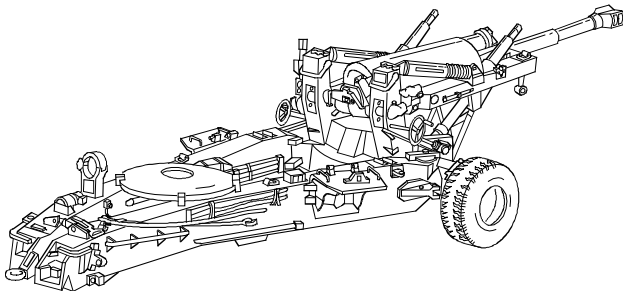


# ARMY TM 9-1025-211-10 MARINE CORPS TM 08198A-10/1

SUPERSEDES COPY DATED 1 OCT 1979

## TECHNICAL MANUAL OPERATOR'S MANUAL FOR

HOWITZER, MEDIUM, TOWED:  
155-MM, M198  
(1025-01-026-6648) (EIC:3EL)



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HEADQUARTERS, DEPARTMENT OF THE ARMY  
HEADQUARTERS, U.S. MARINE CORPS  
JANUARY 1991



## WARNING SUMMARY

### RADIATION HAZARD



### TRITIUM GAS (H<sub>3</sub>)

This item may contain radioactive materiel. Control of this radioactive materiel is mandated by Federal law. Immediately report any suspected lost or damaged items to your Radiation Safety Officer. If your Radiation Safety Officer cannot be reached, contact the TACOM-ACALA safety office during regular duty hours; or call the Rock Island Arsenal Police Office at DSN 793-6135 after duty hours.

All personnel who operate and/or maintain fire control equipment must be aware of the following special precautions:

Use adhesives, cleaning solvents, and cleaning compounds in well-ventilated area away from open flame. Adhesives, cleaning solvents, and sealing compounds are harmful to skin and clothing and may give off harmful vapor.

LOCAL RSO: \_\_\_\_\_ TELEPHONE: \_\_\_\_\_

**A. RULES and REGULATIONS:** Copies of the following rules and regulations are maintained at TACOM-Rock Island, Rock Island, IL 61299-7630. Copies may be requested or information obtained by contacting the TACOM-Rock Island Radiation Safety Officer (RSO), DSN 793-2962/2965, Commercial (309) 782-2962/2965.

- (1) 10CFR Part 19–Notices, Instructions and Reports to Workers; Inspections.
- (2) 10CFR Part 20–Standards for Protection Against Radiation.
- (3) 10CFR Part 21–Reporting of Defects and Noncompliance.
- (4) NRC license, license conditions, and license application.

**B. SAFETY PRECAUTIONS:** The radioactive material used in this instrument is tritium gas (H<sub>3</sub>) sealed or in glass tubes. These sources illuminate the instrumentation for night operations. Tampering with or removal of the sources in the field is prohibited by Federal law. In the event there is no illumination, notify the local RSO or ACALA RSO. If skin contact is made with any area contaminated with tritium, wash immediately with soap and water.

The beta radiation emitted by tritium is a hazard only if the vial or source is broken. Tritium can be taken into the body by inhalation, ingestion, or skin absorption/injection. If the vial is broken, the tritium gas will dissipate into the surrounding air. If released in a confined space such as a storage locker, container, unventilated room, or military vehicle, tritium is absorbed by lungs from air or by skin contact with contaminated surfaces. However, the body naturally eliminates absorbed tritium.

**C. IDENTIFICATION:** Instruments containing radioactive self-luminous vials are identified by means of radioactive warning labels (see above). These labels should not be defaced or removed and should be replaced immediately when necessary. Refer to the local RSO or the ACALA RSO for instructions on handling, storage, or disposal.

**WARNING SUMMARY**  
**(cont)**



**TRITIUM GAS (H<sub>3</sub>)**

**D. STORAGE:** Spare equipment must be stored in the shipping container, as received, until installed on the weapon. Storage of these items is recommended to be in an outdoor shed-type storage or unoccupied building.

**E. SHIPPING:** All radioactively illuminated instruments will be evacuated to the appropriate echelon for inspection and repair. Non-illuminated instruments will be disposed of as radioactive waste. Contact installation Radiation Safety Officer.

**F. EMERGENCY PROCEDURES:** If a source breaks or is not illuminated, follow "SWIMN":

**Stop** - and think.

**Warn** - nearby personnel of situation to avoid additional exposure. Immediately open doors/hatches if exiting room/vehicle/area is not possible. If exiting, move upwind for 15 minutes.

**Isolate** - Do not handle broken tritium devices with bare hands. Use gloves (if available) or a bag. Quickly place item in plastic bag (item 1, appx D) (or, if bag not immediately available, wrap in plastic) and, if possible, move to a non-contaminated area and wait for release by RSO so as not to spread contamination.

**Minimize** - wash hands.

**Notify** - call the Radiation Safety Officer (RSO).

**HAZARDOUS MATERIAL WARNING ICON DEFINITIONS:**



**FIRE** – flame shows that a material may ignite and cause burns.



**EXPLOSION** – rapidly expanding symbol shows that the material may explode if subjected to high temperatures, sources of ignition or high pressure.



**VAPOR** – human figure in a cloud shows that material vapors present a danger to life or health.



**CHEMICAL** – drops of liquid on hand shows that the material will cause burns or irritation.

## WARNING SUMMARY (cont)

### BATTERY WARNINGS



WARNING



#### Lithium Batteries

Lithium – Thionyl Chloride (Li-SOCl<sub>2</sub>) non-rechargeable batteries present a fire, explosion and vapor hazard. Do not recharge, disassemble, heat above 212° F (100° C), incinerate, puncture, crush, short circuit the terminals, or expose contents to water. If they are abused the high energy level can result in extreme heat or fire.

If battery enclosure shows signs of overheating or becomes hot to the touch, immediately turn off equipment (use on/off switch if supplied, or turn off by unscrewing/removing the battery caps).

Li-SOCl<sub>2</sub> batteries contain liquid SOCl<sub>2</sub>, which fumes on contact with air. The fumes or vapors are highly toxic, and the liquid is highly corrosive. Therefore, If you smell a sharp suffocating odor or hear a hissing sound, immediately turn off the equipment, (use on/off switch if supplied, or turn off by unscrewing/removing the battery caps) and leave the area until odor dissipates. NOTE: Personnel can detect the smell of 1 ppm while concentrations of 10 ppm are dangerous. Once the odor has dissipated, always handle leaking batteries with personal protective equipment meeting ANSI or NIOSH/MSHA requirements.

#### Lead Batteries

Use only appropriate batteries for each particular item. Consult the technical manual for the correct battery. Never mix rechargeable batteries with non-rechargeable batteries to prevent damage and potential injury. Never short-circuit the terminals. Pay careful attention to the polarity diagram on battery enclosure. Do not install batteries backwards or severe equipment damage may result.

Use only class 'D' fire extinguisher to extinguish batteries.

Batteries contain sulfuric acid which can cause severe burns. Avoid contact with skin, eyes, or clothing, and remove all metal or jewelry. If battery electrolyte is spilled, stop its burning effects immediately (refer to FM 21-11).

Lead-acid battery gases can explode. Do not smoke, have open flames, or make sparks around a battery, especially if caps are off. If a battery is gassing, it can explode and cause injury to personnel.

- a. Ventilate when charging or using in enclosed space.
- b. Avoid electrolyte contact with skin, eyes, or clothing. If battery electrolyte spills, take immediate action to stop burning effects:
  - External: Immediately flush with cold running water to remove all acid.
  - Eyes: Flush with cold water for at least 15 minutes. Seek immediate medical attention.
  - Internal: Drink large amounts of water or milk. Follow with milk of magnesia, beaten egg, or vegetable oil. Seek immediate medical attention.
  - Clothing or Vehicle: Wash at once with cold water. Neutralize with baking soda or household ammonia solution.

## WARNING SUMMARY (cont)

Wearing safety glasses or goggles when checking batteries. Always check electrolyte level with engine stopped. Do not smoke or use exposed flame when checking battery; explosive gases are present and severe injury to personnel can result.

Remove or disconnect batteries and turn vehicle MASTER switch to OFF prior to performing maintenance in immediate battery area or working on electrical system. Such disconnections prevent electrical shock to personnel or equipment.

Battery acid (electrolyte) is extremely harmful. Always wear safety goggles and rubber gloves, and do not smoke when performing maintenance on batteries. Injury will result if acid contacts skin or eyes. Wear rubber apron to prevent clothing from being damaged.

Remove all jewelry such as rings, dog tags, bracelets, etc. If jewelry contacts battery terminal, a direct short may result in instant heating of tools, damage to equipment, and injury or death to personnel.

### Storage and Shipping

Store batteries in original packaging until ready for use. Examine packages/batteries for bulging, cracking, or signs of leakage before putting the batteries into equipment. Remove any damaged batteries from service and dispose of in accordance with local regulations.

NOTE: When handling batteries that show signs of leaking, bulging, swelling, or deformity, personal protective equipment meeting ANSI or NIOSH/MSHA requirements must be used.

Store in cool, dry, well-ventilated areas separated from other combustible and hazardous materials. Storage of batteries over 100° F (38° C) will cause rapid loss of power.

Do not accumulate or store waste batteries for disposal for more than 90 days.

Do not mix hazardous and non-hazardous waste in the same package.

Do not package any battery if it is hot/warm. Package batteries only when they are cool to the touch.

Batteries for disposal shall be collected, transported and disposed of in a manner that will prevent short-circuit (isolate by taping metal poles/terminals), compacting or mutilation to destroy their physical integrity.

Non-usable batteries shall be disposed of in accordance with local regulations. Contact your local environmental office for instructions. Li-SOCl<sub>2</sub> batteries are classified as hazardous waste.

NOTE: A flashing LED light indicates a low battery condition on the M137A3 panel (counter box) and the M1A2 collimator. The LED may continue to flash for up to 12 hours. Replace the batteries as soon as possible after encountering this condition.

1.5V alkaline or NiCad batteries may be used in place of the 3.6V Lithium-Thionyl Chloride (LiSOCl<sub>2</sub>) batteries for **emergency short-term use only**. Using the 1.5V batteries will severely reduce the battery life and they will not work below 32 °F (0 °C).

### ANTENNA

Remain at least 2 feet from radiating antennas of vehicle mounted radios. Antennas can radiate harmful levels of radio frequency.

## **WARNING SUMMARY (cont)**

### **MERCURY**

Thermal warning device contains 0.367 pounds of mercury. Exposure to mercury can cause burns to the skin, eyes and respiratory tract. May be fatal if swallowed or inhaled. Seek emergency assistance immediately. Call HAZMAT personnel for disposal of mercury IAW state/local requirements.



### **AMMUNITION**



Do not chamber ammunition except immediately prior to firing. When possible, fire or unload ammunition within 5 minutes after chambering. Ammunition left too long in a hot or warm weapon can result in cookoffs or inbore explosions which are hazardous to personnel. Use of ammunition other than that prescribed in this manual is prohibited.

### **HEARING PROTECTION**

The M198 howitzer can generate blast overpressure which may damage hearing or cause injury to lungs or sinuses if proper protective measures are not followed. Supervised wearing of earplugs is required at all times, with the e-a-r type (plastic roll) preferred. The effects of blast can be reduced by moving farther to the rear of the weapon. For this reason, all crew members should move away as far to the rear as practicable. Any crewman who experiences such problems as shortness of breath or bleeding from nose or mouth must be immediately transported to a medical facility for evaluation.

Properly worn foam earplugs provide adequate protection when firing all existing propellant charges, including M203 series and MACS charges, at all quadrant elevations according to the guidelines in the chart on page 2-84.

### **HOWITZER**

#### **General**

The procedures in this technical manual involve the use of a weapon system and live ammunition. All standard safety precautions governing the handling of live ammunition and operation of artillery weapons must be observed.

Injury may occur if equilibrators are over or under charged. Test equilibration by quickly disengaging and engaging the manual control lever, **KEEPING HANDS AWAY FROM ELEVATING HANDWHEEL**. If the handwheel spins, immediately notify unit maintenance.

Make sure personnel are clear of cannon recoil path. Loss of nitrogen pressure can allow cannon to fall out of battery.

To prevent injury from air pressure, never disconnect hose assemblies before closing prime mover cutout cock.

Handbrakes must be set in garrison as well as during field emplacement.

When installing spade key in the firing position, drive in firmly using a sledge hammer.

Keep feet from under firing baseplate.

Prior to loading howitzer for actual firing, all personnel must be familiar with prescribed actions in the event of a misfire (p 2-115) and ensure prefiring checks (p 2-76) are performed.

## **WARNING SUMMARY**

### **(cont)**

When firing howitzer at night, personnel should avoid direct viewing of muzzle flash from their weapon or adjacent weapons when firing top zones. Temporary flash blindness can be caused by intense muzzle flash, resulting in potential reduction of crew efficiency.

Stickers may occur when firing charge 2. When stickers occur, the projectile lodges in tube and hot gasses under pressure are trapped in the chamber. Removal of the primer is dangerous as it will be shooting rearward when released. Do not stand behind the breech when removing the primer; the expelled primer may cause injury to personnel standing in its path or ricochet. Do not grasp the firing mechanism block assembly so that your hand is in the way of the expelling primer.

In case of a MISFIRE/HANGFIRE, follow the Misfire procedures for tube temperature. When breech is opened, to remove the powder charge and primer, if smoke/sparks are coming from the chamber area, do not attempt to remove the charge or close the breech, immediately evacuate the area and notify EOD.

Before attempting to shift direction of howitzer by using speed shift cylinder assembly, be sure weapon is free of all ammunition and WHEELS lever is in the OFF position.

Handbrakes are to remain locked if the howitzer is on any degree of an incline and are not to be released until the lunette is on the prime mover pintle. Release of handbrakes while howitzer is on incline may allow the howitzer to roll causing injury to personnel.

Personnel should stay clear of area between prime mover and howitzer.

The wheel and tire are heavy. To remove or install, use a hoist if available. If hoist is not available, two crewmen are required to remove or install wheel and tire. Use care to avoid injury.

For safety precautions, prior to beginning any painting operations, refer to TM 43-0139. Improper application or removal of CARC paint can be extremely hazardous to your health.

Don't force primer into primer chamber. If primer will not go in, chamber is probably dirty. Forcing primer into primer chamber may cause primer to prematurely ignite powder charge which will cause the howitzer to recoil prematurely and cause serious injury to crew.

Lanyards may not be shortened or injury to personnel may result.

If nitrogen pressure is below 800 psi, the recoil mechanism could slide out of battery and cause severe personal injury. Make sure personnel are clear of recoil path.

## **FIRST AID**

For further information on first aid refer to FM 21-11.

## LIST OF EFFECTIVE PAGES

Dates of issue for original and changed pages are:

Original..... 0..... 14 January 1991  
Change ..... 1..... 15 November 1995  
Change ..... 2..... 28 February 1999  
Change ..... 3..... 6 October 2000  
Change ..... 4..... 15 March 2002  
Change ..... 5..... 30 September 2003  
Change ..... 6..... 15 December 2003

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CHANGE

NO. 6

HEADQUARTERS  
DEPARTMENT OF THE ARMY  
U.S. MARINE CORPS  
WASHINGTON, D.C., 15 December 2003

OPERATOR'S MANUAL  
FOR  
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155-MM, M198  
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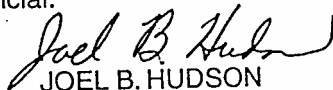
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D-1 through D-4  
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**PETER J. SCHOOMAKER**  
*General, United States Army*  
*Chief of Staff*

Official:

  
JOEL B. HUDSON

*Administrative Assistant to the  
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C5

CHANGE

NO. 5

HEADQUARTERS  
DEPARTMENT OF THE ARMY  
U.S. MARINE CORPS  
WASHINGTON, D.C., 30 September 2003

OPERATOR'S MANUAL  
FOR  
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i and ii  
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A and B  
i and ii  
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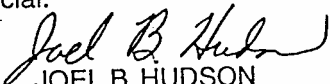
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Chief of Staff

R. P. SHOCKEY  
Director, Program Support  
Marine Corps Systems Command

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U.S. MARINE CORPS  
WASHINGTON, D.C., 15 March 2002

OPERATOR'S MANUAL  
FOR  
HOWITZER, MEDIUM, TOWED:  
155-MM, M198  
(1025-01-026-6648) (EIC:3EL)

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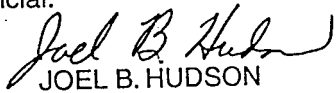
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R. P. SHOCKEY  
Director, Program Support  
Marine Corps Systems Command

Official:



JOEL B. HUDSON

*Administrative Assistant to the  
Secretary of the Army*

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WASHINGTON, D.C., 6 October 2000

OPERATOR'S MANUAL  
FOR  
HOWITZER, MEDIUM, TOWED:  
155-MM, M198  
(1025-01-026-6648) (EIC:3EL)

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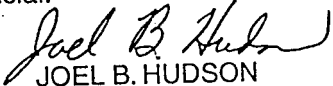
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OPERATOR'S MANUAL  
FOR  
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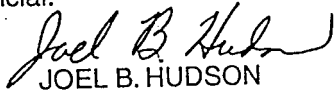
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OPERATOR'S MANUAL  
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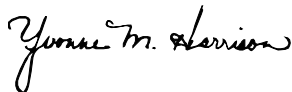
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**OPERATOR'S MANUAL  
FOR  
HOWITZER, MEDIUM, TOWED: 155-MM, M198 (EIC: 3EL)  
(1025-01-026-6648)**

**REPORTING ERRORS AND RECOMMENDING IMPROVEMENTS**

You can help improve this publication. If you find any mistakes or if you know of a way to improve the procedures, please let us know. Submit your DA Form 2028 (Recommended Changes to Publications and Blank Forms), through the Internet, on the Army Electronic Product Support (AEPS) website. The Internet address is <http://aeps.ria.army.mil>. If you need a password, scroll down and click on "ACCESS REQUEST FORM". The DA Form 2028 is located in the ONLINE FORMS PROCESSING section of the AEPS. Fill out the form and click on SUBMIT. Using the form on the AEPS will enable us to respond quicker to your comments and better manage the DA Form 2028 program. You may also mail, fax, or E-mail your letter or DA Form 2028 direct to: AMSTA-LC-CI Tech Pubs, TACOM-RI, 1 Rock Island Arsenal, Rock Island, IL 61299-7630. The E-mail address is TACOM-TECH-PUBS@ria.army.mil. The fax number is DSN 793-0726 or Commercial (309) 782-0726. Marine Corps users submit NAVMC 10772 to: Commander, Marine Corps Logistics Bases (Code 850), Albany, GA 31704-5000. Marine Corps units should also respond to MARCORSYSCOM Attn: (CBG) with a copy of NAVMC 10722 or via Naval message.

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This manual supersedes TM 9-1025-211-10, dated 1 October 1979, including all changes in their entirety.

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## HOW TO USE THIS MANUAL

### GENERAL

- a. Whenever the masculine gender (i.e., crewman) is used in this manual, it includes both masculine and feminine genders.
- b. The text is keyed to the illustrations by numbered callouts. When an item is called out in a procedure, a number in parentheses in the text corresponds with a circled number on the illustration.
- c. Some illustrations of the howitzer may have equilibrator ballistic shields and the recoil mechanism ballistic shield removed for clarity.
- d. The preventive maintenance checks and services table (p 2-10) includes equipment serviceability criteria. The information normally found in the For readiness reporting ... column is in the Procedures column.
- e. Procedures for unmodified howitzers, where applicable, are provided before procedures for modified howitzers.

### INDEXES

- a. **Front Cover Index.** A page reference index of often used portions of the manual.
- b. **Table of Contents.** Lists all chapters and their sections, appendixes, and alphabetical index in order and gives page references to where they begin.
- c. **Chapter Indexes.** All chapters contain indexes with page references.
- d. **Section Indexes.** Lists each paragraph contained in the section and a page reference to the first page of the paragraph.
- e. **Symptom Index.** This quick guide to troubleshooting lists common malfunctions in alphabetical order with a page reference to the test or inspection and corrective action.
- f. **Alphabetical Index.** At the back of the book tells you where in the manual to find a particular subject.

### NOMENCLATURE CROSS-REFERENCE LIST

Throughout this manual, most items are referred to by their official nomenclature. On page 1-2, the items referred to by their common names are listed alphabetically and are followed by their official nomenclature.



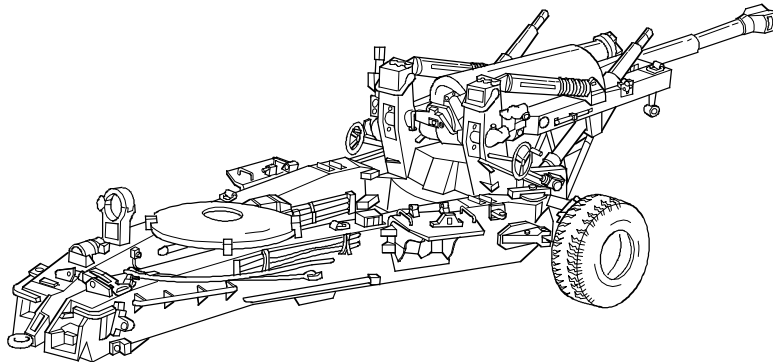
# CHAPTER 1 INTRODUCTION

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**FULL EXTERNAL VIEW OF M198, 155MM,  
MEDIUM, TOWED HOWITZER**

### 1-1. SCOPE

This manual tells the howitzer crew how to operate and maintain the howitzer in the field. It also includes training procedures.

- a. **Type of Manual.** Operator's Manual.
- b. **Model Number and Equipment Name.** Howitzer, Medium, Towed: 155-mm, M198.
- c. **Purpose of Equipment.** To provide artillery fire in support of ground-gaining troops.
- d. **Special Inclusions in Manual.** This manual includes section drill procedures on page 1-18.

### 1-2. MAINTENANCE FORMS AND RECORDS

Department of the Army forms and procedures used for equipment maintenance will be those prescribed by DA PAM 738-750, The Army Maintenance Management System (TAMMS). Marine Corps personnel will use TM 4700-15/1, Equipment Record Procedures.

1-3. HAND RECEIPT (HR) MANUALS

This manual has a companion document with a TM number followed by "-HR" (which stands for Hand Receipt). The TM 9-1025-211-10-HR consists of pre-printed hand receipts (DA Form 2062) that list end item related equipment (i.e., COEI, BII, and AAL) you must account for. As an aid to property accountability, additional -HR manuals may be requisitioned from the following source in accordance with procedures in Chapter 3, AR 25-30:

Commander  
US Army Publications Distribution  
Center-St. Louis  
ATTN: SFIS-APC-S-OC  
1655 Woodson Road  
St. Louis, MO 63114-6181

1-4. REPORTING EQUIPMENT IMPROVEMENT RECOMMENDATIONS (EIR's)

If your M198 howitzer needs improvement, let us know. Send us an EIR. You, the user, are the only one who can tell us what you don't like about your equipment. Let us know why you don't like the design or performance. Put it on an SF 368 (Product Quality Deficiency Report). Mail it to us at: ATTN: AMSTA-AR-QAW-C, TACOM-ARDEC, 1 Rock Island Arsenal, Rock Island, IL 61299-7300 (FAX: Commercial (309) 782-6653, DSN 793-6653) (E-mail: [gawqdrs@ria.army.mil](mailto:gawqdrs@ria.army.mil)). Marine Corps users submit a Product Quality Deficiency Report (SF 368) in accordance with MCO 4855.10, Product Quality Deficiency Report, and TM 4700-15/1, Equipment Record Procedures, to: Commanding General, ATTN: Code (808-1), Marine Corps Logistics Base, 814 Radford Blvd, Albany, GA 31704-1128. We'll send you a reply.

1-5. CORROSION PREVENTION AND CONTROL

- a. Corrosion prevention and control (CPC) of Army materiel is a continuing concern. It is important that any corrosion problems with this item be reported so that the problem can be corrected and improvements can be made to prevent the problem in future items.
- b. While corrosion is typically associated with rusting of metals, it can also include deterioration of other materials such as rubber and plastic. Unusual cracking, softening, swelling, or breaking of these materials may be a corrosion problem. If a corrosion problem is identified, it can be reported using SF 368, Product Quality Deficiency Report. Use of key words such as "corrosion," "rust," "deterioration," or "cracking" will assure that the information is identified as a CPC problem. Submit the form to: ATTN: AMSTA-AR-QAW-C, TACOM-ARDEC, 1 Rock Island Arsenal, Rock Island, IL 61299-7300 (FAX: Commercial (309) 782-6653, DSN 793-6653), (E-mail: [gawqdrs@ria.army.mil](mailto:gawqdrs@ria.army.mil)). Marine Corps users submit Product Quality Deficiency Report to: Commanding General, ATTN: Code (808-1), Marine Corps Logistics Base, 814 Radford Blvd, Albany, GA 31704-1128.

1-6. NOMENCLATURE CROSS-REFERENCE LIST

This listing includes the nomenclature cross-reference list, list of abbreviations/acronyms, and explanation of terms (glossary) used in this manual.

COMMON NAME	OFFICIAL NOMENCLATURE
Dipstick.....	Liquid gage rod-cap
Emergency hose assembly .....	Hose assembly
Handbrakes .....	Left and right manual brake assemblies
Pantel .....	M137/M137A3 panoramic telescope
Service hose assembly .....	Hose assembly
Spade key .....	Machine key
SPEEDSHIFT lever .....	Selector valve handle
WHEELS lever .....	Selector valve handle

## 1-7. LIST OF ABBREVIATIONS/ACRONYMS

The following alphabetical list gives definitions for the abbreviations and acronyms used in this manual.

ADAM	Area denial artillery munition
BCS	Battery computer system
BE	Base ejection
BFS	Brake fluid, automotive, silicone
CHG	Charge
CLGP	Cannon-launched, guided projectile
CLP	Cleaner, lubricant and preservative
comp	Composition
CP	Concrete-piercing
CTA	Common table of allowances
DF	Deflection
ERLS	Elimination of Radioactive Light Sources
EFC	Equivalent full charge
EOD	Explosive ordnance disposal
ET	Electronic time
FZ	Fuze
GB	Green bag
GMD	Grease, molybdenum disulfide
H	Mustard gas
HC	White chemical smoke mixture
HD	Distilled mustard gas
HE	High-explosive
HEAT	High-explosive, anti-tank
HERA	High-explosive, rocket-assisted
HyPAK	Hydraulic power assist kit
ICM	Improved conventional munitions
JTA	Joint table of allowance
LED	Light Emitting Diode
MT	Mechanical time
MTOE	Modified tables of organization and equipment
MTSQ	Mechanical time and superquick
N-m	Newton meters
OHT	Hydraulic fluid, petroleum base
P	Requires removal of supplementary if present
PD	Point detonating
PL-S	Lubricating oil, general purpose, special preservative
prop	Propelling
prox	Proximity
QE	Quadrant elevation
RAAMS	Remote anti-armor mine system
RB	Red bag
RMK	Remarks
RPO	Radiological protection officer
SOP	Standard operating procedure
SQ	Superquick
suppl	Supplementary
TDA	Tables of distribution and allowances
TI	Time
TOE	Tables of organization and equipment
TWD	Thermal warning device
VT	Variable time
VX	Persistent toxic casualty nerve gas
WB	White bag
WP	White phosphorous
wpn	Weapon
WTR	Grease, aircraft, general purpose, wide temperature range

1-8. GLOSSARY

The following is an alphabetical listing of terms with definitions used in this manual. These terms need explanation and are not defined within the text.

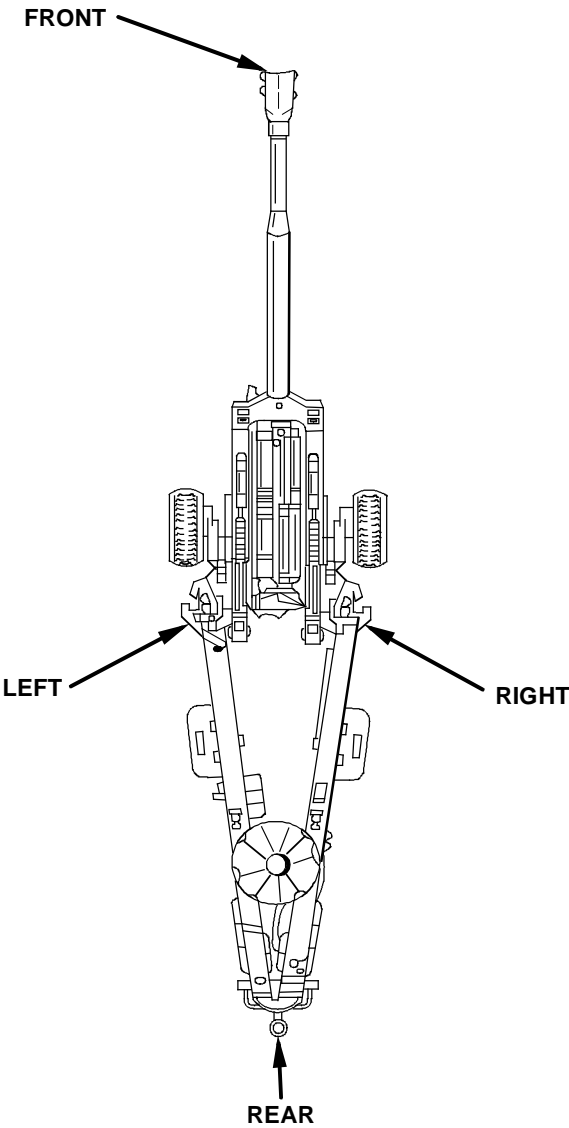
a. **Front of Weapon.** The muzzle end of the howitzer.

b. **Howitzer Section.** Those personnel specified by the current table of organization and equipment that make up a howitzer section.

c. **Left Side of Weapon.** At a person's left-hand side when standing at the breech end of the weapon, facing toward the cannon muzzle.

d. **Rear of Weapon.** The breech end of the howitzer.

e. **Right Side of Weapon.** At a person's right-hand side when standing at the breech end of the weapon, facing toward the cannon muzzle.



Section II. EQUIPMENT DESCRIPTION

Section Index

Paragraph		Page
1-9.	Equipment Characteristics, Capabilities, and Features .....	1-5
1-10.	Location and Description of Major Components .....	1-5
1-11.	Modification and System Improvement Package .....	1-10
1-11.1.	Elimination of Radioactive Light Sources (ERLS) System Improvement.....	1-10.1
1-12.	Data Plates .....	1-11
1-13.	Equipment Data .....	1-15

## 1-9. EQUIPMENT CHARACTERISTICS, CAPABILITIES, AND FEATURES

a. The M198 howitzer provides general support field artillery firing for the light divisions by providing both nuclear and nonnuclear firing.

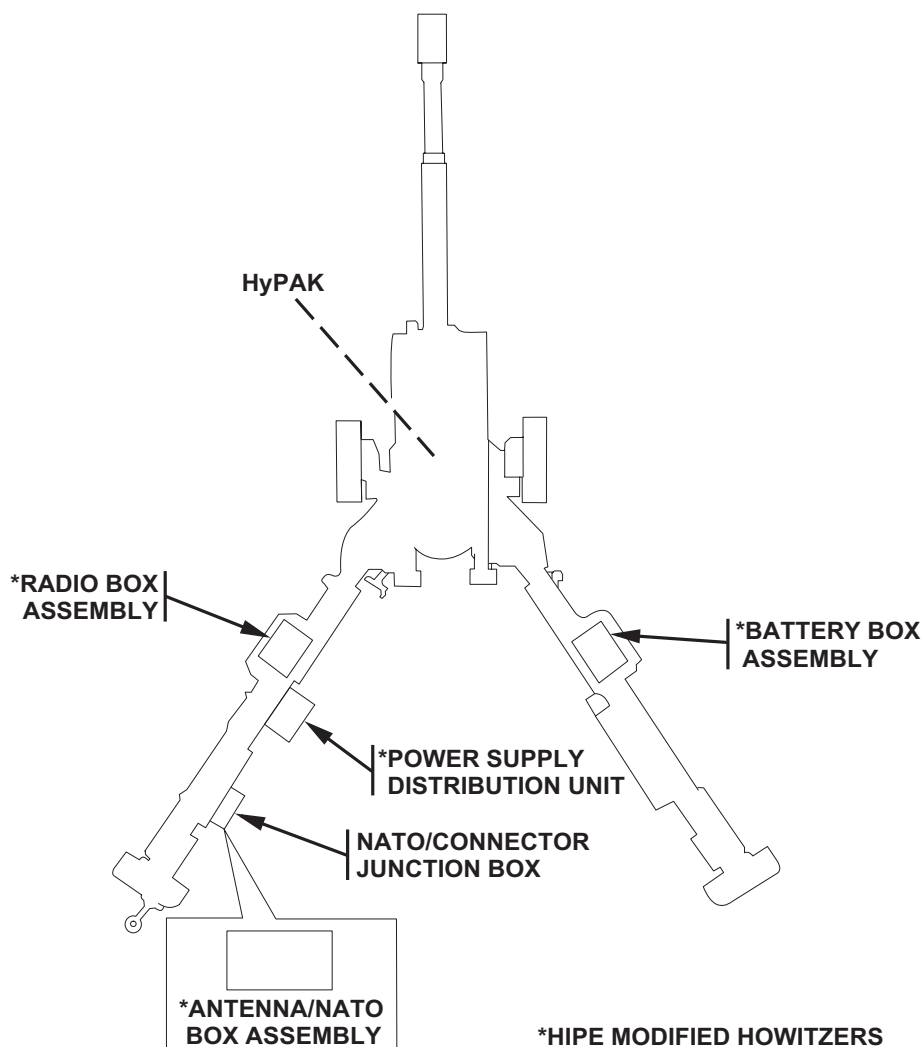
### NOTE

A modified travel lock (to be fabricated by direct support maintenance) will be installed on all howitzers being airlifted by the CH47/CH47D helicopter. The modified travel lock will prevent damage to the helicopter and is to be used for airlift only, and not for towing the howitzer.

b. The M198 is an extended range, split-trail weapon that can be towed by a vehicle or airlifted by a CH47/CH47D or CH53E helicopter. The carriage has retractable wheels and a top carriage which can be rotated 3200 mils to decrease overall length for shipment or storage.

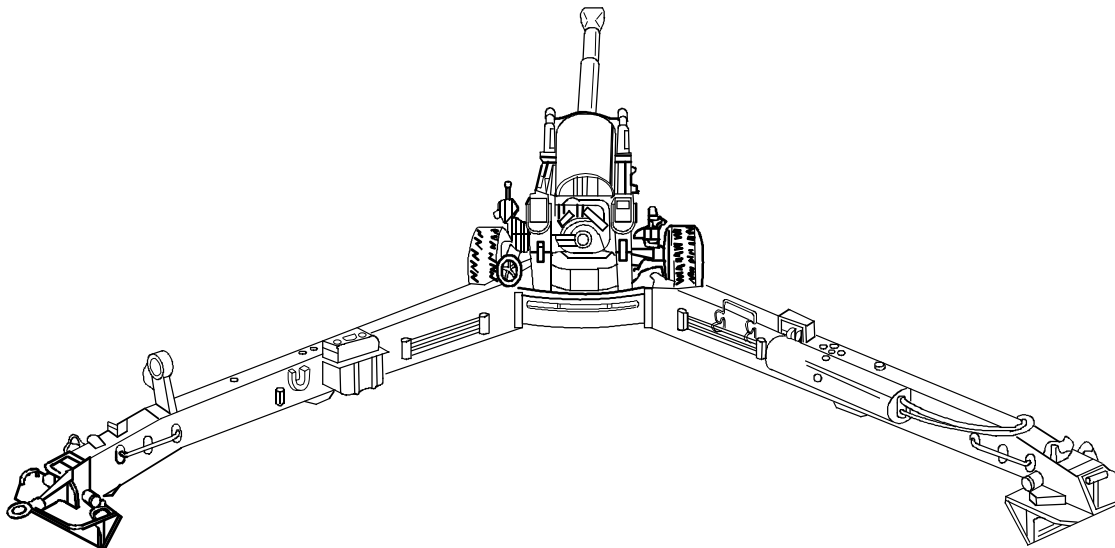
c. The fire control equipment may be used by one or two crewmen for direct or indirect fire. The gunner on the left side controls left and right (traversing) settings and the assistant gunner on the right side controls up and down (elevation) settings. The equipment can also be operated by a gunner on the left side controlling both traversing and elevation settings. All vials, reticles, and counters on the fire control and accessory equipment are radioactively illuminated.

d. The medium weight M198 howitzer has a low profile, may be emplaced rapidly, and has a 6400-mil speed shift assembly.

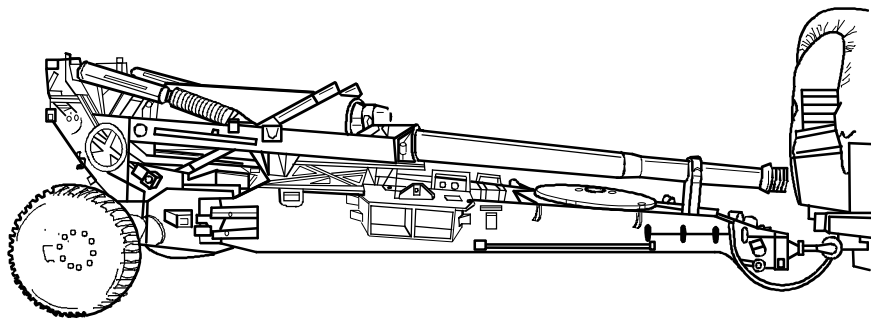


## 1-10. LOCATION AND DESCRIPTION OF MAJOR COMPONENTS

- a. **Howitzer Positions.** The firing, stowed, and towed positions for the M198 howitzer are as shown.



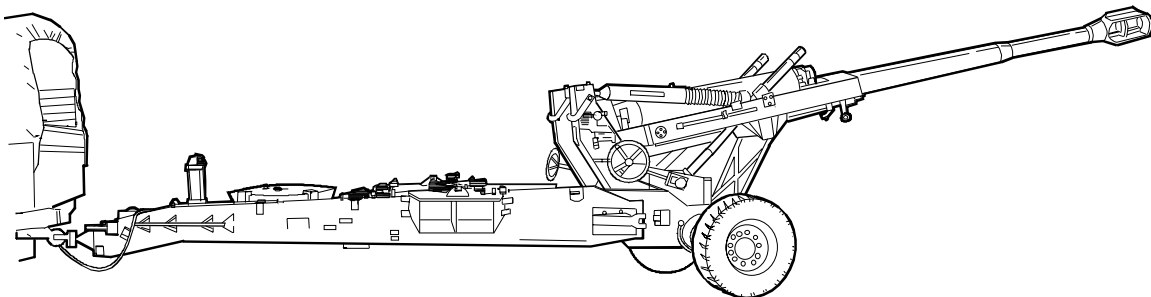
**FIRING POSITION**



**STOWED POSITION**

### NOTE

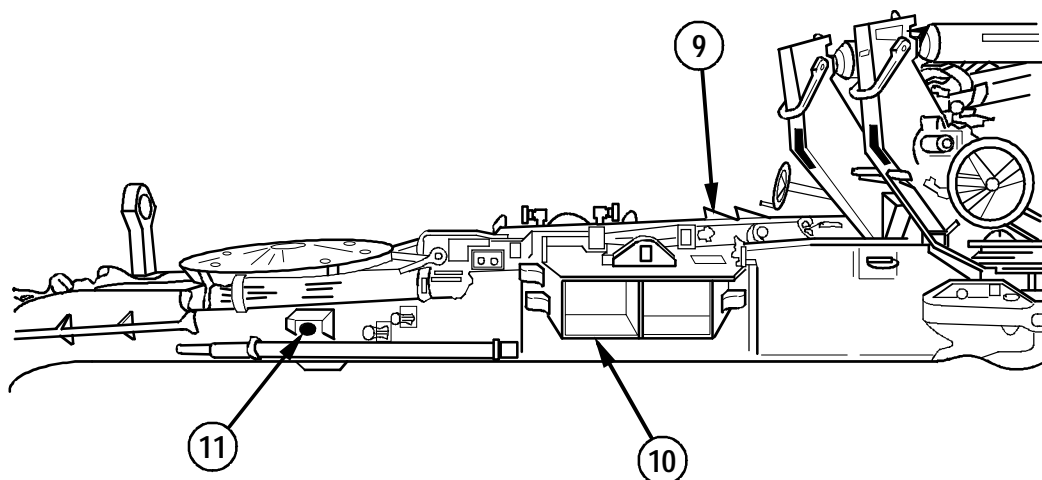
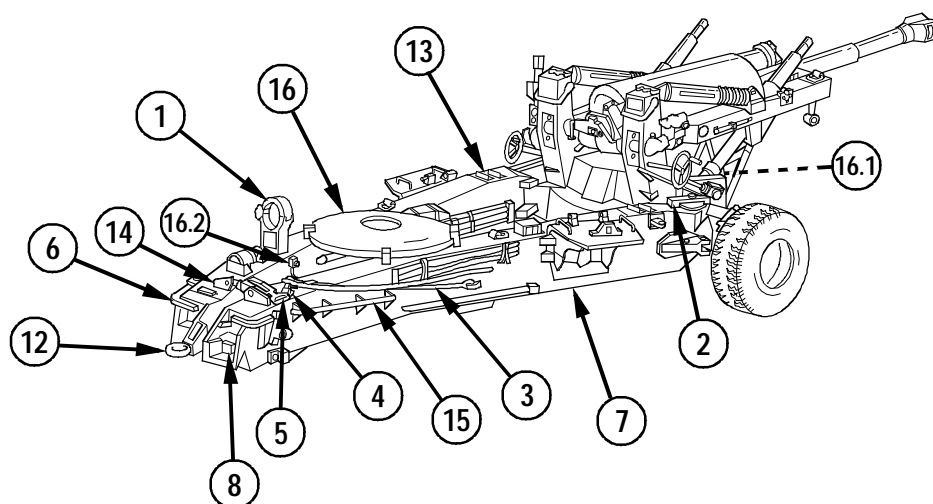
The muzzle brake is removed to tow the weapon in the stowed position.



**TOWED POSITION**

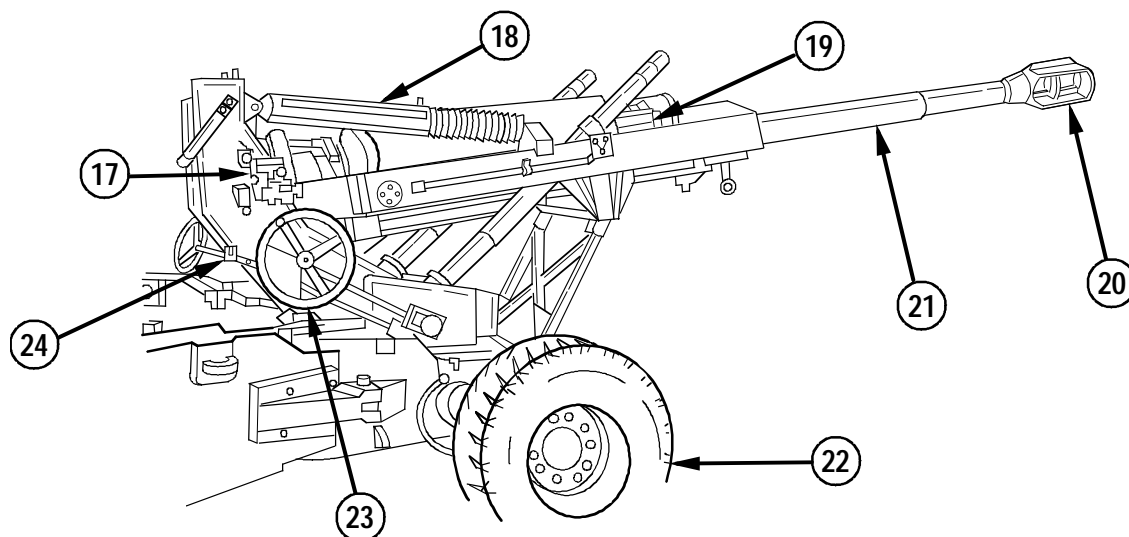
**b. Howitzer Components.** Familiarize yourself with the components of the M198 howitzer. Start with item number 1; then go to numbers 2, 3, 4, 5; and continue until you reach number 37. Go to page 2-1 for a detailed description of the controls and indicators.

Item	Component
1	Gun tube travel lock
2	Brake precheck
3	Service and emergency hose assemblies
4	Cam lock
5	Trail lock handle assembly
6	Lifting handle
7	Right trail
8	Trail retaining pin
9	BCS gun assembly (GA) bracket
10	Spade

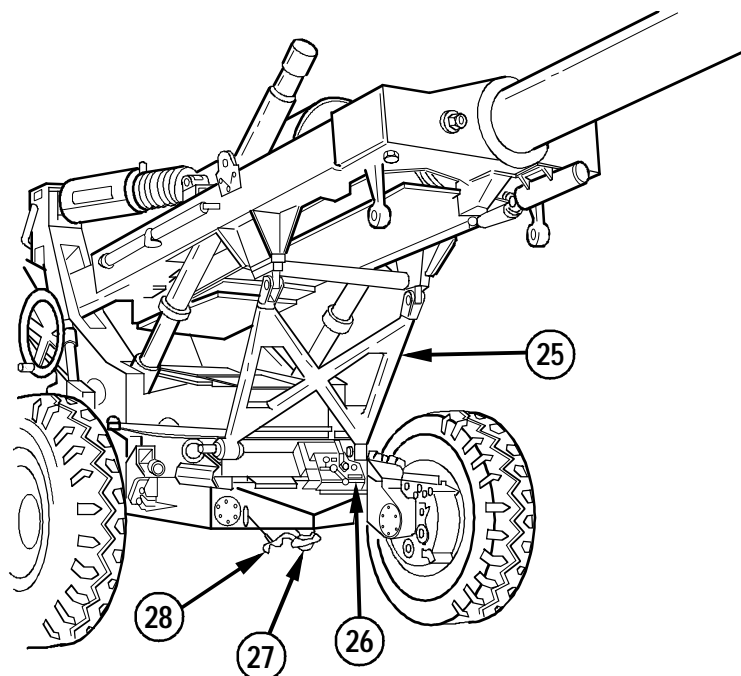


11	Drain cock
12	Lunette
13	Left trail
14	Trail lock
15	Lifting handle
16	Firing baseplate
16.1	HyPAK
16.2	HyPAK NATO Connector

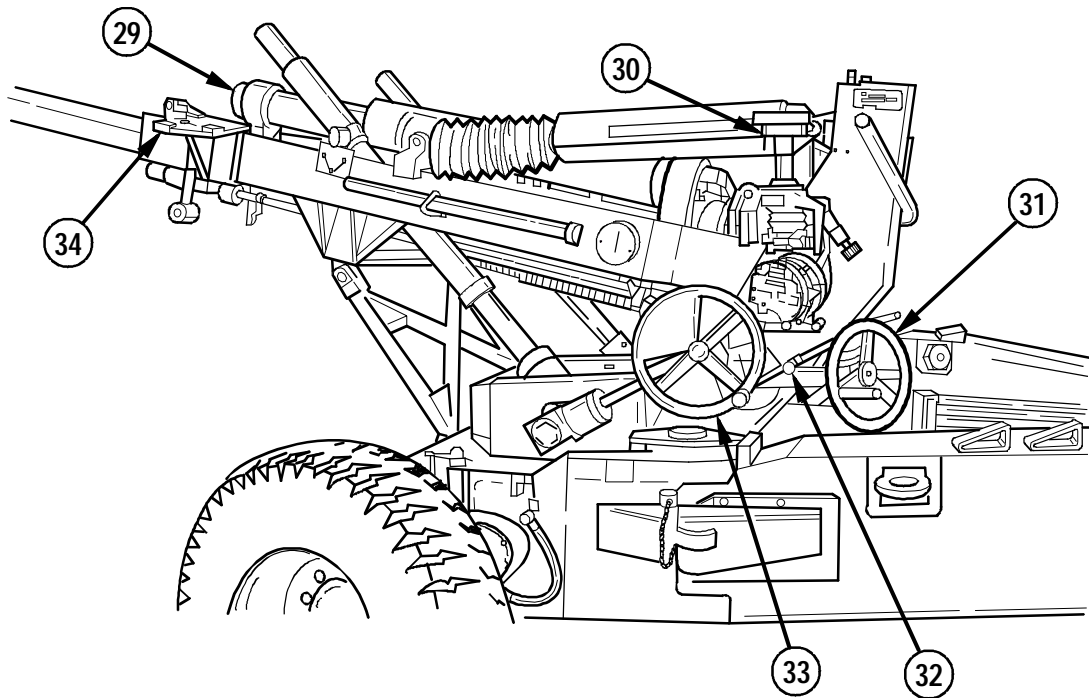
# 1-10. LOCATION AND DESCRIPTION OF MAJOR COMPONENTS (cont)



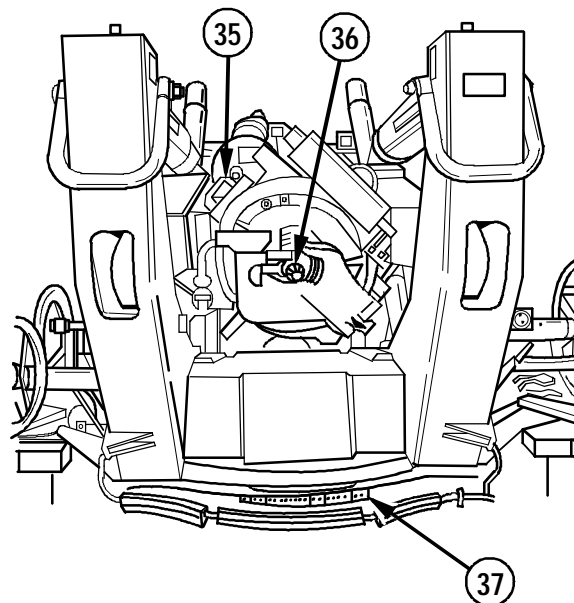
- 17 M172 telescope and quadrant mount
- 18 Equilibrator cylinder (both sides)
- 19 Oil reserve indicator
- 20 Muzzle brake
- 21 Cannon tube
- 22 Wheel (both sides)
- 23 Elevating handwheel (both sides)
- 24 Manual control lever (both sides)



- 25 Travel lock assembly
- 26 Manifold assembly
- 27 Ball
- 28 Lock release lever



- 29 Recoil mechanism
- 30 M171 telescope and quadrant mount
- 31 Traversing handwheel
- 32 Manual control lever (both sides)
- 33 Elevating handwheel (both sides)
- 34 M90 chronograph antenna mounting bracket



- 35 Thermal warning device
- 36 Firing mechanism
- 37 Coarse azimuth scale

## 1-11. MODIFICATION AND SYSTEM IMPROVEMENT PACKAGE

### NOTE

This manual covers both modified and unmodified M198 howitzers. Illustrations and procedures are for the modified howitzer, unless procedures for both modified and unmodified components or assemblies are required for clarity. Procedures that are for the modified howitzer and do not pertain to the unmodified howitzer can be ignored.

All US Army and US Marine Corps M198 howitzers are scheduled to be equipped with a system improvement package (MWO 9-1025-211-50-3). This MWO will affect the M39 carriage assembly only. The following is a brief description of the MWO and areas affected.

#### a. Top Carriage Assembly.

- (1) **Equilibrators:** Warnings on ballistic shields and a warning for repairmen that nitrogen pressure must be bled to zero PSI before performing maintenance.
- (2) **Equilibrator adjustment screw:** Improved adjustment screw components, makes adjustment of equilibrators easier and adds a cover to keep debris from the screw and slide area.
- (3) **Adjustment scales and pointers:** Moved to inside of top carriage uprights, eliminate entanglement of camouflage nets.
- (4) **Top carriage:** Self contained automatic traverse lock, easier to engage and eliminates damage to hydraulic brake line.
- (5) Deleted.
- (6) **Universal joint bellows:** Help contain lubricants in their place.
- (7) **Cradle assembly:** Gussets welded to travel lock area to strengthen the travel lock struts.

#### b. Bottom Carriage Assembly.

- (1) **Suspension:** New axle bushings to help eliminate excessive friction while raising the howitzer to the towed position.
- (2) **Firing base plate:** New lock mechanism easier to lock base plate in position.
- (3) **Hydraulic brake system:** Brake precheck system, more efficient way to check brake condition prior to towing howitzers.
- (4) **Snorkel breather system:** Connects power booster to trail to eliminate water intake into the power booster during fording operations.
- (5) **New drain cock:** Provides crew easier access to bleed pressure in the emergency air tank.
- (6) **Covers and standoffs for brake lines and brake hose assembly hookup diagram:** To help keep howitzer brakes system operable.
- (7) **Lifting handle assemblies:** Located on either trail to provide extended lifting capacity to the howitzer.

**(8) Retention assemblies:** Positive hold-downs for spade keys, airlift clevis assemblies, and receptacles for spade key and trail lock pins.

**(9) Cam lock assembly:** Provides a positive lock for the trail lock mechanism.

**(10) Spade bracket and airlift eye bolt weldments:** Provide protection to help eliminate damage to these areas.

#### NOTE

Other modifications improving the M198 Howitzer are outlined below. The HyPAK modification procedures will be provided for both modified and unmodified configurations.

**c. Breech Mechanism Assembly:** A change in the release lever of the breechblock assembly adds a "click" to the latch so the user can be sure that the breech is closed. This feature improves safety during nighttime operations. Machining the lower lug of the breech ring assembly allows high angle firing (over 1200 mils).

**d. Equilibrator Support Cover Modification:** This is to correct and prevent future cracking in/around the top carriage towers, especially in the welded area around the bosses and top plate.

**e. HyPAK (Hydraulic Power Assist Kit):** This will be installed on some howitzers and is an electrically powered hydraulic system designed to be the primary method of raising and lowering the M198 wheels during howitzer emplacement, displacement, and carriage speed shifting.

### 1-11.1. ELIMINATION OF RADIOACTIVE LIGHT SOURCES (ERLS) SYSTEM IMPROVEMENT

#### NOTE

This manual covers both radioactive tritium ( $H_3$ ) illuminated fire control equipment and ERLS Light Emitting Diode (LED) illuminated fire control and accessory equipment for the M198 howitzer. Both configurations are addressed when procedures are different.

All U.S. Army and U.S. Marine Corps M198 howitzers are scheduled to be equipped with ERLS battery powered LED illuminated fire control and accessory equipment. This change will affect the fire control and fire control accessory equipment only. The following is a brief description of the equipment changes and areas.

**a. M198 Howitzer Fire Control Equipment:** All vials, reticles, counters, and optics on the fire control and accessory equipment are either radioactively illuminated with tritium ( $H_3$ ) gas sealed in Pyrex glass tubes, or by ERLS battery powered LED light sources. The ERLS battery powered LED illuminated fire control and accessory equipment devices are listed below:

**(1) M137A3 Pantel:** Reticle and counters on the M137A3 panoramic telescope are illuminated by ERLS battery powered LED light sources.

**(2) M139A1 Alinement Device:** Optics illuminated by ERLS battery powered LED light sources.

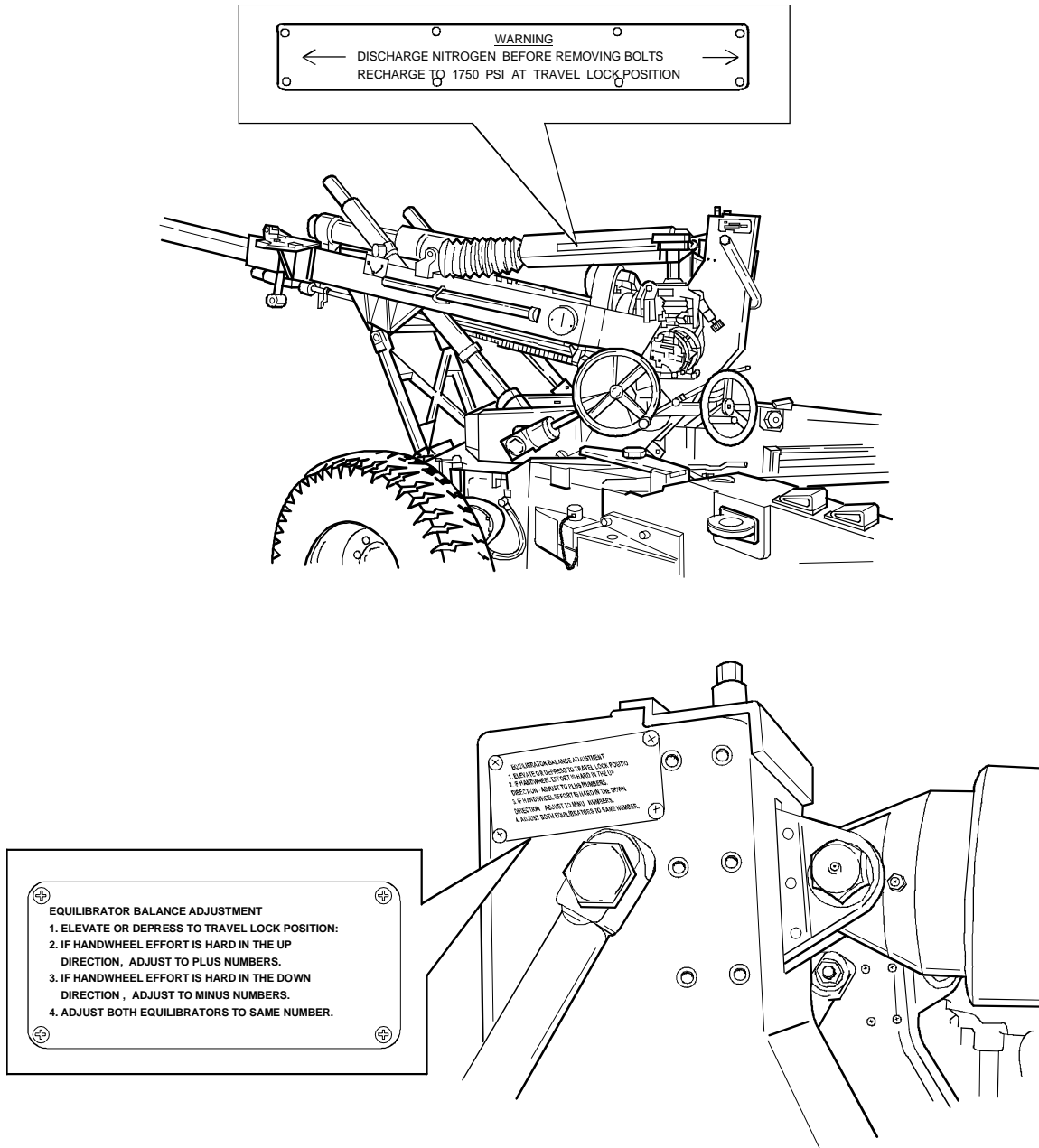
**(3) M1A2 Collimator:** Optics illuminated by ERLS battery powered LED light sources.

**(4) M14A1 Aiming Post Light:** Optics illuminated by ERLS battery powered LED light sources.

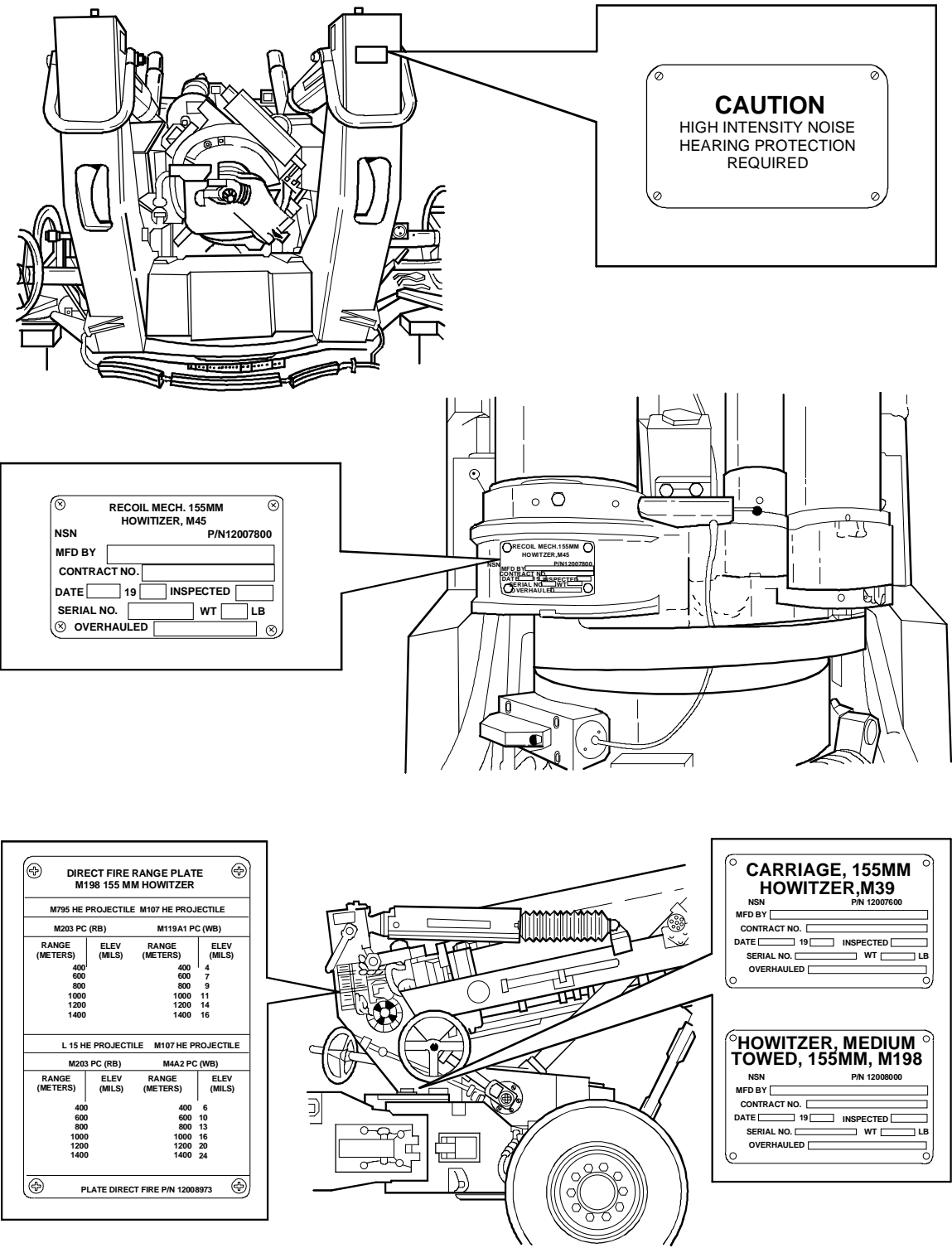


## 1-12. DATA PLATES

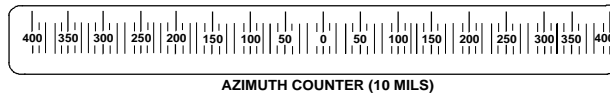
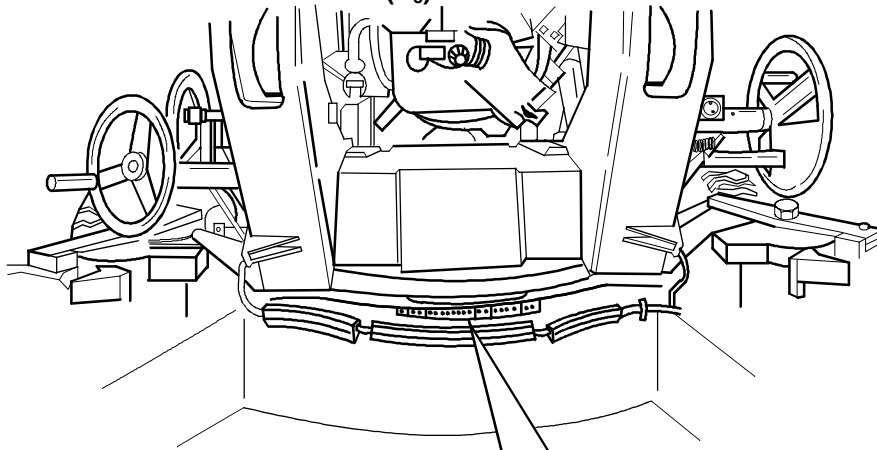
For location of data plates, refer to the following illustrations.



