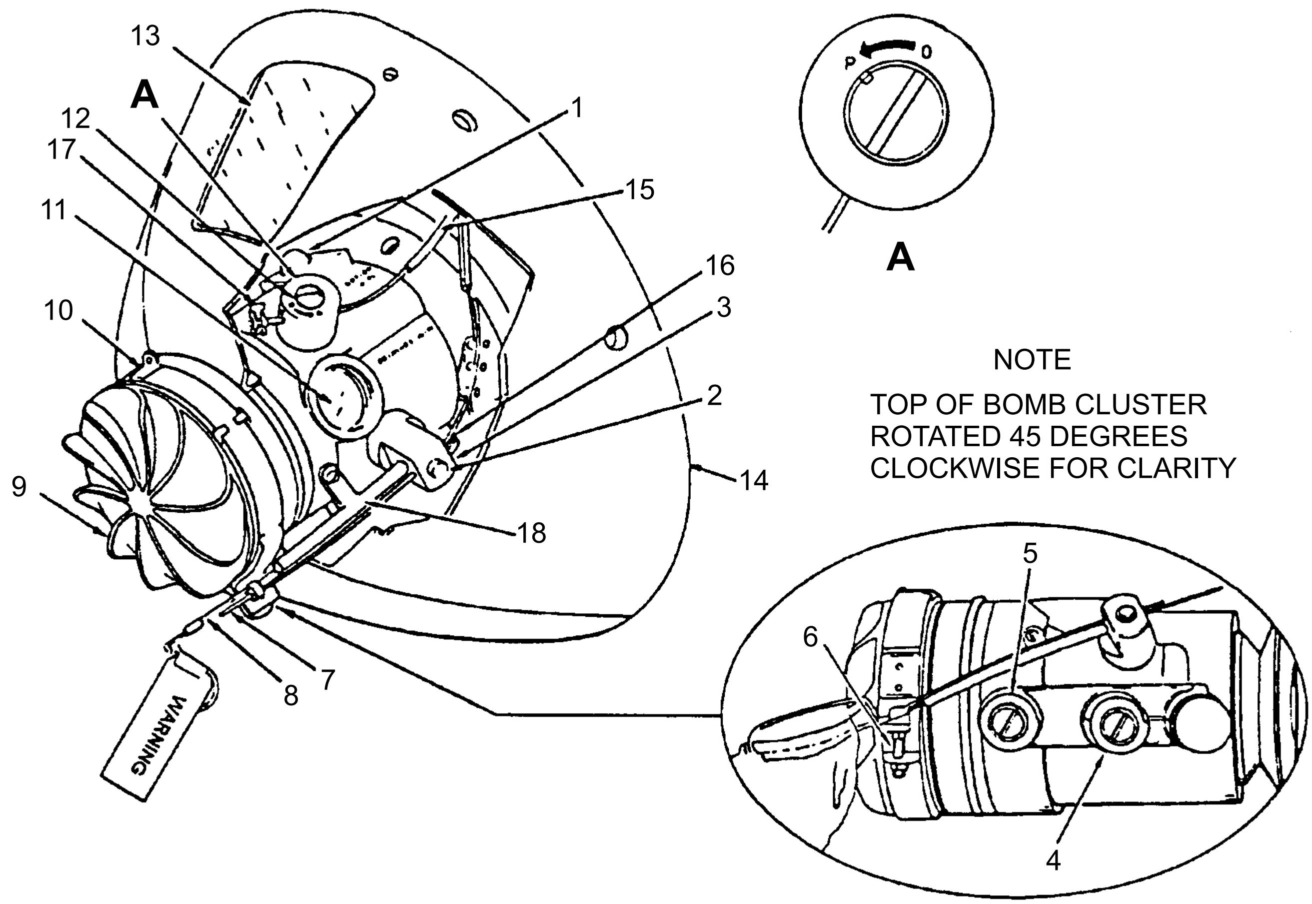
Q3. The M904 fuze has ______ arming delays, which you can set for 2 to 18 seconds in ______ increments; there are any combination of ____ functioning delays from instantaneous to 250 milliseconds.

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 ___________.

Q7. The M904 arms and functions by __________________.



1. Fuze safe/arm indicator	**7. Fuze arming wire**	**13. Indicator observation window**
2. Timer starting pin	**8. Safety pin assembly**	**14. Nose fairing (reference)**
3. Timer starting pin bracket	**9. Impeller**	**15. Option time wire**
4. Option time setting adjustment	**10. Impeller band assembly**	**16. Retainer slide**
5. Primary time setting adjustment	**11. Time setting observation window**	**17. Clip**
6. Band release stud and nut	**12. Option time pin**	**18. Safety pin assembly guide tube**

Figure 1-2.—Installed mechanical time fuze Mk 339 Mod 1 (with option time wire bomb clusters Mk 20 Mods 3, 4, and 6.

MK 339 MOD 1 MECHANICAL TIME FUZE

The Mk 339 Mod 1 mechanical time fuzes (fig. 1-2) are used with dispenser weapons and have the following characteristics:

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

The Mod 1 fuze is installed in the Mk 20 Mods 3, 4, and 6 bomb clusters. 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.

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.*

Physical Description

The primary and option functioning 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.

You already know the primary and option delays for the fuze is preset at the factory. 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 Mod 1 fuze can be adjusted from 1.2 to 100 seconds.

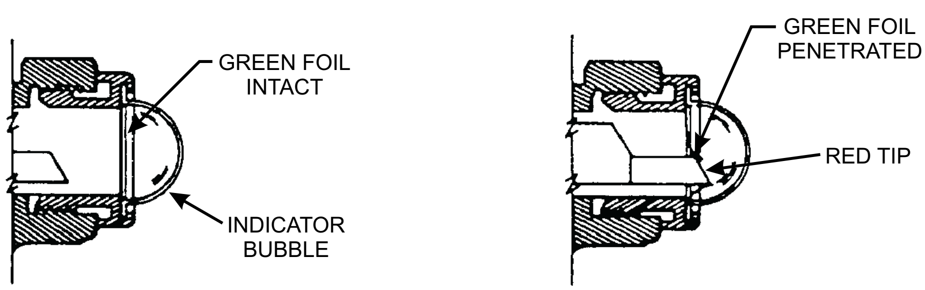
You can tell if the fuze has shifted from the primary to the option mode by the functional mode indicator. You do this by checking the time setting observation window. If the arming wire has been accidentally pulled during handling, the fuzes shift to the option mode. Once the option wire is pulled, the fuze can be reset to the primary mode by reinstalling the option time wire.

The fuze safe/arm indicator (callout 1 of figs. 1-2) provides external evidence of arming (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 (fig. 1-3, view A), and it is armed when the green foil is pierced by the indicator pin (fig. 1-3, view B).

Functional Description

The following paragraph describes the sequence of events that must occur for Mk 339 fuze to function.

MOD 1 (WITH OPTION TIME WIRE).—This fuze is physically and functionally the same as the fuze



A. MK 339 MOD 1 FUZE SAFE/ARM INDICATOR PIN IN SAFE POSITION

B. MK 339 MOD 1 FUZE SAFE/ARM INDICATOR PIN IN ARMED POSITION

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Figure 1-3.—Mechanical time fuze Mk 339 safe/arm indicator pin in safe and armed positions.

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 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 bomb is used with the Mk 339 mechanical time fuze?*

Q2. *The primary and option delay of the Mk 339 fuze is set at the factory. What means can be used to change the settings for tactical requirements?*

Q3. *How can you tell if the Mk 339 fuze has shifted from the primary to the option delay?*

Q4. *Describe what you will see in the observation window of a Mk 339 fuze for the conditions listed below:*

Safe

Armed

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).

M148/M148E1/T45 (Series) Adapter Booster

The M148/M148E1/T45 (series) adapter booster (fig. 1-4) permits the use of mechanical nose fuzes in

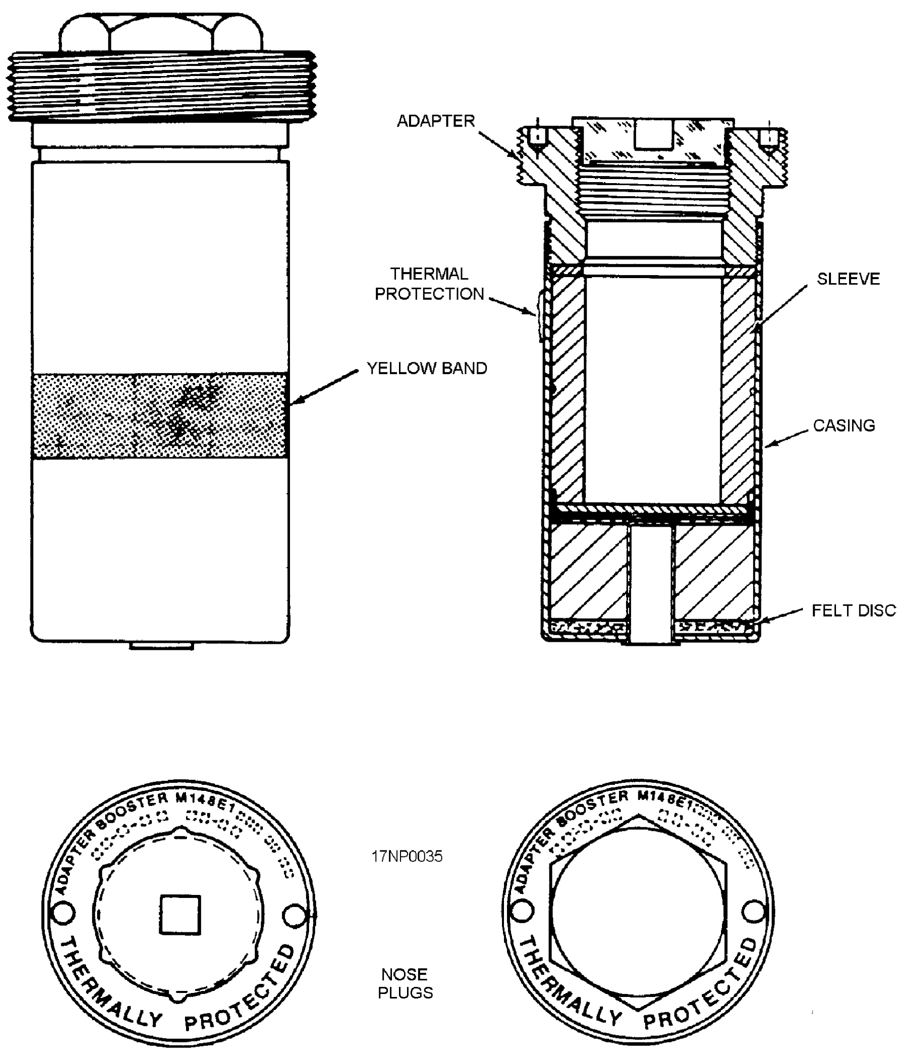


Figure 1-4.—Adapter-booster M148/E1 (series).

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 that is threaded onto the base of the adapter.

The M148E1 adapter booster is similar in external appearance to the earlier M148/T45 (series). The 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. 1-5) permits the use of mechanical tail fuzes with Mk 80 (series) bombs. The M150/T46 adapter boosters differ only in internal construction, and they may be used interchangeably.

REVIEW NUMBER 3 ANSWERS

A1. The Mk 20 is used with the Mk 339 mechanical time fuze.

A2. The primary and option delays can be changed by adjusting the primary and option time-setting dials.

A3. You can tell if the fuze has shifted from the primary to the option delay by checking the time setting observation window of the fuze.

A4. Safe—Green foil is intact.

Armed—Green foil is pierced by the indicator pin.

The M150/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

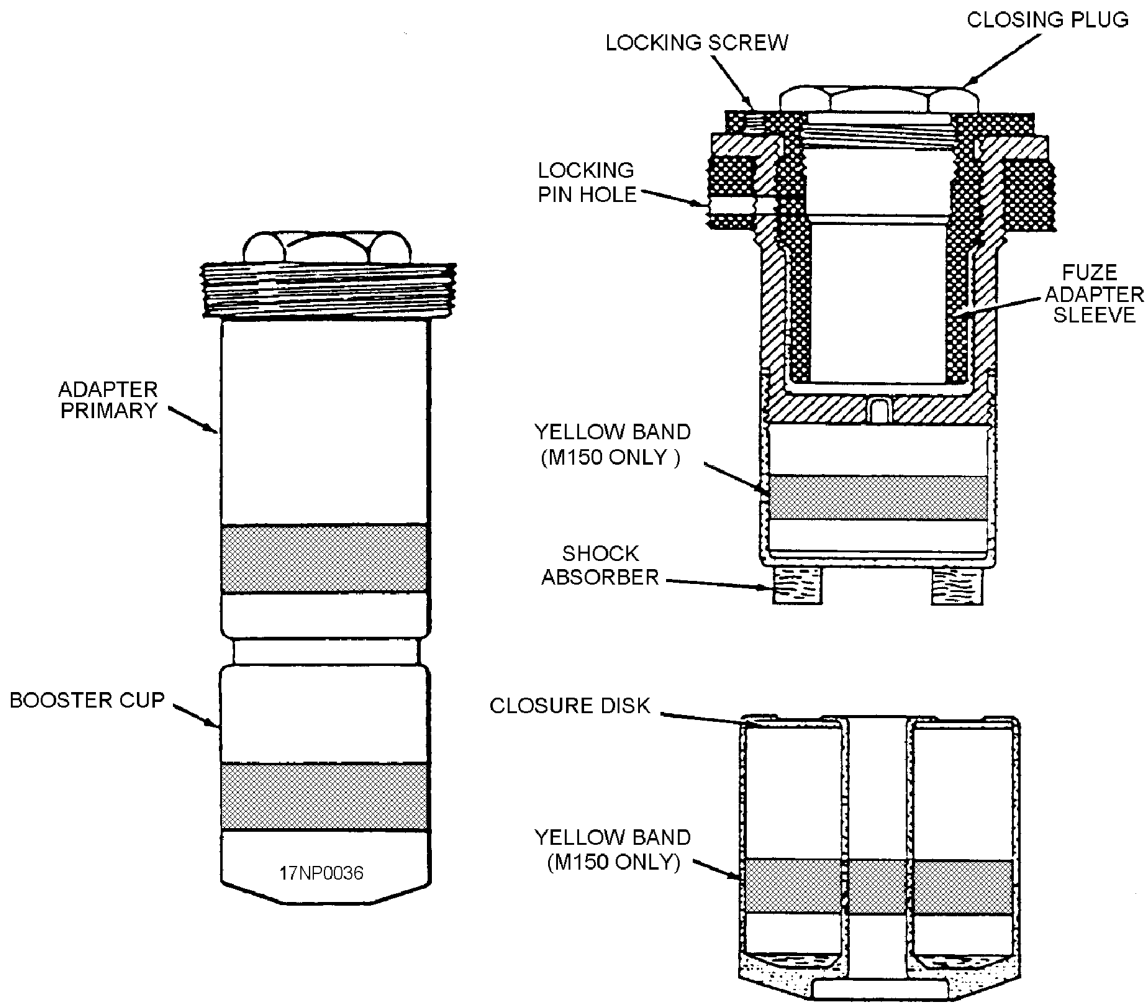


Figure 1-5.—Adapter-booster M150/T46 (series).

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 376 (fig. 1-6) electric bomb fuze provides 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 376 fuze is used with the Mk 43 target-detecting device for airburst capability.

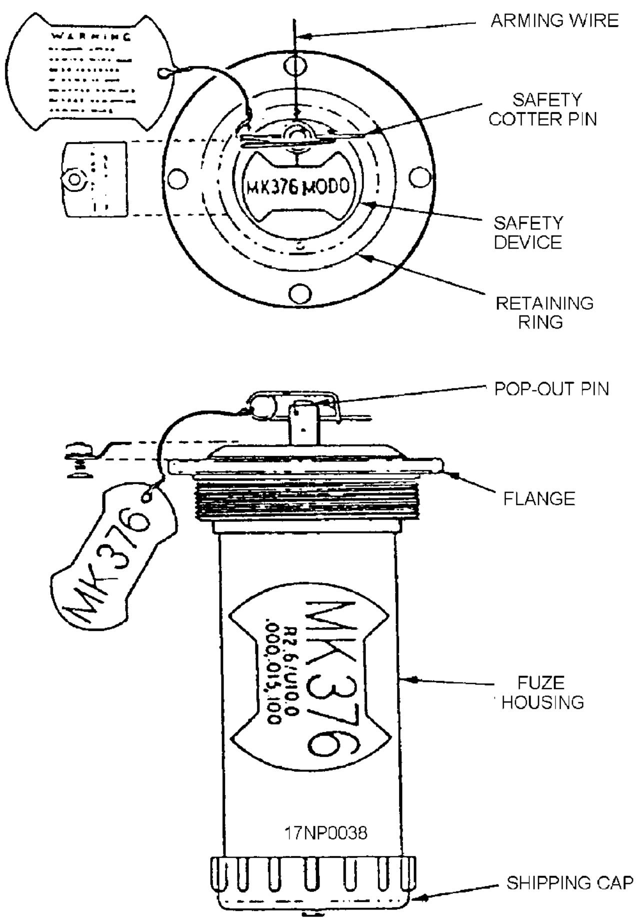


Figure 1-6.—Mk 376 Mod 0 electric fuze.

