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STARLIGHT SCOPE, SMALL HAND-HELD OR INDIVIDUAL WEAPONS MOUNTED, MODEL NO. 6060

CHAPTER 1
INTRODUCTION

Section I. GENERAL

1. Purpose. This training circular provides guidance for the conduct of training with the Starlight Scope, Small Hand-Held or Individual Weapons Mounted, Model No. 6060 (hereafter referred to as the Starlight Scope).

2. Scope. This circular contains a complete description of the Starlight Scope, mechanical training to include assembly, disassembly, operation, functioning, installation, and maintenance, and marksmanship training to include aiming, positions, zeroing, and other information pertinent to its employment and the conduct of operator training. This material is applicable, without modification, to nuclear and nonnuclear warfare.

3. Responsibility of Users. Users of this training circular are encouraged to submit recommended changes and comments to improve the publication. Comments should be keyed to the specific page, paragraph, and line of text in which the change is recommended. Reasons will be provided for each comment to insure understanding and complete evaluation. Comments should be forwarded direct to the Commandant, United States Army Infantry School, Fort Benning, Ga. 31905.

Section II. DESCRIPTION AND DATA

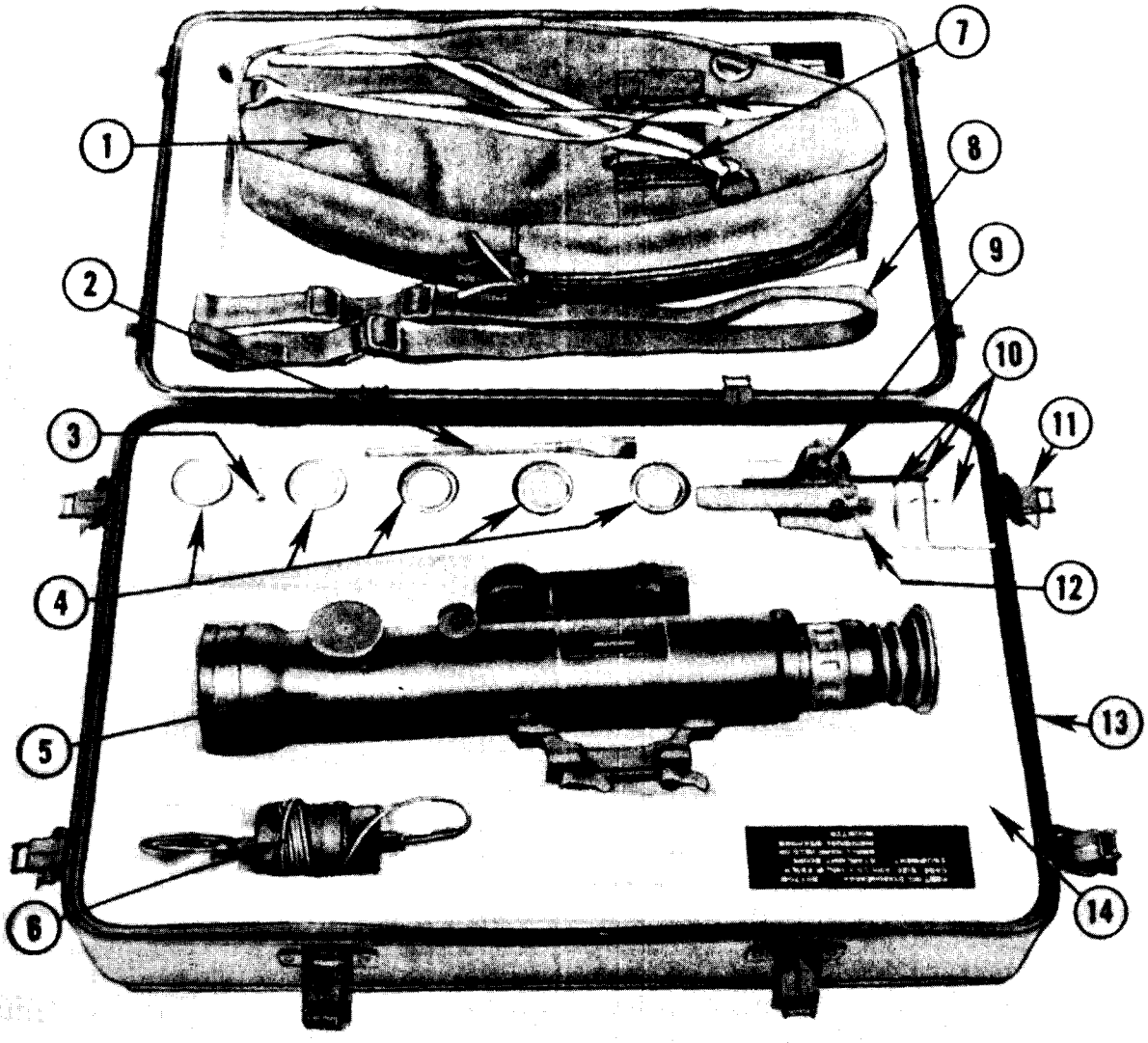
4. Description. *a. General.* The Starlight Scope is a portable, battery powered, electro-optical instrument for passive visual observation and aimed fire of weapons at night. It uses the natural light (moonlight and/or starlight) of the night sky for target illumination. The Starlight Scope, since it does not project a visible or infrared light, offers freedom from the possibility of enemy detection. The Starlight Scope is designed for employment on the M14, M14A2, and XM16E1 rifles, M60 machinegun, 40-mm grenade launcher M79, 90-mm recoilless rifle M67, and the 66-mm high explosive antitank rocket M72.

b. Shipping Container. The Starlight Scope and accessories are shipped and stored in a metal case (fig. 1) with top and bottom foam contour liners to provide maximum protection. The shipping container is fitted with a carrying bundle, eight latches and latch clasps, a pressure relief valve with instruction plate, and identification plate. Inserted under the foam liner in the lid of the shipping container are maintenance forms and TM 11–1090-268-15.

c. Starlight Scope. The Starlight Scope (fig. 2) consists of the main housing, objective lens assembly, objective focusing knob and locking lever, sight reticle assembly with elevation and azimuth adjustment knobs, integral high voltage power supply system with a three-way toggle-type control witch and switch guard, eyepiece assembly with focus ring and attached rubber eyeshield, telescope mount assembly, image intensifier tube, and a lens cap.

(1) The main housing (fig. 2) is a lightweight machined casting of tubular configuration which holds all the other components or subassemblies of the Starlight Scope.

(2) The objective lens assembly (fig 2), located in the front of the main housing, consists of an objective lens cell and four single glass elements. These glass elements are held inside the objective lens assembly by three spacers and a retainer. The interior of the assembly is purged in an atmosphere of dry nitrogen to prevent lens fogging.



1. CANVAS CARRY CASE
2. LENS BRUSH
3. SIGHT RETICLE LAMP (2)
4. BATTERY (5)
5. STARLIGHT SCOPE
6. LOW TEMPERATURE ADAPTER ASSEMBLY
7. KEEPER AND SLIDE ASSEMBLY
8. NYLON CARRYING STRAP
9. WEAPON ADAPTER BRACKET FOR XM16E1
10. ALLEN WRENCH
11. LATCH (8)
12. WEAPON ADAPTER BRACKET FOR M 14 OR M14A2 RIFLE
13. SHIPPING CONTAINER
14. FOAM CONTOUR LINER

Figure 1. Shipping container, Starlight Scope and accessories.

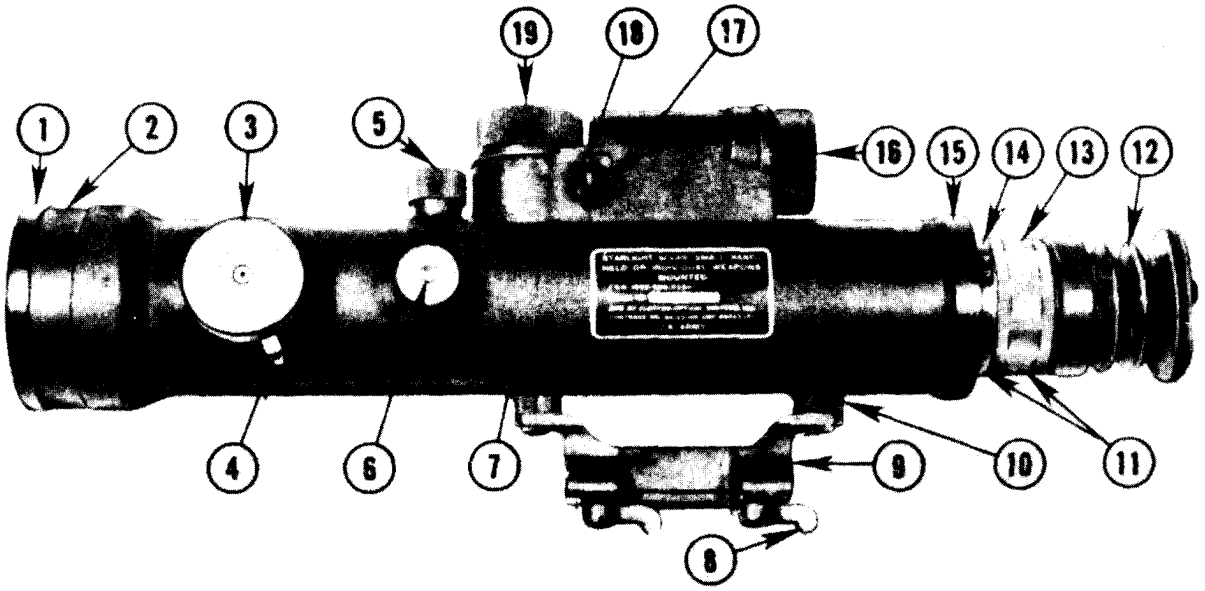
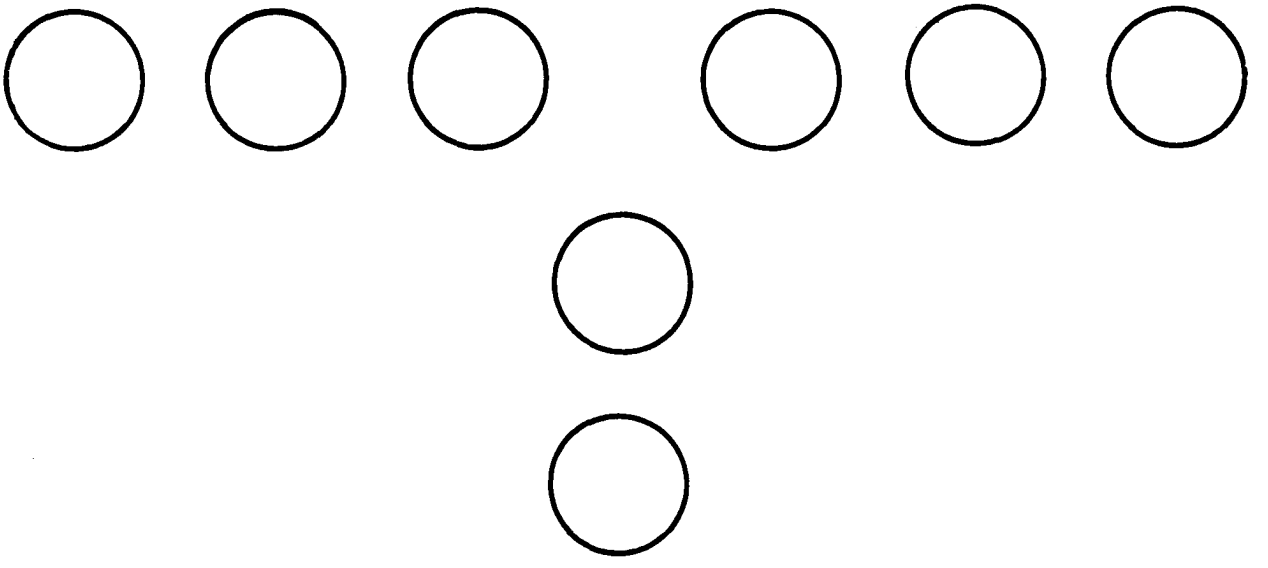


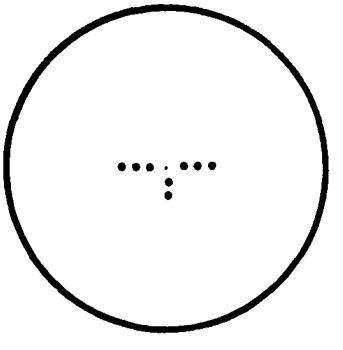
Figure 2. Starlight Scope.

(3) The objective focusing knob and locking lever (fig. 2) permit movement of the objective lens assembly within the main housing for distance focusing. For viewing near objects the objective lens assembly is moved forward in the main housing, and for viewing distant objects the objective lens assembly is moved rearward. This movement is accomplished by an eccentric shaft which is rotated by turning the knurled focusing knob. The locking lever enables the operator to lock the objective lens assembly at the desired distance focal position. This locking action prevents movement of the objective lens assembly when the weapon is fired. When the Starlight Scope is employed as a hand-held viewer, it is usually not necessary to lock the objective lens assembly in place. Locking may be accomplished by rotating the locking lever in either a clockwise or counterclockwise direction; however, for best locking action, clockwise rotation is recommended.

(4) The sight reticle assembly is located in the main housing just forward of the image intensifier tube. The reticle pattern(①, fig. 3) is of a T-type configuration. There are six dots (beads) displayed at the top of the T and two dote (beads) on the stem of the T. The aiming reference dot is the top dot in the stem of the T. The aiming reference dot is positioned in the center of mass of the target to obtain the correct sight picture. The reticle pattern may be adjusted by rotating the elevation and azimuth adjustment knobs. Each click of either the elevation or azimuth adjust-

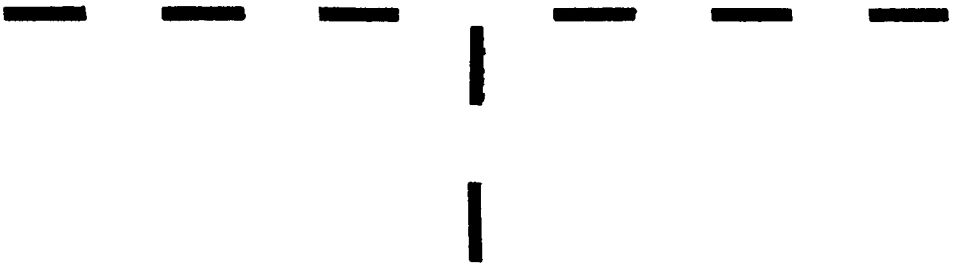


RETICLE PATTERN ENLARGED

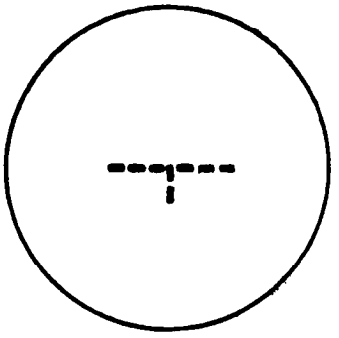


① BEAD TYPE RETICLE

Figure 3. Sight reticle pattern.



RETICLE PATTERN ENLARGED



② BLACK LINE RETICLE

Figure 3.—Continued.

ment knobs moves the strike of the bullet 3 inches (7.62 cm) at 150 meters. The sight reticle is designed for use as a passive (without power) reticle under high light level conditions. However, provisions have been made to permit "charging" of the reticle to compensate for low light level conditions. (A black line reticle (②, fig. 3) will replace the bead-type reticle in the very near future.)

(5) The power supply system for the Starlight Scope consists of a power supply housing (fig. 2), a 6.75-volt mercury cell battery, a high voltage oscillator, wiring, and a toggle switch. The three-position toggle switch (fig. 2) provides for sight ON (passive reticle), sight OFF, and reticle CHARGE positions. The middle position of the switch is sight OFF. The upper position of the switch is sight ON, and the lower position of the switch permits CHARGING of the reticle.

(6) The eyepiece assembly (fig. 2) mates into the rear of the main housing and is held in position by the eyepiece retaining nut. The eyepiece assembly consists of six glass elements (2 doublets, a singlet, and a window). One of the doublets and the singlet glass element are capable of forward and rearward movement by means bf the eyepiece focus ring (fig. 2). This movement enables the operator to focus the eyepiece assembly to meet individual eye requirements. A diopter scale (fig. 2) is engraved on the eyepiece assembly immediately forward of the focus ring. This diopter scale enables the operator, once he has obtained his own focal setting, to preset the eyepiece focus ring, thus eliminating the necessity for refocusing the eyepiece each time the Starlight Scope is used. The eyepiece assembly is purged in an atmosphere of dry nitrogen to prevent lens fogging. Attached to the eyepiece assembly is a rubber eyeshield (fig. 2) which protects the eye from shock caused by recoil when the weapon is fired. The rubber eyeshield also aids in security by providing the operator with a means of covering the areas around the eye, thus preventing light leaks on other areas of the face caused by the visible glow emitted from the rear of the eyepiece assembly.

Note. The Starlight Scope may be shipped with either a "secure" or "nonsecure" rubber eyeshield. The eyeshields are identical except the "secure" eyeshield has a rubber flap over the end which must be pulled aside before the operator can view through the eyepiece. Upon removal of the eyeshield from the eye, the flap closes and is held shut by two magnets.

(7) Installed on the underside of the main housing is the telescope mount assembly which provides a means of mounting the Starlight Scope to the weapons adapter bracket (fig. 2). It is equipped with two locking knobs which are used to secure the mount assembly to the weapons adapter bracket.

(8) The image intensifier tube is located inside the main housing between the sight reticle assembly and the eyepiece assembly. It concentrates and intensifies the ambient light of the night sky to such a degree that distant objects appear as images within the Starlight Scope.

(9) The lens cap (fig. 2) mounts over the objective lens. It has three small pinholes drilled around its center to limit the amount of light entering into the Starlight Scope. This permits operation of the Starlight Scope during daylight hours for zeroing purposes.

d. Accessories. Shipped and stored in the shipping container, as accessories to the Starlight Scope, are five 6.75-volt mercury batteries, two sight reticle lamps, two weapons adapter brackets, three allen wrenches, a low temperature adapter assembly, 8 canvas carrying case, a nylon carrying strap, and a lens brush and lens tissue (fig. 1).

(1) The 6.75-volt mercury battery provides the power required for operation of the Starlight Scope. Five batteries are shipped with the Starlight Scope; however, four are spares since only one is needed for operation of the equipment.

The battery does not have a recharging capability. When its use-life has been expended, the battery is discarded (para 9 *b* (l)).