1-12. DATA PLATES (cont)



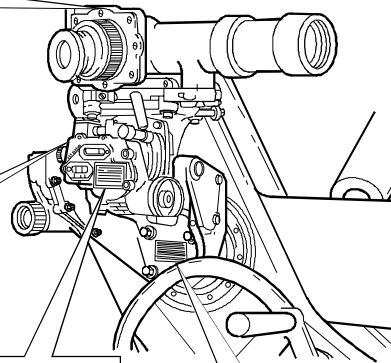
# Radioactive Tritium (H<sub>3</sub>) Gas Illuminated Fire Control Instruments



IF FOUND RETURN TO  
A MILITARY BASE  
DISPOSAL PER AR755-15

TELESCOPE, ELBOW  
M138  
SERIAL NO   
19200 11741626  
  
US

RADIOACTIVE MATERIAL  
CAUTION  
RETICLE ISOTOPE H<sub>3</sub>  
CURIES  DATE



RADIOACTIVE MATERIAL  
CAUTION  
COUNTERS ISOTOPE H<sub>3</sub>  
CURIES 150 DATE

RADIOACTIVE MATERIAL  
CAUTION  
VIALS ISOTOPE H<sub>3</sub>  
CURIES 250 DATE

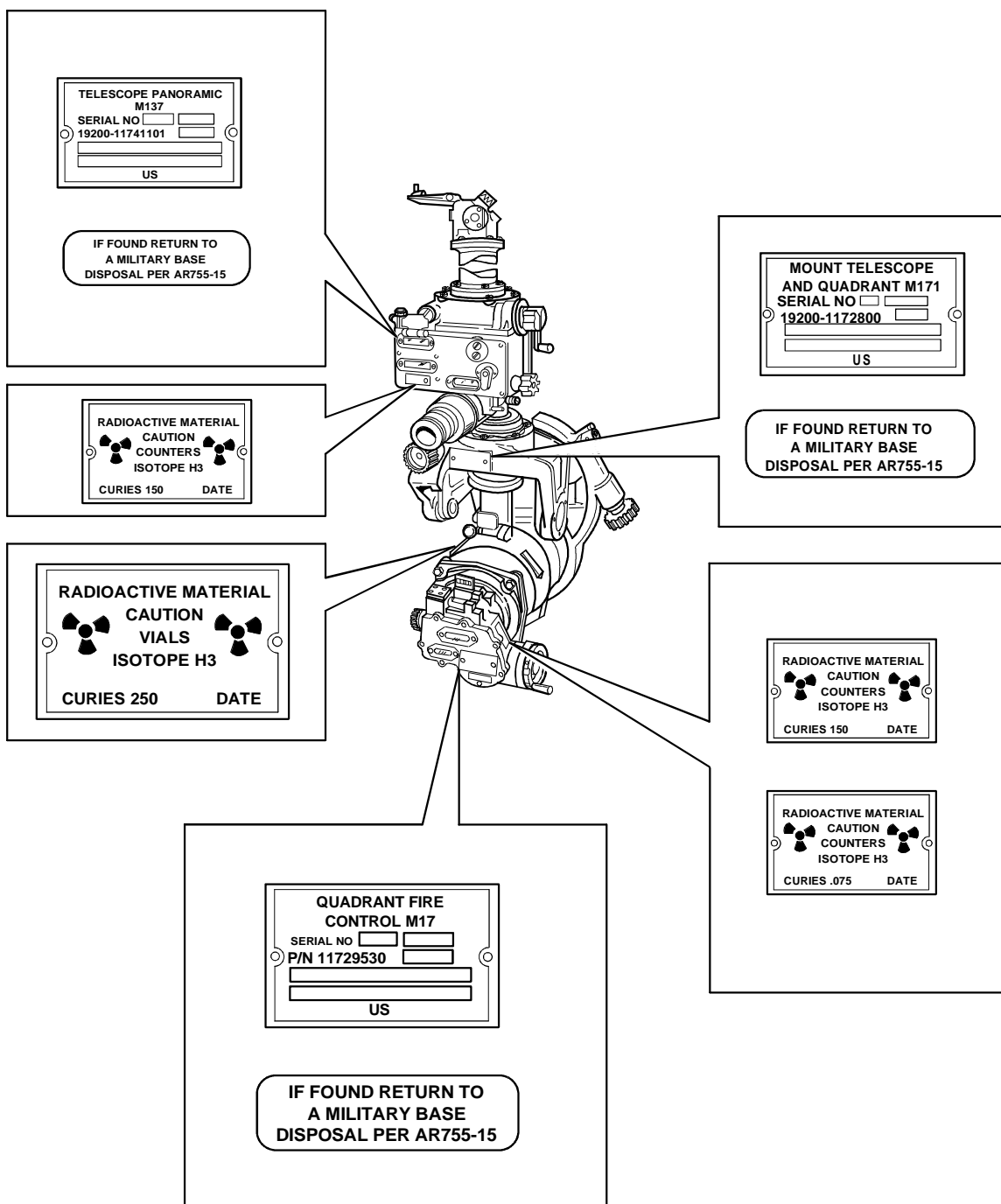
QUADRANT FIRE  
CONTROL M-18  
SERIAL NO   
19200-11729525  
  
US

IF FOUND RETURN TO  
A MILITARY BASE  
DISPOSAL PER AR755-15

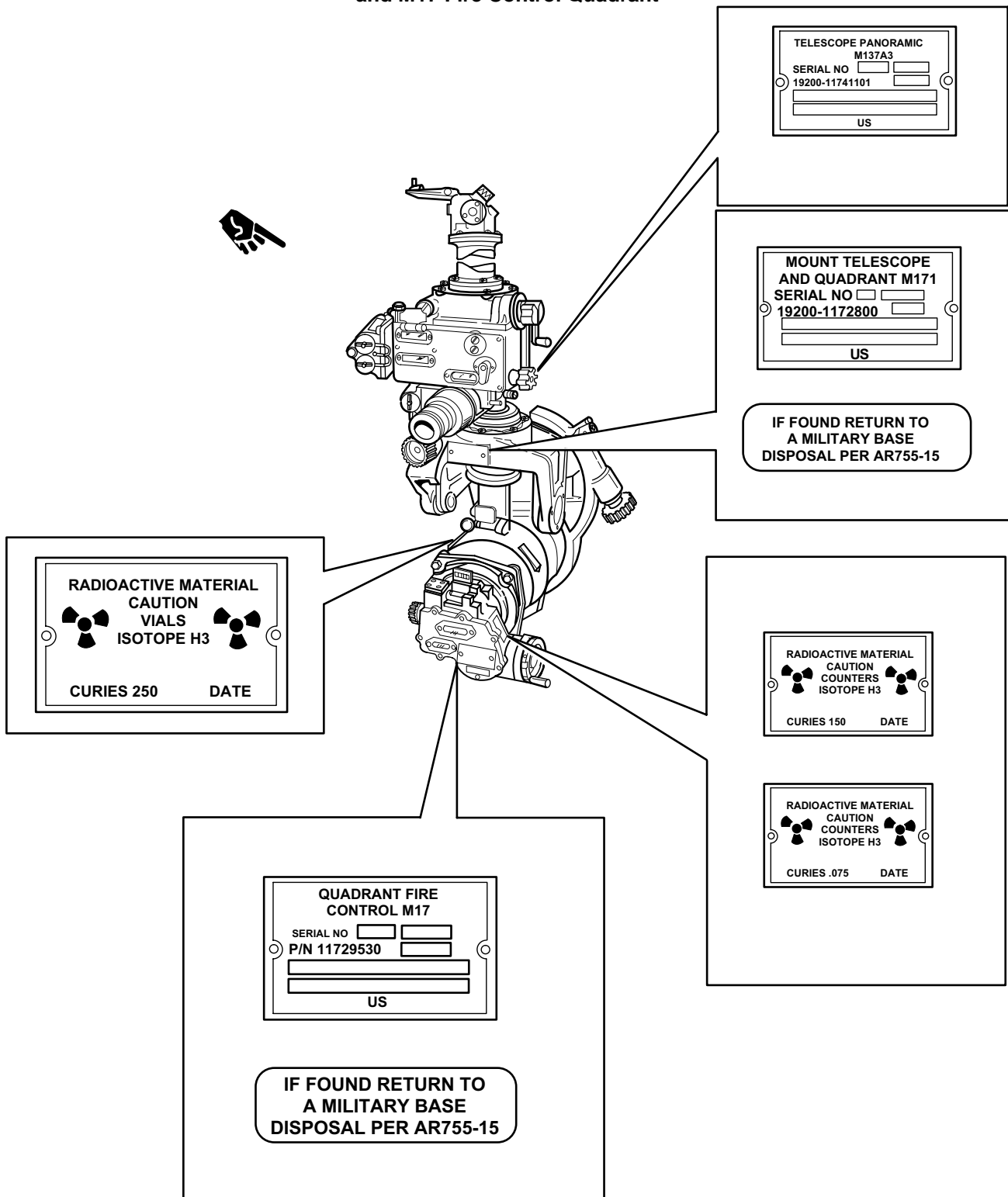
MOUNT, TELESCOPE AND  
QUADRANT : M172  
SERIAL NO   
19200 - 10554823  
  
US

## 1-12. DATA PLATES (cont)

### Radioactive Tritium (H<sub>3</sub>) Gas Illuminated Fire Control Instruments



**ERLS Battery Powered LED Illuminated M137A3 Panoramic Telescope with  
Radioactive Tritium (H<sub>3</sub>) Gas Illuminated M171 Telescope and Quadrant Mount  
and M17 Fire Control Quadrant**





## 1-13. EQUIPMENT DATA

### a. Howitzer Performance Data.

#### Brakes:

Parking ..... Manually operated disk  
Service ..... Air/oil power disk

Breech life ..... Original and five tubes

Breech type ..... Screw block, interrupted thread

#### Dimensions (travel conditions):

Ground clearance at ball of firing baseplate ..... 13 in. (0.33 m)

Height at muzzle brake (towed position) ..... 9 ft 6 in. (2.89 m)

#### Length:

Firing position (without spades) ..... 36 ft 2 in. (11.02 m)

Stowed position ..... 24 ft 5 in. (7.44 m)

Towed position ..... 40 ft 6 in. (12.34 m)

Tread (center-to-center) ..... 7 ft 9 in. (2.36 m)

Width (towed position) ..... 9 ft 2 in. (2.79 m)

EFC rating ..... TM 9-1000-202-14

	<u>Zone</u>	<u>EFC</u>
	8-S	1.000
	8	0.500
	7 Red	0.500
	7 White	0.150
	3-6	0.075
	1-5 Green	0.075
M231	1	0.050
M231	2	0.150
M232	3	0.100
M232	4	0.250
M232	5	1.00

#### Handwheel load:

Elevating ..... 180 in.-lb (20.37 N-m)

Traversing ..... 120 in.-lb (13.50 N-m)

#### HIPE:

Antenna box (including masts) ..... 19.6 lb (8.89 kg)

Antenna box (without masts) ..... 16.6 lb (7.53 kg)

Battery box (with shocks and batteries) ..... 139.4 lb (63.23 kg)

Battery box bracket ..... 21.0 lb (9.53)

PSDU (with shocks) ..... 38.4 lb (17.42 kg)

PSDU bracket ..... 13.6 lb (6.17 kg)

Radio box with shocks (without radio) ..... 26.4 lb (11.98 kg)

Radio box bracket ..... 9.0 lb (4.08)

HyPAK ..... 77 lb (34.96 kg)

Slave cable ..... 70 lb (31.75 kg)

#### WHEELS

Raising ..... 65 sec ± 10 sec

Lowering ..... 30 sec ± 10 sec

#### SPEED SHIFT

Lowering ..... 14 sec ± 5 sec

## 1-13. EQUIPMENT DATA (cont)

### a. Howitzer Performance Data (cont).

Length of recoil (zone 8 (M203)):

Min to 500 mils .....	65 in. $\pm$ 6 (165.10 cm $\pm$ 15.24)
501 to 800 mils .....	56 in. $\pm$ 7 (142.24 cm $\pm$ 17.78)
801 to max mils .....	50 in. $\pm$ 2 (127.0 cm $\pm$ 5.08)

Lunette load (30 in. (76.20 cm)):

Stowed position .....	3500 lb (1587.60 kg)
Towed position .....	500 lb (226.80 kg)

Maximum ranges .....30,000 m w/M203 propelling charge,  
charge 8 (w/RAP rd, M549A1)  
5000 to 9900 m w/M3  
propelling charge using charges 2 thru 5

Maximum terrain slope ..... 10-degree (177.77 mils) cant

Maximum towing speed:

Cross country .....	15 mph (8.04 km/hr)
Improved roads .....	45 mph (72.40 km/hr)
Secondary roads .....	30 mph (48.27 km/hr)

Mils of movement per turn of handwheel:

Elevating .....	10 mils
Traversing .....	10 mils

Muzzle brake ..... Double baffle

On-carriage elevating range ..... -75 to +1275 mils

Prime mover .....5-ton (4536-kg) truck

Rate of fire .....4 rounds/minute–maximum,  
2 rounds/minute–sustained or as  
determined by thermal warning device

Recoil mechanism ..... Hydropneumatic, variable, dependent

Speed shift range ..... 6400 mils

Tires (radial)

Pressure .....	110 psi (758 kPa)
Size .....	11.0 to 20.0, 16 ply
Load range .....	H

Traversing range ..... 400 mils left and 400 mils right of center

Tube life .....Based on wear factor (pullover gage reading)  
(Refer to TM 9-1000-202-14.)

Weight (with HyPAK) (without basic issue items) ..... 15,935 lb (7227.9 kg)

**b. Fire Control Equipment Performance Data.**

**M17 Fire Control Quadrant: (Radioactive tritium H<sub>3</sub> light source)**

Correction ..... ± 95 mils  
 Elevation ..... -280 to +1433 mils  
 Least increment reading (counters) ..... 1 mil  
 Radioactive material:  
     Max surface radiation ..... 0 millirad per hour  
     Tritium H<sub>3</sub> ..... 1.86 curies  
 Weight ..... 7.50 lb (3.40 kg)

**M18 Fire Control Quadrant: (Radioactive tritium H<sub>3</sub> light source)**

Correction ..... ±95 mils  
 Elevation ..... -280 to +1433 mils  
 Least increment reading (counters) ..... 1 mil  
 Radioactive material:  
     Max surface radiation ..... 0 millirad per hour  
     Tritium H<sub>3</sub> ..... 1.95 curies  
 Weight ..... 7.50 lb (3.40 kg)

**M171 Telescope and Quadrant Mount: (Radioactive tritium H<sub>3</sub> light source)**

Cross level adjustment:  
     Left ..... 178 mils  
     Right ..... 178 mils  
 Elevation ..... -270 to +1333 mils  
 Pitch level adjustment:  
     Aft ..... 178 mils  
     Fore ..... 178 mils  
 Radioactive material:  
     Max surface radiation ..... 0 millirad per hour  
     Tritium H<sub>3</sub> ..... 0.15 curies  
 Weight:  
     Adapter assembly ..... 3.25 lb (1.47 kg)  
     Mount ..... 75 lb (34.02 kg)  
     Optical instrument support ..... 2 lb (0.91 kg)

**M172 Telescope and Quadrant Mount:**

Boresighting:  
     Azimuth ..... ±18 mils  
     Elevation ..... ±15 mils  
 Cross level adjustment ..... ±34 degrees  
 Weight:  
     Adapter assembly ..... 4.75 lb (2.15 kg)  
     Mount ..... 27.50 lb (12.47 kg)

## 1-13. EQUIPMENT DATA (cont)

### b. Fire Control Equipment Performance Data (cont).

#### M137 Panoramic Telescope: (Radioactive tritium H<sub>3</sub> light source)

Field of view ..... 10 degrees  
 Movement:  
   Azimuth counter .....(increasing clockwise) 6400 mils  
   Azimuth (deflection) ..... 6400 mils  
   Correction (AZ) ..... ±95 mils  
   Elevation ..... ±300 mils  
   Least increment reading (AZ) ..... 0.25 mil  
 Power ..... 4X  
 Radioactive material:  
   Max surface radiation ..... 0 millirad per hour  
   Tritium H<sub>3</sub> ..... 5.10 curies  
 Weight ..... 19 lb (8.62 kg)

#### M137A3 Panoramic Telescope (ERLS Battery Powered LED Light Source):

Field of view ..... 10 degrees  
 Movement:  
   Azimuth counter .....(increasing clockwise) 6400 mils  
   Azimuth (deflection) ..... 6400 mils  
   Correction (AZ) ..... ±95 mils  
   Elevation ..... ±300 mils  
   Least increment reading (AZ) ..... 0.25 mil  
 Power ..... 4X  
 Batteries:  
   Quantity/Cell Size ..... 2 each/size "C"  
   Voltage ..... 3 volts (each)  
 Weight ..... TBD lb (TBD kg)

#### M138 Elbow Telescope: (Radioactive tritium H<sub>3</sub> light source)

Elevation ..... 60 mils  
 Field of view ..... 8 degrees  
 Power ..... 8X  
 Radioactive material:  
   Tritium H<sub>3</sub> ..... 4.4 curies  
   Max surface radiation ..... 0 millirad per hour  
 Weight ..... 8 lb (3.63 kg)

**c. Auxiliary Equipment Performance Data**

M139 Alinement Device: (Radioactive tritium H<sub>3</sub> light source)

Radioactive material:

Max surface radiation .....0 millirad per hour  
Tritium H<sub>3</sub>.....3 curies  
Weight..... 1.60 lb (0.73 kg)

M139A1 Alinement Device: (ERLS Battery Powered LED Light Source)

Batteries:

Quantity/Cell Size ..... 1 each/size "AA"  
Voltage .....3 volts (each)  
Weight..... TBD lb (TBD kg)

M1A2 Collimator with case: (ERLS Battery Powered LED Light Source)

Batteries:

Quantity/Cell Size ..... 2 each/size "C"  
Voltage .....3 volts (each)  
Weight..... TBD lb (TBD kg)

M1A1 Gunner's Quadrant with case: (not illuminated – no light source)

Least increment reading .....0.1 mil  
Weight..... 3.63lb (1.65 kg)

## SECTION III. TECHNICAL PRINCIPLES OF OPERATION

Paragraph	Section Index	Page
1-14.	Principles of Operation .....	1-18

### 1-14. PRINCIPLES OF OPERATION

- a. The M198 is a medium weight, split trail weapon.
- b. For firing, a hydraulically operated actuator cylinder assembly raises the wheels clear of the ground and the baseplate then supports the weapon.
- c. For large shifts in direction, a hydraulically operated speed shift assembly quickly lifts the weapon and firing baseplate clear of the ground, rotates or shifts the weapon to the new direction, and then lowers it back onto the ground.
- d. The traversing and elevating mechanisms are manually operated.
- e. The two pneumatic pull-type equilibrators are charged with compressed nitrogen gas.
- f. The recoil mechanism is a hydropneumatic dependent type with a variable recoil length.
- g. The cannon is equipped with a muzzle brake to reduce recoil.
- h. The breech mechanism assembly is manually operated, and the weapon is manually loaded.
- i. The weapon is equipped with an air-over hydraulic brake system.

## Section IV. SECTION DRILL

Paragraph	Section Index	Page
1-15.	General .....	1-18
1-16.	Instructions .....	1-19
1-17.	Execution of Command to Fall In .....	1-19
1-18.	Execution of Command to Change Posts .....	1-19
1-19.	Execution of Command to Change Posts (Entire Section) .....	1-20
1-20.	Execution of Command to Call Off .....	1-20
1-21.	Execution of Command to Mount .....	1-20
1-22.	Execution of Command to Dismount .....	1-21
1-23.	Execution of Command to Post .....	1-21
1-24.	Break Periods During Training or Firing .....	1-22
1-25.	Reduced Crew Drill.....	1-22

### 1-15. GENERAL

The purpose of section drill is to improve the howitzer section through execution of assigned tasks and cross-training of section personnel.

## 1-16. INSTRUCTIONS

- a. Section drill must be conducted in silence, except for commands and reports. The section must be drilled until reaction to commands is quick, automatic, and correct.
- b. Battery officers will supervise the drill. Errors will be corrected immediately.
- c. Duties should be rotated during training so that each crewman of the section can perform all duties within the section. Battery overhead personnel should also take part in section drill so that they can perform with a howitzer section, if required.
- d. If the number of available personnel falls below the standard 10-man crew, the reduced crew drill (p 1-22) will be used.

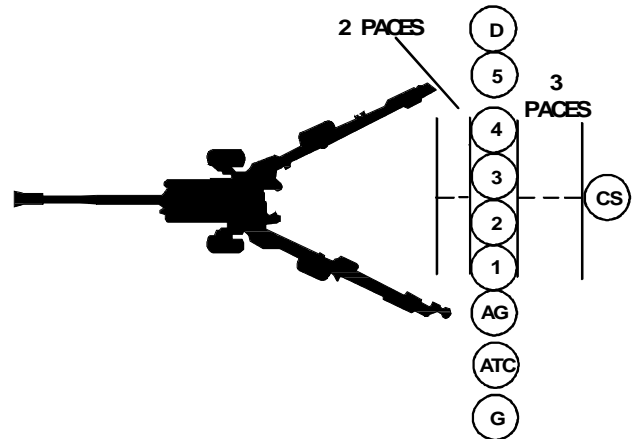
## 1-17. EXECUTION OF COMMAND TO FALL IN

- a. To Fall In. The chief of section takes his assigned post. The preparatory command may indicate the place and direction in which the section is to form. At the first formation for a drill or exercise, the caution, HOWITZER SECTION, precedes the command. The commands are 1. FALL IN or 2. IN FRONT (REAR) OF YOUR PIECE, FALL IN.

### NOTE

The formation for IN REAR OF YOUR PIECE is illustrated.

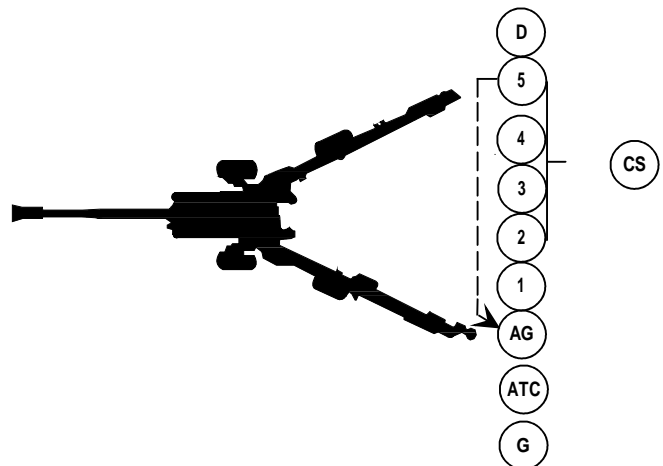
- b. At the command, the section moves at double time and forms a single rank, at close intervals, guiding on the gunner. The numbered cannoneers should be in order between the assistant gunner and the driver of the prime mover. The section stands at attention, centered on and facing the chief of section at a distance of three paces.



## 1-18. EXECUTION OF COMMAND TO CHANGE POSTS

- a. To Change Posts. To have the assistant gunner and numbered cannoneers change posts, the command is 1. CHANGE POSTS, 2. MARCH.

- b. At the command, the assistant gunner and numbered cannoneers, except for cannoneer no. 5, take two steps left, taking the position of the next higher numbered cannoneer. At the same time, cannoneer no. 5 moves at double time to the rear of the rank to the post of the assistant gunner. All other crewmen stand fast.



## 1-19. EXECUTION OF COMMAND TO CHANGE POSTS (ENTIRE SECTION)

- a. To have the entire section change posts, the command is 1. SECTION CHANGE POSTS, 2. MARCH.
- b. At the command, all crewmen of the section take two steps left, except for the crewman at the extreme left. That crewman moves at double time to the rear of the rank and takes the post of the gunner.

## 1-20. EXECUTION OF COMMAND TO CALL OFF

- a. To Call Off. The command is CALL OFF.
- b. All crewmen in rank, except the gunner, execute eyes right.
- c. The section calls off in sequence, GUNNER, AMMUNITION TEAM CHIEF, ASSISTANT GUNNER, 1, 2, 3, 4, 5, DRIVER. Each crewman calls out and turns head smartly to the front.

## 1-21. EXECUTION OF COMMAND TO MOUNT

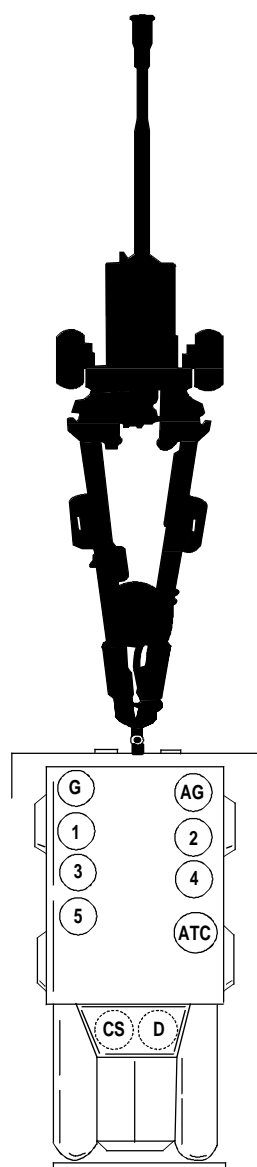
- a. To Mount. To mount, the commands are 1. MOUNT or 2. PREPARE TO MOUNT, MOUNT. If any crewmen of the section are to remain dismounted, their designations are announced with the caution, STAND FAST, given between the preparatory command and the command of execution; for example, 1. PREPARE TO MOUNT; DRIVER STAND FAST, 2. MOUNT.

- b. At the command, MOUNT, the section crewmen take positions as shown.

- c. At the command of execution, the driver and chief of section take their positions at the rear of the prime mover, on the left and right, respectively, where they can observe and assist in loading.

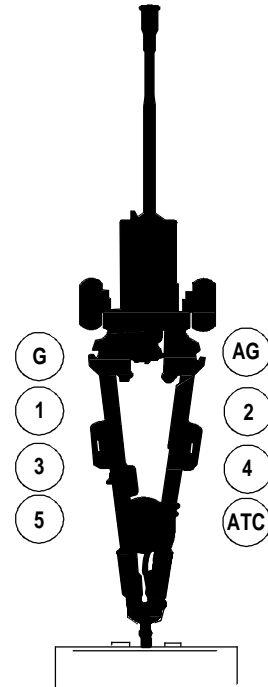
- d. The two columns mount in order from front to rear and take seats as shown. Each cannoneer is assisted in mounting by the person directly behind (or in front in the case of the last cannoneer in column) to ensure promptness and prevent injuries.

- e. Before mounting, the chief of section and driver check that the howitzer is properly coupled, the personnel and equipment are aboard, and the tailgate and safety straps are secure.



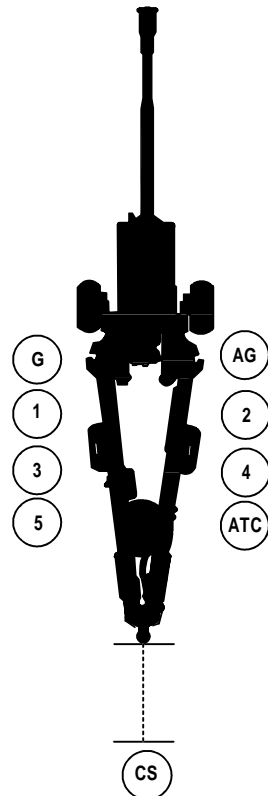
## 1-22. EXECUTION OF COMMAND TO DISMOUNT

- a. To Dismount. The commands are DISMOUNT or 1. PREPARE TO DISMOUNT, 2. DISMOUNT.
- b. At the preparatory command, the personnel in the prime mover unlatch and open the tailgate of the prime mover.
- c. All crewmen of the section assume positions from which they can dismount properly.
- d. At the command of execution, they dismount and, at double time, take the posts shown.



## 1-23. EXECUTION OF COMMAND TO POST

- a. To Post. The command is 1. CANNONEERS, 2. POST. This general command applies whether the section is in or out of ranks, at a halt, or marching.
- b. At the command, the section moves at double time and takes the positions shown. The section then stands at attention.

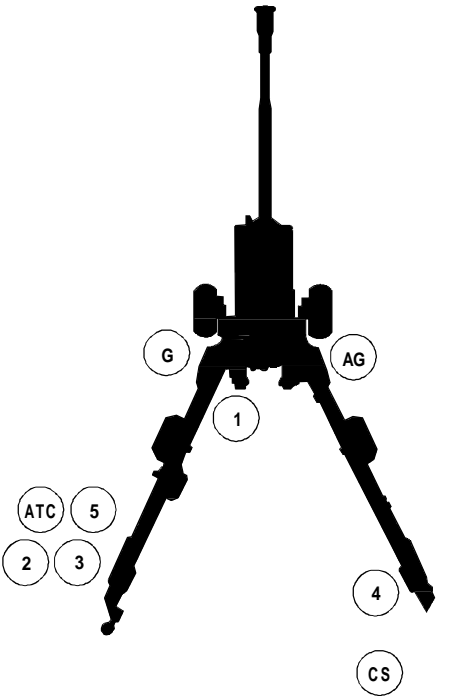


**PIECE UNCOUPLED, NOT  
PREPARED FOR ACTION**

**1-24. BREAK PERIODS DURING TRAINING OR FIRING**

**a. At drill.** When it is desired to give the personnel a rest from drill or to relieve them temporarily from formation or posts, the command, FALL OUT, is given. The command may be given at any time and means that the section is to remain in the drill area.

**b. When Firing.** When firing has been suspended temporarily, but the section is to remain in the vicinity of the prime mover, the command, FALL OUT, is given. Crewmen stand clear of the howitzer so that settings remain undisturbed. During these periods, the chief of section may direct the crewmen to improve their position, to replenish ammunition, or to do other necessary work.



**PIECE PREPARED FOR ACTION**

**1-25. REDUCED CREW DRILL**

**NOTE**

Procedures for operating with a reduced crew have been standardized under the Department of the Army Standardization Program.

**a.** It is normal to expect gun crews to be reduced to less than the prescribed TOE strength due to illness, casualties, battery taskings, and the need to rest personnel. To meet the need of these occasions and the need to maintain operations of the section in as orderly a manner as possible, the duties of the individuals of the section have been combined as shown.

<u>9-Man</u>	<u>8-Man</u>	<u>7-Man</u>
CS	CS	CS
G	G	G
ATC	ATC	ATC
AG	AG	AG/1
1	1	2
2	2	3/5
3/5	3/5	4/D
4	4/D	
D		

**b.** The section chief will assign duties to crew members when the number of available personnel falls below the level shown above.

## CHAPTER 2 OPERATING INSTRUCTIONS

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### Section I. DESCRIPTION AND USE OF OPERATOR'S CONTROLS AND INDICATORS

#### Section Index

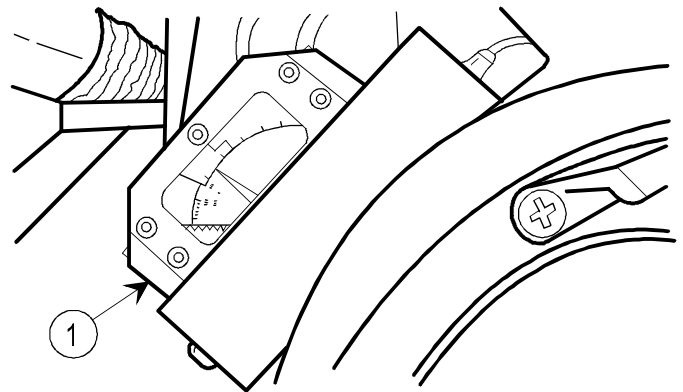
Paragraph		Page
2-1.	General .....	2-1
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#### 2-1. GENERAL

Before attempting to operate the M198 howitzer, make certain you are familiar with the location and operation of all controls and indicators.

#### 2-2. CANNON CONTROLS AND INDICATORS

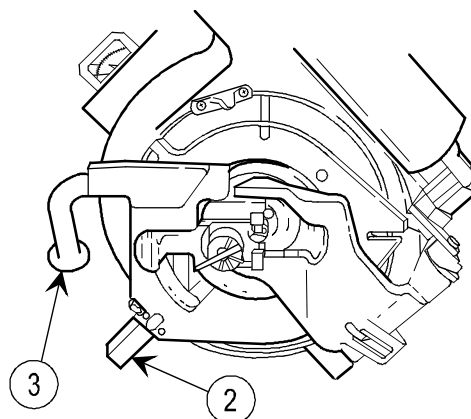
**a. Thermal Warning Device (1).** Measures the temperature of the cannon tube in a region just behind the origin of the rifling. Different misfire/check firing procedures apply depending on whether the indicator points to the green, yellow, or red area of the dial. See page 2-115 for misfire and check firing procedures.



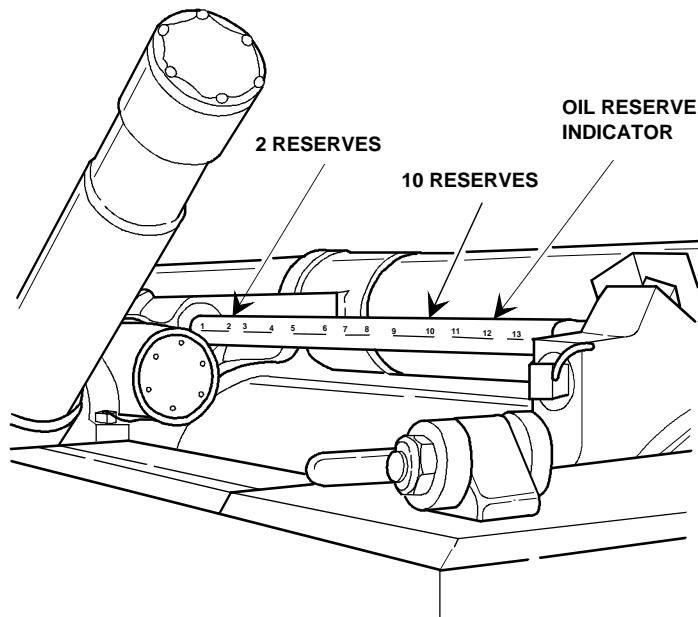
## 2-2. CANNON CONTROLS AND INDICATORS (cont)

**b. Manual Control Handle (2).** Locks the breech-block assembly in place during firing.

**c. Breechblock Handle (3).** Assists in opening and closing the breechblock assembly. To open the breechblock assembly, lift manual control handle (2) up, lift breechblock handle (3) up until it comes in contact with the cam, and swing the breechblock assembly down.



## 2-3. RECOIL MECHANISM CONTROLS AND INDICATORS



The oil reserve indicator shows the number of reserves in the recoil mechanism before, during, and after firing. The location of the end of the piston assembly inside the indicator shows by the corresponding number on the oil reserve indicator the number of oil reserves. The reserve indicator must be between 2 and 10 reserves when the howitzer is fired.

## 2-4. CARRIAGE CONTROLS AND INDICATORS

### WARNING

Injury may occur if equilibrators are over or under charged. Test equilibration by quickly disengaging or engaging the manual control lever, **KEEPING HANDS AWAY FROM ELEVATING HANDWHEEL**. If the handwheel spins, immediately notify unit maintenance.

To ensure manual control lever is completely engaged, allow lever to snap back to engaged position.

If nitrogen pressure is below 800 psi, the recoil mechanism could slide out of battery and cause severe personal injury. Make sure personnel are clear of recoil path.

**a. Equilibrator Adjustment Screws (1).**

Refer to illustration for location of equilibrator adjustment screws. Use to adjust equilibrators during minor temperature changes, correcting for unequal force required to turn elevation handwheel during elevation or depression of cannon tube.

**b. Elevating Handwheel (2).**

Controls elevation and depression of the cannon from either or both sides of the howitzer. To operate the elevating handwheel, the manual control lever (3) must be pushed down. On the gunner's side, turning elevating handwheel clock-wise elevates cannon; turning elevating handwheel counterclockwise depresses cannon. On the assistant gunner's side, turning elevating handwheel clockwise depresses cannon; turning elevating handwheel counterclockwise elevates the cannon.

**c. Manual Control Lever (3).**

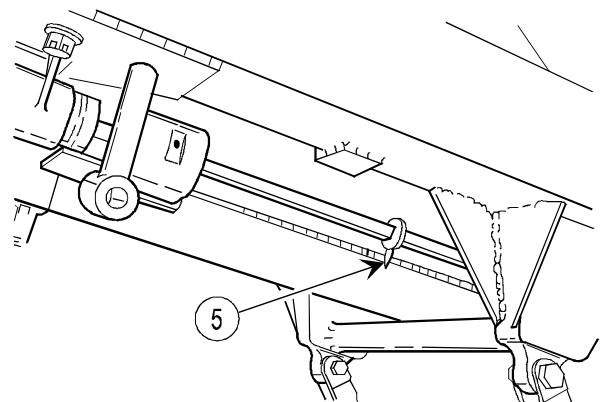
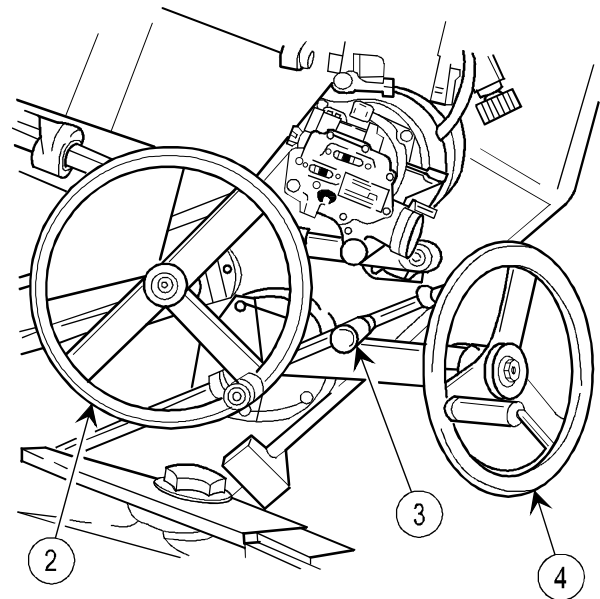
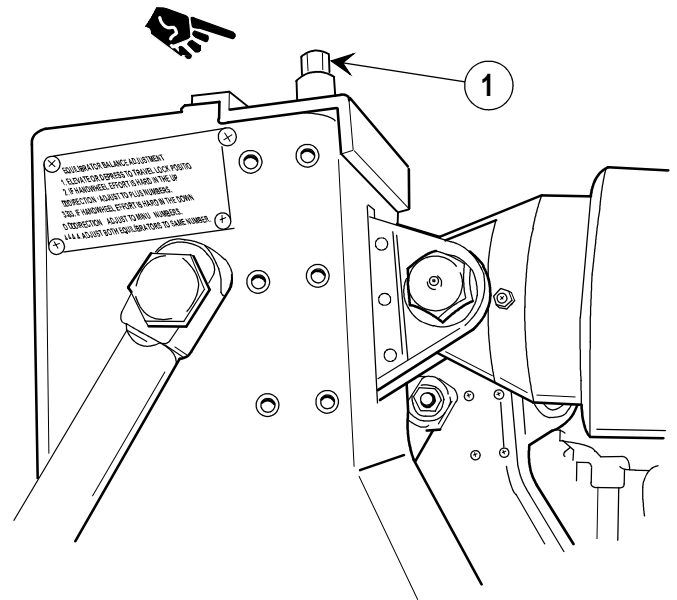
Used to release or secure cannon. Pushing down manual control lever allows cannon to be elevated or depressed; releasing manual control lever locks cannon in place.

**d. Traversing Handwheel (4).**

Used to traverse top carriage during firing operations and to traverse top carriage into stowed position over trails. Turning traversing handwheel clockwise moves cannon to the right; turning traversing handwheel counterclockwise moves cannon to the left.

**e. Recoil Indicator Pointer (5).**

Used to measure the length of recoil after firing. To operate, recoil indicator pointer must be pushed all the way forward (toward the muzzle) on the variable recoil shaft before firing.



## 2-4. CARRIAGE CONTROLS AND INDICATORS (cont)

### f. Travel Lock Assembly (6).

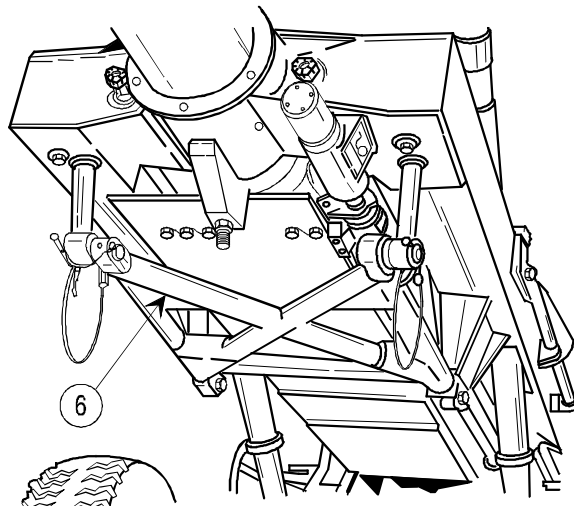
(1) **For Towing.** Secures top carriage to bottom carriage during towing operations; clocked to the underside of cannon cradle when not in use.

#### CAUTION

Without the airlift travel lock, the cannon tube comes dangerously close to the aircraft fuselage of CH47D and can damage the UHF navigation antenna.

Do not use airlift travel lock for towing.

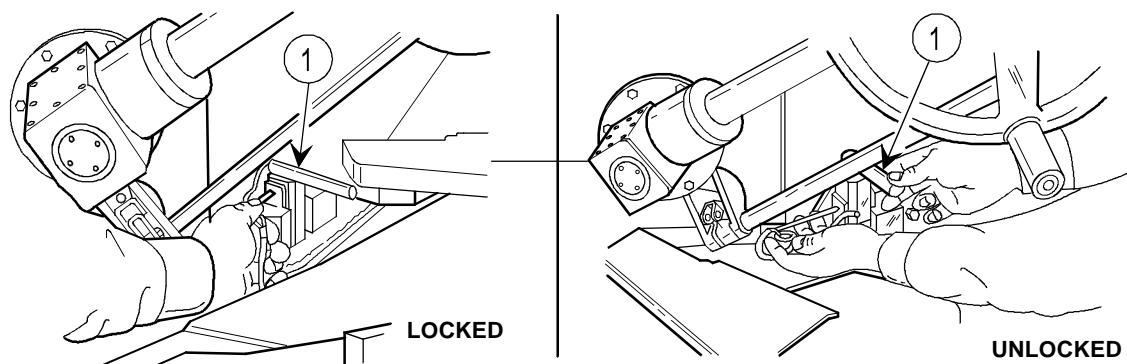
(2) **Airlift Travel Lock.** Secures top carriage to bottom carriage during airlift operations. This travel lock assembly (fabricated by direct support maintenance) lowers the cannon tube 5 ft, 4 in.



## 2-5. TOP CARRIAGE CONTROLS AND INDICATORS

#### NOTE

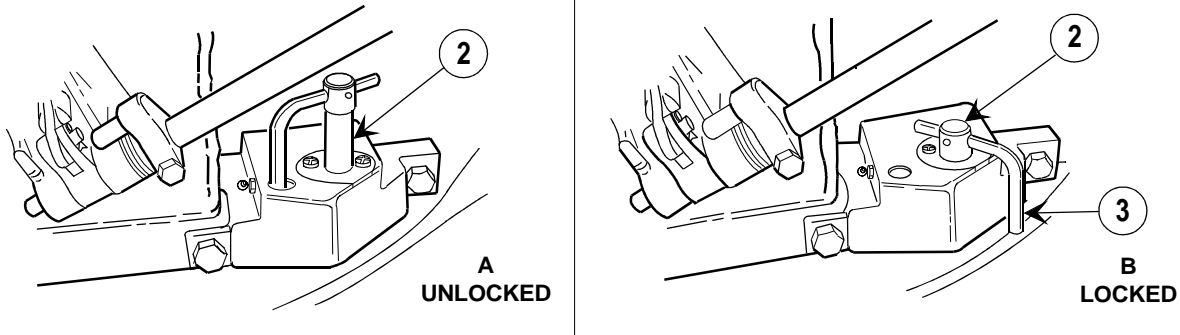
The following procedures apply to howitzers that have not been modified.



When the top carriage locking pin (1) is in the down position, the weapon cannot be traversed. A retaining pin holds the locking pin in the desired position.

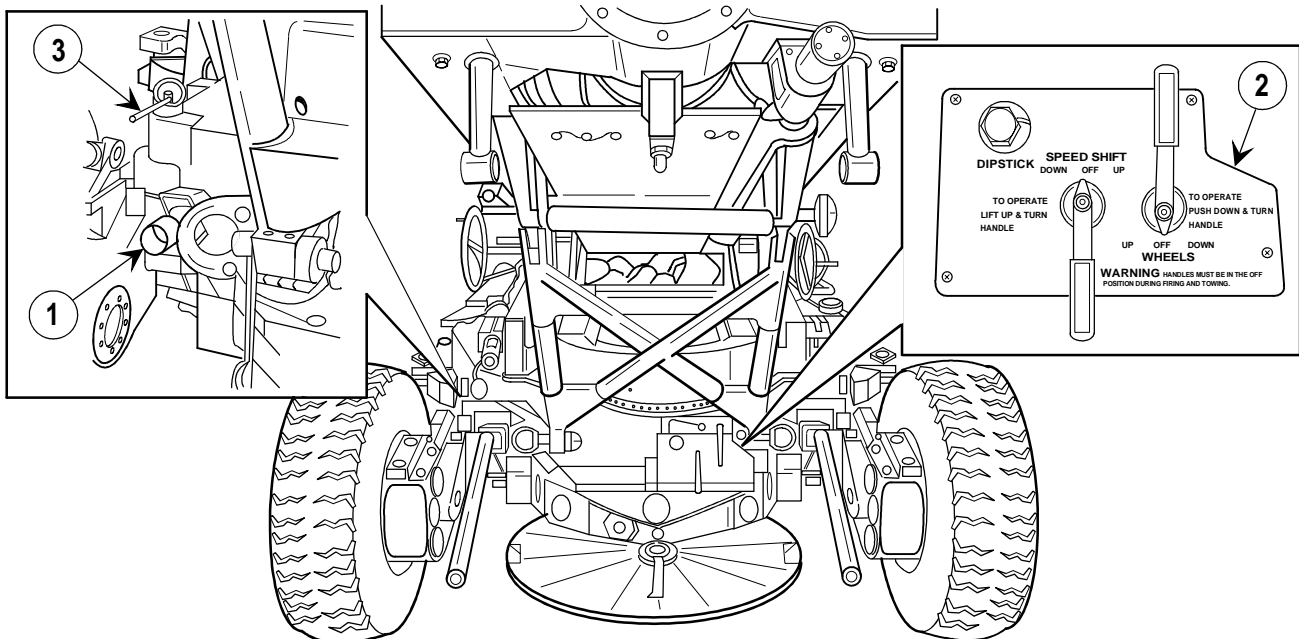
# NOTE

The following procedures apply to the modified howitzers.



To disengage top carriage locking pin (2), lift the pin and rotate to unlocked position (A). Top carriage can be traversed 360 degrees while pin is in unlocked position (A). To engage locking pin (2), traverse top carriage to within 200 mils of center using coarse azimuth scale. Then lift and rotate pin handle (3) to position (B) and continue traversing top carriage until pin (2) engages in bottom carriage hole.

## 2-6. BOTTOM CARRIAGE CONTROLS AND INDICATORS

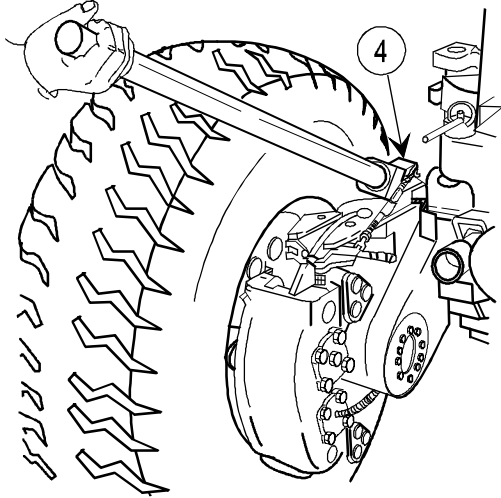


**a. Ram Hydraulic Pumps (1).** Can be used separately or together to activate actuator cylinder assembly and/or speed shift cylinder assembly, depending on the positions of the selector valve handle levers on the manifold assembly.

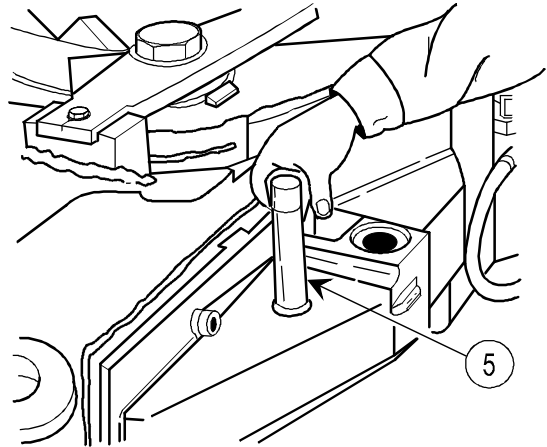
**b. Manifold Assembly (2).** Contains controls for actuator cylinder assembly and speed shift cylinder assembly, plus a dipstick to measure fluid level. The hydraulic-type actuator cylinder assembly provides a way to raise and lower the wheels and is controlled by pushing the WHEELS lever down and moving it from the OFF position to the UP or DOWN position. The hydraulic speed shift cylinder assembly provides a way to rotate the howitzer on its axis 6400 mils. The speed shift cylinder assembly is controlled by lifting up the SPEEDSHIFT lever and moving it from the OFF position to the UP or DOWN position.

**c. Wheel Lock Handle (3).** Locks wheel and axle in the towed or firing modes.

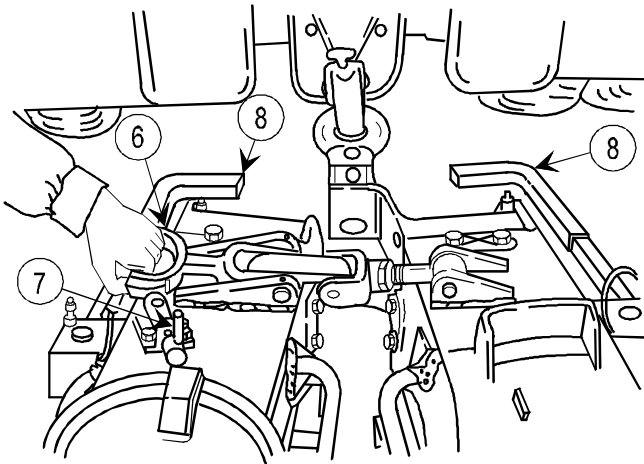
## 2-6. BOTTOM CARRIAGE CONTROLS AND INDICATORS (cont)



**d. Handbrake Assemblies (4).** Engaged by inserting pump handle in socket and lifting up; used to keep howitzer from moving.

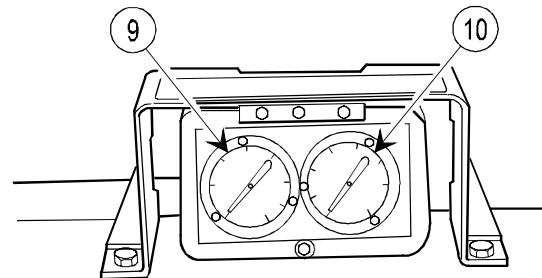


**e. Trail Locking Plugs (5).** Installed in firing (forward) position to secure trail during firing; must be removed to close trail.

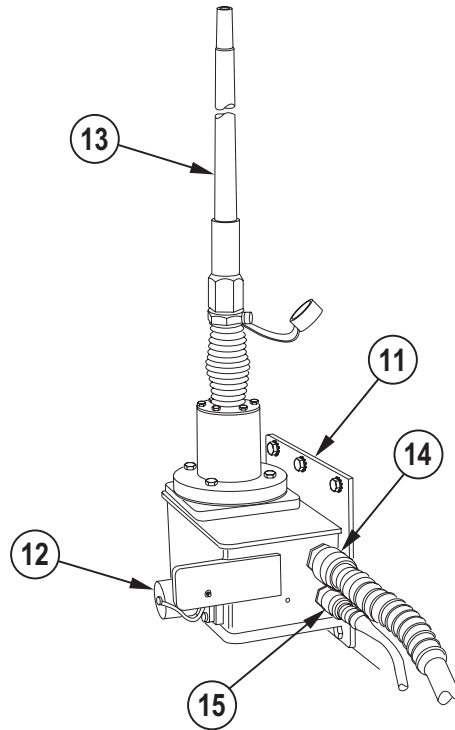


**f. Trail Lock Handle (6).** Located on the right trail and holds trails together during movement. To unlock, pull cam handle (7) to disengage and lift trail lock handle to unlock trails.

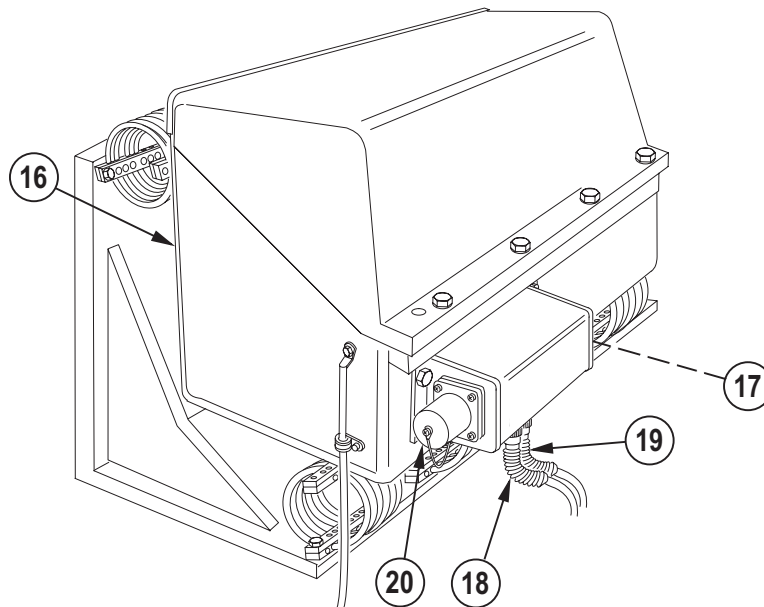
**g. Lifting Handles (8).** Located on the outside rear of each trail. Used to move trails into position.



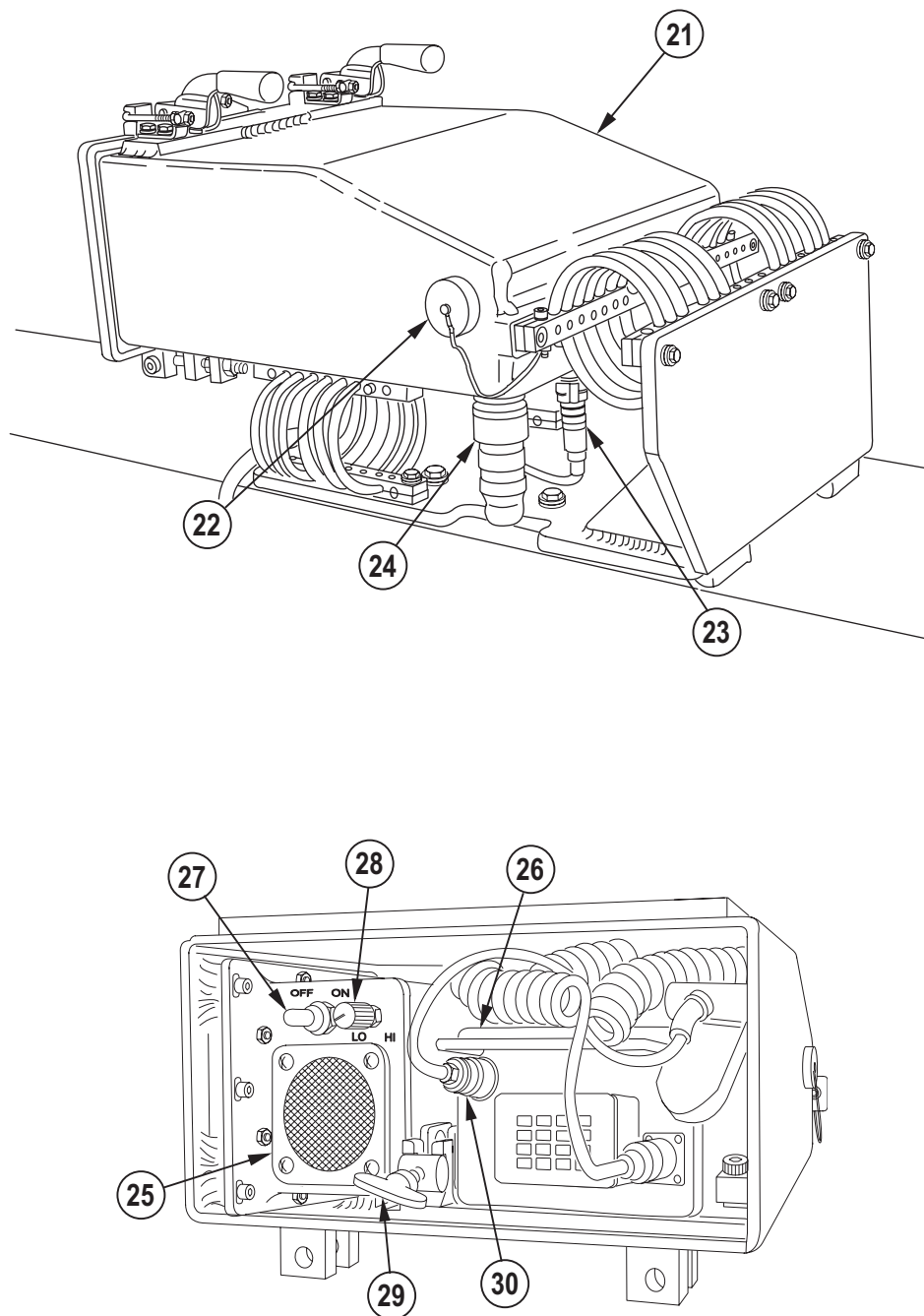
**h. Brake Precheck System.** The high pressure gage (9) and low pressure gage (10) are used to indicate that brake system is operating correctly. They will indicate if service and emergency hoses are properly connected to prime mover, if hydraulic master cylinder is functioning, and if air tank pressure is bled when service lines are disconnected from prime mover.



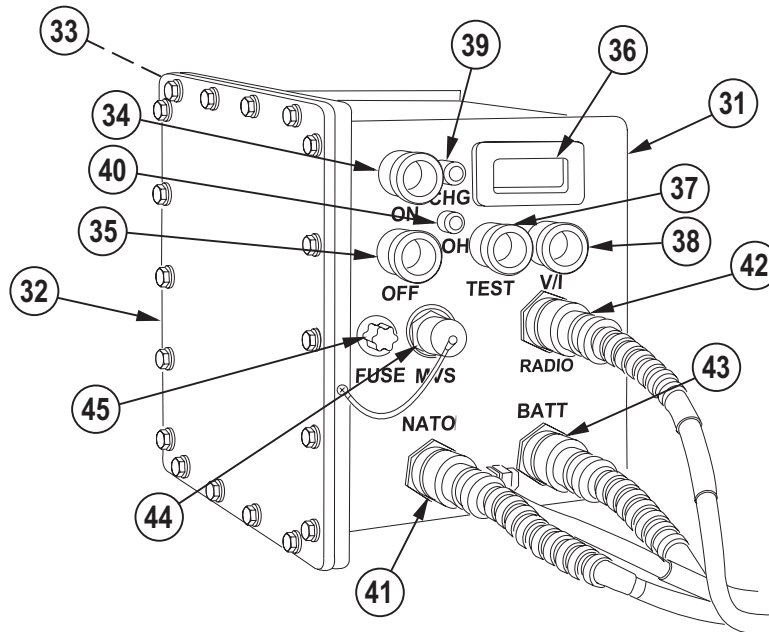
i. **Antenna/NATO Box (11).** Provides enclosure for electrical connections. The NATO connector port with protective cap (12) is the primary connection point for standard NATO power connection. SINCGARS signals are sent and received through the antenna (13). The connection point for PSDU is the power connection (14). The antenna connection (15) is the connection point for the radio box.



j. **Battery Box (16).** Contains batteries to power HIPE kit. Power to HyPAK is cut/enabled using the HyPAK cut-out switch (17). The HyPAK power cable (18) connects battery power to the HyPAK. The input cable (19) is the connection point for power to charge batteries. A secondary NATO connection point for directly charging batteries is the NATO input with protective cap (20).



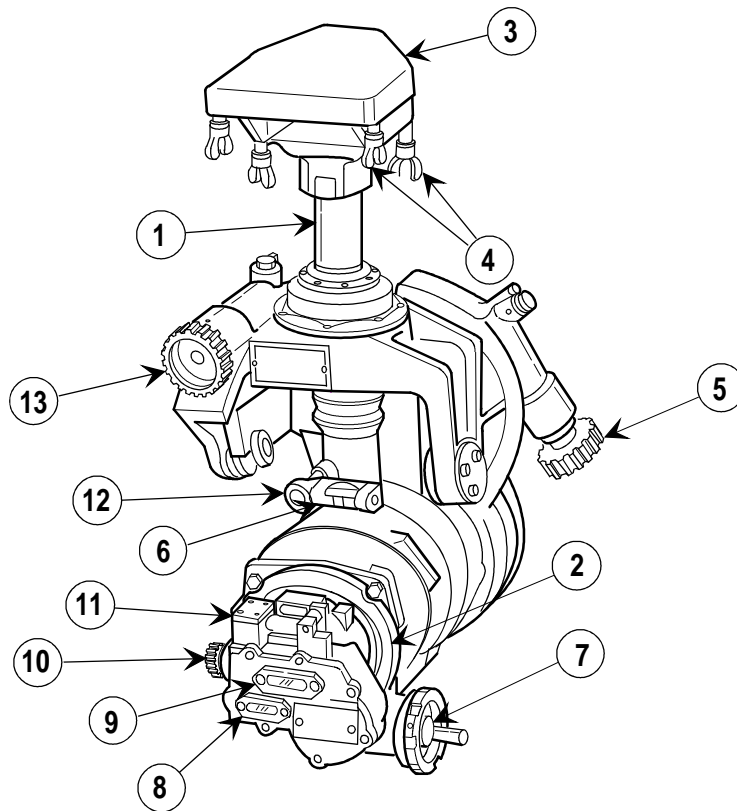
**k. Radio Box Enclosure (21).** Provides mount and protection for radio and speaker. Power to the GDU is provided by the GDU power connection (22). The antenna connection (23) is the input connection point for voice data from antenna. The connection point for power from PSDU is the input power (24). The speaker (25) provides audio from the ASIP radio (26). Toggling the speaker power switch (27) will turn speaker "on" and "off". Rotating the speaker volume control dial (28) will change the output volume of the speaker. A thumb screw (29) locks in the ASIP radio. An internal antenna connection (30) is the connection point between radio box and radio.



**I. Power Supply Distribution Unit (PSDU).** The housing (31) contains electrical components that perform the functions of the PSDU. A cover (32) provides water-tight protection to all components. Heat from the PSDU is dissipated by the cooling fins (33). Pressing the power ON button (34) will power up the PSDU. Pressing the power OFF button (35) will power down the PSDU. When the PSDU is ON, the voltage meter (36) indicates voltage by default in night mode and current when requested. Pressing the TEST button (37) when the PSDU is ON will put the voltage meter in day mode. When the PSDU is OFF, pressing this button will cause voltage meter to display voltage in day mode. When the PSDU is ON or the TEST button is pressed, pressing the V/I button (38) will change the display of the voltage meter to current. The CHG (charge) indicator (39) will be illuminated if the batteries are charging. The OH (overheat) indicator (40) will be illuminated if the PSDU is overheating. The NATO connection (41) is the connection point for input power from the antenna/NATO box. The RADIO connection (42) is the connection point for output power to the radio box. The BATT connection (43) is the connection point for the output power to the battery box. The MVS connection with protective cap (44) provides the connection point for the output power to the MVS. The fuse (45) provides electrical protection to the PSDU and must be changed when blown.



## 2-7. M171 TELESCOPE AND QUADRANT MOUNT AND M17 FIRE CONTROL QUADRANT CONTROLS AND INDICATORS



**a. M171 Telescope and Quadrant Mount (1).** Provides a mount for the pantel and the M17 fire control quadrant (2).

**b. Cover (3).** Protects surface of M171 telescope and quadrant mount (1).

**c. Wingnuts (4).** Hold pantel to M171 telescope and quadrant mount (1).

**d. Pitch Level Control Knob (5).** Centers the bubble in the pitch level vial (6).

**e. M17 Fire Control Quadrant (2).** Controls the cannon elevation during one-person indirect fire and laying operations.

**f. Elevation Control Knob (7).** Changes the reading in the elevation counter (8).

**g. Elevation Counter (8).** Registers cannon elevation in mils during laying and one-person operations.

**h. Elevation Correction Counter (9).** Registers corrections in mils during one-person operations.

**i. Elevation Correction Knob (10).** Changes the readings in the elevation correction counter (9).

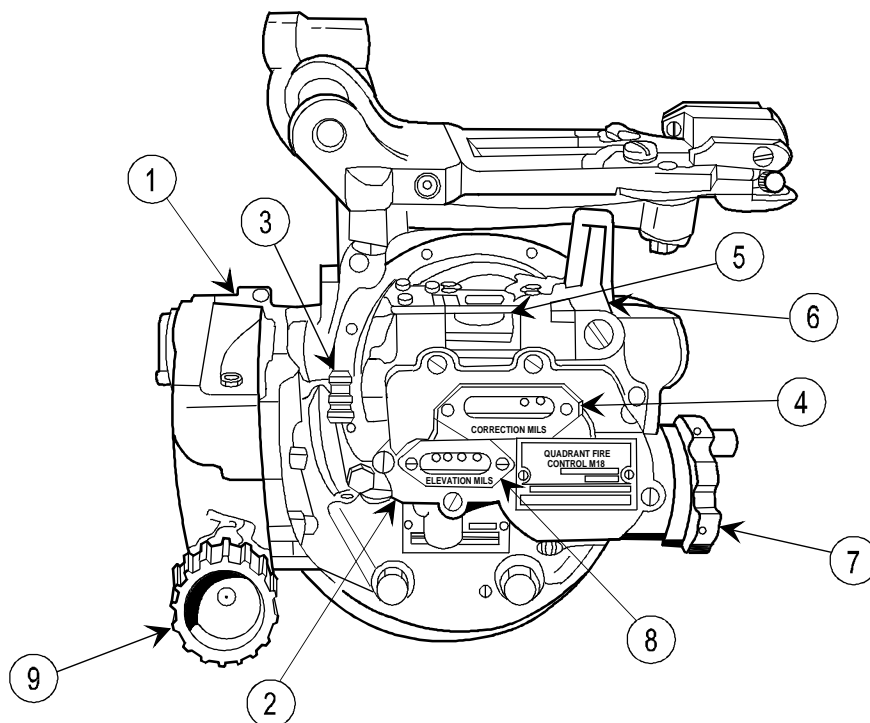
**j. Elevation Level Vial (11).** When the bubble in the elevation level vial is centered, the M17 fire control quadrant (2) is level vertically.

**k. Pitch Level Vial (6).** When the bubble in the pitch level vial is centered, the M171 telescope and quadrant mount (1) is level vertically.

**l. Cross Level Vial (12).** When the bubble in the cross level vial is centered, the M171 telescope and quadrant mount (1) is level horizontally.

**m. Cross Level Control Knob (13).** Centers the bubble in the cross level vial (12).

## 2-8. M172 TELESCOPE AND QUADRANT MOUNT AND M18 FIRE CONTROL QUADRANT CONTROLS AND INDICATORS



**a. M172 Telescope and Quadrant Mount (1).** Provides a mount for M18 fire control quadrant (2) and elbow telescope.

**b. Elevation Correction Knob (3).** Changes the reading in the elevation correction counter (4).

**c. Elevation Level Vial (5).** When the bubble in the elevation level vial is centered, the M18 fire control quadrant (2) is level vertically.

**d. Cross Level Vial (6).** When the bubble in the cross level vial is centered, the M18 fire control quadrant (2) is level horizontally.

**e. Elevation Correction Counter (4).** Registers elevation corrections in mils.

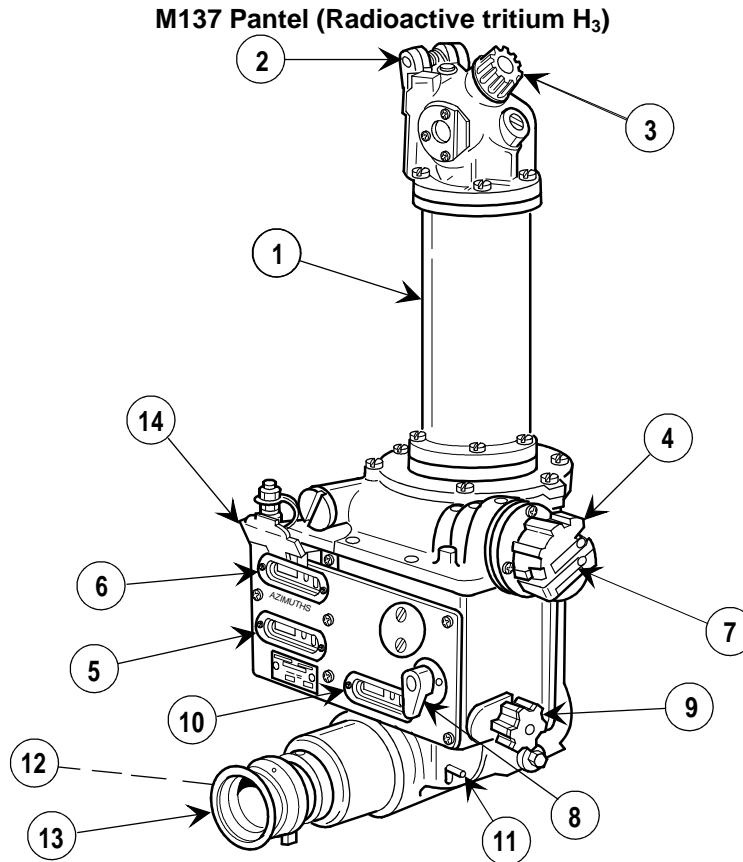
**f. Elevation Control Knob (7).** Changes the readings in the elevation counter (8).

**g. Elevation Counter (8).** Registers the cannon elevation in mils.

**h. M18 Fire Control Quadrant (2).** Controls cannon elevation during all operations.

**i. Cross Level Control Knob (9).** Turning the cross level control knob centers the bubble in the cross level vial (6).

## 2-9. M137 PANORAMIC TELESCOPE (PANTEL) CONTROLS AND INDICATORS



**a. M137 Pantel (1).** Provides direction in indirect fire operations.

**b. Parallax Shield (2).** Reduces distortion and glare and protects the lens.

**c. Elevation Knob (3).** Raises and lowers the reticle pattern in the pantel (1).

**d. Azimuth Knob (4).** Turns the top of the pantel (1) and changes the readings in the deflection counter (5) and the azimuth counter (6).

**e. Azimuth Knob Bar (7).** When turned clockwise (so the word, DIRECT, faces the gunner), the pantel (1) will click every 5 mils.

**f. Deflection Knob (8).** When pushed to the left, keeps the deflection counter (5) from moving while the azimuth knob (4) is turned.

**g. Gunner's Aid Knob (9).** Changes the reading in the correction counter (10).

**h. Locking Pin (11).** When raised, locks elbow assembly with eyepiece (12). When locking pin is depressed, the elbow assembly and eyepiece may be moved horizontally.

**i. Eyepiece (12).** Provides a means to look through the pantel (1). Rubber eyeshield (13) protects the eye and prevents fogging.

**j. Correction Counter (10).** Registers left and right correction values in mils.

**k. Deflection Counter (5).** Registers deflection movement in mils.

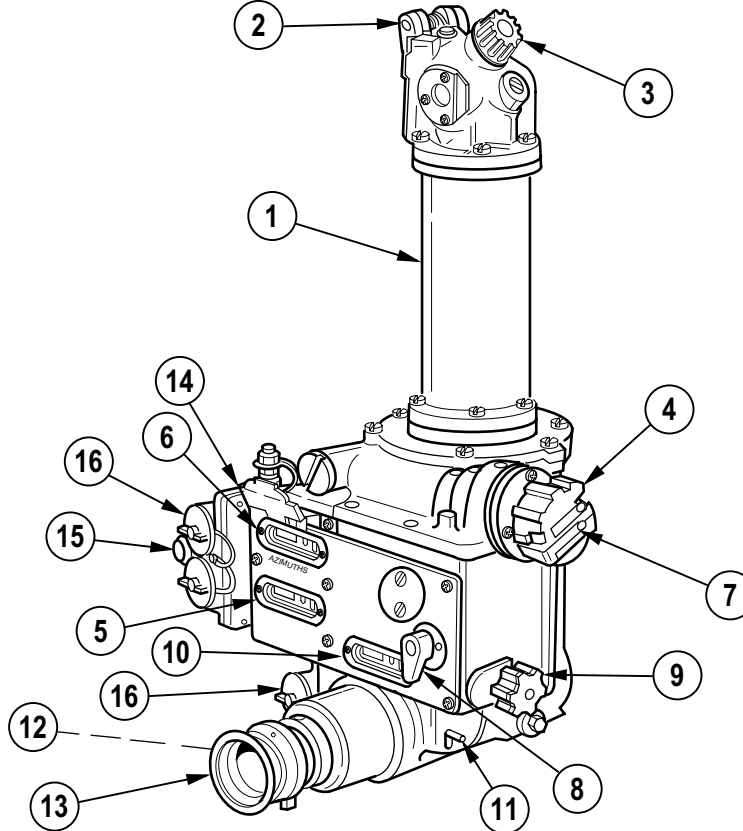
**l. Azimuth Counter (6).** Registers azimuth travel in mils.

**m. Azimuth Counter Door (14).** Covers and protects the azimuth counter (6).



## 2-9.1 M137A3 PANORAMIC TELESCOPE (PANTEL) CONTROLS AND INDICATORS

**M137A3 Pantel (ERLS Battery-Powered LED)**



**a. M137A3 Pantel (1).** Provides direction in indirect fire operations.

**b. Parallax Shield (2).** Reduces distortion and glare and protects the lens.

**c. Elevation Knob (3).** Raises and lowers the reticle pattern in the pantel (1).

**d. Azimuth Knob (4).** Turns the top of the pantel (1) and changes the readings in the deflection counter (5) and the azimuth counter (6).

**e. Azimuth Knob Bar (7).** When turned clockwise (so the word, DIRECT, faces the gunner), the pantel (1) will click every 5 mils.

**f. Deflection Knob (8).** When pushed to the left, keeps the deflection counter (5) from moving while the azimuth knob (4) is turned.

**g. Gunner's Aid Knob (9).** Changes the reading in the correction counter (10).

**h. Locking Pin (11).** When raised, locks elbow assembly with eyepiece (12). When locking pin is depressed, the elbow assembly and eyepiece may be moved horizontally.

**i. Eyepiece (12).** Provides a means to look through the pantel (1). Rubber eyeshield (13) protects the eye and prevents fogging.