DESCRIPTION

The Mk 376 Mod 0 electric tail fuze is detonator safe. The booster contain 4.3 ounces of tetryl explosive. This fuze is classified HERO SAFE, and no unusual RADHAZ precautions are required under normal operating conditions.

Four discreet dc voltages for in-flight selection of functioning delay times are used in the Mk 376 fuze. The Mk 31 safety device automatically selects arming delay times.

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-decelerometer. The safety device contains a pop-out pin that locks the fuze in an unarmed 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 the free-fall mode of delivery is used the Mk 376 fuze, arming is completed 10.0 seconds after release from the aircraft. 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.

FUNCTIONAL OPERATION

The following description applies specifically to the Mk 376 fuze.

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.

FMU-152/B ELECTRONIC BOMB FUZE

The FMU-152/B is an advanced fuze system for use in general purpose and penetrating unitary warheads. The FMU-152/B provides safing, in-flight cockpit selection, and multifunction and multiple delay arming and fuzing functions. The FMU-152/B is a multifunction; multiple delay fuze system with hardened target capabilities that provide arming and fuzing functions for general purpose and penetrating, unitary warheads. The FMU-152/B system operates in three fuze mission phases: the “pre-release,” “pre-arm,” and “post-arm” phases. The “pre-release” phase includes all fuze functions performed prior to the point at which the weapon is released from the delivery aircraft. The “pre-arm” phase includes all fuze functions occurring between weapon release and weapon arming. The “post-arm” phase includes all fuze functions after the weapon is armed.

FMU-143E/B ELECTRIC TAIL FUZE

The FMU-143E/B fuze (fig. 1-7) is used with the GBU-24B/B. It 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).

FMU-139 (SERIES) ELECTRONIC BOMB FUZE

The FMU-139 (series) electronic bomb fuze (fig. 1-8) is an electronic impact or impact-delay fuze. It is used in Mk 80 series general-purpose bombs, including laser-guided bombs. The arming times are in-flight selectable, and the functioning delay must be set during weapon assembly. 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 switch should always be in the X position. The low drag arm time rotary switch is positioned at X for shipping, storage, and all FFCS (fuze function control set) use. The FMU-139 fuze differs from the Mk 376 fuze in that the gag rod and arming wire housing are located in the center of the faceplate (fig. 1-9).

ARMING SAFETY SWITCH MK 122 MOD 0

The Mk 122 Mod 0 arming safety switch (fig. 1-10) 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. 1-11) is a proximity nose element that gives airburst capability for electric-fuzed Mk 80 (series) bombs.

The Mk 43 Mod 0 element is compatible with all electric tail fuzes and is identified by the dark green color of the nose cone. A thermal battery powers its internal circuitry. 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

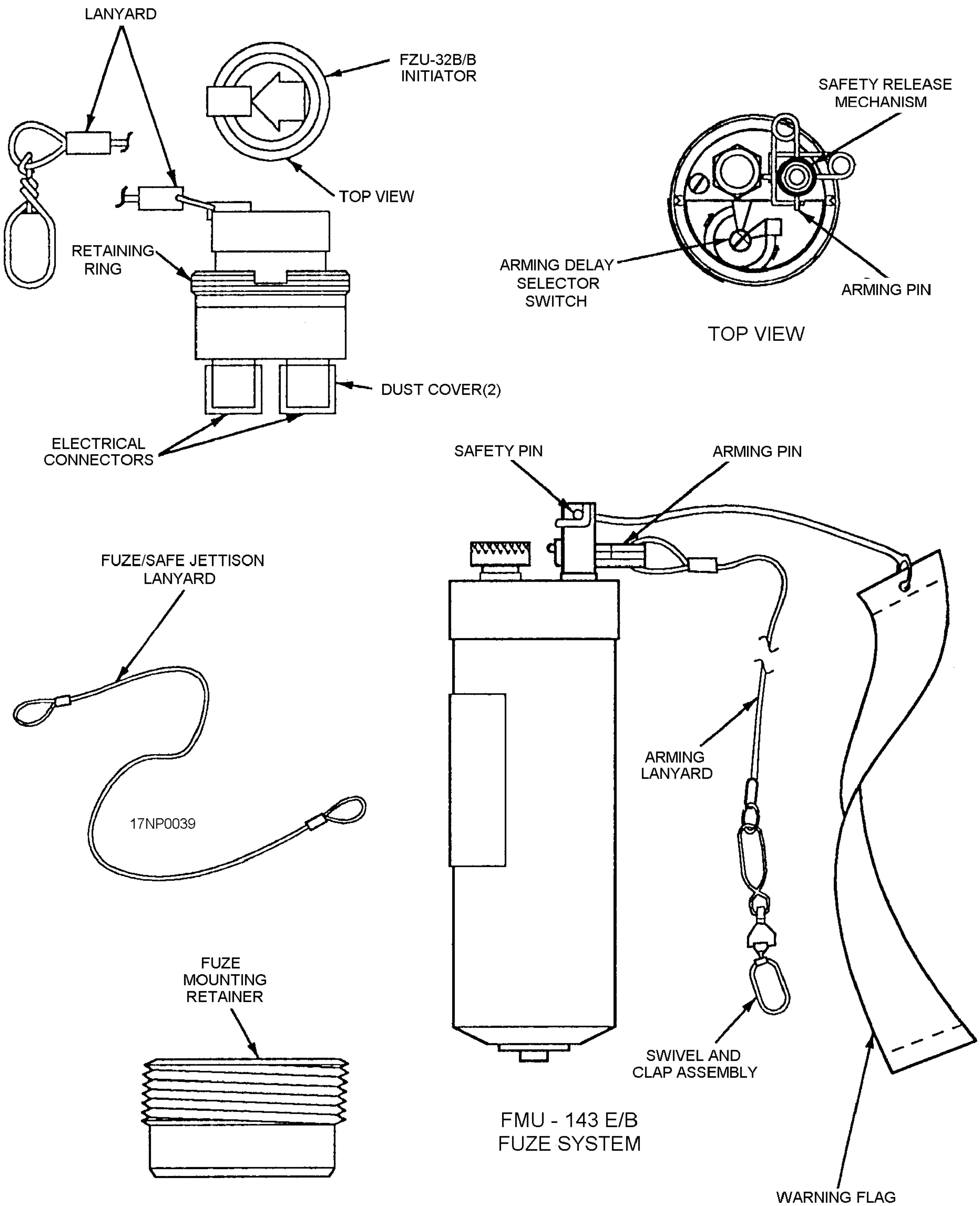


Figure 1-7.—FMU-143E/B electric tail fuze.

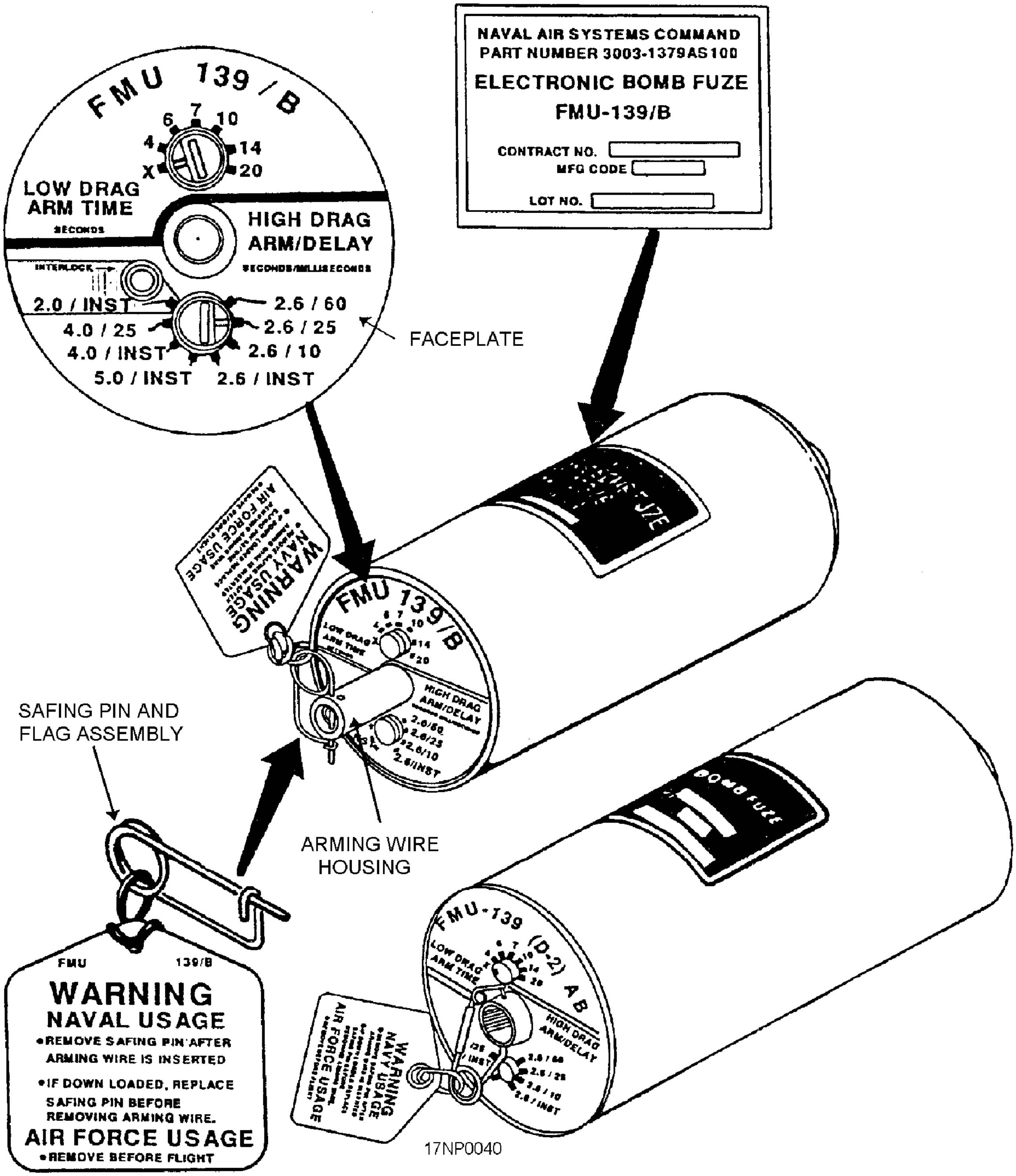


Figure 1-8.—FMU-139 (series) electronic bomb fuze.

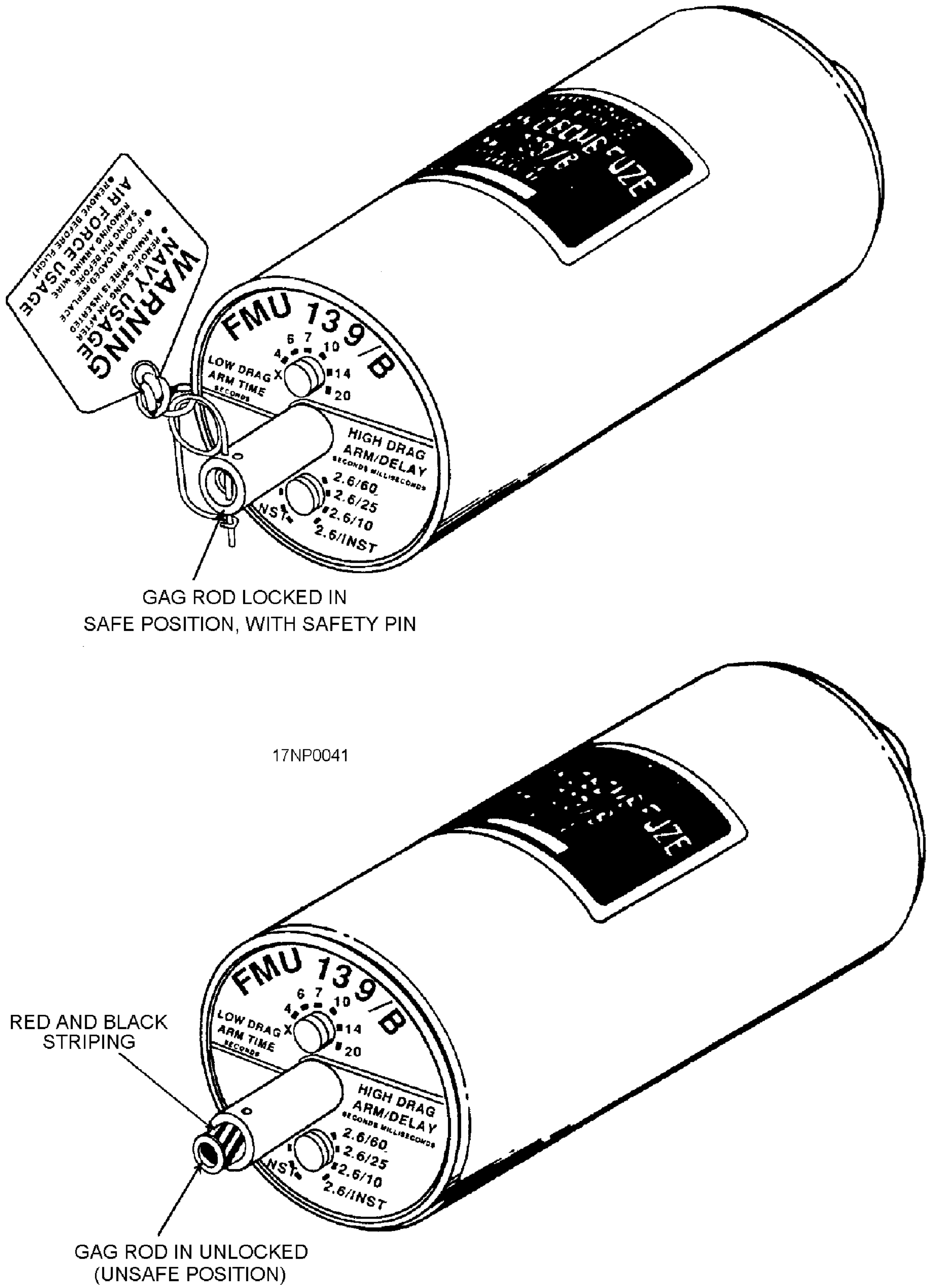


Figure 1-9.—FMU-139 (series) electronic bomb fuze gag rod in safe and unsafe positions.

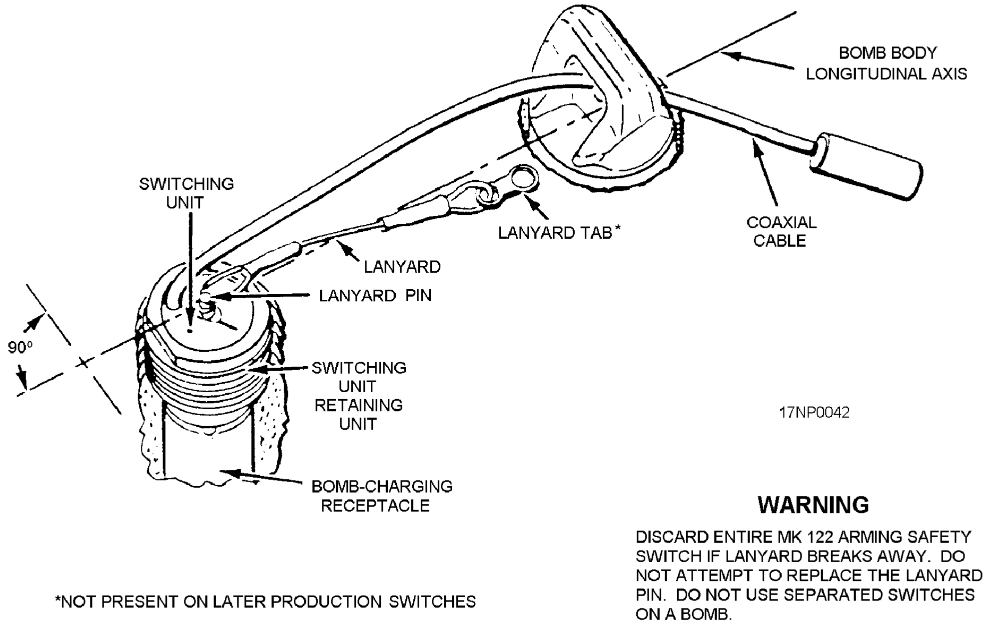


Figure 1-10.—Mk 122 Mod 0 arming safety switch.