(2) Even though two sight reticle lamps are shipped as accessories to the Starlight Scope, the operator is not authorized to remove and/or install lamps within the Starlight Scope. When turned on, the lamp provides the visible illumination necessary to charge the sight reticle.

(3) Two weapons adapter brackets are contained in the shipping container. One bracket is for mounting the Starlight Scope to the M14 or M14A2 rifles and one bracket permits installation of the Starlight Scope to the XM16E1 rifle. A separate weapons adaptor bracket is provided for mounting the Starlight Scope to each of the other weapons listed in paragraph *4a* and may be procured through normal supply channels.

(4) The three allen wrenches are the basic tools required by the operator for disassembly and assembly of the Starlight Scope and for installation of the weapons adapter brackets (saddle block for M60 machinegun excluded).

(5) The low temperature adapter assembly permits operation of the Starlight Scope during low or arctic temperatures. The low temperature adapter assembly may be assembled to the battery housing, permitting the operator to carry the battery inside the battery adapter case. The battery and battery adapter case may then be positioned inside the clothing of the operator where body heat will protect the battery against low temperatures.

Note. Some models do not contain a low temperature adapter assembly.

(6) The canvas carrying case affords protection and provides the operator with a means of transporting the Starlight Scope in other than the shipping container. The case has a keeper and slide assembly for attachment to the pistol or cartridge belt. A zipper is installed for closure of the case.

(7) The nylon carrying strap has adjustable loops at either end for attachment to the Starlight Scope to provide an additional carrying capability.

(8) A lens brush and lens tissue are provided for cleaning the objective lens and the eye lens.

5. Tabulated Data. *a. Starlight Scope.*

Magnification	4 power.
Field of view	171 mils (average).
Eyepiece focus	+4 to – 4 dioptcrs.
Objective lens focus	4 meters to infinity.
Weight	5 pounds, 14 3/4 ounces.
Length	18.50 inches.
Width	3.35 inches.
Height	5.2 inches.
Range	Dependent on ambient light level.
Operating temperature	–65° to + 125° F. at humidity ranging from O to 100 percent.

b. Battery.

Type	BA 1100 ( )-u Mercury.
Voltage	6.75.
Number of cells	5.
Use life	Approximately 100 hours.
Shelf life	2 years at optimum storage

c. Shipping Container.

Length	22.5 inches.
Width	14.25 inches.
Height	6.38 inches.
Weight	16 pounds, 12 ounces

CHAPTER 2
MECHANICAL TRAINING

Section I. DISASSEMBLY AND ASSEMBLY

6. General. *a.* The purpose of mechanical training is to give the operator a knowledge of the basic functioning, controls, and adjustable parts of the Starlight Scope so that he will understand its operation and be able to properly care for it.

b. The operator is authorized to disassemble the Starlight Scope *only* to the extent described in paragraph 7.

c. Even though detail disassembly is not authorized, this should not preclude teaching the operator the nomenclature of the component parts and accessories.

d. The Starlight Scope should be disassembled and assembled only when necessary for instruction or maintenance.

7. Disassembly.

Caution: **Before releasing the shipping container's latches, turn the core of the relief valve as instructed on the side of the shipping container. This valve will release any internal pressure in the shipping container that may have built up during storage or shipment.**

a. Shipping Container.

(1) Place the shipping container flat on the ground or table and raise the latches to remove the lid from the bottom of the container.

(2) Remove the Starlight Scope and accessories from the container.

(3) The top and bottom foam contour liners are force-fitted into the shipping container. There are no screws or bolts holding them in place. The liners are removed by forcefully pulling them from the shipping container.

b. Starlight Scope. The operator is authorized to remove the objective lens cap, focusing knob and locking lever, azimuth and elevation adjustment knobs, battery cap, rubber eyeshield, and the telescope mount assembly.

(1) The objective lens focusing knob is removed by using the allen wrench and unscrewing the socket head screw located in the center of the knob. Lift the knob from the collet (fig. 4).

(2) Remove the locking lever from the collet by turning counterclockwise (fig. 4).

(3) The azimuth adjustment knob is removed by using the allen wrench to loosen the socket head screw located on the side of the knob. Lift the knob from the sight plate (fig. 5).

(4) The elevation adjustment knob is removed as described in (3) above (fig. 6).

(5) Remove the battery cap from the battery housing by turning in a counterclockwise direction (fig. 9).

(6) The rubber eyeshield is removed by forcefully pulling it from the eyepiece assembly (fig. 7).

(7) Remove the two locking screws which secure the telescope mount assembly to the main housing (fig. 8).

Note. A screwdriver is required for this operation.

8. Assembly. The sequence in which the disassembled parts are assembled is not important; however, during training the operator should use the reverse procedure of disassembly.

a. Starlight Scope.

(1) Aline the telescope mount assembly with the mounting studs on the base of the main housing and secure with the two locking screws.

(2) Replace the rubber eyeshield on the eyepiece assembly.
(3) Replace the battery cap on the battery housing.
(4) Position the elevation and azimuth adjustment knobs onto the sight plate and secure by tightening the socket head screws.
(5) Replace the locking lever to the collet and turn until finger tight. Unthread the locking lever ½-turn to provide the required movement for locking and unlocking action.
(6) Seat the focusing knob onto the collet and secure with the socket head screw.

b. Shipping Container.

(1) Insert foam liners in top and bottom of shipping container. Make certain the cutouts in the top and bottom match so that the lid will close when the Starlight Scope and accessories are installed.
(2) Replace the Starlight Scope and accessories in the shipping container.
(3) Aline the lid with the bottom of the shipping container and secure with latch and latch clasps.

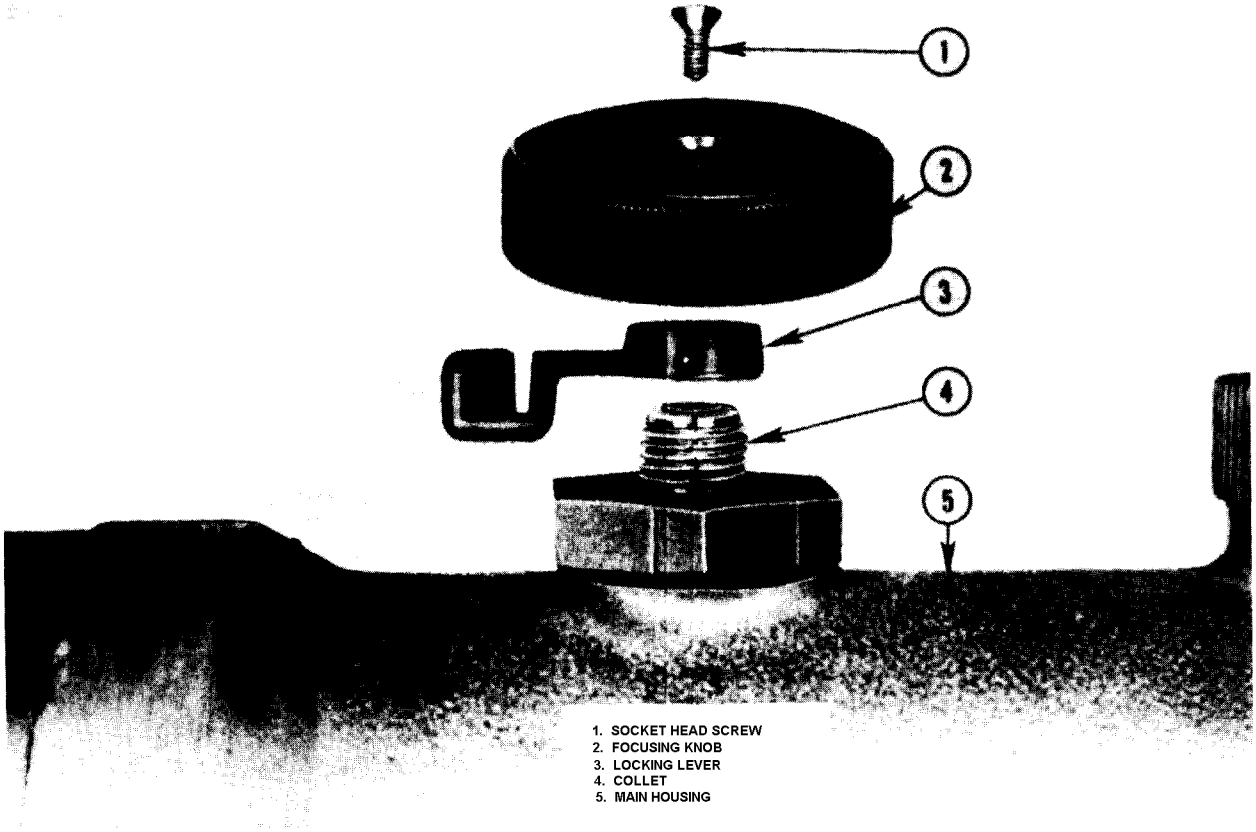
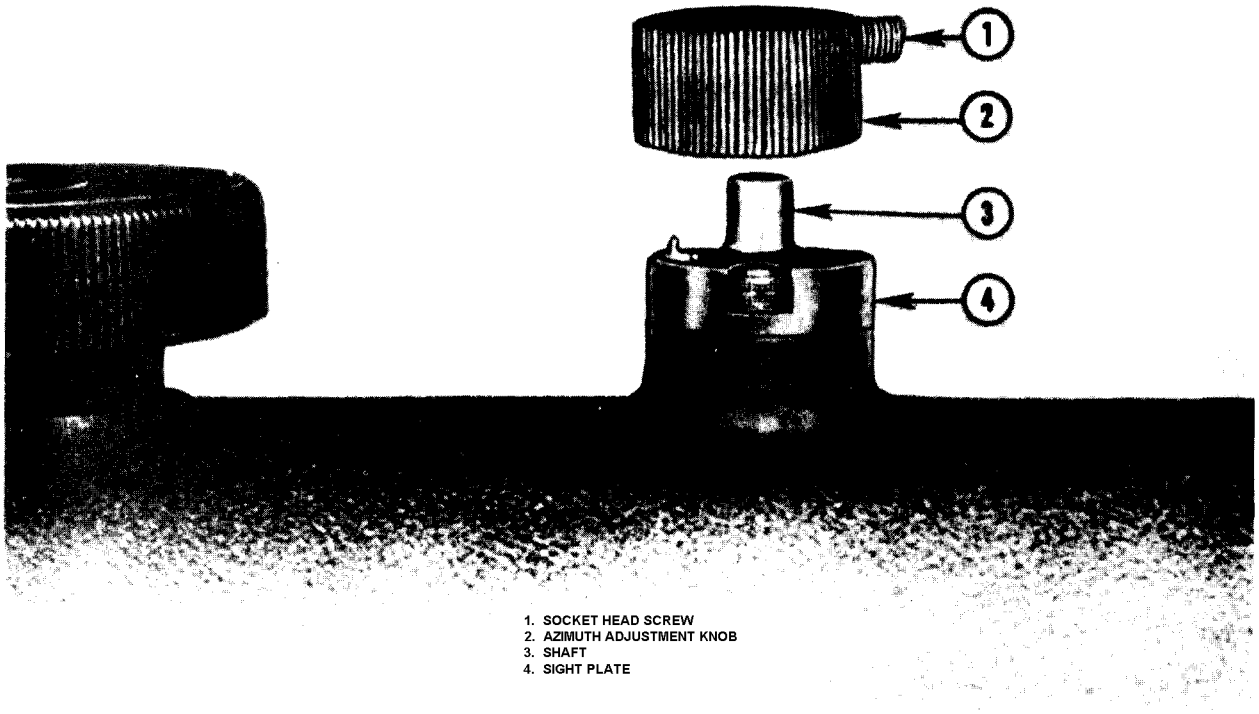


Figure 4. Removal of focusing knob and locking lever.



1. SOCKET HEAD SCREW
2. AZIMUTH ADJUSTMENT KNOB
3. SHAFT
4. SIGHT PLATE

Figure 5. Removal of azimuth adjustment knob.

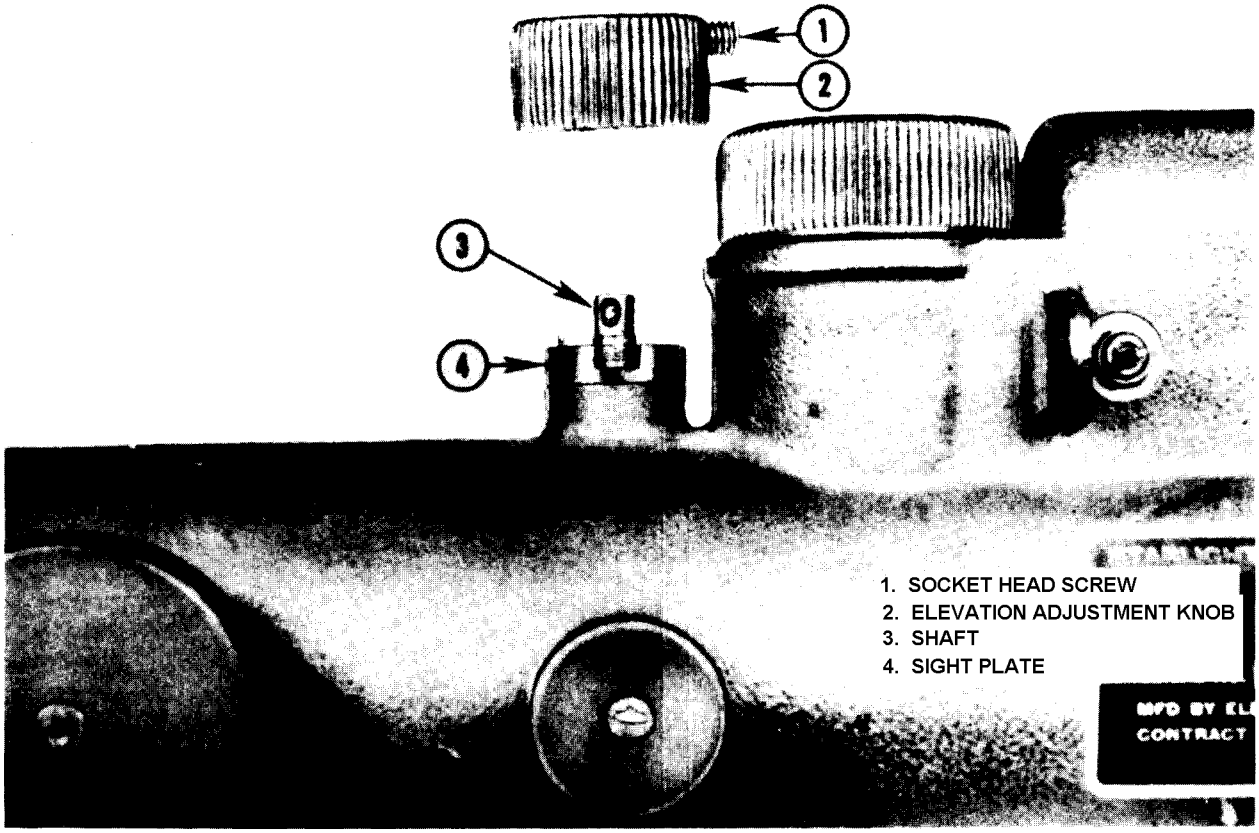
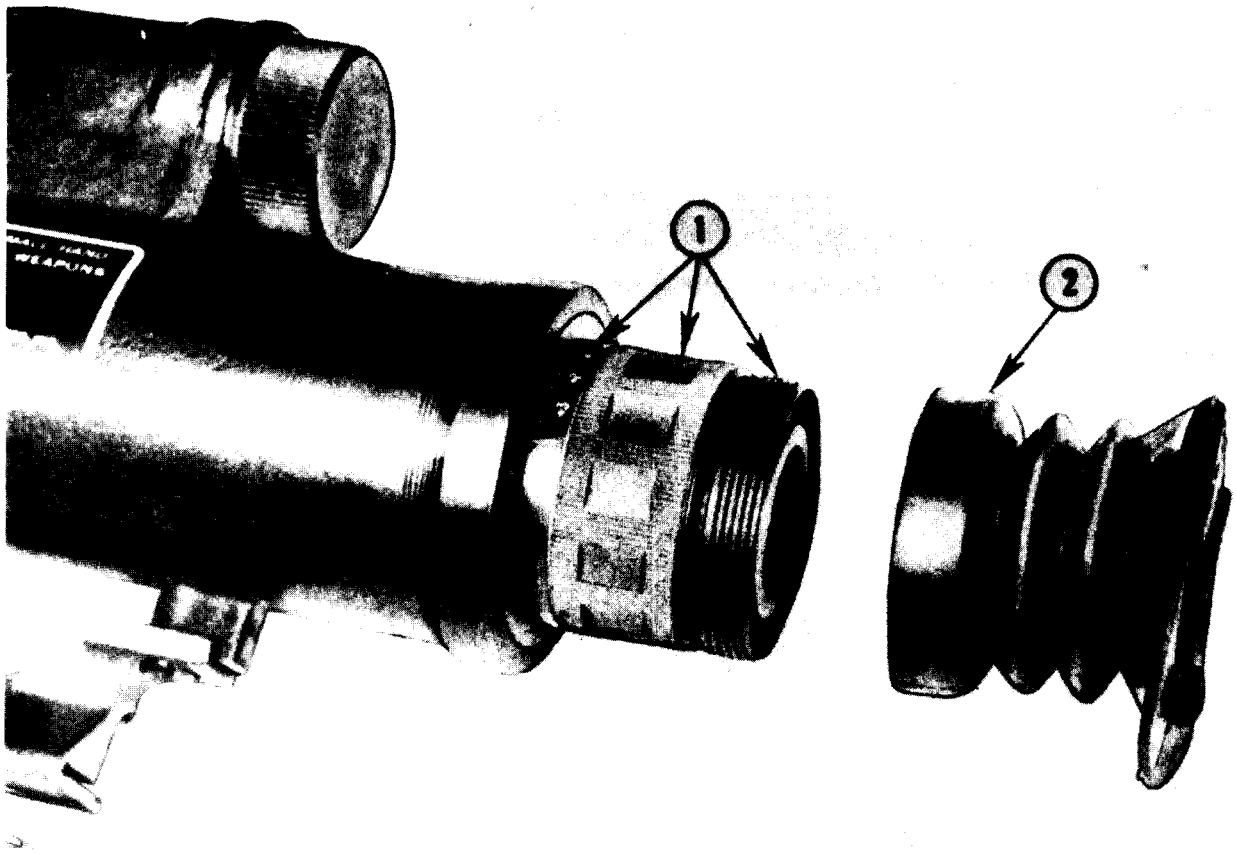
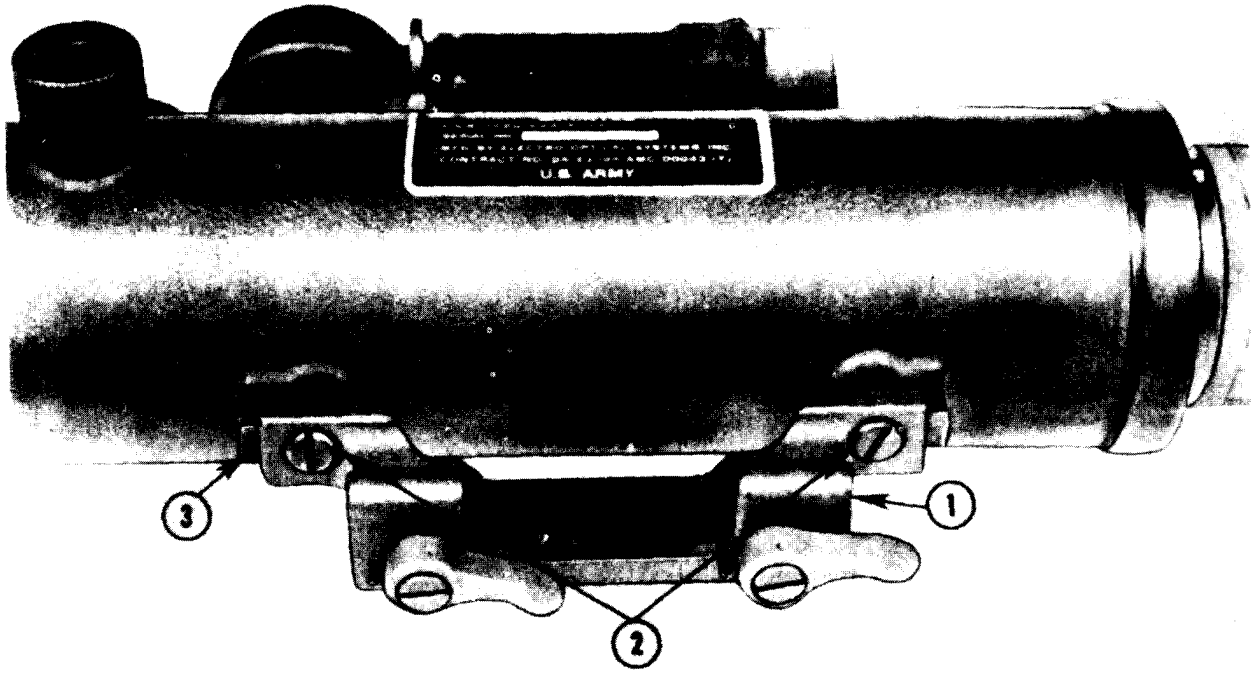


Figure 6. Removal of elevation adjustment knob.