**j. Correction Counter (10).** Registers left and right correction values in mils.

**k. Deflection Counter (5).** Registers deflection movement in mils.

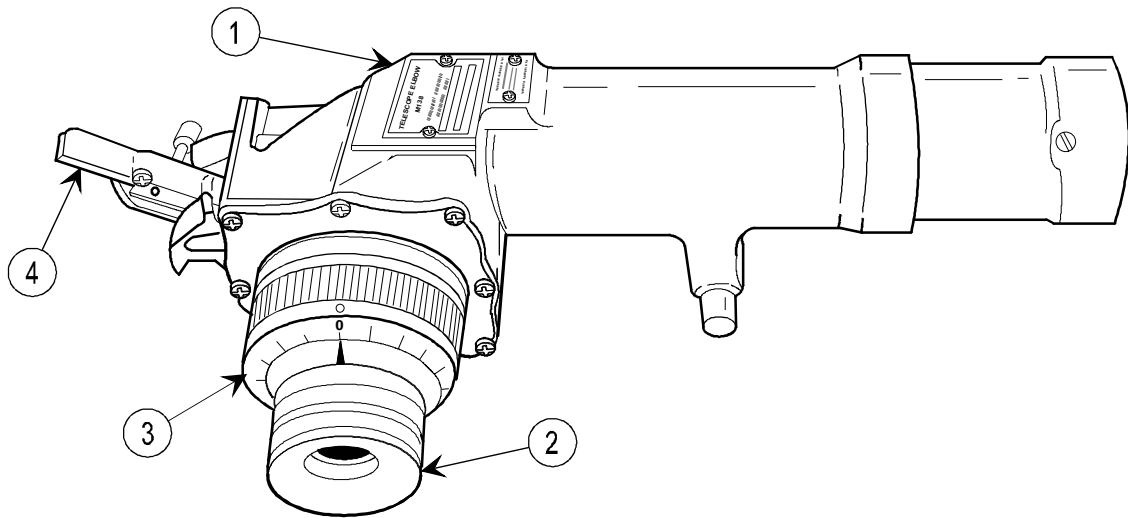
**l. Azimuth Counter (6).** Registers azimuth travel in mils.

**m. Azimuth Counter Door (14).** Covers and protects the azimuth counter (6).

**n. Power Switch (15).** Pushbutton with three-second delay. Turns LED on/off.

**o. Battery Enclosures (16).** Hold batteries that power LED light sources.

2-10. M138 ELBOW TELESCOPE CONTROLS AND INDICATORS



- a. **M138 Elbow Telescope (1).** Provides direction in direct fire operations.
- b. **Eyeshield (2).** Provides a means to look through the elbow telescope (1) and protects the eye.
- c. **Diopter Scale (3).** Provides individual focus.
- d. **Locking Latch (4).** Holds the elbow telescope (1) to the M172 telescope and quadrant mount.

Section II. PREVENTIVE MAINTENANCE CHECKS AND SERVICES (PMCS)

Section Index

Paragraph	Page
2-11. PMCS Procedures.....	2-10

2-11. PMCS PROCEDURES

- a. **General.** Your PMCS table (table 2-1) has been provided so you can keep your equipment in good operating condition and ready for its primary mission.
- b. **Warnings and cautions.** Always observe the WARNINGS and CAUTIONS appearing in your PMCS table BEFORE, DURING and AFTER you operate the equipment. The warnings and cautions appear before certain procedures. You must observe these WARNINGS and CAUTIONS to prevent serious injury to yourself and others or to prevent your equipment from being damaged.
- c. **Explanation of table entries.**
  - (1) **Item number column.** Numbers in this column are for reference. When completing DA Form 2404, Equipment Inspection and Maintenance Worksheet, include the item number for the check/service indicating a fault. Item numbers also appear in the order in which checks and services must be performed for the intervals listed.

**(2) Interval column.** This column tells you when you must do the procedure in the procedure column. BEFORE procedures must be done before you operate or prior to any maintenance, training, transportation, or operational mission involving the Howitzer. DURING procedures must be done during the time you are operating or using the equipment for its intended mission. AFTER procedures must be done immediately after you have operated or used the equipment. WEEKLY as well as BEFORE PMCS procedures must be performed if:

- (a) You are assigned operator and have not operated the item since the last weekly.
- (b) You are operating the item for the first time.
- (c) When a check and service procedure is required for both weekly and before intervals, it is not necessary to do the procedure twice.

**(3) Check/Service column.** This column provides the location and the item to be checked or serviced. The item location is underlined.

**(4) Procedure column.** This column gives the procedure you must do to check or service the item listed in the Check/Service column to know if the equipment is ready or available for its intended mission or for operation. You must do the procedure at the time stated in the interval column. Carefully follow these instructions. If you do not have the tools, or if the procedure tells you to, have unit maintenance do the work.

**(5) Not Fully Mission Capable If: column.** Information in this column tells you what faults will keep your equipment from being capable of performing its primary mission. If you make check and service procedures that show faults listed in this column, do not operate the equipment. Follow standard operating procedures for maintaining the equipment or reporting equipment failure.

#### NOTE

Under normal operations, both the M17 and M18 fire control quadrants are required for use. However, for PMCS purposes, only one of the fire control quadrants is required for the M198 howitzer to be serviceable.

**d. Other table entries.** Information other than warnings, cautions, and notes appear in the PMCS table. Be sure to observe all special information appearing in your table.

**e. Leakage definitions.** Leakage definitions for operator/crew PMCS are classified as follows:

- (1) **Class I.** Seepage of fluid (as indicated by wetness or discoloration) not great enough to form drops.
- (2) **Class II.** Leakage of fluid great enough to form drops but not enough to cause drops to drip from item being checked/inspected.
- (3) **Class III.** Leakage of fluid great enough to form drops that fall from the item being checked/inspected.

## 2-11. PMCS PROCEDURES (cont)

### CAUTION

Equipment operation is allowable with minor leakages (Class I or II). Of course, you must consider the fluid capacity in the item/system being checked/inspected. When in doubt, notify your supervisor.

When operating with Class I or Class II leaks, continue to check fluid levels as required in your PMCS.

Class III leaks should be reported to your supervisor or unit maintenance.

**f. Equipment does not perform.** If your equipment does not perform as required, refer to Chapter 3 under Troubleshooting for possible problems. Report any malfunctions or failures on DA Form 2404, or refer to DA PAM 738-750.

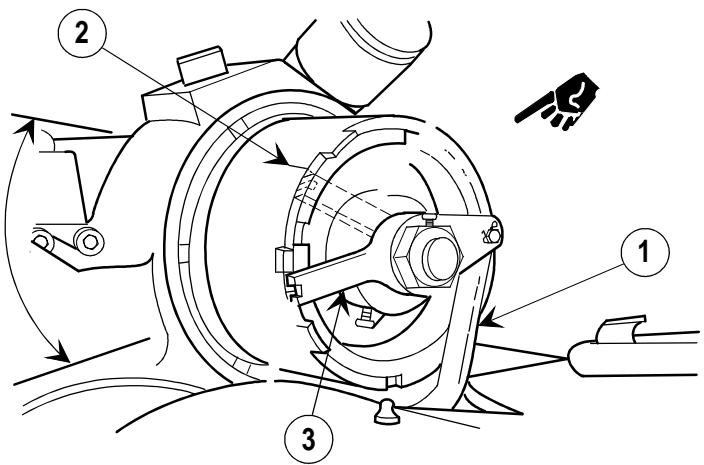
**Table 2-1. PREVENTIVE MAINTENANCE CHECKS AND SERVICES FOR M198 HOWITZER**

Item No.	Interval	Location	Crewmember	Not Fully Mission Capable If:
		Item to Check/ Service		
			Procedure	
1	Before	DA FORM 2408-4	<b>Chief of Section</b>  Check to see if your weapon has been borescoped within 180 days immediately preceding firing and after 1000 EFC rounds, and pullover gaged at 1000, 1500, and every 100 EFC rounds thereafter (TM 9-1000-202-14).	Weapon has not been borescoped/pullover gaged in accordance with instructions.
1.1	Before	RECOIL MECHANISM	<b>Chief of Section</b>	
<b>WARNING</b> If nitrogen pressure is below 800 psi, the recoil mechanism could slide out of battery and cause severe personal injury. Make sure personnel are clear of recoil path.				
<b>CAUTION</b> If nitrogen pressure is below 800 psi, the recoil mechanism could slide out of battery while elevating the howitzer and could cause damage to equipment or hang out of battery during firing.				
			Have unit mechanic check the nitrogen pressure of the recoil mechanism, when any of the following conditions are met:	Nitrogen pressure is not 1100±50 psi.



2-11. PMCS PROCEDURES (cont)

Table 2-1. PREVENTIVE MAINTENANCE CHECKS AND SERVICES FOR M198 HOWITZER (cont)

Item No.	Interval	Location	Crewmember	Not Fully Mission Capable If:
		Item to Check/ Service		
2	Before	VARIABLE RECOIL RIGID CONNECTING LINK	Chief of Section and Assistant Gunner	
<div>WARNING</div> <div>Make sure all personnel are clear of cannon recoil path. Loss of nitrogen pressure can allow cannon to fall out of battery.</div>				
			<div></div>	<div><p>The variable recoil rigid connecting link does not move.</p><p>Cannon will not remain in the in-battery position when weapon is elevated.</p><p>The 55-degree scribe line (2) does not lie within the notch when cannon is elevated to 1025 mils.</p></div>


**Table 2-1. PREVENTIVE MAINTENANCE CHECKS AND SERVICES FOR M198 HOWITZER (cont)**

Item No.	Interval	Location	Crewmember Procedure	Not Fully Mission Capable If:
		Item to Check/Service		
3	Before	TRAVERSING HANDWHEEL	<p><b>Gunner</b></p> <p>Check for smooth operation, making sure there is no binding or jerking motion and that backlash of the handwheel is no more than 1/12 turn of the handwheel (3-1/8 in. (79.0 mm)).</p>	Traversing mechanism does not operate.
<p style="text-align: center;"><b>CAUTION</b></p> <p>Use only authorized tires when towing the howitzer. The M900 series prime mover tires can be used for emergency towing only. The super single tires are bigger in diameter and require mounting in reverse. The tires increase the width of the howitzer and create further stress on the hub and wheel bearings, causing excessive wear. The 900 series truck tires (11.00 x 20) gross vehicle weight is not sufficient to safely transport the howitzer, except in extreme emergencies.</p> <p>Never reinflate a tire that has been run flat without first having the wheel and tire disassembled and inspected by the battery motor pool.</p>				
4	Before	WHEEL AND TIRE	<p><b>Gunner</b></p> <p>Check tires for cuts, nails, bulges, and proper inflation (110 psi (7.73 kg/cm<sup>2</sup>)) for radial. Check that lug nuts are tight.</p>	<p>One or both tires are flat or missing.</p> <p>Tread depth is 1/16 in. (0.16 cm) or less.</p>

## 2-11. PMCS PROCEDURES (cont)

Table 2-1. PREVENTIVE MAINTENANCE CHECKS AND SERVICES FOR M198 HOWITZER (cont)

Item No.	Interval	Location	Crewmember Procedure	Not Fully Mission Capable If:
		Item to Check/ Service		



WARNING

If broken or not illuminated, follow radioactive materials procedures in the front of this manual.

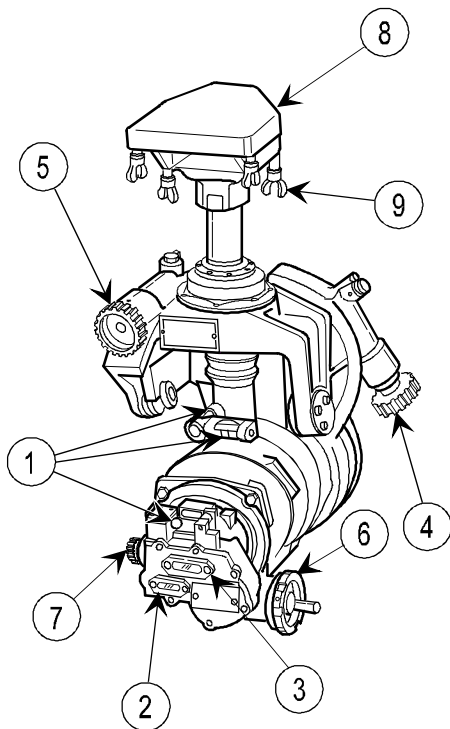
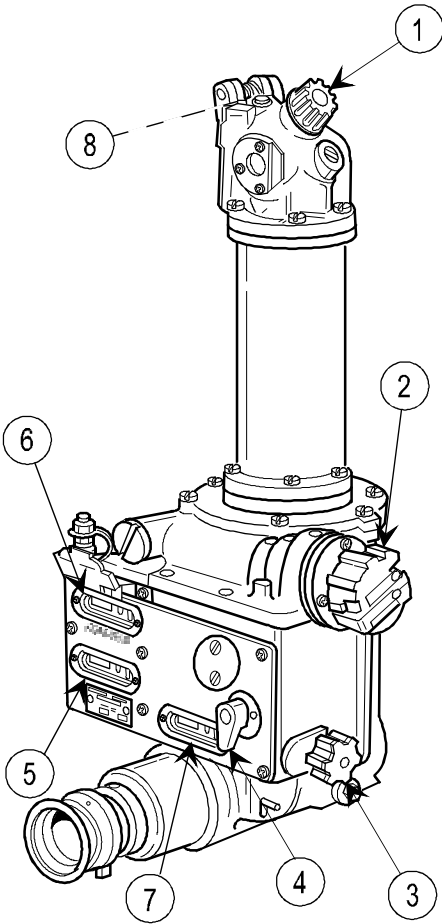

5	Before	M171 TELESCOPE AND QUADRANT MOUNT AND M17 FIRE CONTROL QUADRANT	Gunner <div></div>	
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Table 2-1. PREVENTIVE MAINTENANCE CHECKS AND SERVICES FOR M198 HOWITZER (cont)

Item No.	Interval	Location	Crewmember Procedure	Not Fully Mission Capable If:
		Item to Check/ Service		
			<p>a. Check level vials (1) and counters (2 and 3) for illumination.</p> <p>b. Marking must be clear and level vials and bubble must be present. Wipe level vials (1) with cheesecloth (item 9, appx D) moistened with lens cleaning compound (item 6, appx D). Wipe dry.</p> <p>c. Check for smooth operation of control knobs by turning pitch level control knob (4) and cross level control knob (5).</p> <p>d. Turn elevation control knob (6). Elevation counter (2) should turn and elevation correction counter (3) should not turn. Turn elevation correction knob (7). Elevation correction counter (3) should move in 1-mil increments. Elevation counter should change by amount of correction applied.</p> <p>e. M171 mount must have a cover (8). Mounting surface must be free of nicks or burrs. Clean surface with crocus cloth (item 8, appx D), and wipe dry.</p> <p>f. Check for presence of wing nuts (9).</p>	<p>Level vials and counters are not illuminated or level vials are broken.</p> <p>Bubble is missing.</p> <p>Control knobs do not operate.</p> <p>Correction counter turns when elevation counter turns and M18 quadrant is <u>nonoperational</u>. Elevation counter does not move in 1-mil increments or the elevation counter is not accurate, and M18 quadrant is non-operational.</p> <p>Two or more nuts are missing.</p>

2-11. PMCS PROCEDURES (cont)

Table 2-1. PREVENTIVE MAINTENANCE CHECKS AND SERVICES FOR M198 HOWITZER (cont)

Item No.	Interval	Location	Crewmember	Not Fully Mission Capable If:
		Item to Check/ Service	Procedure	
6	Before	M137 PANORAMIC TELESCOPE (Radioactive tritium H <sub>3</sub> )	<div><p>Gunner</p><p>a. All knobs (1, 2, 3, and 4) should turn freely. Check for rust. Clean with wiping rag (item 24, appx D) moistened with cleaning compound (item 5, appx D). Wipe dry.</p></div>	Knobs do not turn.
<div><p><b>WARNING</b></p><p>If broken or not illuminated, follow radioactive materials procedures in the front of this manual.</p></div>				

**Table 2-1. PREVENTIVE MAINTENANCE CHECKS AND SERVICES FOR M198 HOWITZER (cont)**

Item No.	Interval	Location	Crewmember Procedure	Not Fully Mission Capable If:
		Item to Check/ Service		
			<p><b>b.</b> Check counters (5, 6, and 7) and reticles (8) for illumination.</p> <p><b>c.</b> Install telescope on mount and check for tight mounting.</p> <p><b>d.</b> Turn azimuth knob (2). Deflection counter (5) and azimuth counter (6) should turn; correction counter (7) should not turn.</p> <p><b>e.</b> Turn gunner's aid knob (3). It should move in 1-mil increments. Deflection counter (5) should change by the amount of correction applied. Azimuth counter (6) should not change.</p> <p><b>f.</b> Check reticle image.</p> <p><b>g.</b> Turn deflection knob (4) to RELEASE position. Turn azimuth knob (2). Deflection counter (5) should not turn and azimuth counter (6) should turn. Turn deflection knob (4) back to ENGAGE position.</p> <p><b>h.</b> Check pantel with alinement device. If pantel cannot be alined to 4800 mils <math>\pm</math> 0.5-mil tolerance, notify unit maintenance.</p>	<p>Reticles or counters are not illuminated.</p> <p>Telescope cannot be secured to mount.</p> <p>Counters will not turn or correction counter turns.</p> <p>Gunner's aid knob will not move in one direction or in 1-mil increments. Deflection counter does not change by amount of correction applied. Azimuth and/or deflection counter move more than 1/4-mil.</p> <p>Reticle image is not clearly visible.</p> <p>Deflection counter turns.</p>

2-11. PMCS PROCEDURES (cont)

Table 2-1. PREVENTIVE MAINTENANCE CHECKS AND SERVICES FOR M198 HOWITZER (cont)

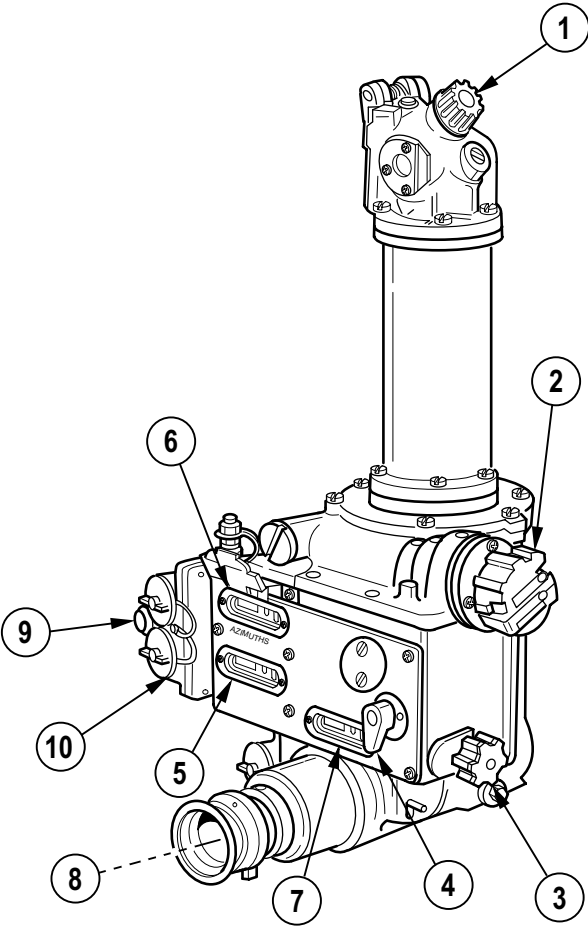




Item No.	Interval	Location	Crewmember Procedure	Not Fully Mission Capable If:
		Item to Check/ Service		
6.1	Before	M137A3 PANORAMIC TELESCOPE (ERLS Battery-Powered LED)	<p><b>Gunner</b></p>  <p>a. All knobs (1, 2, 3, and 4) should turn freely. Check for rust. Clean with wiping rag (item 24, appx D) moistened with cleaning compound (item 5, appx D). Wipe dry.</p> <p>b. Check counters (5, 6, and 7) and reticles (8) for illumination.</p> <p>1. Press red power switch (9) on counter box battery enclosure (10). Wait 3 seconds and recheck.</p>	<p>Knobs do not turn.</p> <p>Reticles or counters are not illuminated.</p> <p>Counters are not illuminated.</p>

Table 2-1. PREVENTIVE MAINTENANCE CHECKS AND SERVICES FOR M198 HOWITZER (cont)

Item No.	Interval	Location	Crewmember Procedure	Not Fully Mission Capable If:
		Item to Check/ Service		
		<div><div><b>WARNING</b> Read and follow all warnings in WARNING SUMMARY. Pay careful attention to those about batteries.</div><div></div></div>		
			<div><div><p>2. Install new batteries in battery enclosures on counterbox and telescope elbow (see procedure, page 3-24 paragraph 24 step 3) then recheck.</p><p>If reticles or counters are still not illuminated, Notify unit maintenance.</p><p>c. Install telescope on mount and check for tight mounting.</p><p>d. Turn azimuth knob (2). Deflection counter (5) and azimuth counter (6) should turn; correction counter (7) should not turn.</p><p>e. Turn gunner's aid knob (3). It should move in 1-mil increments. Deflection counter (5) should change by the amount of correction applied. Azimuth counter (6) should not change.</p><p>f. Check reticle image.</p><p>g. Turn deflection knob (4) to RELEASE position. Turn azimuth knob (2). Deflection counter (5) should not turn and azimuth counter (6) should turn. Turn deflection knob (4) back to ENGAGE position.</p><p>h. Check pantel with alinement device. If pantel cannot be aligned to 4800 mils ± 0.5-mil tolerance, notify unit maintenance.</p></div></div>	<div><div><p>Reticles or counters are not illuminated.</p><p>Telescope cannot be secured to mount.</p><p>Counters will not turn or correction counter turns.</p><p>Gunner's aid knob will not move in one direction or in 1-mil increments. Deflection counter does not change by amount of correction applied. Azimuth and/or deflection counter move more than 1/4-mil.</p><p>Reticle image is not clearly visible.</p><p>Deflection counter turns.</p><p>Pantel cannot be aligned to 4800 mils ± 0.5-mil tolerance.</p></div></div>

**2-11. PMCS PROCEDURES (cont)****Table 2-1. PREVENTIVE MAINTENANCE CHECKS AND SERVICES FOR M198 HOWITZER (cont)**

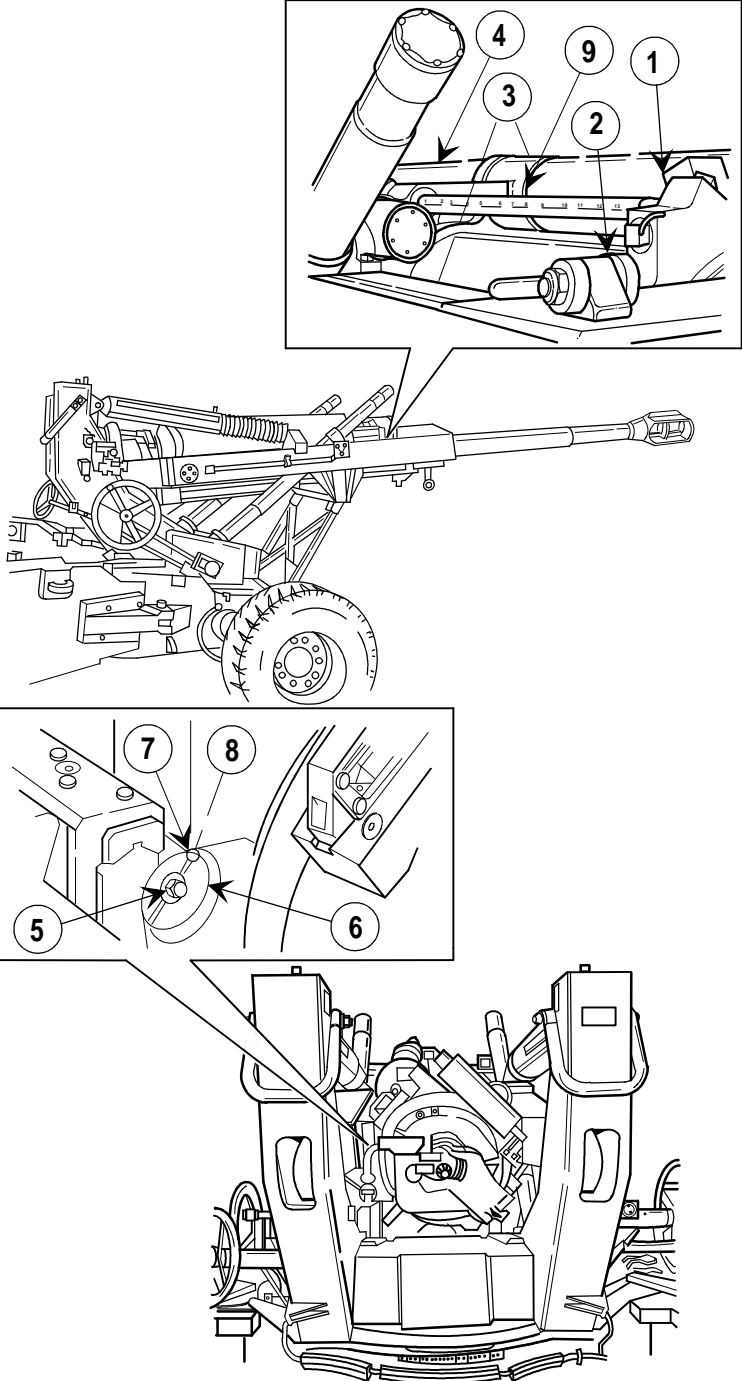
Item No.	Interval	Location	Crewmember Procedure	Not Fully Mission Capable If:
		Item to Check/Service		
7	Before	RECOIL MECHANISM	<p>Assistant Gunner</p> 	

Table 2-1. PREVENTIVE MAINTENANCE CHECKS AND SERVICES FOR M198 HOWITZER (cont)

Item No.	Interval	Location	Crewmember Procedure	Not Fully Mission Capable If:															
		Item to Check/ Service																	
			<p>a. Check recoil mechanism for oil leakage at front yoke assembly (1), oil valve assembly (2), recoil cylinder assemblies (3), and recuperator cylinder assembly (4). Oil leakage from back of recoil cylinder assemblies is considered normal unless leakage is over two reserves per day during firing. If leakage is from other points or is more than two reserves per day, notify unit maintenance.</p> <p>b. Clean all foreign material from safety relief valves (5) at rear of recoil cylinder assemblies with a wiping rag (item 24, appx D). Check for presence of restraint keys (6), capscrews (7), and lock wire (8) for both recoil cylinder and the recuperator.</p>	<p>Any oil leakage found at front yoke or filler valve assembly.</p> <p>Restraint keys, cap-screws, or lock wire are missing from one or both recoil cylinder assemblies or recuperator.</p>															
<p style="text-align: center;"><b>NOTE</b></p> <p>The oil reserve indicator must be visible at all times. Oil reserve reading should be:</p> <table><tr><td><u>Oil Reserve Level</u></td><td></td><td><u>Quarter of Year</u></td></tr><tr><td>6</td><td>for the</td><td>1st</td></tr><tr><td>5</td><td>for the</td><td>2nd</td></tr><tr><td>4</td><td>for the</td><td>3rd</td></tr><tr><td>3</td><td>for the</td><td>4th</td></tr></table>					<u>Oil Reserve Level</u>		<u>Quarter of Year</u>	6	for the	1st	5	for the	2nd	4	for the	3rd	3	for the	4th
<u>Oil Reserve Level</u>		<u>Quarter of Year</u>																	
6	for the	1st																	
5	for the	2nd																	
4	for the	3rd																	
3	for the	4th																	
			<p>c. Check that the oil reserve indicator (9) is on or between 2 and 10 reserves. If oil exceeds 10 reserves, or less than 2 reserves, notify unit maintenance.</p>	<p>Oil leakage is over two reserves per day or if indicator shows no oil reserves.</p>															

2-11. PMCS PROCEDURES (cont)

Table 2-1. PREVENTIVE MAINTENANCE CHECKS AND SERVICES FOR M198 HOWITZER (cont)

Item No.	Interval	Location	Crewmember Procedure	Not Fully Mission Capable If:
		Item to Check/ Service		
8	Before	EQUILIBRATOR CYLINDERS	Assistant Gunner	

**WARNING**

Make sure personnel are clear of cannon recoil path. Loss of nitrogen pressure can allow cannon to fall out of battery.

a. Elevate and depress the weapon by operating the elevating hand-wheel. It should take the same effort to elevate and depress the weapon. If not, elevate cannon to travel lock and perform step b.

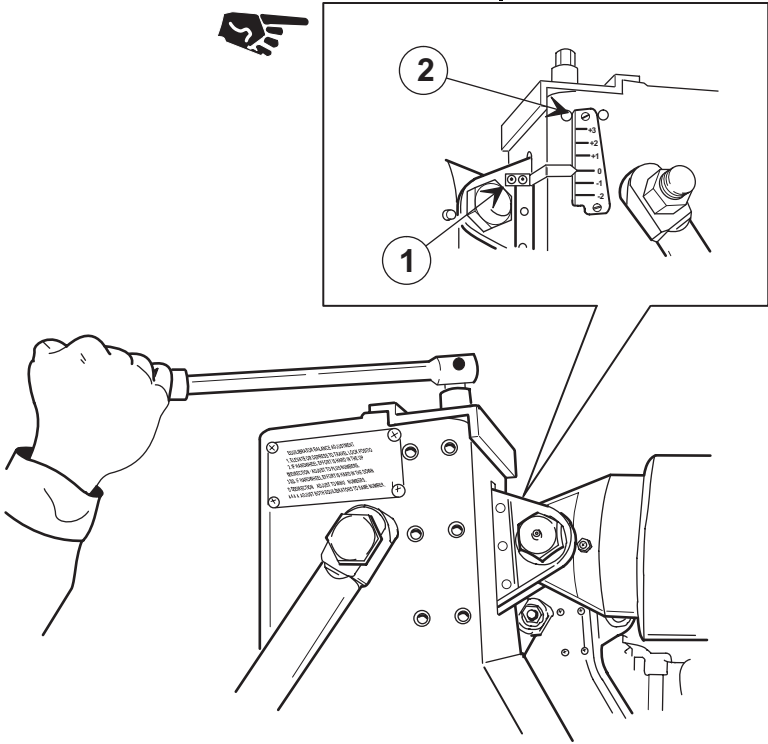


Table 2-1. PREVENTIVE MAINTENANCE CHECKS AND SERVICES FOR M198 HOWITZER (cont)

Item No.	Interval	Location	Crewmember Procedure	Not Fully Mission Capable If:
		Item to Check/Service		
<p style="text-align: center;"><b>NOTE</b></p> <p>Raising the dial pointer (1) on the scale (2) will decrease the effort required to elevate weapon, while lowering the dial pointer will increase the effort required to elevate the weapon.</p>				
9	Before	ELEVATING MECHANISM	<p><b>b.</b> Turn adjusting screw to raise or lower the dial pointer (1) on the scale (2). Make the same adjustment on both scales by moving one number at a time until proper adjustment has been made. Once the adjustment has been made, operate the elevating handwheel to ensure weapon will elevate with the same amount of effort. If equal effort between elevation and depression cannot be obtained, notify unit maintenance.</p> <p><b>Assistant Gunner</b></p> <p><b>a.</b> Elevate and depress cannon tube. Check for smooth operation, making sure there is no binding or jerking motion and that backlash of handwheel is not more than 1/12 turn of the handwheel (4-1/4 in. (10.7 cm). If backlash exceeds 1/12 turn, notify unit maintenance.</p>	<p>Equilibrator cannot be adjusted using adjusting screw or unable to elevate cannon tube.</p> <p>The elevating mechanism does not operate.</p>

**2-11. PMCS PROCEDURES (cont)****Table 2-1. PREVENTIVE MAINTENANCE CHECKS AND SERVICES FOR M198 HOWITZER (cont)**


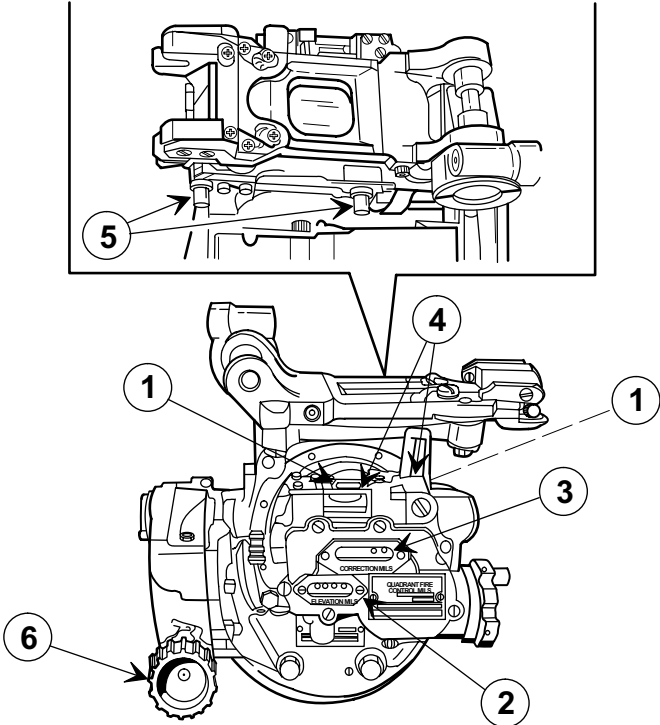
Item No.	Interval	Location	Crewmember Procedure	Not Fully Mission Capable If:
		Item to Check/Service		
9	Before	ELEVATING MECHANISM (cont)	Assistant Gunner	
<p style="text-align: center;"><b>NOTE</b></p> <p>To ensure friction clutch engages, allow manual release lever to snap back to the released position.</p>				
10	Before	M172 TELESCOPE AND QUADRANT MOUNT AND M18 FIRE CONTROL QUADRANT	Assistant Gunner	Friction clutch does not operate properly.
<div>  <p style="text-align: center;"><b>WARNING</b></p> <p>If broken or not illuminated, follow radioactive materials procedures in the front of this manual.</p> </div>				

Table 2-1. PREVENTIVE MAINTENANCE CHECKS AND SERVICES FOR M198 HOWITZER (cont)

Item No.	Interval	Location	Crewmember Procedure	Not Fully Mission Capable If:
		Item to Check/Service		
			 <p>a. Check level vials (1) and counters (2 and 3) for illumination.</p> <p>b. Check that level vial covers (4) move freely. Markings on level vials must be clear, and bubble must be present. Wipe level vials (1) and gunner's quadrant seats (5) clean with cheesecloth (item 9, appx D), moistened with lens cleaning compound (item 6, appx D). Wipe dry.</p> <p>c. Turn cross level control knob (6). Check for binding.</p>	<p>Level vials or counters are not illuminated or level vials are broken.</p> <p>Bubble is missing from one or more level vials.</p> <p>Cross level control knob does not operate and M17 quadrant is inoperable.</p>

## 2-11. PMCS PROCEDURES (cont)

Table 2-1. PREVENTIVE MAINTENANCE CHECKS AND SERVICES FOR M198 HOWITZER (cont)

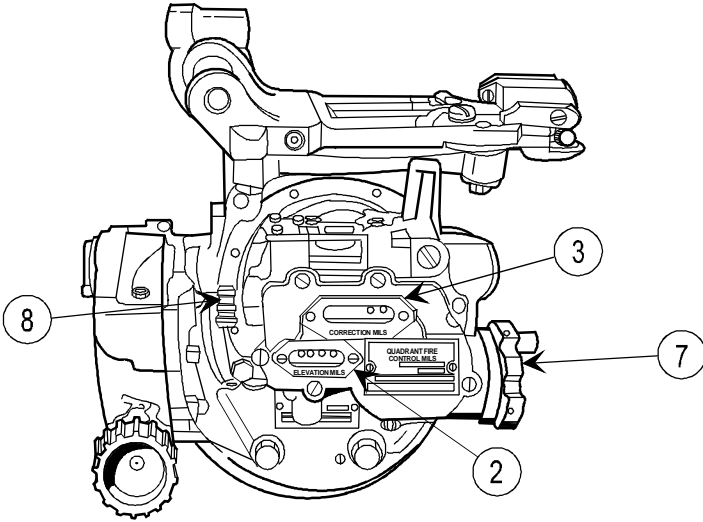
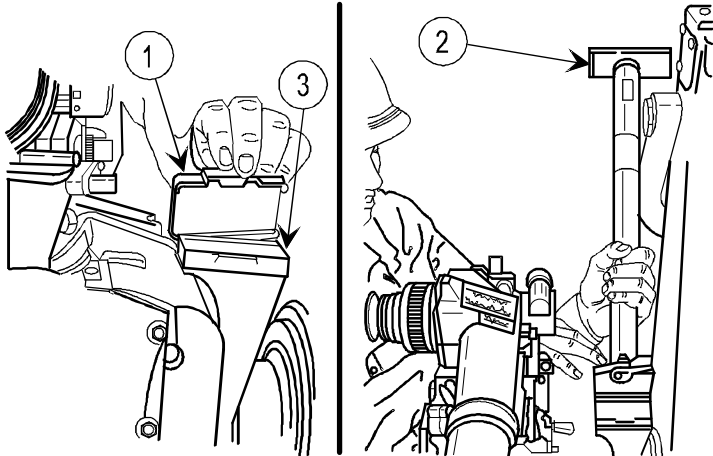

Item No.	Interval	Location	Crewmember Procedure	Not Fully Mission Capable If:
		Item to Check/ Service		
10	Before	M172 TELESCOPE AND QUADRANT MOUNT AND M18 FIRE CONTROL QUADRANT (cont)	<p>Assistant Gunner</p>  <p>d. Turn elevation control knob (7). Elevation control counter (2) should turn, and elevation correction counter (3) should not turn.</p> <p>e. Turn elevation correction knob (8). Elevation correction counter (3) should move in 1-mil increments. Elevation counter (2) should change by amount of correction applied.</p> <p>f. Telescope mounting surface must not be nicked or burred. Clean surface with crocus cloth (item 8, appx D).</p>	<p>Correction counter turns when elevation control knob is turned and M17 quadrant is nonoperational.</p> <p>Elevation correction counter does not move in 1-mil increments or does not change by the amount of correction applied, and the M17 quadrant is nonoperational.</p>

Table 2-1. PREVENTIVE MAINTENANCE CHECKS AND SERVICES FOR M198 HOWITZER (cont)

Item No.	Interval	Location	Crewmember Procedure	Not Fully Mission Capable If:
		Item to Check/ Service		
11	Before	M139 ALINEMENT DEVICE (Radioactive tritium H <sub>3</sub> )	Assistant Gunner 	
<div><div></div><div><p><b>WARNING</b></p><p>If broken or not illuminated, follow radioactive materials procedures in the front of this manual.</p></div></div>				
			<div><div>a. Check for illumination.</div><div>b. Remove protective cover (1). Check mounting surface for nicks and burrs. Install alinement device (2) on trunnion dovetail (3), and check for tight mounting.</div></div>	

2-11. PMCS PROCEDURES (cont)

Table 2-1. PREVENTIVE MAINTENANCE CHECKS AND SERVICES FOR M198 HOWITZER (cont)

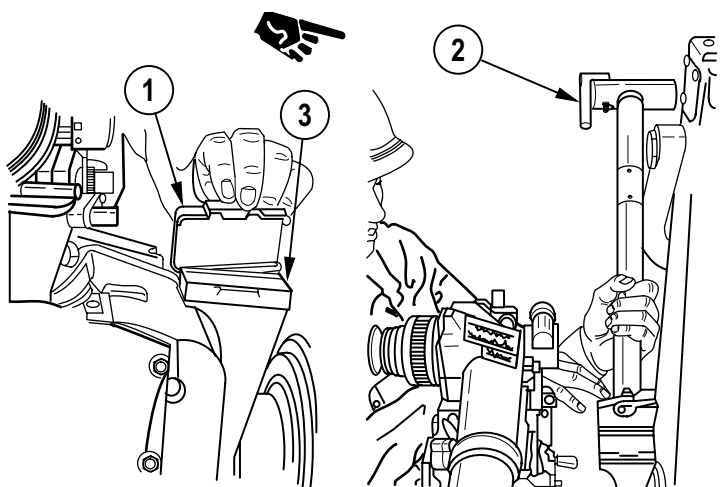





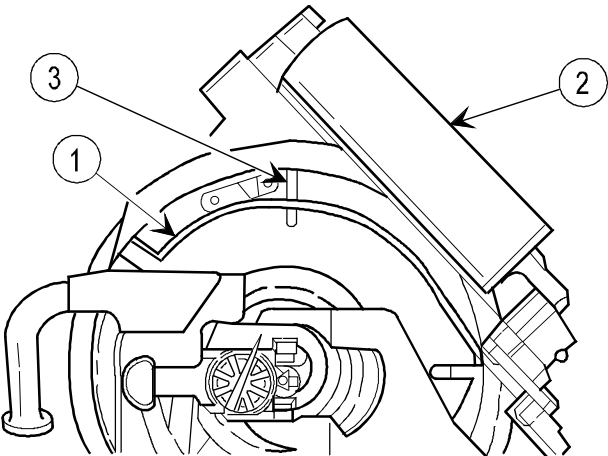
Item No.	Interval	Location	Crewmember Procedure	Not Fully Mission Capable If:
		Item to Check/ Service		
11.1	Before	M139A1 ALINEMENT DEVICE (ERLS Battery-Powered LED)	<p>Assistant Gunner</p>  <p>a. Check for illumination.</p> <p>Not illuminated.</p> <div><p><b>WARNING</b> Read and follow all warnings in WARNING SUMMARY. Pay careful attention to those about batteries.</p></div> <p>1. Replace battery (see procedure, page 3-14 malfunction 24, test or inspection step 3) and recheck.</p> <p>If still not illuminated after replacing battery, notify unit maintenance.</p> <p>b. Remove protective cover (1). Check mounting surface for nicks and burrs. Install alinement device (2) on trunnion dovetail (3), and check for tight mounting.</p> <p>Not illuminated.</p> <p>Surface has nicks and/or burrs.</p> <p>Mounting not tight.</p>	

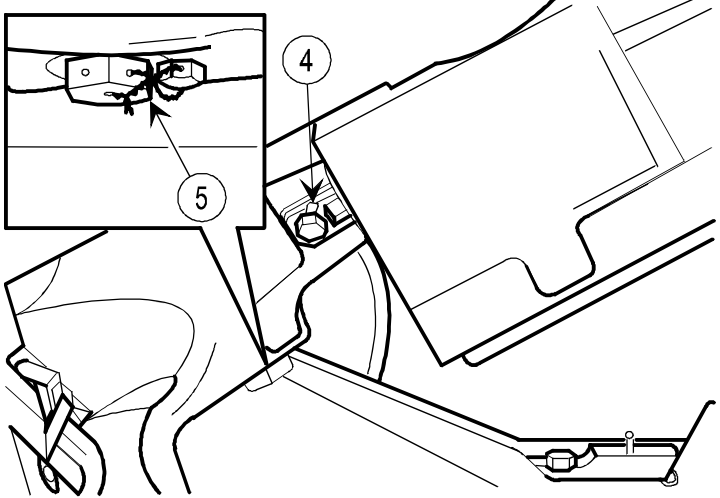
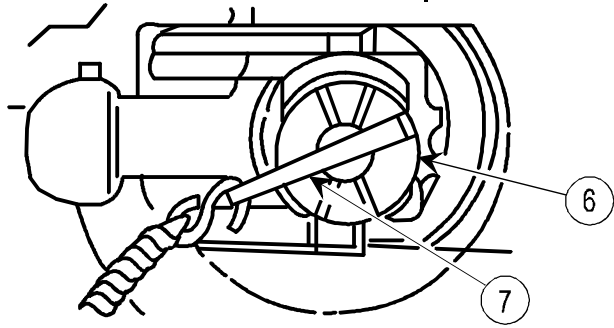
Table 2-1. PREVENTIVE MAINTENANCE CHECKS AND SERVICES FOR M198 HOWITZER (cont)

Item No.	Interval	Location	Crewmember Procedure	Not Fully Mission Capable If:
		Item to Check/Service		
12	Before	M138 ELBOW TELESCOPE	Assistant Gunner	
<div>  <p><b>WARNING</b> If broken or not illuminated, follow radioactive materials procedures in the front of this manual.</p> </div>				
			<p>a. Check for illumination.</p> <p>b. Check optics. Diopter scale should turn freely and allow individual focus. No inside moisture is allowed.</p> <p>c. Mount telescope and check for secure mounting.</p>	

**2-11. PMCS PROCEDURES (cont)****Table 2-1. PREVENTIVE MAINTENANCE CHECKS AND SERVICES FOR M198 HOWITZER (cont)**

Item No.	Interval	Location	Crewmember Procedure	Not Fully Mission Capable If:
		Item to Check/Service		
13	Before	<b>THERMAL WARNING DEVICE</b>	<b>Cannoneer No. 1</b> <ol style="list-style-type: none"> <li>Inspect for moisture inside thermal warning device (fogging of window). If defective, notify unit maintenance.</li> </ol>	
<p align="center"><b>NOTE</b></p> <p>If thermal warning device is inoperable, refer to tube temperature definitions in Misfire/Check Firing Procedures to determine tube temperature.</p>				
14	Before	<b>BREECH MECHANISM ASSEMBLY</b>	<b>Cannoneer No. 1</b>  <ol style="list-style-type: none"> <li>Check breechblock assembly (1) and breech counterbalance (2) by opening and closing breechblock assembly. Check for smooth operation and alinement of witness marks (3).</li> </ol>	<p>The breechblock assembly will not close or the witness marks do not aline.</p>

**Table 2-1. PREVENTIVE MAINTENANCE CHECKS AND SERVICES FOR M198 HOWITZER (cont)**

Item No.	Interval	Location	Crewmember Procedure	Not Fully Mission Capable If:
		Item to Check/Service		
			 <p>b. Check for loose bolts and missing or damaged parts, especially the torque key (4) and tube lock key (5). If bolts are loose, missing, or not lock wired, or if parts are damaged, notify unit maintenance.</p> 	<p>Torque key, tube lock key, capscrews, or lock wire missing.</p>
			<p><b>CAUTION</b></p> <p>Do not check operation of firing mechanism with primer cavity exposed. This will damage the firing pin.</p>	
			<p>c. Place firing mechanism (6) in firing position and check for proper operation by manually tripping the lanyard lever (7).</p>	<p>The primary and spare firing mechanism do not operate properly.</p>

## 2-11. PMCS PROCEDURES (cont)

Table 2-1. PREVENTIVE MAINTENANCE CHECKS AND SERVICES FOR M198 HOWITZER (cont)

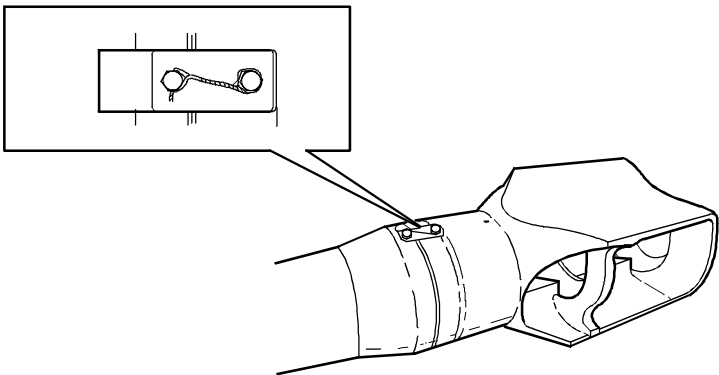
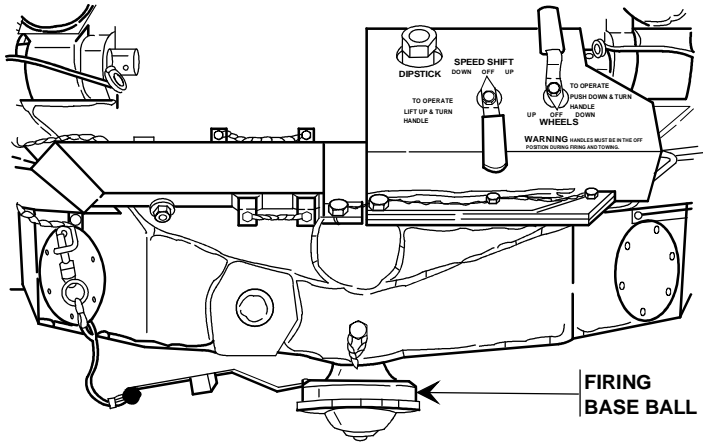
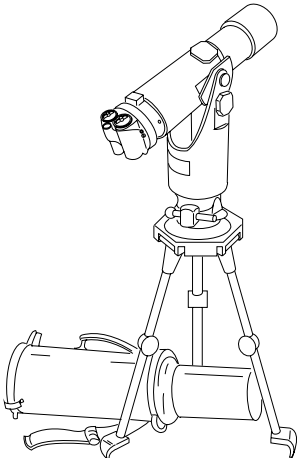
Item No.	Interval	Location	Crewmember Procedure	Not Fully Mission Capable If:
		Item to Check/ Service		
15	Before	MUZZLE BRAKE	<p>Cannoneer No. 1</p>  <p>a. Check for cracks over 1 in. (2.54 cm) long.</p> <p>b. Check for loose or missing bolts, muzzle brake key, and lock wire. If loose or missing, notify unit maintenance.</p>	<p>Muzzle brake cracks are over 1 in. (2.54 cm) long.</p> <p>Bolts, muzzle brake key, or lock wire missing.</p>

Table 2-1. PREVENTIVE MAINTENANCE CHECKS AND SERVICES FOR M198 HOWITZER (cont)

Item No.	Interval	Location	Crewmember Procedure	Not Fully Mission Capable If:
		Item to Check/Service		
16	Before	BOTTOM CARRIAGE, FIRING BASE BALL, FIRING BASE-PLATE	<p>Cannoneer No. 3</p>  <p>a. Make sure the firing base ball is free from dirt, burrs, and scoring. Do not lube. If rust is present notify unit maintenance.</p> <p>b. Inspect firing baseplate and attaching hardware for completeness.</p>	<p>Locking assembly does not operate, is broken, or does not lock into place because of cracks in firing base-plate.</p>





2-11. PMCS PROCEDURES (cont)

Table 2-1. PREVENTIVE MAINTENANCE CHECKS AND SERVICES FOR M198 HOWITZER (cont)

Item No.	Interval	Location	Crewmember Procedure	Not Fully Mission Capable If:
		Item to Check/ Service		
17	Before	M1A2 COLLIMATOR (ERLS Battery-Powered LED)	<div>Cannoneer No. 2</div> <div></div> <div><div>a. Check to ensure collimator is complete and operating properly.</div><div>b. Check for dirt or condensation on internal optics.</div><div>c. Check reticle image for illumination.</div><div>1. Press red power on/off switch on battery enclosure. Wait three seconds and recheck.</div></div>	<div>Collimator is not complete and/or does not operate properly.</div> <div>Dirt or condensation on internal optics.</div> <div>Not illuminated.</div> <div>Not illuminated.</div>

## 2-11. PMCS PROCEDURES (cont)

Table 2-1. PREVENTIVE MAINTENANCE CHECKS AND SERVICES FOR M198 HOWITZER (cont)

Item No.	Interval	Location	Crewmember Procedure	Not Fully Mission Capable If:
		Item to Check/ Service		
 		<div><b>WARNING</b> Read and follow all warnings in WARNING SUMMARY. Pay careful attention to those about batteries.</div>  		
			2. Install new batteries in battery enclosure (see procedure, page 3-24 paragraph 24 step 3) then recheck.	Not illuminated.
			3. Repeat step 1. above. If still not illuminated, notify unit maintenance.	Not illuminated. Notify unit maintenance
			d. Check for damage. If damaged, notify unit maintenance. If not damaged, clean and mount.	Collimator is damaged and aiming posts are not available.

2-11. PMCS PROCEDURES (cont)

Table 2-1. PREVENTIVE MAINTENANCE CHECKS AND SERVICES FOR M198 HOWITZER (cont)

Item No.	Interval	Location	Crewmember Procedure	Not Fully Mission Capable If:
		Item to Check/ Service		

**NOTE**

Howitzer must be hooked to prime mover. Prime mover air pressure of 90 psi or above must be maintained while performing brake system PMCS.

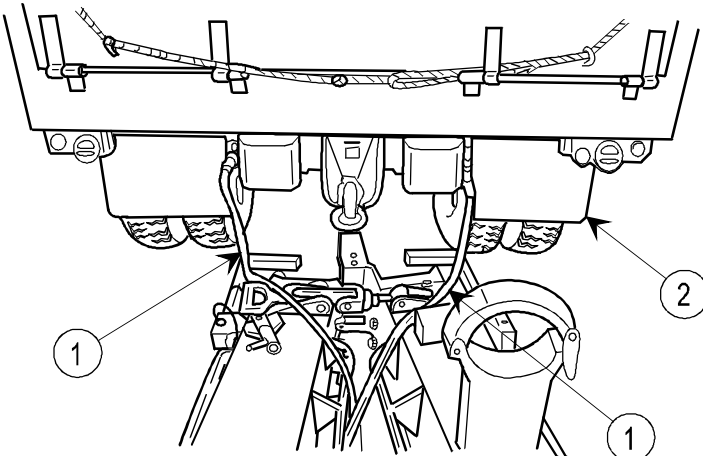
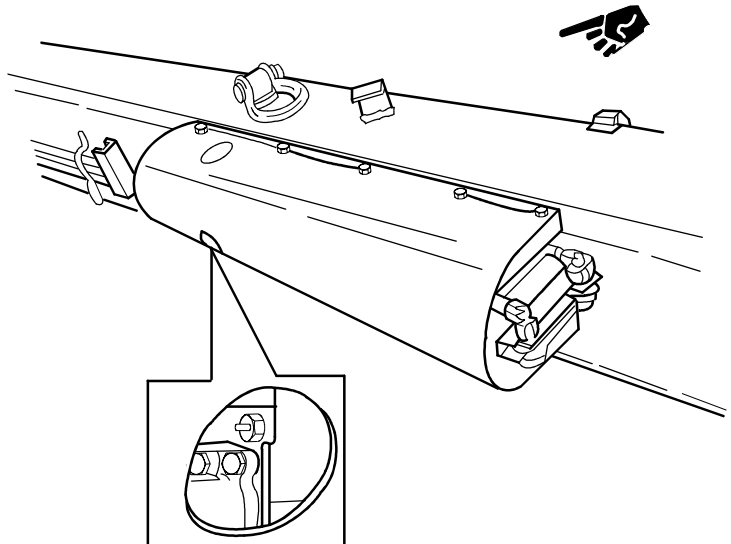
18	Before	<b>BRAKE SYSTEM</b>	<b>Cannoneers No. 4 and 5 and Prime Mover Driver</b>	
				
			<p>a. Connect hose assemblies (1) to prime mover (2), and open prime mover cutout cocks.</p> <p>b. Charge brake system by running the prime mover until its tank (until prime mover gage reads 90 psi or more) and the tank on the howitzer are charged.</p> <p>c. Apply brakes. Check length of travel of power booster indicator rod. If indicator rod moves more than 1-3/4 in. (4.45 cm), notify unit maintenance.</p>	Indicator rod extends more than 1-3/4 in. (4.45 cm).

Table 2-1. PREVENTIVE MAINTENANCE CHECKS AND SERVICES FOR M198 HOWITZER (cont)

Item No.	Interval	Location	Crewmember Procedure	Not Fully Mission Capable If:	
		Item to Check/Service			
		<p style="text-align: center;"><b>NOTE</b></p> <p>Steps d., e., and f. apply to howitzers that have not been modified.</p>			
			<div></div>	<p>d. With brake system charged, indicator rod should not extend more than 1/2 in. (1.27 cm). If indicator rod extends more than 1/2 in. (1.27 cm), check for proper hose connection. If hoses are connected properly and indicator rod is still extended, notify unit maintenance.</p> <p>e. Apply brakes. Indicator rod should extend 1-3/4 in. (4.45 cm), indicating enough pressure to stop the howitzer and prime mover.</p> <p>f. Release brakes. Indicator rod should retract to approximately 1/2 in. (1.27 cm). If indicator rod does not retract, notify unit maintenance.</p>	<p>Indicator rod extends more than 1/2 in. (1.27 cm).</p> <p>Indicator rod does not retract.</p>

2-11. PMCS PROCEDURES (cont)

Table 2-1. PREVENTIVE MAINTENANCE CHECKS AND SERVICES FOR M198 HOWITZER (cont)

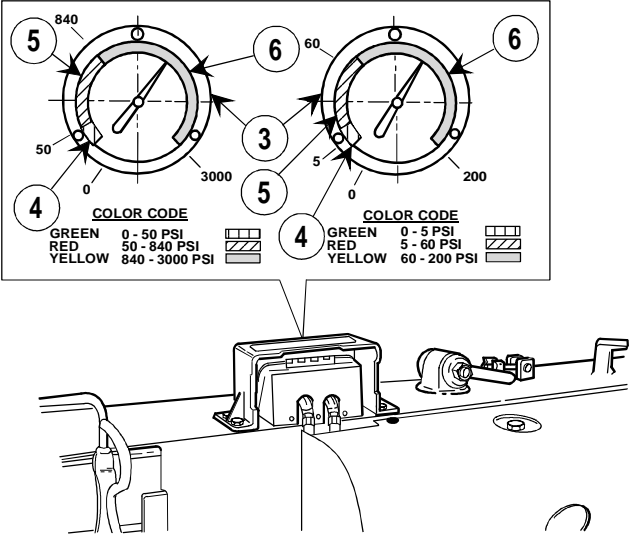
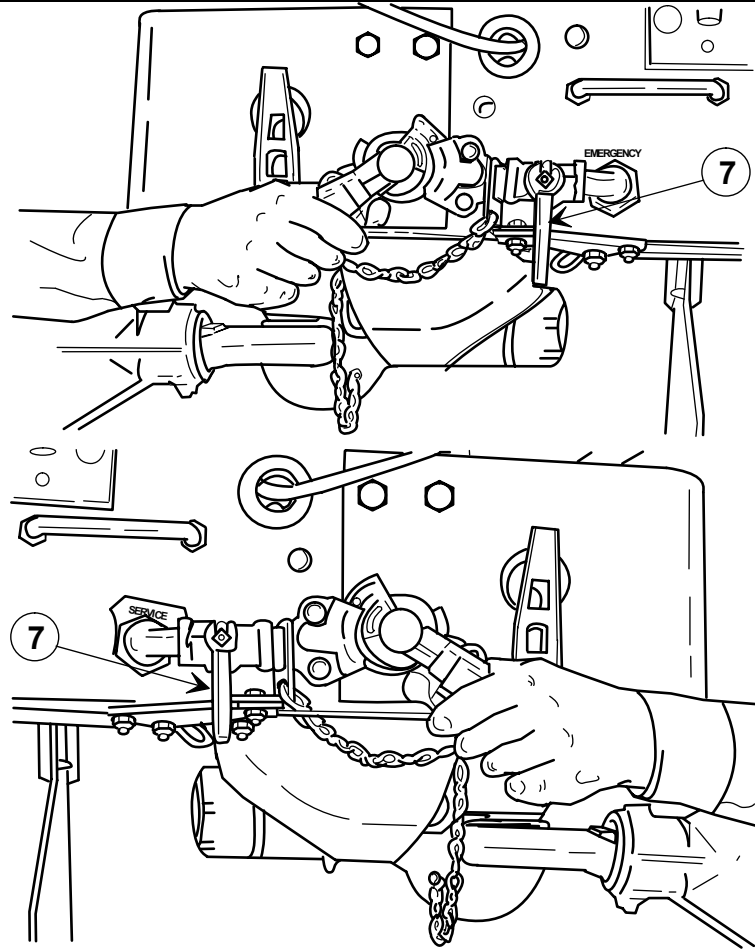
Item No.	Interval	Location	Crewmember Procedure	Not Fully Mission Capable If:
		Item to Check/Service		
18	Before	BRAKE SYSTEM (cont)	<p>Cannoneers No. 4 and 5 and Prime Mover Driver</p>  <p><b>NOTE</b> Steps g. and h. apply to howitzers that have been modified.</p> <p><b>g.</b> The low pressure and high pressure gages (3) should register in the green area (4). If either gage is in the red area (5), check that the hoses are correctly connected to prime mover. If the hoses are properly connected and gage remains in the red area, notify unit maintenance.</p> <p><b>h.</b> Apply prime mover brakes. Both gages should move to the yellow area (6), indicating there is enough pressure to stop the howitzer and prime mover. When the prime mover brakes are released, the gages should return to the green area. If gages remain in the red or yellow area, notify unit maintenance.</p>	<p>If gage or gages remain in the red.</p> <p>Gages remain in yellow or red area.</p>

Table 2-1. PREVENTIVE MAINTENANCE CHECKS AND SERVICES FOR M198 HOWITZER (cont)

Item No.	Interval	Location	Crewmember Procedure	Not Fully Mission Capable If:
		Item to Check/Service		
				
<p style="text-align: center;"><b>WARNING</b></p> <p>To prevent injury from air pressure, never disconnect hose assemblies before closing prime mover cutout cock.</p>				
			<p>i. Close prime mover cutout cock (7).</p> <p>j. Disconnect hose assemblies from prime mover. This should automatically set the brakes on howitzer. The indicator rod should extend approximately 1-3/4 in. (4.45 cm).</p>	<p>Indicator rod does not extend to approximately 1-3/4 in. (4.45 cm).</p>

2-11. PMCS PROCEDURES (cont)

Table 2-1. PREVENTIVE MAINTENANCE CHECKS AND SERVICES FOR M198 HOWITZER (cont)

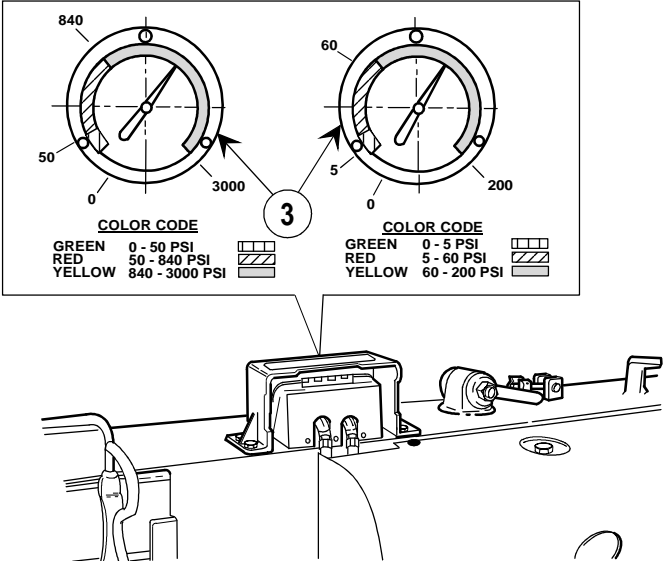





Item No.	Interval	Location	Crewmember Procedure	Not Fully Mission Capable If:
		Item to Check/ Service		
18	Before	BRAKE SYSTEM (cont)	<p>Cannoneers No. 4 and 5 and Prime Mover Driver</p>  <p><b>NOTE</b> Step k. applies to howitzers that have been modified.</p>	
			<p>k. Gages (3) should move to yellow, indicating brakes are set.</p> <p>l. Move howitzer slightly with prime mover to assure brakes are set. If brakes are not set, notify unit maintenance when mission is completed.</p> <p><b>CAUTION</b> The howitzer may be towed without properly functioning brakes only in emergency or wartime situations. The prime mover driver will be aware that the howitzer's brakes are not functioning properly and that stopping distances will increase. Towing speeds should be reduced accordingly.</p>	<p>Gages do not register in the yellow area.</p> <p>Brakes will not set.</p>
			<p>m. Disconnect brake lines if brake system is not functioning correctly. Bleed any air from howitzer's emergency air tank.</p>	

Table 2-1. PREVENTIVE MAINTENANCE CHECKS AND SERVICES FOR M198 HOWITZER (cont)

Item No.	Interval	Location	Crewmember Procedure	Not Fully Mission Capable If:
		Item to Check/ Service		
18.1	Before	NATO SLAVE CABLE	<b>Cannoneers No. 4 and 5</b> <ol style="list-style-type: none"> <li>Inspect NATO slave cable for any cuts to the insulation exposing the electrical wire inside.</li> <li>Inspect both ends of slave cable. <ol style="list-style-type: none"> <li>Check inside of NATO plug for rubber protective boot on center "Positive" post and any missing outer "Negative" contact fingers.</li> <li>Ensure cables are securely attached to NATO plug, i.e., no bare wires.</li> </ol> </li> </ol>	
18.2	Before	HIPE Equipment for HIPE Modified Howitzers	<b>Chief of Section</b> <ol style="list-style-type: none"> <li>Check all HIPE boxes (Antenna/ NATO, PSDU, Radio, and Battery) for damage).</li> <li>Check all cables and connectors for damage.</li> <li>Connectors engaged completely by checking that the "yellow dots" are aligned.</li> <li>HyPak cut off switch is in the "ON" position.</li> </ol>	
18.3	Before	HIPE System Voltage for HIPE Modified Howitzers	<b>Chief of Section</b> <p><b>CAUTION</b></p> <p>If system voltage falls below 18V, the system will automatically shut down to avoid damaging the batteries.</p> <p>Check system voltage by pressing the TEST button. If 20V or less, perform HIPE system battery charging (refer to Paragraph 3-39.1).</p>	



Table 2-1. PREVENTIVE MAINTENANCE CHECKS AND SERVICES FOR M198 HOWITZER (cont)

Item No.	Interval	Location	<u>Crewmember</u> Procedure	Not Fully Mission Capable If:		
		Item to Check/Service				
		<div><b>WARNING</b> If broken or not illuminated, follow radioactive materials procedures in the front of this manual.</div>				
19	During	M137/M137A3 PANORAMIC TELESCOPE	<b>Gunner</b>  Check counters and reticles for illumination.  1. Press red power on/off switch on battery enclosure. Wait three seconds and recheck.	Reticles or counters are not illuminated.  Not illuminated.		
		<div><div></div><b>WARNING</b> Read and follow all warnings in WARNING SUMMARY. Pay careful attention to those about batteries.</div>				<div></div>
			2. Install new batteries in battery enclosure (see procedure, page 3-24 paragraph 24 step 3) then recheck.  3. Repeat step 1. (above). If still not illuminated, notify unit maintenance.	Not illuminated.  Not illuminated. Notify unit maintenance.		