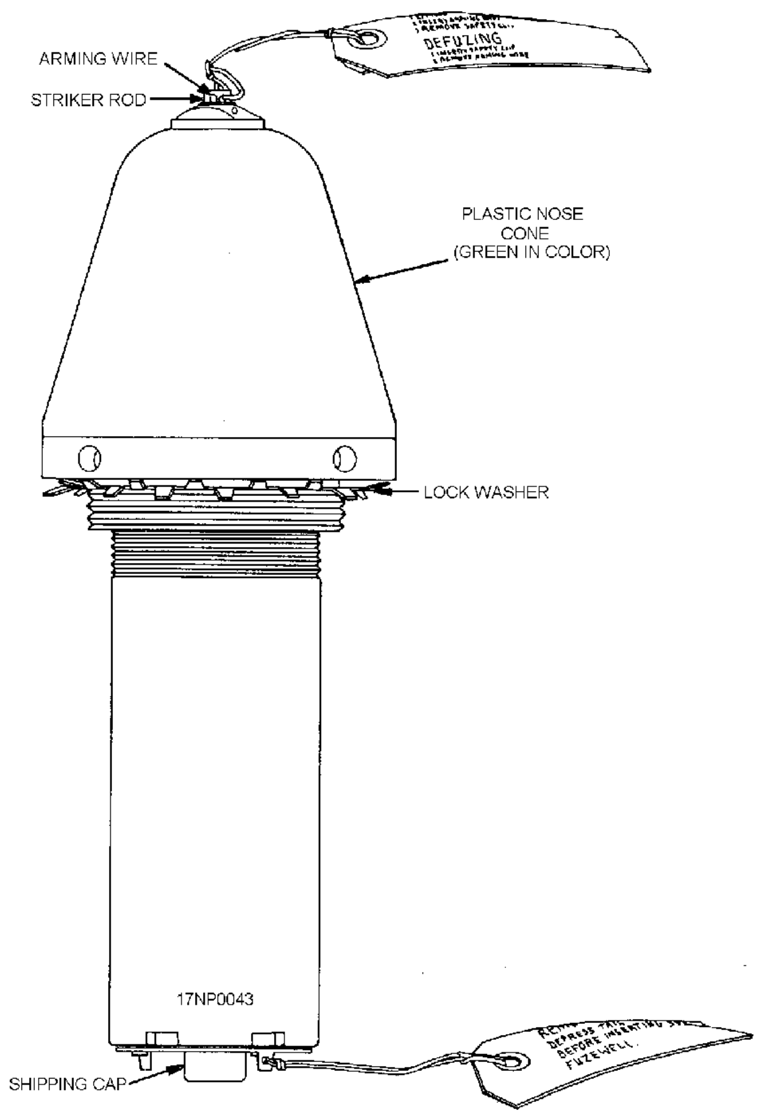


Figure 1-11.—Mk 43 Mod 0 target detecting device.

alternate method used to provide operation when the fuze is not initiated with the +300 volts dc. The conventional mode is selected by initiating the fuze with +300 volts dc. When the fuze is initiated with +300 volts dc, the Mk 43 operates automatically.

The fuze circuitry produces a lobe pattern. It radiates a pattern at right angles (fig. 1-12) to the longitudinal axis of the weapon.

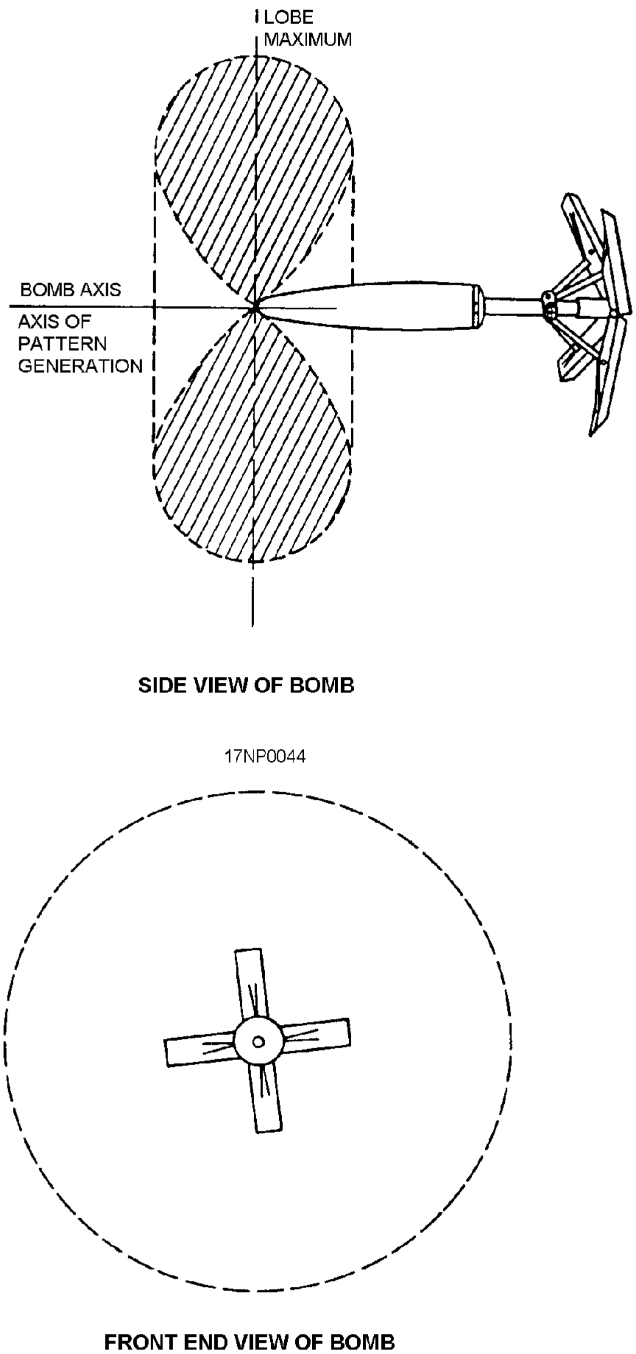


Figure 1-12.—Mk 43 Mod 0 target detecting device antenna pattern.

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. Detonation of the bomb is delayed by either 0.015 second or 0.100 second, depending on the delay that is selected.

FMU-140/B DISPENSER PROXIMITY FUZE

The FMU-140/B (fig. 1-13) has an optional arm and fire (timer) mode. It is used with the Rockeye II and Gator weapons. The FMU-140/B is a self-powered doppler radar device acting as a radar altimeter. Arming times and functioning altitudes are variable and are preflight selectable on the fuze faceplate, located on the side of the fuze. In the proximity mode, if the preselected altitude is reached before the fuze has had time to arm, or the dispenser is released below the pre-selected altitude, the fuze will have the potential to function anytime after arming. If the fuze has not functioned by the time it reaches an altitude of 300 ±25 feet, it will function at that time.

REVIEW NUMBER 4

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 the Mk 376 fuze because it is classified as _____.

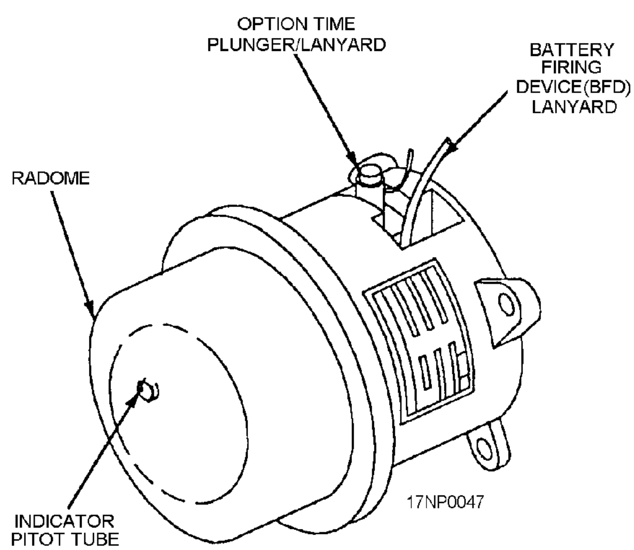


Figure 1-13.—FMU-140/B dispenser proximity fuze.

Q3. *Name the electric fuzes that are 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?*

AIRCRAFT BOMB AMMUNITION AND ASSOCIATED COMPONENTS

LEARNING OBJECTIVE: *Identify the purpose and types of aircraft bombs, the safety procedures to be followed during bomb shipment, and the methods used to carry bombs*.

Aircraft bombs are 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.

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. Bomb assembly procedures are discussed in chapter 13 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 are 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 fig 1-14. The basic difference between the bombs listed in fig 1-14 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. 1-15) 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 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. Refer to *Airborne Weapons Packaging/Handling/Stowage*, NAVAIR 11-120A-1.1 or appropriate MIL-STD 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 either mechanical or electric fuzes.

FUZE CHARGING CIRCUIT

The forward and aft charging tubes 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 for the installation of suspension lugs. The suspension lugs are

PHYSICAL CHARACTERISTICS

	MK 81	MK 82	MK 83	MK 84
Weight:				
Conical:	260 lb.	531 lb.	985 lb.	1970 lb.
Retard:	305 lb.	565 lb.	1105 lb.	N/A
Dimensions:				
Length:	76 in.	90 in.	119 in.	154 in.
Diameter:	9 in.	11 in.	14 in.	18 in.
Suspension Provisions:	14 in.	14 in.	14 in.	30 in.

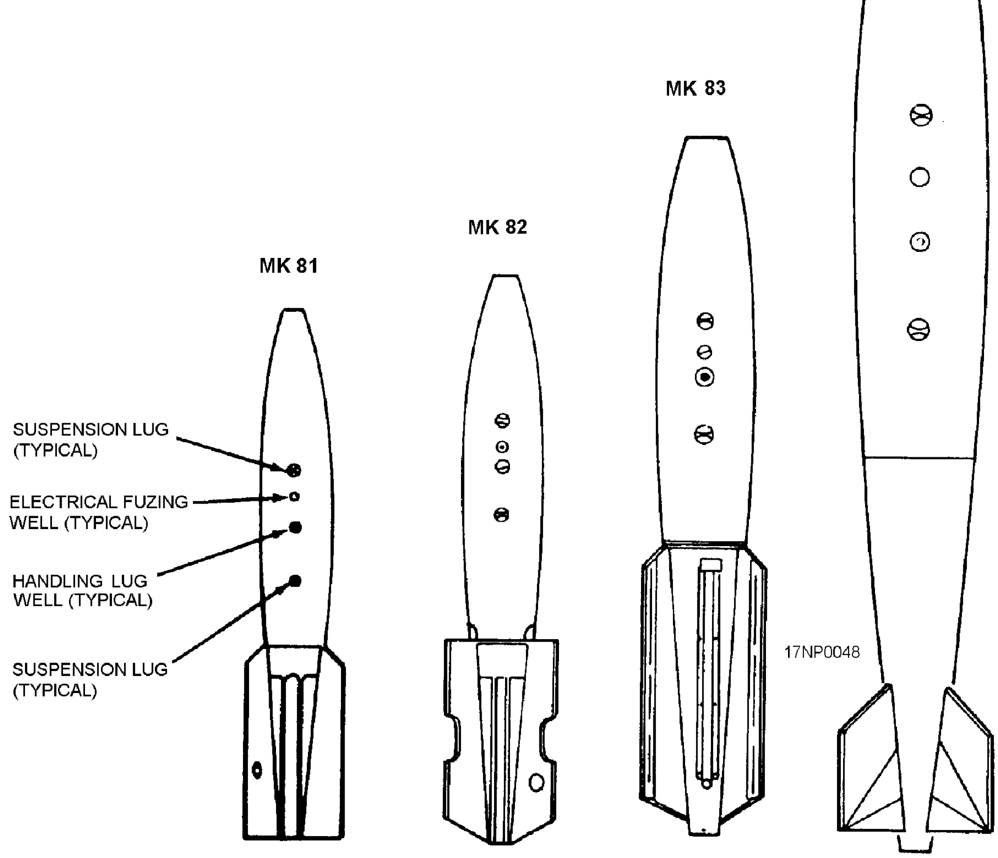


Figure 1-14.—Specifications for general-purpose bombs.

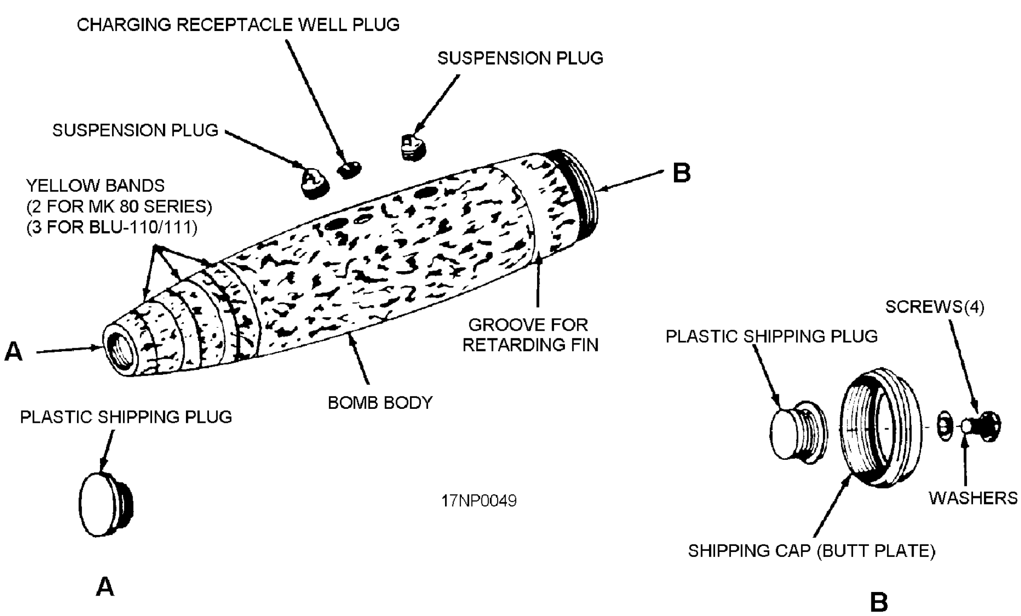


Figure 1-15.—LDGP bomb Mk 80 (series)—exploded view (shipping configuration).

spaced 14 or 30 inches apart, depending upon the size of the bomb. Suspension lugs (fig. 1-16) 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.