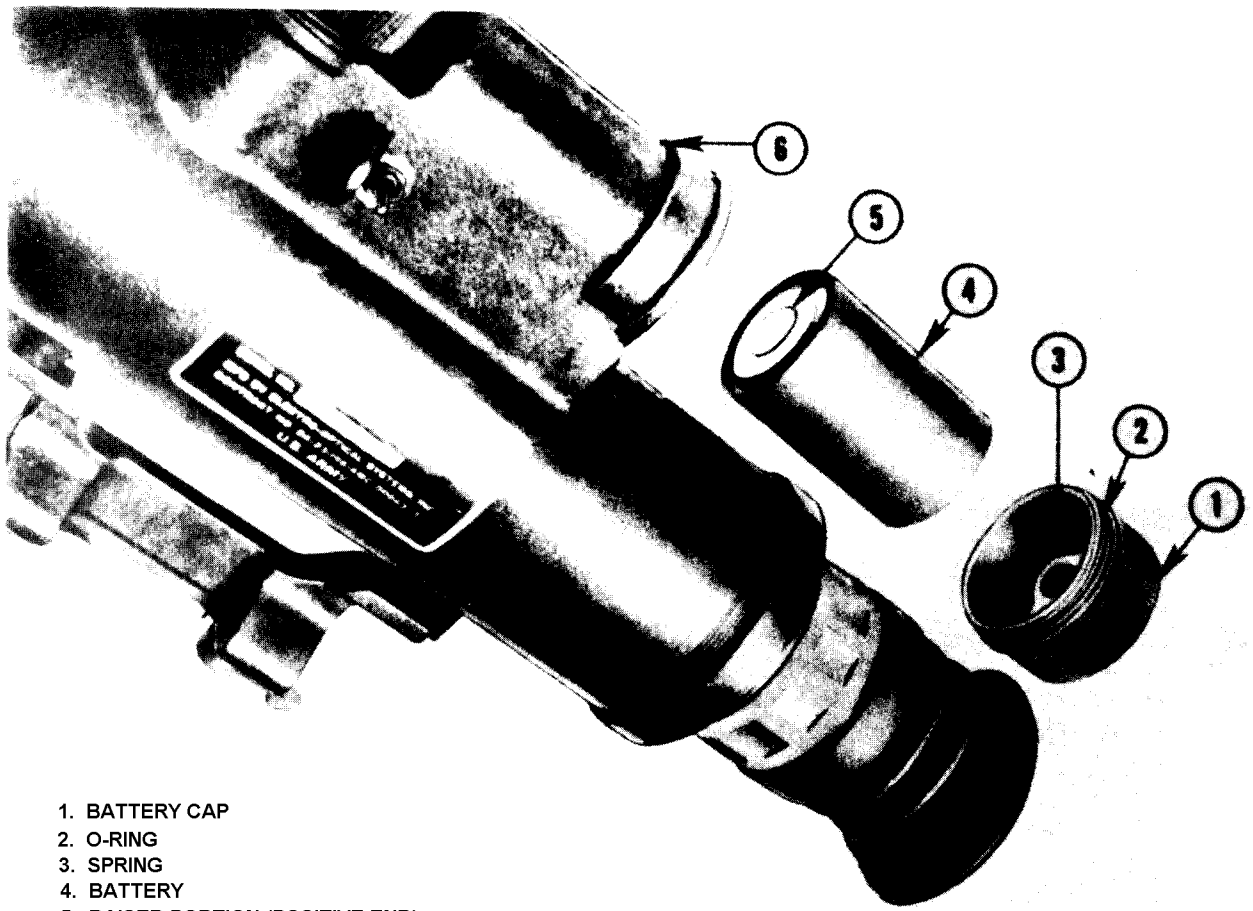
1. EYEPIECE ASSEMBLY
2. RUBBER EYEPIECE

Figure 7. Removal of rubber eyeshield.



1. TELESCOPE MOUNT ASSEMBLY
2. LOCKING SCREWS (2)
3. MOUNTING STUD (2)

Figure 8. Removal of telescope mount assembly.



1. BATTERY CAP
2. O-RING
3. SPRING
4. BATTERY
5. RAISED PORTION (POSITIVE END)
6. BATTERY HOUSING

Figure 9. Installation of battery.

Section II. OPERATION AND FUNCTIONING

9. Operation. *a. General.* The Starlight Scope, although designed to function under the most rugged conditions, is a precision electro-optical instrument and must be handled carefully.

b. Precautions. To prevent damage to the equipment and injury to himself, the operator should observe the following safety precautions:

(1) The contents of the mercury battery are highly irritable to the eyes and oral and nasal tissues; therefore, caution must be exercised when handling and discarding the batteries. To prevent explosion, the battery should not be disposed of by fire. Batteries should be disposed of by burying, or dumping them into a large body of water.

(2) When the image intensifier tube is inadvertently exposed to intense light, it will automatically cut off to prevent burning out the tube and to protect the operator's eye. Continuous exposure of an activated tube to intense light should be avoided.

(3) The Starlight Scope should never be aimed directly at the sun (image intensifier tube ON or OFF) since it will result in a complete failure of the tube.

(4) When operating the Starlight Scope, care must be taken in the viewing procedure. If the rubber eyeshield is not positioned around the eye and against the face, visible light emitted from the eyepiece assembly will "leak" around the eyeshield, illuminating the operator's face.

c. Preoperational Inspection.

(1) Open the shipping container as described in paragraph 7a(l) and remove the Starlight Scope.

(2) Visually inspect all external parts, surfaces, and threads for dust, cracks, chips, or other damage. Visually examine the objective lens assembly and eyepiece assembly for lens fogging or other signs of moisture. Operate the focusing and adjustment knobs to determine their operability.

(3) Check the telescope mount assembly to insure it is secured to the main housing. Inspect lock knobs for freedom of movement. Examine guide groove for burrs, cracks, or any other damage that would prevent mounting.

(4) During daylight operations, insure the lens cap is properly positioned over the objective lens assembly.

d. Installation of Battery.

(1) Insure control switch is in OFF (center) position.

(2) Remove. battery cap as described in paragraph 7 *b* (5).

(3) Insert battery, positive end first, into the battery housing (fig. 9). To identify the positive end, note the (+) or (–) markings on opposite ends of the battery. Should it be necessary to install a battery during the hours of darkness, the positive end can readily be identified by feeling for the "raised portion" located on the positive end of the battery.

(4) Replace the battery caps as instructed in paragraph 8 *a* (3).

e. Operational Sequence. A definite sequence should be used when placing the Starlight Scope in operation. This sequence should be continuously stressed with the new operator until it become second nature and automatic. To place the Starlight Scope in operation during the hours of daylight (the lens cap must be positioned over the objective lens) or darkness:

(1) Position the rubber eyeshield around the eye so as to prevent the visible light emitted from the eyepiece assembly from illuminating other areas of the face.

(2) Move the control switch to the ON (passive reticle) position. If the reticle pattern is not visible, move and hold the control switch in the reticle CHARGE position. Normally, a 5-second charge is sufficient to activate the reticle. Return control switch to the ON position.

(3) Focus the eyepiece assembly by rotating the eyepiece focus ring until the reticle pattern is sharp and clear.

(4) Point the Starlight Scope at a distant target. *After insuring the objective lens focusing knob locking lever is in the unlocked position,* rotate the focusing knob until the image being viewed is clear and sharp. To retain a clear and sharp image, the operator must make an objective lens focal adjustment whenever the range between the Starlight Scope and the target changes.

(5) After operation, return the control switch to the OFF position and remove the rubber eyeshield from the eye.

Caution: **When removing the "non-secure" rubber eyeshield from the eye, the operator must exercise care to prevent the visible light from illuminating his face or l portion of his body. When the Starlight Scope is turned off, visible light will continue to be emitted from the eyepiece assembly for a few moments.**

f. Extreme Cold. A low temperature adapter assembly is provided as a special accessory to the Starlight Scope to permit operation in temperatures as low as –65° F. The assembly is installed (fig. 10) to the Starlight Scope as follows:

(1) Insure the control switch is in the OFF position.

(2) Remove the battery cap and battery from the battery housing.

(3) Insert the low temperature adapter tube into the battery housing and turn the tube cap clockwise until secured.

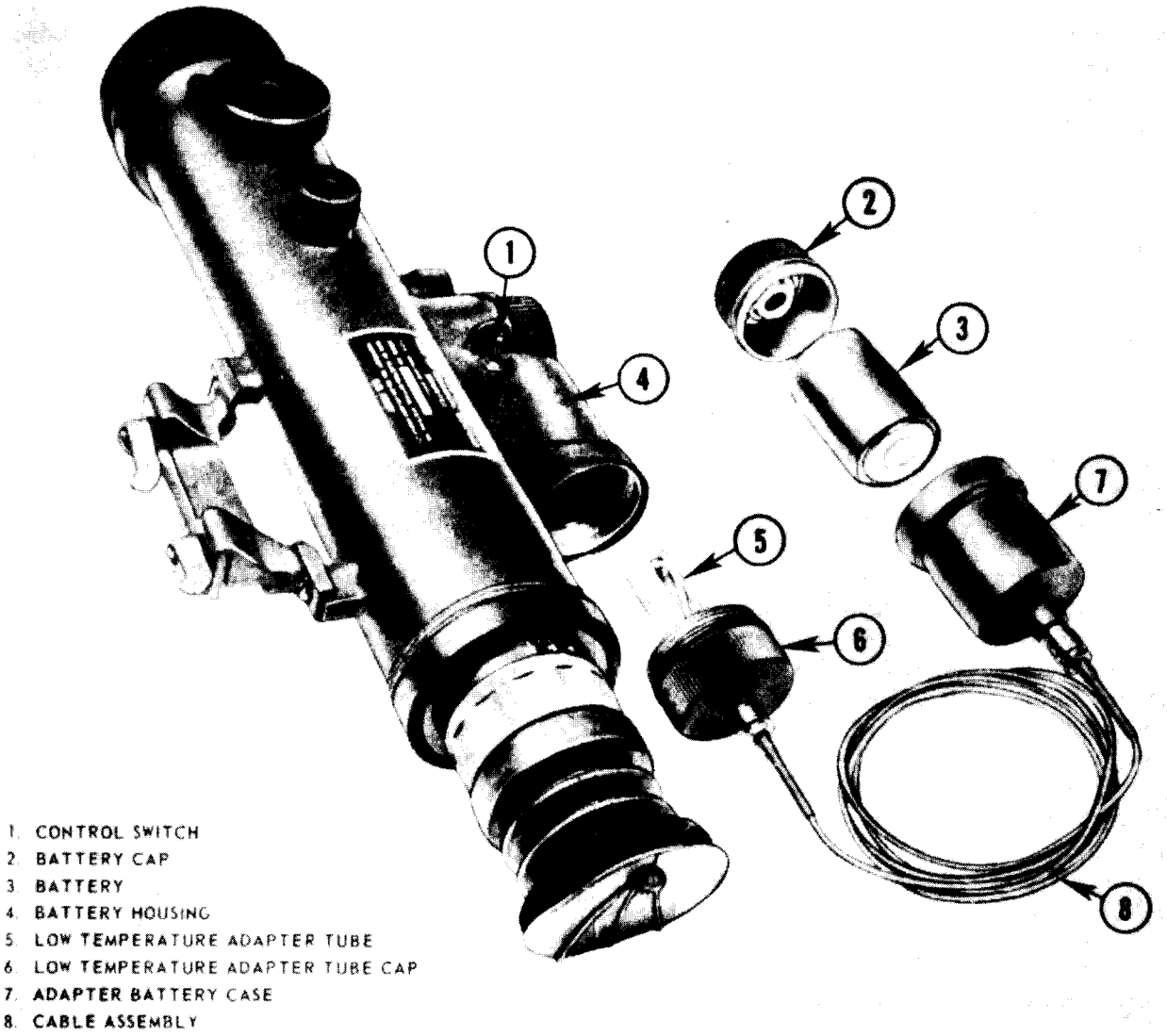


Figure 10. Installation of low temperatures adapter assembly.

(4) Insert the battery, positive end first, into the adapter battery case. Secure with the buttery cap from the Starlight Scope.

(5) The battery and adapter buttery case are carried inside the operator's clothing for protection against extreme low temperatures.

(6) Once the low temperature adapter assembly has been installed, the Starlight Scope is operated in the normal manner. The lenses may have a tendency to fog and frost up in cold weather and will require frequent clearing. The operator should avoid breathing into the rubber eyeshield as this will increase the fogging and frosting of the eyelens.

g. Extreme Heat. The Starlight Scope is designed for operation without damage at temperatures up to +125° F.

h. Dusty or Sandy Conditions. The lens will require frequent cleaning when the Starlight Scope is operated in dusty or sandy areas. The operator should first remove most of the accumu-

lated dust or sand with the lens cleaning brush, then use the lens tissue for thorough cleaning of the lenses.

i. Rainy or Humid Conditions. The Starlight Scope is capable of satisfactory operation in rainy or humid conditions.

Caution: **To prevent corrosion or deterioration, thoroughly dry all parts of the Starlight Scope after exposure to rain or high humidity.**

10. Functioning. For reasons of clarity and to preclude discussions of a classified nature, only the basic functioning of the Starlight Scope is described in this training circular.

a. Power Supply. When the control switch is moved to the ON position, the 6.75-volt battery furnishes power to the oscillator. The oscillator receives this 6,75 voltage and increases it to 2,800 volts. The increased voltage is transmitted to the multiplier plate of the image intensifier tube. The multiplier plate insures that each stage of the three-stage image intensifier tube receives the required voltage for operation.

b. Objective Lens Assembly. The objective lens assembly, utilizing the ambient light of the night sky, focuses an image of the scene being viewed onto the front face (cathode) of the image intensifier tube. Under nighttime illumination conditions, this image is very dim and not visible to the naked eye.

c. Image Intensifier Tube. The image intensifier tube receives the dim image and transmits it to the screen (anode) at the rear of the tube. In so doing, the brightness of the image is amplified to such a degree it can be seen with the naked eye.

d. Eyepiece Assembly. The eyepiece magnifies and focuses the image, enabling the operator to view the amplified image displayed on the anode of the image intensifier tube.

e. Sight Reticle. The sight reticle pattern (fig. 3) is composed of eight reticle beads. Positioned in the center of each bead is a small dot of phosphor. The phosphor, when subjected to radiation, gives off light. The intensity of light radiation striking the phosphor determines the use of the PASSIVE or CHARGED reticle.

(1) When the control switch is moved to the ON passive reticle position, light radiation from the night sky entering the Starlight Scope through the objective lens strikes the phosphor dots causing them to illuminate. Under moonlight rind / or starlight conditions, light radiation is intense enough to illuminate the phosphor dots.

(2) When operating the Starlight Scope under low light level conditions (no moonlight or starlight), the intensity of light may not be sufficient to activate the phosphor dote. To compensate for this, the operator moves the control switch to the reticle CHARGE position, turning on the sight reticle lamps. The intensity of light emitted by the lamp is sufficient to charge the phosphor dots. It may be necessary to maintain the reticle CHARGE position of the control switch for a few seconds to provide an adequate charge to the phosphor dote (switch is spring loaded and automatically returns to the OFF position when pressure is released). After charging, the control switch must be manually returned to the ON position to resume operation.