2-11. PMCS PROCEDURES (cont)

Table 2-1. PREVENTIVE MAINTENANCE CHECKS AND SERVICES FOR M198 HOWITZER (cont)

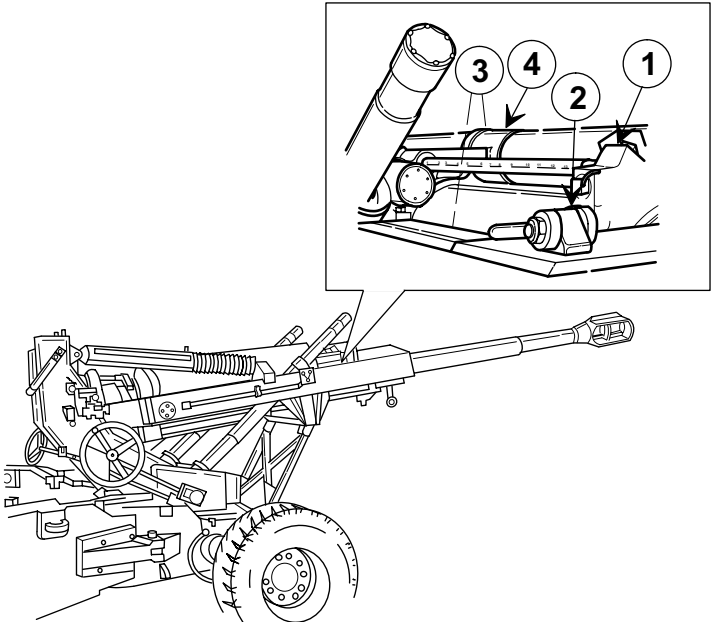
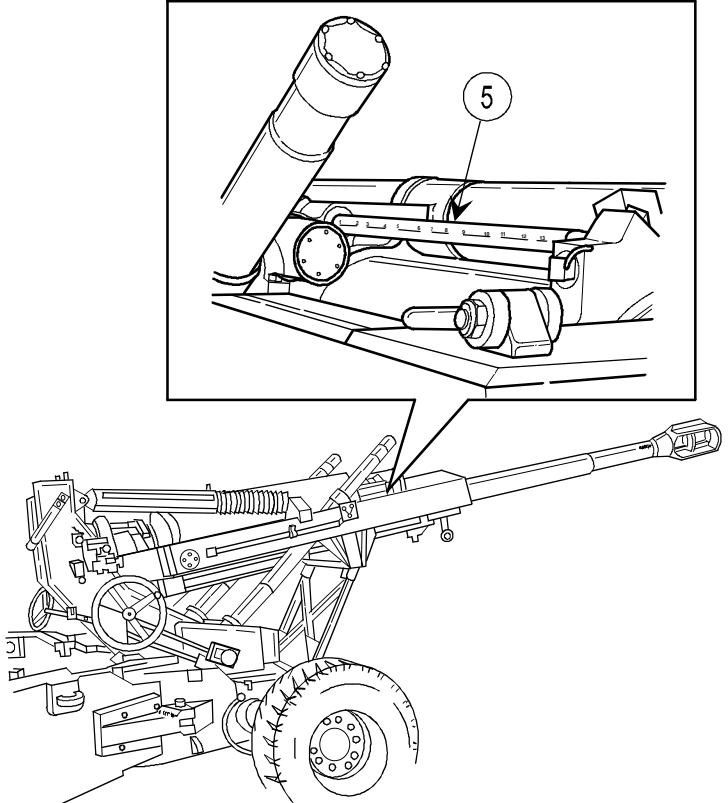
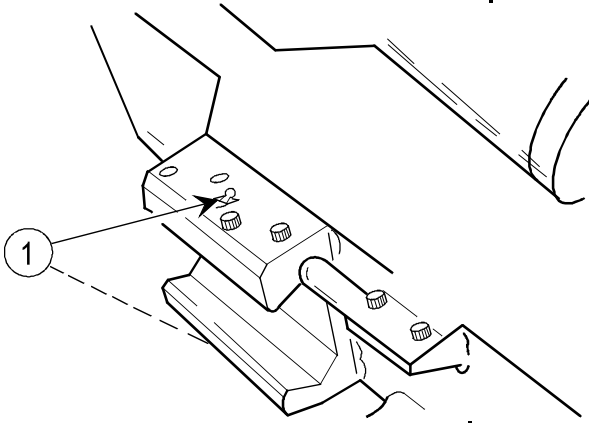
Item No.	Interval	Location	<u>Crewmember</u> Procedure	Not Fully Mission Capable If:
		Item to Check/Service		
20	During	RECOIL MECHANISM	<div>Assistant Gunner</div> <div></div> <div>a. Check recoil mechanism for oil leakage at front yoke assembly (1), oil valve assembly (2), recoil cylinder assemblies (3), and recuperator cylinder assembly (4). Oil leakage from back of recoil assemblies is considered normal unless leakage is over two reserves per day during firing. If leakage is from other points or is more than two reserves per day, notify unit maintenance.</div>	<div>Oil leakage detected at front yoke or valve assembly or leakage is greater than two reserves from rear of recoil cylinders.</div>

Table 2-1. PREVENTIVE MAINTENANCE CHECKS AND SERVICES FOR M198 HOWITZER (cont)

Item No.	Interval	Location	Crewmember Procedure	Not Fully Mission Capable If:
		Item to Check/ Service		
20	During	RECOIL MECHANISM (cont)	<p>Assistant Gunner</p>  <p><b>NOTE</b> The oil reserve indicator must be visible at all times.</p> <div> <p><b>b.</b> Check that oil reserve indicator (5) is on or between 2 and 10 reserves. If oil exceeds 10 reserves, or less than 2 reserves, notify unit maintenance.</p> <p><b>c.</b> Check for presence of restraint keys, capscrews, and lock wire for both recoil cylinders and recuperator assemblies.</p> </div>	<p>Indicator shows no oil reserves.</p> <p>Restraint keys, capscrews, or lock wire missing.</p>

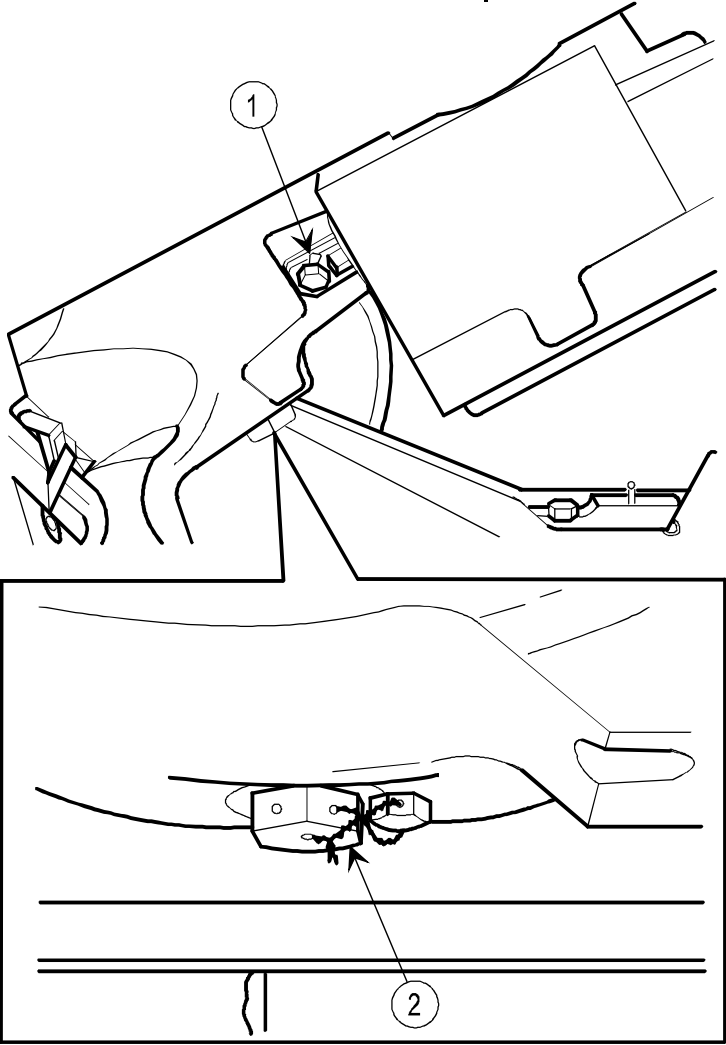


**Table 2-1. PREVENTIVE MAINTENANCE CHECKS AND SERVICES FOR M198 HOWITZER (cont)**

Item No.	Interval	Location	Crewmember Procedure	Not Fully Mission Capable If:
		Item to Check/Service		
21	During	CARRIAGE	<p><b>Chief of Section and Assistant Gunner</b></p> <p>a. Check for smooth operation, length of recoil, and complete movement to battery position without shock.</p>  <p><b>Assistant Gunner</b></p> <p>b. Lube cradle guide assembly (1) with WTR grease (item 13, appx D) during excessive firing.</p> <p>c. Clean firing residue from top and bottom recoil mechanism rails.</p>	Recoil slams into battery.
22	During	THERMAL WARNING DEVICE	<p><b>Cannoneer No. 1</b></p> <p><b>NOTE</b></p> <p>If thermal warning device is inoperable, refer to tube temperature definitions in Misfire/Check Firing Procedures to determine tube temperature.</p> <p>Check operation of thermal warning device. Indicator should show cannon tube temperature during firing.</p>	

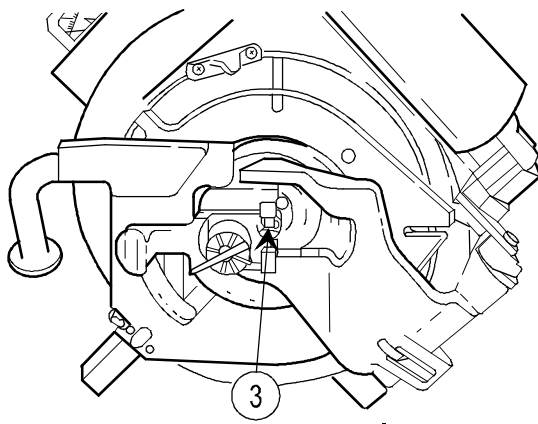
## 2-11. PMCS PROCEDURES (cont)

Table 2-1. PREVENTIVE MAINTENANCE CHECKS AND SERVICES FOR M198 HOWITZER (cont)

Item No.	Interval	Location	Crewmember Procedure	Not Fully Mission Capable If:
		Item to Check/Service		
23	During	BREECH MECHANISM ASSEMBLY	Cannoneer No. 1  	Torque key, tube lock key, capscrews, or lock wire missing.

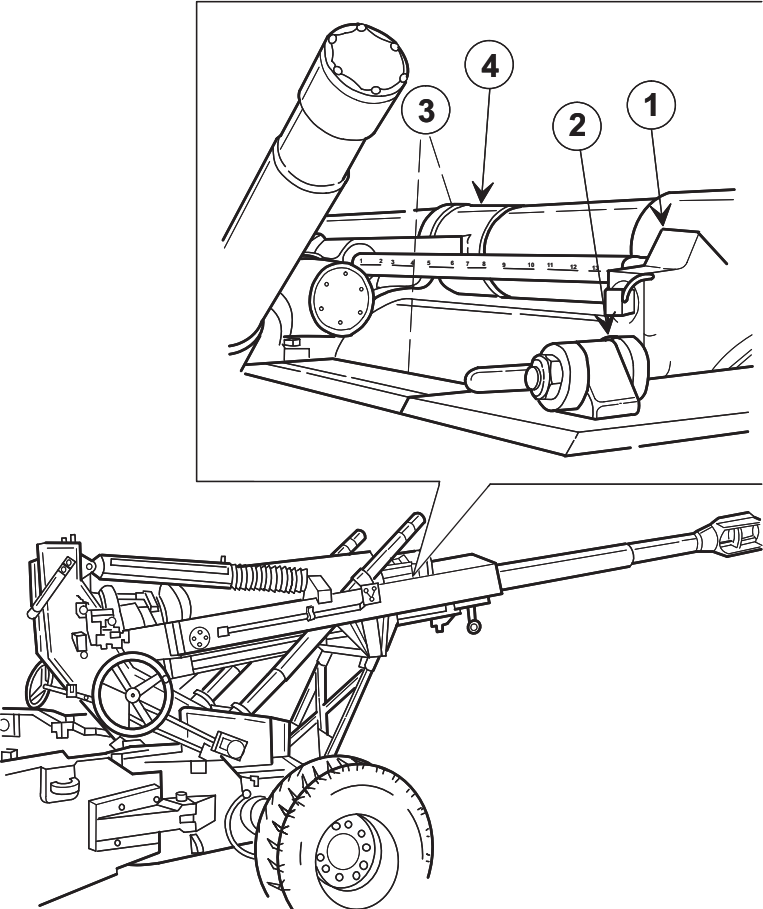
- a. Check for lock wire, loose bolts, and missing or damaged parts, especially the torque key (1) and tube lock key (2).

Table 2-1. PREVENTIVE MAINTENANCE CHECKS AND SERVICES FOR M198 HOWITZER (cont)

Item No.	Interval	Location	Crewmember Procedure	Not Fully Mission Capable If:
		Item to Check/ Service		
24	During	MUZZLE BRAKE	 <p>b. Inspect primer cavity (3) for corrosion or powder fouling. Clean primer cavity by inserting reamer assembly as far as it will go and briskly rotating reamer assembly. Remove loose powder with primer cleaning brush.</p> <p>c. Check to be sure that vent hole in obturator spindle assembly is clear. Run primer cleaning brush through vent hole several times with push-pull movement or by inserting vent cleaning tool through vent and rotating it clockwise until clean.</p> <p><b>Cannoneer No. 1</b></p> <p>a. Check for cracks over 1 in. (2.54 cm) long.</p> <p>b. Check for loose or missing bolts, muzzle brake key, and lock wire. If loose or missing, notify unit maintenance.</p>	Muzzle brake cracks are over 1 in. (2.54 cm) long. Bolts, muzzle brake key, or lock wire are missing.
24.1	During	HIPE System Voltage for HIPE Modified Howitzers	<p><b>Chief of Section</b></p> <p><b>CAUTION</b></p> <p>If system voltage falls below 18V, the system will automatically shut down to avoid damaging the batteries.</p> <p>Check system voltage by pressing the TEST button. If 20V or less, perform HIPE system battery charging (refer to Paragraph 3-39.1).</p>	

## 2-11. PMCS PROCEDURES (cont)

**Table 2-1. PREVENTIVE MAINTENANCE CHECKS AND SERVICES FOR M198 HOWITZER (cont)**

Item No.	Interval	Location	Crewmember Procedure	Not Fully Mission Capable If:
		Item to Check/ Service		
25	After	EQUIPMENT RECORD HOLDER	<b>Chief of Section</b> <ol style="list-style-type: none"> <li>Record the number of rounds fired on DA form 2408-4.</li> <li>Ensure all the required forms (DA PAM 738-750) are present.</li> </ol>	
26	After	RECOIL MECHANISM	<b>Assistant Gunner</b> 	

**Table 2-1. PREVENTIVE MAINTENANCE CHECKS AND SERVICES FOR M198 HOWITZER (cont)**

Item No.	Interval	Location	Crewmember Procedure	Not Fully Mission Capable If:
		Item to Check/Service		
			<p>a. Check recoil mechanism for oil leakage at front yoke assembly (1), oil valve assembly (2), recoil cylinder assemblies (3), and recuperator cylinder assembly (4). Oil leakage from back of recoil cylinder assemblies. If leakage is over two reserves per day during firing or if leakage is from other areas, notify unit maintenance.</p> <p>b. Check lock wire, bolt, and restraint key on both recoil and recuperator cylinder assemblies.</p> <p>c. Clean firing residue from top and bottom recoil mechanism rails.</p> <p>d. Clean residue from variable recoil shaft.</p>	<p>Oil leakage at front yoke or valve assembly.</p> <p>Leakage is greater than two reserves from rear of recoil cylinders.</p> <p>Lock wire, bolts, or restraint keys are missing.</p>

**2-11. PMCS PROCEDURES (cont)****Table 2-1. PREVENTIVE MAINTENANCE CHECKS AND SERVICES FOR M198 HOWITZER (cont)**

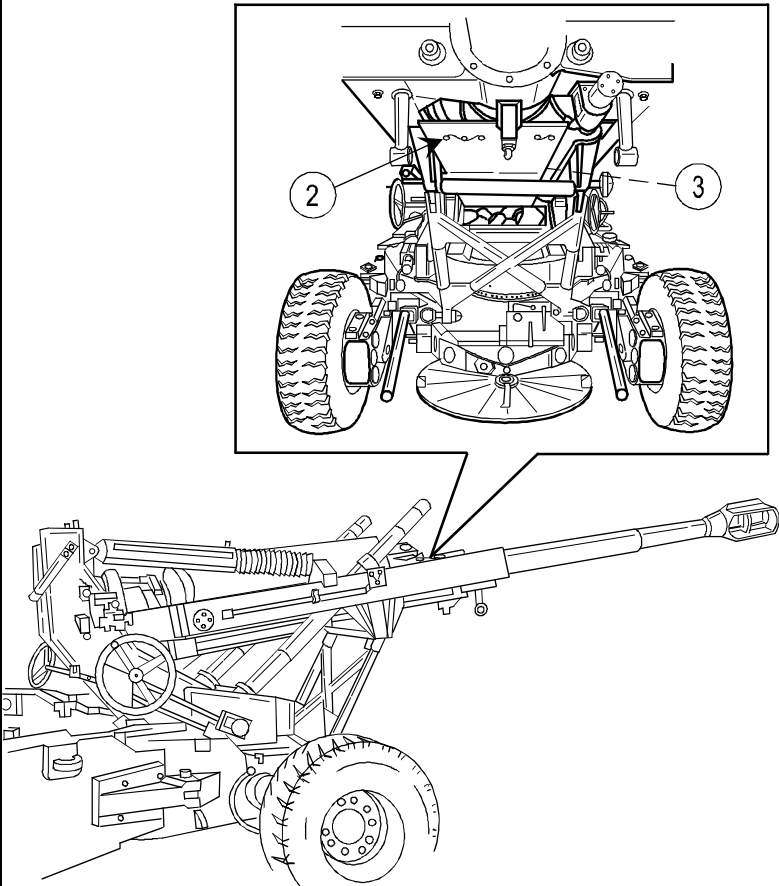
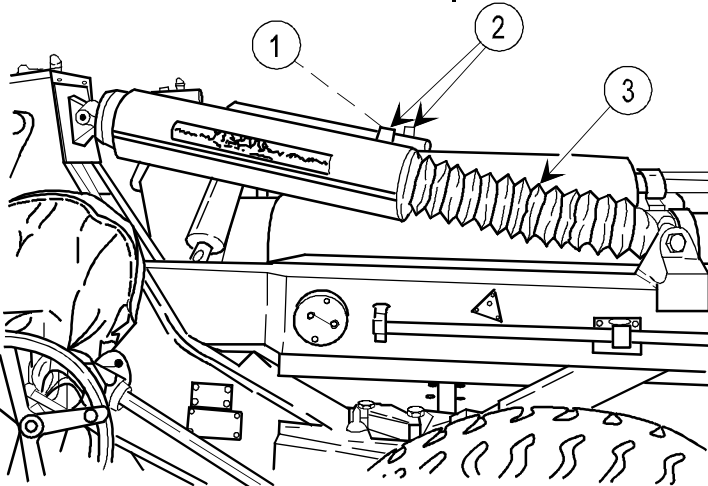
Item No.	Interval	Location	Crewmember Procedure	Not Fully Mission Capable If:
		Item to Check/ Service		
27	After	FRONT RECOIL YOKE ASSEMBLY	<p>Assistant Gunner</p>  <p>Check for presence of lock wire on front recoil yoke assembly screws (2). Do not tighten screws. If lock wire is missing, notify unit maintenance.</p>	Lock wire is missing.

Table 2-1. PREVENTIVE MAINTENANCE CHECKS AND SERVICES FOR M198 HOWITZER (cont)

Item No.	Interval	Location	Crewmember Procedure	Not Fully Mission Capable If:
		Item to Check/ Service		
28	After	MIDDLE RECOIL YOKE ASSEMBLY	Assistant Gunner  Check for presence of lock wire on middle recoil yoke assembly screws (3). Do not tighten screws. Notify unit maintenance if lock wire is missing.	Lock wire is missing.
29	After	EQUILIBRATOR CYLINDERS	Assistant Gunner   <ol style="list-style-type: none"> <li>Inspect for moisture around both check valves (1) and caps (2). Remove any foreign matter with wiping rag (item 24, appx D).</li> <li>Check bellows (3) for damage or wear. If damaged, notify unit maintenance.</li> </ol>	

## 2-11. PMCS PROCEDURES (cont)

Table 2-1. PREVENTIVE MAINTENANCE CHECKS AND SERVICES FOR M198 HOWITZER (cont)

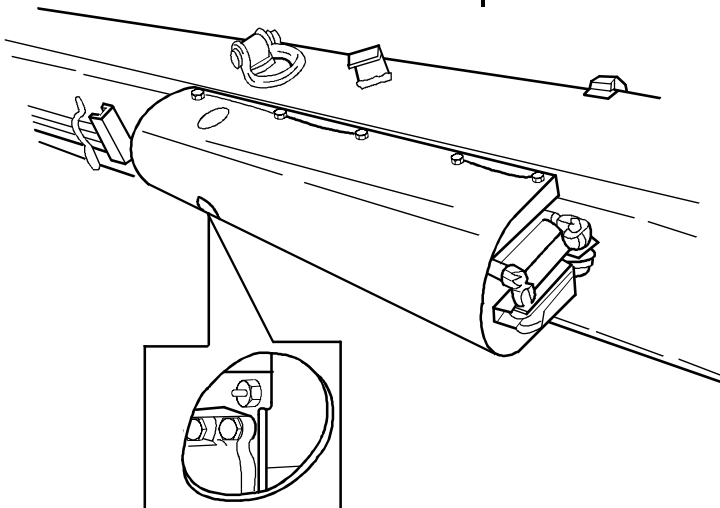
Item No.	Interval	Location	Crewmember Procedure	Not Fully Mission Capable If:
		Item to Check/Service		
30	After	BRAKE SYSTEM	<p><b>Cannoneers No. 4 and 5 and Prime Mover Driver</b></p> <ol style="list-style-type: none"> <li>Connect hose assemblies to prime mover. Open prime mover cutout cocks.</li> <li>Charge brake system by running prime mover until its tank and the tank on the howitzer are charged.</li> </ol>  <ol style="list-style-type: none"> <li>For unmodified howitzers, the indicator rod should not extend more than approximately 1/2 in. (1.27 cm). Check that hoses are connected properly.</li> <li>Apply prime mover brakes. For unmodified and modified howitzers, the indicator rod should not extend more than 1-3/4 in. (4.45 cm). If indicator rod extends more than 1-3/4 in. (4.45 cm), notify unit maintenance.</li> </ol>	Indicator rod extends beyond 1-3/4 in. (4.45 cm).

Table 2-1. PREVENTIVE MAINTENANCE CHECKS AND SERVICES FOR M198 HOWITZER (cont)

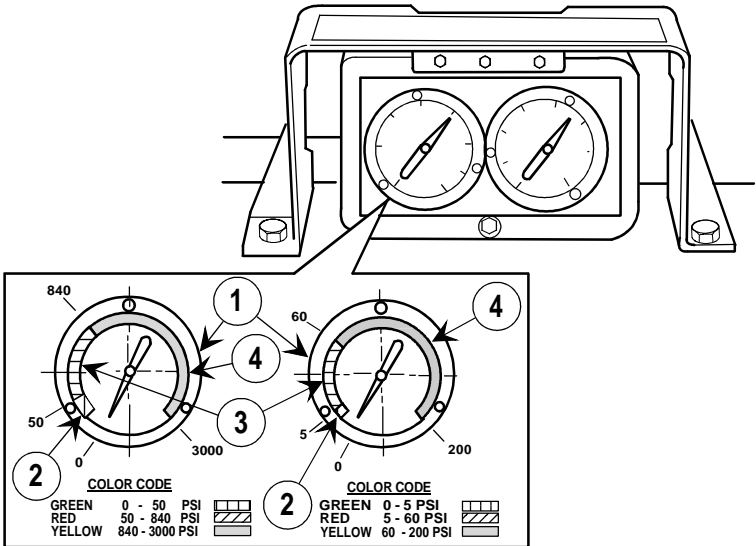




Item No.	Interval	Location	Crewmember Procedure	Not Fully Mission Capable If:
		Item to Check/ Service		
			<div></div> <p>e. On modified howitzers, the low pressure and high pressure gages (1) should register in the green areas (2). If either gage is in the red area (3) or yellow area (4), check that hoses are connected correctly between the prime mover and howitzer.</p> <p>f. Apply prime mover brakes. Both gages should move to the yellow area (4), indicating there is enough pressure to stop the howitzer and prime mover. When the prime mover brakes are released, the gages should return to the green area. If gages remain in the red or yellow area, notify unit maintenance.</p>	Gages remain in the red or yellow area.



Table 2-1. PREVENTIVE MAINTENANCE CHECKS AND SERVICES FOR M198 HOWITZER (cont)

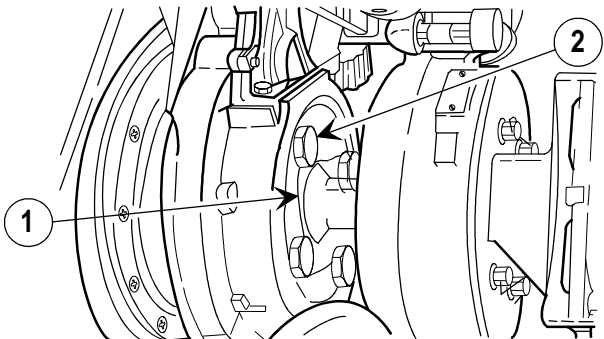
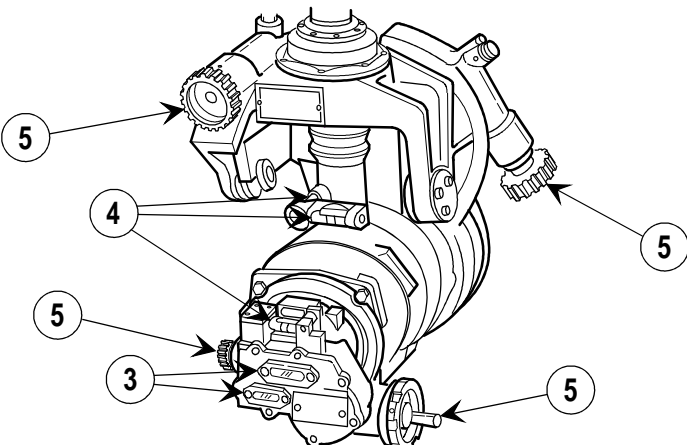

Item No.	Interval	Location	Crewmember Procedure	Not Fully Mission Capable If:
		Item to Check/ Service		
31	After	M1A2 COLLIMATOR (ERLS Battery-Powered LED)	<p><b>Cannoneer No. 2</b></p> <ol style="list-style-type: none"> <li>Check to ensure collimator is complete and operating properly.</li> <li>Check for dirt or condensation on internal optics.</li> <li>Check reticle image for illumination.               <ol style="list-style-type: none"> <li>Press red power on/off switch on battery enclosure. Wait three seconds and recheck.</li> </ol> </li> </ol>	<p>Collimator is not complete and/or does not operate properly.</p> <p>Dirt or condensation on internal optics.</p> <p>Not illuminated.</p> <p>Not illuminated.</p>
<div>   <div> <p><b>WARNING</b></p> <p>Read and follow all warnings in WARNING SUMMARY. Pay careful attention to those about batteries.</p> </div>   </div>				
			<ol style="list-style-type: none"> <li>Install new batteries in battery enclosure (see procedure, page 3-24 paragraph 24 step 3) then recheck.</li> <li>Repeat step 1. (above). If still not illuminated, notify unit maintenance.</li> <li>Check for damage. If damaged, notify unit maintenance. If not damaged, clean and stow.</li> </ol>	<p>Not illuminated.</p> <p>Not illuminated. Notify unit maintenance.</p> <p>Collimator is damaged and aiming posts are not available.</p>

## 2-11. PMCS PROCEDURES (cont)

Table 2-1. PREVENTIVE MAINTENANCE CHECKS AND SERVICES FOR M198 HOWITZER (cont)

Item No.	Interval	Location	Crewmember Procedure	Not Fully Mission Capable If:
		Item to Check/Service		
32	After	M1A2 AIMING POST AND M14A1 AIMING POST LIGHTS	<b>Cannoneer No. 5</b>  Check for damage; clean and stow.	Trail lock does not operate.
33	Weekly	M1A1 GUNNER'S QUADANT	<b>Chief of Section</b>  a. Check level vial for cracks, breaks, and legibility.  b. Check for free cover movement.	
34	Weekly	TRAILS	<b>Ammunition Team Chief</b>  a. Check trail lock to assure trails will lock into closed position. Rotate cam handle to disengage trail lock handle.  b. Check that trail retaining pin is present. If missing, notify unit maintenance.  c. Check trail hinge pins by opening and closing trails. Trails should not bind in either direction. If trails bind, notify unit maintenance.	
35	Weekly	WHEEL AND AXLE	<b>Gunner</b>  a. Check the wheel nuts. If loose, have unit maintenance torque to 450-500 ft-lb (610.2-678 N-m).  b. Check wheels for dents or cracks. Notify unit maintenance.	

Table 2-1. PREVENTIVE MAINTENANCE CHECKS AND SERVICES FOR M198 HOWITZER (cont)

Item No.	Interval	Location	Crewmember Procedure	Not Fully Mission Capable If:
		Item to Check/Service		
36	Weekly	M171 TELESCOPE AND QUADRANT MOUNT AND M17 FIRE CONTROL QUADRANT	Gunner	
				
				<div><div><div>a. Check that lock wire (1) is fastened to mounting screws (2).</div><div>b. Check all surfaces for dirt, dust, rust, moisture, and corrosion.</div></div><div>Mounting screws are loose or missing.</div></div>
<div><div></div><div><div>WARNING</div><div>If broken or not illuminated, follow radioactive materials procedures in the front of this manual.</div></div></div>				
			<div><div><div>c. Check all illuminated counters (3) and vials (4) for illumination.</div><div>d. Turn all knobs (5) to check for proper operation and smoothness of operation.</div></div><div>Counters or vials broken or not illuminated.</div></div>	

## 2-11. PMCS PROCEDURES (cont)

Table 2-1. PREVENTIVE MAINTENANCE CHECKS AND SERVICES FOR M198 HOWITZER (cont)

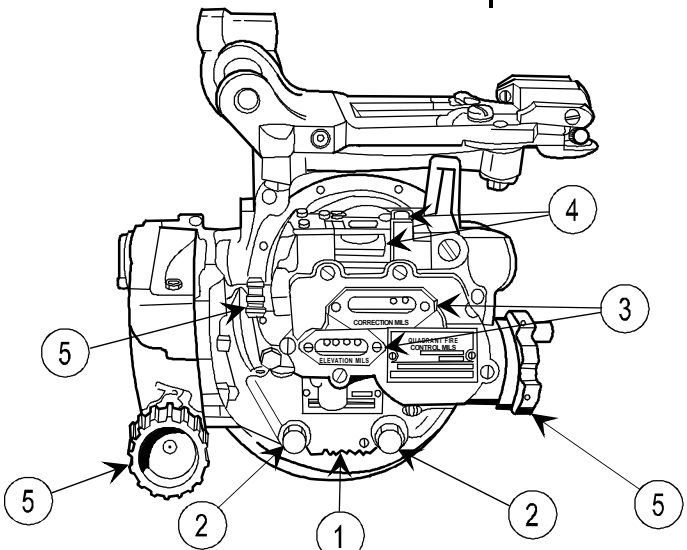
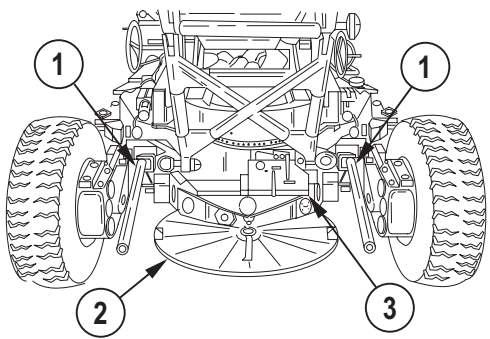
Item No.	Interval	Location	Crewmember Procedure	Not Fully Mission Capable If:
		Item to Check/Service		
37	Weekly	M172 TELESCOPE AND QUADRANT MOUNT AND M18 FIRE CONTROL QUADRANT	Assistant Gunner	
			 <p>a. Check that lock wire (1) is fastened to mounting screws (2).</p> <p>b. Check all surfaces for dirt, dust, rust, moisture, and corrosion.</p>	Mounting screws are loose or missing.
			<p><b>WARNING</b></p> <p>If broken or not illuminated, follow radioactive materials procedures in the front of this manual.</p> <p>c. Check all illuminated counters (3) and vials (4) for illumination.</p> <p>d. Turn all knobs (5) to check for proper operation and smoothness of operation.</p>	Counters or vials broken or not illuminated.

Table 2-1. PREVENTIVE MAINTENANCE CHECKS AND SERVICES FOR M198 HOWITZER (cont)

Item No.	Interval	Location	Crewmember Procedure	Not Fully Mission Capable If:
		Item to Check/ Service		
38	Weekly	SUSPENSION SYSTEM	<p>Cannoneers No. 3 and 4</p>  <p>a. Operate hydraulic pumps (1) and lower weapon onto firing baseplate (2) to check for proper operation of manifold assembly (3) and wheel and axle (p 2-5). Operate speed shift assembly (p 2-5) and check for proper operation.</p> <p>b. Repeat above procedures using HyPak switch. If system does not function, notify unit maintenance.</p>	Hydraulic pump or manifold assembly does not operate.

## 2-11. PMCS PROCEDURES (cont)

Table 2-1. PREVENTIVE MAINTENANCE CHECKS AND SERVICES FOR M198 HOWITZER (cont)

Item No.	Interval	Location	Crewmember Procedure	Not Fully Mission Capable If:
		Item to Check/Service		
39	After	HIPE Equipment for HIPE Modified Howitzers	<b>Chief of Section</b> <ol style="list-style-type: none"> <li>Check all HIPE boxes (Antenna/ NATO, PSDU, Radio, and Battery) for damage).</li> <li>Check all cables and connectors for damage.</li> <li>Connectors engaged completely by checking that the "yellow dots" are aligned.</li> <li>HyPak cut off switch is in the "ON" position.</li> </ol>	
40	After	HIPE System Voltage for HIPE Modified Howitzers	<b>Chief of Section</b> <p><b>CAUTION</b></p> <p>If system voltage falls below 18V, the system will automatically shut down to avoid damaging the batteries.</p> <p>Check system voltage by pressing the TEST button. If 20V or less, perform HIPE system battery charging (refer to Paragraph 3-39.1).</p>	

## SECTION III. OPERATION UNDER USUAL CONDITIONS

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### 2-12. GENERAL

a. The personnel of the howitzer section consist of the following:

(1) A chief of section (CS) whose duties and responsibilities are the following:

- (a) Training and efficiency of personnel.
- (b) Performance of his section in training; firing, testing, and adjusting fire control equipment; and inspection and maintenance of all section equipment, including the prime mover.
- (c) Observance of safety precautions.
- (d) Preparation of field fortifications for protection of equipment, ammunition, and personnel.
- (e) Camouflage discipline and local security, and radiological, biological, and chemical security discipline.
- (f) Maintenance of forms in the equipment record folder.
- (g) Policing the section area.

## 2-12. GENERAL (cont)

(2) A gunner (G) who assists the chief of section in carrying out the duties specified in subparagraph (1). The gunner's specific duties are described in this manual.

(3) An ammunition team chief (ATC) who leads and directs the handling of ammunition and assists chief of section in the supervision of howitzer section. The ATC also performs duties as listed in this manual and other duties as directed.

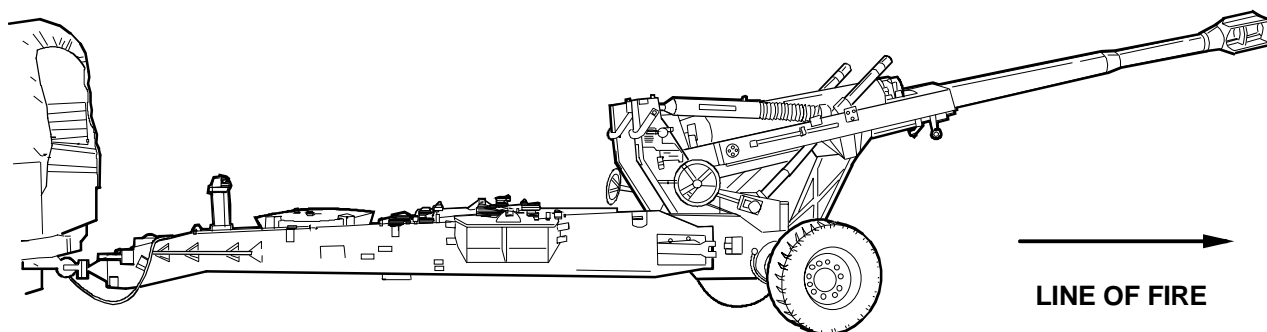
(4) An assistant gunner (AG) who assists the gunner and, in an emergency, acts as the gunner. The assistant gunner's specific duties are described in this manual.

(5) Five cannoneers, numbered 1 to 5, who perform duties as listed in this manual and other duties as directed.

(6) A prime mover driver (PMD) whose primary duty is to drive the prime mover of the section. Maintenance and other duties are described by this manual or directed by the chief of section.

b. Section equipment is listed in the appropriate tables of organization and equipment (TOE's) and appendix B of this manual.

## 2-13. EMPLACING THE HOWITZER



### WARNING

NEVER lower Howitzer off of its wheels without the trails being spread fully in the open position. The Howitzer could tip over to the side.

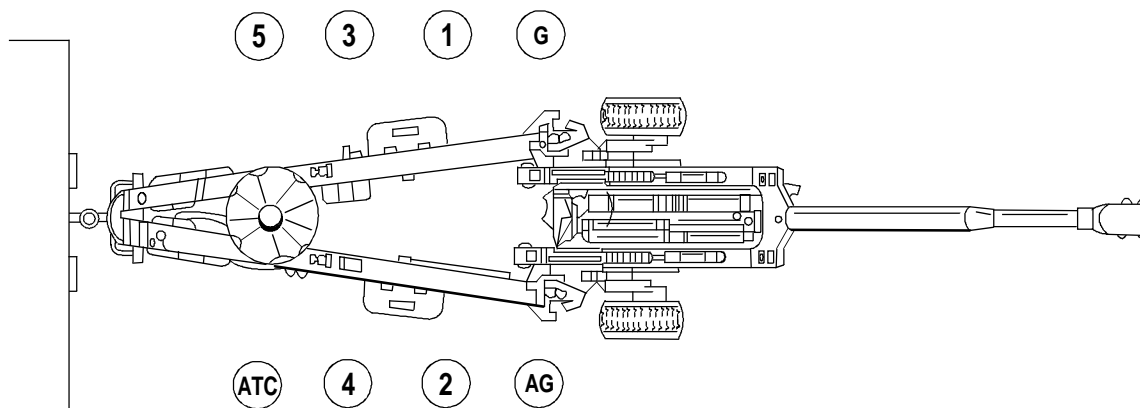
### CAUTION

Do not use the firing baseplate and detent assembly as a speed shift assembly. The bottom carriage could be damaged, which would require replacing the entire howitzer.

### NOTE

- The chief of section supervises the occupation of the firing section position. The prime mover driver should drive the prime mover into the firing position opposite the line of fire.
- Procedures for preparation for firing have been standardized under the Department of the Army Standardization Program.
- Prime mover engine should not be operating while HyPAK is in operation.

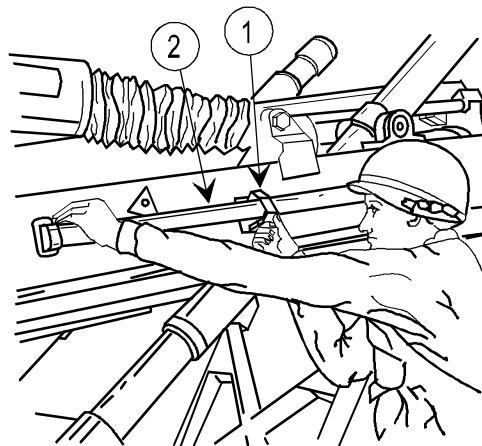
- 1 After prime mover comes to a complete stop, the chief of section commands, DISMOUNT. Upon hearing the command, the section exits through rear of prime mover.



2 All section members take positions as illustrated.

3 The chief of section commands, PREPARE FOR ACTION.

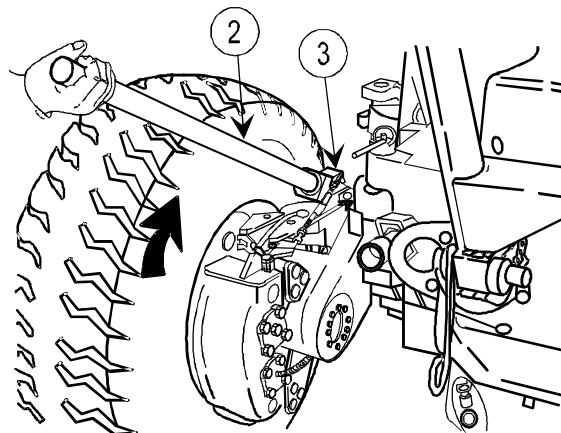
4 The assistant gunner unlatches holder (1) on right side and removes pump handle (2). Gunner unlatches holder on left side and removes pump handle.



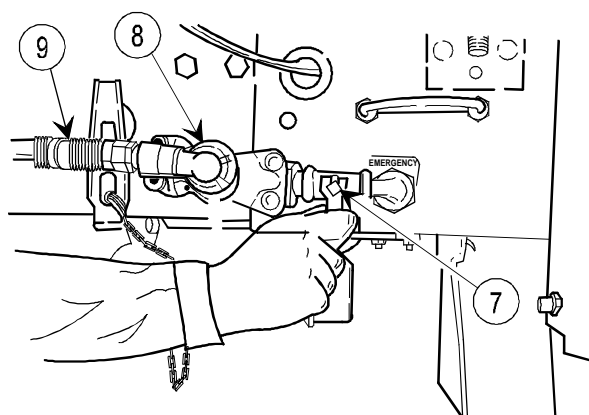
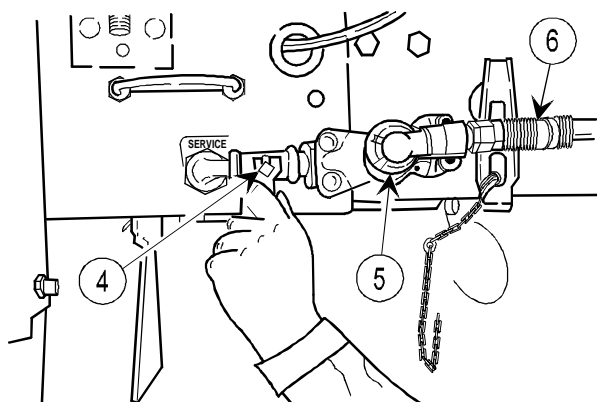
### WARNING

Handbrakes must be set in garrison as well as during field emplacement.

5 The gunner and assistant gunner set left and right handbrakes by inserting pump handles (2) into handbrakes sockets (3) and raising up to the locked position.



## 2-13. EMLACING THE HOWITZER (cont)

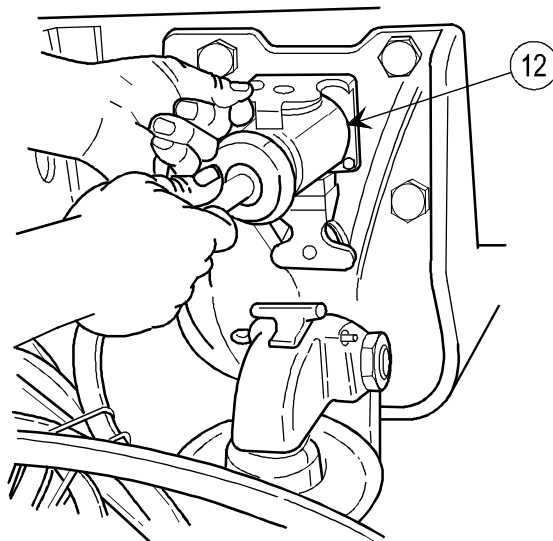
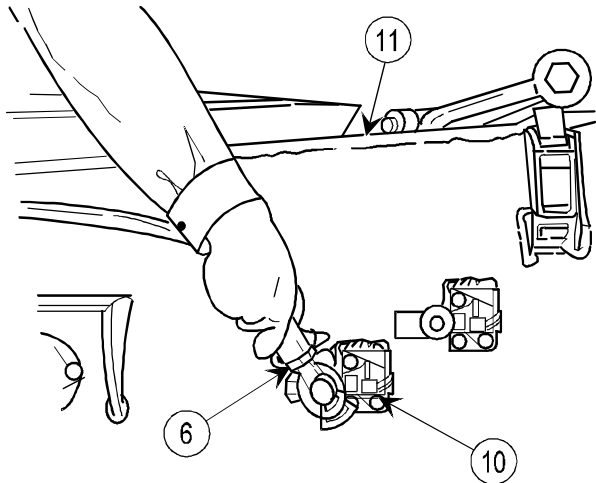


### WARNING

To prevent injury to personnel, never disconnect hose before closing prime mover cutout cock.

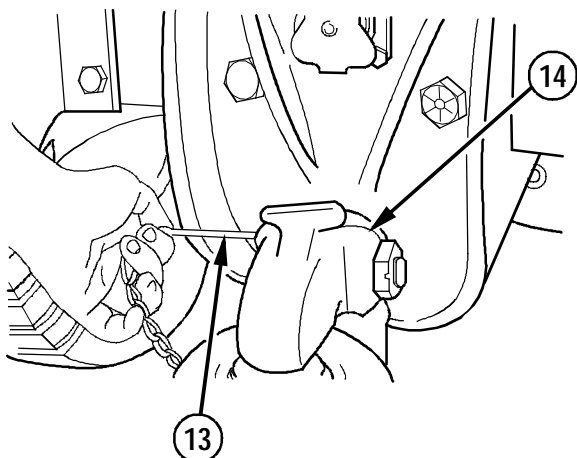
- 6** Cannoneer no. 4 closes service air line cutout cock (4) at prime mover, uncouples service air line coupling (5), and passes service hose assembly (6) to Cannoneer no. 2.

- 7** Cannoneer no. 5 closes emergency air line cutout cock (7) at prime mover, disconnects emergency air line coupling (8), and passes emergency hose assembly (9) to Cannoneer no. 2.

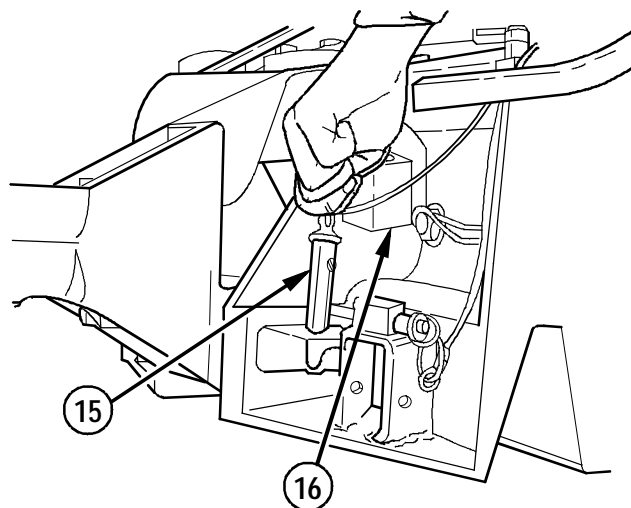


- 8** Cannoneer no. 2 connects service hose assembly (6) to dummy coupling (10) on right trail (11). The emergency hose assembly is connected to other dummy coupling.

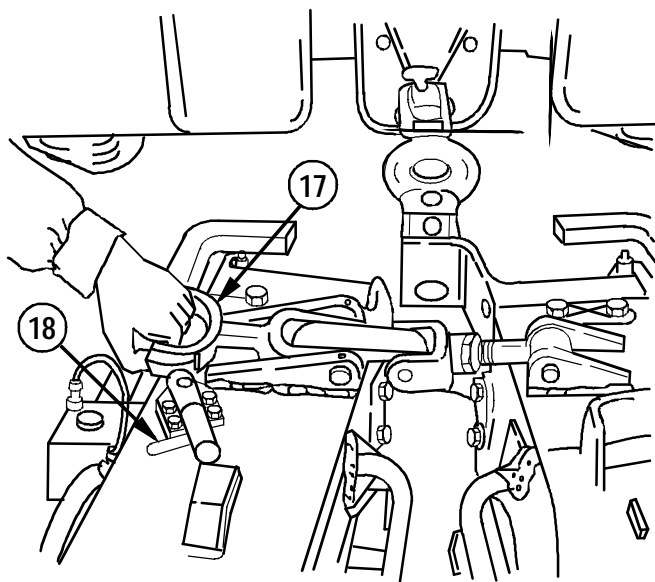
- 9** Cannoneer no. 5 disconnects cable assembly (12) from prime mover, if connected.



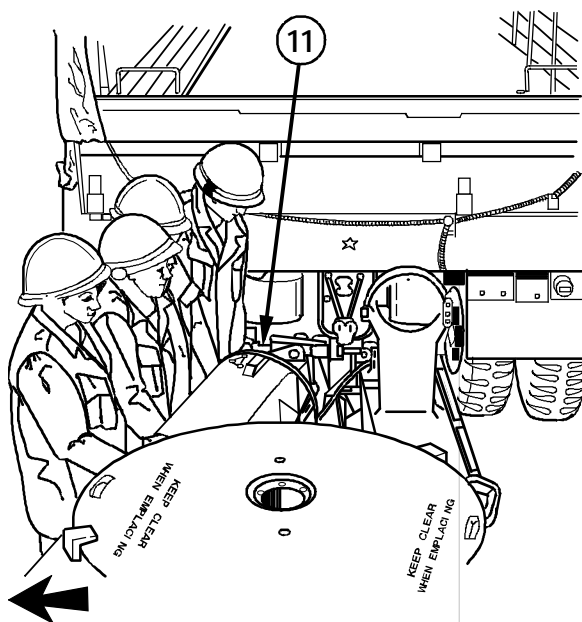
- 10** Cannoneer no. 4 removes cotter pin (13) and unlatches pintle (14) on prime mover.



- 11** Cannoneer no. 4 removes trail retaining pin (15) and inserts in top block (16).

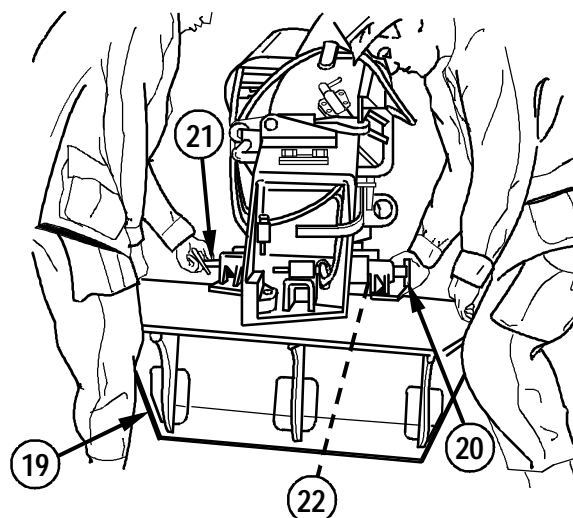
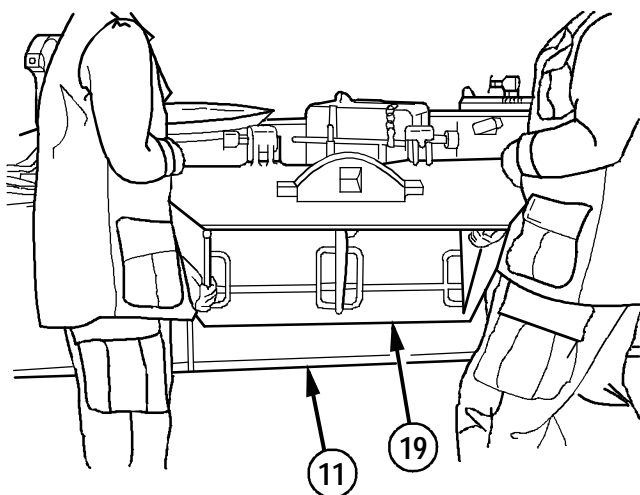


- 12** Cannoneer no. 4 unlocks trail lock (17) by rotating cam handle (18) clockwise to disengage trail lock handle. Pull trail lock handle straight up.



- 13** Cannoneers no. 2 and 4, the ammunition team chief, and the assistant gunner then open right trail (11).

## 2-13. EMPLACING THE HOWITZER (cont)



- 14 Cannoneers no. 2 and 4 remove right spade (19) and attach it to right trail (11) as follows:

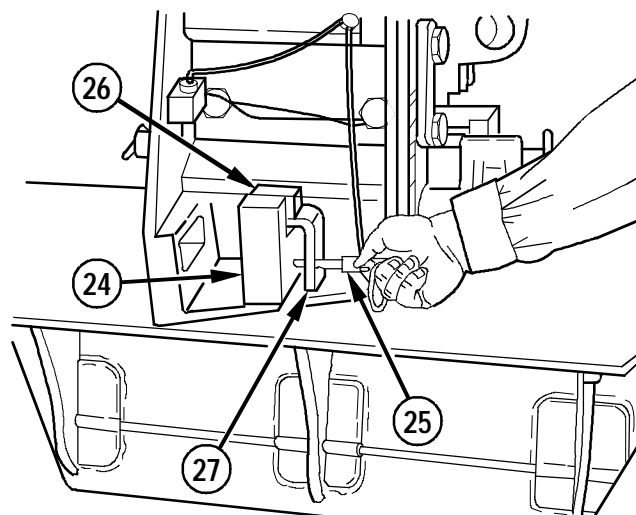
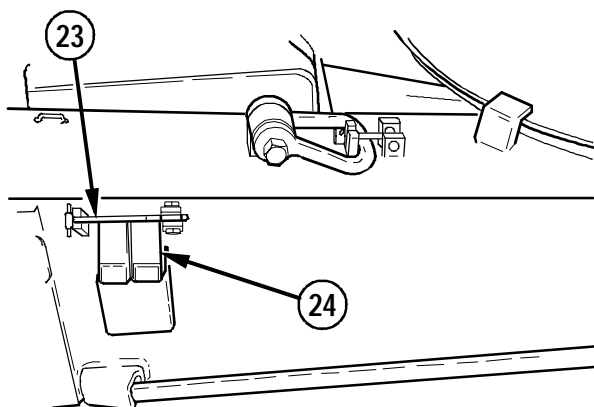
### CAUTION

Do not use hammer on plunger handles (20) when inserting pins (21). A hammer would damage the pins.

- a. Pull out plunger handles (20) and lift right spade (19) straight up until pins (21) can be inserted in spade brackets (22). Push in plunger handles (20).

### NOTE

If necessary, use hand hammer (6-lb sledge) to drive spade key far enough into position so that spade retaining pins can be inserted.

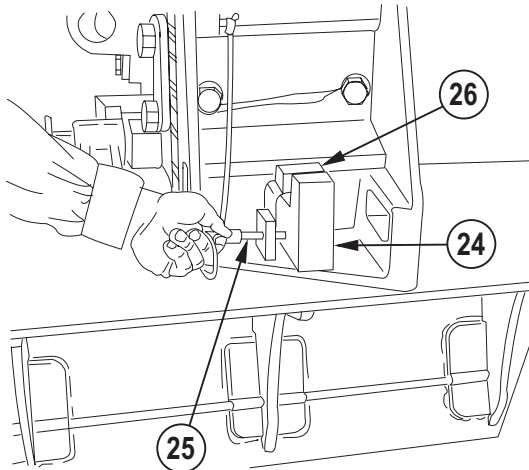


- b. Cannoneer no. 5 unscrews and lifts screw assembly (23) to remove spade key (24) from left trail. Cannoneer no. 5 passes spade key (24) to ammunition team chief.

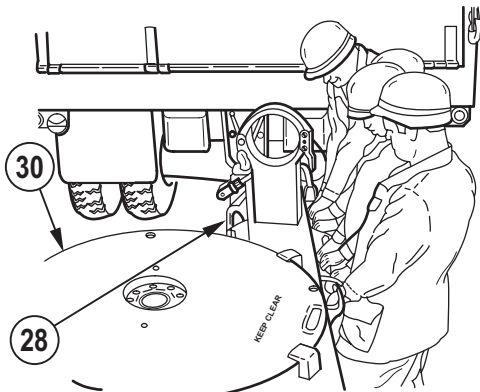
- c. Cannoneers no. 2 and 4 hold right spade in position until the ammunition team chief inserts spade key (24), removes spade retaining pin (25) from block (26), and inserts spade retaining pin (25) in right spade key.

### CAUTION

Do not fire howitzer without spade retaining pin (25) installed.



- 15** Cannoneers no. 1 and 3 remove left spade, bring spade to trail end and pass it under trail to cannoneer no. 2. Cannoneers no. 1 and 2 attach spade to left trail while cannoneer no. 5 inserts spade key (24), removes pin (25) from block (26), and inserts spade retaining pin (25) in left spade key.



- 16** Cannoneers no. 1, 3, and 5 and gunner (at left trail (28)), and the assistant gunner, the ammunition team chief, and cannoneers no. 2 and 4 (at right trail) raise lunette from pintle when the chief of section commands, LIFT. The chief of section then commands the driver to move prime mover forward. The left trail is spread, and then trails are lowered to the ground.

### WARNING

If NATO slave cable is not correctly aligned directly in front of its receptacle prior to connecting it, electrical arcing may occur that will result in damage to equipment and/or injury to personnel.

### CAUTION

For HIPE modified howitzers. Power is being drawn from the towing vehicles batteries anytime the NATO cable is connected between the towing vehicle and the howitzer.

### NOTE

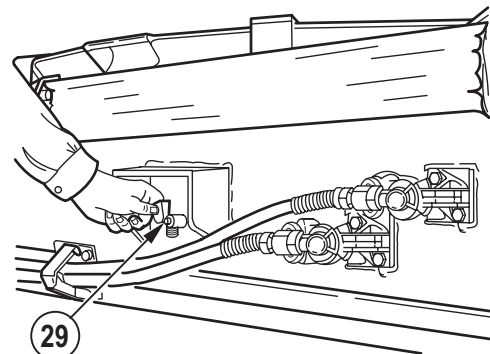
For HIPE modified howitzers. If battery voltage is above 20 volts proceed to step 16.1. If battery voltage is below 20 volts proceed to step 16.2.

- 16.1** Cannoneers no. 2 and 5 remove the NATO slave cable from the towing vehicle. Cannoneer no. 5 wraps one end of the slave cable around the gun tube travel lock, one time. Cannoneer no. 5 removes the dust cover from the left trail NATO receptacle and plugs the slave cable into the left trail NATO receptacle. Cannoneer no. 2 removes the dust cover from the towing vehicle's NATO receptacle and plugs the other end of the NATO slave cable into the NATO receptacle on the towing vehicle.

### NOTE

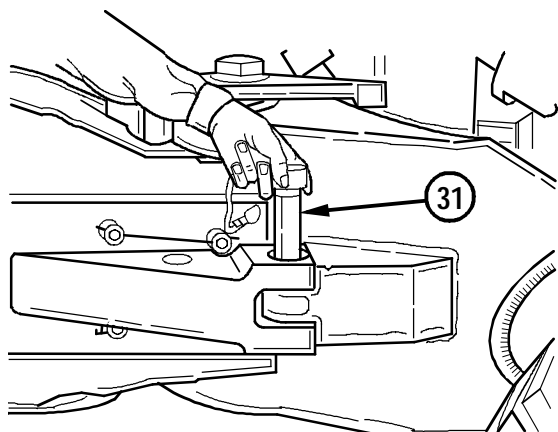
Step 16.2 applies to HIPE modified howitzers.

- 16.2** Cannoneers no. 2 and 5 remove the NATO slave cable from the towing vehicle. Cannoneer no. 5 removes the dust cover from the battery box NATO connector and plugs the slave cable into the connector. Cannoneer no. 2 removes the dust cover from the towing vehicles NATO connector and plugs the other end of the NATO slave cable into the connector on the towing vehicle.



- 17** Cannoneer no. 4 opens drain cock (29) on emergency reserve air tank.
- 18** Cannoneers no. 3 and 4 remove firing base-plate (30) from left trail (28) and place it in front of howitzer.

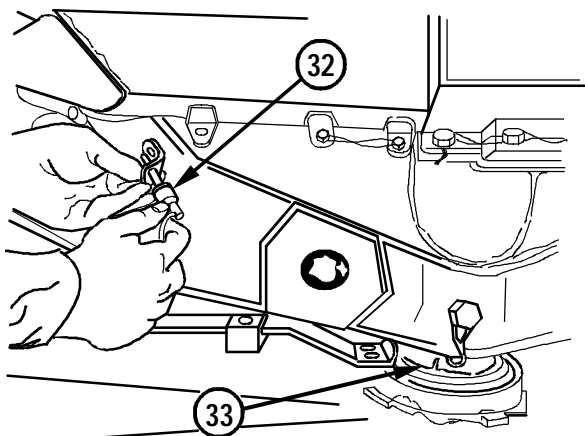
## 2-13. EMPLACING THE HOWITZER (cont)



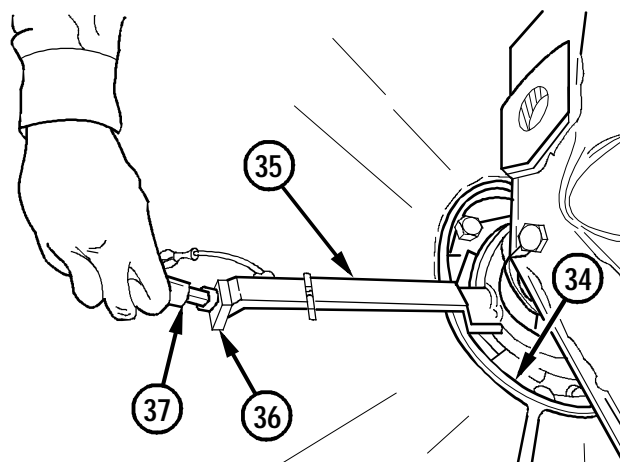
### WARNING

When installing trail locking plug (31) in the firing position, drive plug in firmly using a sledge hammer. Undesirable displacement may occur, causing inaccurate firing and injury to personnel.

- 19 The gunner removes left trail locking plug (31) and the assistant gunner removes right trail locking plug from the stowed position (rear) and installs it in the firing position (front).



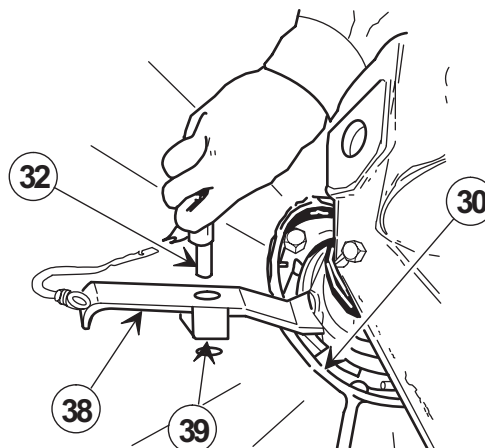
- 20 Cannoneer no. 4 removes quick release pin (32) and, with cannoneer no. 3, lifts firing baseplate and positions it on ball (33).



### NOTE

Step 21 applies to howitzers that have not been modified.

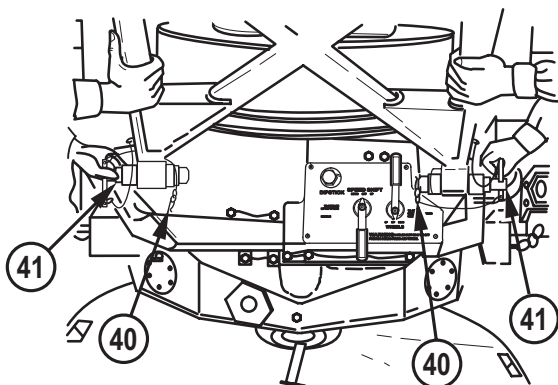
- 21 Cannoneer no. 3 then locks firing baseplate (34) in place by positioning lock release lever (35) with locking bracket (36). Cannoneer no. 3 then inserts quick release pin (37) in locking bracket.



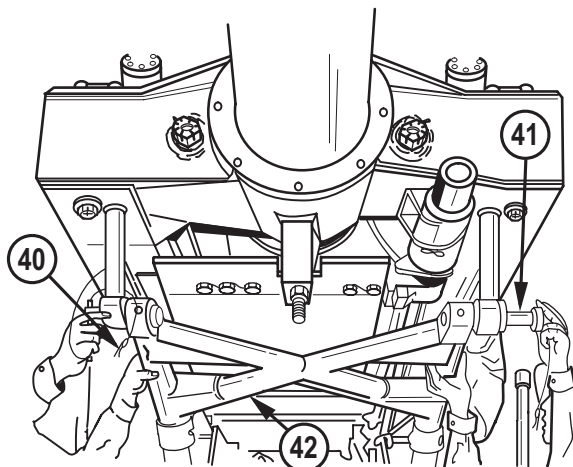
### NOTE

Step 22 applies to modified howitzers.

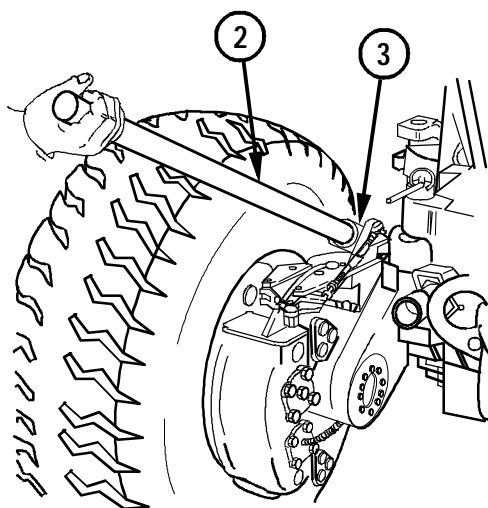
- 22 Cannoneer no. 3 then locks firing baseplate (30) in place by rotating lock-release lever (38) until locking bracket (39) is positioned over hole in baseplate. Cannoneer no. 3 then inserts quick release pin (32) through locking bracket and into firing baseplate hole.



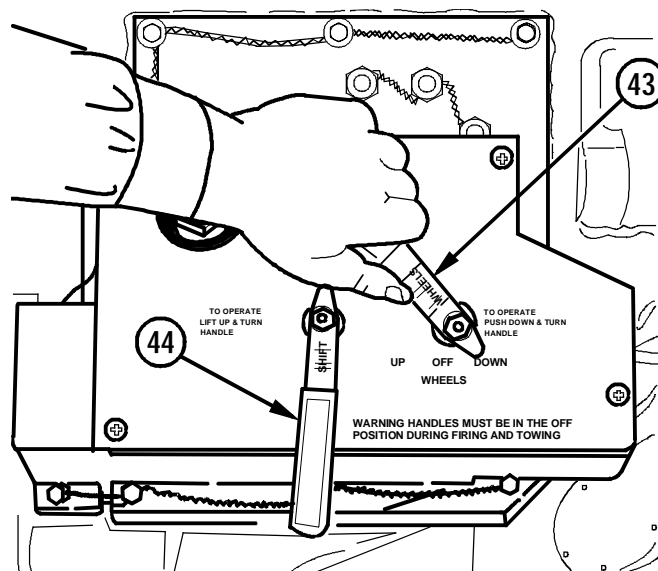
- 23** Cannoneers no. 3 and 4 remove retaining pins (40) and travel lock pins (41).



- 24** Cannoneers no. 3 and 4 swing travel lock assembly (42) up and insert travel lock pins (41) and retaining pins (40).



- 25** Cannoneer no. 3 releases left handbrake and cannoneer no. 4 releases right handbrake by inserting pump handle (2) in handbrake socket (3) and pulling down.



**WARNING**  
NEVER lower Howitzer off of its wheels without the trails being spread fully to the open position. The Howitzer could tip over to the side.

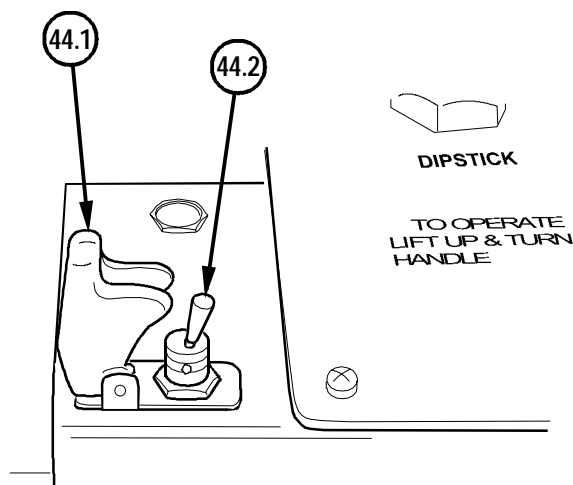
**NOTE**  
Be sure to move WHEELS lever (43) all the way to the desired position.

- 26** Cannoneer no. 3 ensures SPEEDSHIFT lever (44) is in the OFF position and then pushes down and moves WHEELS lever (43) to the DOWN position.

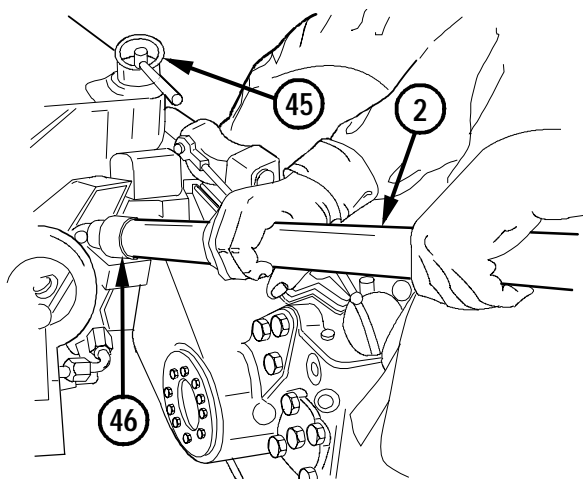
## 2-13. EMPLACING THE HOWITZER (cont)

### NOTE

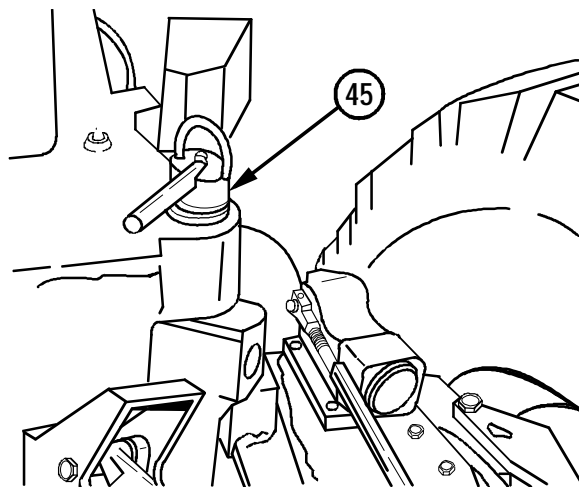
HIPE modified howitzers must have HyPak cut off switch, located on battery box, in the "ON" position. If HyPAK unit is not functional, go to step 27. After performing step 26.1 or step 27, proceed to step 28.



- 26.1** Cannoneer no. 3 lifts switch guard (44.1) and activates toggle switch (44.2) to release pressure from wheel lock handles (45).



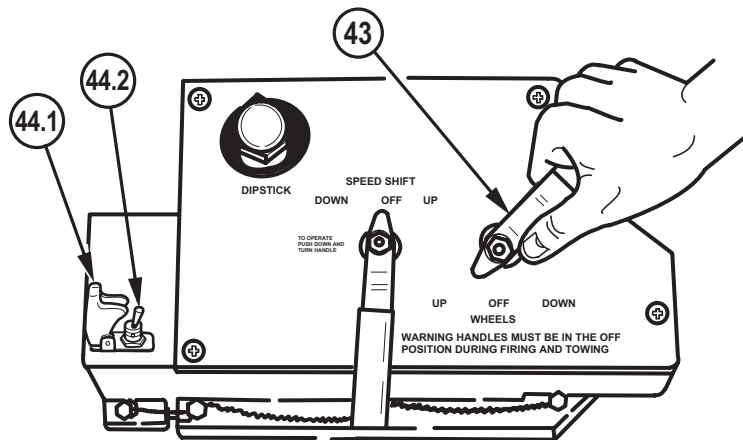
- 27** Cannoneer no. 4 inserts pump handle (2) into right hydraulic adapter (46), and cannoneer no. 3 inserts pump handle into left hydraulic adapter. They pump up and down until pressure is off wheel lock handles (45).



### WARNING

Keep feet from under howitzer and firing baseplate.

- 28** Cannoneer no. 4 moves right wheel lock handle (45) and cannoneer no. 3 moves left wheel lock handle (45) to the released position by lifting up and turning handle towards center of howitzer.



### WARNING

NEVER lower Howitzer off of its wheels without the trails being spread fully in the open position. The Howitzer could tip over to the side.

### WARNING

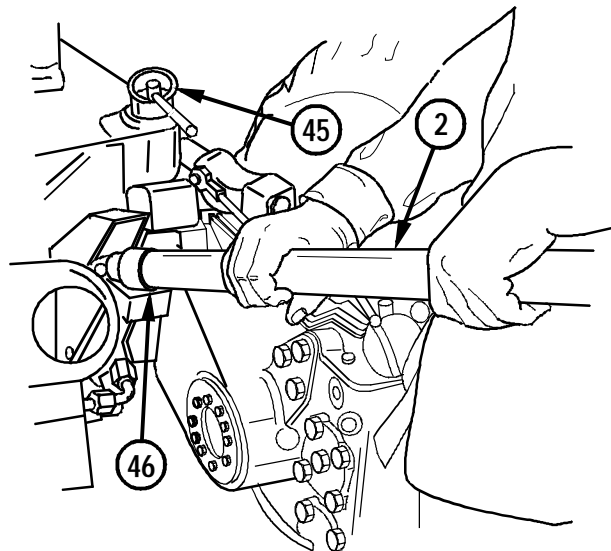
Keep feet from under howitzer and firing baseplate.