REVIEW NUMBER 4 ANSWERS

A1. *All electric capability for Mk 80 with either conical or retarding fins, thermally protected bombs, and laser-guided bombs is provided by the Mk 376 electric bomb fuzes.*

A2. *No unusual RADHAZ precautions are taken when using the Mk 376 fuze because it is classified as HERO SAFE.*

A3. *The Mk 376 electric fuze and FMU 139 are 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.*

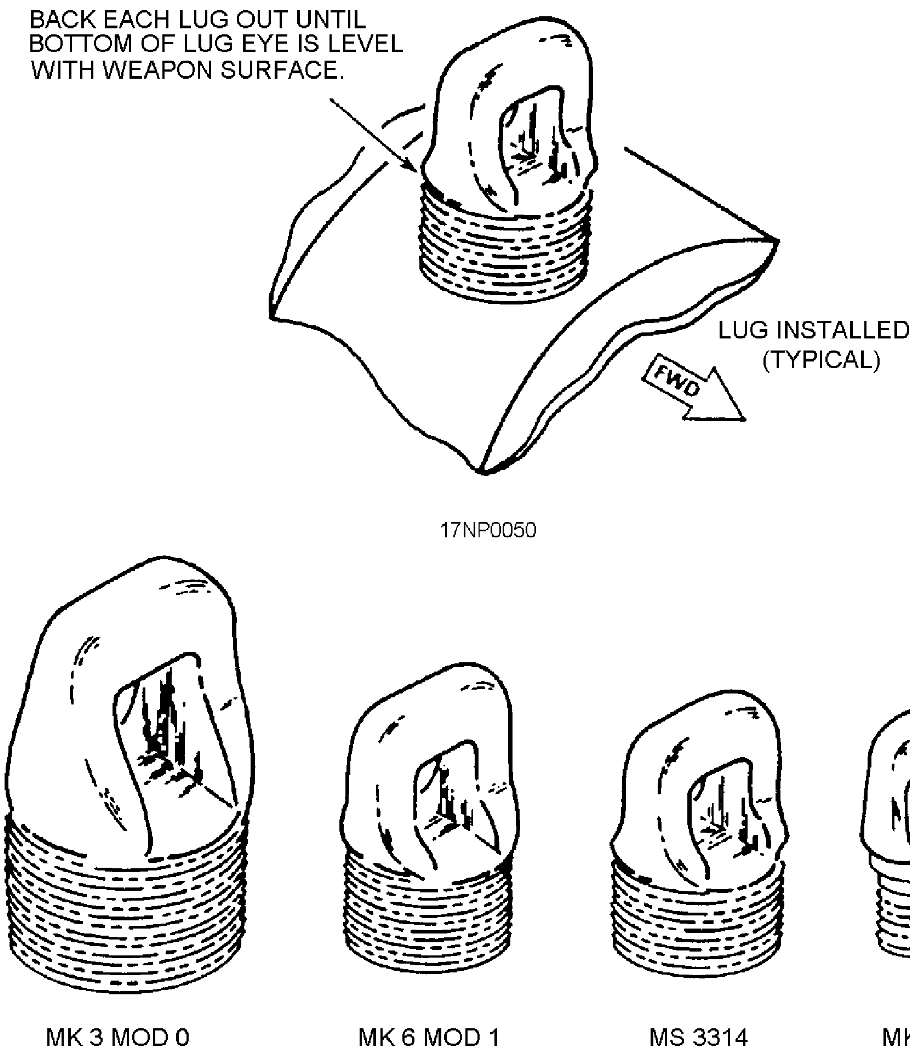


Figure 1-16.—Suspension lug installation.

NOSE PLUGS

There are two basic nose plugs (fig. 1-17) used in general purpose 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.

IDENTIFICATION

The high-explosive filler of the bomb (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. 1-18) 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. 1-18) or safety clips, MAU 166, 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.

Normally, arming wire assemblies are shipped in spiral-wound fiber tubes, over packed 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 1-3.

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. 1-19). Some fin assemblies are shipped with bomb lugs attached to the shipping crate, depending upon the particular Navy Ammunition Logistics Code (NALC).

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

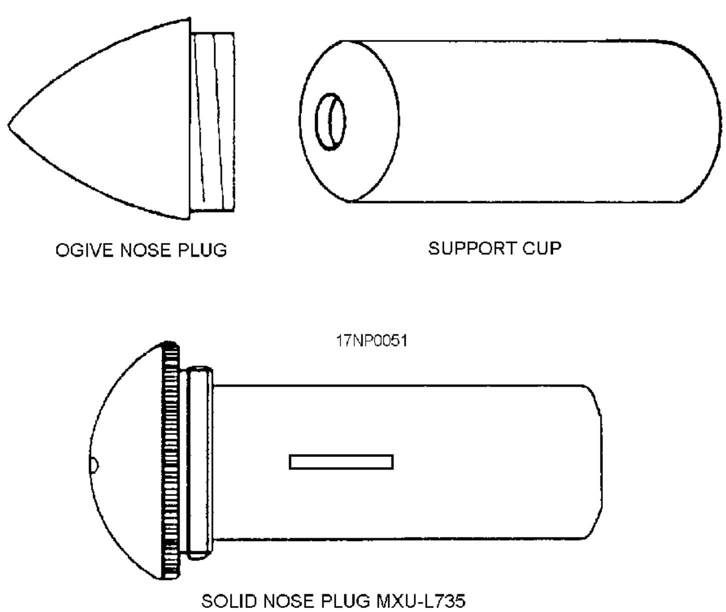


Figure 1-17.—Nose plugs.

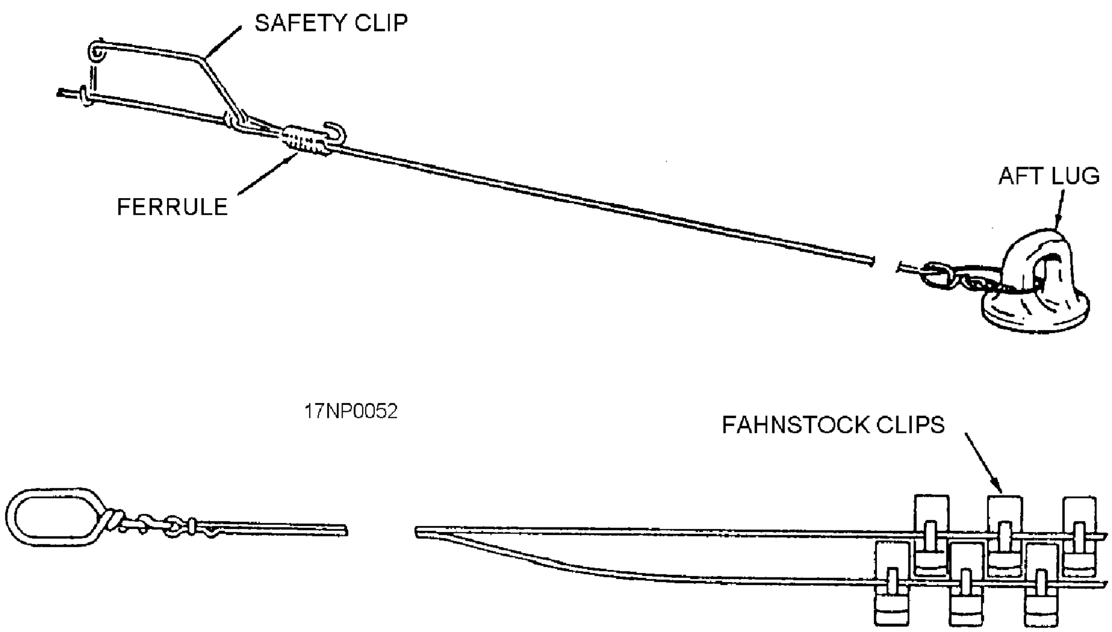
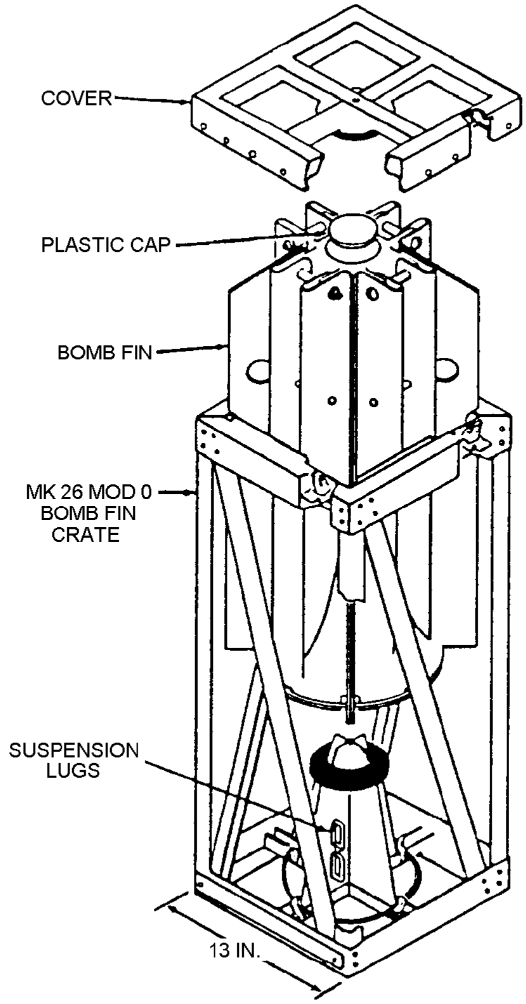


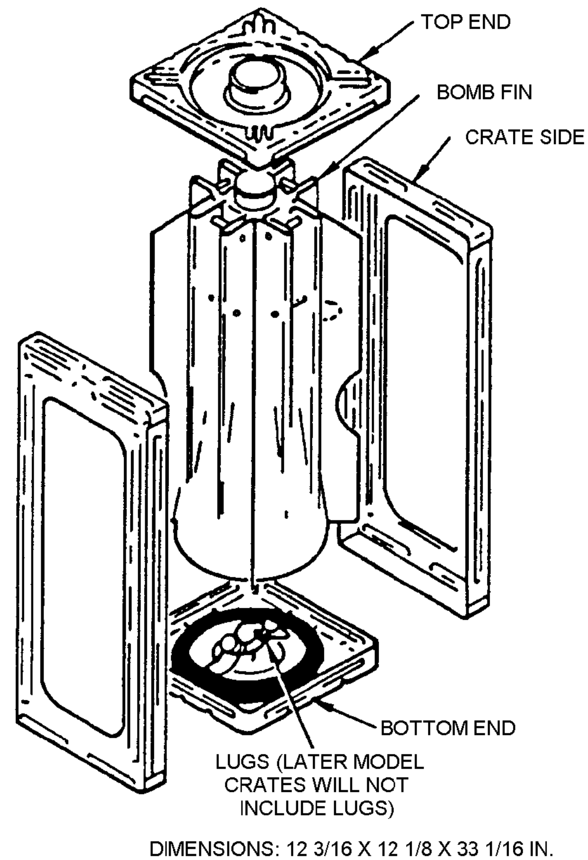
Figure 1-18.—Arming wire assemblies.

Table 1-3.—Arming Wire Data

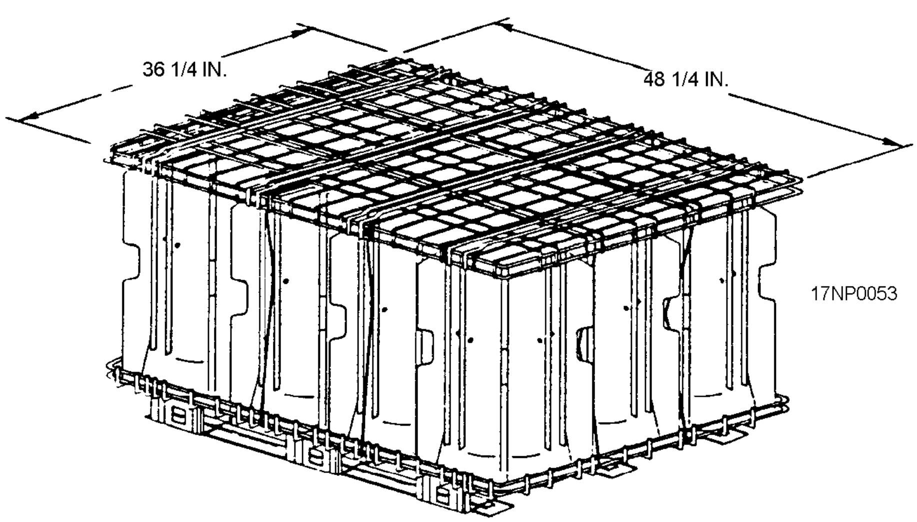
Arming Wires/Hardware	Type	Material	Dia. (in.)	Leg Lengths (in.)
Mk 1 Mod 0	Single	Brass	0.064	57.0
Mk 2 Mod 0	Double	Brass	0.064	57.0
Mk 3 Mod 0	Single	Steel	0.032	57.0
Mk 4 Mod 0	Double	Brass	0.064	96.0
Mk 9 Mod 0	Single	Brass	0.064	90.0
MAU-166 Swivel & Loop Assy only	Arming Wire Accessory Kit			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



FIN CRATE MK 26 MOD 0



FIN CRATE MK 28 MOD 0



ADAPTER PALLET, ADU-383/E

Figure 1-19.—Fin shipping configurations.

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 typical BSU-33 conical fin assembly (fig. 1-20) 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 the types of conical fins is their physical size, the larger the bomb, and the larger the fin.

Snakeye Fin Assemblies

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

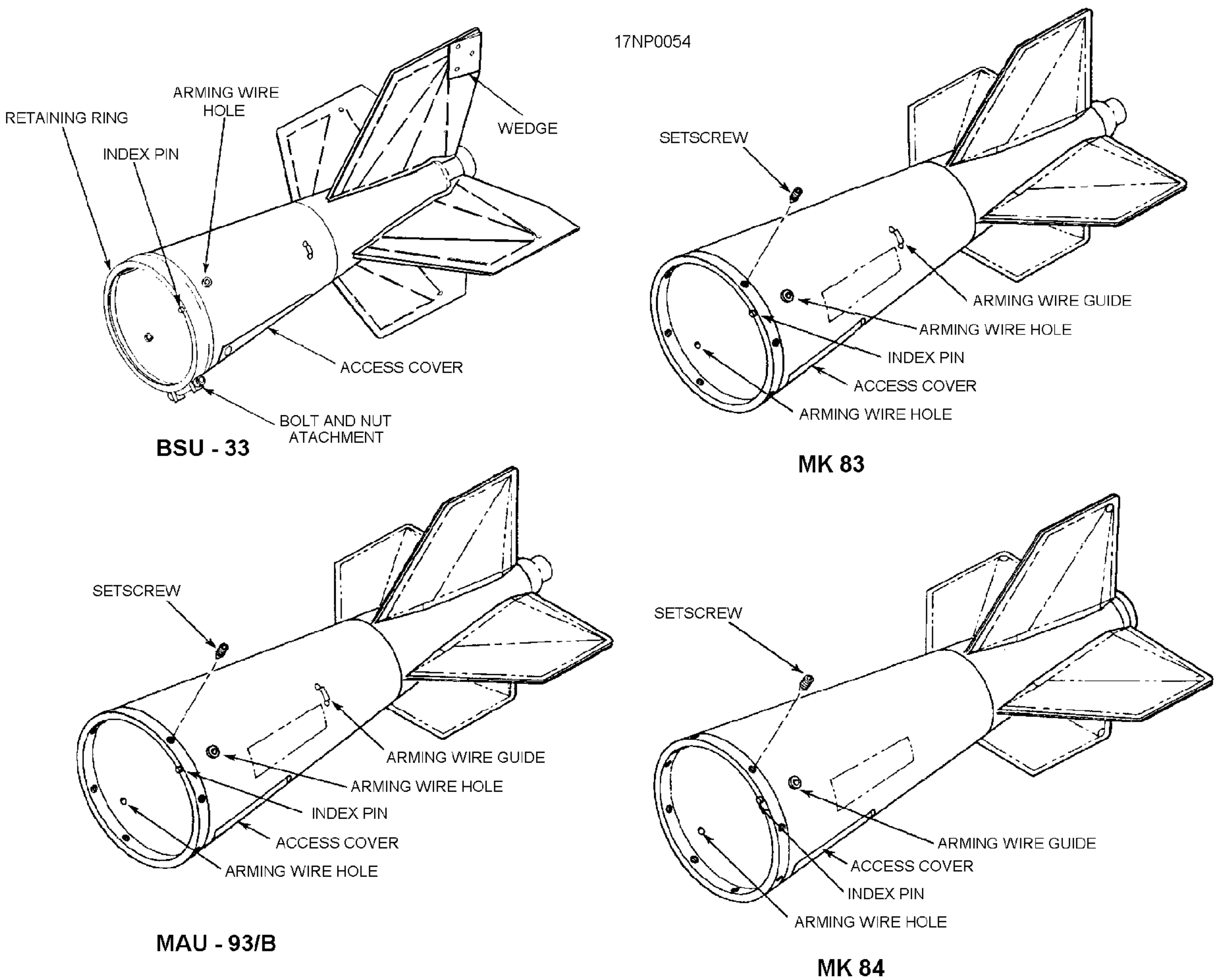


Figure 1-20.—Typical fin assemblies.

MK 15 AND MODS SNAKEYE FIN ASSEMBLY.—The Mk 15 bomb fin assembly (fig. 1-21) is a retarding fin. It is used with the 500-pound LDGP, Mk 82 bombs. 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. Eight setscrews (fig. 1-22) attach the fin.

The crushing of a convoluted steel tube absorbs the shock. 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. 1-22) is prevented from opening by a cotter pin, which stays installed until an arming wire is installed. 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 fuzing.

MAU-91A/B FIN ASSEMBLY.—The MAU-91A/B fin assembly (fig. 1-23) is a retarded tail fin 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.