Caution: **When charging the reticle, the operator should insure the lens cap is positioned over the objective lens to prevent the visible light, emitted by the sight reticle lamp, from being detected.**

Section III. INSTALLATION

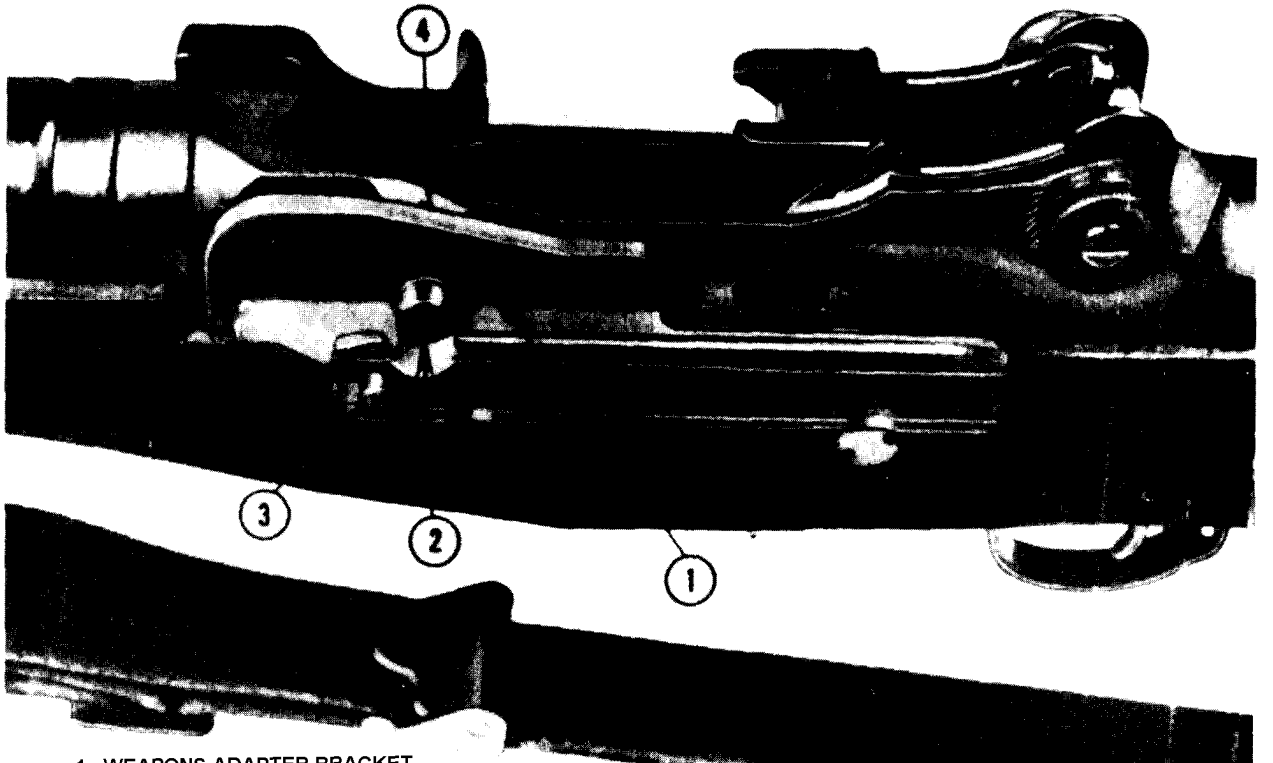
18. Weapons Adapter Brackets. *a. M414 or M14A2 Rifle.* Aline the weapon adapter bracket with the groove and screw recess on the left side of the receiver (fig. 11). Secure the bracket to the receiver by tightening the socket head screw of the bracket with the allen wrench.

b. XM16E1 Rifle. Unthread the wingnut to the threadstop on the screw of the weapon adapter bracket (fig. 12). Pull tab away from the bracket and slide the mounting ear under the carrying handle of the rifle. Position the slotted groove in the hose of the bracket over the top of the receiver group inside the opening of the carrying handle. Firmly tighten the wingnut until the tab is pulled tightly against the carrying handle and bracket.

c. M72 Light Antitank Weapon. Position the weapon adapter bracket on the tube of the weapon so that the bracket notch and location stops engage the front of the firing mechanism. Swing the hinged lower clamp around the bottom of the tube, and engage and secure the dial lock latch (fig. 13).

d. 90-mm Recoilless Rifle M67. Position the backup plate of weapon adapter bracket against the inside of the M103 sight mounting bracket (fig. 14). Place the mounting pad of the bracket against the left side of the M103 sight mounting bracket so that the screw holes in the mounting pad mate with the screw holes in the backup plate. Install and tighten the three socket head screws with the allen wrench.

e. M60 Machinegun. The weapon adapter bracket for the M60 machinegun consists of n saddle block and a sight, adopter bracket (fig. 15).



1. WEAPONS ADAPTER BRACKET
2. SOCKET HEAD SCREW
3. PIN STOP
4. GROOVE

Figure 11. Installation of weapon adapter bracket to the M14 or M14A2 rifle.

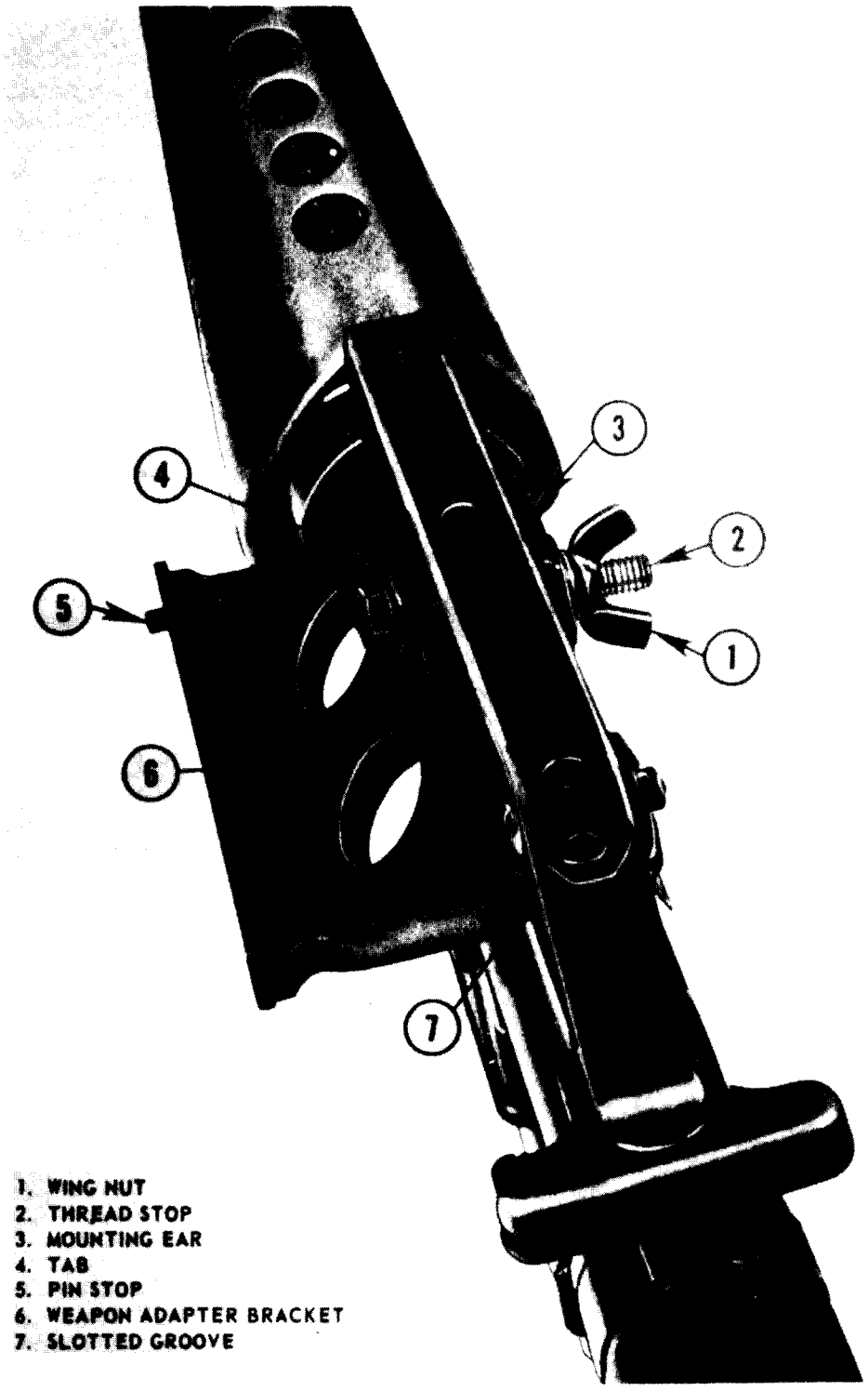


Figure 12. Installation of weapon adapter bracket to the XM16E1 rifle.

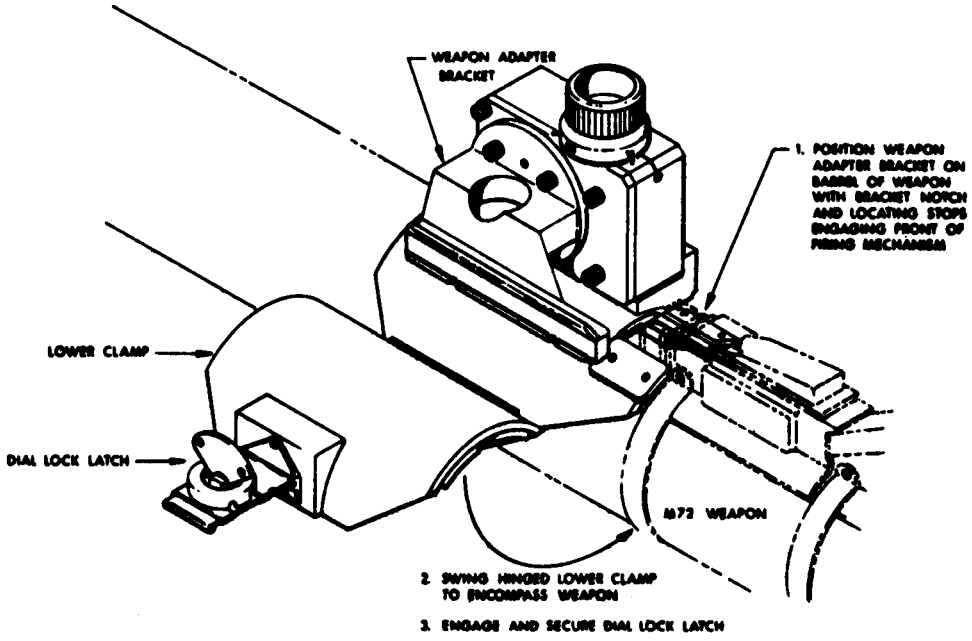


Figure 13. Installation of weapon adapter bracket to the M72.

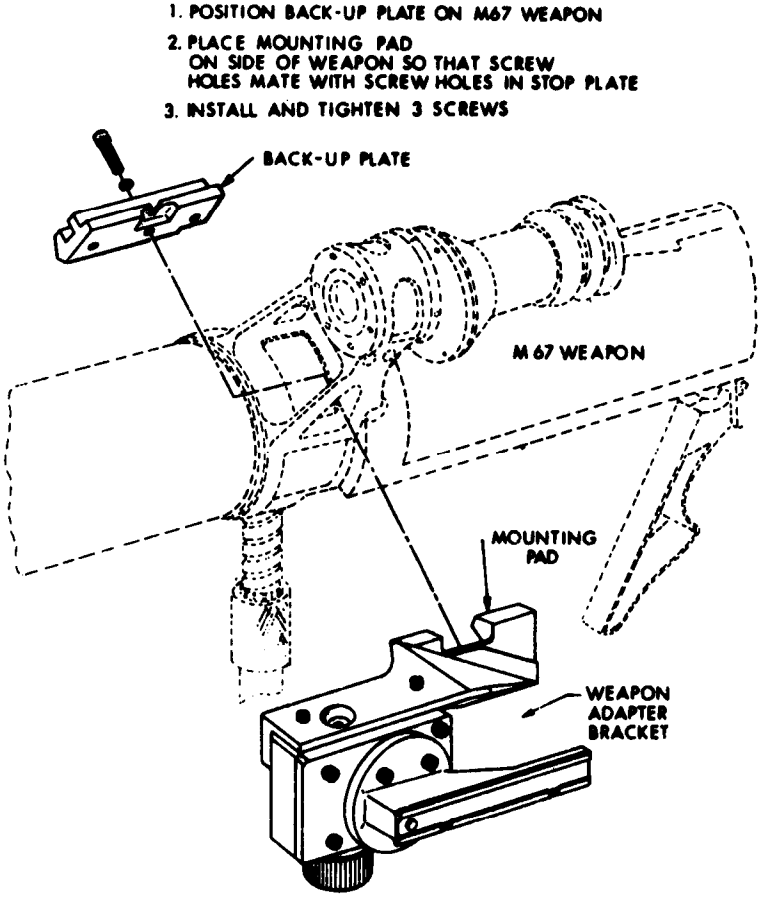


Figure 14. Installation of weapon adapter bracket to the 90-mm recoilless rifle M67.

To install the saddle block to the M60 machinegun, refer to figure 16 and mount as follows:

(1) Clear the M60 machinegun as outlined in FM 23-67.

(2) Remove barrel group (1, fig. 16).

(a) Cock the weapon.

(b) Place safety (1) on the SAFE position.

(c) Raise barrel lock lever (2).

(d) Pu11 barrel group (3) straight forward and remove.

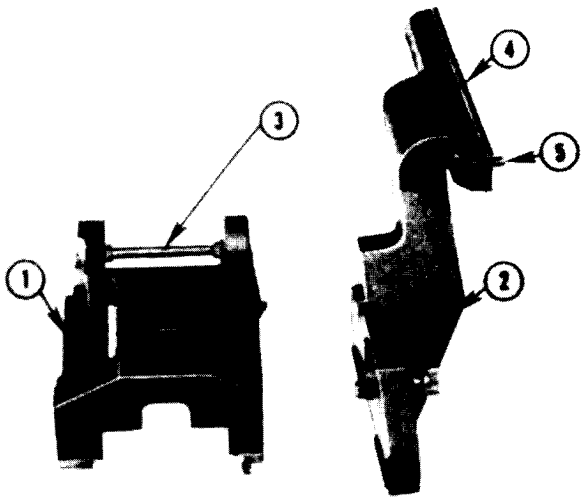
Caution: **With the barrel group removed, do not allow the bolt to go forward as this will cause damage to the cam roller on the bolt.**

(3) Remove forearm assembly (①, fig. 16). Insert nose of cartridge into the latch hole in the bottom of forearm assembly (4). Apply pressure to the cartridge, releasing the forearm latch; raise the rear of the forearm assembly slightly and remove it to the front (5).

(4) Remove barrel lock lever and barrel locking shaft (②, fig. 16).

Caution: **The detent plunger (6) and detent spring (7) are under spring tension. Before removing lock pin (8), place hand over top of barrel lock lever (9) to prevent loss of parts upon removal of lock pin. Insure barrel lock lever is in vertical position.**

(a) Remove lock pin (8), detent pin (1O), detent spring (7), and plunger (6) from barrel lock lever (9).



1. SADDLE BLOCK
2. SIGHT ADAPTER BRACKET
3. SADDLE LOCK SHAFT
4. GUIDE RAIL
5. PIN STOP

Figure 16. Weapon adapter bracket for the M60 machinegun.

(b) Withdraw barrel lock shrift (11) from left side of receiver group and remove barrel lock lever.

(5) Installation of saddle block (③, fig. 16).

(a) Loosen four set screws (13) and (14) (two set screws are located on each side of the saddle block). Remove saddle lock shaft from saddle block (15).

(b) Place saddle block in position on weapon (12), insuring the half moon recess on left side of the saddle block is seated under the windage knob or the rear sight.

(c) Replace barrel lock lever and insert saddle lock shaft (from the left side of the machinegun) into its recess in the saddle block (15). Insure the half moon cut on the saddle lock shaft is positioned down when replacing the shaft.

(d) Reassemble barrel lock lever (reverse procedure given in paragraph (4) above) onto the saddle lock shaft.

(e) Tighten four set screws (13) and (14) and tighten saddle block screw (16).

Note. Since the saddle block will not interfere with normal operation of the machinegun, it should not be removed aftcr installation. Install the sight adaptcr bracket whenever the Starlight Scope is to be used.

(6) Sight adapter bracket installation (④, fig. 16).

(a) Plato sight adapter bracket (19) in place against saddle block (12).

(b) Install and tighten lock washer (17) and screw (18) through sight adapter bracket into saddle block.

(c) Replace forearm assembly and barrel group by reversing procedure given in (2) and (3) above.

f. 40-mm Grenade Launcher M79. The weapon adapter bracket for the M79 is not being produced currently. A discussion of the correct mounting procedures is withheld pending receipt and testing of the item.