- 29** Cannoneer no. 3 pushes down and moves WHEELS lever (43) slowly to the UP position, allowing howitzer to settle on firing baseplate. Cannoneers no. 3 and 4 relock handbrakes by inserting pump handles in handbrake sockets and raising up to the locked position.

### NOTE

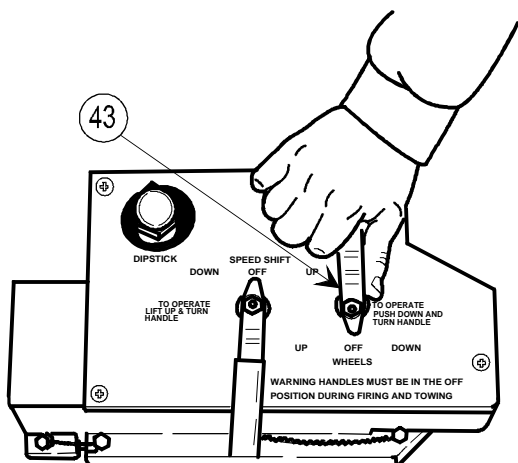
Step 29.1 applies to HyPAK modified howitzers. If HyPAK unit is not functional, go to step 30. After performing step 29.1 or step 30, proceed to step 31.

- 29.1** Cannoneer no. 3 activates toggle switch (44.2) until wheels are in the fully up position. Close switch guard (44.1).



- 30** Cannoneers no. 3 and 4 then insert pump handles (2) into hydraulic adapters (46) and pump up and down until wheels are fully up.
- 31** Cannoneer no. 3 moves left wheel lock handle (45) and cannoneer no. 4 moves right wheel lock handle (45) towards wheels to the locked position.

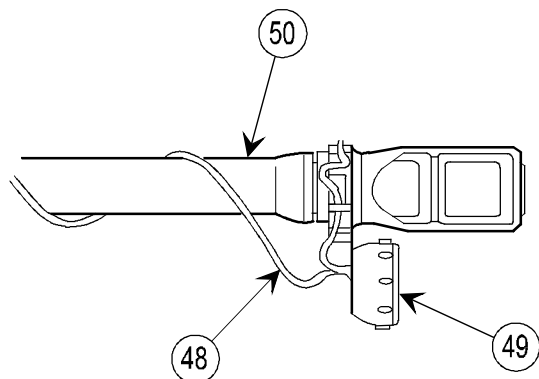




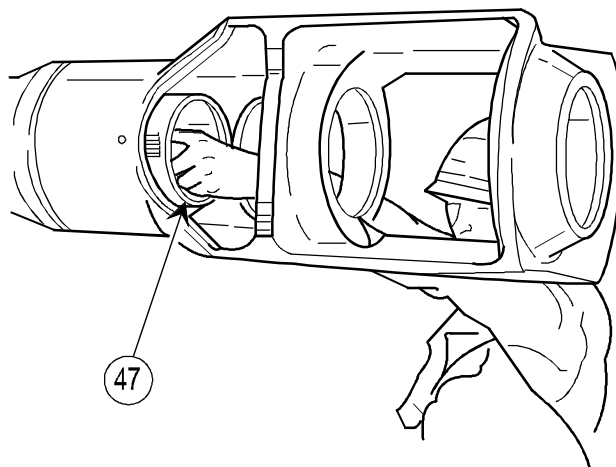
### NOTE

Move WHEELS lever back and forth on either side of OFF mark to relieve pressure on the hydraulic system.

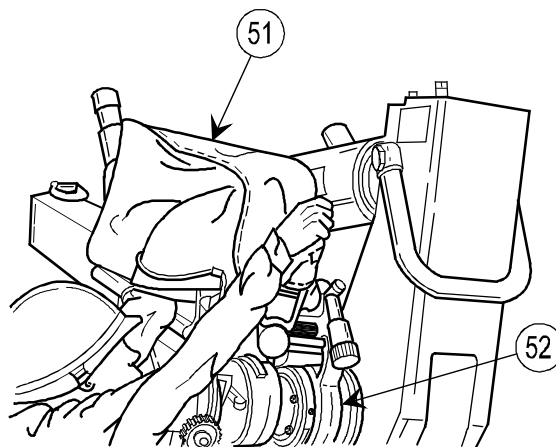
- 32** Cannoneer no. 3 pushes down and moves WHEELS lever (43) to the OFF position.



- 34** Cannoneer no. 3 then disconnects cable assembly (48) from vehicular taillight (49) and removes vehicular taillight from cannon tube (50), if installed.
- 35** The assistant gunner elevates or depresses cannon tube to 0 mils (or other elevation dictated by unit SOP).



- 33** Depress cannon tube within reach. The ammunition team chief removes muzzle plug (47).



- 36** The gunner removes fire control equipment carrying case from left trail and installs batteries, if ERLS equipped.
- 37** The gunner removes telescope and mount cover (51) from M171 telescope and quadrant mount (52).

## 2-13. EMPLACING THE HOWITZER (cont)

### WARNING



When using radioactively illuminated fire control equipment, follow radiation hazard procedures in the front of this manual.

**38** The gunner levels M171 telescope and quadrant mount as follows:

- Roll back the protective covers on the cross level vial (53), pitch level vial (54), and elevation level vial (55).
- Turn cross level control knob (56) to center bubble in cross level vial (53).
- Turn pitch level control knob (57) to center bubble in pitch level vial (54).
- Turn elevation correction knob (58) to zero elevation correction counter (59).

**39** Loosen two wingnuts (60), remove protective cover (61), open fire control equipment carrying case, and stow protective cover in carrying case.

### NOTE

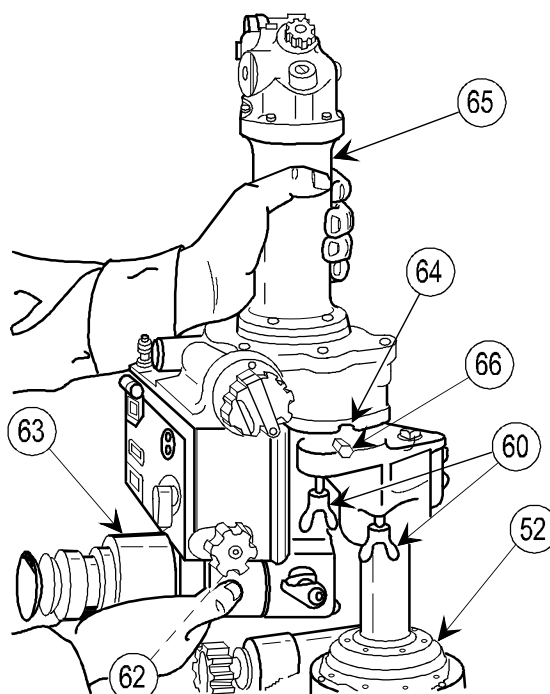
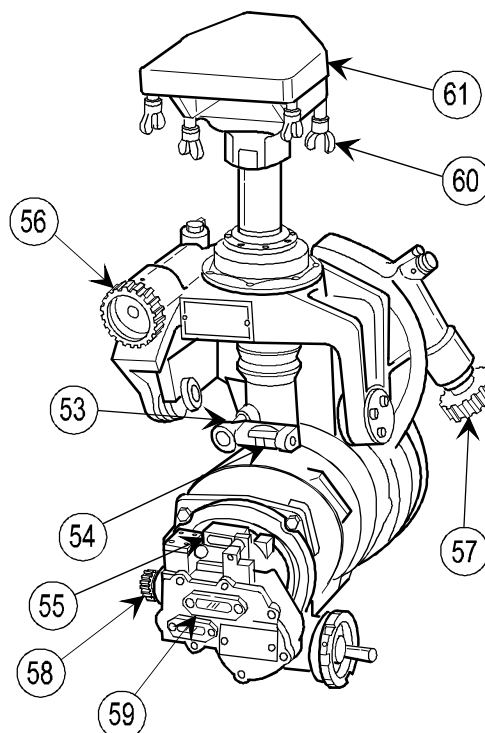
Steps 40 and 41 are written and illustrated for the M137 pantel but also apply to the M137A3 pantel.

**40** The gunner removes M137/M137A3 pantel (65) from fire control equipment carrying case and installs as follows:

- Depress locking pin (62) of eyepiece (63). Swing eyepiece and lock in position, approximately 90 degrees to pantel counterbox.
- Align keyways (64) on each side of M137/M137A3 pantel (65) with alignment keys (66) on each side of M171 telescope and quadrant mount (52). Seat M137/M137A3 pantel on mount.
- Tighten wingnuts (60) to secure M137/M137A3 pantel (65) on M171 telescope and quadrant mount (52).

### CAUTION

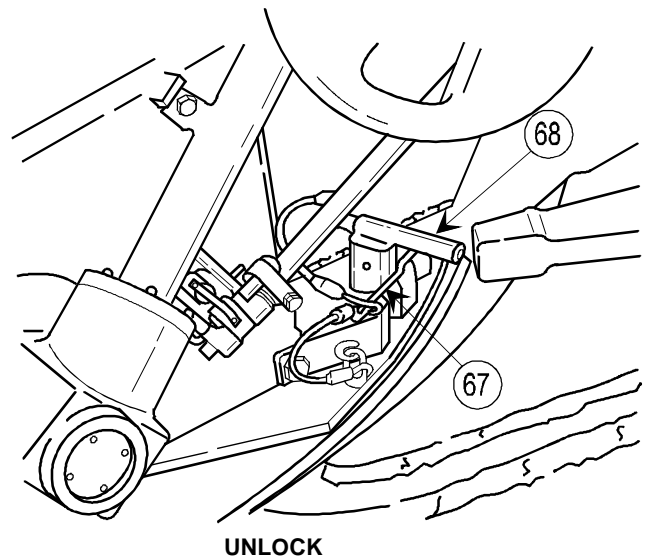
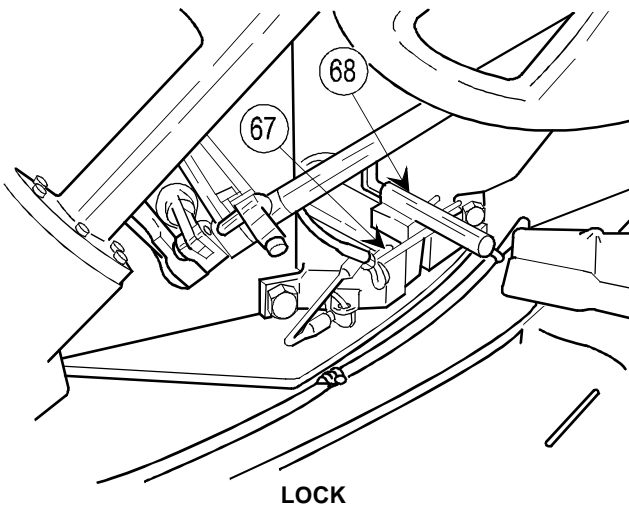
Do not use the firing baseplate and detent assembly as a speed shift assembly. Trails must be shifted before howitzer is lowered onto firing baseplate, otherwise speed shift.



**41** The gunner obtains initial reading from aiming circle. If reading from aiming circle differs more than 10 mils, assistant gunner unlocks right brake and the gunner directs the crew to shift trails until readings between M137/M137A3 pantel (65) and aiming circle are less than 10 mils. All crewmen lift both trails and shift them to the desired position.

**NOTE**

Step 42 and CAUTION apply to howitzers that have not been modified.



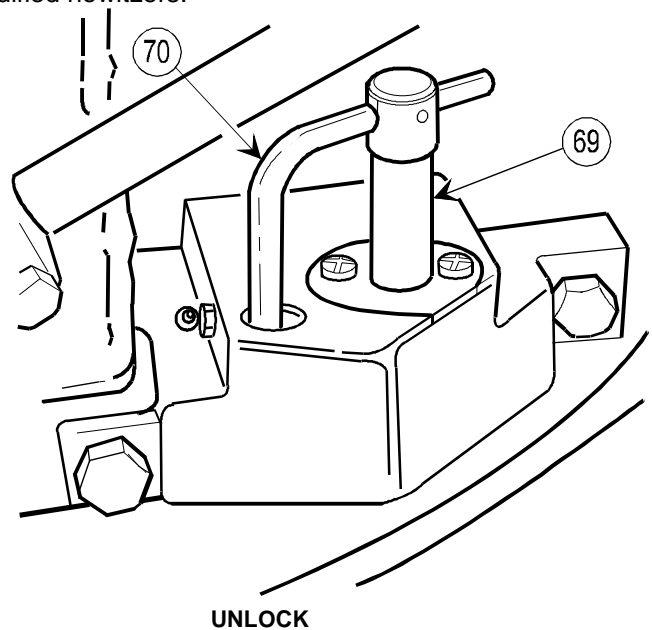
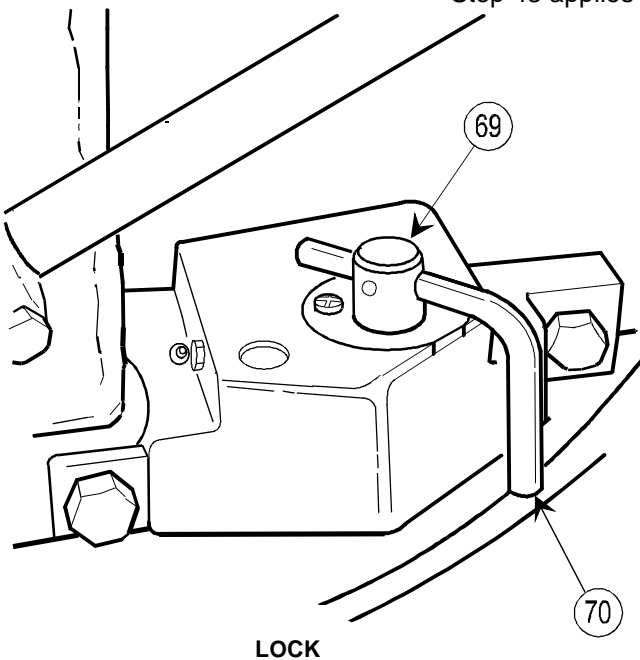
**CAUTION**

Do NOT traverse the top carriage unless the wheels are locked in the up (firing) or down (towed) position.

- 42** The gunner removes retaining pin (67) from top carriage locking pin (68), pulls up on top carriage locking pin to the unlocked (up) position and secures top carriage locking pin with retaining pin.

**NOTE**

Step 43 applies to modified howitzers.



- 43** The gunner unlocks the top carriage by lifting up on the retaining pin (69) and rotating retaining pin (69) until handle (70) is positioned in counterbore hole.

## 2-13. EMPLACING THE HOWITZER (cont)

### CAUTION

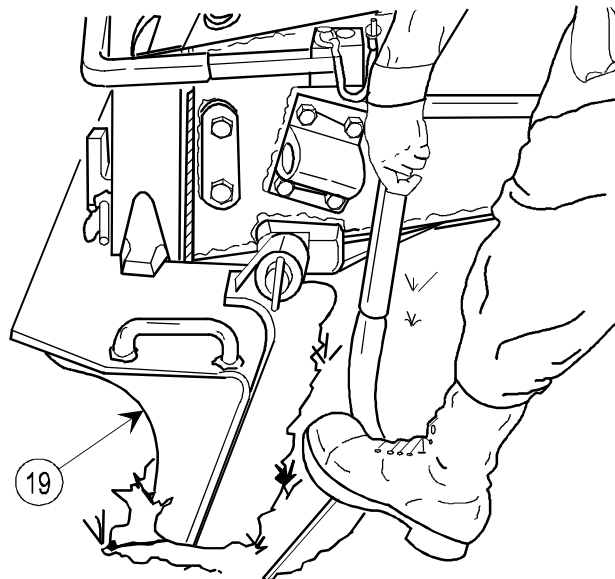
Spades must be dug in a minimum of 6 inches (15.24 cm). Dirt must not be removed from rear of spade.

### NOTE

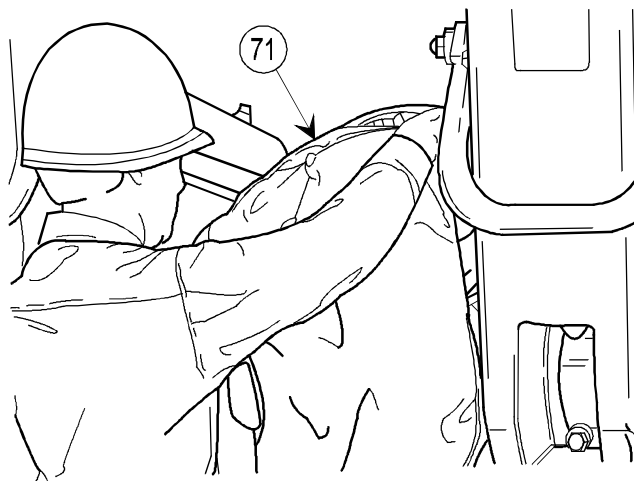
The howitzer may be laid at this time. Laying instructions begin on page 2-64.

If ground is hard, remove trail locking plugs, insert handling bar into socket on trail with spade installed, slide trail in the width of spade, dig hole, slide trail back into hole, and reinstall trail locking plugs.

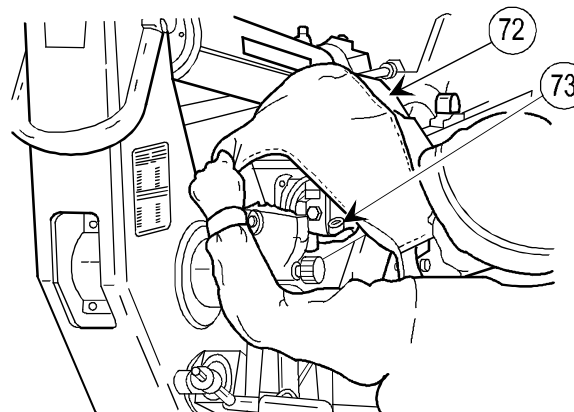
- 44 Cannoneer no. 4 digs in right spade (19) while cannoneer no. 3 digs in left spade.



- 45 Cannoneer no. 1 removes breech cover (71).



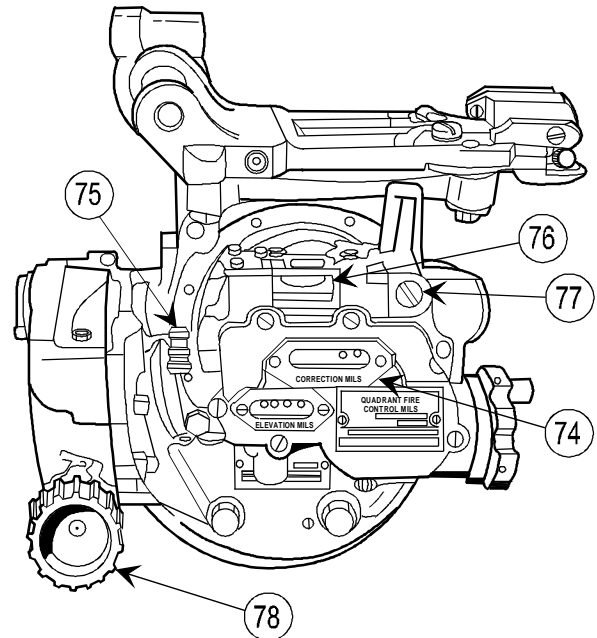
- 46 The assistant gunner removes telescope and mount cover (72) from M172 telescope and quadrant mount (73).



- 47** The assistant gunner levels M172 telescope and quadrant mount as follows:
- Zero elevation correction counter (74) by turning elevation correction knob (75).
  - Roll back protective covers on elevation level vial (76) and cross level vial (77).
  - To center bubble in cross level vial (77), turn cross level control knob (78).

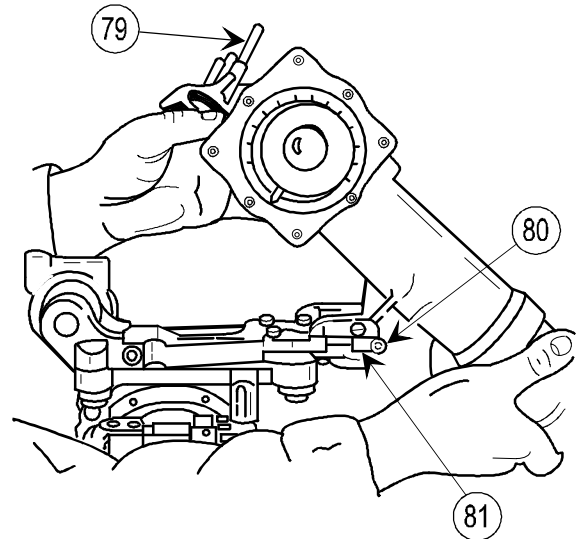
**NOTE**

Each time weapon is traversed, elevated, or depressed, M172 telescope and quadrant mount must be checked to make sure it is level.

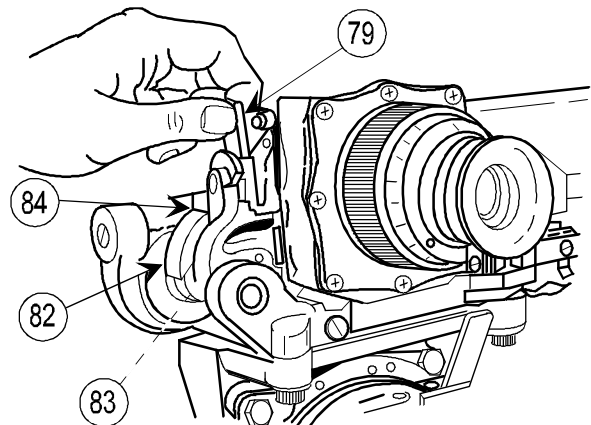


- 48** The assistant gunner removes M138 elbow telescope from fire control equipment carrying case.
- 49** The assistant gunner installs M138 elbow telescope as follows:

- Push down on locking latch (79).
- Insert telescope T-rod (80) into keyway (81) on M172 telescope and quadrant mount with eyepiece end raised.
- Lower eyepiece end of telescope until latch assembly (82) engages mount shaft (83).
- Pull locking latch (79) up to a vertical position and turn lock-release lever (84) clockwise until snug.



- 50** Cannoneer no. 1 gets swab and bucket of water.



**NOTE**

Paragraph 2-13.1 pertains to HIPE modified howitzers only.

## 2-13.1 OPERATING THE HIPE SYSTEM

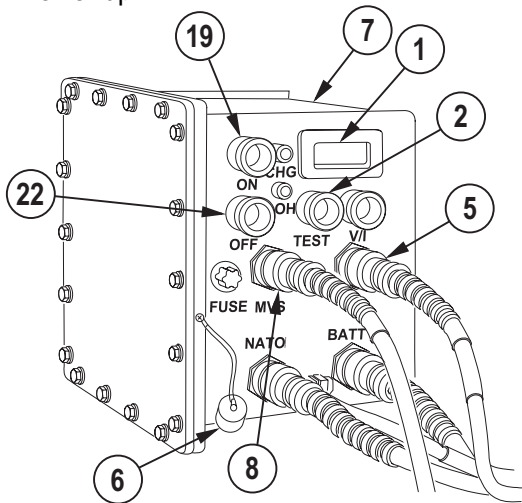
**CAUTION**

If system voltage falls below 18V, the system will automatically shut down to avoid damaging the batteries.

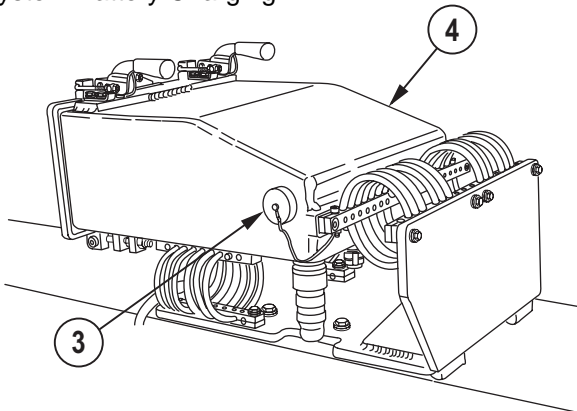
**NOTE**

HIPE system voltage must be 20V or more to operate radio, GDU, and VMS.

### 1 Power up.



a. Check battery voltage at voltage meter (1) by depressing the "TEST" button (2). If voltage is below 20V, charge battery. Refer to Para 3-39.1, HIPE System Battery Charging.



b. Remove protective dust cover (3) from GDU connection port on the radio box (4) and connect GDU power cable (5) to connection port.

c. Remove protective dust cover (6) from MVS connection port on the PSDU (7) and connect MVS power cable (8) to connection port.

**CAUTION**

Be careful not to damage radio connecting cables or pins during radio installation.

d. Open toggle clamps (9) on radio box cover (10) and open radio box (4). Unscrew and disengage thumbscrew (11) from clamp (12) and swing clamp out.

**NOTE**

Radio antenna cable is connected to SINCGARS radio after the radio is installed.

e. Position radio antenna cable (13) to obtain clearance for installing SINCGARS radio (14).

f. Gently slide SINCGARS radio (14) into radio box enclosure (15) until the communications port (16) on the radio slides into the cable connection plug (17) in back of radio box (4).

g. Connect radio antenna cable (13) to the connection port (18) on front of SINCGARS radio (14).

h. Swing clamp (12) back across the front of the radio until thumbscrew (11) can be engaged and tightened.

i. Turn power on by depressing the "ON" button (19) on the PSDU (7).

j. Move the radio power switch (20) to the "ON" position. Using the radio speaker volume control knob (21), adjust radio speaker volume per unit SOP.

**NOTE**

Monitor HIPE system and prime mover battery levels.

### 2 Power down.

a. If radio box (4) is not open, release toggle clamps (9) and open radio box.

b. Adjust radio speaker volume control knob (21) and move radio power switch (20) to the "OFF" position.

- c. Turn power off by depressing the "OFF" button (22) on the PSDU (7).

**CAUTION**

Be careful not to damage radio connecting cables or pins during radio removal.

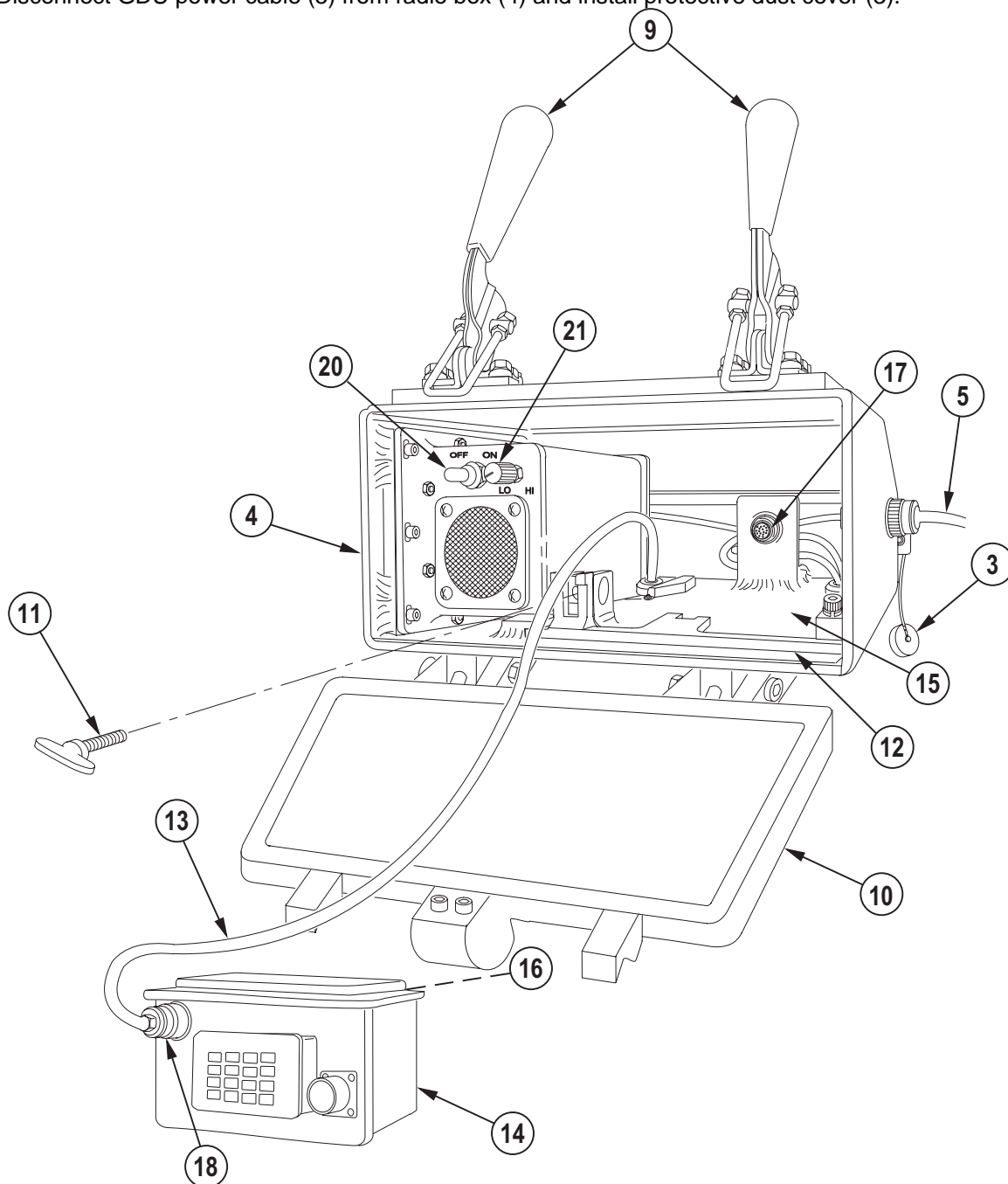
**NOTE**

Follow Unit SOP for removal of SINCGARS radio.

- d. Unscrew thumbscrew (11) until it can be disengaged from clamp (12) and swing clamp out. Disconnect radio antenna cable (13) from SINCGARS radio (14) and remove radio completely from radio box (4). Swing clamp back into the closed position until thumbscrew can be engaged and tightened. Close radio box cover (10) and secure with toggle clamps (9).

- e. Disconnect MVS power cable (8) from PSDU (7) and install protective dust cover (6).

- f. Disconnect GDU power cable (5) from radio box (4) and install protective dust cover (3).



## 2-14. LAYING THE HOWITZER USING M2 AIMING CIRCLE

### WARNING



When using radioactively illuminated fire control equipment, follow radiation hazard procedures in the front of this manual.

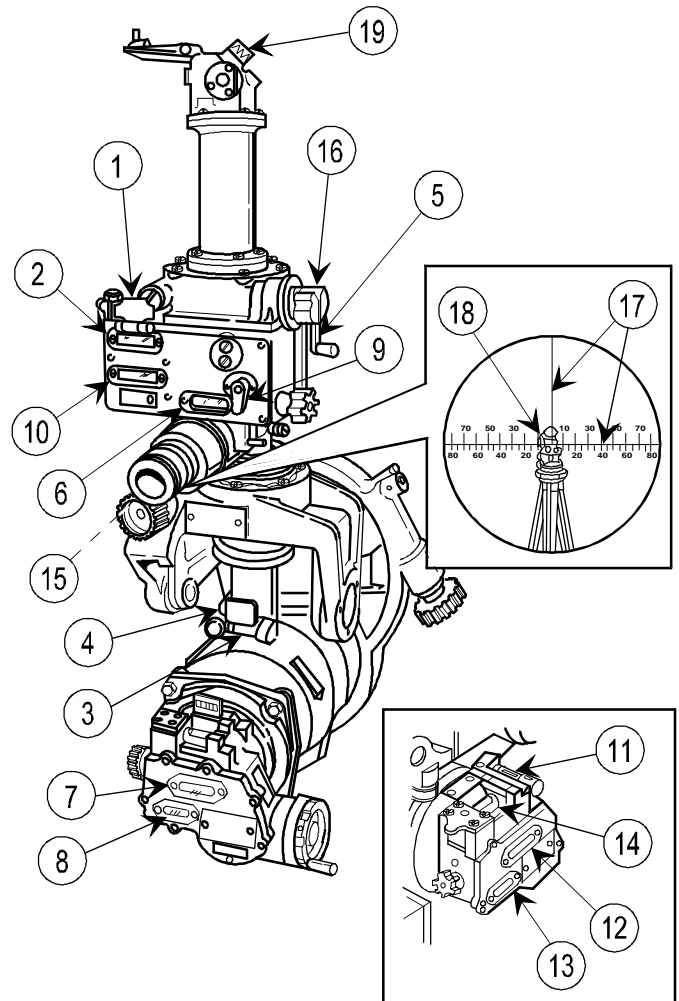
### NOTE

Lay the howitzer under the direction of the gunnery sergeant when he announces, BATTERY ADJUST, AIMING POINT THIS INSTRUMENT.

### NOTE

The following steps are written and illustrated for the M137 pantel but also apply to the M137A3 pantel.

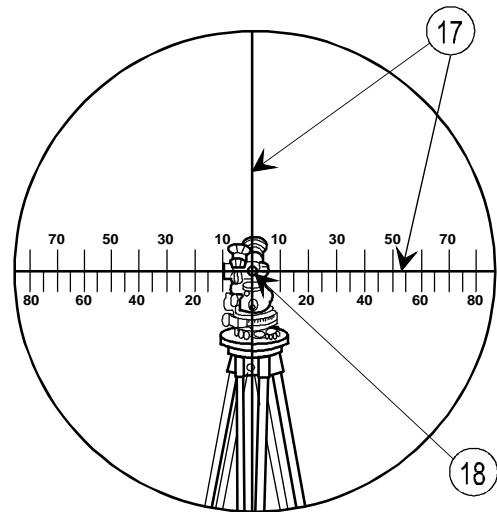
- 1 Upon the command, ADJUST, the gunner lifts door (1) which covers azimuth counter (2) on pantel.
- 2 The gunner checks to ensure that:
  - a. Bubbles in pitch level vial (3) and cross level vial (4) on M171 telescope and quadrant mount are centered.
  - b. Azimuth knob bar (5) reads INDIRECT.
  - c. Correction counter (6) on M137/M137A3 pantel is set at zero.
  - d. Elevation correction counter (7) on M17 fire control quadrant is set at zero.
  - e. Elevation counter (8) on M17 fire control quadrant is set at zero (or another elevation dictated by unit SOP).
  - f. The gunner engages deflection knob (9), sets deflection counter (10) at 3200, and then disengages deflection knob.
- 3 The assistant gunner checks M18 fire control quadrant to ensure that:
  - a. Cross level vial (11) is centered.
  - b. Elevation correction counter (12) is set at zero.
  - c. Elevation counter (13) is set at zero (or another elevation dictated by unit SOP).



- 4 The assistant gunner depresses or elevates cannon tube until bubbles center in M18 fire control quadrant elevation level vial (14), and recenters cross level vial and elevation level vial as required.
- 5 Sighting through eyepiece (15), the gunner rotates head of M137/M137A3 pantel by turning azimuth knob (16) until pantel crosshairs (17) are centered on reflector (18) of aiming circle. Pantel horizontal crosshair alignment is obtained by turning elevation knob (19).

6 When pantel crosshairs (17) are alined on reflector (18) of aiming circle, the gunner announces to the gunnery sergeant, NUMBER (SO-AND-SO), AIMING POINT IDENTIFIED.

7 The gunnery sergeant determines the aiming circle reading to pantel and announces, NUMBER (SO-AND-SO), DEFLECTION (SO MUCH).



8 Upon announcement of the azimuth, the gunner repeats the deflection reading to the gunnery sergeant by announcing, NUMBER (SO-AND-SO), DEFLECTION (SO MUCH), and turns azimuth knob (16) until the announced azimuth appears on azimuth counter (2).

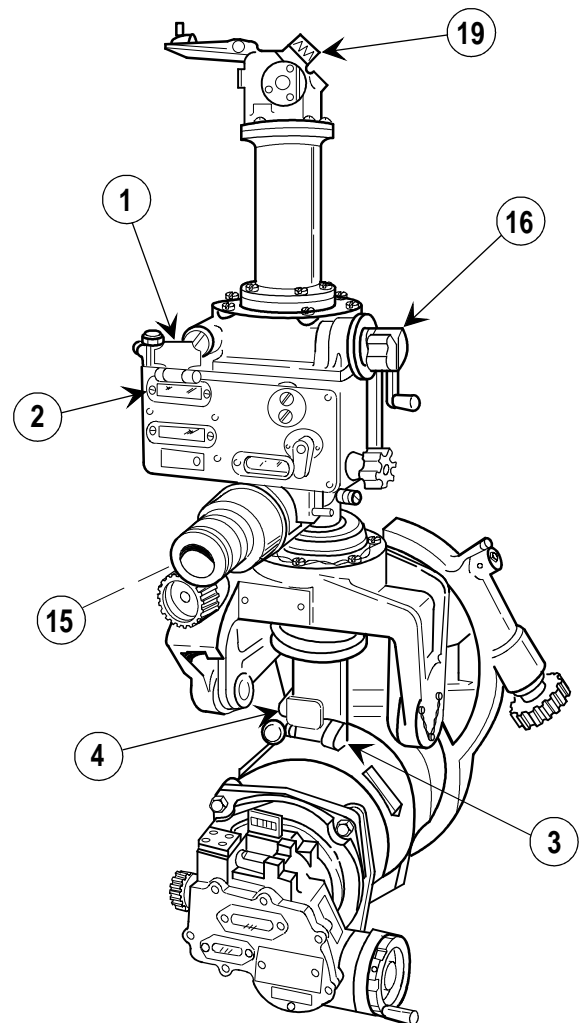
9 Operating traversing handwheel and sighting through eyepiece (15), the gunner traverses the howitzer until pantel crosshairs (17) are centered on reflector (18) of aiming circle with bubbles centered in pitch level vial (3) and cross level vial (4). Horizontal crosshair alinement is obtained by turning elevation knob (19).

10 The gunner announces to the gunnery sergeant, NUMBER (SO-AND-SO), READY FOR RECHECK.

11 The gunnery sergeant determines a new aiming circle reading to pantel and announces, NUMBER (SO-AND-SO), DEFLECTION (SO MUCH).

12 Upon announcement of the new azimuth, the gunner repeats the deflection reading and the difference between the new deflection reading and the reading on azimuth counter (2) to the gunnery sergeant by saying, NUMBER (SO-AND-SO), DEFLECTION (SO MUCH), (SO MANY) MILS.

13 The gunner then turns azimuth knob (16) until the new deflection appears on azimuth counter (2).

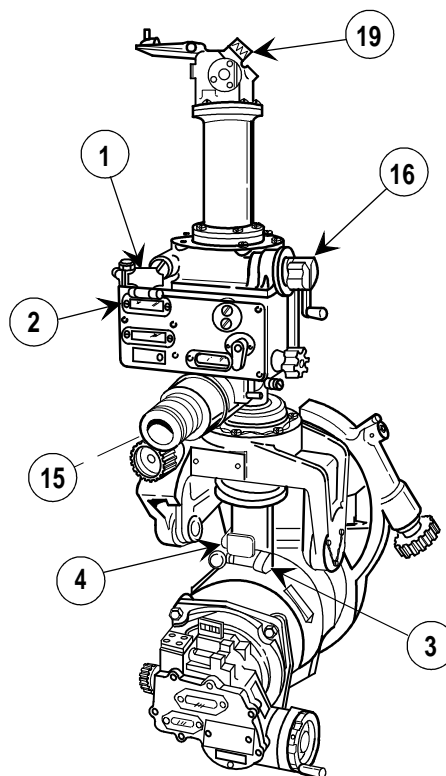


## 2-14. LAYING THE HOWITZER USING M2 AIMING CIRCLE (cont)

- 14 Operating traversing handwheel and sighting through eyepiece (15), the gunner traverses the howitzer until pantel crosshairs are centered on the reflector of aiming circle with bubbles centered in pitch level vial (3) and cross level vial (4). Horizontal crosshair alinement is obtained by turning elevation knob (19).
- 15 The gunner and gunnery sergeant repeat steps 10 thru 14 above until the difference between the announced aiming circle reading to pantel and the reading on azimuth counter (2) is 0 mils. When the difference announced by the gunner in step 12 is 0 mils, the gunnery sergeant announces, NUMBER (SO-AND-SO) IS LAID.

### WARNING

Position of M171 telescope and quadrant mount and cannon tube must not be disturbed until M1A1/M1A2 collimator and/or aiming posts have been emplaced.



- 16 Upon command, LAID, the gunner records reading on azimuth counter (2). The gunner then lays collimator.

## 2-15. EMPLACING THE M1A2 COLLIMATOR

### WARNING



When using radioactively illuminated fire control equipment, follow radiation hazard procedures in the front of this manual.

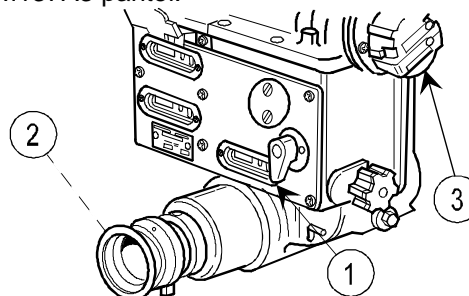
### NOTE

The M1A2 collimator is emplaced immediately after laying operations.

The following steps are written and illustrated for the M137 pantel and M1A2 collimator but also apply to the M137A3 pantel.

The M1A2 collimator is the primary reference aiming point for the M198 howitzer. The collimator is normally placed on left rear side of weapon to facilitate its maximum use. Emplacement distances away from weapon will vary due to type of terrain but must be between 4 and 15 meters. Optimum distance is between 5 to 12 meters. The M1A2 collimator should not be emplaced more than 4 meters above or below M137/M137A3 pantel.

- 1 With deflection counter set at 3200 mils, the gunner disengages deflection knob (1) and then sights through eyepiece (2). The gunner turns azimuth knob (3) until a convenient place to locate collimator is sighted.





### WARNING

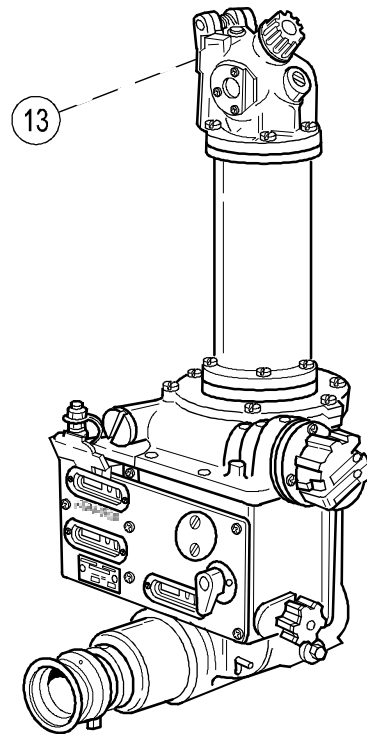
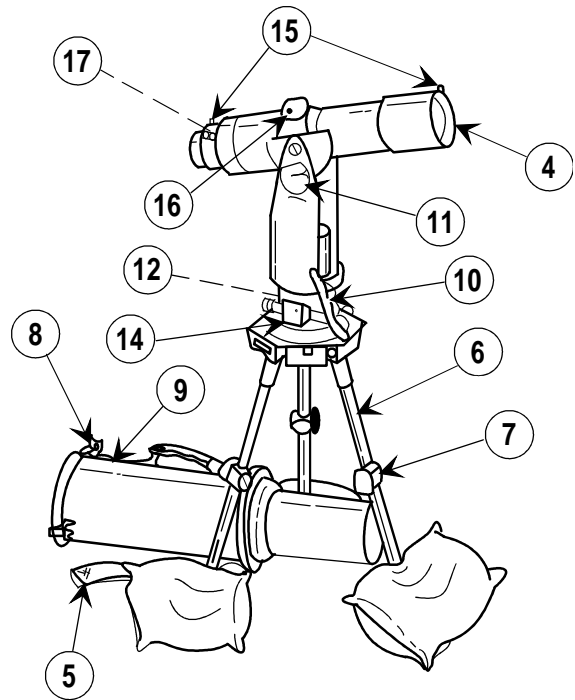
The M137 pantel is radioactively illuminated and should be checked for illumination before using in a dim light. If not illuminated, follow radioactive materials procedures listed in the front of this manual.

2 Under directions from the gunner, cannoneer no. 2 emplaces collimator (4) as follows:

- a. Unfasten strap (5) holding legs.
- b. Extend legs (6) as necessary. Lock by tightening locking knobs (7).
- c. Rotate legs (6) to the down position. Point one leg toward the M137/M137A3 pantel. Set each leg firmly into the ground and place a sandbag on each leg.
- d. Release latches (8) holding cover (9). Remove cover from collimator and place between collimator legs with closed end toward muzzle.
- e. Unfasten strap (10). Loosen elevation clamping knob (11) and rotate collimator (4) to a horizontal position.
- f. Ensure azimuth adjustment is in center of traversing capabilities by operating azimuth adjustment knob (12).

### NOTE

During night operation, M137/M137A3 pantel objective lens (13) may not be visible from M1A2 collimator. To increase visibility, place green M14A1 aiming post light to M137/M137A3 pantel eyepiece.



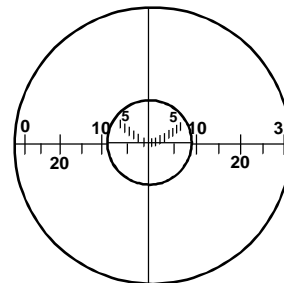
g. Loosen azimuth clamping knob (14). Sighting down front and rear sights (15), rough lay collimator on pantel objective lens (13). Tighten azimuth clamping knob (14). Adjust collimator elevation as required and tighten elevation clamping knob (11).

h. Loosen cross level clamping knob (16). Rotate M1A2 collimator (4) until bubble of cross level vial (17) centers. Tighten cross level clamping knob (16).

## 2-15. EMPLACING THE M1A2 COLLIMATOR (cont)

### NOTE

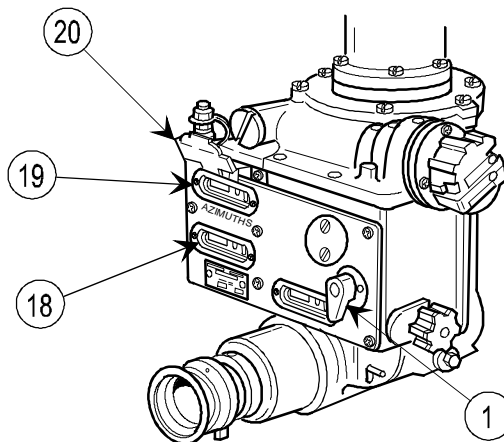
To ensure accurate laying and referring, the gunner, when sighting through M137/M137A3 pantel, should view a minimum of 11 mils of M1A2 collimator reticle area.



- 3 Sighting through M137/M137A3 pantel, the gunner turns pantel azimuth knob, commands cannoneer no. 2 to turn M1A2 collimator azimuth adjustment knob until pantel crosshairs are centered with collimator reticle center, and announces to cannoneer no. 2, SET.

- 4 With M1A2 collimator emplaced, the gunner engages deflection counter (18) on M137/M137A3 pantel by turning deflection knob (1) counterclockwise to the ENGAGE position.

- 5 The gunner records the value appearing on azimuth counter (19), and closes azimuth counter door (20) on M137/M137A3 pantel.



## 2-16. EMPLACING THE M1A2 AIMING POSTS

### NOTE

The M1A2 aiming posts are the alternate aiming reference for the howitzer and are emplaced, time permitting, immediately after the collimator is emplaced.

- 1 With howitzer laid on initial azimuth of fire, the gunner checks to ensure that:
  - a. Pantel pitch and cross level vial bubbles are centered.
  - b. Pantel correction counter is set at zero.

### NOTE

Two aiming posts are used for each howitzer. To ensure equal spacing of aiming posts, the same cannoneer should pace the distance from howitzer.

- 2 Cannoneer no. 5 emplaces aiming posts as follows:
  - a. Remove aiming post cover and aiming posts from stowage brackets on right trail.
  - b. Remove aiming posts from cover and assemble.

### NOTE

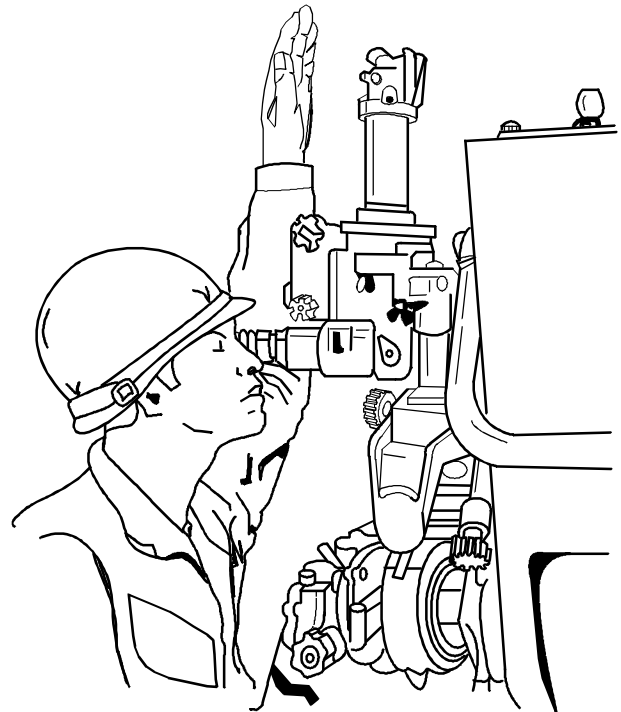
Unit SOP should state which light will be used on near post and which will be used on far post and should give instructions for aiming post location.

- c. At night, remove M14A1 aiming post lights from storage chest, install batteries, and install on aiming posts. ■
- 3 Cannoneer no. 5 runs out approximately 50 meters with both aiming posts and sticks the near post (short post) in the ground. He continues an additional 50 meters, stops and faces the gunner, and emplaces the far aiming post (long post) aligned with the body. Cannoneer returns to the near aiming post and positions it by observing hand signals of the gunner.

**NOTE**

The following steps are written and illustrated for the M137 pantel but also apply to the M137A3 pantel.

- 4 Sighting through M137/M137A3 pantel, the gunner rotates the azimuth knob until proper site picture is obtained on far aiming post. By extending his left hand above his head (right hand if posts are to rear of weapon) and having the cannoneer move the post as directed by the following movements:

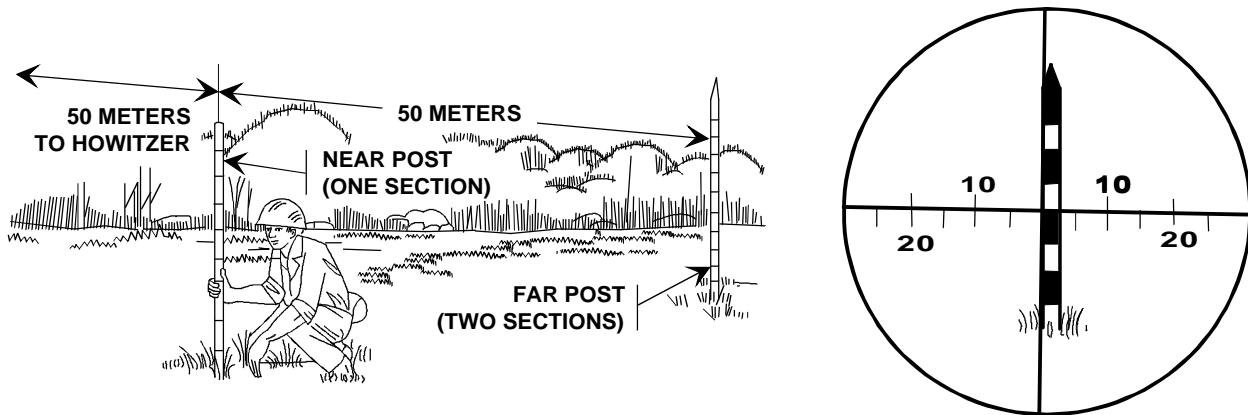


- a. Move aiming post left or right as directed by direction of hand movement.
- b. Up and down movement represents emplace.
- c. Clenched fist represents stop.
- d. Tapping on top of helmet and moving hand (left or right) represents movement of top of aiming post.
- e. Hand waved in a circular motion means for cannoneer to come in.

**NOTE**

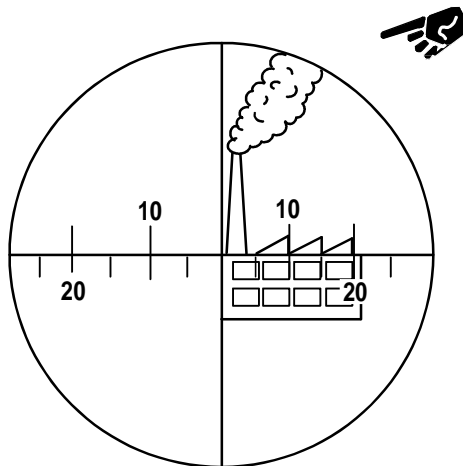
At night, this method can be used with a flashlight in the on/off mode.

## 2-16. EMPLACING THE M1A2 AIMING POSTS (cont)



- 5 After aiming posts are emplaced, sight picture should be as illustrated (no displacement). The gunner then records the value indicated on azimuth counter.

### 2-16.1. ESTABLISHING ALTERNATE AIMING POINTS



#### a. Distant Aiming Point (DAP).

#### NOTE

The following steps are written and illustrated for the M137 pantel but also apply to the M137A3 pantel.

- (1) Sighting through the M137/M137A3 pantel, the gunner rotates the azimuth knob until proper sight picture is obtained on a DAP.
- (2) The gunner records the value appearing on azimuth counter on the gunner's reference card to the nearest quarter (0.25) mil.

**b. Switching Aiming Points.** In the event that a gunner needs to switch aiming points any time after he has established one, i.e. switch from the collimator to the aiming post, or switch from the aiming post to the DAP, the following steps will place the gunner on his new aiming point.

**NOTE**

If in a fire mission, follow steps (1) through (7), if not, follow steps (1) through (4), these steps will place the gunner on his new aiming point.

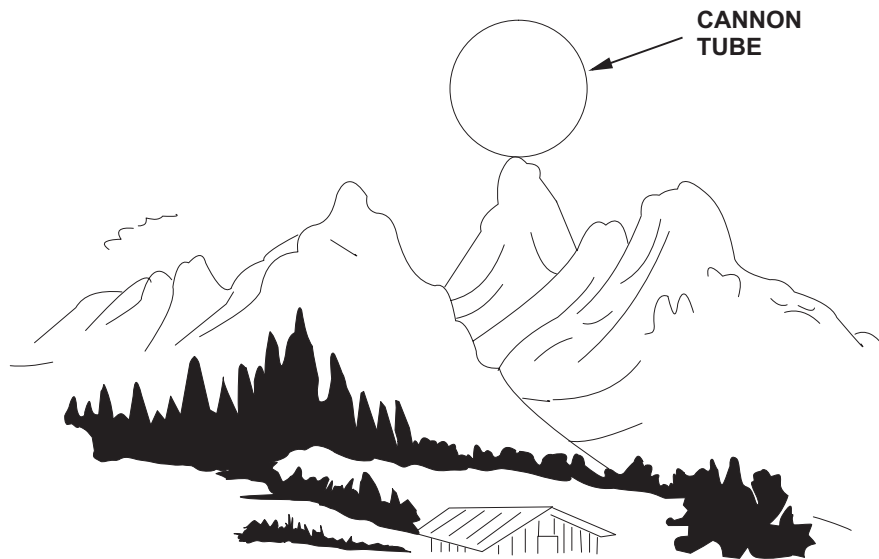
- (1) The gunner sets the deflection counter back to 3200 by turning the azimuth knob.
- (2) The gunner then pushes the deflection knob to the left (release position).
- (3) The gunner opens the azimuth counter door, turns the azimuth knob until the azimuth counter shows the value he has on his gunner's reference card for the aiming point he wishes to use.
- (4) The gunner closes azimuth counter door and pushes the deflection knob to the right (engage).
- (5) The gunner will set the deflection given in the fire mission on the deflection counter using the azimuth knob.
- (6) While sighting through eyepiece, the gunner traverses weapon until the proper sight picture is obtained.
- (7) The gunner then levels M171 telescope and quadrant mount and rechecks sight picture (see Laying for Direction and Elevation and Loading and Firing the Howitzer During Indirect Fire Missions, para 2-22 6m).
- (8) Fire according to the fire command.

## 2-17. MEASURE SIGHT-TO-CREST

- 1 The chief of section sights along the bottom edge of the bore and directs the gunner to traverse left or right and the assistant gunner to elevate or depress the cannon tube until the bottom edge of the bore clears the highest crest in the field of fire.
- 2 The chief of section directs the assistant gunner to MEASURE THE QUADRANT.
- 3 The assistant gunner centers the cross level bubble by turning the cross level control knob, centers the elevation level bubble by turning the elevation control knob, and reports the reading that appears on the elevation counter.
- 4 Chief of Section: Determine range-to-crest to the nearest 100 meters (FM 6-50) and report site-to-crest and range-to-crest to executive officer. Record site-to-crest and range-to-crest.

### NOTE

The sight to crest can also be measured using the gunner's quadrant by placing the gunner's quadrant on the M172 telescope and quadrant mount quad seats, with the LINE-OF-FIRE arrow pointing toward the muzzle of the Howitzer, then moving radial arm index up or down and turning the micrometer knob until the bubble centers.



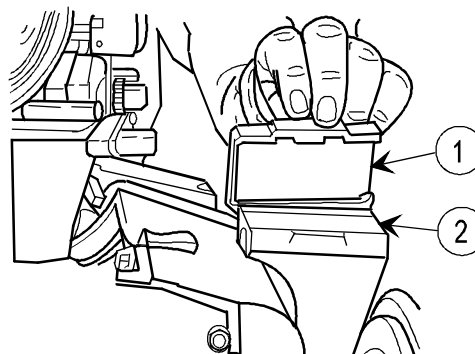
## 2-18. CHECKING ALIGNMENT OF M137/M137A3 PANTEL USING M139/M139A1 ALINEMENT DEVICE



### WARNING

When using radioactively illuminated fire control equipment, follow radiation hazard procedures in the front of this manual.

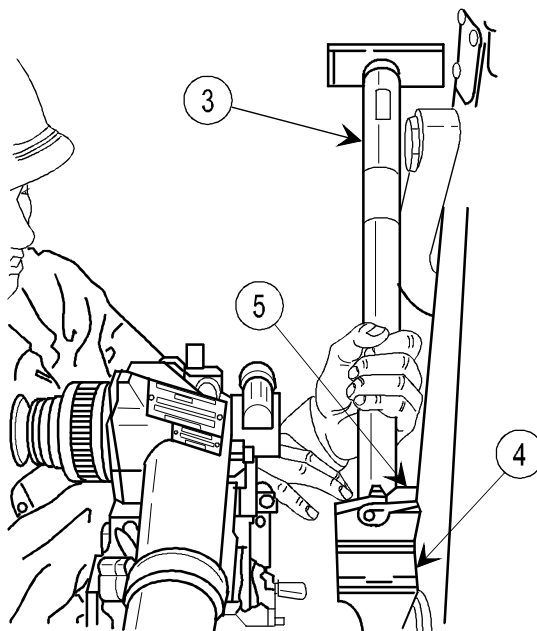
- 1 The assistant gunner removes protective cover (1) from dovetail (2) on right trunnion and ensures dovetail is clean by wiping with a clean rag (item 24, appx D).



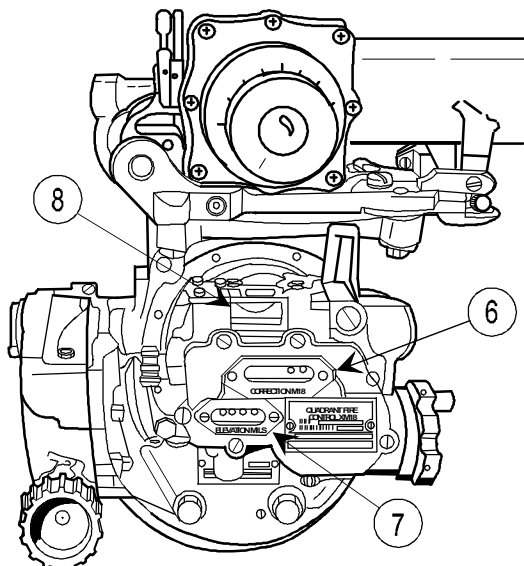
### NOTE

The following steps are written and illustrated for the M139 alinement device but also apply to the M139A1 alinement device.

- 2 The assistant gunner removes M139/M139A1 alinement device (3) from carrying case, installs battery in M139A1, and ensures mating surface (4) is clean by wiping mating surface with a clean rag (item 24, appx D). Remove protective plastic caps from head of alinement device and store in carrying case.
- 3 The assistant gunner mates alinement device (3) to dovetail of mounting bracket, ensuring that the mating surface of alinement device fits dovetail. The assistant gunner then turns alinement device latch (5) to lock device in place.



- 4 The assistant gunner sets M18 fire control quadrant elevation correction counter (6) at 00 and elevation counter (7) at 0000. The assistant gunner levels cannon tube by turning elevating handwheel until bubble in elevation level vial (8) centers.



## 2-18. CHECKING ALIGNMENT OF M137/M137A3 PANTEL USING M139/M139A1 ALINEMENT DEVICE (cont)

### NOTE

Steps 5 through 11 are written and illustrated for the M137 pantel but also apply to the M137A3 pantel.

- 5 The gunner levels M171 telescope (p 2-64) and quadrant mount and closes parallax shield (9). After leveling mount, the gunner ensures that bubble in pitch level vial (10) remains centered until alignment check of pantel is complete.
- 6 The gunner lifts azimuth counter door (11) and turns azimuth knob (12) until a 4800-mil reading is obtained on azimuth counter (13).
- 7 The gunner sights through eyepiece (14). The vertical pantel azimuth crosshair (15) should align with crosshairs (16) of alinement device.

### NOTE

To center crosshair for elevation, turn elevation knob (17).

- 8 If pantel crosshair (15) does not align with alinement device crosshairs (16) when azimuth counter (13) reads 4800 mils  $\pm$  0.5, the assistant gunner proceeds as follows:

- a. Remove alinement device (3) from dovetail (2).
- b. Reclean mounting surfaces (4) and reinstall alinement device (3). If pantel crosshair aligns, alignment checks are completed. If alignment is not obtained, perform comparison test (p 3-65).

- 9 The gunner opens the parallax shield (9) and closes azimuth counter door (11).

### CAUTION

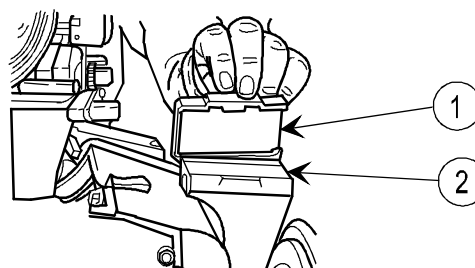
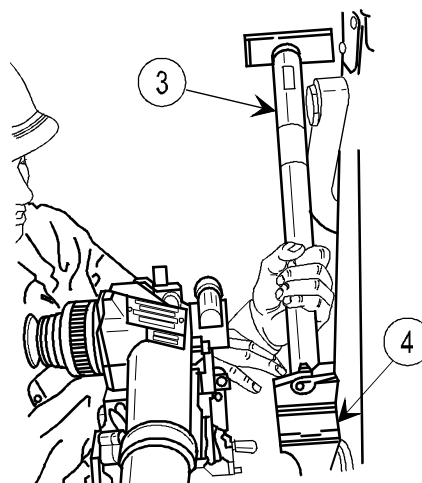
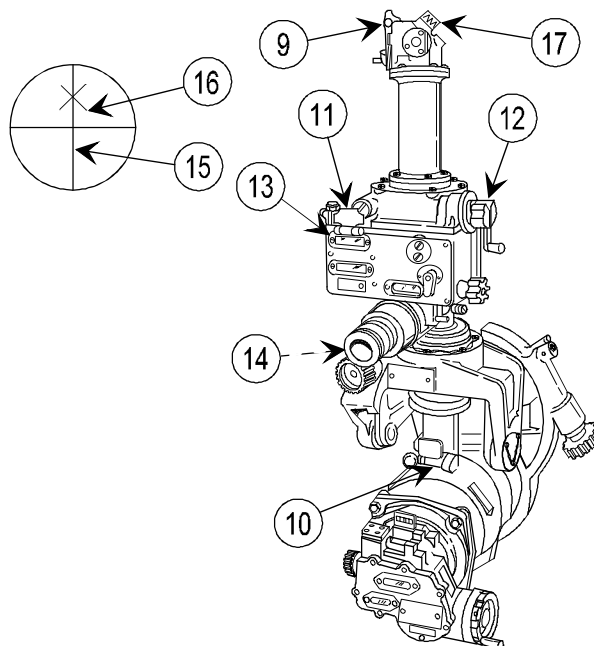
Failure to remove alinement device during firing may damage device.

- 10 The assistant gunner removes and stores alinement device (3).

### CAUTION

Failure to install protective cover on dovetail may result in damage to dovetail.

- 11 The assistant gunner installs protective cover (1).



## 2-19. BORESIGHTING M138 ELBOW TELESCOPE USING DISTANT AIMING POINT



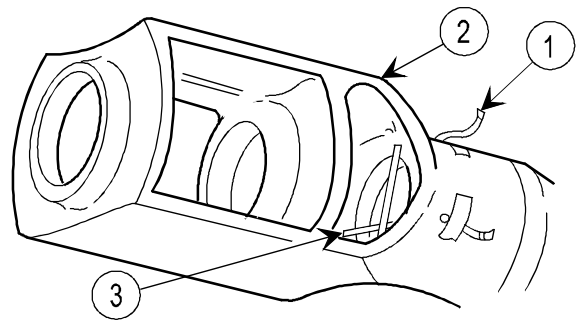
**WARNING**  
When using radioactively illuminated fire control equipment, follow radiation hazard procedures in the front of this manual.

### NOTE

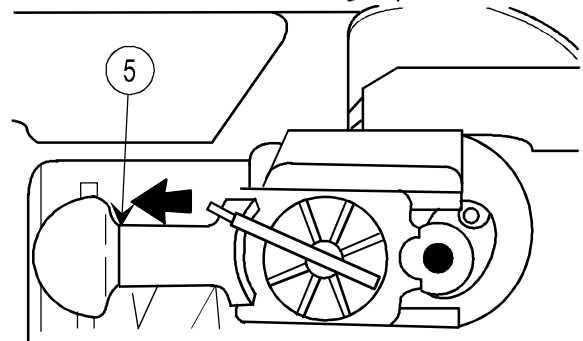
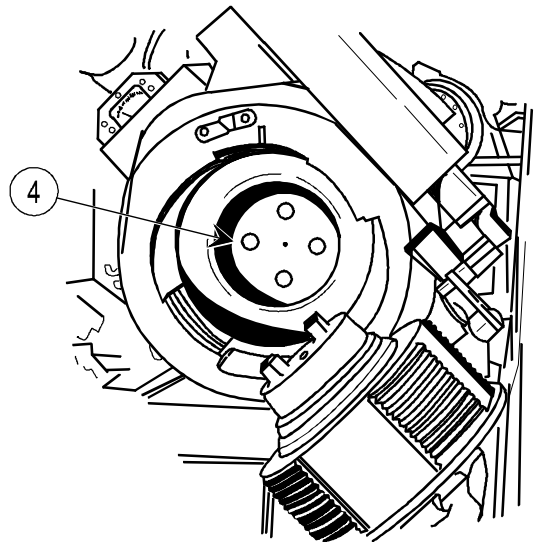
Boresighting the M138 elbow telescope is not mandatory when occupying a new position, but should be done as soon as time permits. The M138 elbow telescope and M172 telescope and quadrant mount reduce the need to boresight after installing and removing the telescope. Boresight M138 elbow telescope by the distant aiming point method.

- 1 The assistant gunner cross-levels M172 telescope and quadrant mount by centering bubble in cross level vial on M18 fire control quadrant.

- 2 The assistant gunner stretches a cord (1) (item 11, appx D) tightly through drilled holes in muzzle brake (2) over witness marks and fastens it in place, forming muzzle boresights (3).

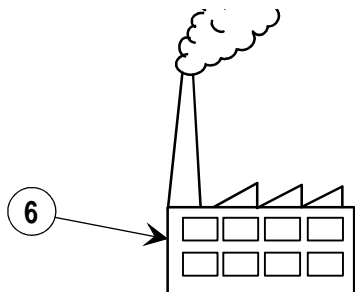


- 3 Cannoneer no. 1 opens breech and installs breech boresight disk (4). If disk is not available, cannoneer no. 1 slides firing mechanism block assembly (5) left to the open position.



## 2-19. BORESIGHTING M138 ELBOW TELESCOPE, USING DISTANT AIMING POINT (cont)

- 4 The chief of section selects a distant aiming point (6) with a well defined vertical and horizontal axis, ideally at least 1500 meters from the weapon. If such an aiming point is not available, the chief of section boresights at engagement range for direct fire.