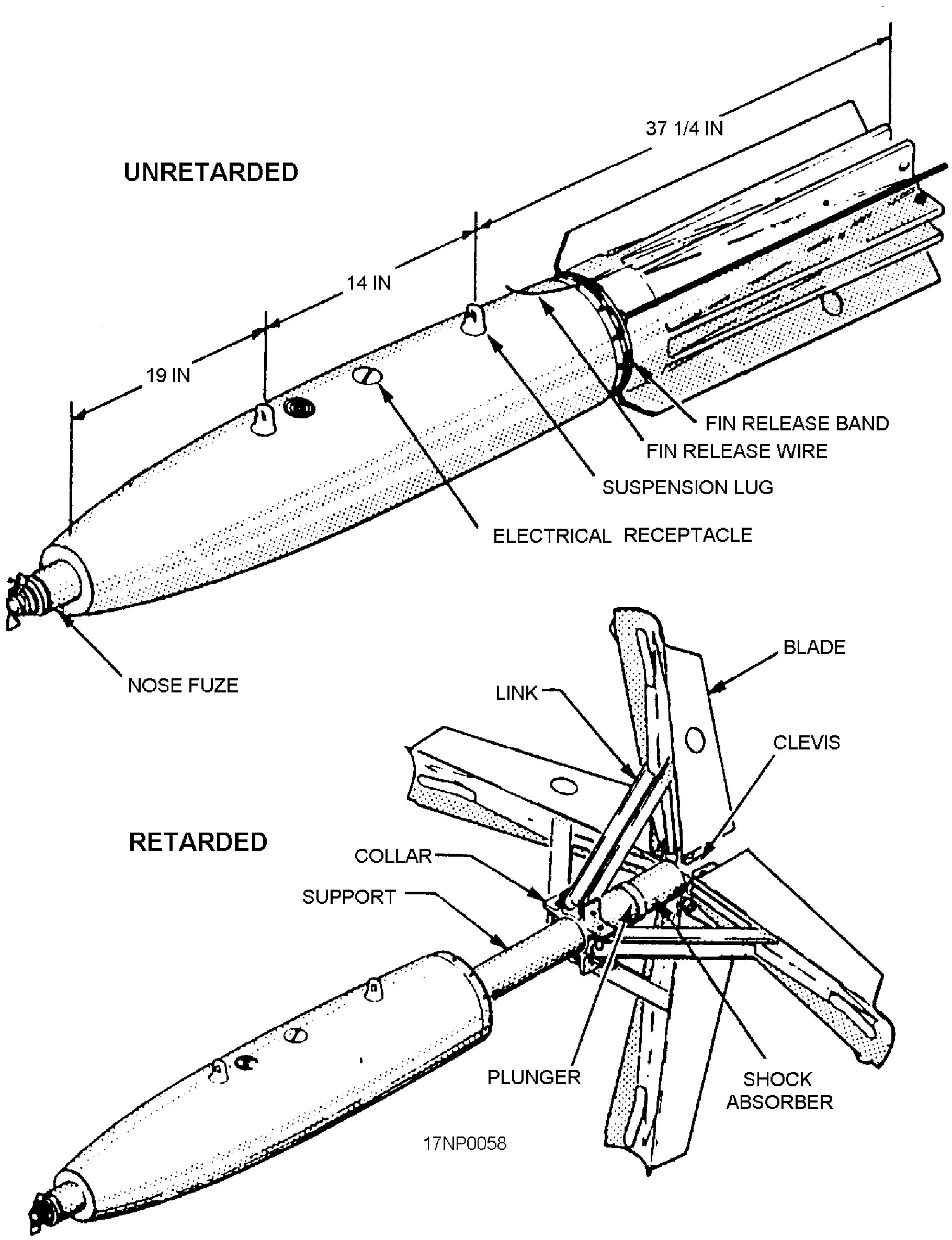


Figure 1-21.—Mk 15 fin with Mk 82 bomb body.

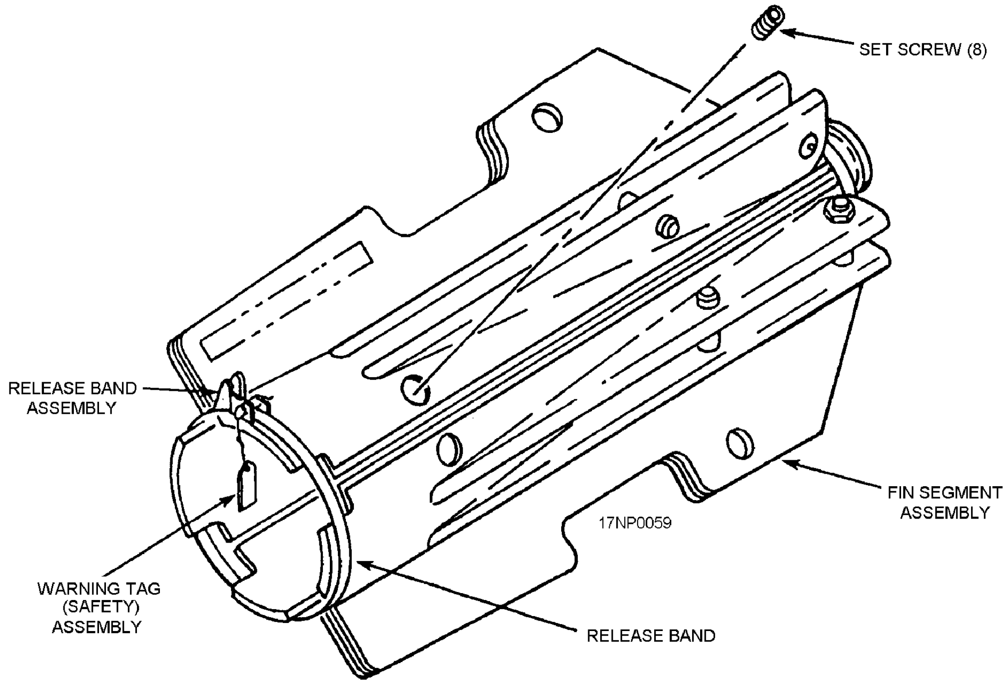


Figure 1-22.—Fin release band for Mk 15 fin.

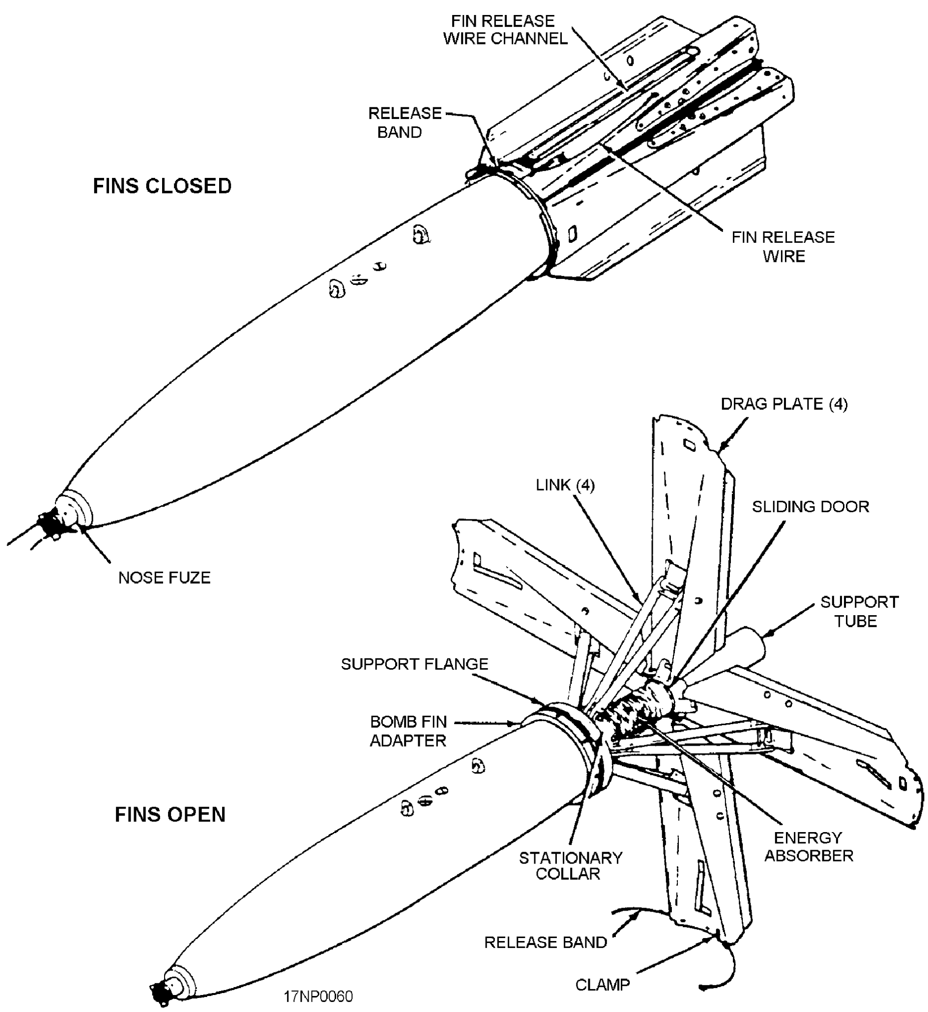


Figure 1-23.—Typical MAU-91A/B fin with ADU-320/B adapter on Mk 83 bomb body.

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 that is 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.

Fin adapter ADU-320/B attaches the MAU-91 fins to the Mk 83 bomb. 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 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. 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 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 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.

BSU-85/B Air Inflatable Retarder

The BSU-85/B bomb fin attaches to the Mk 83 general-purpose bomb. It is an air-inflatable retarder designed for very low altitudes. It can be dropped in either high-drag (retarded) or low-drag (unretarded) mode (fig. 1-24). The BSU-85/B fin

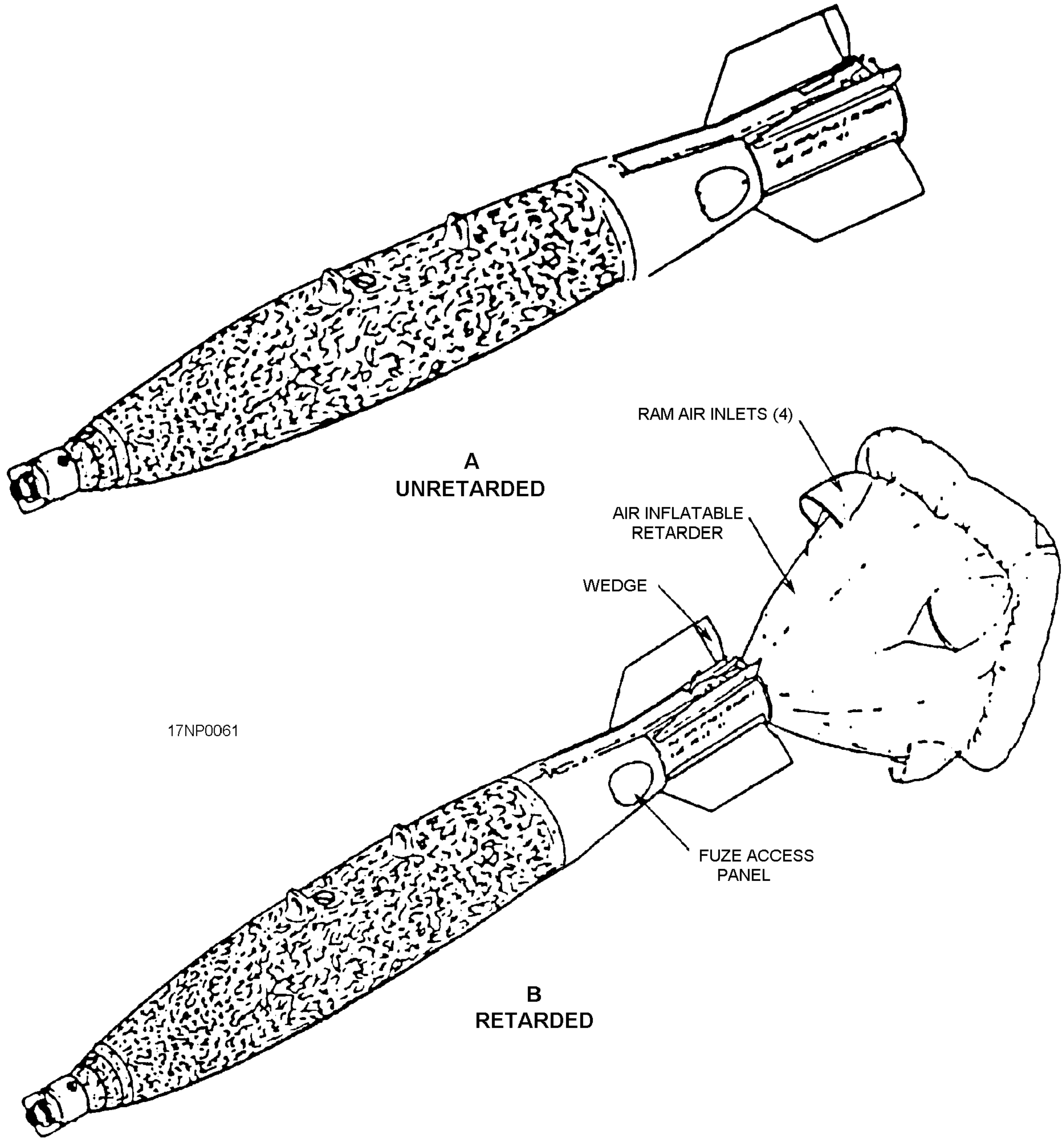


Figure 1-24.—Typical BSU-85/B air-inflatable retardable fin with high and low drag configurations.

(fig. 1-25) 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 (fig. 1-25, views A and B). The four fixed fins provide low-drag aerodynamic stability. The wedges installed on the trailing edges provide stabilizing spin during a low-drag and high-drag release. When stored in its original shipping/storage container, its shelf life is 10 years.

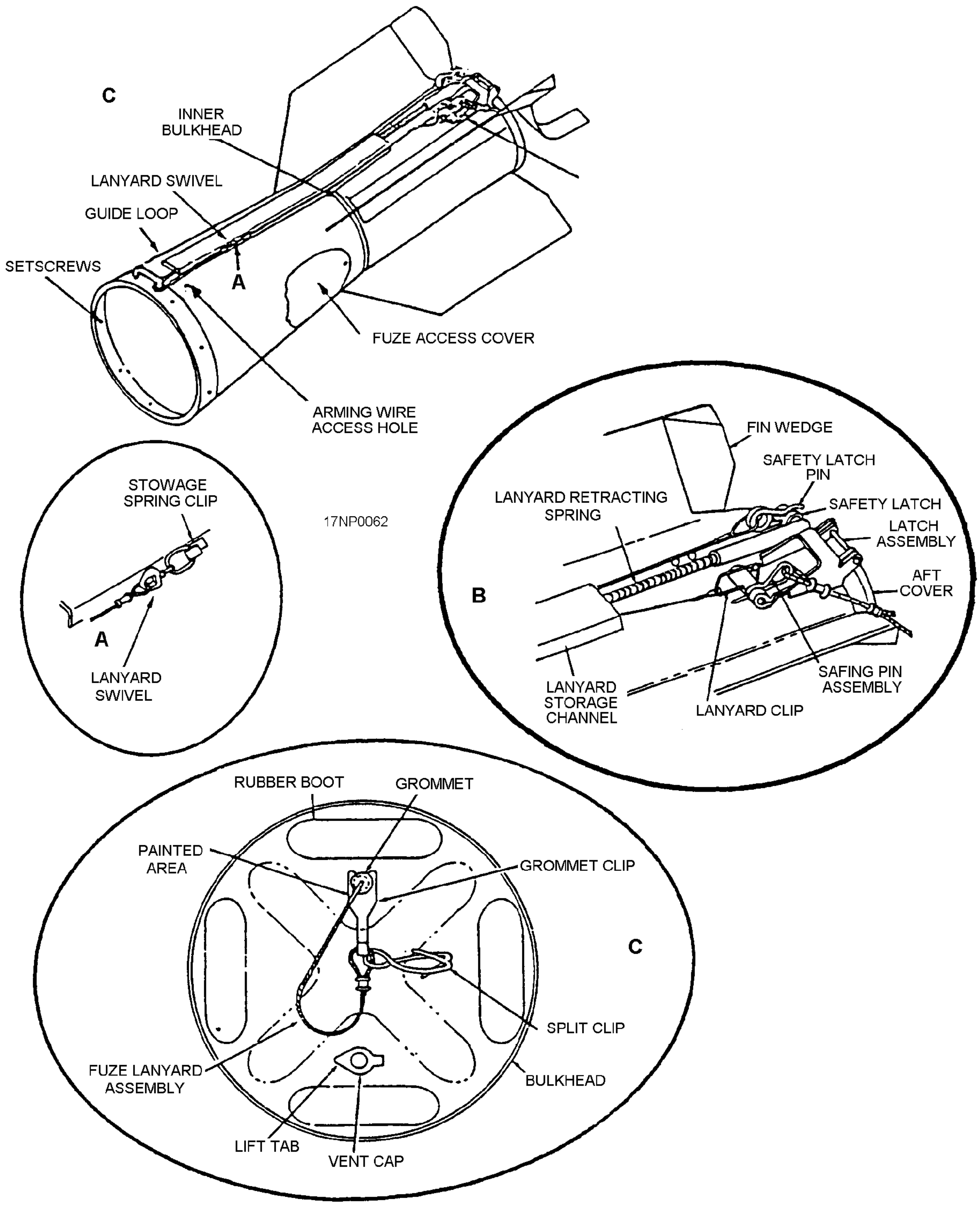


Figure 1-25.—BSU-85/B air-inflatable retarded fin (top and rear view).