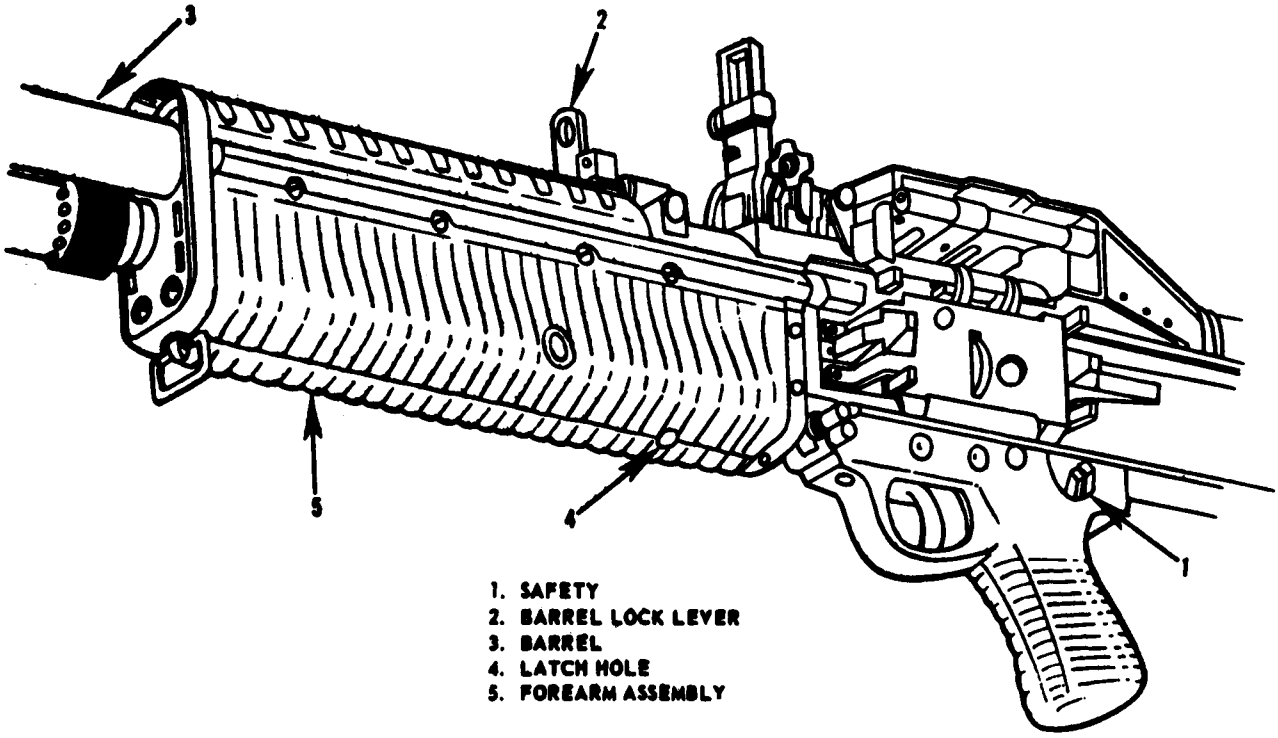
12. Starlight Scope. *a. General.* Regardless of which weapon the Starlight Scope is employed with, the procedure for mounting to the weapons adapter brackets are the same. Each weapon adapter bracket has an identical guide rail (fig. 17) which mates with the telescope mount assembly of the Starlight Scope.

b. Mounting. The Starlight Scope is mounted to the weapon adapter bracket as follows:

(1) Rotate lock knobs of the telescope mount assembly forward (toward objective lens) until they come to stop on the pins Iocated on the assembly,

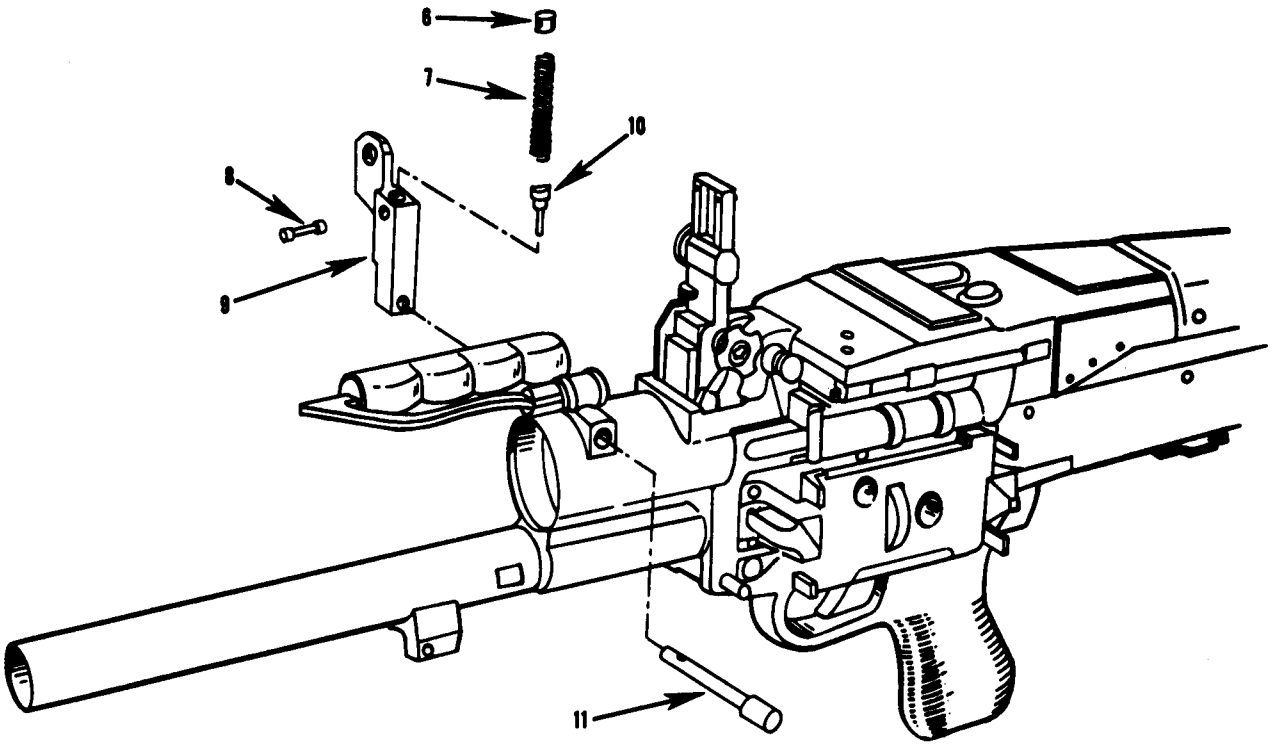
(2) Slide the telescope mount assembly onto the guide rail of the weapons adapter bracket from the rear until positioned against the pin stop of the guide rail.

(3) The Starlight Scope is locked to the weapons adapter bracket by rotating the two locking knobs of the telescope mount assembly in a rearward direction.



① *Removal of barrel group and forearm assembly from the M60 machinegun*

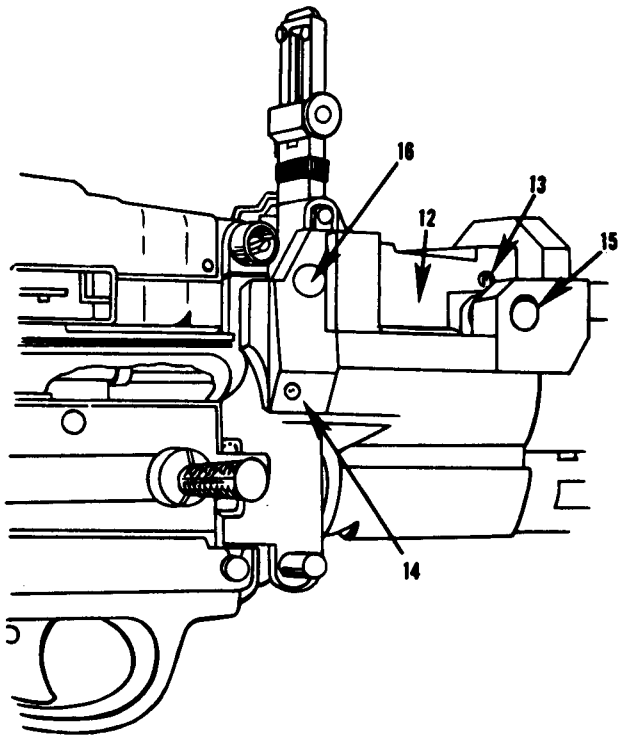
Figure 16. Attaching the bracket to the M60 machinegun.



6. DETENT PLUNGER
7. DETENT SPRING
8. LOCK PIN
9. BARREL LOCK LEVER
10. DETENT PIN
11. BARREL LOCK SHAFT

③ *Removal of barrel locking lever and barrel locking shaft from the M60 machinegun*

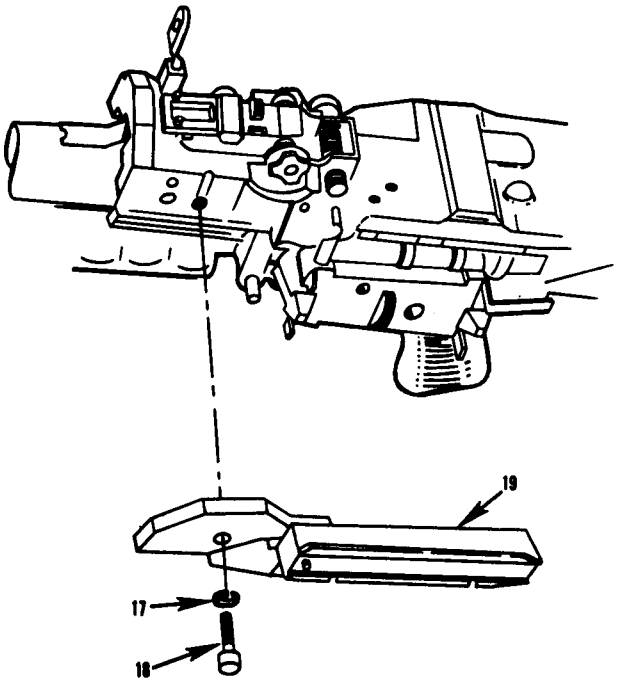
Figure 16.—Continued.



12. SADDLE BLOCK
13. SET SCREWS
14. SET SCREWS
15. SADDLE LOCK SHAFT RECESS
16. SADDLE BLOCK SCREW

③ *Installation of saddle block to the M60 machinegun*

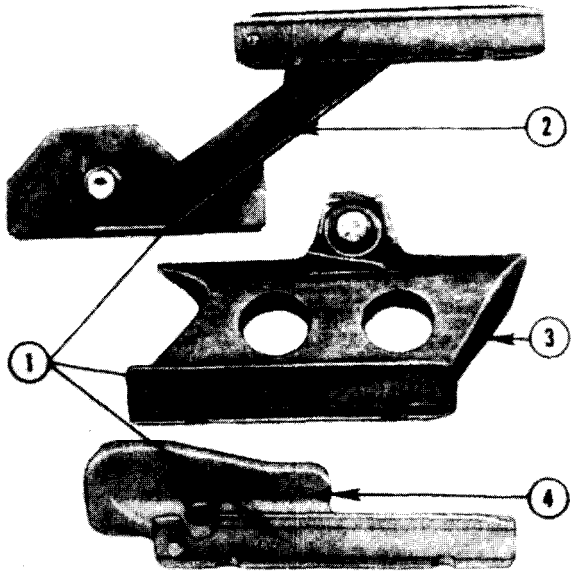
Figure 16.—Continued.



17. LOCK WASHER
18. SOCKET HEAD SCREW
19. SIGHT ADAPTER BRACKET

④ *Installation of sight adapter bracket to saddle block*

Figure 16.—Continued.



1 GUIDE RAIL
2 SIGHT ADAPTER BRACKET FOR M60 MACHINEGUN
3 WEAPONS ADAPTER BRACKET FOR XM16E1 RIFLE
4 WEAPONS ADAPTER BRACKET FOR M14 OR M14A2 RIFLE

Figure 17. Weapons adapter brackets showing guide rail.

Section IV. MAINTENANCE, TROUBLESHOOTING, AND DESTRUCTION

13. General. This section contains information on maintenance, troubleshooting, and destruction. The discussion on maintenance is confined to that information necessary for the operator to maintain the Starlight Scope. For information concerning organizational and higher echelons of maintenance see TM 11-1090-268–15.

14. Tools and Equipment. The wrenches, batteries, and other accessories contained in the shipping container, with the exception of a screwdriver, provide the tools and equipment necessary for operator maintenance. A screwdriver is required to disassemble the telescope mount assembly from the main housing.

15. Care and Cleaning. *a. General.* To insure the Starlight, Scope is ready for operation at all times, inspect it systematically to discover and correct defects before serious damage or failure results. Note defects during operation and insure appropriate corrective action is taken upon completion of operations. All defects, deficiencies, and corrective action taken will be recorded on DA Form 2404 (Equipment Inspection and Maintenance Worksheet) at the earliest opportunity.

b. Special Instructions.

(1) Clean exposed glass surfaces of the objective lens and eyepiece lens by removing loose dirt with the lens brush and then clean the glass surfaces with lens tissue. Dampen lens tissue with water if necessary (distilled water if available).

(2) Clean all exposed metal surfaces on the Starlight Scope and low temperature adapter assembly with a cloth. Dampen cloth with water if necessary.

(3) No lubricating materials are required by the operator for maintenance of the Starlight Scope.

c. Daily Preventive Maintenance. The operator must perform the following daily preventive maintenance services:

(1) Inspect and service the shipping container

for dirt, dents, holes, damaged latches, latch clasps, missing parts, identification and instruction plates, and for movability of pressure relief valve. If unserviceable, replace the shipping container.

(2) Remove the Starlight Scope and accessories from the shipping container and inspect top and bottom liners for tears, dirt accumulation, and water-soaked condition. Remove loose dirt with a soft brush and clean with a damp cloth. Remove wet liners and allow to dry. Replace liners if damaged.

(3) Inspect and service canvas carrying case for holes, tears, dirt, and water-soaked condition. If damaged or mildewed, replace canvas carrying case.

(4) Inspect and service main housing of Starlight Scope for dents, cracks, and loose or missing parts. Tighten loose parts and report missing parts or damaged main housing to organizational maintenance.

(5) Inspect and service objective and eyepiece lenses for dirt, dust, cracks, scratches, and signs of fogginess or moisture. If lenses are scratched, cracked, and fogginess or moisture appears to be within the objective or eyepiece assembly, report condition to organizational maintenance.

(6) Inspect objective lens focus knob and locking lever for dirt, free operation, positive locking action, or damage. Remove *only* the focus knob and locking lever if dirty or damaged. Clean the focus knob and locking lever and reassemble to the collet. Replace damaged knob or lever and reassemble. Report faulty operation of focus knob or locking lever to organizational maintenance.

(7) Inspect the azimuth and elevation adjustment knobs for dirt, damage, and freedom of operation. Remove *only* the azimuth or elevation adjustment knobs if dirty or damaged. Clean dirty knob and reassemble. Replace damaged knob and reassemble. Report faulty operation to organizational maintenance.

(8) Inspect battery for corrosion, leakage, or other damage. Dispose of a defective battery.

(9) Remove battery cap from battery housing and inspect and service for dirt, cracks, dents, and damaged battery spring or O-ring. Replace damaged battery cap, spring, or O-ring. Install new battery and reassemble battery cap.

(10) Inspect exterior of oscillator cap for dirt, cracks, and dents. *Do not* remove oscillator cap from oscillator housing. Clean outside surfaces only. Report damaged oscillator cap to organizational maintenance.

(11) Although the operator is not authorized to remove the oscillator cap, it is possible to check the functioning of the oscillator. Move the control switch to the ON position and listen for operating hum which is audible if oscillator is working. If operating hum cannot be heard, report condition to organizational maintenance.

(12) With control switch in the ON position, look into the eyepiece and inspect for operation of the image intensifier tube. *Do not attempt removal of the image tube from the main housing.* Return control switch to the OFF position. Report all failures or malfunctions of image tube to organizational maintenance.

(13) Inspect telescope mount assembly for cracks, breaks, dents, dirt, and operability of locking knobs. Service and replace as required,

(14) Inspect rubber eyeshield for dirt, oil, cracks, flexibility, and other damage. Remove eyeshield if dirty or damaged. Clean with a clean, wet cloth. Replace damaged eyeshield and assemble new eyeshield onto the eyepiece assembly.

(15) Insuring the control switch is in the OFF position, remove the lens cap and inspect for dirt, obstructed holes, cracks, or other damage. Clean with wet cloth and reassemble to objective lens assembly, Replace damaged lens cap and reassemble.

16. Troubleshooting. This paragraph provides information useful in diagnosing and correcting

unsatisfactory operation or failure of the Starlight Scope. Each trouble symptom stated is followed by a list of probable causes of the trouble. The possible remedy recommended is described opposite the probable cause. Since the operator is limited to only minor corrective actions, most corrective measures will be performed at organizational or higher support levels.

TROUBLESHOOTING GUIDE

Probable cause	*Possible remedy*
a. Objective Lens Will Not Focus.	
(1) Damaged eccentric shaft.	(1) Report to organizational maintenance.
(2) Damaged focus knob.	(2) Replace focus knob.
(3) Damaged objective lens assembly.	(3) Report to organizational maintenance.
b. Eyepiece Assembly Will Not Focus.	
(1) Damaged eyepiece focus ring	(1) Report to organizational maintenance.
(2) Dirt or sand accumulated around focus ring.	(2) Clean area around focus ring.
c. Weak or No Illumination of Imaae Intensifier Tube.	
(1) Weak or defective battery	(1) Replace battery.
(2) Defective oscillator	(2) Report to organizational maintenance.
(3) Defective image intensifier tube.	(3) Report to organizational maintenance.
(4) Defective control switch	(4) Report to organizational maintenance.
(5) Loose battery cap	(5) Tighten battery cap.
(6) Defective battery cap spring	(6) Replace battery cap spring.
(7) Defective oscillator cap and/or assembly	(7) Report to organizational maintenance.
d. Image Blurred.	
(1) Objective lens dirty or fogged	(1) Clean lens.
(2) Eyepiece lens dirty or fogged	(2) Clean lens.
(3) Objective lens out of focus	(3) Adjust by rotating focus knob.
(4) Eyepiece out of focus	(4) Adjust by rotating eyepiece focus ring.
(5) Weak battery	(5) Replace battery.
(6) Defective oscillator	(6) Report to organizational maintenance.
(7) Defective image intensifier tube	(7) Report to organizational maintenance.
(8) Defective objective lens assembly	(8) Report to organizational maintenance.
(9) Defective eyepiece assembly	(9) Report to organizational maintenance.
e. Focusing Knob Will Not Rotate.	
(1) Dirt or sand accumulated around focusing knob.	(1) Clean focusing knob.
(2) Locking lever dammed	(2) Replace locking lever.
(3) Collet damaged	(3) Report to organizational maintenance.
f. Control Switch Will Not Detent.	
(1) Defective control switch	(1) Report to organizational maintenance.
g. Elevation or Azimuth Adjustment Knob Will Not Rotate.	
(1) Dirt or sand accumulated around knob. . . .	(1)
(2) Defective adjustment assembly	(2) Report to organizational maintenance.
h. Reticle Will Not Adjust.	
(1) Defective azimuth or elevation adjustment knob assembly.	(1) Report to organizational maintenance.

TROUBLESHOOTING GUIDE—Continued

Probable cause	*Possible remedy*
i. Reticle Lamp Will Not Illuminate.	
(1) Defective reticle lamp	(1) Report to organizational maintenance.
(2) Defective power switch	(2) Report to organizational maintenance.
(3) Weak or defective battery	(3) Replace battery.
j. Low Temperature Adapter Assembly Will Not Operate.	
(1) Wrong polarity of battery in adapter . . . . . battery case.	(1) Reverse position of battery.
(2) Defective or weak battery	(2) Replace battery.
(3) Defective cable assembly	(3) Report to organizational maintenance.
k. Starlight Scope Will Not Mount on Weapon.	
(1) Dirt or sand between mounting grooves.	(1) Clean telescope mount assembly.
(2) Telescope mount assembly damaged.	(2) Replace telescope mount assembly.
(3) Damaged weapn adapter bracket	(3) Replace weapon adapter bracket.
(4) Damaged lock knobs	(4) Replace telescope mount assembly.

17. Destruction To Prevent Enemy Use. *a. General.*

(1) Destruction of the Starlight Scope and related material, when subject to capture or abandonment in the combat zone, will be undertaken by the using unit when, in the judgment of the unit commander, such action is necessary in accordance with the unit's mission, or policy established by the commander concerned. If at all possible, the Starlight Scope should be evacuated.

(2) When the commander concerned considers it necessary, he orders the Starlight Scope's destruction to prevent one or more of the following:

(a) Capture by the enemy.

(b) Abandonment in the combat zone.

(c) To deprive enemy intelligence agencies knowledge of its existence, functioning, or exact specifications.

b. Principles of Destruction.