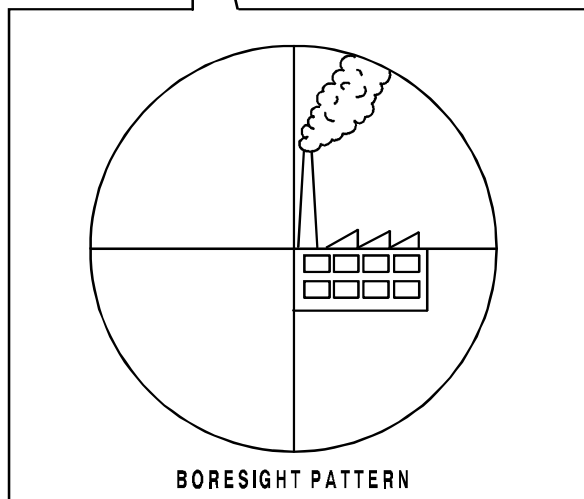
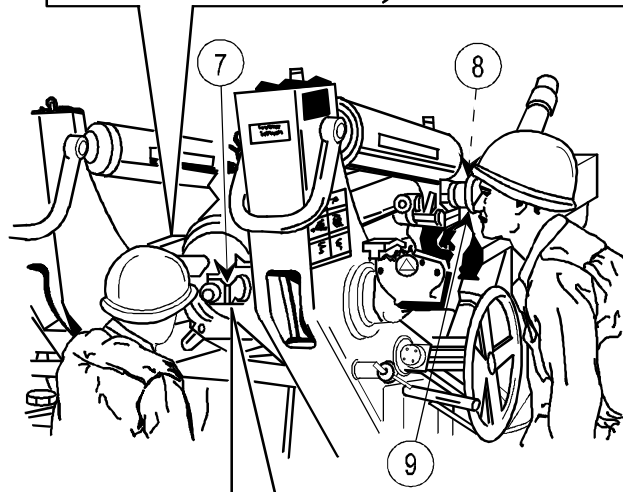
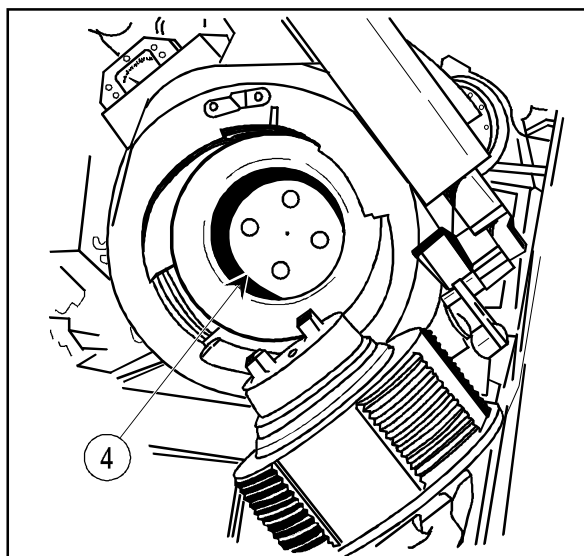


- 5 The chief of section, looking through breech boresight disk (4) (or primer cavity (7)) directs the elevation, depression, or traversing of cannon tube until muzzle boresights are alined on distant aiming point.

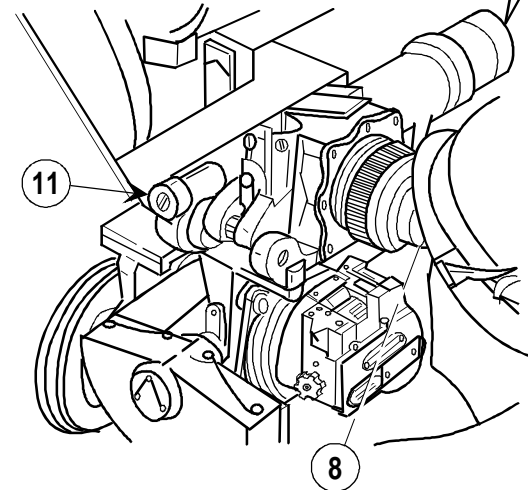
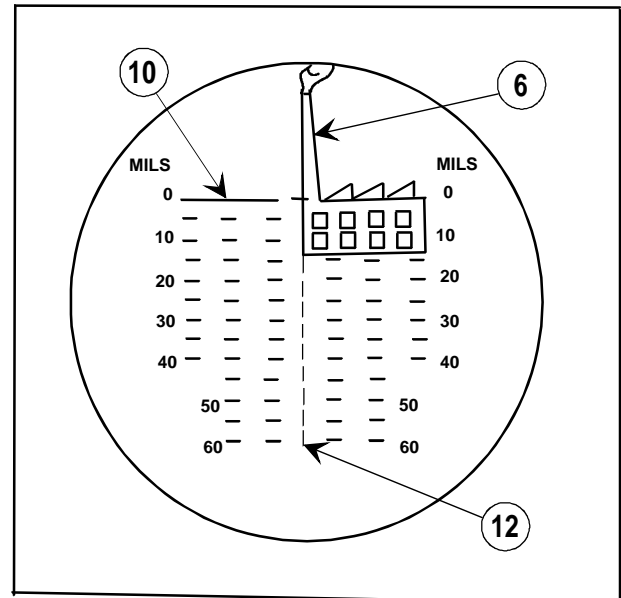
### NOTE

If breech boresight disk is not available, perform step 6. If breech boresight disk is available, proceed to step 7.

- 6 The assistant gunner, looking through eyepiece (8), adjusts diopter scale (9). Using a calibrated gunner's quadrant and the quadrant seats on the M172 telescope and quadrant mount, the assistant gunner measures the elevation to the distant aiming point and elevates the muzzle 2.3 mils. The assistant gunner checks cross level of the M172 telescope and quadrant mount and adjusts if necessary.



- 7 The assistant gunner sights through eyepiece (8). If elevation line (10) is aligned with distant aiming point (6), M138 elbow telescope is in boresight.
- 8 If elevation line is not aligned with distant aiming point, the assistant gunner turns elevation adjusting screw (11). If elevation line is misaligned by more than 0.5 mils, repeat steps 1 thru 7 prior to adjustment.
- 9 The vertical reticle line (12) should be on distant aiming point (6). If line is not in alignment, repeat steps 1 thru 7. If azimuth correction is still required, notify unit maintenance.
- 10 The assistant gunner removes cord from muzzle brake; cannoneer no. 1 removes breech boresight disk, if installed.



## 2-19.1. BORESIGHTING M137/M137A3 PANORAMIC TELESCOPE USING DISTANT AIMING POINT

### NOTE

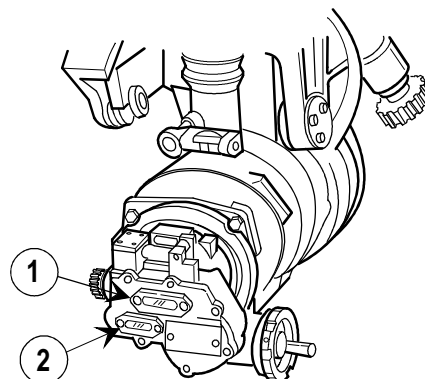
The following procedures must be performed by the section chief only after comparison tests of three M139/M139A1 alinement devices have been performed, eliminating the alinement device as the cause for misalignment (see para 3-54, M139/M139A1 Alinement Device Comparison Test).

High angle shoes on gunner's quadrant must be tested for accuracy prior to checking trunnion level (see para 3-49, Test of Gunner's Quadrant).

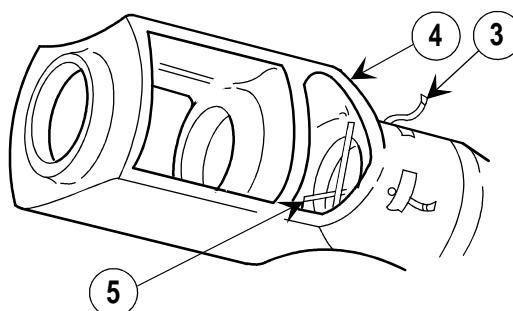
Distant aiming point (DAP) must be a minimum of 1500 meters from the howitzer and the howitzer should be aligned with the DAP prior to checking trunnion level within 90 mils cant. If trunnions are not within 90 mils cant, level trunnions (see para 3-50, Leveling Trunnions).

## 2-19.1. BORESIGHTING M137/M137A3 PANORAMIC TELESCOPE USING DISTANT AIMING POINT (cont)

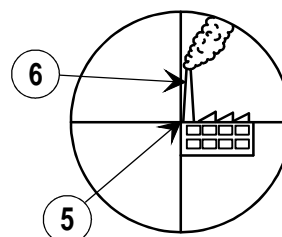
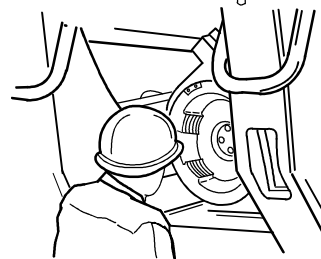
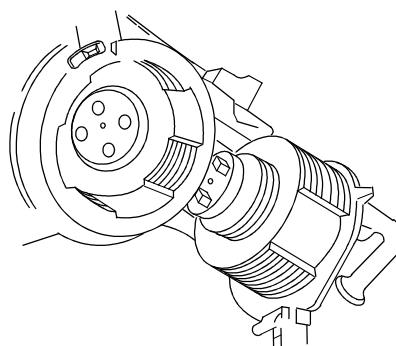
- 1 Emplace howitzer in firing position.
- 2 The gunner sets elevation correction counter (1) and elevation counter (2) to read 0.00 mils. Gunner then selects a sharply defined DAP, at least 1500 meters from the howitzer.



- 3 The assistant gunner stretches a cord (3) tightly through the drilled holes of the muzzle brake (4), ensuring cord is over witness marks. He then fastens the cord in place, forming muzzle boresight cross hairs (5).



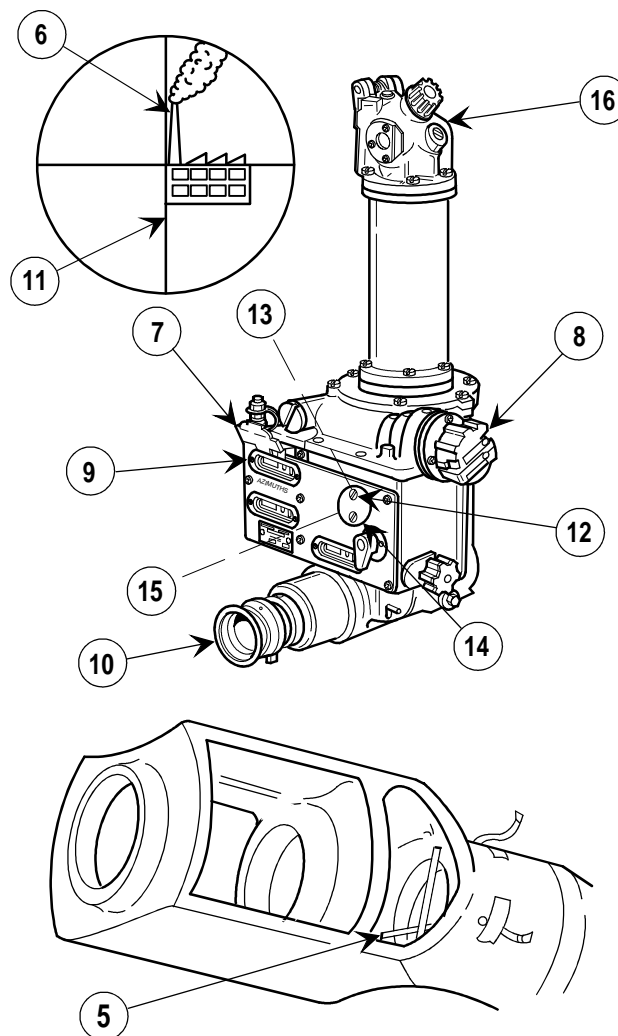
- 4 Cannoneer no. 1 opens breech and inserts breech boresight disk.
- 5 While looking through breech boresight disk, cannoneer no. 1 directs gunner to elevate, depress, or traverse cannon tube until muzzle boresight cross hairs (5) are aligned on left edge of DAP (6).
- 6 The assistant gunner checks trunnion level with a gunner's quadrant placed on adapter assembly quadrant pads. If the gunner's quadrant reading exceeds 90 mils cant, level trunnions (para 3-50).
- 7 The gunner levels the M171 telescope and quadrant mount. Repeat steps 5 thru 7 as necessary to ensure trunnions are level and muzzle boresight cross hairs (5) are aligned with DAP (6).



# NOTE

The following steps are written and illustrated for the M137 pantel but also apply to the M137A3 pantel.

- 8 The gunner lifts azimuth counter door (7) and turns azimuth knob (8) until a reading of 3200 mils is obtained on azimuth counter (9).
- 9 The gunner looks through eyepiece (10). The vertical pantel cross hair (11) should be on the left edge of the same aiming point as the vertical muzzle boresight. If they are on the same point, the weapon is in boresight. If they are not, proceed to step 10.
- 10 Loosen two setscrews (12) and two lockwashers (13), but do not remove from cover (14).
- 11 Remove cover (14).
- 12 Turn slotted eccentric (15) clockwise approximately 1/4 turn to disengage azimuth counter (9).
- 13 Turn azimuth knob (8) clockwise to align vertical pantel cross hair (11) with left edge of DAP (6).
- 14 Turn slotted eccentric (15) counterclockwise to engage azimuth counter (9).
- 15 Using azimuth knob (8), turn head (16) counterclockwise at least 80 mils.
- 16 Look through the eyepiece (10) and use azimuth knob (8) to align vertical pantel cross hair (11) on left edge of DAP (final movement in a clockwise direction).
- 17 With vertical pantel cross hair (11) on left edge of DAP, azimuth counter (9) reading should be 3200 mils. If it is not, notify unit maintenance for repair of M137/M137A3 panoramic telescope. If reading is 3200 mils, weapon is boresighted.
- 18 Install cover (14) and tighten two setscrews (12) and two lockwashers (13) to secure.
- 19 Remove muzzle boresight cross hairs (5) and breech boresight disk.



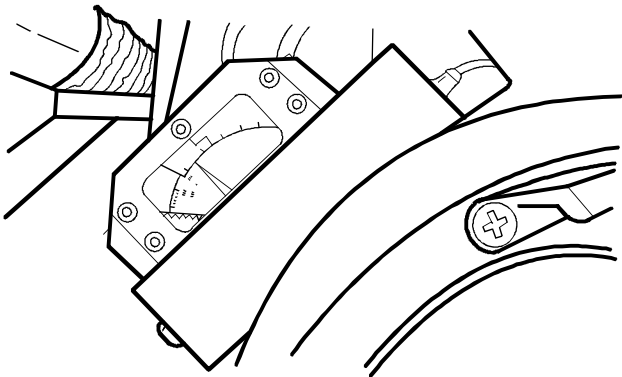
# NOTE

If misalignment of M137/M137A3 panoramic telescope and M139/M139A1 alinement device persists, notify Unit Maintenance for repair of M137/M137A3 panoramic telescope, M139/M139A1 alinement device, or dovetail adapter on the trunnion.

2-20. USING THE THERMAL WARNING DEVICE

NOTE

The thermal warning device shows the temperature of the cannon tube so that you may take the proper action in the event of a misfire or checkfire. Use the chart below as a guide.

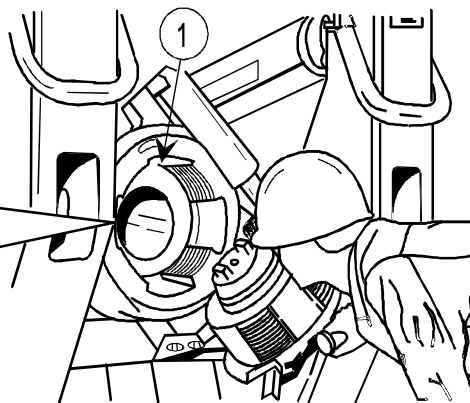
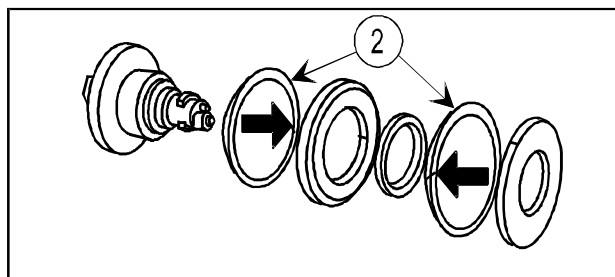


Temperature/Color Code	Tube Condition	Crew Must Do the Following
0° to +170°F (-18° to +77°C)/Green	Cold	In case of misfire or check fire, go to page 2-115.
+170° to +350° F (+77° to +177°C)/Yellow	Warm	Notify fire direction center that cannon tube is warm. In case of misfire or check fire, go to page 2-115.
+170° to +300°F (+77° to 149°C)/Yellow	Warm/Hot Weather	Notify fire direction center that cannon tube is warm under hot weather conditions. In case of misfire or check fire, go to page 2-115.
Above +350°F (+177°C)/Red	Hot	Fire combat emergency missions only. In case of misfire or check fire, go to page 2-115.

NOTE

Hot weather is any weather in which the outside temperature is expected to exceed 100°F (38°C) during the day.

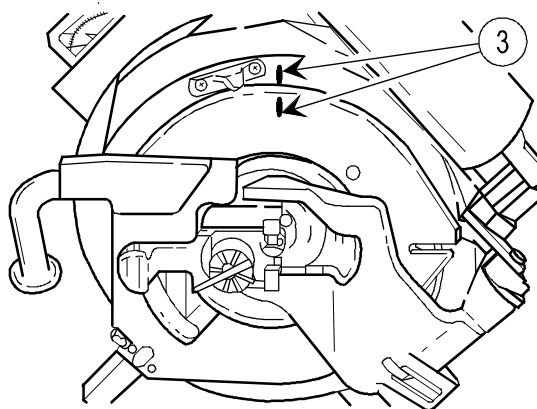
## 2-21. PREFIRING CHECKS



### NOTE

After a move, make the following checks before firing the first round.

- 1 Cannoneer no. 1 looks through cannon tube (1) to ensure no foreign matter is present.
- 2 Ensure that splits on split rings (2) are 180° apart.
- 3 Cannoneer no. 1 ensures witness marks (3) are alined.





**NOTE**

The optimum number of reserves before firing is four. This allows recoil oil to expand during the heat of firing.

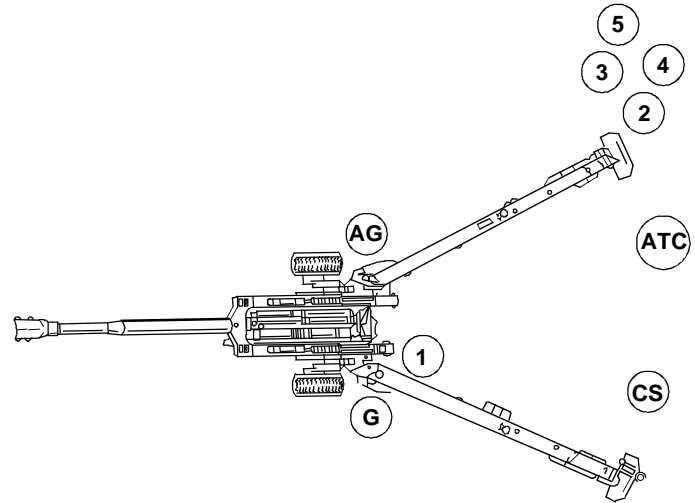
- 4 The assistant gunner checks to see if oil reserve indicator shows between two and ten reserves.

**2-22. LAYING FOR DIRECTION AND ELEVATION AND LOADING AND FIRING THE HOWITZER DURING INDIRECT FIRE MISSIONS**

**NOTE**

Procedures for firing drills have been standardized under the Department of the Army Standardization Program.

To eliminate backlash when laying for direction and elevation, make sure the last motion of all control and leveling knobs is in a clockwise direction.



- 1 At the command, FIRE MISSION, from the chief of section, the section takes positions as shown above. The chief of section then relays the fire mission to the crew.

**WARNING**

Prior to loading howitzer for actual firing, all personnel must be familiar with prescribed actions in the event of a misfire (p 2-115) and ensure prefiring checks (p 2-76) are performed.

**CAUTION**

Do not fire weapon when speed shift cylinder assembly is supporting howitzer.

- 2 Cannoneer no. 4 repeats PROJECTILE, and selects and prepares projectile (p 4-34). (For preparation of M712 projectile (Copperhead), see p 4-60.)
- 3 Cannoneer no. 3 repeats PROPELLING CHARGE, and selects and prepares propelling charge (p 4-49).
- 4 Cannoneer no. 2 repeats FUZE, and selects and prepares fuze (p 4-37).
- 5 Cannoneer no. 1 opens breechblock assembly.

**WARNING**



When using radioactively illuminated fire control equipment, follow radiation procedures in the front of this manual.

## 2-22. LAYING FOR DIRECTION AND ELEVATION AND LOADING AND FIRING THE HOWITZER DURING INDIRECT FIRE MISSIONS (cont)

- 6 The gunner lays for direction as follows:

### NOTE

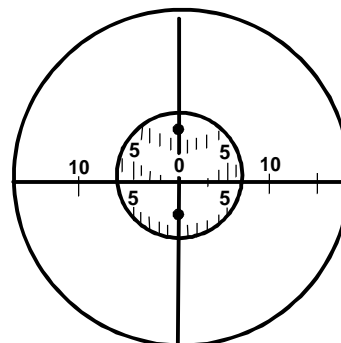
If a collimator is used, the gunner performs the following:

- a. On the command, DEFLECTION (SO MUCH), the gunner turns azimuth knob until deflection appears in deflection counter. He then reads the setting to the chief of section.

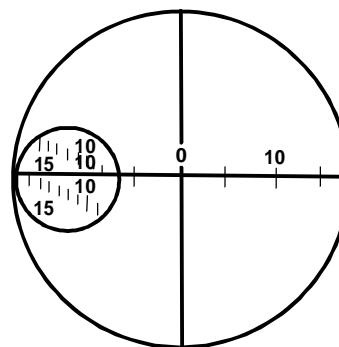
### NOTE

Each time howitzer is traversed or cannon is elevated or depressed, level the M171 telescope and quadrant mount.

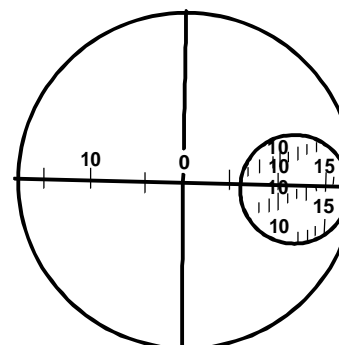
- b. While sighting through eyepiece, the gunner traverses weapon until a proper sight picture on collimator is obtained.
- c. The gunner then levels M171 telescope and quadrant mount and rechecks sight picture.
- d. If the weapon has not been displaced, the sight picture will appear as shown.
- e. If the weapon has experienced right displacement (collimator reticle pattern slopes upward to the left), the gunner traverses the weapon until the left portion of the pantel reticle is matched with the collimator reticle. For example, the 10- and 15-mil marks are alined as shown.
- f. If the weapon has experienced left displacement (collimator reticle pattern slopes upward to the right), the gunner traverses the weapon until the right portion of the pantel reticle is matched with the collimator reticle. For example, the 10- and 15-mil marks are alined as shown.



NO DISPLACEMENT



RIGHT DISPLACEMENT



LEFT DISPLACEMENT

### NOTE

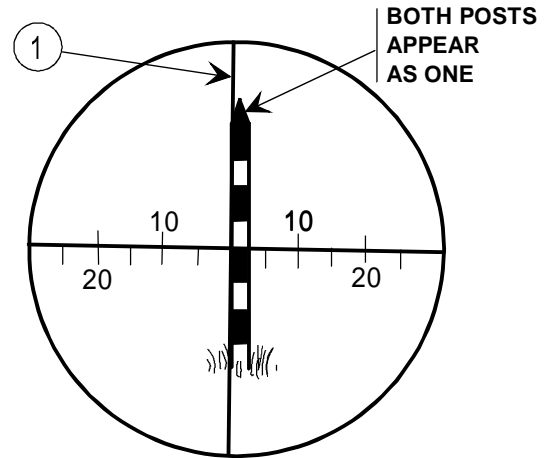
If aiming posts are used, the gunner performs the following:

- g. On the command, DEFLECTION (SO MUCH), the gunner turns azimuth knob until deflection appears in deflection counter. He then reads the setting to the chief of section.
- h. While sighting through eyepiece, the gunner traverses weapon until a proper sight picture on aiming posts is obtained.
- i. The gunner then levels M171 telescope and quadrant mount and rechecks sight picture.

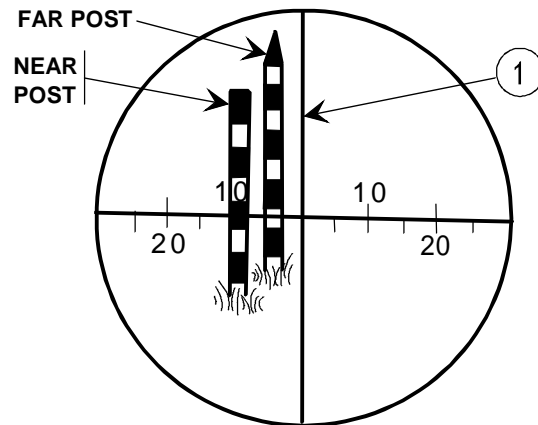
#### NOTE

At night aiming posts are identified as near or far by color of aiming post lights. Unit SOP will dictate which color goes on which aiming post.

- j. If the weapon has experienced no displacement, the sight picture will appear as shown.

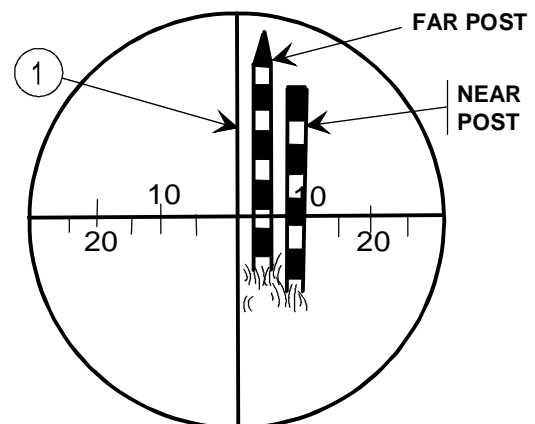


NO DISPLACEMENT



CORRECTED FOR RIGHT DISPLACEMENT

- k. If the weapon has experienced right displacement (the far aiming post is to the right of the near aiming post), the gunner traverses the weapon until the far aiming post is exactly halfway between the near aiming post and the pantel vertical reticle line (1) as shown.



CORRECTED FOR LEFT DISPLACEMENT

- l. If the weapon has experienced left displacement (the far aiming post is to the left of the near aiming post), the gunner traverses the weapon until the far aiming post is exactly halfway between the near aiming post and the pantel vertical reticle line (1) as shown.
- m. The gunner then releveles M171 telescope and quadrant mount (if necessary), rechecks and adjusts sight picture (if necessary) by traversing, and announces READY to the chief of section.

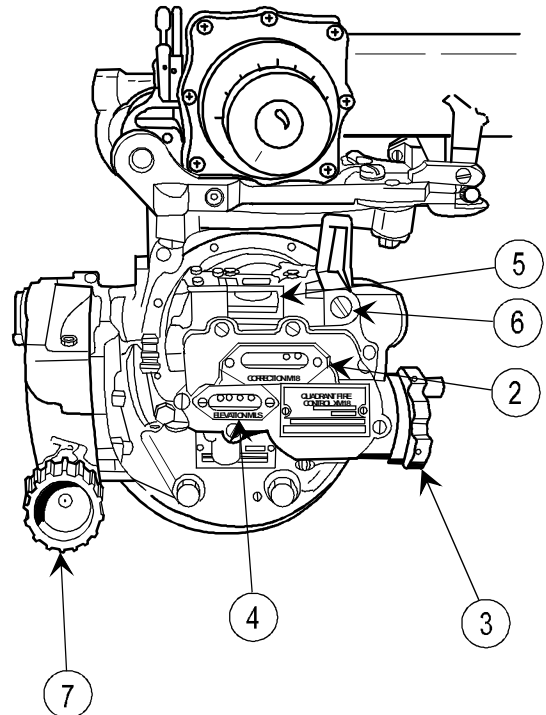
## 2-22. LAYING FOR DIRECTION AND ELEVATION AND LOADING AND FIRING THE HOWITZER DURING INDIRECT FIRE MISSIONS (cont)

### NOTE

During normal operation, the assistant gunner lays the howitzer for elevation using the M18 fire control quadrant. However, during one-man indirect fire operations, the gunner lays the howitzer for elevation using the M17 fire control quadrant.

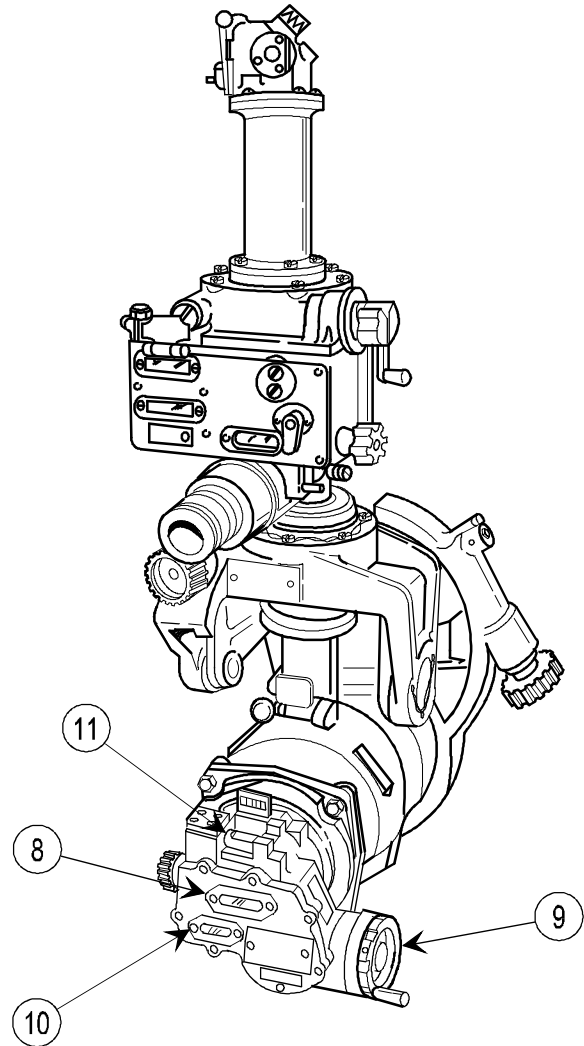
- 7 Using the M18 fire control quadrant, the assistant gunner lays the howitzer for elevation as follows:

- a. On the command, QUADRANT (SO MUCH), the assistant gunner ensures elevation correction counter (2) reads 00 and rotates elevation control knob (3) until announced quadrant appears in the elevation counter (4). He then reads the setting to the chief of section.

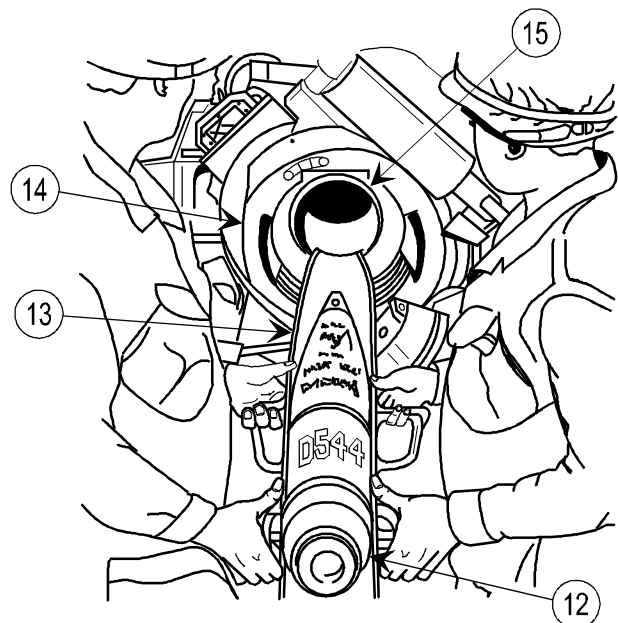


- b. The assistant gunner elevates or depresses the cannon tube until bubble in the elevation level vial (5) centers. The assistant gunner centers the bubble in the cross level vial (6) by turning the cross level control knob (7). The assistant gunner rechecks and adjusts both bubbles (if necessary), and announces SET to the chief of section.
- c. The gunner's quadrant can also be used to lay for quadrant. The chief of section sets the announced quadrant on the gunner's quadrant using the radial arm index and micrometer knob. He places and holds the gunner's quadrant firmly on the M18 fire control quadrant seats with the LINE-OF-FIRE arrow pointing toward muzzle. The chief of section directs the assistant gunner to elevate or depress until the bubble is centered.

- 8** Using the M17 fire control quadrant (during one-man indirect fire operations) the gunner lays the howitzer for elevation as follows:
- On the command, QUADRANT (SO MUCH), the gunner ensures elevation correction counter (8) reads 00 and rotates elevation control knob (9) until announced quadrant appears in elevation counter (10). He then reads setting to chief of section.
  - The gunner elevates or depresses cannon tube until bubble centers in elevation level vial (11).
  - The gunner rechecks the M171 telescope and quadrant mount pitch and cross level vials, pantel sight picture, and adjusts as necessary. The gunner then announces READY to the chief of section.



- 9** Cannoneers no. 4 and 5 place projectile (12) on loading tray (13). They lift upward and place loading tray on breech ring assembly (14) so that front edge of loading tray rests against rear face of cannon tube (15).



**2-22. LAYING FOR DIRECTION AND ELEVATION AND LOADING AND FIRING THE HOWITZER DURING INDIRECT FIRE MISSIONS (cont)**



- 10** Cannoneer no. 1 places loading rammer assembled on staff sections against base of projectile and pushes projectile into breech until the rotating band clears the Swiss notch recess. Cannoneer no. 5 removes loading tray.

**NOTE**

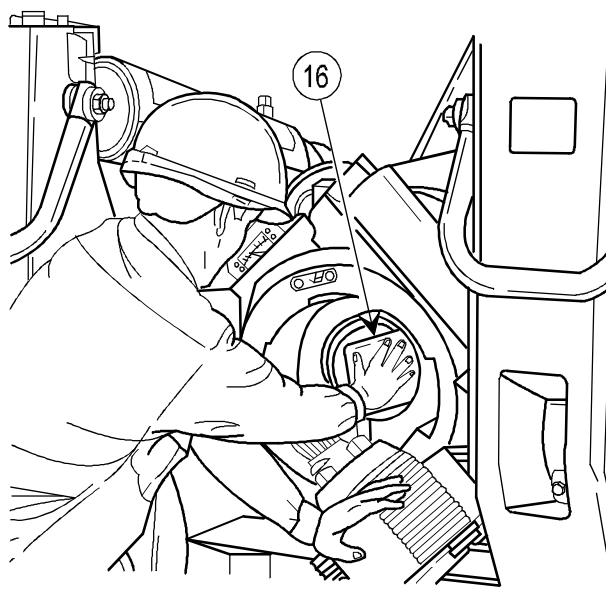
Ramming at low gun elevations will be done using two 4-foot (1.22-m) cleaning staff sections. If the gun is elevated to the extent that two staff sections cause interference with the ground, one staff section may be removed and replaced with a 2-foot (0.61-m) staff section. Do not use only a single staff section.

- 11** Upon the command, READY, RAM, from cannoneer no. 4, the projectile is rammed into place by cannoneers no. 1 and 4, using loading rammer and staff.

**WARNING**

Do not leave a propelling charge in chamber longer than necessary before firing. Temperature changes affect performance characteristics of a powder charge. Those changes occur rapidly in a hot chamber.

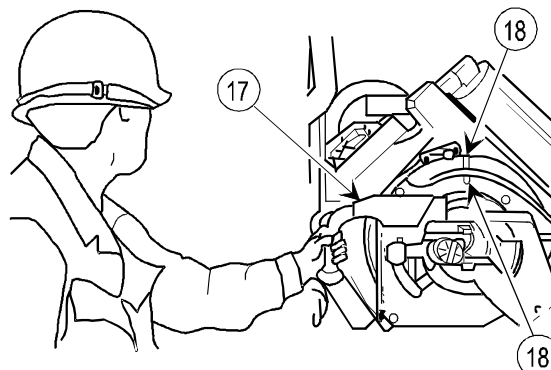
- 12** Cannoneer no. 3 hands prepared propelling charge (16) to cannoneer no. 1 who checks the charge and then announces CHARGE (SUCH-AND-SUCH) to the chief of section. Cannoneer no. 1 then inserts the charge into the chamber with red igniter base to rear, except for the MACS charge, which may be loaded in either direction. The propelling charge is pushed in until the base is approximately 3 inches (7.62 cm) from rear face of cannon tube into Swiss notch recess.



**WARNING**

Do not close breechblock if the powder charge red igniter base cannot be seen. A possible hang fire may occur if the red igniter pad is installed toward the muzzle brake.

- 13 Cannoneer no. 1 announces, I SEE RED, and closes breechblock assembly (17), making sure it is locked in place and that witness marks (18) are aligned.



**WARNING**

The lanyard lever must be positioned prior to inserting the primer.

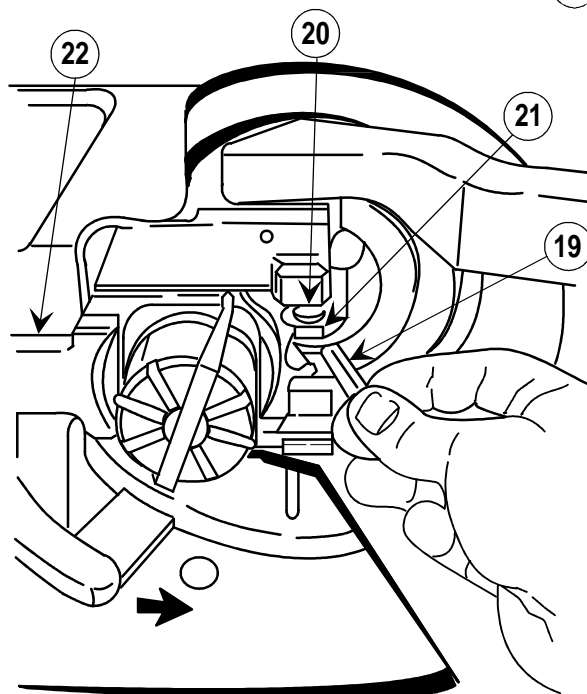
The lanyard will not be shortened because injury to personnel may result.

Don't force primer into primer chamber. If primer will not go in, chamber is probably dirty. Forcing primer into primer chamber may cause primer to prematurely ignite powder charge, which will cause the howitzer to recoil prematurely and cause serious injury to crew.

**NOTE**

The lanyard lever can be repositioned by pushing in on "hole end" of lever and rotating.

- 14 Cannoneer no. 1 inserts primer (19) into primer cavity (20) until it seats against cartridge extractor (21).
- 15 Cannoneer no. 1 slides firing mechanism block assembly (22) closed and announces PRIMED.

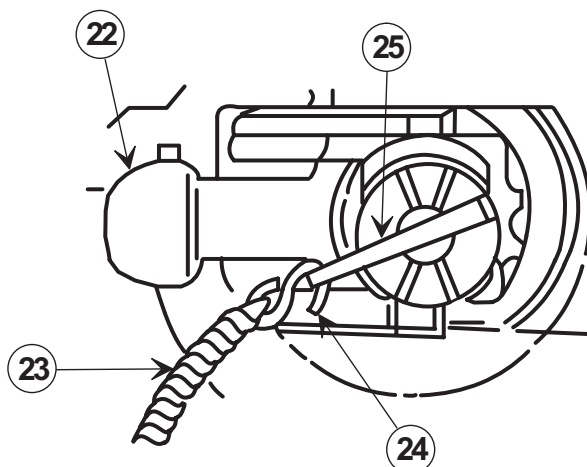


**WARNING**

The lanyard will not be attached until the command HOOK UP is announced by the chief of section.

The chief of section must ensure that all personnel are clear of the path of recoil.

- 16 After the assistant gunner announces SET, the gunner announces READY, and cannoneer no. 1 announces PRIMED, the chief of section will command HOOK UP, STAND BY.
- 16.1 After hook up, cannoneer no. 1 attaches lanyard (23) by inserting S-hook (24) through hole in lanyard lever (25).



2-22. LAYING FOR DIRECTION AND ELEVATION AND LOADING AND FIRING THE HOWITZER DURING INDIRECT FIRE MISSIONS (cont)

WARNING

When firing, personnel in the area will stay clear of the recoil path.

When firing howitzer at night, personnel should avoid direct viewing of muzzle flash from their weapon or adjacent weapons when firing top zones. Temporary flash blindness can be caused by intense muzzle flash, resulting in potential reduction of crew efficiency.

WARNING

The M198 howitzer can generate blast overpressure which may damage hearing or cause injury to lungs or sinuses if proper protective measures are not followed. Supervised wearing of earplugs is required at all times, with the e-a-r type (plastic roll) preferred. The effects of blast can be reduced by moving further to the rear of the weapon. For this reason, all crew members not required to fire the weapon should move away as far to the rear as practicable. Any crewman who experiences such problems as shortness of breath or bleeding from nose or mouth must be immediately transported to a medical facility for evaluation.

The degree of hearing protection required is based on propelling charge used and number of rounds fired daily by the crew. For training missions, earplugs provide adequate protection if M4A2 (WB), zone 6, or lower charges are used. When firing higher zones, consult the following chart.

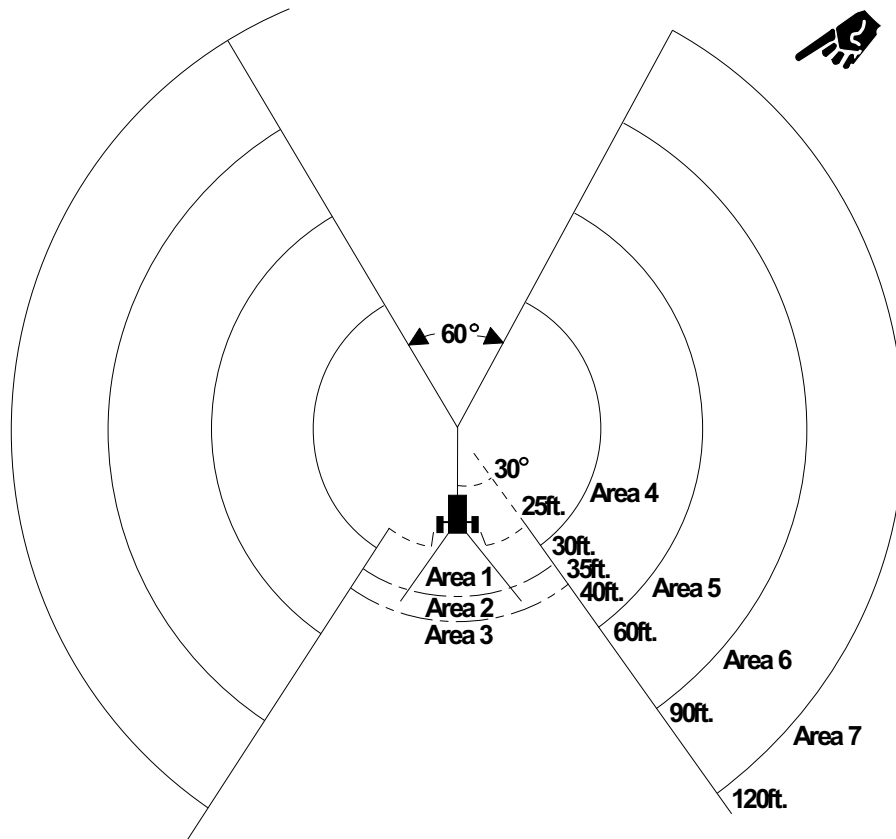
Properly worn foam earplugs provide adequate protection when firing all existing propellant charges, including M203 series and MACS charges, at all quadrant elevations according to the guidelines in the following chart.

Hazard Assessment Point Values for the M198, 155-mm Towed Howitzer

Charge/Zone	Areas						
	1	2	3	4	5	6	7
M203	5.24	3.79	1.11	3.01	1.44	0.51	0.18
M119	4.65*	3.36*	0.98*	1.34*	0.64*	0.23*	0.1*
M4A2	1.14*	0.27	0.10	1.12*	0.54*	0.19*	0.1*
M3A1	0.34*	0.15	0.10	0.35*	0.17*	0.1*	0.1*
M232/5	1.60	1.60	0.94	1.43	0.36	0.30	0.19
M232/4	1.40	1.40	0.31	0.79	0.27	0.20	0.15
M232/3	0.80	0.80	0.23	0.54	0.22	0.15	0.11
M231/2	3.22	3.22	0.14	0.15	0.10	0.10	0.10
M231/1	0.95	0.95	0.10	0.30	0.10	0.10	0.10

These point values are based on the use of approved single hearing protection. Exposure of any personnel must not exceed 1000 points in a 24-hour period. In battery formation, points from the firing of adjacent weapons must be included. (See illustration for definition of areas.) The areas must be rotated as the azimuth is changed. Point values less than 0.1 have been set to 0.1. Areas not defined in this table have unknown hazard due to lack of data.

\*Point values extrapolated and scaled from M203 data.



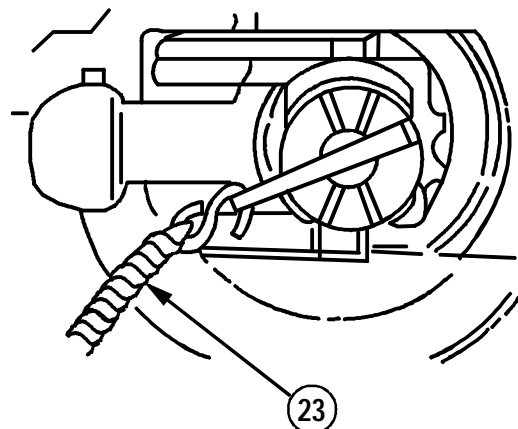
**M198 155-MM Towed Howitzer Personnel Areas**



# **NOTE**

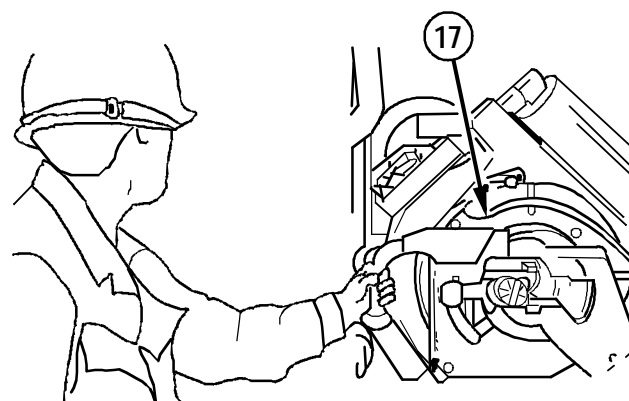
When cannoneer no. 1 has announced, PRIMED, the assistant gunner has announced, SET, and the gunner has announced, READY, the chief of section may command, FIRE, unless restricted by the fire command.

- 17 When the chief of section commands, FIRE, or drops raised arm, cannoneer no. 1 pulls lanyard (23) with a steady pull.



# **WARNING**

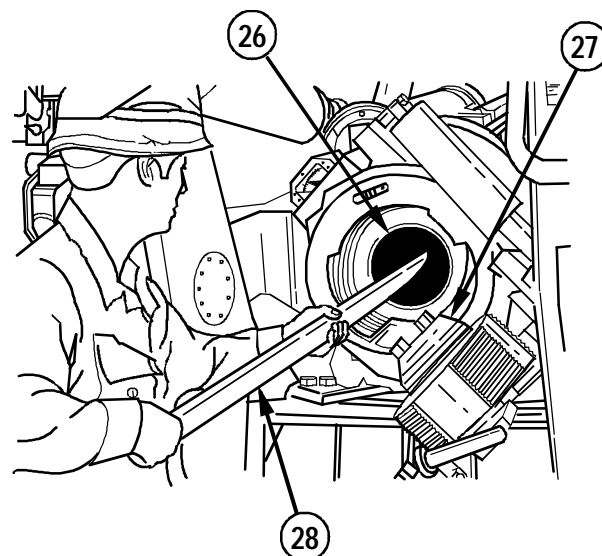
In case of a failure to fire, refer to misfire and check firing procedures (p 2-115). Use the misfire and check firing procedure that corresponds to the cannon tube temperature.



# **NOTE**

The primer is ignited by impact of hammer against firing pin. The firing mechanism assembly returns automatically to the ready position when lanyard is released.

- 18 When cannon tube returns to the in-battery position, cannoneer no. 1 unhooks the lanyard (23), then opens breechblock assembly (17).
- 19 Cannoneer no. 1 swabs powder chamber (26), spindle assembly (27), and gas check seat using chamber swab (28); inspects cannon tube; and announces, BORE CLEAR.

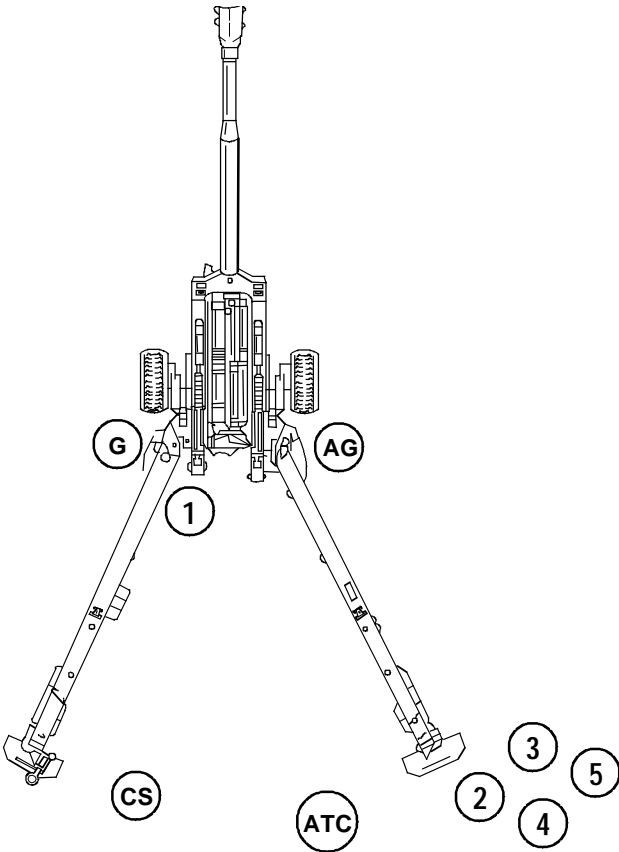


2-23. LAYING FOR DIRECTION AND ELEVATION AND LOADING AND FIRING THE HOWITZER DURING DIRECT FIRE MISSIONS

WARNING

Direct fire on targets closer than 800 meters from the howitzer during combat situations only. Lethal fragments can travel up to 600 meters from point of burst.

The one-person sight system should only be used when the target and the howitzer are at the same elevation, with no mask (sight-to-crest) obstacles in between. Firing at targets above or below the howitzer position requires adjustments to the quadrants listed on the range chart. Adjustments must be computed by the Fire Direction Center in accordance with FM 6-40, paragraph 8-4. For this reason, the primary means of direct fire will be the two-person sight method.

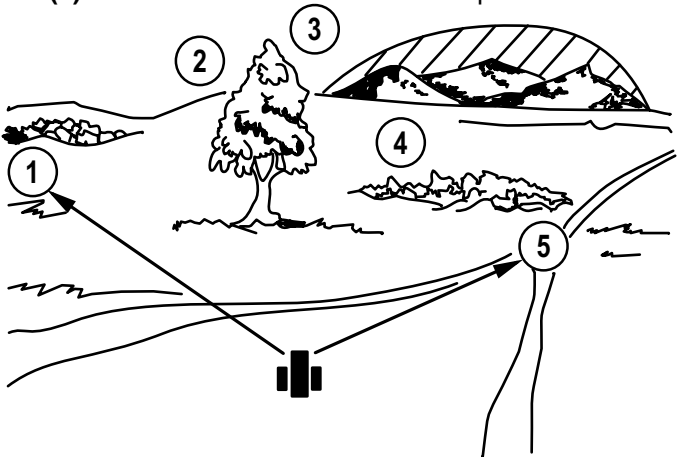


NOTE

Procedures for firing drills have been standardized under the Department of the Army Standardization Program. The following procedures are for two-person operations. For one-person, one-sight operations, the gunner assumes duties of the assistant gunner and performs them on left side of howitzer.

a. **Duties of the Chief of Section.** Upon receipt of the order to fire direct fire, the chief of section does the following:

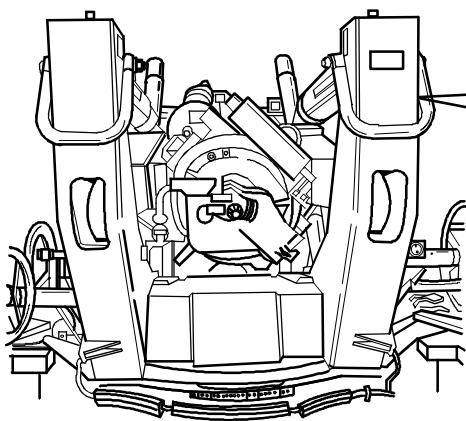
- (1) Commands the section to take positions as illustrated above .



NO.	SHELL	CHG	FZ	T1	DF	QE	RANGE	DESCRIPTION	RMK
1	HE	7	Q		3800	4	250	ROCK PILE	
2	HE	5GB	Q		3015	6	150	TREE	
3	1CM	1	T1	2.0	2800	1000	500	DEAD SPACE	SWEEP 200 m
4	HE	1	T1	2.0	2447	30	400	HEDGE ROW	KJ
5	HE WP	1	T1	2.0	1831	30	400	RD JCT	KJ

(2) Announces target to section, i.e., TARGET, ROCK PILE.

(3) Determines quadrant of target from range card, i.e., 4 mils. If range card is not prepared, quadrant may be obtained from direct fire range plate.



DIRECT FIRE RANGE PLATE			
M198 155 MM HOWITZER			
M795 HE PROJECTILE		M107 HE PROJECTILE	
M203 PC (RB)		M 119A1 PC (WB)	
RANGE (METERS)	ELEV (MILS)	RANGE (METERS)	ELEV (MILS)
400 -		400 -	4
600 -		600 -	7
800 -		800 -	9
1000 -		1000 -	11
1200 -		1200 -	14
1400 -		1400 -	16
L15 HE PROJECTILE		M107 HE PROJECTILE	
M203 PC (RB)		M4A2 PC (WB)	
RANGE (METERS)	ELEV (MILS)	RANGE (METERS)	ELEV (MILS)
400 -		400 -	6
600 -		600 -	10
800 -		800 -	13
1000 -		1000 -	16
1200 -		1200 -	20
1400 -		1400 -	24
PLATE DIRECT FIRE P/N 12008973			

#### NOTE

The M795 HE projectile and L15 projectile are not available.

(4) Determines and announces lead, in mils, by estimating speed of target for particular shell and charge. Approximate leads are as follows:

0 to 5 mph (0.00 to 8.05 km/hr).....	5 mils
6 to 10 mph (9.65 to 16.09 km/hr) .....	10 mils
11 to 15 mph (17.69 to 24.13 km/hr) .....	15 mils

(5) Gives the fire commands as follows:

- (a) TARGET (DESCRIPTION/LOCATION)
- (b) SHELL (TYPE)
- (c) CHARGE (TYPE)
- (d) FUZE (TYPE)
- (e) LEAD (LEFT OR RIGHT SO MUCH)
- (f) RANGE (SO MUCH)
- (g) FIRE AT WILL (unless otherwise notified)

(6) Gives the following subsequent commands based on observed effect:

- (a) CHANGE IN LEAD (RIGHT OR LEFT SO MUCH)
- (b) CHANGE IN QUADRANT (ADD OR DROP)

## 2-23. LAYING FOR DIRECTION AND ELEVATION AND LOADING AND FIRING THE HOWITZER DURING DIRECT FIRE MISSIONS (cont)



### WARNING

When using radioactively illuminated fire control equipment, follow radiation hazard procedures in the front of this manual.

**b. Duties of the Assistant Gunner.** The assistant gunner lays the howitzer for elevation as follows:

### NOTE

To eliminate backlash when laying for direction and elevation, make sure the last motion of all control and leveling knobs is in a clockwise direction.

(1) Cross-levels M172 telescope and quadrant mount by centering bubble in cross level vial.

(2) Using direct fire range plate, determines elevation based on announced range, charge, and projectile and elevates or depresses cannon tube to keep appropriate mil line of elbow telescope on center mass of target, then announces, SET.

(3) Continues to announce, SET, as long as target is being tracked.

(4) For subsequent rounds, changes the mil line based on commands from the chief of section.

**c. Duties of the Gunner.** The gunner lays the howitzer for direction as follows:

### NOTE

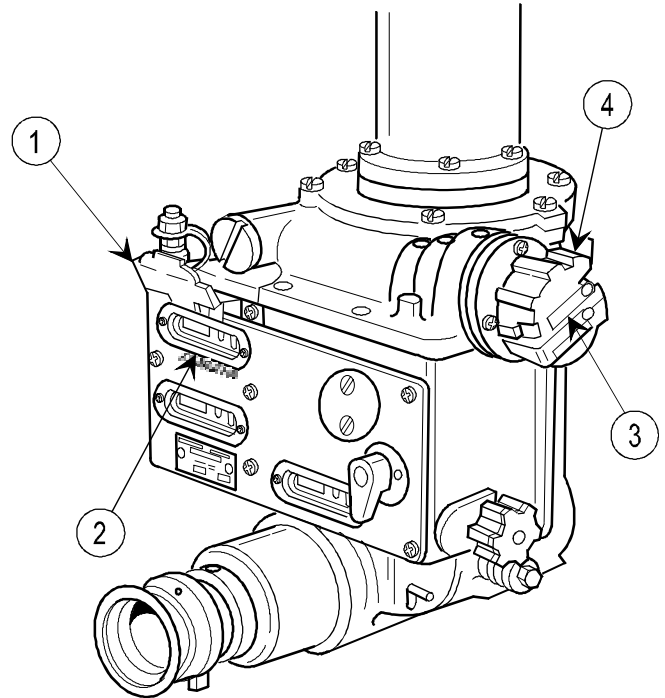
To eliminate backlash when laying for direction and elevation, make sure the last motion of all control and leveling knobs is in a clockwise direction.

(1) Cross-levels M171 telescope and quadrant mount by centering bubble in cross level vial.

### NOTE

Central laying is the preferred method for direct fire.

(2) Opens azimuth counter door (1), sets azimuth counter (2) to 3200 by turning azimuth knob (3), and turns azimuth bar knob (4) to DIRECT.



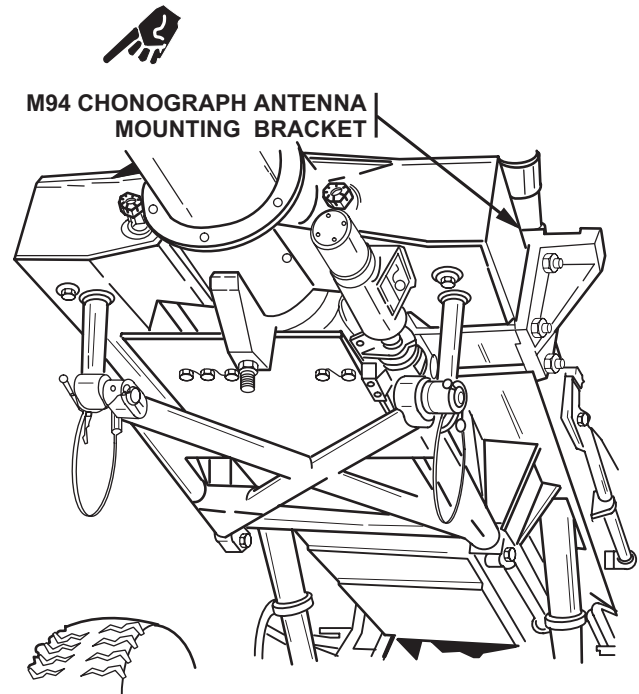
(3) Tracks target (if moving) by traversing weapon. If a lead is announced by the chief of section, it can be applied with azimuth knob (3). With azimuth bar knob (4) on DIRECT, azimuth counter (2) will click every 5 mils. The lead can also be applied with reticle lead. The gunner should use appropriate mil line of reticle pattern to obtain desired lead.

(4) When proper sight picture exists and cannoneer no. 1 announces, PRIMED, the assistant gunner announces, SET, continuously until the gunner commands, FIRE.

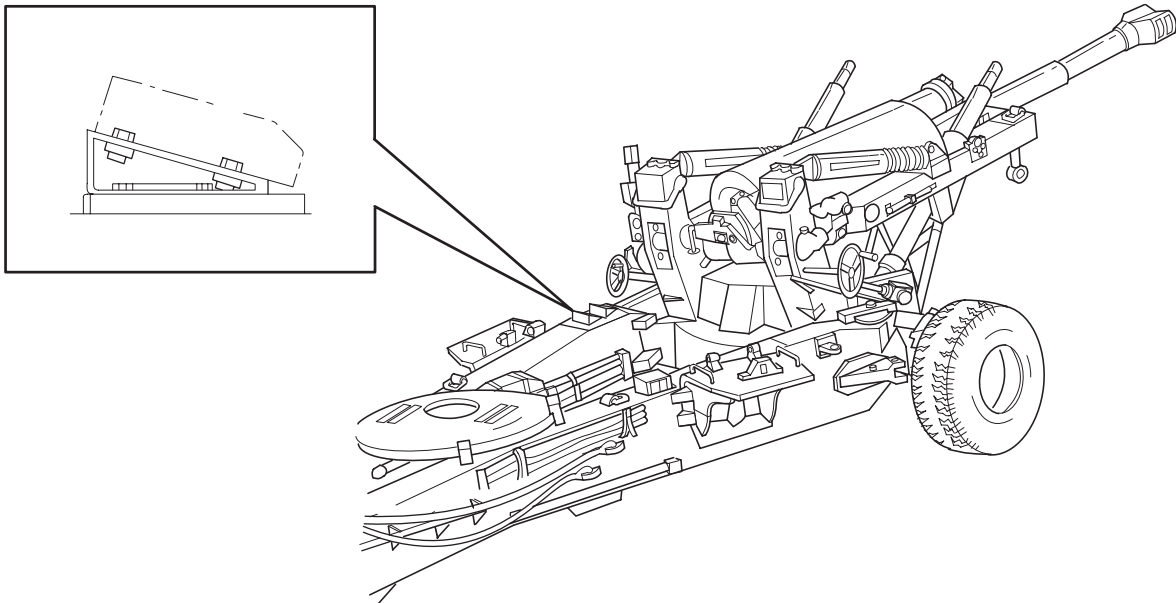
d. **Duties of Remainder of Section.** Performs duties as in indirect fire until END OF MISSION or CHECK FIRING is commanded by the chief of section.

## 2-24. M94 CHRONOGRAPH

The M94 chronograph antenna mounting bracket mounted on the cradle assembly is for installation of the M94 chronograph antenna bracket assembly. Instructions for the operation of the M94 chronograph are in TM 9-1290-364-14&P.



## 2-25. BATTERY COMPUTER SYSTEM (BCS) GUN ASSEMBLY



Three gun assembly (GA) brackets are mounted on top of trails, immediately forward of the spade stowage brackets. One GA bracket is on the right trail; two GA brackets are on the left trail. Instructions for operation of the BCS gun assembly are in TM 11-7440-283-12-2.

## 2-26. TRAVERSING BEYOND CARRIAGE TRAVERSE LIMITS AND OPERATING SPEED SHIFT SELECTOR VALVE

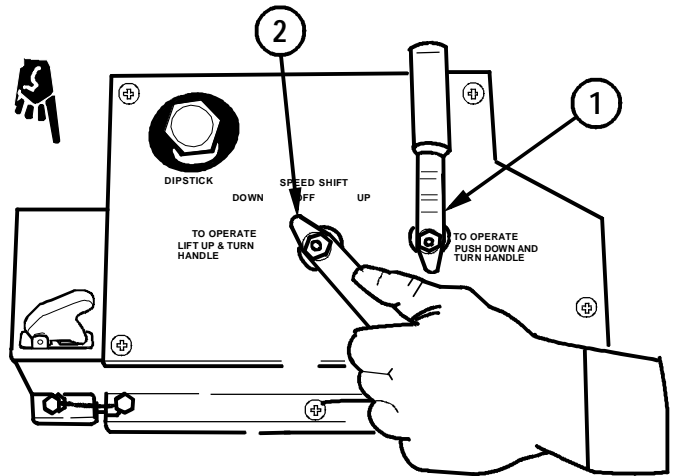
### CAUTION

Do not use the firing baseplate and detent assembly as a speed shift cylinder assembly.

### NOTE

Prime mover engine should not be operating while HyPAK is in operation.

- 1 Upon receipt of the command DEFLECTION (SUCH-AND-SUCH), the gunner determines the deflection to be out of normal traverse limits. The gunner traverses tube to center of traverse and engages traverse locking pin (see Switching Aiming Points, page 2-70.1). The gunner then announces SPEED SHIFT, MUZZLE RIGHT or MUZZLE LEFT as required.



### WARNING

Before attempting to shift direction of howitzer by using speed shift selector valve, be sure weapon is free of all ammunition and WHEELS lever (1) is in the OFF position.

Howitzer should not be speed shifted without top carriage pin inserted. Failure of the traversing mechanism could result in injury to personnel or damage to equipment.

- 2 Cannoneer no. 3 lifts up and moves SPEED SHIFT lever (2) to the DOWN position.

### NOTE

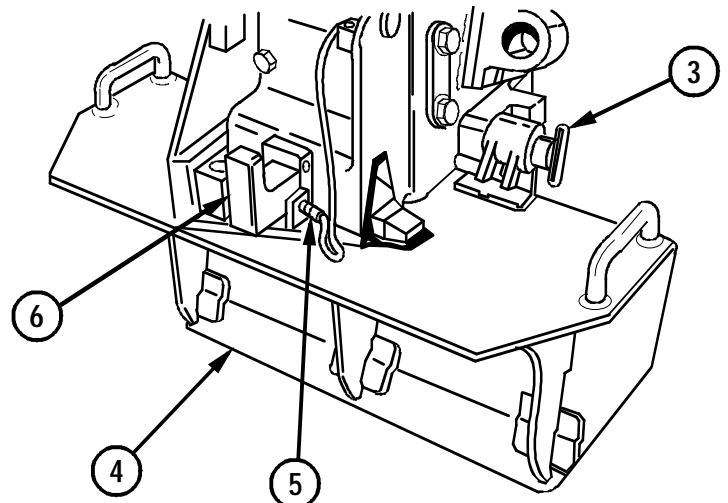
The 800-mil elevation provides the balance point for speed shifting howitzer on level ground. Balance point may be affected if howitzer is on an incline. Higher elevations will produce a higher load at the ends of trails, while lower elevations will produce a negative (no load) condition.

- 3 The assistant gunner elevates or depresses cannon tube as required to position cannon tube at approximately 800-mil elevation.

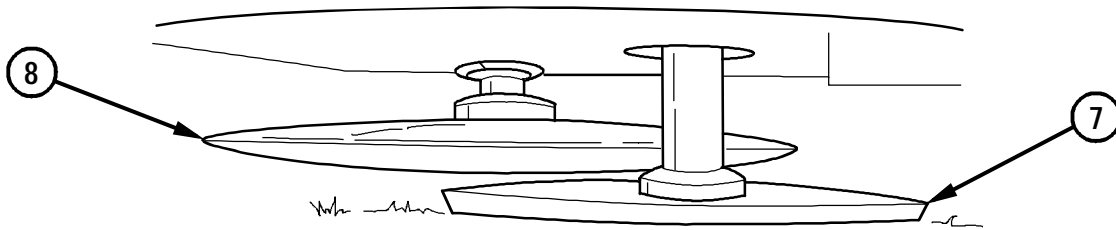
### NOTE

Be sure that plunger handles (3) on spades (4) are inserted into trails so that spades can hang loose and pivot.

- 4 If necessary, remove spade retaining pins (5) and spade keys (6).



- 5 When speed shift (7) is being lowered, cannoneers no. 1 and 5, and driver should hold down left trail, and cannoneer no. 2, the ammunition team chief, and the assistant gunner should hold down right trail.



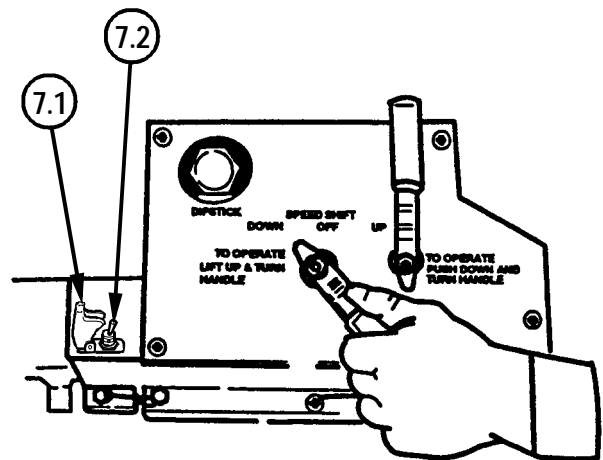
**NOTE**

When speed shifting the weapon on soft soil, such as mud or sand, place logs, ammunition packing material, or other similar supports under speed shift assembly (7) for stabilization.

**NOTE**

Step 5.1 applies to HyPAK modified howitzers. If HyPAK unit is not functional, go to step 6. After performing step 5.1 or step 6, proceed to step 7.

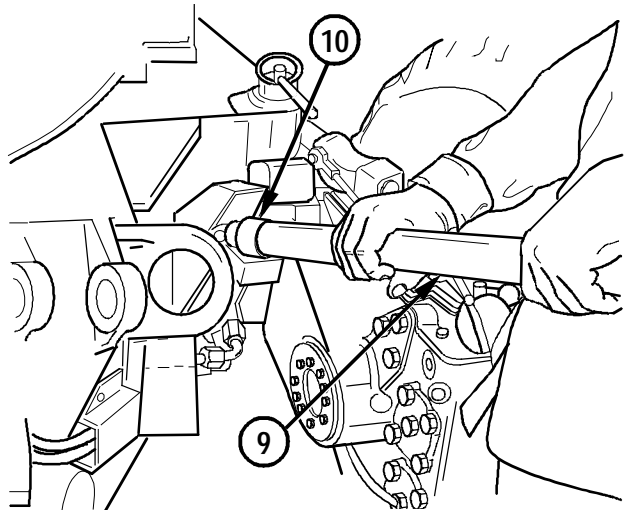
- 5.1 Cannoneer no. 3 lifts switch guard (7.1) and activates toggle switch (7.2) to lower speed shift (7) until clearance is obtained beneath firing baseplate (8).