BSU-86/B Bomb Fin

The BSU-86/B bomb fin is used with general-purpose bombs, Mk 82 Mods, or the practice bomb BDU-45/B (fig. 1-26). 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 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.

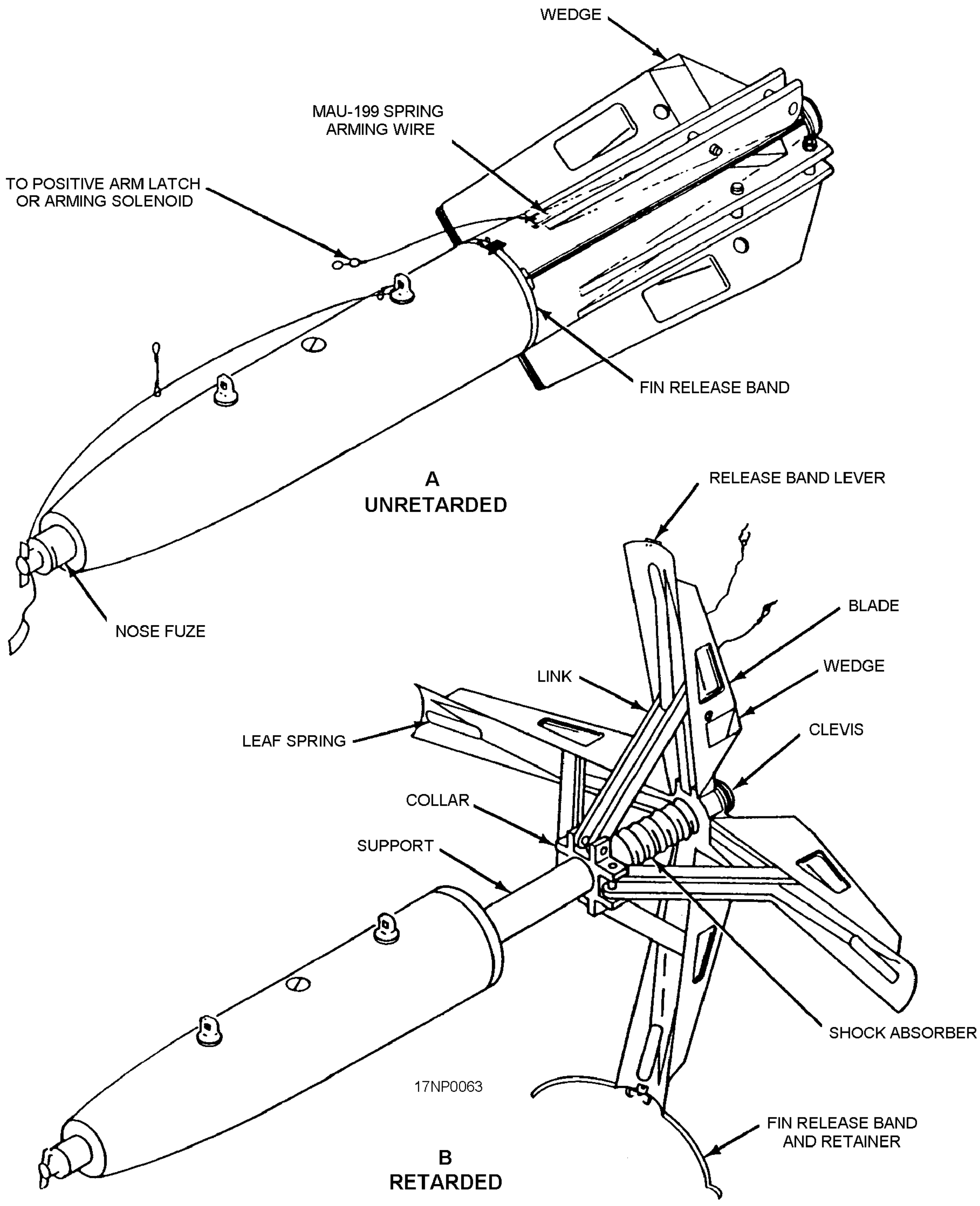


Figure 1-26.—BSU-86/B fin with Mk 82 bomb.

REVIEW NUMBER 5

Q1. What type of bomb is used in most bombing operations?

Q2. Name the type of pallets on which bombs are shipped.

Q3. The Mk 15 fin is used with the ________ LDGP bomb.

Q4. What adapter is used to mate the MAU-91A/B fin to the Mk 83 bomb?

Q5. List the three modes of delivery used with Snakeye fins.

GUIDED BOMB UNITS

LEARNING OBJECTIVE: *Identify the different types, purpose, use, and operation of guided bomb units.*

GBU-12, GBU-16, AND GBU-10 (PAVEWAY II)

The GBU-12, GBU-16, and GBU-10 (PAVEWAY II) guided bomb units (GBUs) (fig. 1-27) are Mk 82/BLU-111, Mk 83/BLU-110, and Mk 84/BLU-117 LDGP bombs configured to detect a target illuminated by a laser beam. The modification consists of MAU-169 series computer control group (CCG) and MXU-650, 651, or 667 series airfoil group (AFG). 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 (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 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.

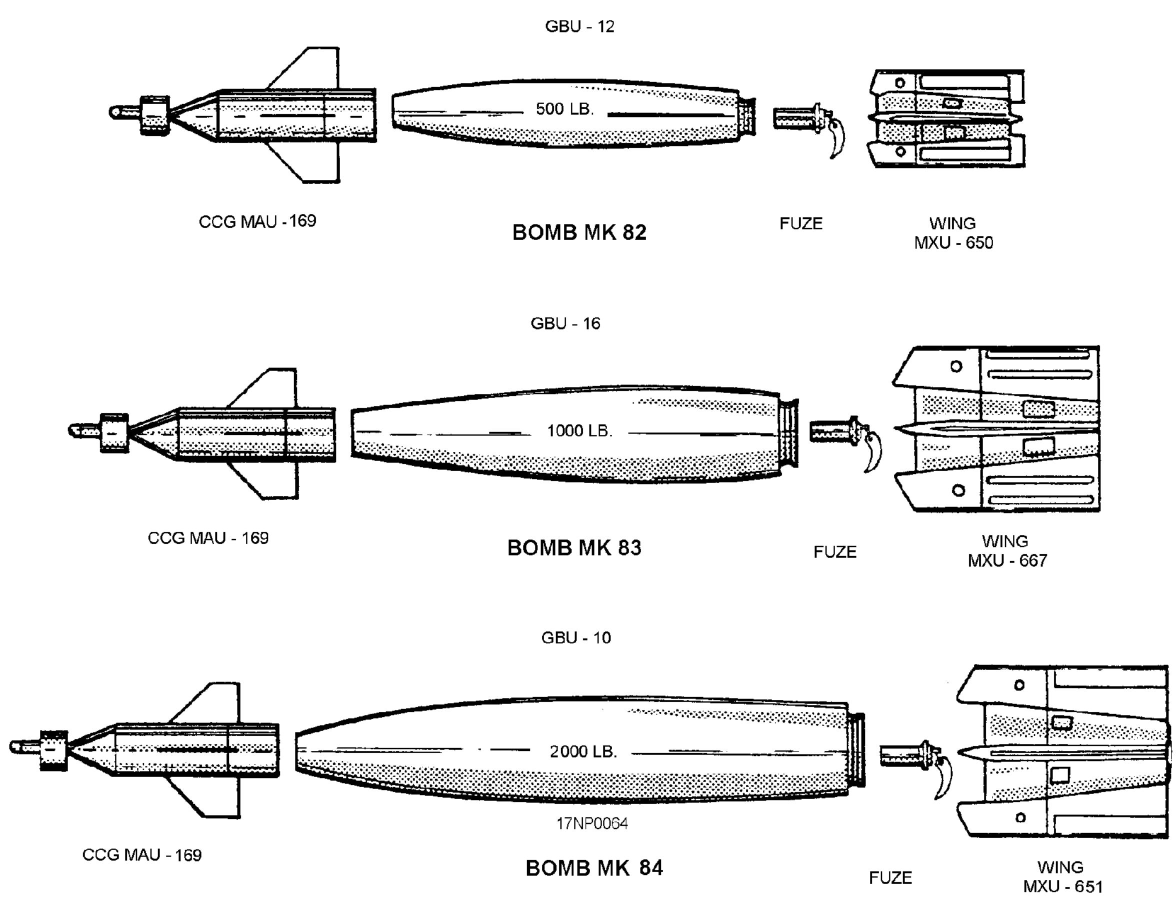


Figure 1-27.—Typical guided bomb unit configurations.

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

GBU-24B/B (PAVEWAY III)

The GBU-24B/B (PAVEWAY III) (fig. 1-28) is a converted BLU-109A/B 2000 pound class bomb designated as a hard target penetrator (HTP). The associated components required for conversion are fuze, airfoil group, FZU generator, 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 GBU-24B/B has a thermal protective coating applied to the surface to extend the cook-off time. The GBU-24B/B must not be missing more than 20 square inches of thermal coating in a single area or more than 40 square inches total.

JOINT DIRECT ATTACK MUNITION (JADM) (GBU-31 SERIES)

The Joint Direct Attack Munition (JADM) series are Mk80/BLU series bombs with a JDAM kit installed. The kit consists of strakes which increase the release envelope, a tail section that houses a Global Positioning System, Inertial Measurement Unit, flight controls and a aircraft interface.

REVIEW NUMBER 6

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.

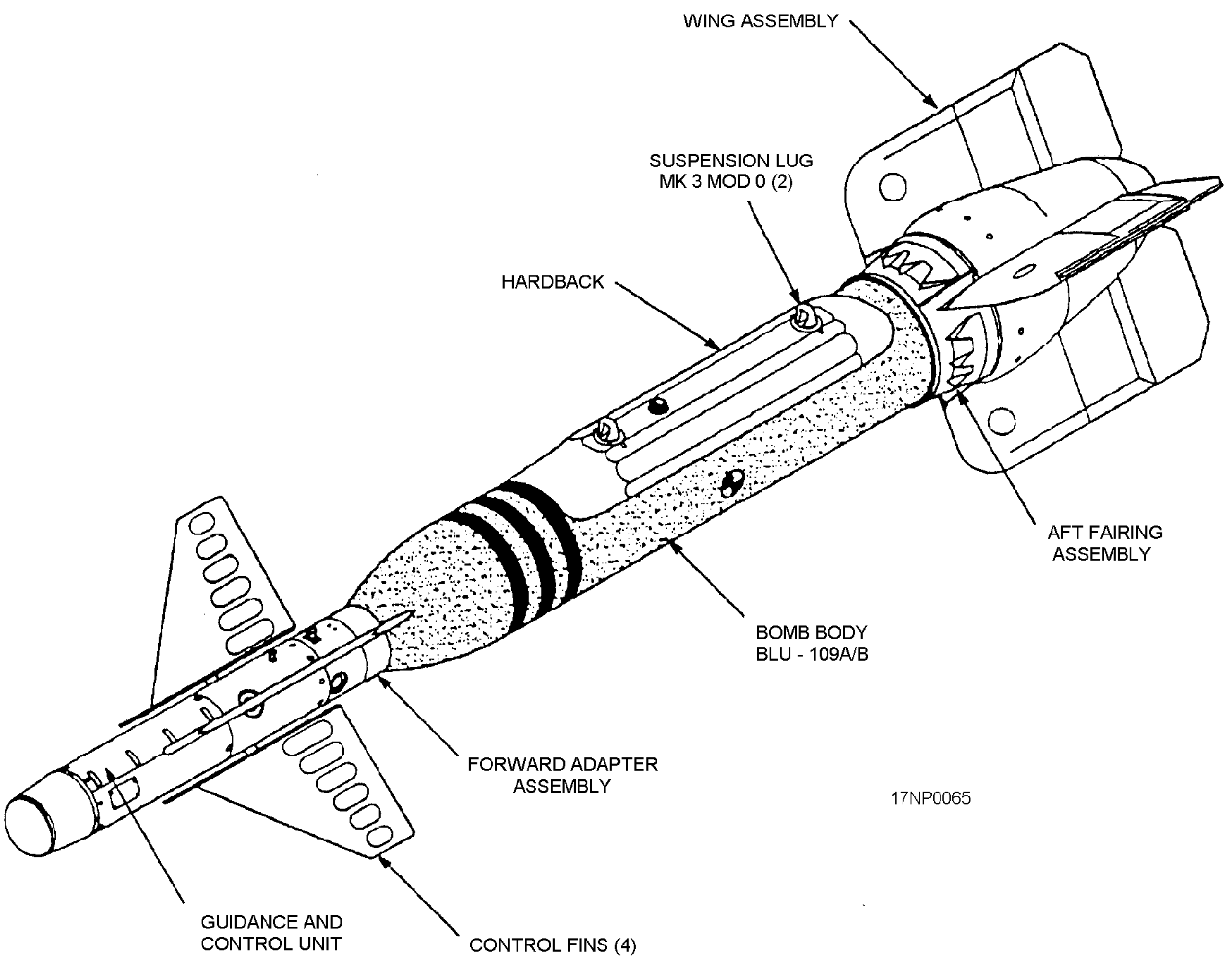


Figure 1-28.—GBU-24B/B.

DESTRUCTORS

LEARNING OBJECTIVE: *Identify the types, purpose, and use of destructors (DSTs).*

The destructor mine consists of an LDGP aircraft bomb and a Mk 75 modification kit. The Mk 75 modification kit (fig. 1-29) contains the Mk 32 arming

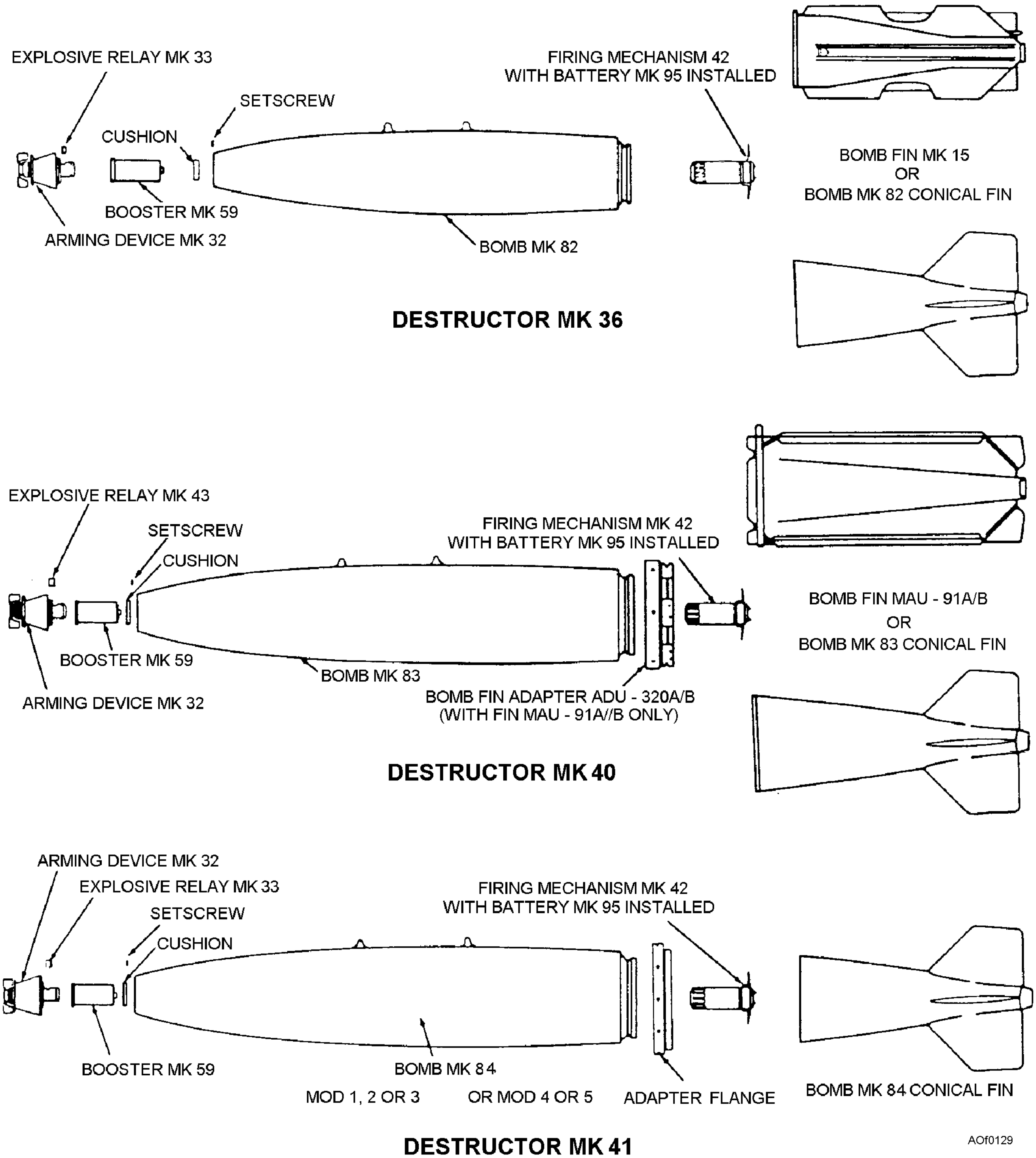


Figure 1-29.—Typical destructor configurations.