(1) Destruction should be as complete as possible within limitations of time and equipment. In any event, the most important parts are destroyed or evacuated. The same essential parts are destroyed or evacuated in all units to prevent the enemy from constructing one complete Starlight Scope from several damaged ones.

(2) Personnel are trained in the prescribed methods of destruction.

(3) The issue and use of special equipment, such as incendiary grenades, are command decisions and depend on the tactical situation.

(4) Methods described are listed in the order of their effectiveness. Follow the sequence in which the steps are given.

c. Methods of Destruction.

(1) *Destruction by burning.* Stand the Starlight Scope on end, preferably in a hole, with the objective lens up. Position a thermate grenade on the objective lens and pull the pin. Insure that the grenade has destroyed the optics and image intensifier tube.

(2) *Destruction by weapons fire.* Place the Starlight Scope on end, preferably in a hole, with the objective lens up. Fire one or more rounds into the Starlight Scope through the objective lens. Insure that the round(s) penetrates completely through the objective lens, reticle lens, image intensifier tube, and the eyepiece assembly.

CHAPTER 3
MARKSMANSHIP TRAINING

Section I. INTRODUCTION

18. General. Marksmanship training for the Starlight Scope must be considered as a continuation of marksmanship training received by the rifleman, grenndier, machinegunner, or recoilless rifle rifleman. Many of the elements of marksmanship as taught for each of these weapons must also be practiced when using the Starlight Scope. If the soldier has mastered these fundamentals, he can expect excellent results when employing the Starlight Scope in its weapons mounted role. Marksmanship training as contained in FM 23-67, FM 23-71, FM 23-11, FM 23-9, FM 23-31, and FM 23-33 provides a firm foundation for Starlight Scope marksmanship training. Army Subject Schedule 23-39 also provides an excellent guide for the conduct of training Starlight Scope operators.

19. Purpose of Marksmanship Training. Marksmanship training is designed to develop skills in aiming and zeroing techniques so that the soldier can effectively employ the Starlight Scope to detect and place aimed fire on an enemy at night.

Section II. PREPARATORY MARKSMANSHIP

20. Aiming and Positions. The integrated act of shooting (aiming and steady hold) applies equally when firing the rifle with the Starlight Scope mounted.

21. Aiming. In aiming, the firer is concerned with correctly pointing his weapon so that the bullet or projectile will hit the target when he fires. Normally, wit h the exception of the recoilless rifle rifleman, this requires proper alinement of the front and rear sights in relation to the target. This relationship is known as sight picture and involves two elements: sight alinement and placement of the aiming point. Since the Starlight Scope is an optical instrument which does not require alinement of a front and rear sight, the operator need only be concerned with the placement of the aiming point to obtain the correct sight picture.

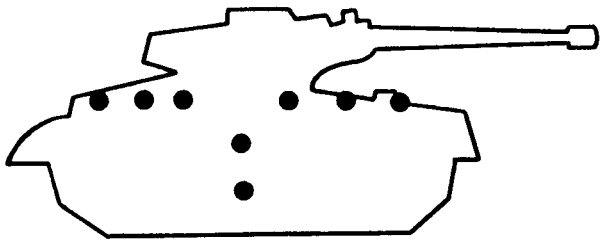
a. The correct sight picture (stationary target) is obtained when the aiming references dot (bend-type reticle) of the sight reticle is positioned in the center of mass of the target (fig. 18).

b. The correct sight picture (stationary target) is obtained when the top of the center line (black line reticle) of the sight reticle is positioned in the center of mass of the target (fig. 19).

22. Positions. Since the Starlight Scope, when installed, increases the weight of the weapon (5 pounds, 14 3/4 ounces), the importance of obtaining a good firing position and applying as many of the steady hold factors as possible cannot be overemphasized. The basic positions as taught in the field manuals listed in paragraph 18 should be used. However, it will be necessary to modify the position of the head to compensate for the "offset" of the Starlight Scope from the weapon.

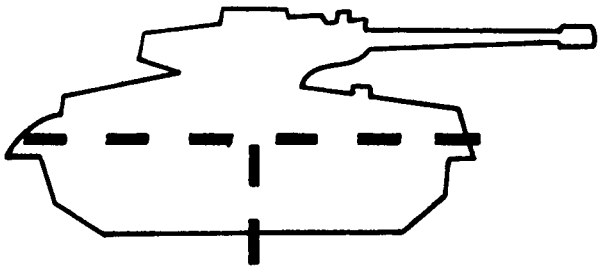
a. The Starlight Scope may be employed from any firing position (fig. 20 through 33).

b. The positions beat suited for operation of the Starlight Scope are those that afford the greatest stability. Normally, these positions are the prone supported, foxhole supported, and the biped or tripod mounted positions.



BEAD TYPE RETICLE

Figure 18. Correct sight picture (bead-type reticle).



BLACK LINE RETICLE

Figure 19. Correct sight picture (black line reticle).

Figure 20. Prone position.

Figure 21. Prone supported.

Figure 22. Open-legged sitting position.

Figure 23. Prone position with M67 recoilless rifle.

Figure 24. Cross-legged sitting position.

Figure 25. Squatting position.

Figure 26. Kneeling position.

Figure 27. Kneeling position with M72.

Figure 28. Standing position.

Figure 29. Foxhole supported.

Figure 30. Prone position M14A2 (bipod).

Figure 31. Prone position M60 machinegun (bipod).

Figure 32. Prone position M60 (tripod).

Figure 33. Prone position XM16E1 (bipod).

Section III. ZEROING PROCEDURES

22. General. The Starlight Scope may be zeroed during the hours of daylight or darkness. The lens cap must be positioned over the objective lens during daylight operation. When zeroing in daylight, it may be necessary to cover one or two of the small pinholes in the lens cap to reduce the amount of light entering the Starlight Scope. If it is necessary to cover one or two of the holes in the lens cap for daylight zeroing, then provisions should be made to permit the operator to reconfirm his zero during the hours of darkness without the lens cap. The reason for this is: when one or more holes in the lens cap are covered and the cap is rotated on the objective lens, the accuracy of the zero may change. The operator may also experience difficulty when attempting to zero the Starlight Scope just prior to darkness (dusk). The light level at dusk is too low to permit the image intensifier tube to resolve the zero target with the lens cap in place, yet the light 1evel at dusk is still intense enough to cause the image intensifier tube to automatically cut off when the lens cap is removed from the objective lens.

24. Zeroing the Starlight Scope to the M14, M14A2, or XM16E1 Rifles. The recommended distance for zeroing the Starlight Scope is l50 meters. When the Starlight Scope has been zeroed at 150 meters, the bottom dot of the sight reticle is positioned in the center of mass of the target to obtain the correct sight picture for engagement of target at 300 meters. However, an accurate zero may also be obtained at either a closer or greater range. There are several methods of zeroing the Starlight Scope. They are:

a. Stable Rest Zeroing. This method of zeroing the Starlight Scope requires a minimum of ammunition; however, the accuracy of the zero is dependent on the stability of the rest. Zeroing is accomplished as follows:

(1) Place or select a target at the desired zero range. The battlesight zero range of 250 meters may be used or a greater or lesser range may be more practical. Regardless of what zero range is used, the firer must know the rear sight setting of his weapon for that particular range.
(2) Adjust the rear sight of the weapon for the zero range.
(3) Mount the Starlight Scope to the weapon

and place the combination onto a stable rest.

(4) Carry out operating instructions as outlined in paragraph 9 *e* (l) through (4).

(5) Sight through the rear sight of the weapon (not Starlight Scope) and aline on the aiming point of the zero target.

(6) Without disturbing the lay of the weapon or Starlight Scope combination, sight through the Starlight Scope and, by manipulating the azimuth and elevation adjustment knobs, move the sight reticle until the aiming reference dot is alined on the same point of aim as the sights of the rifle.

(7) When the aiming reference dot and the rifle sights are alined on the same point of aim on the zero target, the Starlight Scope and weapon are zeroed for that specific range. Situation permitting, the operator should fire a few rounds to confirm the zero. When making adjustments in elevation or deflection, adjustments are made in the direction of the error.

b. Battlesight Zeroing. In keeping with current doctrine of the United States Army, which prescribes a 250-meter battlesight zero and the soldier's need to be able to determine this zero at 26 meters or 1,000 inches, a battlesight zero for the Starlight Scope may also be obtained at this range. The principles of zeroing, as described in FM 23-71, form a firm basis for teaching battlesight zeroing of the Starlight Scope. The 25-meter zero target may be used; however, the center of the shot group has been moved to compensate for the offset of the Starlight Scope when mounted. The Starlight Scope is zeroed at 25 meters as follows:

(1) Mount the Starlight Scope to the M14, M14A2, or XM16E1 rifle.

(2) The operator may select what position is to be used; however, the foxhole, prone supported, or biped position is recommended for greater stability. The position selected must be located at the prescribed 25 meters or 1,000 inches from the target.

(3) Carry out operating instructions as described in paragraph *9e* (1) through (4).

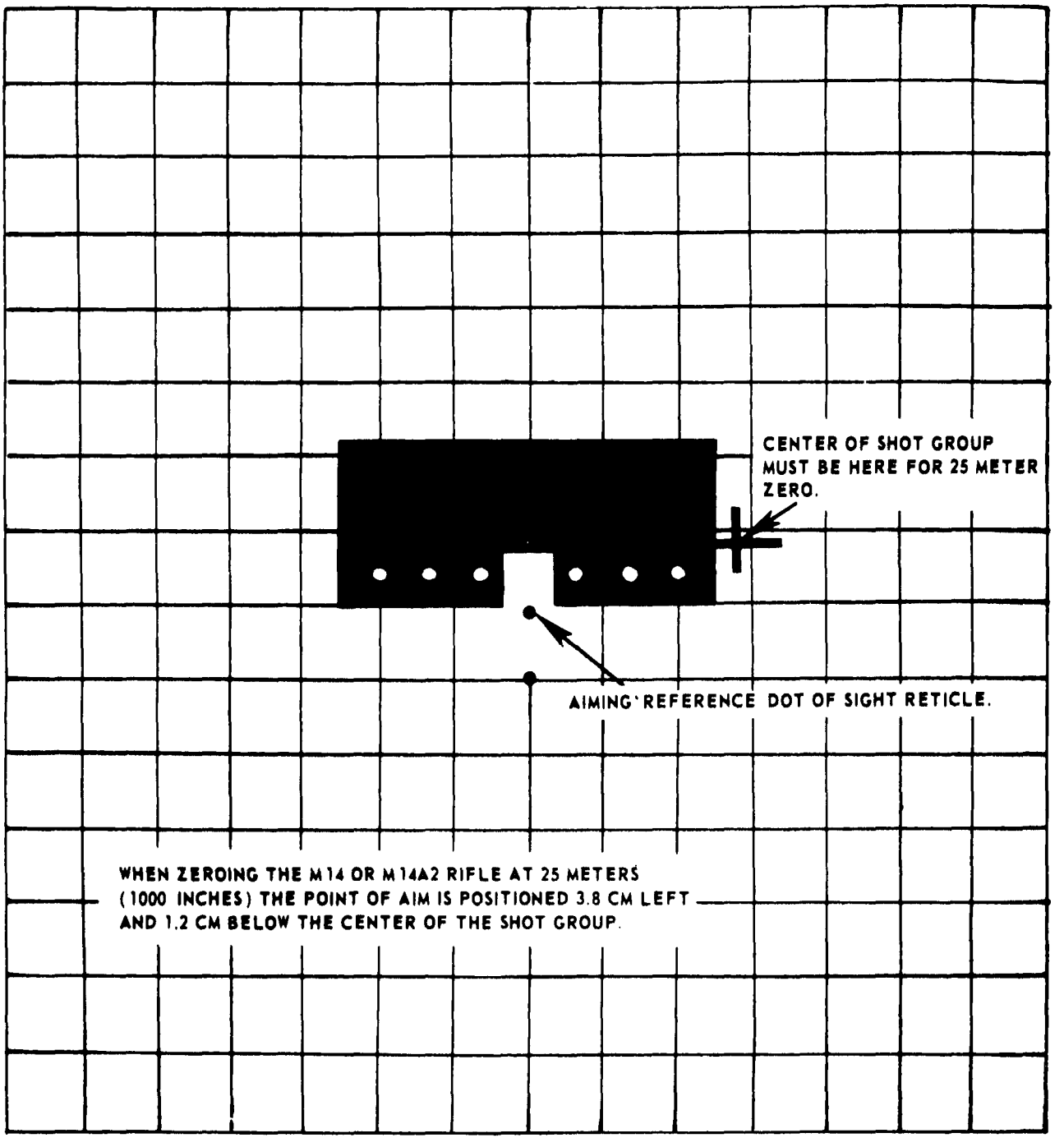
(4) Sight through the Starlight Scope and position the aiming reference dot of the sigh t reticle on the target as illustrated in ① and ②, figure 34. Fire a three-round shot group, insuring that the aiming reference dot is at the exact same point of aim on the target each time a round is fired,

(5) Move to the target line and analyze the target to determine the location of the center of the shot group in relation to point of aim. The correct relationship between point of aim and the center of the shot group when zeroing with the M14 or M14A2 rifles is illustrated in ①, figure 34. The correct relationship when firing the XM16E1 rifle is illustrated in ②, figure 34.

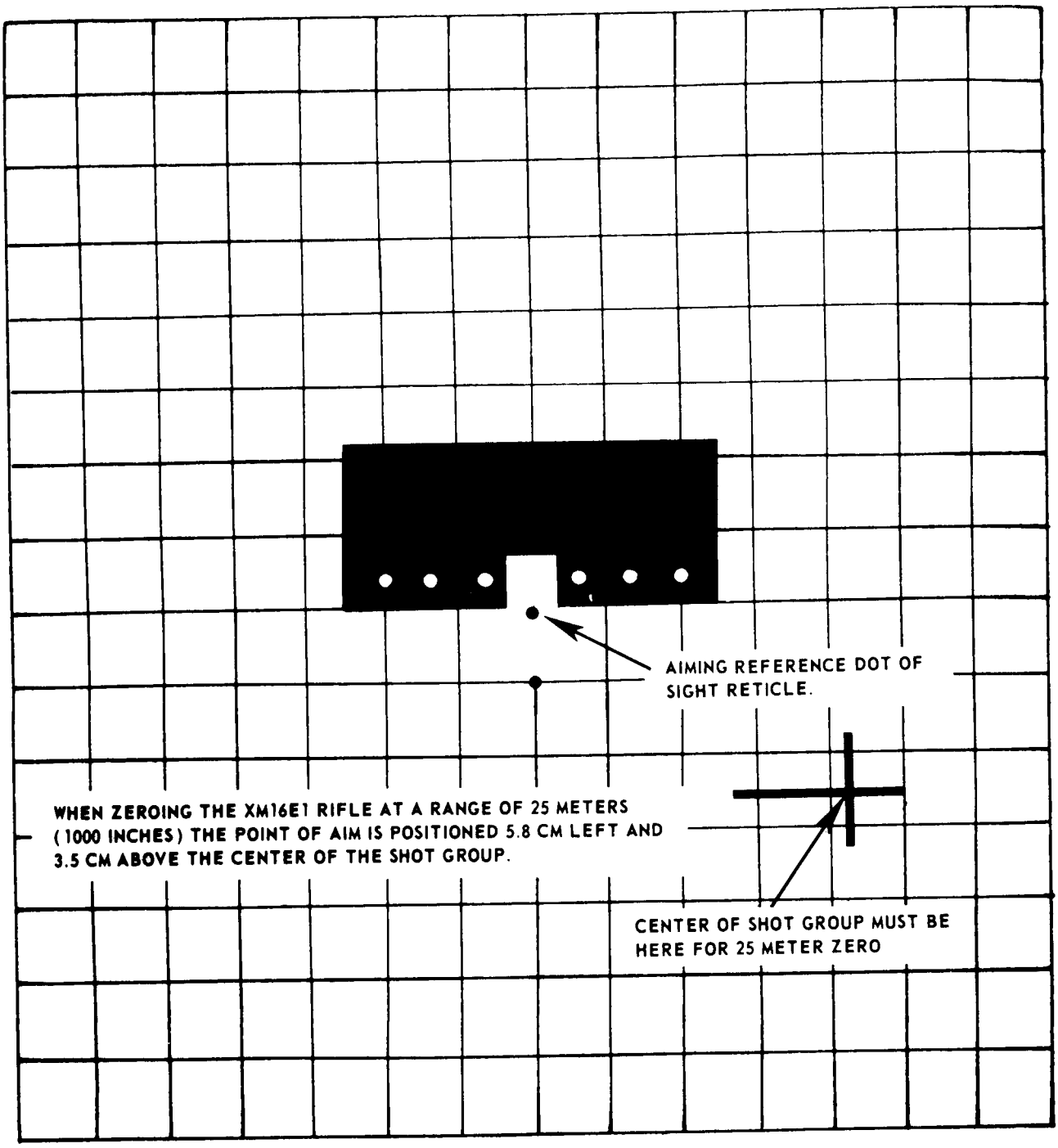
(6) Adjust the sight reticle by turning the elevation and/or azimuth adjustment knobs until the aiming reference dot is at the prescribed location as illustrated in ① and ② , figure 34. One click of the azimuth or elevation adjustment knob will move the strike of the bullet 1.27 centimeters or a little less than one square on the 25-meter target. Adjustments are made in the direction of the error from where the center of the shot group must be. For example, if the center of the shot group is high and left of where the shot group must be, then the operator adjusts for this error by moving the sight reticle up and to the left.

(7) Repent the procedures as outlined in (4) through (6) above until proper relationship between the point of aim and the center of the shot groups has been obtained.