- 6 Cannoneers no. 3 and 4 insert pump handles (9) into hydraulic adapters (10) and pump up and down to lower speed shift (7) until clearance is obtained beneath firing baseplate (8).

**CAUTION**

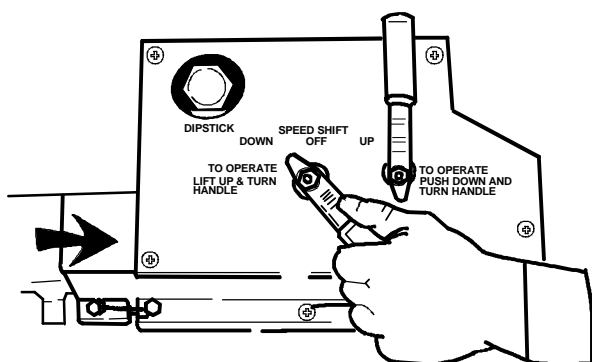
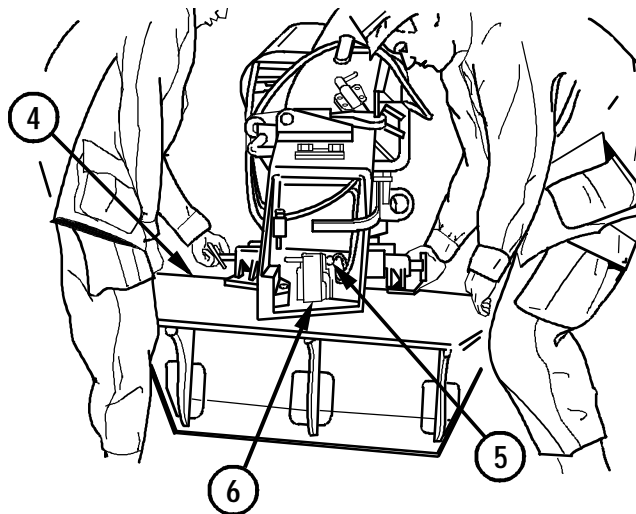
Never fire howitzer while speed shift is supporting weapon.



- 7 When gunner or chief of section commands TRAILS UP, cannoneers no. 1, 3, 5, and the driver lift left trail and cannoneers no. 3 and 4, the ammunition team chief, and the assistant gunner lift right trail and move trails in direction indicated by the gunner. When pantel vertical hairline is alined or close to aiming point, the gunner commands TRAILS DOWN. The gunner then unlocks top carriage and traverses howitzer on aiming point.

## 2-26. TRAVERSING BEYOND CARRIAGE TRAVERSE LIMITS AND OPERATING SPEED SHIFT SELECTOR VALVE (cont)

- 8 The assistant gunner and the ammunition team chief pivot spades (4) to firing position and reinstall spade keys (6) and spade retaining pins (5), if removed.



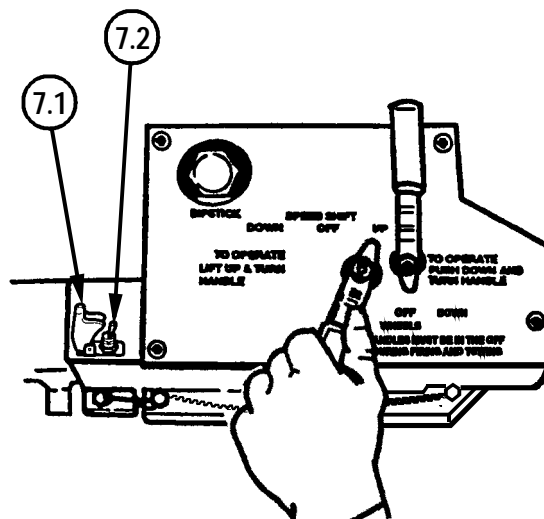
### WARNING

Keep feet from under firing base-plate.

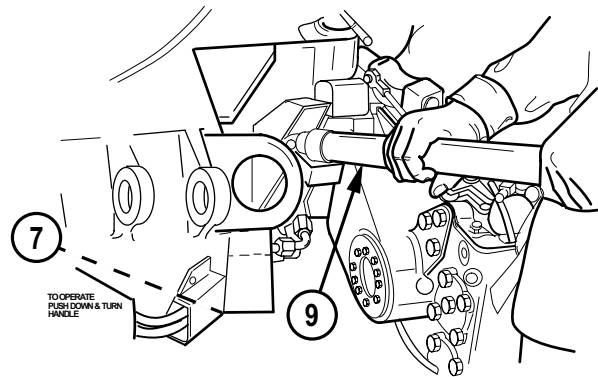
- 9 Cannoneer no. 3 lifts up SPEED SHIFT lever and moves it to the UP position to allow howitzer to lower to the ground.

### NOTE

Step 9.1 applies to HyPAK modified howitzers. If HyPAK unit is not functional, go to step 10. After performing step 9.1 or step 10, proceed to step 11.



- 9.1 Cannoneer no. 3 lifts switch guard (7.1) and activates toggle switch (7.2) to raise speed shift (7) until speed shift is in the fully UP position.



- 10 Cannoneers no. 3 and 4 pump up and down on pump handles (9) to raise speed shift (7). Cannoneer no. 3 lifts up SPEED SHIFT lever and moves it to the OFF position. ■

- 11 All emplace weapon.

## 2-27. PREPARATION OF HOWITZER FOR TOWING

### CAUTION

Towing restrictions are limited to: 15 mph (25 km/h) maximum over cross-country roads, 30 mph (48 km/h) maximum over secondary roads, and 45 mph (72 km/h) maximum over improved roads.

During scheduled stops, check the howitzer brakes to ensure lugnuts are tight. Check the temperature of the hubs and brakes. If hubs and brakes are too hot to touch, let them cool before continuing.

### NOTE

- Procedures for march order have been standardized under the Department of the Army Standardization Program.
- For preparation of the howitzer for airlift, refer to FM 55-450-1, Army Helicopter External Load Operations.
- The airlift travel lock will be installed on all howitzers being airlifted by the CH-47D helicopter to prevent damage to the helicopter. Fabrication is done at direct support maintenance. (The airlift travel lock is to be used for airlift only and not for towing the howitzer.)
- Prime mover engine should not be operating while HyPAK is in operation. ■

- 1 Check tires for damage and correct inflation pressure.
- 2 The chief of section ensures there is no ammunition in cannon tube.
- 3 After depressing cannon tube within reach, cannoneer no. 4 installs muzzle plug.
- 4 Cannoneer no. 3 installs vehicular taillight on cannon tube, connects cable assembly, and then wraps cable assembly around the cannon tube several times to eliminate the slack and to aid in the securing of taillight.



**CAUTION**

Do not move howitzer if top carriage locking pin is disengaged. Movement with locking pin disengaged will allow the top carriage to swing and break the traversing angle drive unit housing and/or the internal ring gear.

**NOTE**

Step 5 applies to howitzers that have not been modified.

**CAUTION**

Do not traverse the top carriage unless the wheels are locked in the up (firing) position or down (towed) position. When traversing the top carriage with wheels partially up, the traversing angle drive unit may strike the wheel actuator and break the traversing angle drive unit housing.

- 5 The gunner engages top carriage locking pin (1) by removing retaining pin (2) and pushing down on top carriage locking pin. The gunner then inserts retaining pin to secure top carriage locking pin.

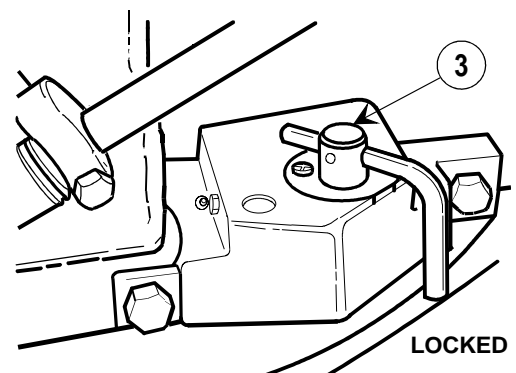
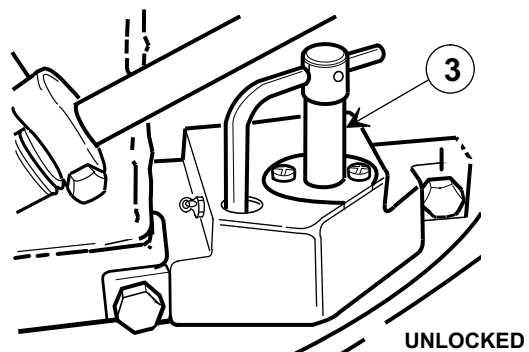
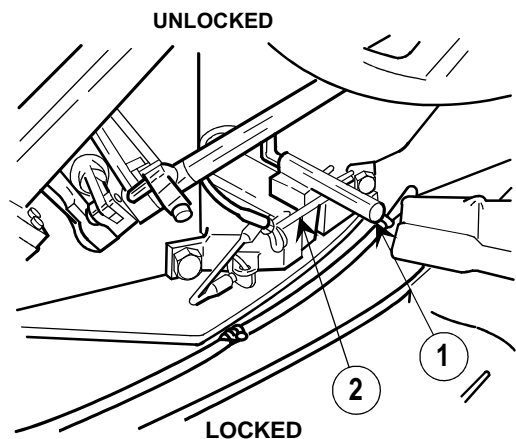
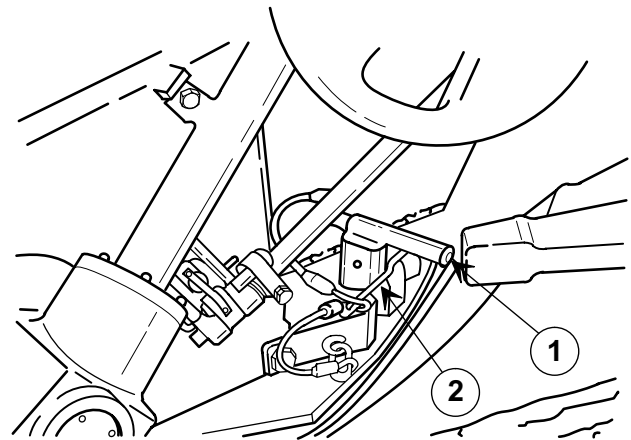
**NOTE**

The top carriage locking pin should remain in the unlocked position during normal use. Rotate pin to the locked position just prior to centering top carriage for attaching the travel lock.

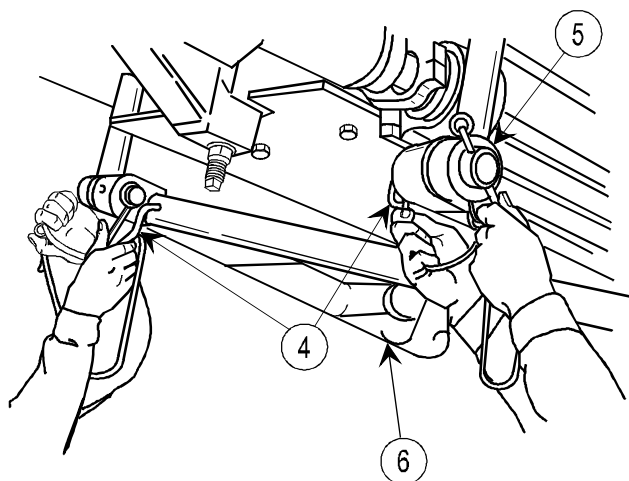
**NOTE**

Steps 6, 7, and 8 apply to howitzers that have been modified.

- 6 The gunner disengages top carriage locking pin (3) by lifting and rotating the top carriage locking pin to the unlocked position.
- 7 The gunner engages the top carriage locking pin (3) by lifting and rotating to the locked position. Then traverse top carriage until top carriage locking pin (3) engages in the bottom carriage.
- 8 The gunner and assistant gunner elevate the cannon tube to approximately 250 mils.



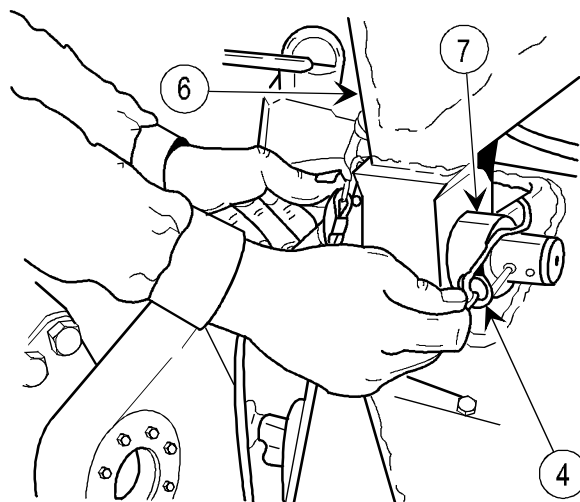
## 2-27. PREPARATION OF HOWITZER FOR TOWING (cont)



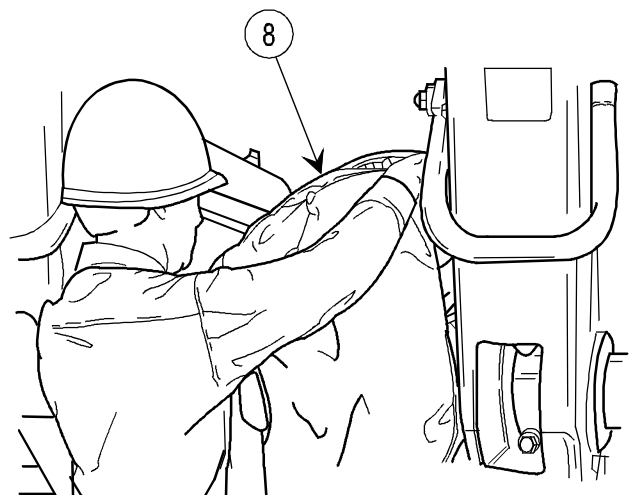
- 9** Cannoneers no. 3 and 4 remove retaining pins (4) and travel lock pins (5) and lower travel lock assembly (6).

### CAUTION

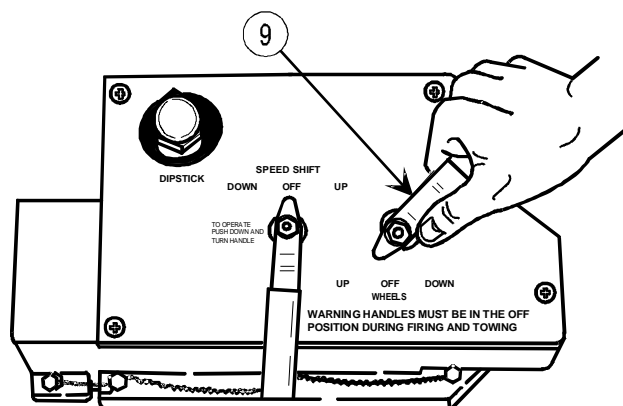
Both travel lock pins (5) must be installed in lower travel lock assembly (6) before moving howitzer.



- 10** The gunner elevates or depresses cannon tube until travel lock assembly (6) is aligned in brackets (7). Cannoneers no. 3 and 4 then insert travel lock pins (5) and retaining pins (4).



- 11** Cannoneer no. 1 installs breech cover (8).

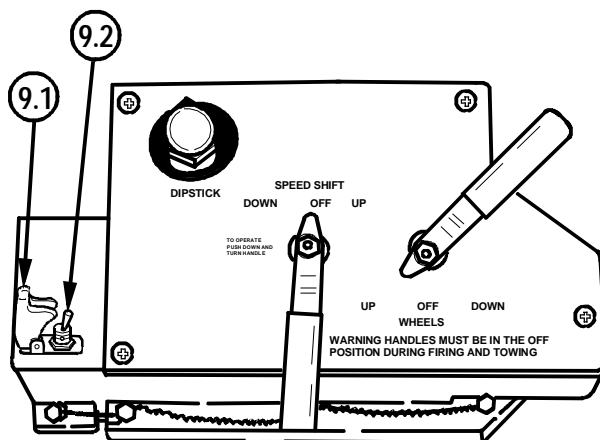


- 12** Cannoneer no. 3 pushes down and turns WHEELS lever (9) to the UP position.

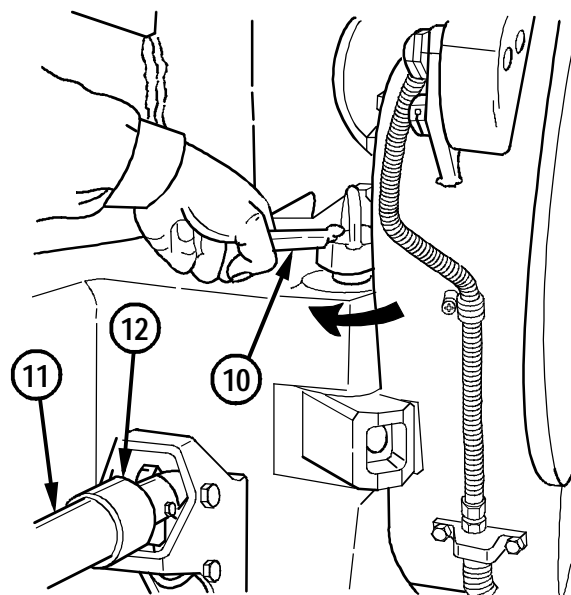
**NOTE**

Step 12.1 applies to HyPAK modified howitzers. If HyPAK unit is not functional, go to step 13. After performing step 12.1 or step 13, proceed to step 14.

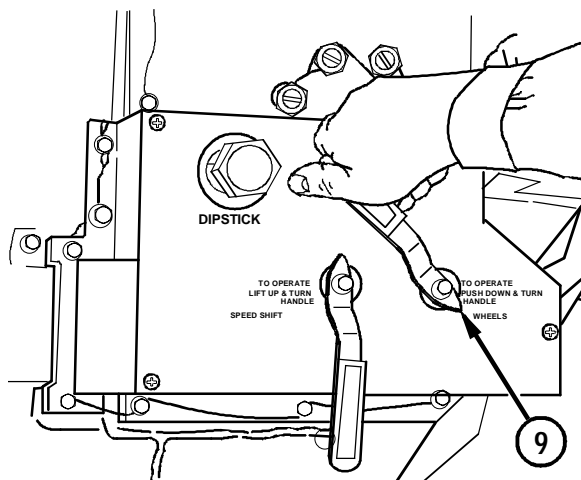
- 12.1** Cannoneer no. 3 lifts switch guard (9.1) and activates toggle switch (9.2) until pressure is off wheel lock handles (10).



- 13** Cannoneers no. 3 and 4 place pump handles (11) in hydraulic adapters (12) and pump until pressure is off wheel lock handles (10).
- 14** Cannoneers no. 3 and 4 then turn wheel lock handles (10) in (toward center of howitzer).



- 15** Cannoneer no. 3 pushes down and turns WHEELS lever (9) to the DOWN position.

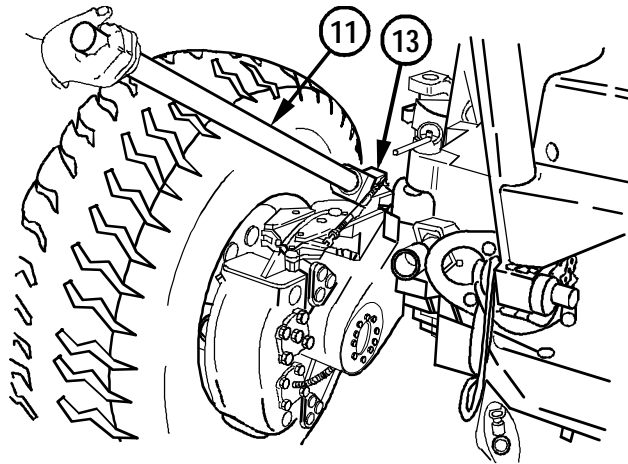


## 2-27. PREPARATION OF HOWITZER FOR TOWING (cont)

### WARNING

Handbrakes are to remain locked if the howitzer is on any degree of an incline and are not to be released until the lunette is on the prime mover pintle. Release of handbrakes while howitzer is on incline may allow the howitzer to roll causing injury to personnel.

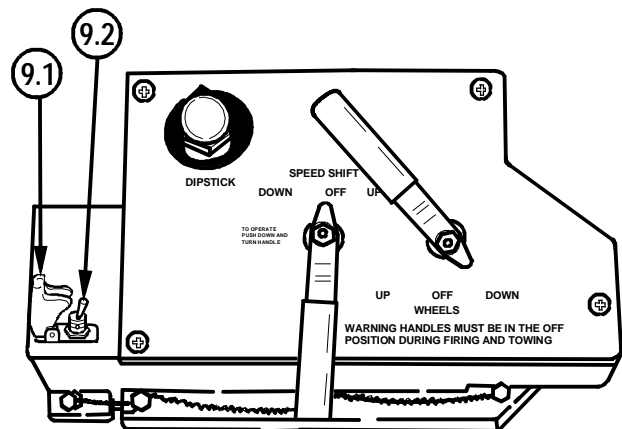
- 16** Cannoneers no. 3 and 4 release handbrakes by inserting pump handles (11) in handbrake sockets (13) and pulling downward.

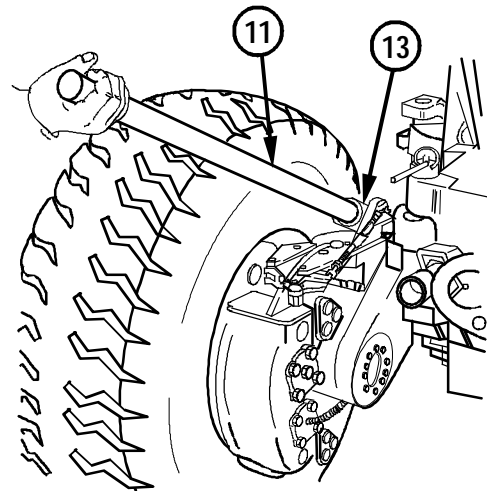
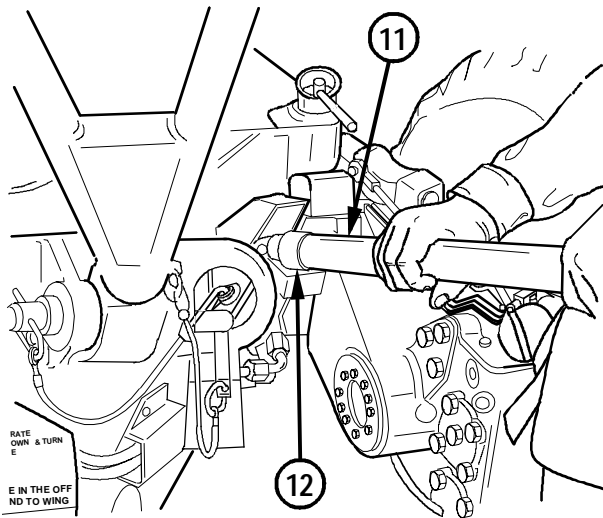


### NOTE

Step 16.1 applies to HyPAK modified howitzers. If HyPAK unit is not functional, go to step 17. After performing 16.1 or step 17, proceed to step 18.

- 16.1** Cannoneer no. 3 activates toggle switch (9.2) until carriage is up and then closes switch guard (9.1).





### WARNING

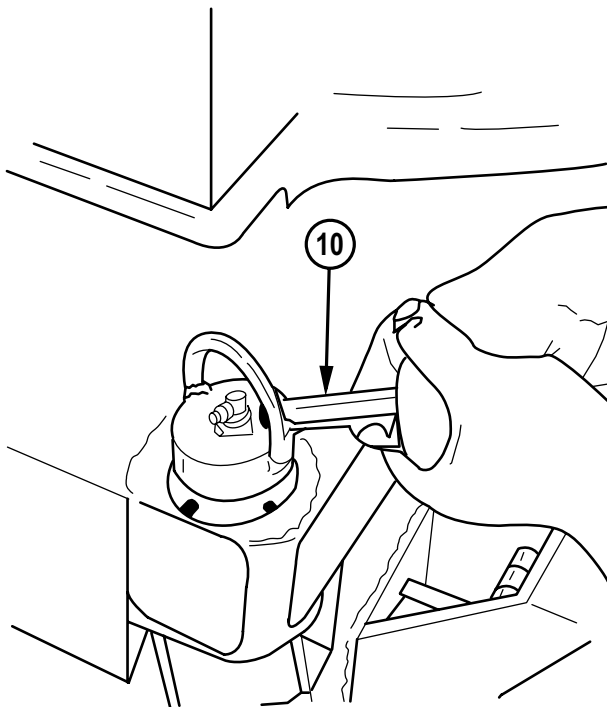
Keep feet from under firing baseplate.

- 17** Cannoneers no. 3 and 4 insert pump handles (11) in hydraulic adapters (12) and pump up and down until carriage is up.

- 18** If handbrakes were released in step 15, cannoneers no. 3 and 4 engage handbrakes by inserting pump handles (11) in handbrake sockets (13) and raising up to the locked position.

### WARNING

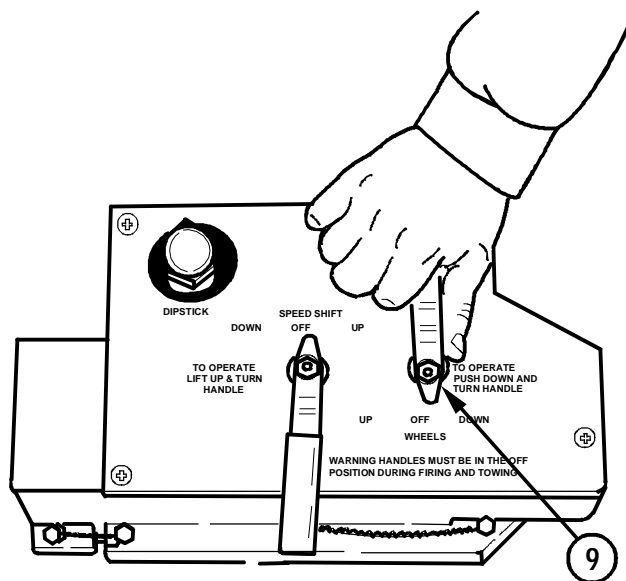
Do not pull on electrical cable to disconnect NATO slave cable from HyPAK NATO receptacle. Damage to equipment and/or injury to personnel can occur.



- 19** Cannoneers no. 3 and 4 turn wheel lock handles (10) (toward wheels).

- 19.1** Cannoneer no. 2 disconnects the NATO slave cable from the towing vehicle's NATO receptacle and installs the dust cover onto the receptacle. Cannoneer no. 5 disconnects the NATO slave cable from the HyPAK NATO receptacle on the right trail and installs the dust cover onto the receptacle. Cannoneer no. 5 unwraps the cable from the gun tube travel lock and both cannoneers no. 2 and 5 stow slave cable in towing vehicle.

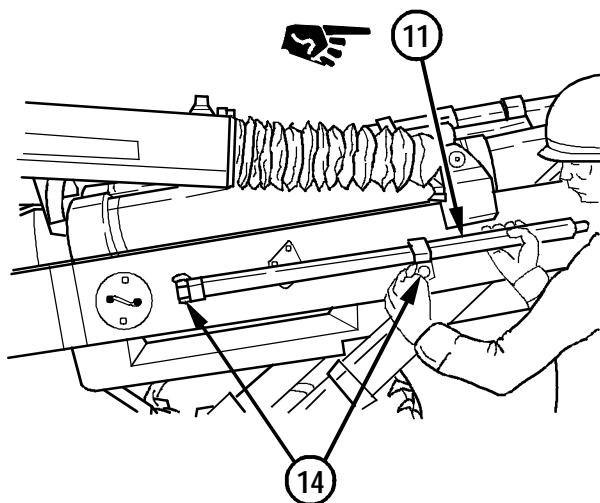
## 2-27. PREPARATION OF HOWITZER FOR TOWING (cont)



### NOTE

To relieve pressure from wheel actuator, move lever (9) back and forth, prior to moving to the OFF position.

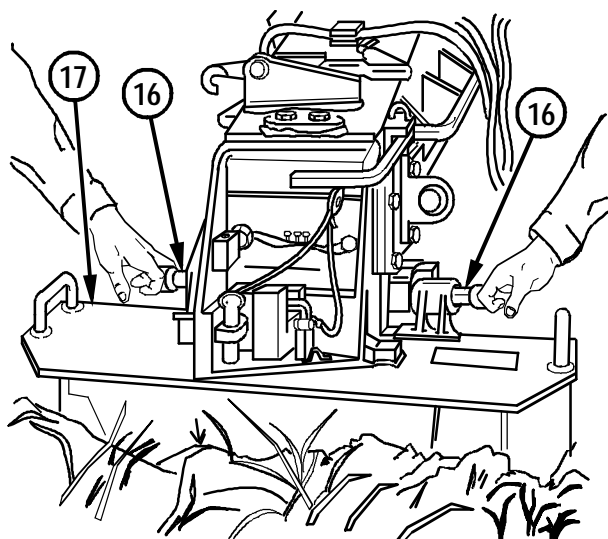
- 20** Cannoneer no. 3 pushes down and turns WHEELS lever (9) to the OFF position.



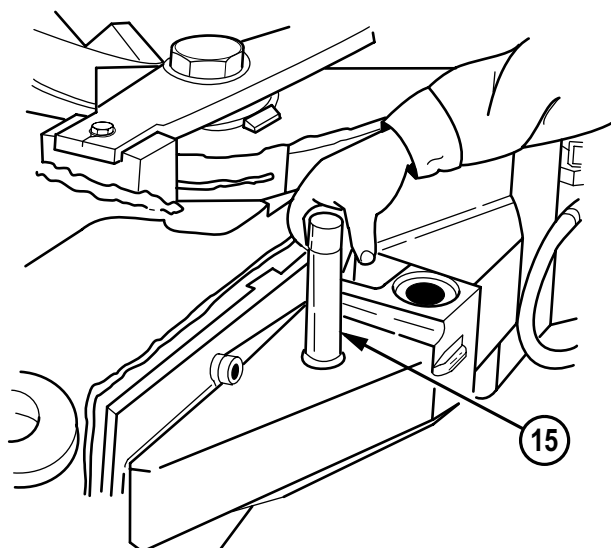
**NOTE**

Move WHEELS lever back and forth on either side of the OFF mark to relieve pressure on the hydraulic system.

- 21 Cannoneers no. 3 and 4 replace pump handles (11) in their holders (14).



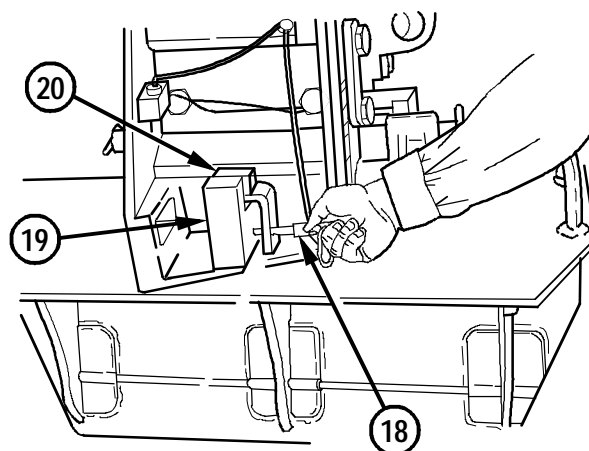
- 23 Cannoneer no. 2 and the assistant gunner pull out plunger weldment handles (16) on right spade (17). Cannoneers no. 1 and 3 pull out plunger weldment handles on left spade.



**NOTE**

Drive out locking plugs (15) with a sledge hammer.

- 22 The gunner and assistant gunner move left and right trail locking plugs (15) from the firing position (front) to the stowed position (rear).

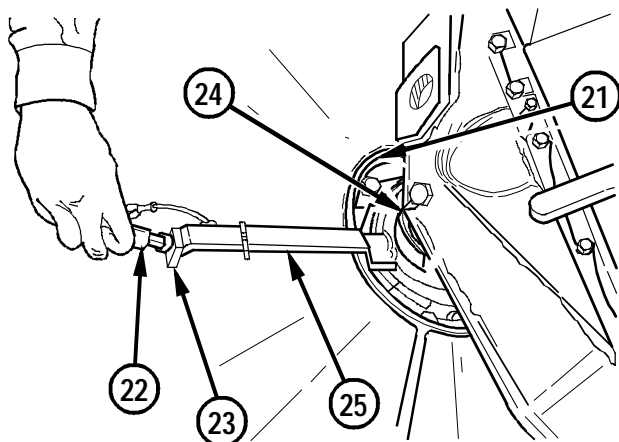


**NOTE**

It may be necessary to use weapons handling bar or sledge hammer to loosen spade keys.

- 24 Cannoneer no. 5 removes left and right spade retaining pins (18) and spade keys (19). Stow spade retaining pins (18) in blocks (20) and spade keys on left trail.

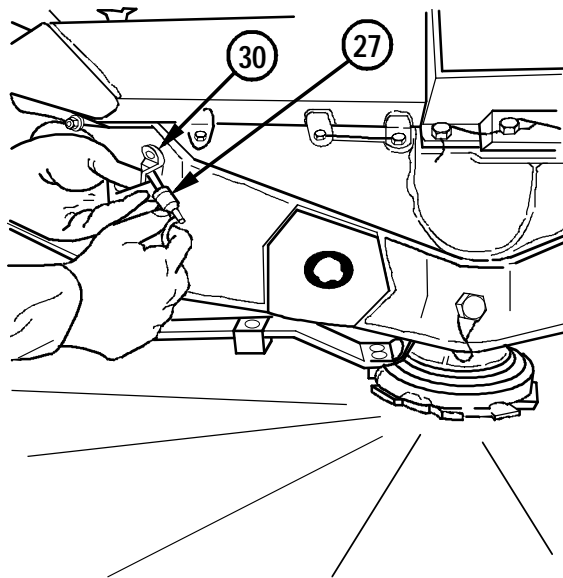
## 2-27. PREPARATION OF HOWITZER FOR TOWING (cont)



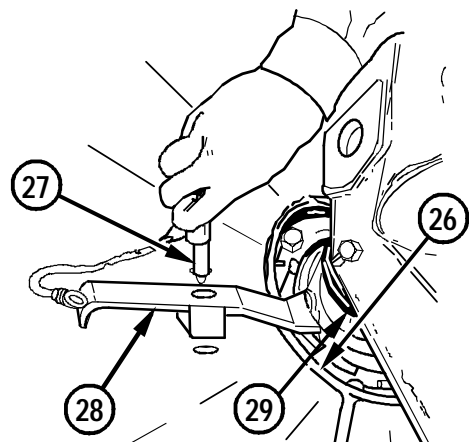
### NOTE

Step 25 applies to howitzers that have not been modified.

- 25** Cannoneers no. 3 and 4 support the firing baseplate (21), while cannoneer no. 4 removes quick release pin (22) from locking bracket (23) and unlocks firing baseplate (21) from ball (24), using cam lock lever (25).



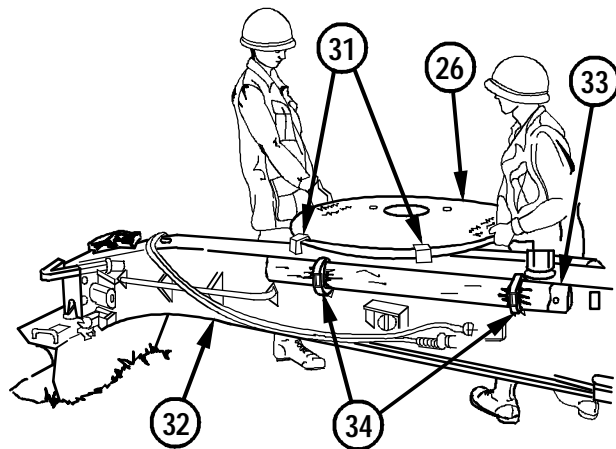
- 27** Cannoneer no. 4 places quick release pin (27) in stowage bracket (30).



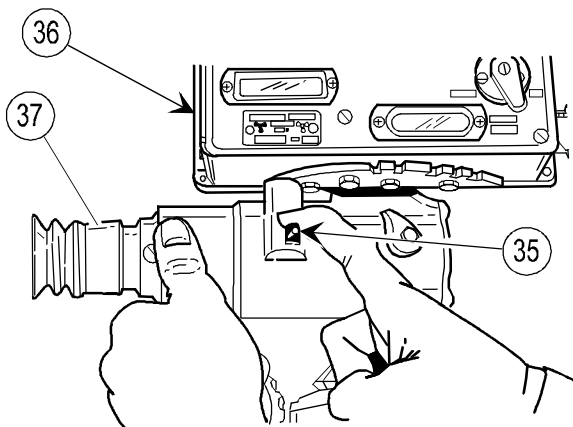
### NOTE

Step 26 applies to modified howitzers.

- 26** Cannoneers no. 3 and 4 support firing baseplate (26), while cannoneer no. 4 removes quick release pin (27) from handle assembly (28) and unlocks firing baseplate (26) from ball (29) using handle assembly (28).



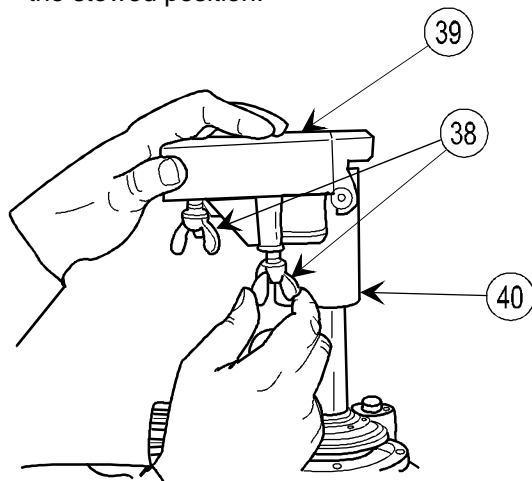
- 28** Cannoneers no. 3 and 4 place firing baseplate (26) in stowage brackets (31) on right trail (32).
- 29** After putting aiming posts in aiming post cover (33), the ammunition team chief places cover and aiming posts in stowage brackets (34) on right trail (32).



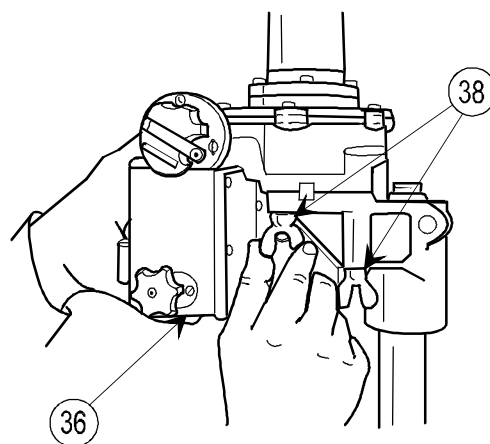
### WARNING

When using radioactively illuminated fire control equipment, follow radiation hazard procedures in the front of this manual.

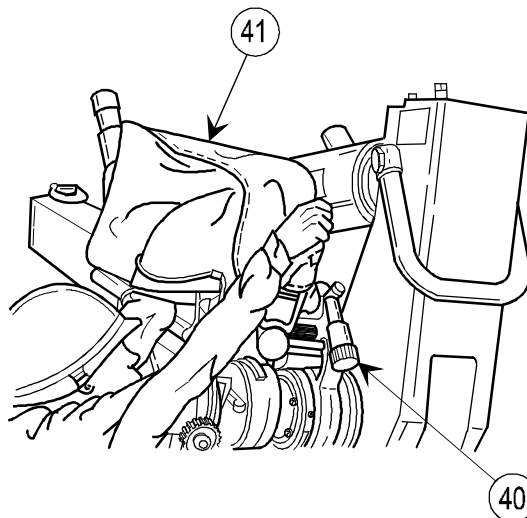
- 30** The gunner releases locking pin (35) on pantel (36) and moves elbow (37) with eyepiece to the stowed position.



- 32** The gunner places protective cover (39) on M171 telescope and quadrant mount (40) and tightens two wingnuts (38). He then rotates the protective covers on the cross level vial, pitch level vial, and elevation level vial to the closed position.



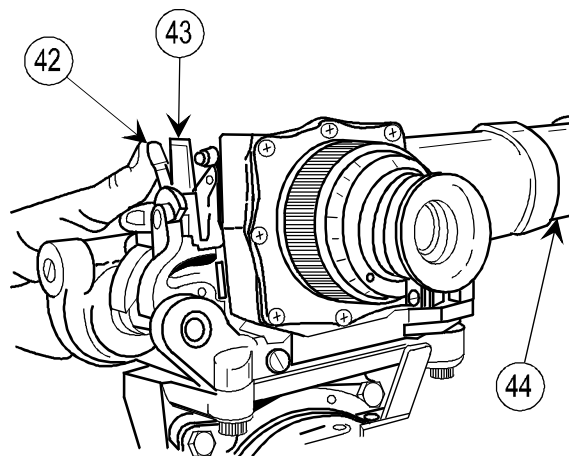
- 31** The gunner removes batteries (M137A3 only), loosens four wingnuts (38), removes pantel (36) and places the pantel and batteries (ERLS only) in fire control equipment carrying case.



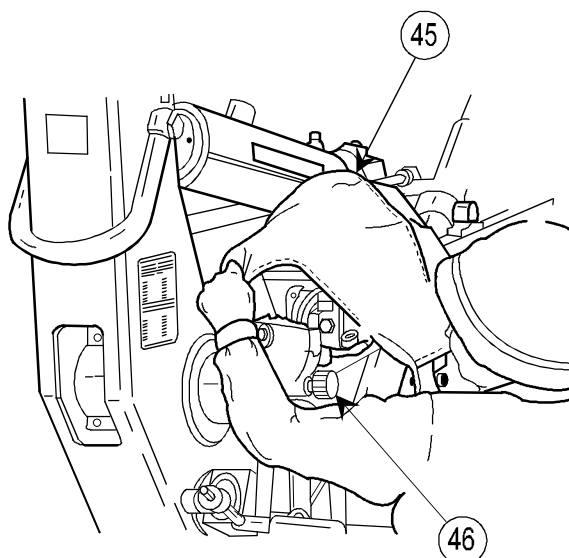
- 33** The gunner places cover (41) over M171 telescope and quadrant mount (40). He then secures the cover with the drawstring provided.

## 2-27. PREPARATION OF HOWITZER FOR TOWING (cont)

- 34** The assistant gunner rotates lock-release lever (42) counterclockwise and pulls locking latch (43) down, removes elbow telescope (44), replaces the protective cover assembly, and places it in fire control equipment carrying case.



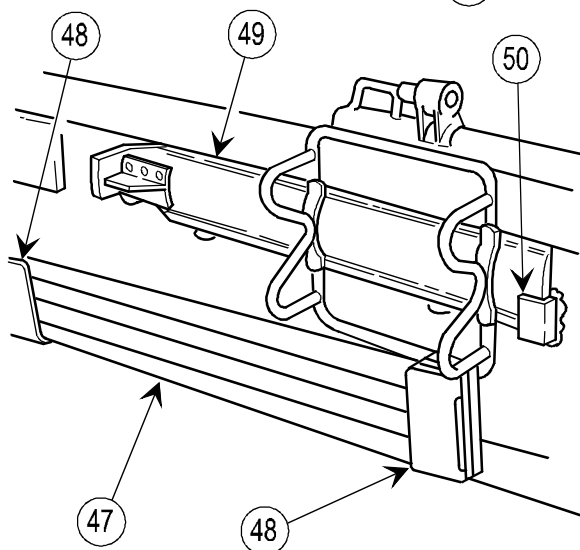
- 35** The assistant gunner rotates the protective covers on the elevation level vial and cross level vial to the closed position. The assistant gunner places cover (45) on M172 telescope and quadrant mount (46) and secures it with drawstrings provided.

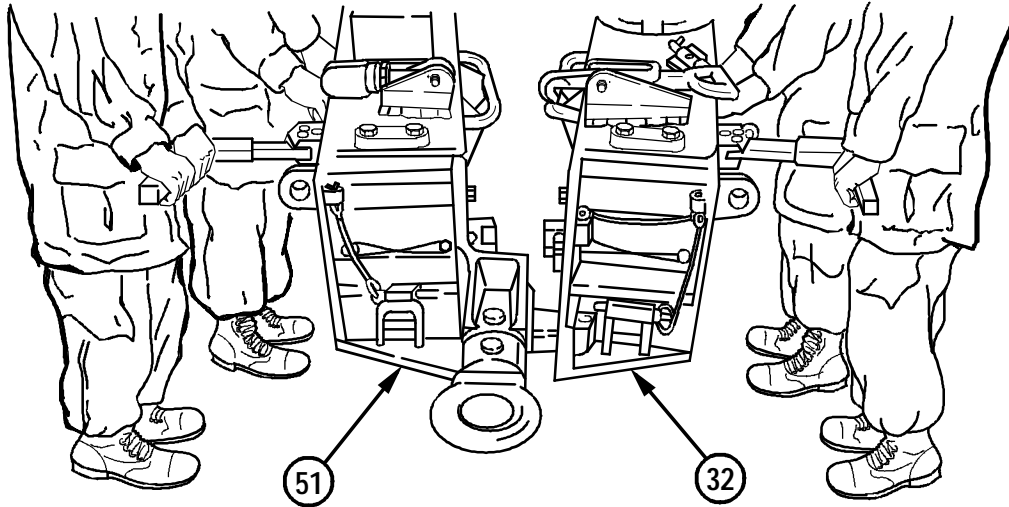


- 36** The gunner ensures that all fire control equipment is properly placed within the fire control equipment carrying case and that the case is securely latched. The gunner places fire control equipment carrying case in its stowage rack on the left trail. He then secures the case to the trail with two web straps provided.

- 37** Cannoneer no. 2 disassembles rammer staff, places staff sections (47) in stowage brackets (48) on both trails and places bell (if used) rammer in its stowage bracket on left trail. (Illustration is of right trail.)

- 38** Cannoneer no. 3 places loading tray (49) in its stowage brackets (50).

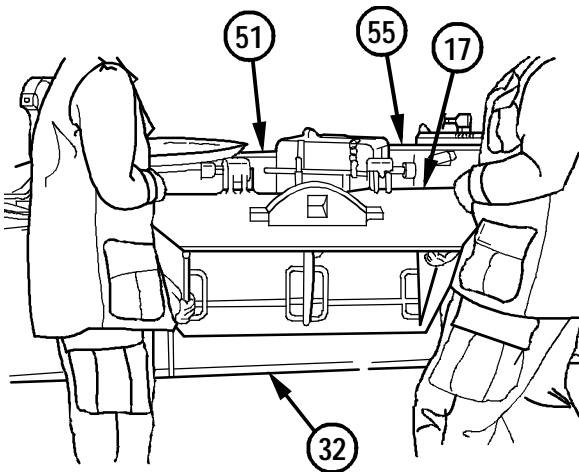
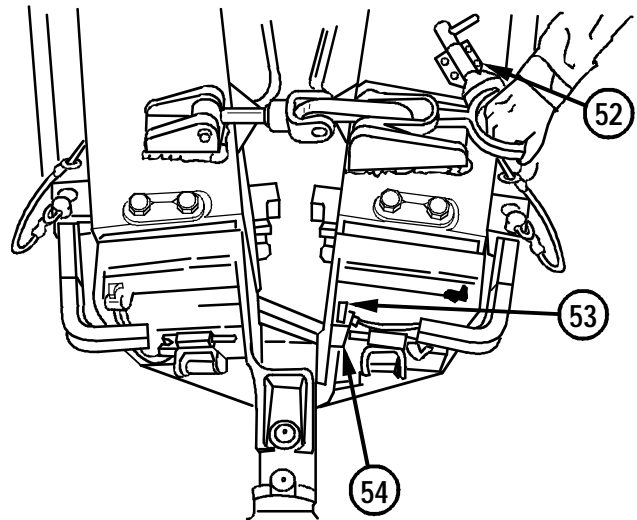




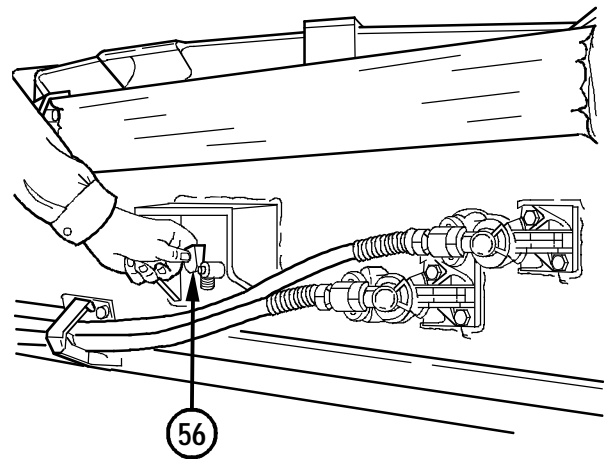
### CAUTION

Do not hook left trail to prime mover prior to closing and locking the right trail. Failure to follow proper trail closure procedures could damage the trails and bottom carriage.

- 39 When the chief of section commands, LIFT, the gunner and cannoneers no. 1, 3, and 5 lift left trail (51), the assistant gunner, cannoneers no. 2 and 4, and the ammunition team chief lift right trail (32), and all personnel close trails.
- 40 Cannoneer no. 4 connects trail latch mechanism, lowers handle toward trail, and engages trail cam lock (52). He then removes trail retaining pin (53) from stowage block (54) and places pin (53) in position. The chief of section commands TRAIL DOWN. The crew lowers the howitzer to the ground.



- 41 Cannoneers no. 3 and 1 return left spade (55) to the stowed position on left trail (51). Cannoneers no. 2 and 4 return right spade (17) to right trail (32).



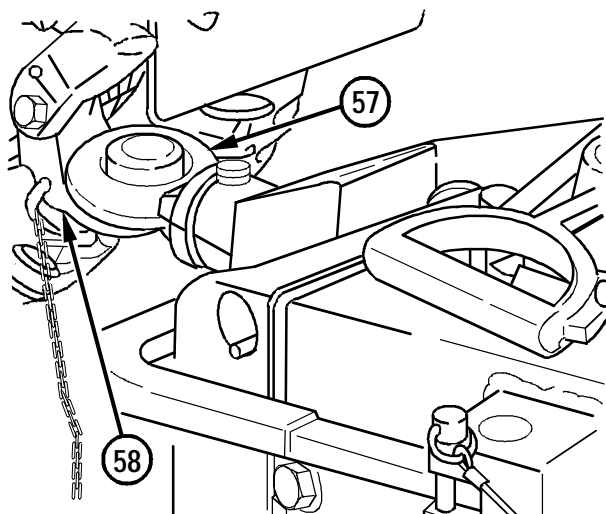
- 42 Cannoneer no. 2 closes air drain cock (56) on emergency reserve air tank.

## 2-27. PREPARATION OF HOWITZER FOR TOWING (cont)

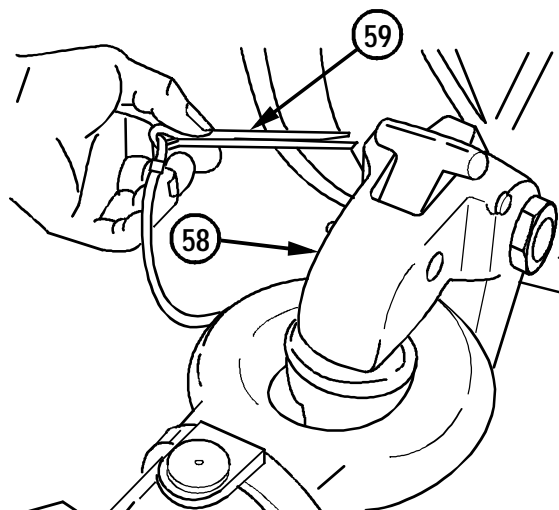
### WARNING

Personnel should stay clear of area between prime mover and howitzer.

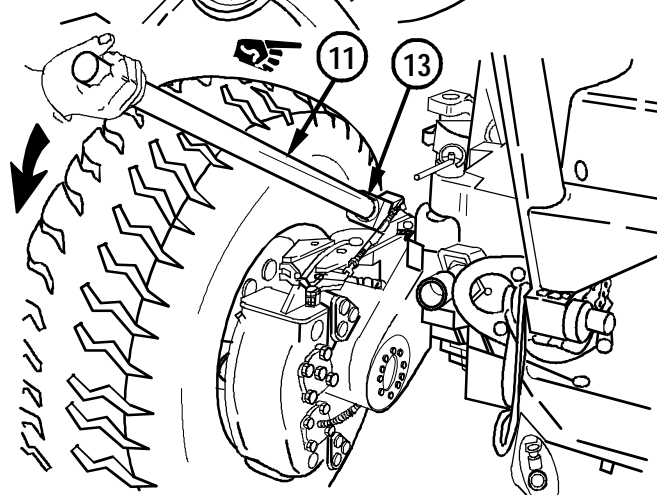
- 43 The chief of section directs the driver to back prime mover close to howitzer.
- 44 When the chief of section commands, LIFT, the assistant gunner, cannoneers no. 2 and 4, and the ammunition team chief lift right trail, and the gunner and cannoneers no. 1, 3, and 5 lift left trail to raise lunette (57). The chief of section directs the driver to back until pintle (58) is under lunette (57), and all personnel lower lunette on pintle.



- 45 Cannoneer no. 4 latches pintle (58) and secures it with cotter pin (59).

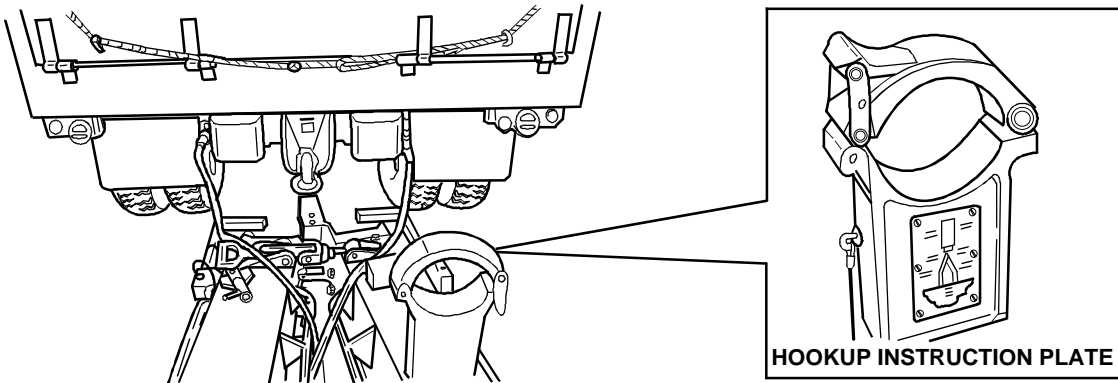


- 46 Gunner and assistant gunner release handbrakes by inserting pump handles (11) in handbrake sockets (13) and pulling downward.



### CAUTION

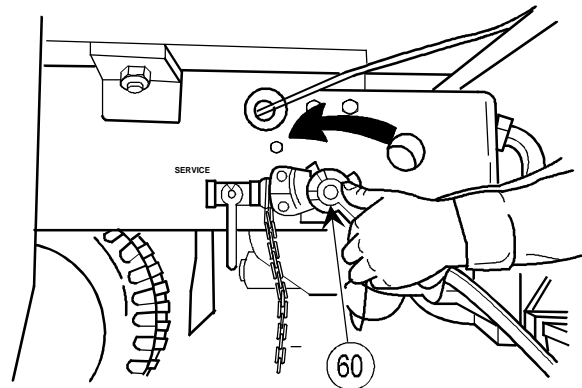
Make sure service hose assembly is connected to service coupling (left side) of prime mover and emergency hose assembly is connected to emergency coupling (right side) of prime mover. Hose assemblies are identified by a metal band. When hose assemblies are properly attached, they will cross each other.



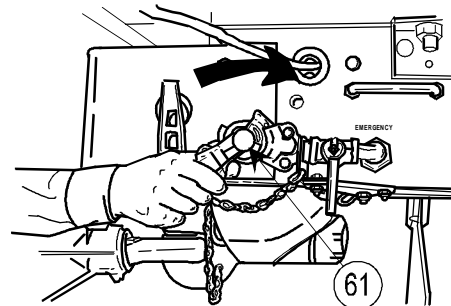
**NOTE**

The hose couplings should be color-coded the same as the prime mover: yellow for service and red for emergency.

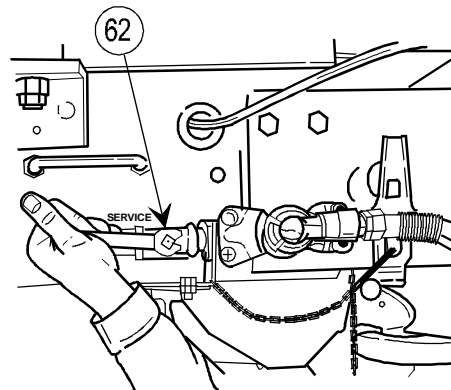
- 47** Cannoneer no. 4 disconnects service hose assembly (60) from dummy coupling and passes it to the ammunition team chief who connects it to prime mover.



- 48** Cannoneer no. 4 disconnects emergency hose assembly (61) from dummy coupling and passes it to cannoneer no. 5, who connects it to prime mover.



- 49** The ammunition team chief opens service air line cutout cock (62).



## 2-27. PREPARATION OF HOWITZER FOR TOWING (cont)

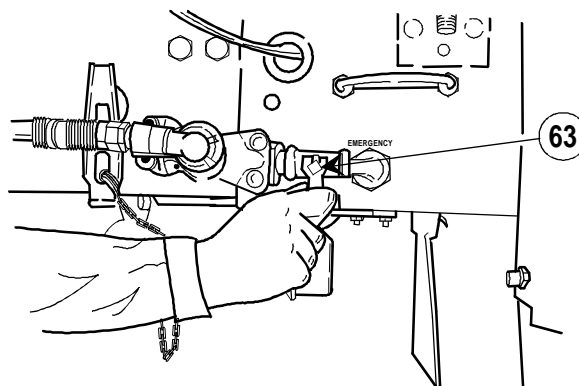
- 50 Cannoneer no. 5 opens emergency air line cutout cock (63).

### CAUTION

Failure to check power booster indicator rod could result in damage to the disk brake carrier and lining assembly.

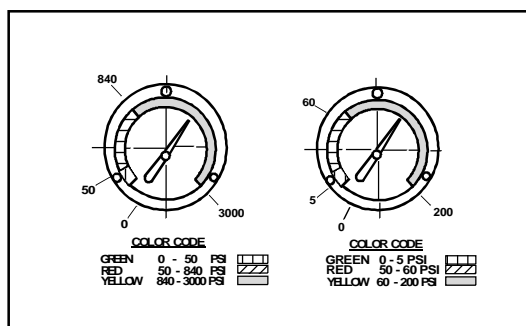
### NOTE

The driver should start and run the prime mover until at least 90 psi is attained to make sure brakes are operating correctly.



- 51 The driver applies brakes on prime mover, and the chief of section checks power booster indicator rod to ensure it does not protrude more than 1-3/4 in. (4.45 cm). If rod extends more than 1-3/4 in., notify unit maintenance.

- 52 The driver releases brakes on prime mover, and the chief of section checks power booster indicator rod to ensure it does not protrude more than 1/2 in. (1.27 cm).

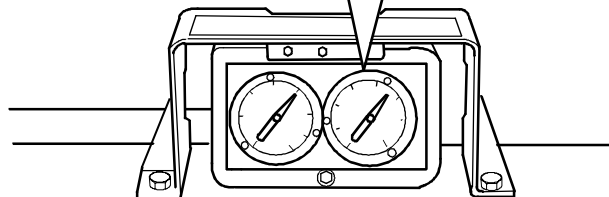


### NOTE

Step 53 applies to howitzers that have been modified.

- 53 The driver applies brakes. The chief of section ensures that both pointers move to yellow zones on gage. The driver releases the brake and both pointers return to green area.

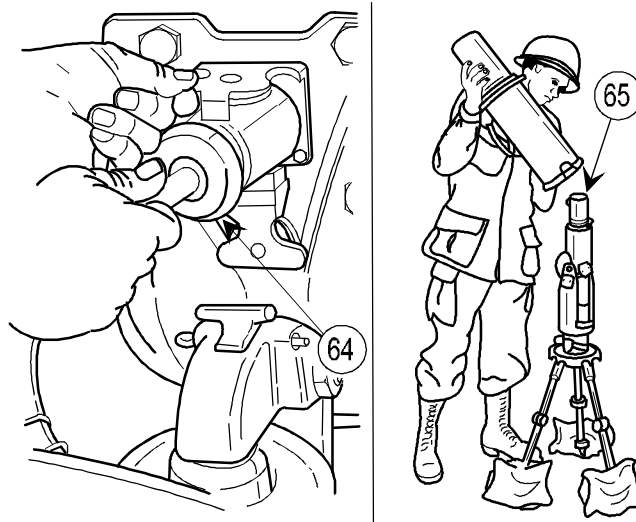
- 54 If required, cannoneer no. 5 connects cable assembly (64) to prime mover.



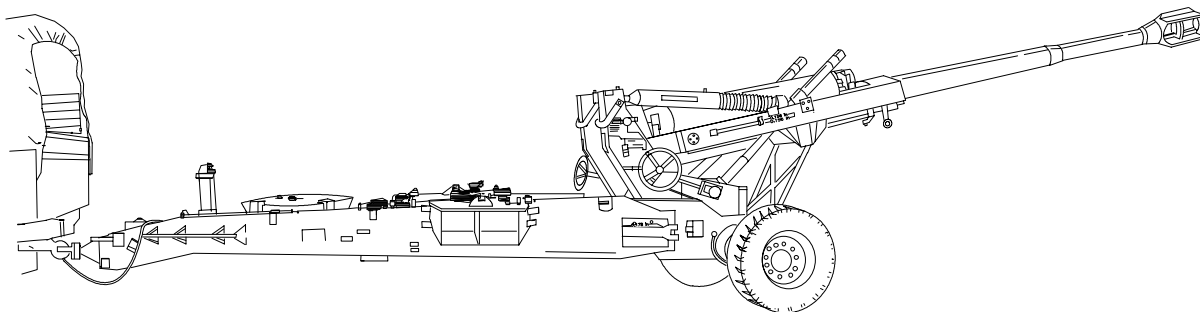
### WARNING

When using radioactively illuminated fire control equipment, follow radiation hazard procedures in the front of this manual.

- 55 Cannoneer no. 2 recovers collimator (65) and sandbags.

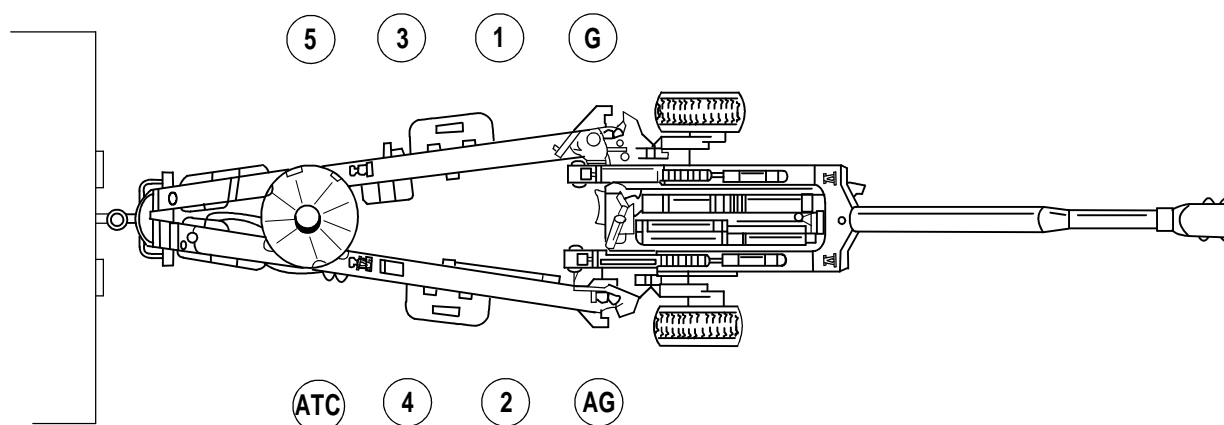


## 2-28. PLACING HOWITZER IN STOWED POSITION

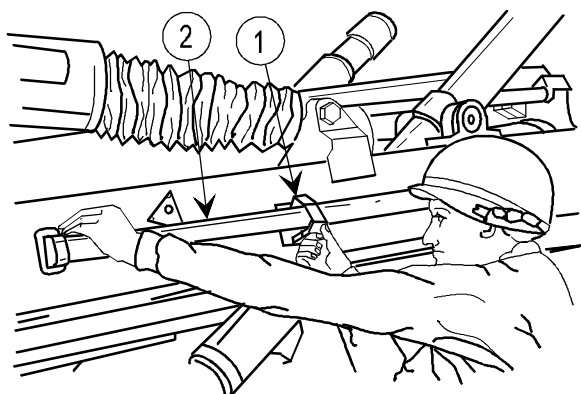


### NOTE

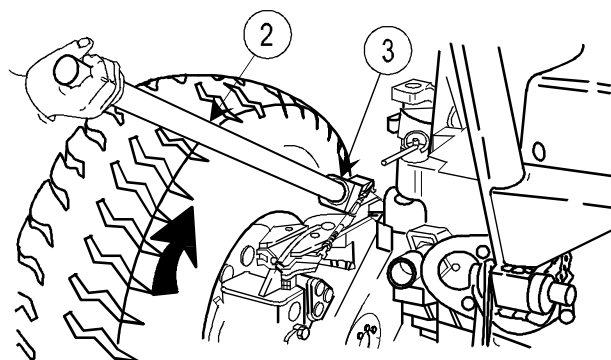
Ensure howitzer is on level ground and elevated to approximate travel lock position when traversing gun into stowed position.



- 1 After prime mover comes to a complete stop, the chief of section commands, DISMOUNT. Upon hearing the command, the section exits through rear of prime mover.
- 2 All section members take position as illustrated.
- 3 The chief of section commands, PREPARE FOR ACTION.

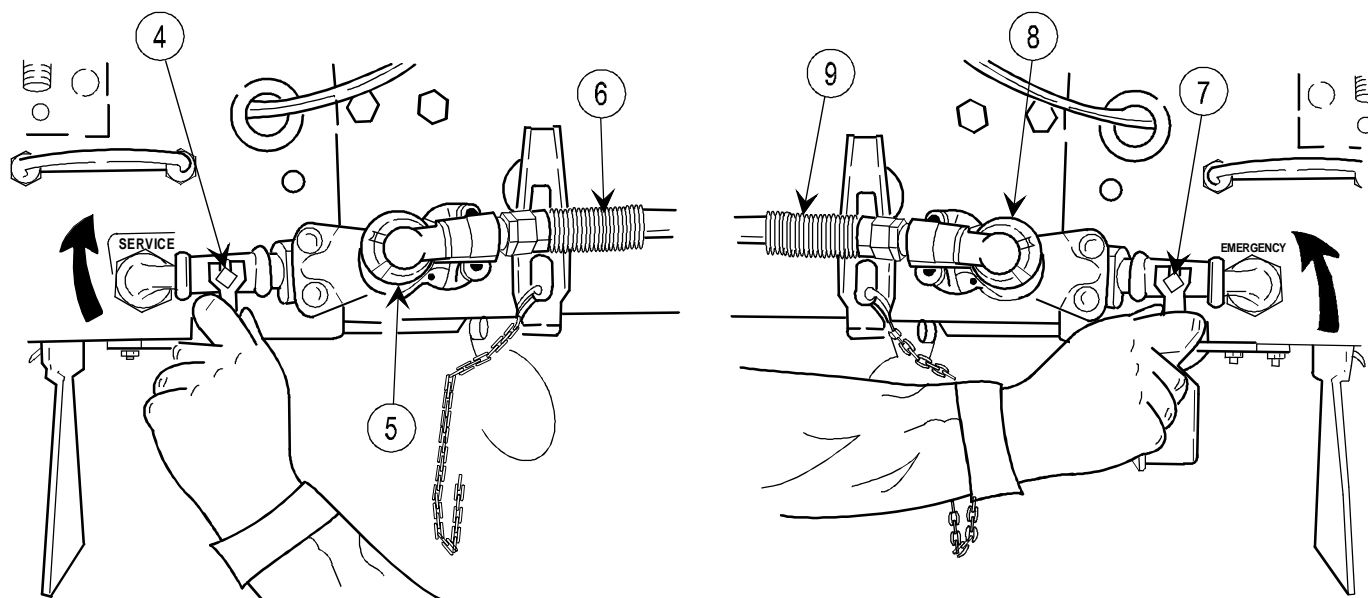


- 4 Assistant gunner unlatches holder (1) on right side and removes pump handle (2). Gunner unlatches holder on left side.



- 5 The gunner and assistant gunner set left and right handbrakes by inserting pump handles (2) into handbrake sockets (3) and raising up to locked position.

## 2-28. PLACING HOWITZER IN STOWED POSITION (cont)

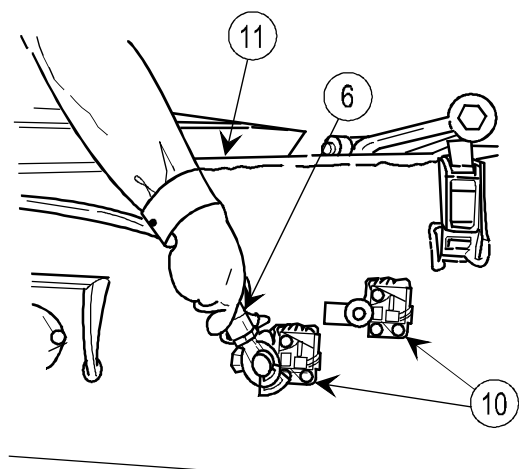


### NOTE

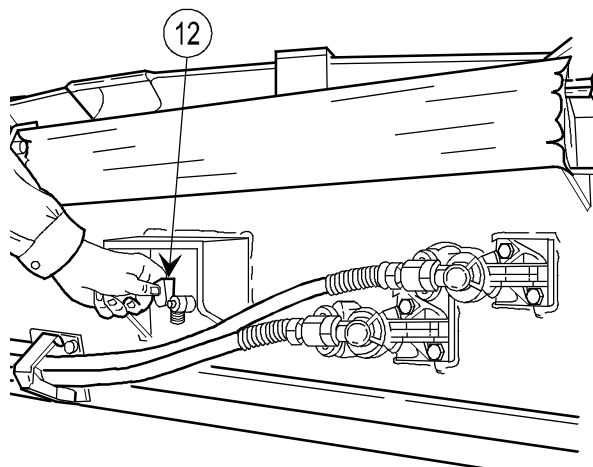
Precheck gages should indicate EMERGENCY brakes are set when service and emergency lines are disconnected.