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.

REVIEW NUMBER 5 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. *The Mk 15 fin is used with the Mk 82 bomb in either a low-drag or high-drag configuration.*

A4. *The ADU-320/B adapter is used to mate the MAU-91A/B fin to the Mk 83 bomb.*

A5. *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 in-flight selected mode (pilot option), where the pilot selects either the retarded or nonretarded mode of delivery.*

REVIEW NUMBER 6 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.*

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 DSTs 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 with a conical fin for nonretarded delivery only. The standard LDGP bomb markings plus white stripes (fig. 1-30) identify DSTs.

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

REVIEW NUMBER 7

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.*

ANTITANK BOMB CLUSTER MK 20, CBU-99, AND CBU-100

LEARNING OBJECTIVE: *Identify the purpose and use of the various configurations of the Mk 20, CBU-99, and CBU-100 antitank bomb clusters. Describe the function of the Mk 118 Mods 0 and 1 antitank bomb.*

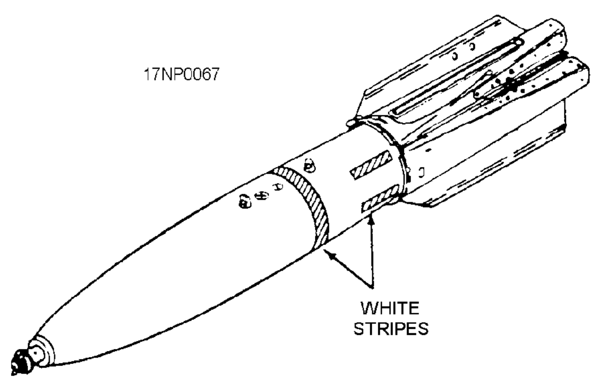


Figure 1-30.—DST identification markings.

The antitank bomb cluster (fig. 1-31) is an air-launched, conventional free-fall weapon. The Mk 20, CBU-99, and CBU-100 are used against armored vehicles.

The CBUs 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 Mk 20 bomb cluster weighs 490 pounds and contains 247 Mk 118 antitank bombs. The information on configuration, functional description, and shipping and storage containers of the Mk 7 bomb dispenser and its associated components can be found in NAVAIR 11-5A-3, also information on decanning, preparation for use, and recanning procedures are found in NAVAIR 11-140-9.

MK 20 MODS/CBU-99/CBU-100, BOMB CLUSTER CONFIGURATIONS

The configurations of the Mk 20 Mods/ CBU-99/CBU-100 are listed in (table 1-4).

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 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.

REVIEW NUMBER 7 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 40 DST.*

A3. *The Mk 41 DST can only be delivered in the nonretarded mode.*

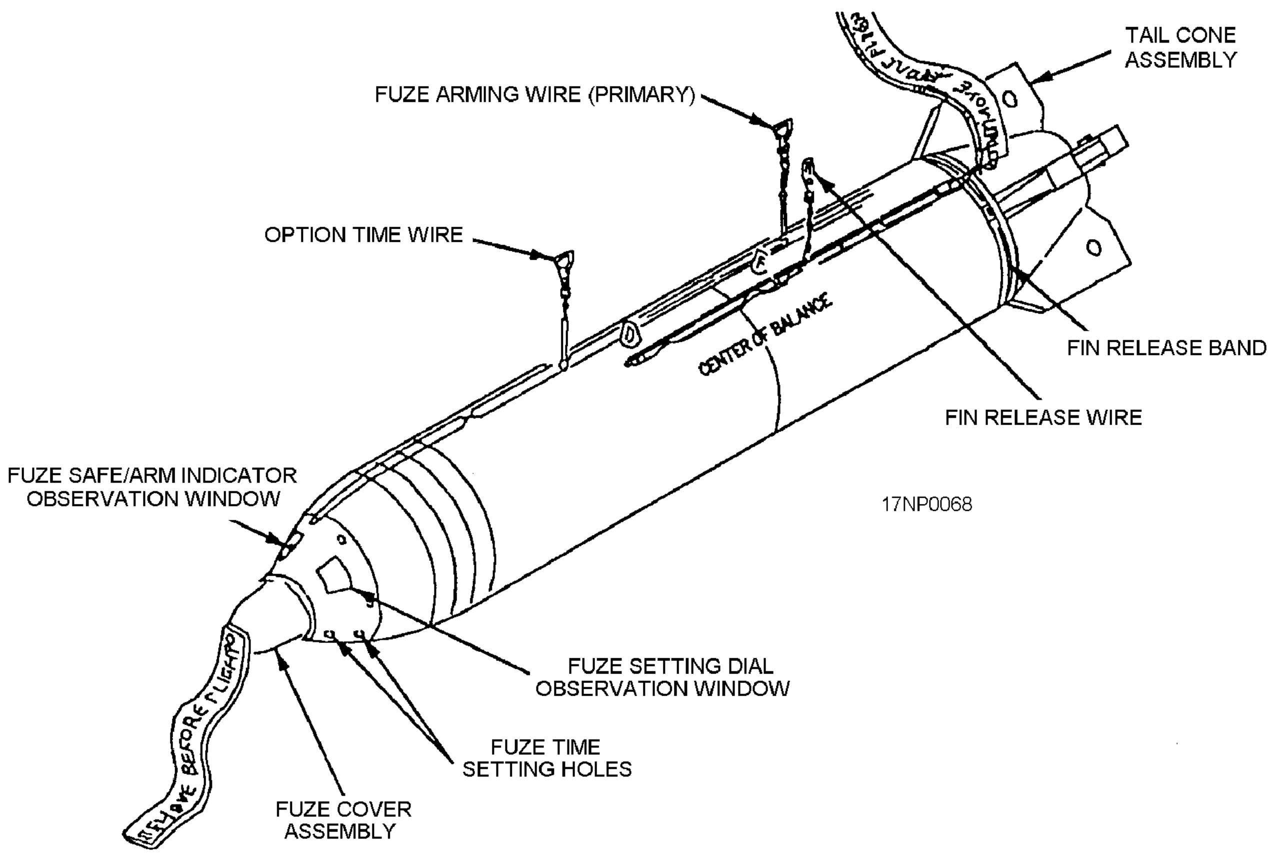


Figure 1-31.—Antitank bomb cluster Mk 20 Mods and CBU-99 and CBU-100.

Table 1-4.—Bomb Cluster Mk 20 Mods and CBU-99 and CBU-100 Configurations

BOMB CLUSTER	BOMB DISPENSER	FUZE	EXPLOSIVE PAYLOAD
Mk 20 Mod 3	Mk 7 Mod 3	Mk 339 Mod 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 1 Mechanical Time Fuze	247 Mk 118 Mod 0 antitank bombs with Mk 1 Mod 0 fuzing system
Mk 20 Mod 6	Mk 7 Mod 6 Thermally protected	Mk 339 Mod 1 Mechanical Time Fuze	247 Mk 118 Mod 1 antitank bombs with Mk 1 Mod 1 fuzing system
MJU-5/B	Mk 7 Mod 3	Mk 339 Mod 1 Mechanical Time Fuze	Chaff
CBU-78/B & B/B	SUU-58/B	Mk 339 Mod 1 Mechanical Time Fuze	45 BLU-91B AT/AV and 15 BLU-92/B AP
CBU-78 B/B	SUU-58/B	FMU-140/B	45 BLU-91B AT/AV and 15 BLU-92/B AP
CBU-99/B	SUU-75/B Thermally protected	Mk 339 Mod 1	247 Mk 118 Mod 0 bombs
CBU-99A/B	SUU-75A/B Thermally protected	FMU-140/B	247 Mk 118 Mod 0 bombs
CBU-100/B	SUU-76/B Thermally protected	Mk 339 Mod 1	247 Mk 118 Mod 0 bombs
CBU-100A/B	SUU-76A/B Thermally protected	FMU-140/B	247 Mk 118 Mod 0 bombs

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 Mk 7 Mods 3, 4, and 6 bomb dispensers have 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 and 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 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.

Mk 118 Mod 0 and Mod 1 Antitank Bomblets

The antitank bomblets Mk 118 Mod 0 (fig. 1-32) consists of a Mk 1 Mod 0 fuzing system, a shaped-charge warhead, and fixed stabilizing fins. It is loaded in the Mk 20 Mod 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 Mod 6 bomb clusters only.

FUNCTIONAL DESCRIPTION

When the Mk 20 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 band, and the movable fins snap open by spring-force.

Functioning of the fuze initiates the linear-shaped charges in the dispenser; that cut 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.

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.

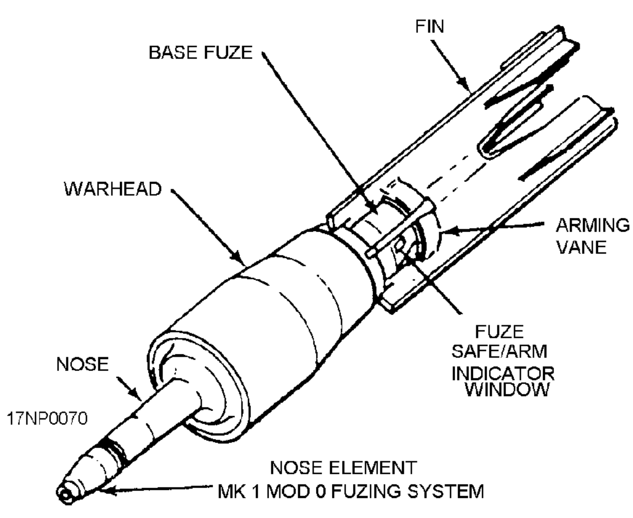


Figure 1-32.—Antitank bomblets Mk 118 Mod 0 and Mod 1.

SHIPPING AND STORAGE CONTAINERS

The Mk 427 Mod 0 and Mod 1 shipping and storage containers encase one fully assembled Mk 20 bomb cluster. The 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 is used to ship and store two fully assembled Mk 20 bomb clusters. The cradle consists of plastic upper and lower shell assemblies, which are shock-mounted on a metal cradle assembly. The weapon cradle has forklift guides, lifting eyes; hand truck brackets, and lifts devices to permit the use of handling equipment. Four supports are provided on each cradle to aid in stacking the cradle assemblies.

REVIEW NUMBER 8

Q1. *Name the main structure of the Mk 7 bomb dispenser.*

Q2. *The Mk 20 bomb cluster weighs ______ and contains ____ bomblets.*

Q3. *Name the component used to stabilize the bomb after release from the aircraft.*

Q4. *Describe the purpose of the Mk 339 Mod 1 mechanical time fuze.*

Q5. *List the components of the Mk 118 Mod 0 and Mod 1 antitank bomblets.*

Q6. *What shipping container is used to ship and store the Mk 20 bomb cluster?*

CBU-78/B and B/B GATOR

The CBU-78/B and B/B GATOR weapon is delivered as an all-up-round (AUR) (fig. 1-33). The weapon consists of the SUU-58/B dispenser, Mk 339

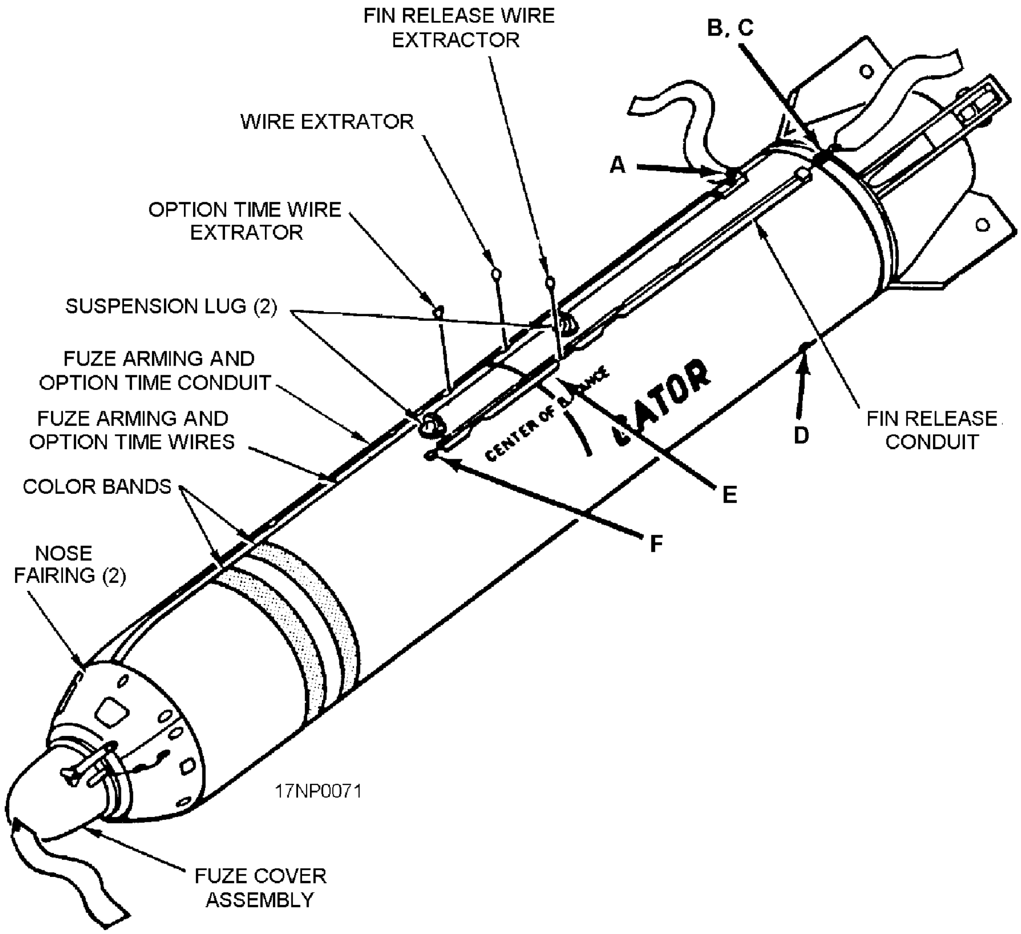


Figure 1-33.—CBU-78/B and B/B GATOR weapon.

Mod 1 fuze, Kit Modification Unit KMU-428/B, and 60 mines (45 BLU-91/B and 15 BLU-92/B). The fuze initiation time is preset and is activated upon weapon release from the aircraft. Fuze time settings are primary mode (1.2 seconds) and option mode (4.0 seconds). The KMU-428/B adapts the mines to the dispenser; it also provides mine activation/self-destruct time selection.

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.

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.

PRACTICE BOMBS

LEARNING OBJECTIVE: *Identify the different types, 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 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, 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 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 (fig. 1-34). 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.

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.

BDU-48/B

The BDU-48/B is a 10-pound practice bomb (fig. 1-35). 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 (fig. 1-35) 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.