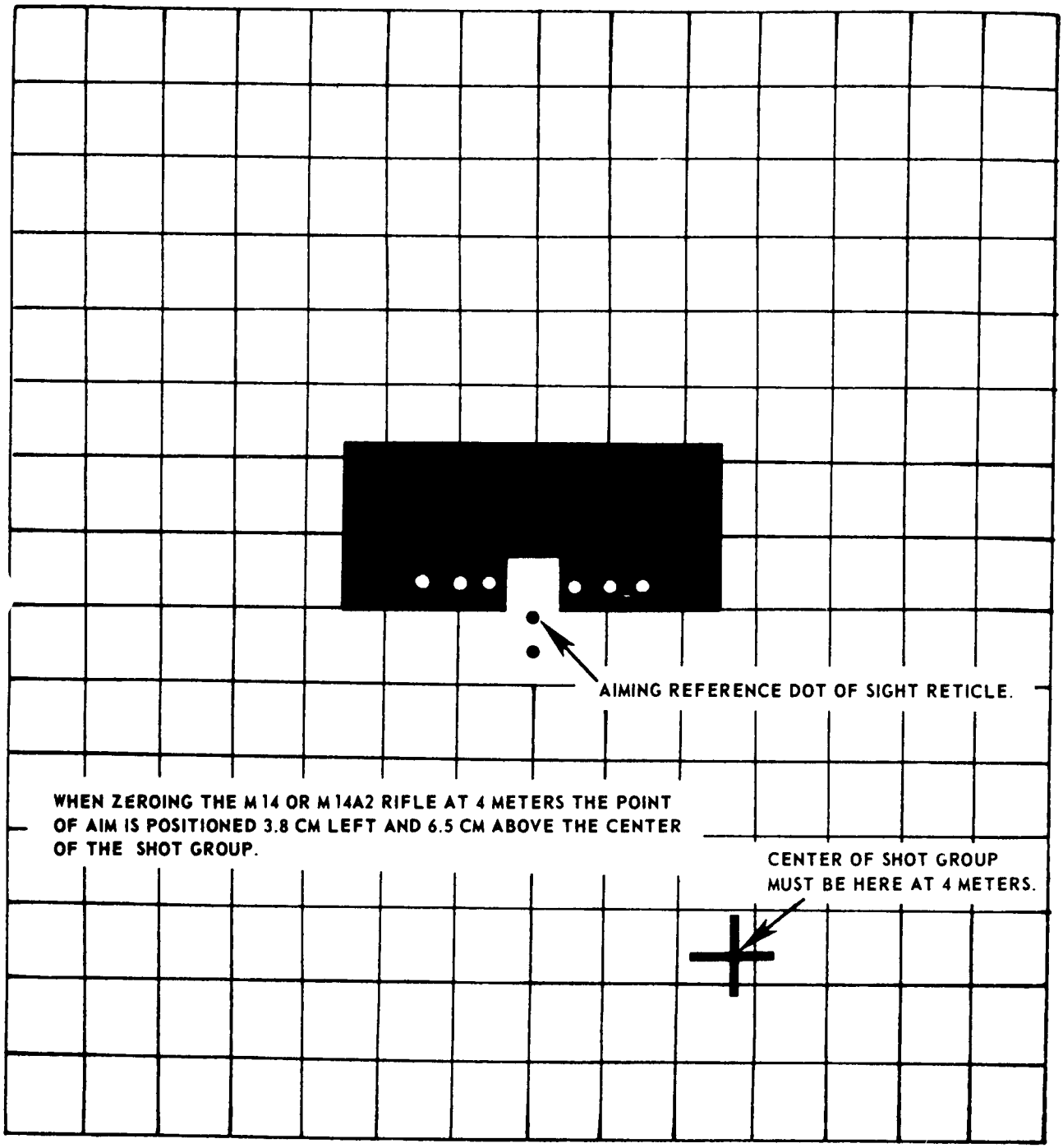
(8) A method of obtaining a battlesight zero at 4 meters can also be accomplished by following the procedures outlined in (4) through (7) above, and by changing the relationship of the point of aim and the strike of the round as illustrated in ③, figure 34, for the M14 and M14A2 rifles or ④, figure 34, for the XM16E1 rifle. When obtaining a 4-meter zero the (operator must try for as accurate a



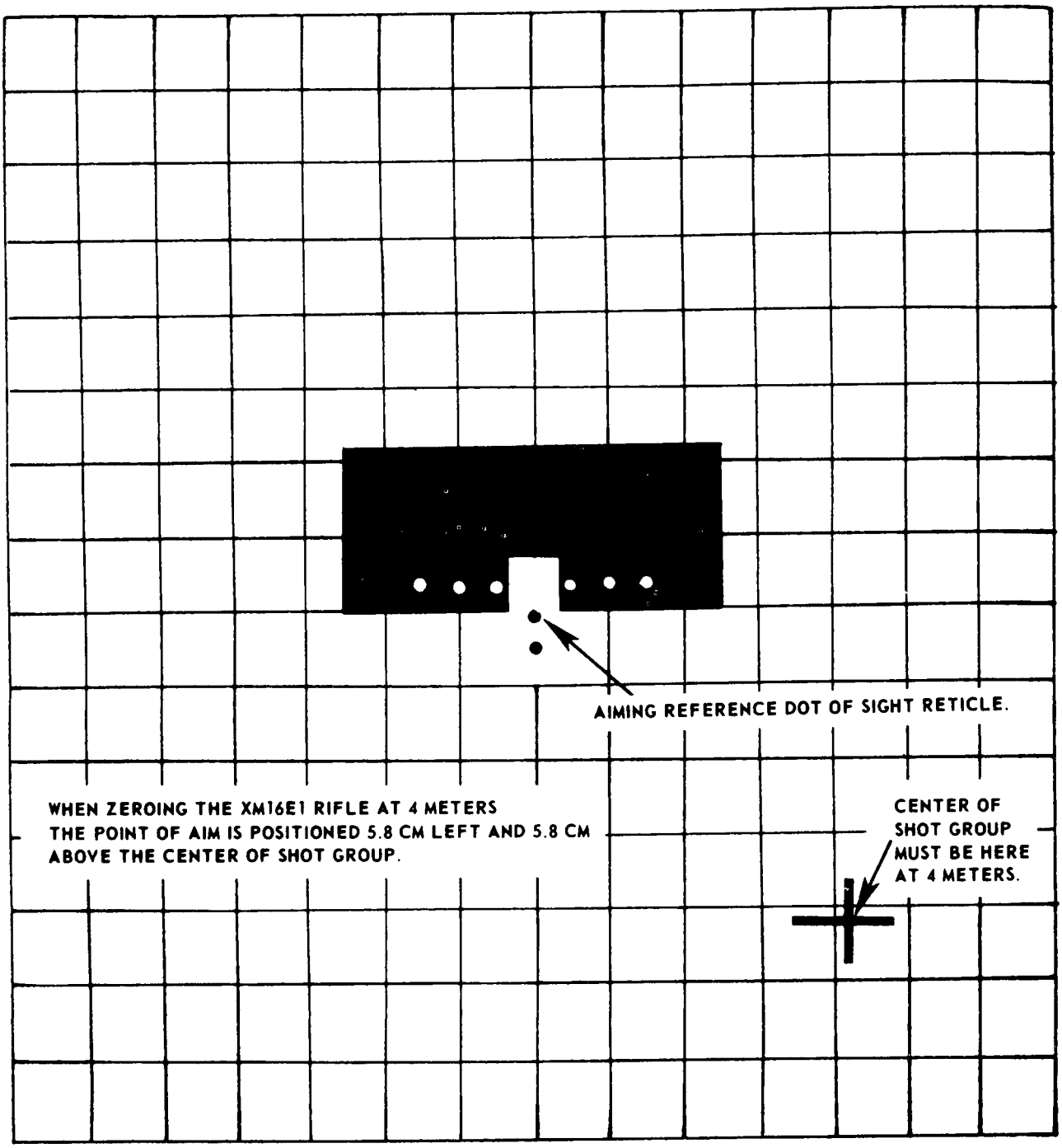
① *25-meter zeroing chart, M14 and M14A2 rifles*
Figure 34. Zeroing.



③ *25-meter zeroing chart, XM16E1 rifle*
Figure 34.—Continued.



⑧ *4-meter zeroing chart, M14 and M14A2 rifles*
Figure 34.—Continued.



④ *4-meter zeroing chart, XM16E1 rifle*
Figure 34.—Continued.

zero as possible, for a very slight error at 4 meters results in a major error at 250 meters.

(9) The advantage of the 4-meter zero, as compared to a 25-meter zero, is that the operator can see the strike of the round on the target and can adjust the sight reticle without moving from the weapon, thus eliminating movement time between weapon and target and reducing the time required for zeroing. When zeroing at 4 meters, each click of the azimuth or elevation adjustment knob moves the strike of the round .2 centimeter.

(10) Due to the differences between firers, weapons, and ammunition, and the difficulty in obtaining a precise zero at 4 or 25 meters, zeroes obtained at these ranges should be confirmed by firing on the actual range.

c. Field Expedient Zeroing. This method of zeroing is similar to the method described in FM 23-71. This method may require the we of an observer to assist in locating the strike of the round and giving the changes in elevation and deflection necessary to bring it to the point of aim. During daylight zeroing the observer should be equipped with binoculars, and during the hours of darkness a Starlight Scope, to assist him in this procedure. This method of zeroing is conducted as follows:

(1) The operator mounts the Starlight Scope to his weapon and carries out operating instructions as described in paragraph *9e* (1) through (4).

(2) The operator and observer pick out a target that provides a definite point of aim and one that will aid in observing the strike of the bullet. This can be u hillside, a brick house, or any dry or metal surface.

(3) Center the aiming reference dot in the Starlight Scope's field of view. This may be accomplished by sighting through the scope and estimating if the aiming reference dot is centered. It may also be accomplished by counting the total number of clicks the aiming reference dot can be moved in both elevation and azimuth and then positioning the aiming reference dot at midpoint.

(4) Place the aiming reference dot at the point of aim and fire one round. The observer notes the strike of the bullet and gives the elevation and deflection change necessary to bring it to the point of aim. He dose this by estimating the distance between the strike of the bullet and the aiming point. He converts these distances to clicks by dividing the error (in inches) by the number of inches one click will move the strike of the bullet at that range. For example, an operator fires one round at his zero target at a range of 150 meters. The observer estimates the strike of the round to be 2 feet above and 3 feet right of the aiming point. His corrections would be: up 8 clicks (24 inches at that range) and right 12 clicks (36 inches at that range). The operator makes these adjustments to the reticle and fires a confirming round.

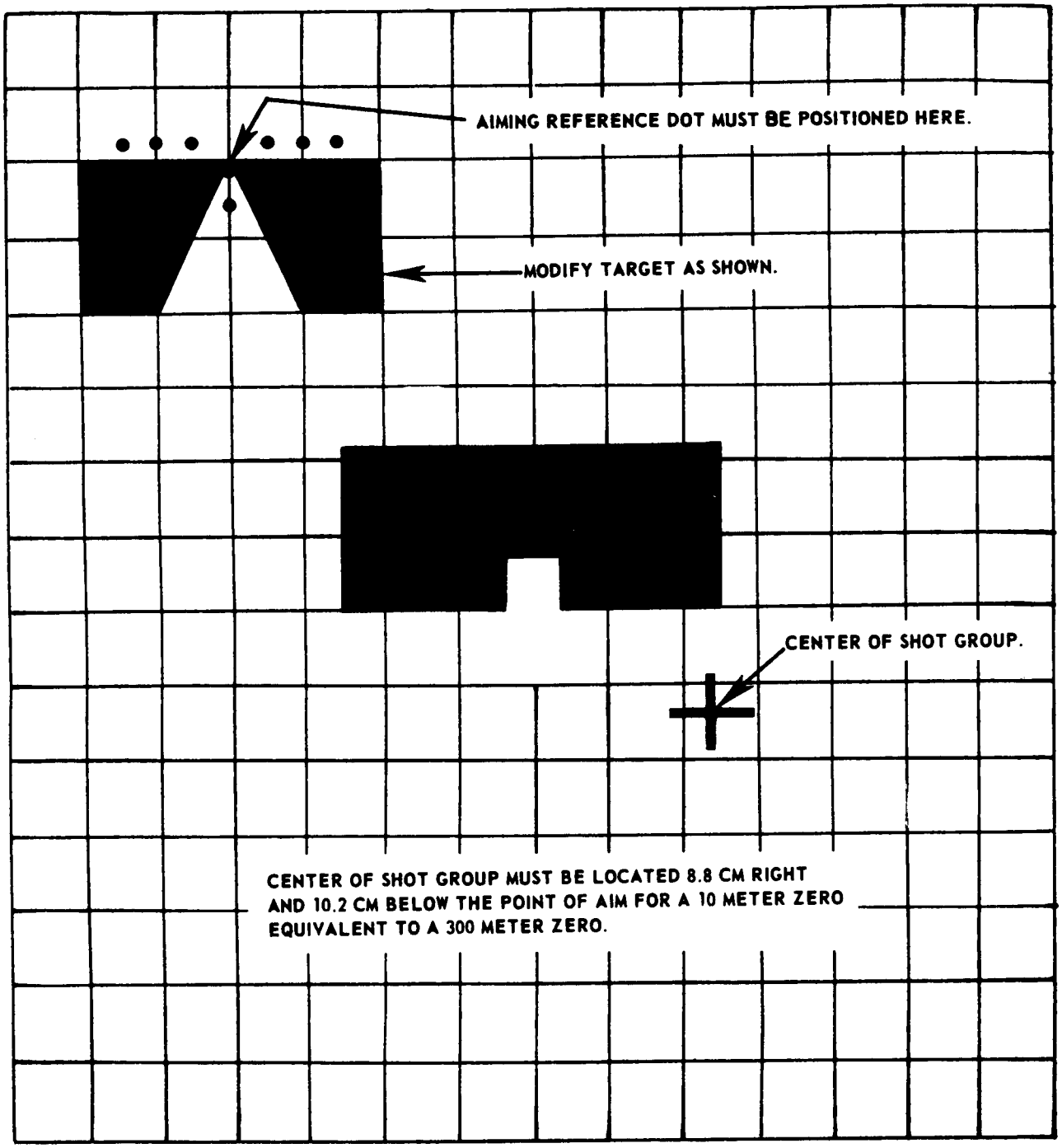
(5) He continues the foregoing procedures until the point of aim and strike of the bullet coincide.

(6) Because the operator is making a sight change on the basis of one shot, it is extremely important that the shot be well-aimed and correctly fired. He should also use his most stable firing position.

d. Holdoff. To engage targets at other than the zero range, the operator must apply holdoff to compensate for the rise and fall in the trajectory of the round. To engage targets at ranges less than the zero range, the point of aim will be below the center of mass.

25. Zeroing Starlight Scope to M60 Machinegun. The procedures used to zero the Starlight Scope to the M60 machinegun are basically the same as those for the rifle. Zeroing can be accomplished using the basic (l0-meter) method, known distance target method, and the field expedient method. Regardless of which procedure is used, the basic marksmanship techniques as described in FM 23-67 will apply.

a. Basic (10-Meter) Zero. This method of zeroing is equivalent to a 300-meter zero and



⑥ *10-meter zeroing chart, M60 machinegun (300-meter)*
Figure 34.—Continued.

may be used when engaging targets at ranges of 500 meters or less. The standard 25-meter target (⑤, fig. 34), modified as shown, is used in lieu of the standard machinegun targets; however, the target is still positioned 10 meters from the muzzle of the weapon. Zeroing is accomplished as follows:

(1) Mount the Starlight Scope to the M60 machinegun and carry out operating instructions as described in paragraph 9 *e* (1) through (4).

(2) Sight through the Starlight Scope and position the aiming reference dot of the sight reticle on the target as illustrated in ⑤, figure 34. Fire three rounds (single shot) to establish a shot group. The operator must insure the aiming reference dot is positioned at the exact same point of aim each time a round is fired.

(3) The operator checks his target to determine the location of the center of the shot group in relation to where his rounds must strike the target for an accurate zero. The correct relationship between the point of aim and the center of the shot group is illustrated in ⑤, figure 34. This relationship must be obtained to have an accurate lo-meter zero. If the center of the shot group is other than shown in ⑤, figure 34, then the operator must adjust the elevation and/or azimuth adjustment knob of the Starlight Scope to bring the point of aim and the center of the shot group into proper alinement.

(4) After making adjustments for elevation and/or deflection, the operator re-lays on his target and fires a confirming round. If the round dose not strike the target at the desired location, he treats this hit as the center of a three-round shot group, makes further adjustments as necessary, and fires smother round. He continues this procedure until the point of aim and the strike of the round are in the proper relationship.

b. Known Distance Target Method. When using this method to zero the M60 machinegun, the tripod should be used. If the tripod is not available, a stable rest must be provided to afford maximum stability for the weapon and Starlight Scope combination. The Starlight Scope is zeroed to the M60 machinegun as follows:

(1) Zero the M60 machinegun.

(2) Mount the Starlight Scope to the M60 machinegun and carry out operating instructions as described in paragraph *9e* (1) through (4).

(3) Select a target at a known distance. Place this range setting on the rear sight and aline the sight on the distant aiming point.

(4) Without disturbing the lay of the weapon, sight through the Starlight Scope and dine the aiming reference dot on the same point of aim.

(5) Recheck to insure the lay of the weapon has not been disturbed and that both eights are alined on the same point of aim on the target.

(6) If the situation permits, fire a few rounds to confirm the zero.

c. Field Expedient Zeroing. The procedures as prescribed in paragraph *24c* may be used to zero the Starlight Scope to the M60 machinegun. The operator may fire a short burst in lieu of the one round as described.

d. 500-Meter Zero. The Starlight Scope may also be zeroed to the M60 machinegun at 10 meters to correspond to a 500-meter zero. This is accomplished by following the procedures as outlined in paragraph *25a;* however, the point of aim and the center of the shot group must be alined as shown in ⑥, figure 34.

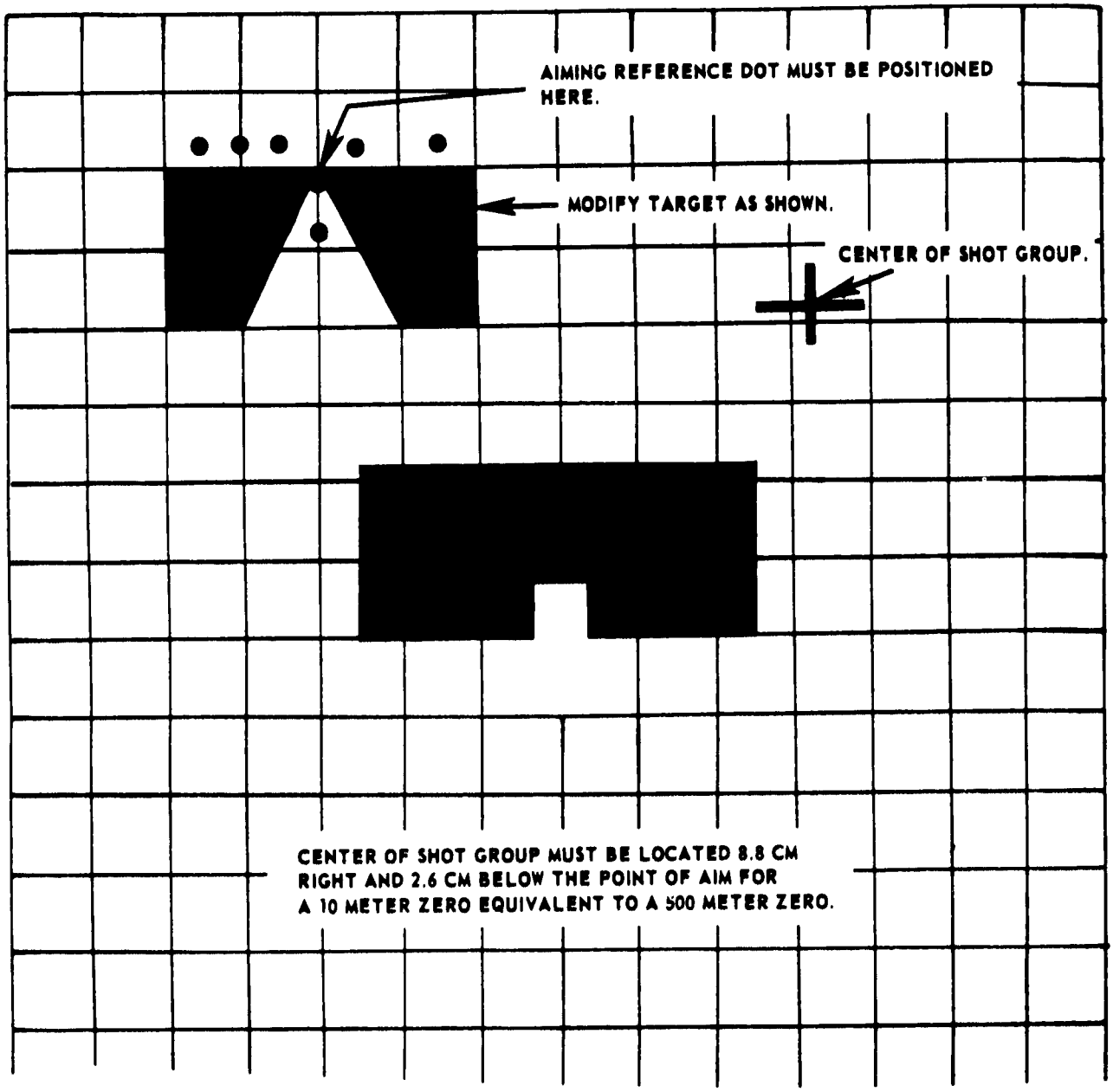
26. Zeroing the Starlight Scope to the 90-mm Recoilless Rifle M67. The Starlight Scope may be zeroed to the M67 using a known distance or infinity target. Using either method, the M103 sight is first boresighted to the M67 as outlined in FM 23-11.

a. Known Distance Target.

(1) Mount the Starlight Scope to the weapon and carry out operating instructions as described in paragraph *9e* (1) through (4).

(2) Select a known distance target with a distinct aiming point.

(3) Sight through the M103 sight and position the vertical line that corresponds


AIMING REFERENCE DOT MUST BE POSITIONED HERE.
MODIFY TARGET AS SHOWN.
CENTER OF SHOT GROUP.
CENTER OF SHOT GROUP MUST BE LOCATED 8.8 CM RIGHT AND 2.6 CM BELOW THE POINT OF AIM FOR A 10 METER ZERO EQUIVALENT TO A 500 METER ZERO.

with the range to the target on the aiming point.

(4) Without disturbing the lay of the weapon, set the elevation indexing ring (fig. 14) of the weapons adapter bracket at the same range setting as the M103 sight. Each clockwise click of the elevation knob (fig. 14) will increase the range by 50 meters.

(5) Sight through the Starlight Scope and aline the aiming reference dot of the might reticle on the same point of aim.

(6) Recheck to insure both sights are alined on the same point of aim. If the situation permits, the operator should fire to confirm the accuracy of the zero.

b. Infinity Target. Infinity zeroing with the M67 and the Starlight Scope is accomplished by using the same procedure as described in a above with the exception that the boresight cross of the M103 sight is alined on the infinity target and the elevation indexing ring is positioned on zero.

27. Zeroing the Starlight Scope to the M72. To zero the Starlight Scope to the M72 LAW, the following procedures should be used:

a. Select a known distance target at a range of 200 meters or less.

b. Extend the M72 and mount the Starlight scope.

c. Carry out operating instructions as described in paragraph 9 *e* (1) through (4).

d. Place the M72 and Starlight Scope in a stable rest position or assume a position that will provide maximum stability.

e. Look through the sight of the M72 and aline the corresponding range line of the eight with a specific point on the target.

f. Set the elevation indexing ring of the weapons adapter bracket (fig. 13) at the same range matting. Each clockwise click of the elevation knob (fig. 13) will increase the range by 25 meters.

g. Without disturbing the lay of the weapon, sight through the Starlight Scope and, by manipulating the elevation and azimuth adjustment knobs, aline the aiming reference dot of the eight reticle on the same point of aim.

h. Recheck both sights to insure that they are alined on the same point of aim.

CHAPTER 4
EMPLOYMENT CONSIDERATIONS

28. General. The purpose of the Starlight Scope is to provide an efficient, secure viewing capability for friendly forces during the conduct of night combat operations. Although the Starlight Scope does not give the soldier the width, depth, or clarity of vision enjoyed during daylight, he can see well enough at night to aim and fire his weapon, to observe the effect of fires, and to observe the terrain, the enemy, and his own forces, and perform numerous other tasks that confront a soldier in the field at night. Consideration of the factors affecting the employment and proper use of the Starlight Scope will permit more effective execution of night offensive and defensive operations, aid in coordination and control within unite, boost morale, and promote troop confidence.

29. Factors Affecting Employment. This paragraph discusses the factors that may affect the employment of the Starlight Scope. The degree to which these factors aid or limit the operational capabilities of the Starlight Scope will vary depending on the light level, weather conditions, operator eye fatigue, and the terrain over which the Starlight Scope is being employed at that particular moment of the night.

a. Light. Since the Starlight Scope is designed to function using the ambient light of the night sky, the most effective operation can be expected under conditions of bright moonlight and starlight. As the ambient light level decreases, the viewing capabilities of the Starlight Scope diminish proportionately. When the sky is overcast and the ambient light level is low, the viewing capabilities of the Starlight Scope can be greatly increased by the use of flares or illuminating shells on the flanks, left or right front, and by using visible light such as that produced by searchlights. When the Starlight Scope is employed with artificial illumination, the depth and clarity of vision is vastly superior to that experienced by the naked eye under similar light conditions. Infrared illumination may also be used to provide increased viewing capabilities under very low ambient light conditions.

b. Weather Conditions. Clear nights provide the most favorable operating conditions for the Starlight Scope. Just as rain, sleet, snow, smoke, or fog affects the viewing capabilities of the individual, so will they affect the range capabilities of the Starlight Scope. Even so, the Starlight Scope can be expected to provide some degree of viewing capability in most adverse weather conditions.

c. Terrain. To adequately describe the effects of terrain on the employment of the Starlight Scope, it is necessary to approach the subject using different types of terrain under varying ambient light conditions.

(1) When viewing from open terrain into densely wooded terrain, penetration of the wood line, even under the most favorable ambient light conditions, is limited to a few meters. The operator will experience difficulty in detecting targets against a very dark background.

(2) When viewing from open terrain into sparsely wooded terrain under moonlight and starlight conditions, penetration into woods is greatly improved depending on the depth of the woods, height and location of moon, and the range of the Starlight Scope to the woods.

(3) When viewing from sparsely or densely wooded terrain into open terrain under moonlight and starlight conditions, viewing capabilities are excellent. When operating under these conditions, the starlight Scope should not be employed

at a depth inside the woods that would limit its field of view.

(4) When moving through densely wooded terrain, under all ambient light conditions, viewing capabilities may be limited to a few meters.

(5) When moving through sparsely wooded terrain under moonlight conditions, viewing capabilities are good. As the ambient light level decreases down to and below starlight, effectiveness is decreased.

(6) When operating in dense or sparse woods, the operator may experience difficulty in depth perception due to the closeness of objects being viewed plus the magnification of the objects by the Starlight Scope.

(7) The operator should experience little difficulty in following trails or roads under moonlight or starlight conditions.

(8) When operating in open terrain under moonlight and starlight conditions, viewing capabilities are limited only by the ambient light level and the range at which the Starlight Scope is capable of resolving a target.

(9) When using the Starlight Scope to view on or across rivers, streams, or lakes under moonlight and starlight conditions, the reflection of light off the water provides for maximum viewing capabilities.

d. Operator Eye Fatigue. Most operators will initially experience eye fatigue after 5 or 10 minutes of continuous observation through the Starlight Scope. After several periods on the scope, he should be able to observe for longer periods of time. To aid in maintaining a continued viewing capability and lessen eye fatigue, the operator may alternate eyes during the viewing period.

30. Employment Considerations. The employment of the Starlight Scope in night offensive or defensive operations is not limited to the uses suggested below. The actual employment of the Starlight Scope will be limited only by the imagination of the user.

a. Offensive Operation. The Starlight Scope may be used in night offensive operations to—

(1) Maintain direction and control of attacking troops.

(2) Provide supporting weapons with a means of delivering accurate fires.

(3) Select targets for supporting weapons, including mortars and artillery, and aid in the adjustment of fires.

(4) Speed up the advancement of attacking troops by aiding in locating and overcoming obstacles en route.

(5) Assist patrols or parties in night reconnaissance activities.

(6) Improve efficiency in embarking, crossing, debarking, and control during river crossings or other types of amphibious operations.

b. Defensive Operations. The Starlight Scope may be used in night defensive operations to-

(1) Make possible the early detection and placing of effective fires on an attacking enemy.

(2) Detect and destroy enemy patrols, infiltration teams, and guerrilla-type troops.

(3) Identify friendly patrols and aid in their passage of lines.

(4) Select targets for direct and indirect fire weapons and to aid in the adjustment of these fires.

(5) Aid in the location and evacuation of casualties.

(6) Promote the confidence of troops holding defensive positions by providing them with a night-seeing capability.

CHAPTER 5
STARLIGHT SCOPE OPERATOR'S TRAINING COURSES

31. General. The Starlight Scope operator's training courses as outlined in this chapter are designed to teach the soldier the fundamentals and basic skills required for operation of the Starlight Scope. They are offered as a guide in preparing lesson plans and scheduling periods of instruction. Army Subject Schedule 23-39 should be consulted for detailed information regarding the conduct. *of* training for each course. Ammunition requirements are listed in tables I, II, and III, paragraph 35.

32. Starlight Scope Operator's Training Course (7 Hours). This course consists of 3 hours devoted to conference, demonstration, and practical exercises on characteristics, tabulated data, components, functioning, operation, disassembly and assembly, installation, maintenance, aiming, positions, zeroing procedures, and factors affecting employment. The last 4 hours cover range firing exercises applying 25-meter zeroing procedures and field target engagement under table I, paragraph 35.

33. Starlight Scope Operator's Training Course Modified (4 Hours). This course is designed for training of operators at installations where facilities and time may be limited. The course consists of a 1-hour conference and demonstration on description, tabulated data, components, operation, installation, and maintenance procedures. Three hours are devoted to conference and demonstration on aiming, zeroing procedures, and practical exercises applying 4-meter zeroing procedures and field target engagement under table II, paragraph 35.

34. Starlight Scope Operator's Proficiency Course (2 Hours). This course is designed to maintain the proficiency of trained Starlight Scope operators. The course will not be presented to individuals who have not received training under the courses as listed in paragraphs 32 and 33. This course consists of a 2-hour class on review of the Starlight Scope system and practical exercises applying field expedient zeroing procedures and field target engagement under table III, paragraph 35.

35. Ammunition Tables.

a. Table I. Starlight Scope Operator's Training Course (Total Rounds—35).

Purpose	Position	Target	Range	Rounds	Time limit
Zeroing	Prone supported or bipod	Standard 25-meter	25 m	15	None.
Field target firing	Prone supported or bipod	Standard field firing range.	75–300 m	20	None

b. Table II. Starlight Scope Operator's Training Course Modified (Total Rounds—30).

Purpose	Position	Target	Range	Rounds	Time limit
Zeroing	Prone supported or bipod	Standard 25-meter	4 m	10	None.
Field target firing	Prone supported or bipod	Standard field firing range.	75–300 m	20	None.

c. Table III. Starlight Scope Operator's Proficiency Course (Total Rounds—30).

Purpose	Position	Target	Range	Rounds	Time limit
Field expedient zeroing	Prone supported or bipod	Standard field firing range.	75–300 m	10	None.
Field target firing	Prone supported or bipod	Standard field firing range.	75–300 m	20	None.

APPENDIX I
REFERENCES

AR 345-15	Safeguarding Nondefense Information.
AR 380-5	Safeguarding Defense Information.
AR 385-63	Regulations for Firing Ammunition for Training, Target Practice, and Combat.
AR 622-5	Qualification in Arms—Qualification and Familiarization.
FM 20-60	Battlefield Illumination.
FM 21-5	Military Training Management.
FM 21-6	Techniques of Military Instruction.
FM 21-75	Combat Training of the Individual Soldier and Patrolling.
FM 23-8	U.S. Rifle, 7.62-mm, M14 and M14E2.
FM 23-9	Rifle, 6.66-mm, XM16E1.
FM 23-11	90-mm Recoilless Rifle, M67.
FM 23-12	Technique of Fire of the Rifle Squad and Tactical Application.
FM 23-31	40-mm Grenade Launcher, M79.
FM 23-33	66-mm High Explosive Antitank Rocket, M72.
FM- 23-67	Machinegun, 7.62-mm, M60.
FM 23-71	Rifle Marksmanship.
TM 9-258	Elementary Optics and Application To Fire Control Instruments.
TM 9-1900	Ammunition, General.
TM 9-6920-210-14	Operator, Organizational, and Field Maintenance Manual: Target, Target Material, and Training Course Layouts.
TM 11-1090-268-15	Organizational, DS, GS, and Depot Maintenance Manual, Including Repair Parts and Special Tool Lists: Starlight Scope, Small Hand-Held or Individual Weapons Mounted (FSN 1090-688-9954).
TM 11-1090-269-16	Organizational, DS, GS, and Depot Maintenance Manual, Including Repair Parts and Special Tool Listsa: Crew-Served Weapon Night Vision Sight (FSN 1090-911-1370).
TM 11-6860-228-16	organizational, DS, GS, and Depot Maintenance Manual for Night Observation Device Medium Range.
ASubjScd 7-2	Rifle Squad Tactical Training.
ASubjScd 28-39	Starlight Scope, Small Hand-Held or Individual Weapons Mounted, Model No. 6060.
TA 23-100-1 through 23-100-6	Ammunition, rockets, and missilese for training.
TC 5-9	Near Infrared Night Vision and Detection Equipment and Its Application.

APPENDIX II
SAFETY

1. General. Safety precautions must be observed during all marksmanship training. This appendix lists the important precautions and references for conduct of this training, but is not intended to replace AR 385–63 or local range regulations. The surface danger area for range firing with the Starlight Scope varies due to the different weapons systems to which it will adapt and their range in caliber. Consequently, range safety requirements to be followed will vary. It is mandatory, therefore, that the latest range safety directives and local range regulations be consulted to determine current safety requirements.

2. Safety Precautions. *a. General.* Prior to conducting range firing exercises with the Starlight Scope, insure the following references are studied thoroughly: FM 23-67, FM 23-9, FM 23–71, FM 23-8, FM 23-11, FM 23-31, and FM 23-33.

b. Special. When firing during the hours of darkness, the following special precautions apply:

(1) A blinking red light must be used in addition to the red range flag displayed at the entrance of the range.

(2) Two red lights will be mounted on the red and white striped pole indicating firing limits. They must be visible to all firers.

(3) A check of the down range area will be made to insure all personnel and equipment are clear of the area. This will be accomplished by asking twice over a public address system "IS THERE ANYONE DOWN RANGE?" Pause each time long enough to permit a response.

(4) No one will move forward of the firing line at any time until the firing line has been checked and cleared by safety personnel and then *only on command from the officer in charge of firing.*

(5) Safety personnel will insure individuals assigned to specific firing points, but who are not firing, remain at their designated station.

APPENDIX III
ADVICE TO INSTRUCTORS

1. Purpose. This appendix is a guide for instructors. Its contents should not limit their initiative and originality.

2. Presentation. *a.* Instruction should be presented using explanation, demonstration, and practical application. Since the Starlight Scope increases the weight of the weapon and makes positions and the integrated act of shooting even more important, the coach and pupil method should prove invaluable during marksmanship training.

b. Each man's training must be closely supervised to insure a high standard of efficiency and coordination.

3. Training Objectives. To provide the soldier with information in sufficient detail to enable him to effectively employ the Starlight Scope in combat.

4. Assistant Instructors. Prior to instruction, train selected personnel as demonstrators and assistant instructors. Assistant instructors must be able to correct errors and answer questions pertaining to the training. To give the students a clear picture of the work under discussion, insure that demonstrators are trained and thoroughly rehearsed so that demonstrations are correct in every detail.

5. General Training Notes. *a.* The minimum time required to train a Starlight Scope operator is 4 hours; however, the 7-hour course is recommended. Training in tactics and techniques of employment should be covered during unit training. The proficiency course is designed to maintain the proficiency of trained operators. It should not be presented to soldiers who have not completed the operator's training course or the operator's training course modified.

b. Although the importance of mechanical and other phases of training should not be de-emphasized, the importance of experience gained from range firing exercises, during the hours of darkness, cannot be overemphasized.

c. Training aids for instruction may be constructed using the photographs and diagrams contained within this training circular as a guide. The training aids should be available in sufficient time to assure that all assistant instructors are thoroughly familiar with them.

d. During classroom presentations, the class may be divided into small groups under the direct supervision of an assistant instructor. The size of the groups will be dependent on the availability of Starlight Scopes.

e. During daylight instruction, the lens cap must be positioned over the objective lens to prevent damage to the image intensifier tubes.

6. Conduct of Training. Army Subject Schedule 23-39 should be used as a guide in preparing lesson plans and scheduling periods of instruction with the Starlight Scope. The schedule of instruction and scope of training may be limited by the amount of time available, the duties of personnel to be trained, and the equipment available.

7. Security. Since the Starlight Scope is classified, adequate physical security measures in accordance with applicable Department of Defense and military department directives will be instituted during all operations with the Starlight Scope.

TC 23-11

By Order of the Secretary of the Army:

HAROLD K. JOHNSON,
General, United States Army,
Chief of Staff.

Official:
KENNETH G. WICKHAM,
Major General, United Statea Army,
The Adjutant General.

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To be distributed in accordance with DA Form 12-11 requirements for U.S. Rifle, 7.62MM, M14; Rifle 5.56MM, M16E1; 90MM Recoilless Rifle, M16E1; 90MM Recoilless Rifle, M67; 40MM Grenade Launcher, M79; 66MM Heat Rocket, M72; Machinegun 7.62MM, M60.

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