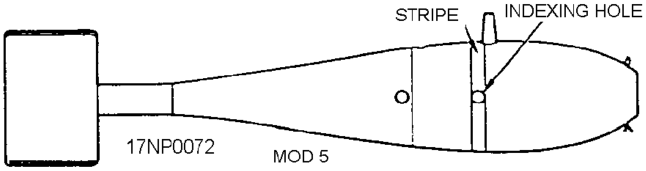


Figure 1-34.—Mk 76 Mod 5 practice bomb.

REVIEW NUMBER 8 ANSWERS

A1. The cargo section is the main structure of the Mk 7 bomb dispenser.

A2. The Mk 20 bomb cluster weighs <u>490 pounds</u> and holds <u>247 Mk 118 antitank bomblets</u>.

A3. The tail cone assembly, attached to the aft end of the cargo section, stabilizes the bomb after it is released from the aircraft.

A4. The Mk 339 Mod 1 mechanical time fuze is used to initiate the linear-shaped charges in the cargo section wall.

A5. 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*

A6. The Mk 427 Mod 0 and Mod 1 shipping containers are used to ship and store Mk 20 bomb clusters.

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 (fig. 1-36) 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

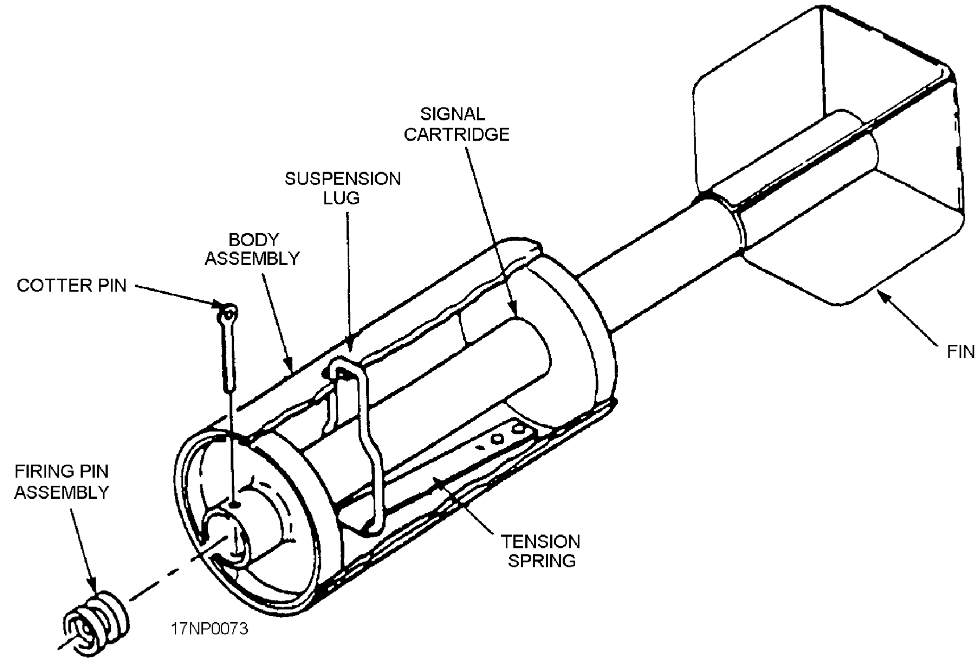


Figure 1-35.—BDU-48/B practice bomb.

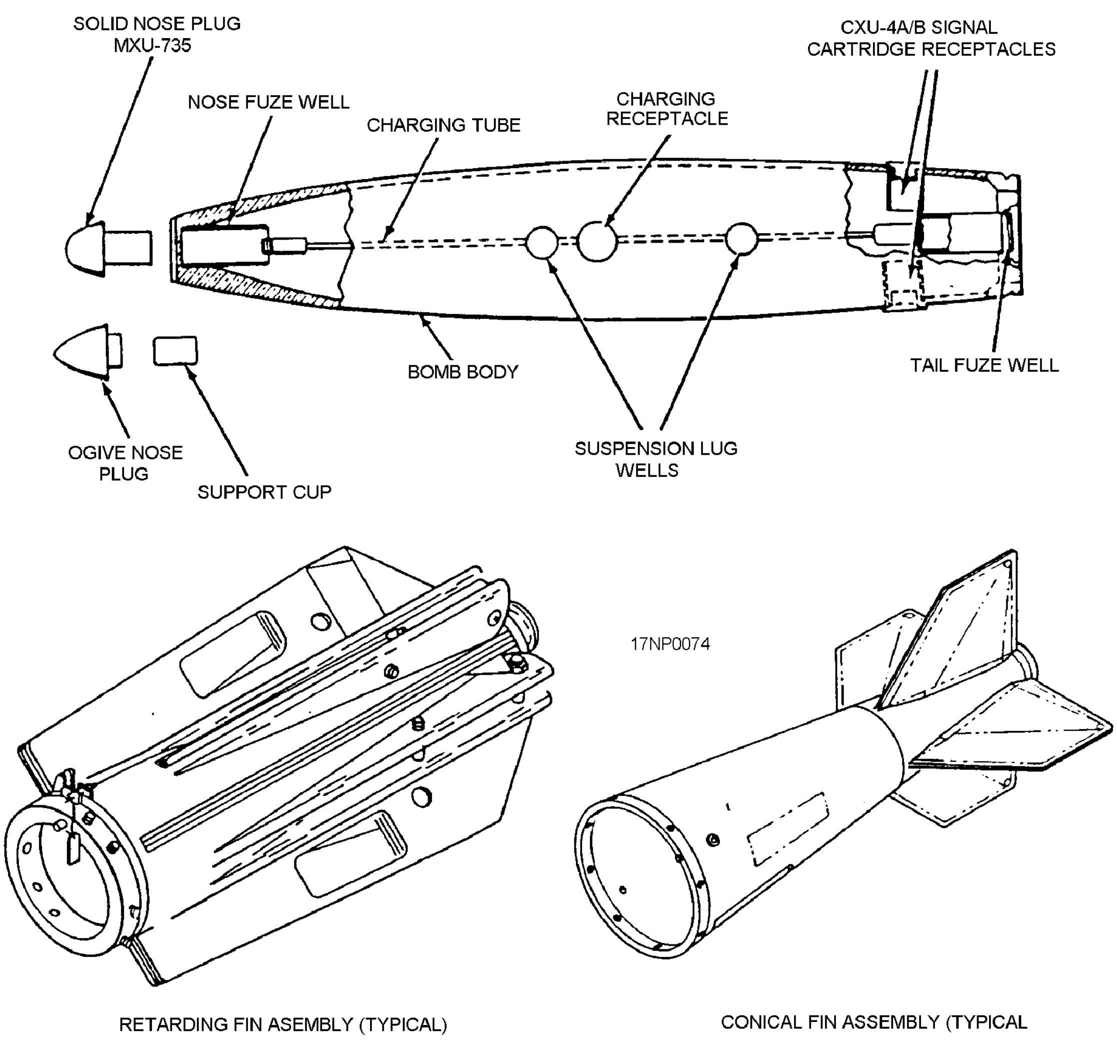


Figure 1-36.—BDU-45/B practice bomb.

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. 1-37) 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.

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.

LASER GUIDED TRAINING ROUND (LGTR)

The LGTR (fig. 1-38) is designed to provide realistic laser guided bomb (LGB) tactical training. The training round consists of a guidance and control section, pneumatic controls for moveable control surfaces, power supply, and a standard practice bomb signal cartridge. Once initiated, the system cannot be reset. The signal cartridge (spotting charge) is impact initiated and does not require safety or cotter pins.

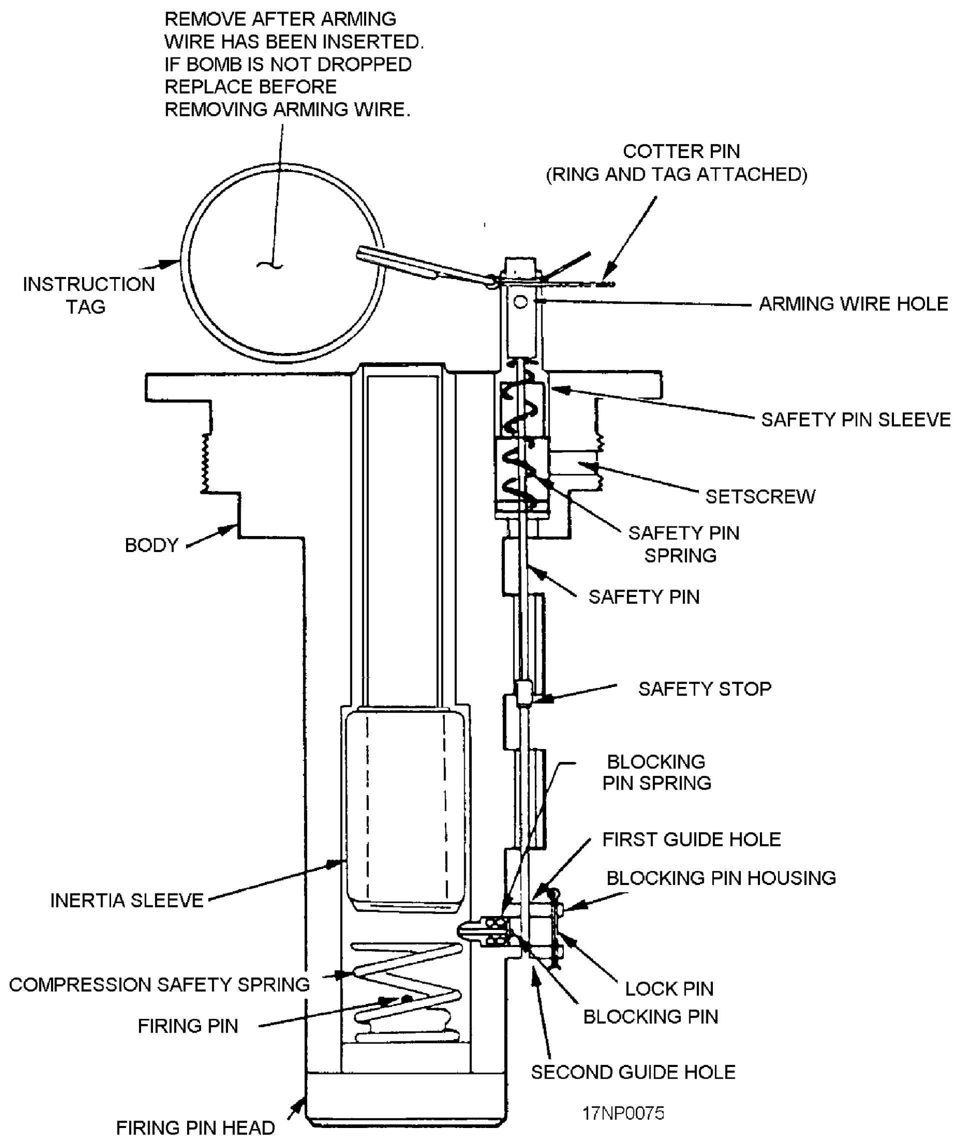


Figure 1-37.—Mk 89 Mod 0 bomb spotting charge adapter.

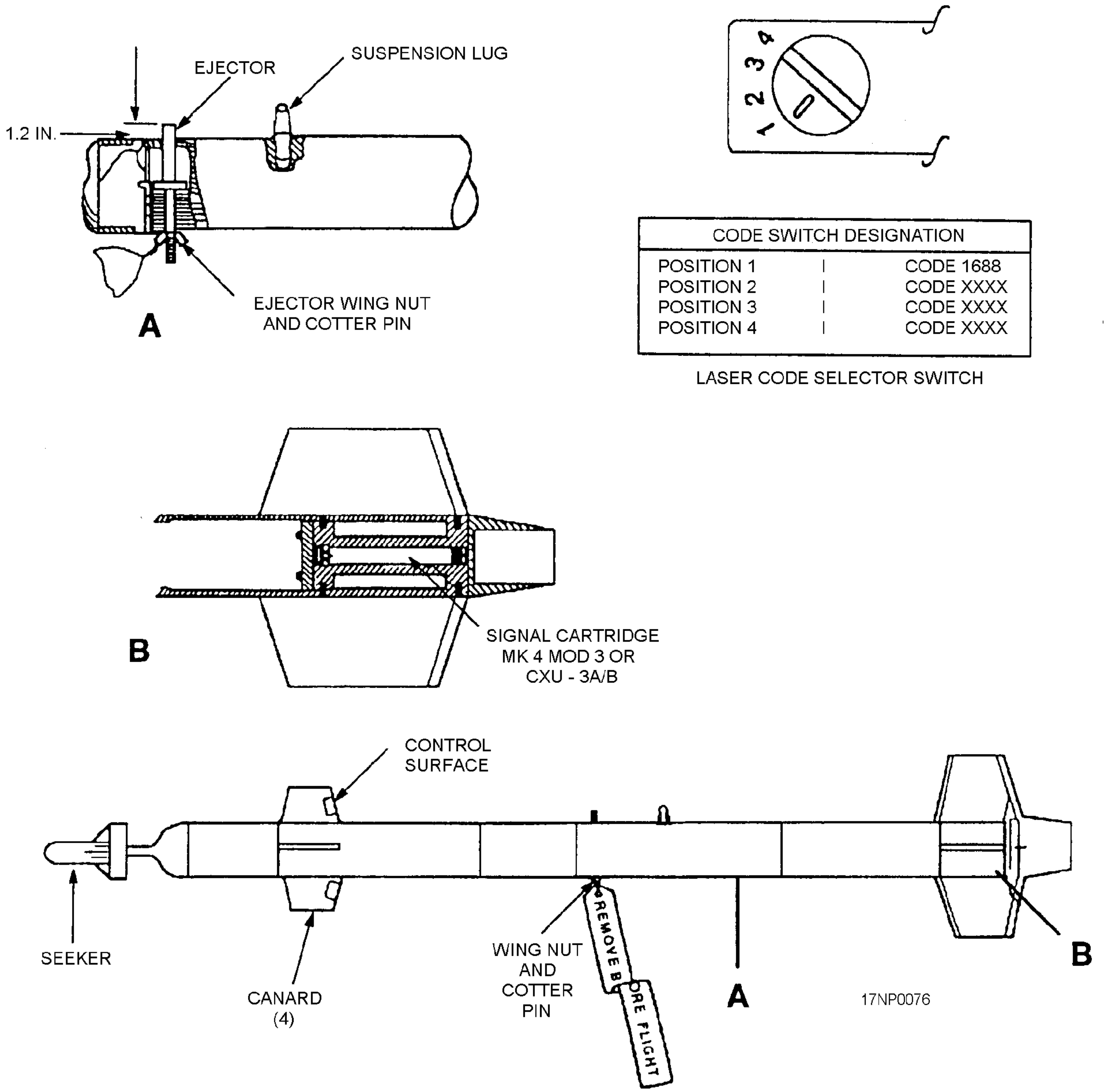


Figure 1-38.—Laser guided training round (LGTR).

REVIEW NUMBER 9

Q1. Describe the primary purpose of practice bombs.

Q2. List the two general types of practice bombs.

Q3. List the types of subcaliber practice bombs.

Q4. What color are Mk 80 (series) inert LDGP bombs painted?

SAFETY PRECAUTIONS

LEARNING OBJECTIVE: *Recognize the safety precautions to follow when working with bombs, 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; however, 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 them.

Fuzes are packed in sealed, moisture proof containers, and should not be unsealed until they 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 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.

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.

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 crewmembers 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 10

Q1. *What is the maximum length of time that the Mk 376 electrical tail fuzes can be used after they are removed from their container?*

Q2. *In what location should you **never** pack or unpack fuzes?*

Q3. *Why is explosive bomb ammunition hazardous?*

Q4. *Handling ________ causes more injuries than handling ___________.*

REVIEW NUMBER 9 ANSWERS

A1. *Practice bombs are primarily used for safety when training new or inexperienced pilots and ground-handling crews.*

A2. *The two general types of practice bombs are the subcaliber and the full-scale bombs.*

A3. *The Mk 76 Mod 5 subcaliber practice bomb is used for impact firing only.*

The BDU-48/B subcaliber practice bomb is used to simulate retarded weapons delivery.

A4 *Mk 80 (series) inert LDGP bombs are painted blue.*

REVIEW NUMBER 10 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.*

A3. *Explosive bomb ammunition is hazardous because of its tendency to set off all explosive material near it if it is detonated.*

A4. *Handling <u>practice bombs</u> causes more injuries than handling <u>bomb ammunition containing high explosives</u>.*