- 6** The ammunition team chief closes service air line cutout cock (4) at prime mover, uncouples service air line coupling (5), and passes service hose assembly (6) to cannoneer no. 4.

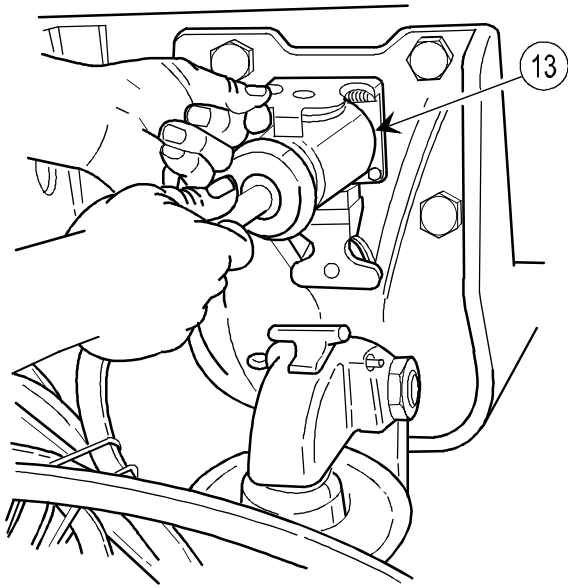
- 7** Cannoneer no. 5 closes emergency air line cutout cock (7) at prime mover, disconnects emergency air line coupling (8), and passes emergency hose assembly (9) to cannoneer no. 4.



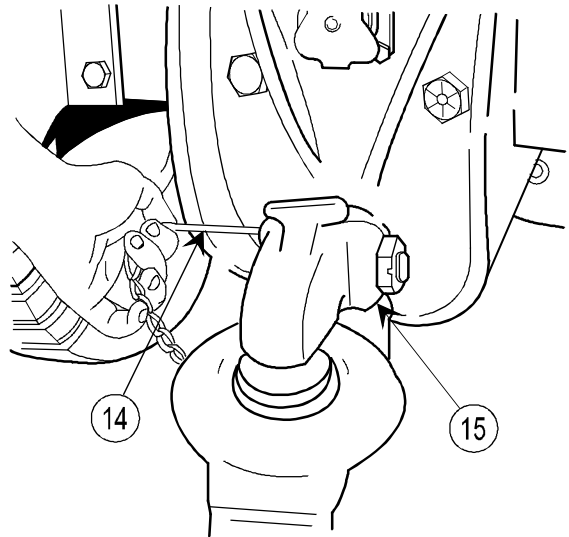
- 8** Cannoneer no. 4 connects service hose assembly (6) to dummy coupling (10) on right trail (11). The emergency hose assembly is connected to other dummy coupling (10).



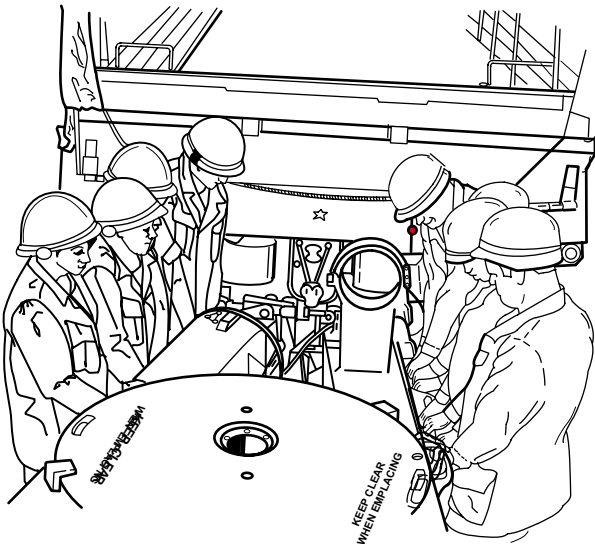
- 9** Cannoneer no. 4 opens drain cock (12) on emergency reserve air tank. Both pointers on gage should return to 0 psi.



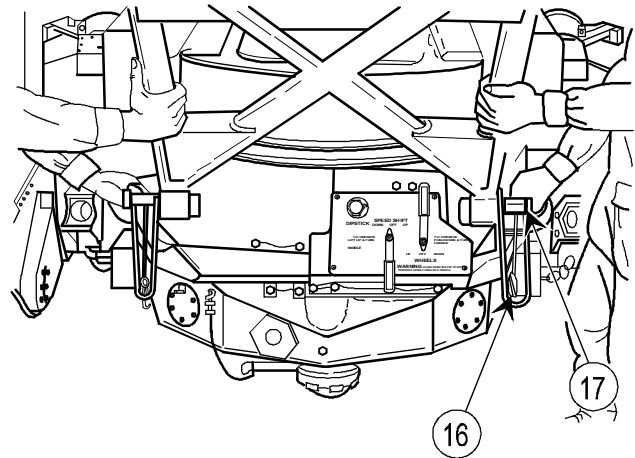
**10** Cannoneer no. 5 disconnects cable assembly (13) from prime mover, if connected.



**11** The ammunition team chief removes cotter pin (14) and unlatches pintle (15) on prime mover.



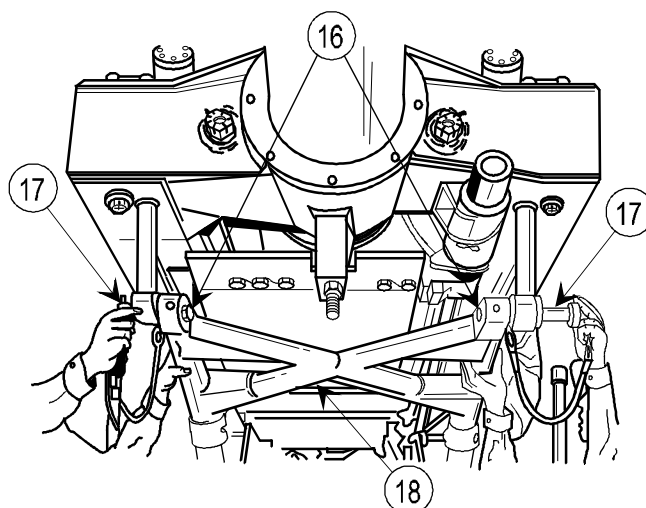
**12** With cannoneers no. 1, 3, and 5, and the gunner at left trail lifting handle and the assistant gunner, the ammunition team chief and cannoneers no. 2 and 4 at the right trail, raise lunette from pintle when chief of section commands LIFT. The chief of section then commands the driver to move prime mover forward. Trails are then lowered to the ground.



**13** Cannoneer no. 3 removes left retaining pin (16) and travel lock pin (17). Cannoneer no. 4 removes right retaining pin and travel lock pin.

## 2-28. PLACING HOWITZER IN STOWED POSITION (cont)

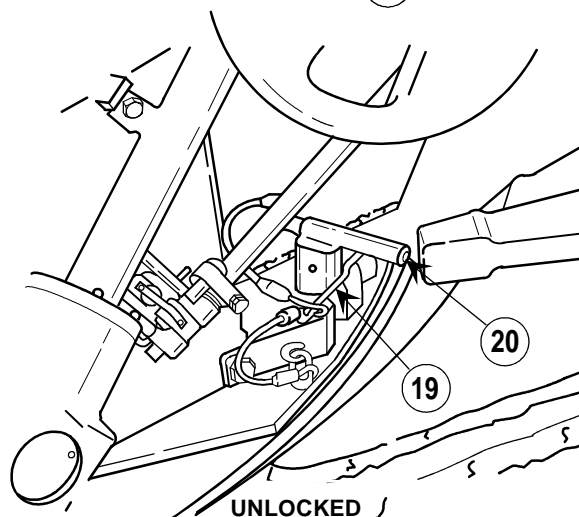
- 14** Cannoneers no. 3 and 4 swing travel lock assembly (18) up and insert travel lock pins (17) and retaining pins (16).



### NOTE

Step 15 applies to howitzers that have not been modified.

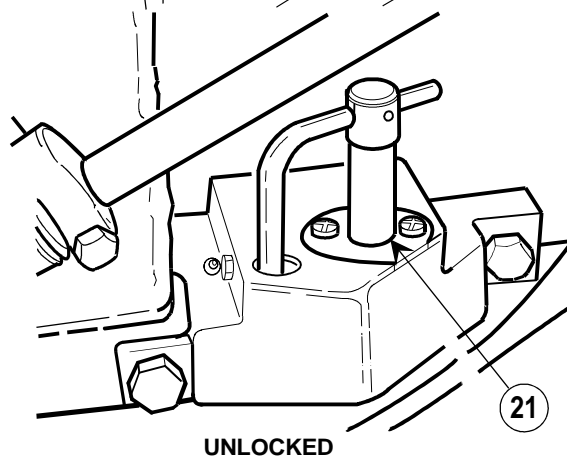
- 15** The gunner removes retaining pin (19) from top carriage locking pin (20), pulls up on top carriage locking pin to the disengaged (up) position and secures top carriage locking pin with retaining pin.

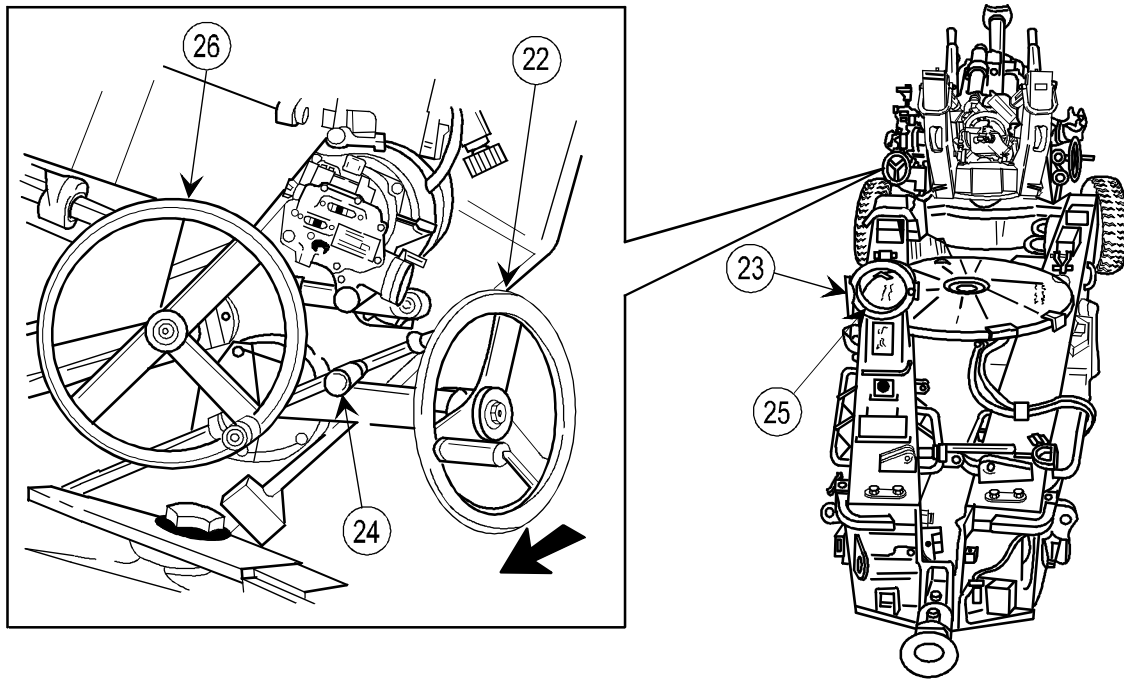


### NOTE

Step 16 applies to howitzers that have been modified.

- 16** The gunner pulls up locking pin (21) to disengage pin from bottom carriage and rotate pin to unlocked position.





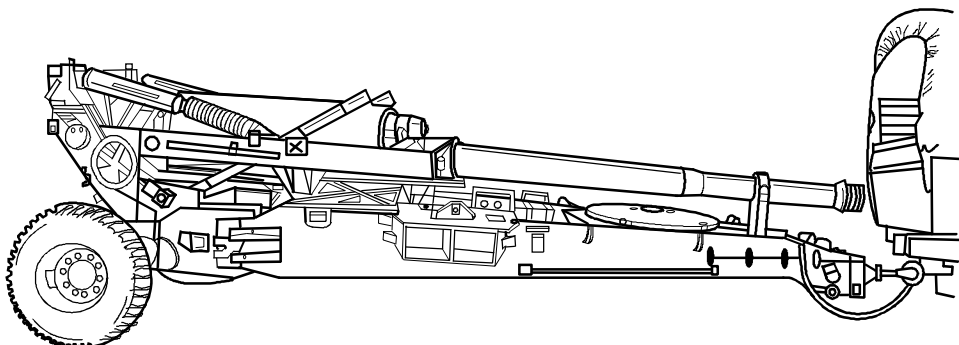
#### NOTE

Chief of section may designate other crew members to assist in traversing cannon tube to stowed position. Prior to traversing the top carriage, check gun records and/or bottom carriage for an indication of broken or damaged internal ring gear teeth. If the ring gear has been damaged, but is still usable, the damaged teeth will be repositioned over the right trail. If this is the case, the top carriage will have to be traversed counterclockwise instead of clockwise.

- 17 The gunner rotates the traversing handwheel (22) clockwise, traversing the cannon tube to the right until the tube is directly over the gun tube travel lock on the left trail.
- 18 Cannoneer no. 5 opens the lock release lever (23). The gunner depresses the manual control lever (24) and lowers the cannon tube onto the travel lock cradle (25) by rotating the elevating handwheel (26) counterclockwise, then secures the lock release lever completing the stow.

#### CAUTION

The muzzle brake must be removed to tow weapon in the stowed position. Notify unit maintenance for removal. Towing howitzer in stowed position should be a limited/supervised operation. With the muzzle brake removed, the cannon tube will hit the 900 series prime mover's tailgate in a sharp right turn.



Section IV. OPERATION UNDER  
UNUSUAL CONDITIONS

Section Index

Paragraph	Page
2-29. General.....	2-110
2-30. Extreme Cold Weather Conditions.....	2-110
2-31. Extreme Hot Weather Conditions .....	2-111
2-32. Operation in Hot, Damp, and Salty Atmosphere .....	2-112
2-33. Unusual Terrain Conditions.....	2-112
2-34. Fording Operations.....	2-112
2-35. Emergency Procedures.....	2-115

2-29. GENERAL

This section contains special instructions for operating and servicing the weapon under unusual conditions. Take special care in cleaning and lubricating when extremes in temperature, humidity, and terrain conditions are present or anticipated, in addition to performing all normal preventive maintenance services. Proper cleaning, lubrication, and storage and handling of oil and lubricants not only ensure proper operation and functioning but also guard against excessive wear of the working parts and deterioration of the materiel.

2-30. EXTREME COLD WEATHER CONDITIONS

WARNING

Do not grasp metal parts, such as knobs, levers, covers, etc. with bare hands.

a. General Problems.

(1) Extensive preparation of materiel scheduled for operation in extreme cold weather is necessary. Generally, extreme cold will cause lubricants to thicken or congeal.

CAUTION

It is important that the approved practices and precautions be followed. FM 9-207 contains general cold weather information applicable to the M198 howitzer. It must be considered an essential part of this technical manual.

(2) For description of operation in extreme cold, refer to FM 31-70, FM 31-71, and FM 9-207.

b. **Equilibrators.** Extreme cold temperatures will cause a corresponding decrease of nitrogen pressure in the equilibrators, making it difficult to elevate the cannon tube. Manually adjust the equilibrators (p 3-34) to develop equal handwheel loads while elevating and depressing. If equilibrators cannot be manually adjusted properly, notify unit maintenance.

c. **Tires.** Tires should be inflated to their respective pressures (p 1-16) at ambient temperature.

d. **Fire Control Equipment.**

(1) When not in use, keep fire control equipment covered in the proper carrying cases or properly stowed.

(2) Do not let snow or ice accumulate on equipment. Keep moving parts free of moisture.

(3) Use only dry rags (item 24, appx D) and dry lens paper (item 21, appx D) for cleaning.

(4) Working parts may operate or function sluggishly. The operator should be able to differentiate between sluggishness and lack of movement because of built-in stops. Do not force movements beyond their stops.

(5) Do not expose M137/M137A3 pantel, M138 elbow telescope, or M139/M139A1 alinement device to sudden changes in temperature by moving them from very cold to warm or warm to very cold areas. Lenses, windows, or prisms may fracture.

## 2-31. EXTREME HOT WEATHER CONDITIONS

### a. General Problems.

(1) In hot climates, the film of oil necessary for operation and preservation will quickly disappear. Inspect the cannon and carriage daily, paying particular attention to hidden surfaces, such as bore and chamber, springs, spring seats, firing pin, and other likely places where corrosion might occur and not be quickly noticed.

(2) Perspiration from the hands can help cause rusting. After handling, clean, wipe dry, and lubricate. Lubrication instructions are in appendix F of this TM. All lubrication instructions are mandatory.

### b. Ammunition Problems.

(1) Since explosives are adversely affected by high temperatures, ammunition must be protected from sources of high temperatures, including the direct rays of the sun. Elements in primers and fuzes are particularly sensitive to high temperatures.

#### WARNING

Do not fire WP projectiles which are known to have been stored in other than a base down position. Firing of such projectiles could contribute to inbore or close-in premature malfunctions.

(2) Whenever practicable, store white phosphorous-loaded smoke projectiles at temperatures below the melting point (+111.4°F (+44.11°C)) of the white phosphorous filler. If not practicable, white phosphorous projectiles should be stored on their bases so that if the white phosphorus filler melts, it will resolidify with void spaces in the normal position (in the nose of the projectile) when the temperature falls below its melting point. Prematures have been caused by voids in the base end of the white phosphorous projectile, and erratic performance may result from voids in its side. Refer to page 4-53 for precautions in handling ammunition in high temperatures.

**c. Tires.** Cover tires with available materials to protect them from the direct rays of the sun, to keep them from overinflating, and to keep the rubber from deteriorating. Inflate tires to their respective pressures at ambient temperature.

**d. Equilibrators.** Extreme hot temperatures will cause a corresponding increase of nitrogen pressure in the equilibrators, making it difficult to depress the cannon tube. Manually adjust the equilibrators to develop equal handwheel loads while elevating and depressing. If equilibrators cannot be manually adjusted properly, notify unit maintenance.

## 2-32. OPERATION IN HOT, DAMP, AND SALTY ATMOSPHERE

- a. Inspect materiel daily when it is being operated in hot, moist, and salty areas.
- b. When the weapon is active, clean and lubricate the bore and exposed metal surfaces daily. Lubrication instructions are in appendix F of this TM. All lubrication instructions are mandatory.
- c. Moist and salty atmospheres can destroy the rust-preventive qualities of oils and greases. Inspect parts daily for corrosion. Keep covers in place as much as firing conditions permit.
- d. When the weapon is inactive, cover the unpainted parts with a film of PL-S (item 17, appx D). All covers should be in place.
- e. Do not break moisture-resistant seals of ammunition containers until the ammunition is to be used.
- f. Keep ammunition dry and free from mud, corrosion, or foreign matter. Provide proper drainage around the area to keep the ammunition as dry as possible.
- g. Proximity (VT) fuzes must be protected against dampness. Although the fuzes are nearly waterproof, any exposure to dampness may increase the number of duds. Rain or immersion in water will speed up deterioration. Especially in tropical climates, the storage time of unpacked fuzes should be kept to a minimum. Store fuzes in their original sealed containers as long as it is practical.
- h. Optical instruments are protected against moisture by pressurized nitrogen. If moisture is present, notify unit maintenance.
- i. Salt deposits are especially harmful to optical surfaces. Loosen deposits by sponging with a clean wiping rag (item 24, appx D). Do not rub deposits.

## 2-33. UNUSUAL TERRAIN CONDITIONS

- a. **Soft or Rough Terrain.** When traveling on soft or rough terrain, such as mud, sand, or snow, use care when backing weapon attached to prime mover.
- b. **Sand, Dust, and Dirt.** Inspect and lubricate the materiel, except exposed lubricated parts, frequently when operating in sandy or unusually dusty areas. Be careful to keep sand and dust out of mechanisms and oil receptacles when inspecting and lubricating and when making adjustments and repairs. Keep all covers in place as much as firing conditions permit. Shield parts from flying sand and dust with tarpaulins or with the telescope and mount covers during disassembly and assembly operations. When beginning an action in sandy or dusty areas, remove lubricants from recoil rails and any other exposed lubricated parts, situation permitting. Sand and dirt on lubricants will form an abrasive which will cause rapid wear. Dry surfaces wear less than do surfaces coated with lubricant contaminated with sand or dirt. Clean and lubricate all exposed parts after the action is over. Lubrication instructions are in appendix F of this TM. All lubrication instructions are mandatory.

## 2-34. FORDING OPERATIONS

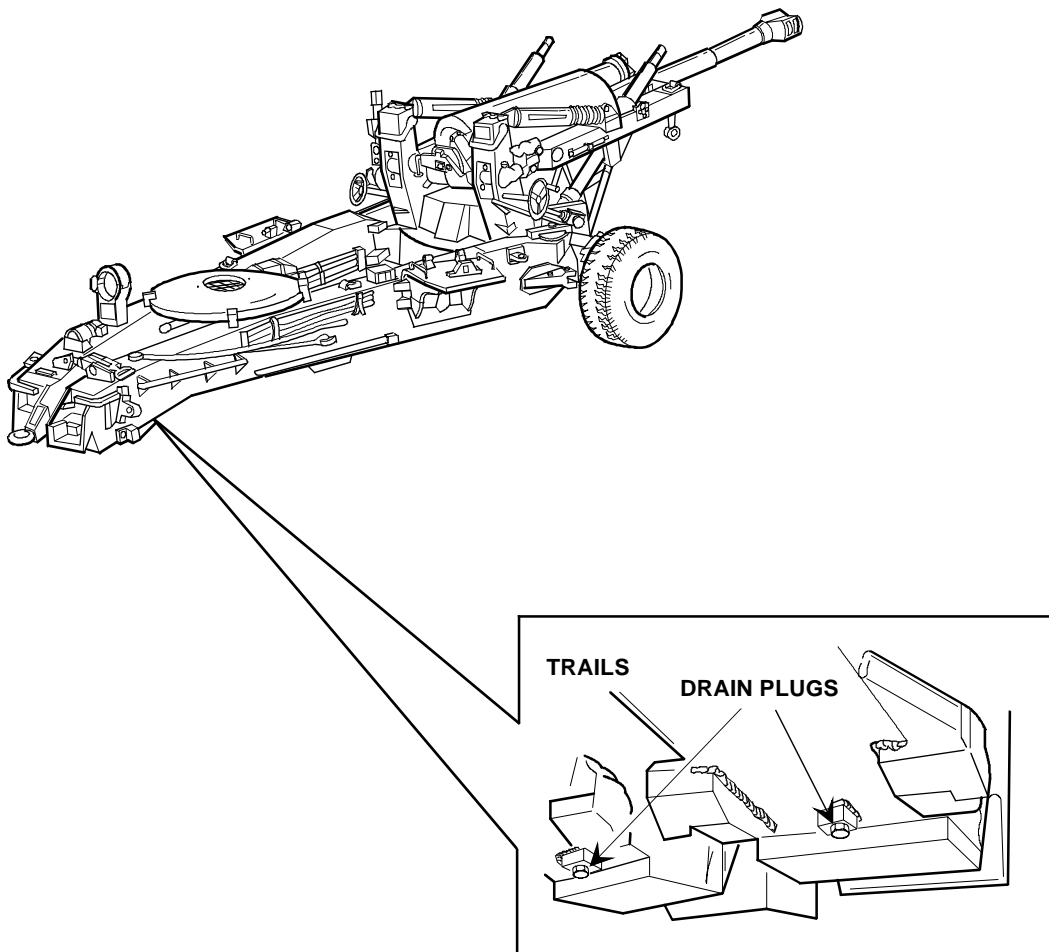
**After-Fording Operations.** Immediately after weapon is towed from the water, if tactical situation permits, perform the following services:

(1) Notify unit maintenance to remove the wheels with hubs and thoroughly clean with cleaning compound (item 5, appx D) and dry all working parts of the handbrakes and wheel bearings, and lubricate the handbrakes. Check power booster reservoir for contamination. Notify unit maintenance if contaminated. Lubrication instructions are in appendix F of this TM. All lubrication instructions are mandatory.

(2) Empty any water from the materiel and clean, dry, and apply the proper lubricant to all exposed unpainted surfaces, paying special attention to the bore and chamber, the recoil rails, and the equilibrator rod. Notify unit maintenance for necessary disassembly, cleaning, and lubrication. Lubrication instructions are in appendix F of this TM. All lubrication instructions are mandatory.

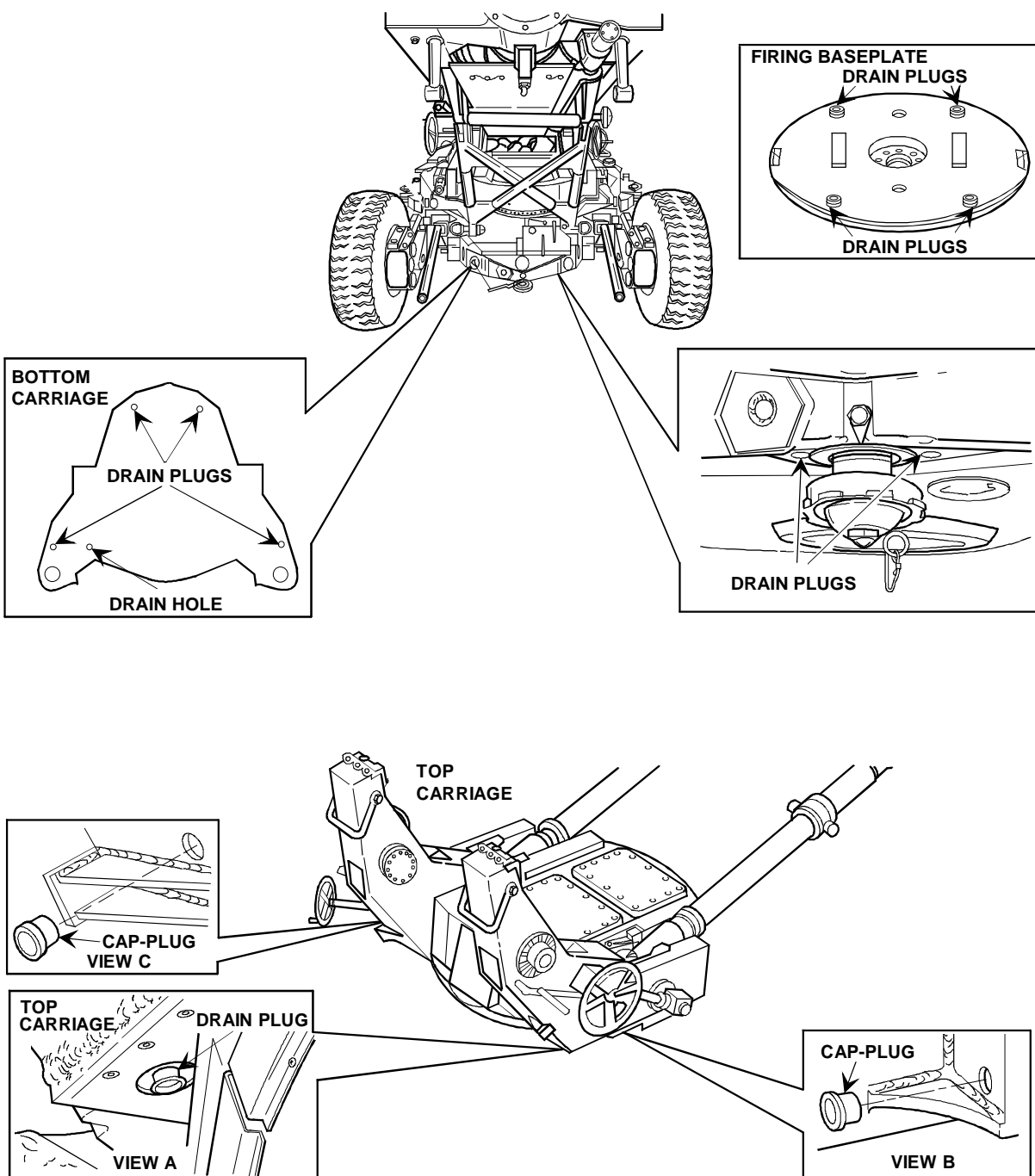
(3) Saltwater immersion greatly increases rusting and corrosion, especially on unpainted surfaces. Remove all traces of saltwater and salt deposits from every part of the cannon and carriage. Apply PL-S (item 17, appx D) and notify unit maintenance so that the cannon and carriage are disassembled, cleaned, and lubricated as soon as possible. Lubrication instructions are in appendix F of this TM. All lubrication instructions are mandatory.

(4) Two drain plugs, one on each trail, are located toward the end of bottom side of trail. To remove these plugs, notify unit maintenance.



## 2-34. FORDING OPERATIONS (cont)

(5) Four drain plugs are located on the bottom carriage, one plug by the trail hinge points and one on each side by the ball where the firing baseplate attaches. Six drain plugs are located on the top carriage: two on the underside (view A), one on the left and right side (view B), and one on the rear left and right trunnion posts (view C). (See page 2-113 for additional drain plug location.) For removal of drain plugs on trails, notify unit maintenance. Make sure all drain plugs are reinstalled after all moisture is removed.



## 2-35. EMERGENCY PROCEDURES

Refer to FM 3-3 and FM 3-5 for nuclear, biological, and chemical (NBC) decontamination procedures.

## Section V. MISFIRE AND CHECK FIRING PROCEDURES

### Section Index

Paragraph		Page
2-36.	General Precautions.....	2-115
2-37.	Definitions.....	2-115
2-38.	Misfire and Check Firing Preventive or Corrective Procedures .....	2-116
2-39.	Misfire Procedures for Cold Tube .....	2-118
2-40.	Misfire Procedures for Warm Tube.....	2-119
2-41.	Special Misfire Procedures for Warm Tube in Hot Weather .....	2-120
2-42.	Misfire Procedures for Hot Tube .....	2-121
2-43.	Unloading a Sticker Round.....	2-122
2-44.	Unloading an Unfired Round.....	2-122

## 2-36. GENERAL PRECAUTIONS

Conditions described below are rarely encountered with a properly maintained weapon and when authorized and properly maintained ammunition is fired. To avoid injury to personnel and damage to equipment, these conditions must be understood. To determine tube temperature and which action to take, refer to page 2-75 for instructions for using the thermal warning device, and paragraph 2-37 for definitions.

## 2-37. DEFINITIONS

- 1 Checkfire.** A checkfire is a command normally given by the executive officer. In an emergency, the command may be given by anyone who interrupts a fire mission.
- 2 Misfire.** A misfire is a failure of a round to fire after initiating action is taken. This may be due to the failure in the functioning of the primer, igniter, propelling charge, or firing mechanism. A misfire in itself is not dangerous; however, it cannot be immediately distinguished from a hangfire. Therefore, misfires must be treated as delayed firings until determined otherwise.
- 3 Hangfire.** A hangfire is a delay in the functioning of the primer, igniter, or propelling charge. The delay, though unpredictable, ranges from a fraction of a second to several minutes. A hangfire cannot be distinguished immediately from a misfire.

### WARNING

Do not stand behind breech when removing the primer. Do not grasp the firing mechanism block assembly so that your hand is exposed to being hit by the expelled primer.

### NOTE

Stickers may occur when firing charge 2. When a sticker does occur, hot gasses under pressure are trapped in the chamber. Removal of the primer is dangerous, as it will be shooting rearward when released. The expelled primer may cause injury to personnel standing in its path or ricochet.

## 2-37. DEFINITIONS (cont)

- 4 **Sticker.** A sticker is a projectile that is lodged in the tube after being fired. Stickers result from insufficient chamber pressure. Either fire out with charge 5 or higher or notify explosive ordnance disposal (EOD). If a sticker round is encountered, follow the procedures for unloading a sticker round (p 2-122).
- 5 **Cookoff.** The functioning of the propelling charge or projectile when initiated by the heat of the weapon.
- 6 **Cold tube.** Any tube that has or has not exceeded rates of fire and does not cause water from a wet swab to boil, fry, or steam off when placed just forward of the gas check sheet.
- 7 **Hot tube.** Any tube that has or has not exceeded the rates of fire, but does cause water from a wet swab to boil, fry, or steam off when placed just forward of gas check sheet.
- 8 **Hot Weapon.** A hot weapon is one in which the tube and breech have been brought to a sufficiently high temperature by previous firings so that they can transmit, in several minutes time, enough heat to the round to activate its explosive components.
- 9 **Hot Weather.** Hot weather is any weather in which the outside temperature is expected to exceed +100°F (+38°C) during the day.

## 2-38. MISFIRE AND CHECK FIRING PREVENTIVE OR CORRECTIVE PROCEDURES

### WARNING

In the event of a failure to fire, keep the weapon trained on the target. When firing is interrupted, promptly remove the projectile from the chamber if time allows as indicated by the thermal warning device (p 2-118).

In case of a MISFIRE/HANGFIRE, follow the Misfire procedures for tube temperature. When breech is opened, to remove the powder charge and primer, if smoke/sparks are coming from the chamber area, do not attempt to remove the charge or close the breech, immediately evacuate the area and notify EOD.

- 1 **General.** Misfires and checkfires are not dangerous in themselves; however, two conditions hazardous to crew and equipment can develop if the proper corrective procedures are not followed.
  - a. In case of a checkfire or a misfire, the weapon may unexpectedly fire. All personnel should stay clear of the recoiling parts and muzzle. The weapon should be kept trained on the target until the projectile has been removed from the weapon.
  - b. If a charge or projectile is chambered in a hot tube following any failure to fire, the possibility of a cookoff exists.
- 2 **Misfire and Check Firing Procedures.**
  - a. Failure to fire with a cold tube (green range on thermal warning device). When indicator is in the green zone (below +170°F (+77°C)), there are no restrictions with respect to misfire instructions, and normal cold tube misfire procedures apply (p 2-118). In this region, there is little danger of cookoff.

- b. Failure to fire with a warm tube (yellow range on thermal warning device). The warm tube has two upper boundaries. When there is failure to fire, use +350°F ( +177°C) as the upper boundary. (In hot weather use +300°F ( +149°C).) For misfires occurring when the indicator is in the yellow zone, follow procedures on page 2-119. (In hot weather follow procedures on p 2-120.)
- c. Failure to fire with a hot tube (red range on thermal warning device). If the indicator reaches the red zone, the weapon should be used in combat emergency only. There is an immediate danger of cookoff if a misfire occurs. Follow procedures on page 2-121.

- 3 Inspection of Primer After Removal.** After a primer has been removed, it should be inspected to determine whether the primer or the firing mechanism caused the misfire. If the primer has been dented and not fired, the primer is at fault. If the printer has not been dented, the firing mechanism is at fault. If the firing mechanism caused the misfire, refer to the troubleshooting table (p 3-3).

**WARNING**

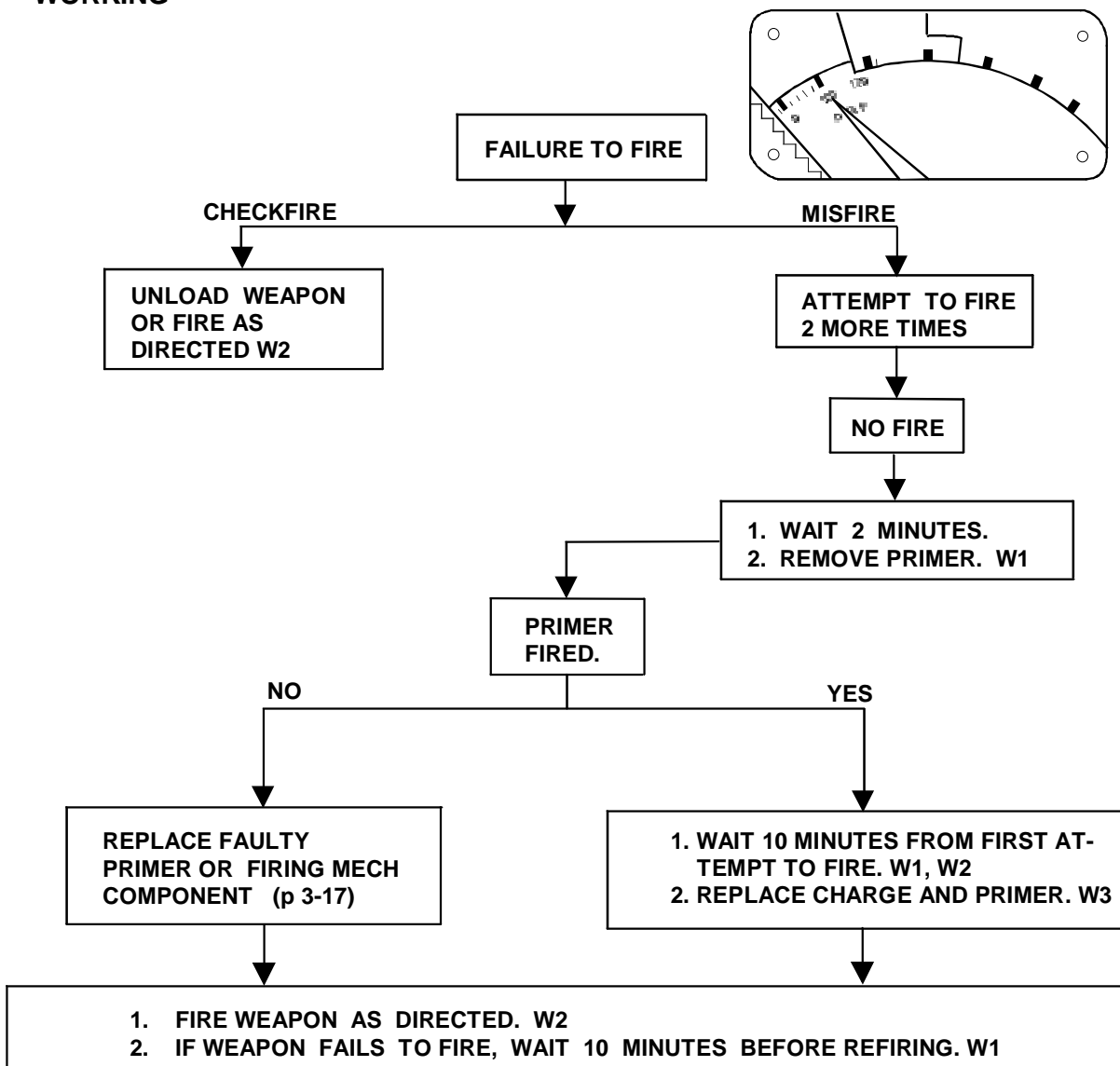
Projectiles and fuzes that have been rammed and then removed from the tube must **not** be reused. Unloading may have created some non-standard conditions. They must be turned over to authorized personnel for destruction or demilitarization. Only an M712 Copperhead projectile that has been rammed and extracted from a cold tube may be reused.

**WARNING**

In the event of failure of the thermal warning device, use the definitions of COLD TUBE and HOT TUBE for the misfire/check firing procedures.

- 4 Notification of EOD Personnel.** If a projectile cannot be cleared from the weapon within the specified time, EOD personnel must be notified to remove the stuck projectile.

**2-39. MISFIRE PROCEDURES FOR COLD TUBE (THERMAL WARNING DEVICE GREEN READING) -0° to +170°F (-17° to +77°C) OR USE COLD TUBE DEFINITION IF TWD IS NOT WORKING**



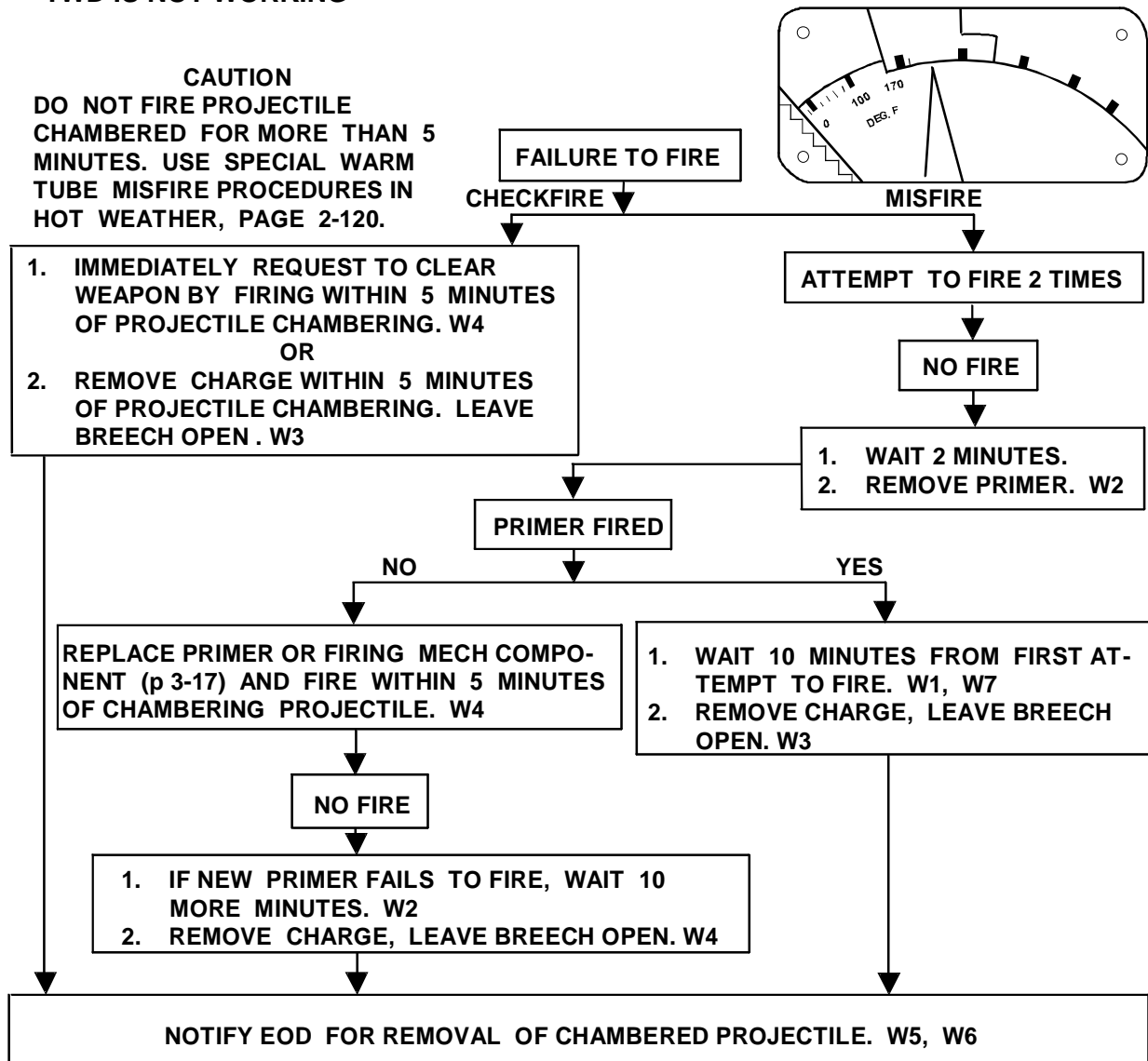
**WARNING**

**W1-HANGFIRE POSSIBLE; STAND CLEAR OF RECOILING PARTS.**  
**W2-IF SMOKE/SPARKS ARE COMING FROM CHAMBER AREA, DO NOT REMOVE CHARGE OR CLOSE BREECH, EVACUATE AREA, NOTIFY EOD.**  
**W3-DO NOT FIRE UNLOADED PRIMER, CHARGE, OR PROJECTILE. SEPARATE, MARK UNSERVICEABLE.**

**NOTE**

See page 2-123 for use of bell rammer.

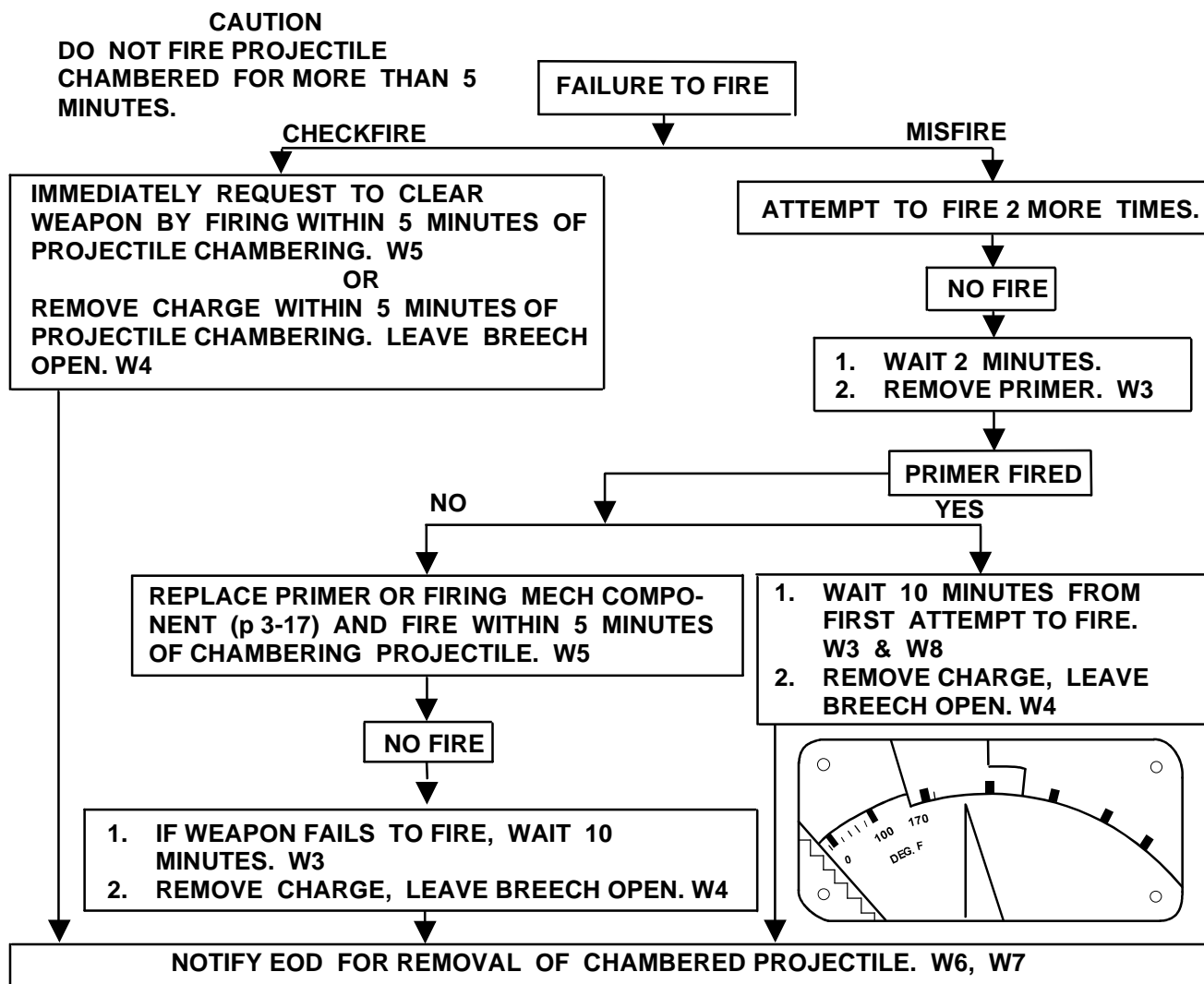
**2-40. MISFIRE PROCEDURES FOR WARM TUBE (THERMAL WARNING DEVICE YELLOW READING) +170° TO +350°F (+77° TO +177°C) (W1) OR USE HOT TUBE DEFINITIONS IF TWD IS NOT WORKING**



**WARNING**

W1-WEATHER IS CONSIDERED HOT IF OUTSIDE TEMPERATURE IS EXPECTED TO REACH +100°F (+38°C) DURING THE DAY.  
W2-HANGFIRE POSSIBLE; STAND CLEAR OF RECOILING PARTS.  
W3-DO NOT FIRE DOWNLOADED AMMUNITION, SEPARATE, MARK UNSERVICEABLE.  
W4-A HEATED PROJECTILE MAY CAUSE AN INBORE EXPLOSION IF FIRED AFTER 5 MINUTES.  
W5-WAIT UNTIL TWD FALLS BELOW +160°F (+71°C) BEFORE PERMITTING EOD TO REMOVE PROJECTILE.  
W6-NEVER FIRE A PROJECTILE OR CHARGE THAT HAS BEEN ALLOWED TO COOL IN A HEATED TUBE. SEPARATE, MARK UNSERVICEABLE.  
W7-IF SMOKE/SPARKS ARE COMING FROM CHAMBER AREA, DO NOT REMOVE CHARGE OR CLOSE BREECH, EVACUATE AREA, NOTIFY EOD.

**2-41. SPECIAL MISFIRE PROCEDURES FOR WARM TUBE IN HOT WEATHER (THERMAL WARNING DEVICE YELLOW READING) +170° TO +300°F (+77° TO +149°C) OR USE HOT TUBE DEFINITION IF TWD IS NOT WORKING**



**WARNING**

W1-IF PROJECTILES ARE NOT PROPERLY SHADED, TREAT A WARM TUBE AS A HOT TUBE.

W2-WEATHER IS CONSIDERED HOT IF OUTSIDE TEMPERATURE IS EXPECTED TO REACH +100°F (+38°C) DURING THE DAY.

W3-HANGFIRE POSSIBLE; STAND CLEAR OF RECOILING PARTS.

W4-DO NOT FIRE UNLOADED AMMUNITION. SEPARATE, MARK UNSERVICEABLE.

W5-A HEATED PROJECTILE MAY CAUSE AN INBORE EXPLOSION IF FIRED AFTER 5 MINUTES.

W6-WAIT UNTIL THERMAL WARNING DEVICE FALLS BELOW +160°F (+71°C) BEFORE PERMITTING EOD TO REMOVE PROJECTILE.

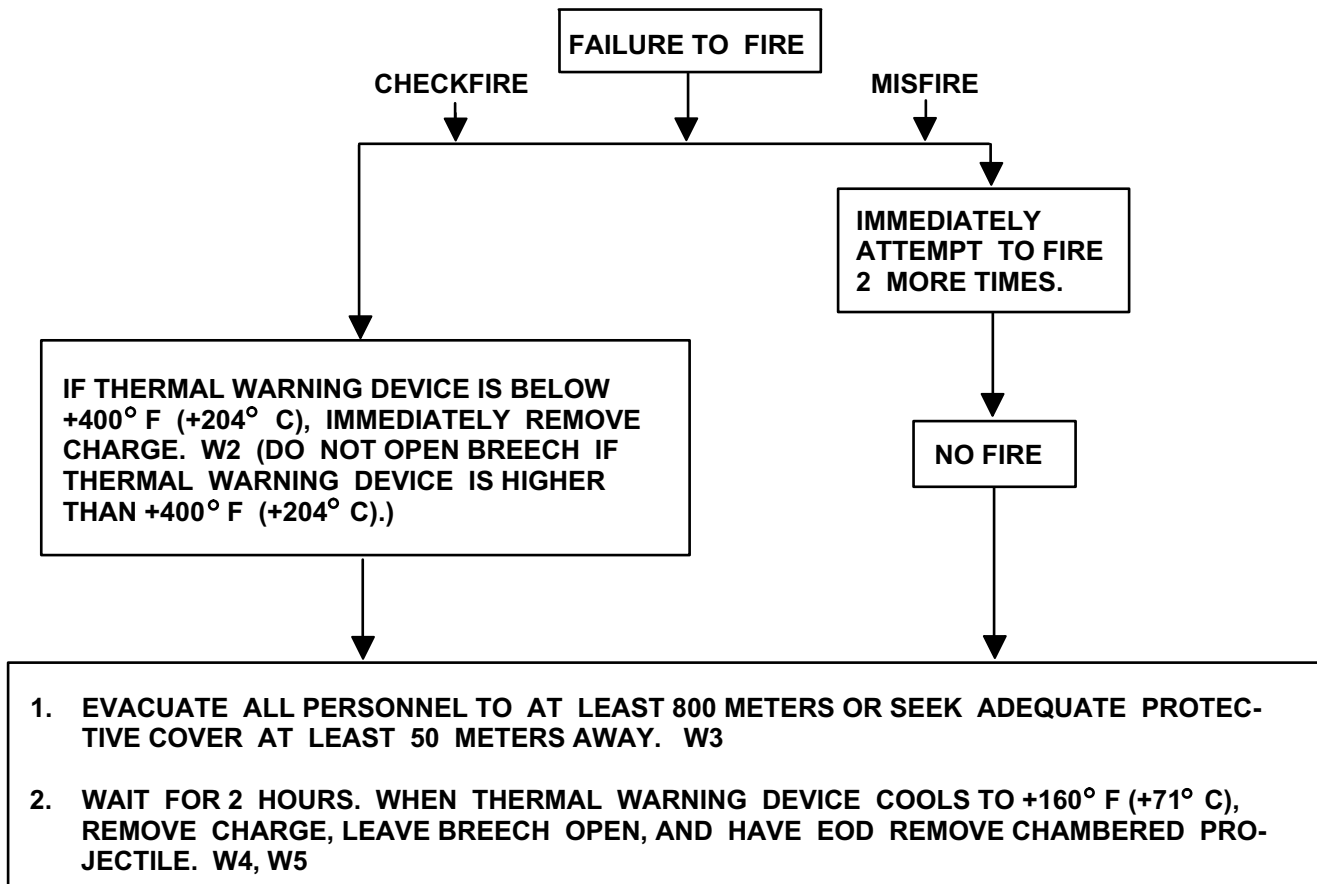
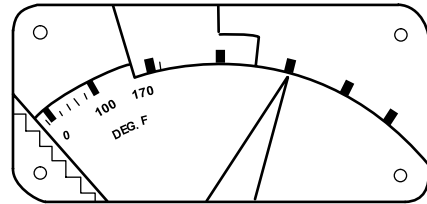
W7-NEVER FIRE A PROJECTILE CHARGE THAT HAS BEEN ALLOWED TO COOL IN A HEATED TUBE. SEPARATE, MARK UNSERVICEABLE.

W8-IF SMOKE/SPARKS ARE COMING FROM CHAMBER AREA, DO NOT REMOVE CHARGE OR CLOSE BREECH, EVACUATE AREA, NOTIFY EOD.

**2-42. MISFIRE PROCEDURES FOR HOT TUBE (THERMAL WARNING DEVICE RED READING ABOVE +350°F (+177°C), TWD RED READING ABOVE +300°F (+149°C) IN HOT WEATHER, OR USE HOT TUBE DEFINITION IF TWD IS NOT WORKING**

**WARNING**  
DO NOT FIRE IN A HOT TUBE EXCEPT IN A COMBAT SITUATION.

DO NOT TAKE CORRECTIVE ACTION EXCEPT AS STATED BELOW.



**WARNING**

W1-WEATHER IS CONSIDERED HOT IF OUTSIDE TEMPERATURE IS EXPECTED TO REACH +100°F (+38°C) DURING THE DAY.

W2-CHARGE COOKOFF POSSIBLE AFTER 1 MINUTE.

W3-DO NOT TAKE COVER IMMEDIATELY TO REAR OF WEAPON.

W4-DO NOT FIRE UNLOADED PRIMER AND CHARGE. SEPARATE, MARK UNSERVICEABLE.

W5-NEVER FIRE A PROJECTILE OR PRIMER CHARGE THAT HAS BEEN ALLOWED TO COOL IN A HEATED TUBE. SEPARATE, MARK UNSERVICEABLE.

## 2-43. UNLOADING A STICKER ROUND

### WARNING

Stickers may occur when firing charge 2. When stickers occur, the projectile lodges in tube and hot gasses under pressure are trapped in the chamber. Removal of the primer is dangerous as it will be shooting rearward when released. Do not stand behind the breech when removing the primer; the expelled primer may cause injury to personnel standing in its path or ricochet. Do not grasp the firing mechanism block assembly so that your hand is in the way of the expelling primer.

- 1 Standing to the left side of the breech, cannoneer no. 1 grasps the knob on the firing mechanism block assembly (1) and pulls outward until it is free to be opened. Keeping the knob out, cannoneer no. 1 then firmly slides the firing mechanism block assembly toward the open position until the primer pops and the gasses vent.

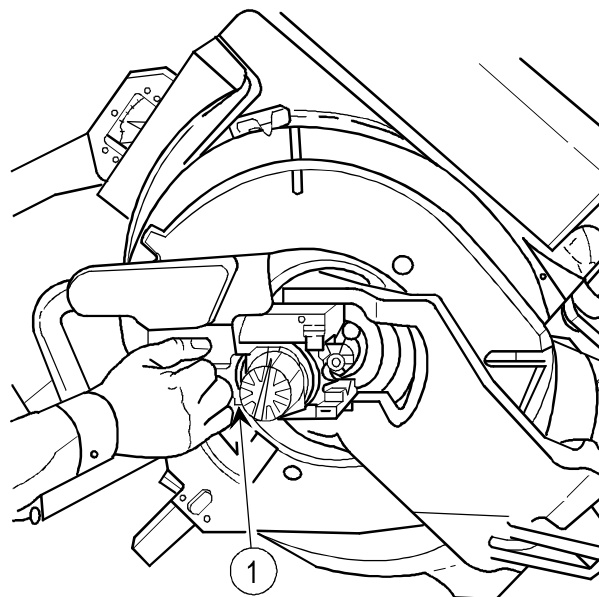
### CAUTION

Check with local SOP before firing sticker rounds.

- 2 Fire at charge 5 or higher with proper authority.

### NOTE

No significant range loss is expected when firing sticker.



## 2-44. UNLOADING AN UNFIRED ROUND

### WARNING

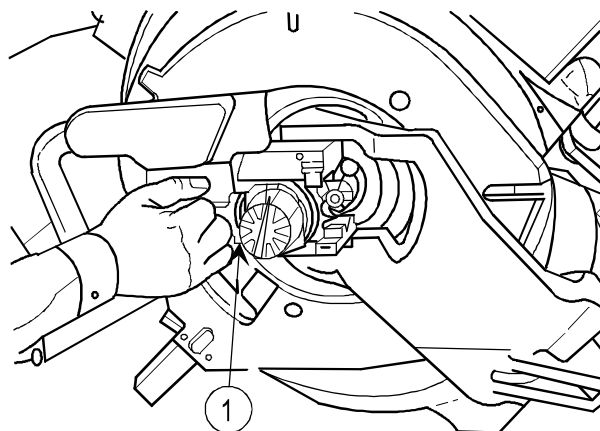
A complete round, once loaded, should be fired. However, if an unfired projectile must be removed, proceed as follows. For misfire/check firing procedures, refer to page 2-115.

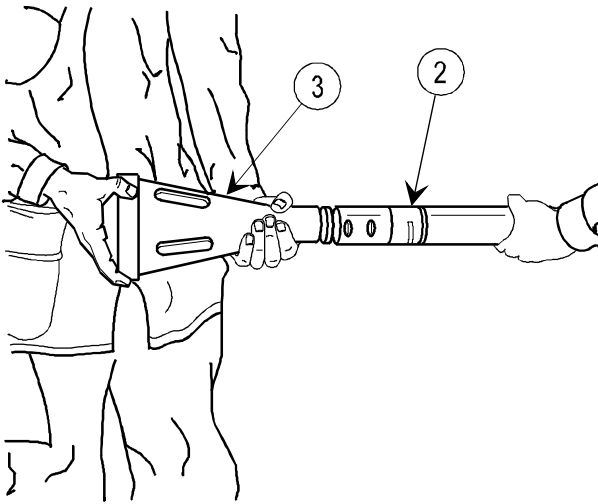
For extraction of M712 projectile (Copperhead), see page 4-60.

### NOTE

The following unloading procedures do not apply to the MACS propelling charge.

- 1 Cannoneer no. 1 slides firing mechanism block assembly (1) left to eject primer, and then slides firing mechanism block assembly right to firing position.



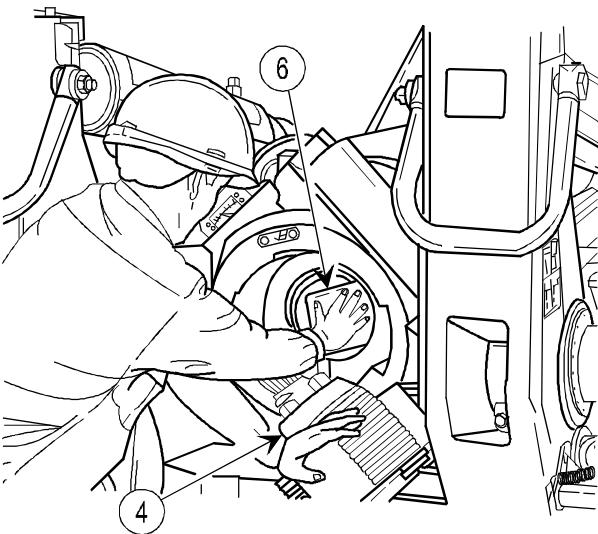


- 2 The assistant gunner levels cannon tube.

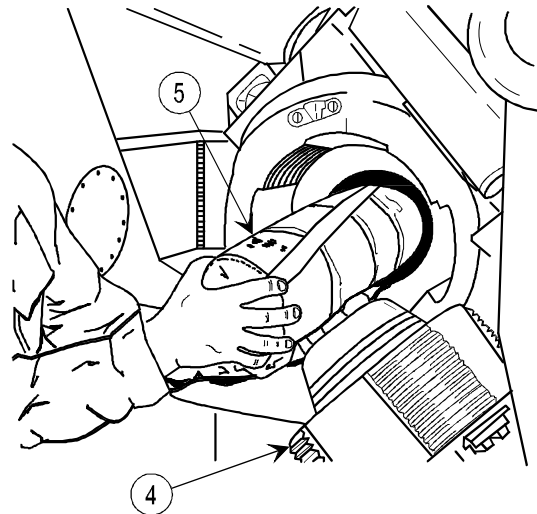
**WARNING**

Ensure that proper artillery rammer (8767210) is used.

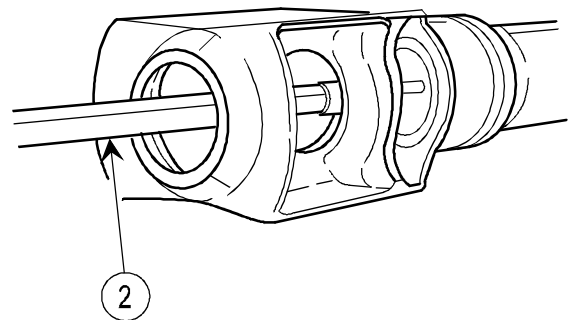
- 3 The ammunition team chief assembles at least seven sections of rammer staff (2) to bell rammer (3).



- 6 Cannoneer no. 3 hands chamber swab (6) (item 9, appx B), to cannoneer no. 1 who places it in powder chamber and closes breechblock assembly.



- 4 Cannoneer no. 1 opens breechblock assembly (4).
- 5 Cannoneer no. 1 removes propelling charge (5) and hands it to cannoneer no. 3.



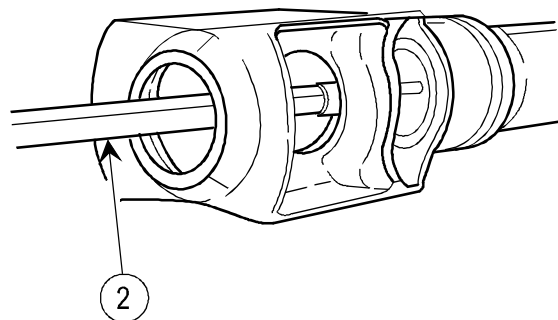
- 7 Cannoneers no. 4 and 5, and the ammunition team chief insert bell rammer end of rammer staff (2) into bore and push carefully until it encloses fuze and comes into contact with ogive of projectile.

## 2-44. UNLOADING AN UNFIRED ROUND (cont)

- 8 Cannoneers no. 4 and 5, and the ammunition team chief push or, if necessary, tap rammer staff (2) until projectile is dislodged from its seat.

### NOTE

If round cannot be removed, notify EOD.



- 9 Cannoneers no. 4 and 5 and the ammunition team chief push projectile from cannon tube into powder chamber.
- 10 Cannoneer no. 1 opens breechblock assembly and removes chamber swab. Cannoneers no. 2 and 3 position projectile loading tray on breech ring assembly to accept projectile. Cannoneers no. 4 and 5, and the ammunition team chief push projectile onto projectile loading tray.
- 11 Cannoneers no. 4 and 5, and the ammunition team chief remove rammer staff (2) from cannon tube.
- 12 Cannoneer no. 2 isolates removed round for inspection by local explosive ordnance disposal (EOD) personnel.

## UNLOADING PROCEDURES FOR MACS PROPELLING CHARGE ONLY

- 1 Slide firing mechanism block assembly left to eject primer, then slide firing mechanism block assembly right to firing position.
- 2 Open breech block assembly.

### NOTE

MACS increments must be removed one at a time.

- 3 Lift increment out of the swiss notch by using the thin black charge separator as a tool. Slide the separator along the side of the increment then under to lift it up and out of the swiss notch.
- 4 If MACS charge two or higher was loaded into the weapon then elevate the cannon as needed to get the increments to slide back into the swiss notch. Repeat step 3 above for each increment.
- 5 Follow instruction in previous section for unloading the projectile after MACS has been removed.

## CHAPTER 3 MAINTENANCE INSTRUCTIONS

### Chapter Index

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Section II. Troubleshooting Procedures.....	3-1
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## Section I. LUBRICATION INSTRUCTIONS

### Section Index

Paragraph	Page
3-1. General .....	3-1

### 3-1. GENERAL

Lubrication instructions are in appendix F of this TM. All lubrication instructions are mandatory.

## Section II. TROUBLESHOOTING PROCEDURES

### Section Index

Paragraph	Page
3-2. Introductory Information.....	3-1
3-3. Symptom Index.....	3-2
3-4. Troubleshooting Procedures .....	3-3

### 3-2. INTRODUCTORY INFORMATION

**a.** Use the symptom index (p 3-2) as a quick guide to troubleshooting. Common malfunctions are listed in alphabetical order with a page number reference to the troubleshooting table where a test or inspection and corrective action are provided.

**b.** The troubleshooting table (p 3-3) lists the common malfunctions which you may find during operation or maintenance of the M198 howitzer or its components. Perform the tests/inspections and corrective actions in the order listed.

**c.** This manual cannot list all malfunctions that may occur, nor all tests or inspections and corrective actions. If a malfunction is not listed or is not corrected by listed corrective action, notify your supervisor.

### 3-3. SYMPTOM INDEX

#### Troubleshooting Procedure Page

#### CANNON

Blowback occurs around breechblock assembly .....	3-3
Breech mechanism assembly does not operate freely .....	3-5
Primer fails to extract.....	3-3
Primer fails to fire.....	3-3
Thermal warning device housing and band clamps are loose on cannon tube .....	3-3

#### CARRIAGE

Both gages indicate pressure without prime mover brakes applied .....	3-12
Brakes are locked.....	3-11
Brakes are weak (gages are in the red) .....	3-12
Length of recoil is incorrect .....	3-6
Play in traversing handwheel exceeds 1/12 turn (3-1/8 in. (7.94 cm)).....	3-7
Speed shift cylinder assembly cannot be extended or retracted .....	3-10
Top carriage is difficult to traverse .....	3-7
Traversing mechanism will not hold top carriage in cant position.....	3-7
Weapon is difficult to elevate and depress.....	3-6
Wheels will not lock in up/down position .....	3-9
Wheels will not move up or down.....	3-8
Wheels wobble .....	3-9

#### FIRE CONTROL EQUIPMENT

Counter dials, reticles, or level vials are broken .....	3-14
Counters, level vials, or reticles are not illuminated.....	3-14
Fire control knobs do not turn freely.....	3-14
Fitted parts of fire control equipment are loose.....	3-14
Moisture is in fire control equipment .....	3-13
M1A2 collimator reticle image is not sharp .....	3-15

#### RECOIL MECHANISM

Oil leaks from front yoke assembly .....	3-5
Oil leaks from recuperator cylinder assembly .....	3-6
Oil leaks from replenisher cylinder assembly.....	3-6
Oil reserve indicator shows oil reserve higher than 10 reserves or less than 2 reserves .....	3-5
Weapon does not return to battery or slams into battery .....	3-6

### 3-4. TROUBLESHOOTING PROCEDURES

Table 3-1. Troubleshooting

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
-------------	--------------------	-------------------

#### CANNON

1. THERMAL WARNING DEVICE HOUSING AND BAND CLAMPS ARE LOOSE ON CANNON TUBE.

No further inspection is required.

Notify unit maintenance.

2. PRIMER FAILS TO FIRE.

Step 1. Make sure firing mechanism block assembly is completely closed (to the extreme right).

Move firing mechanism block assembly to the extreme right.

Step 2. Check for defective primer.

Go to misfire procedures (p 2-115).

3. PRIMER FAILS TO EXTRACT.

Step 1. Check for stuck primer.

Open breechblock assembly, slide vent cleaning tool through vent hole, and tap out primer.

Step 2. Check the primer casing for deformity, and check the primer cavity in the breechblock assembly for dirt or fouling.

Clean the primer cavity with vent cleaning tool.

Step 3. Check for worn or damaged cartridge extractor.

If damaged, notify unit maintenance.

4. BLOWBACK OCCURS AROUND BREECHBLOCK ASSEMBLY.

Step 1. Check to see if split rings are properly installed.

3-4. TROUBLESHOOTING PROCEDURES (cont)

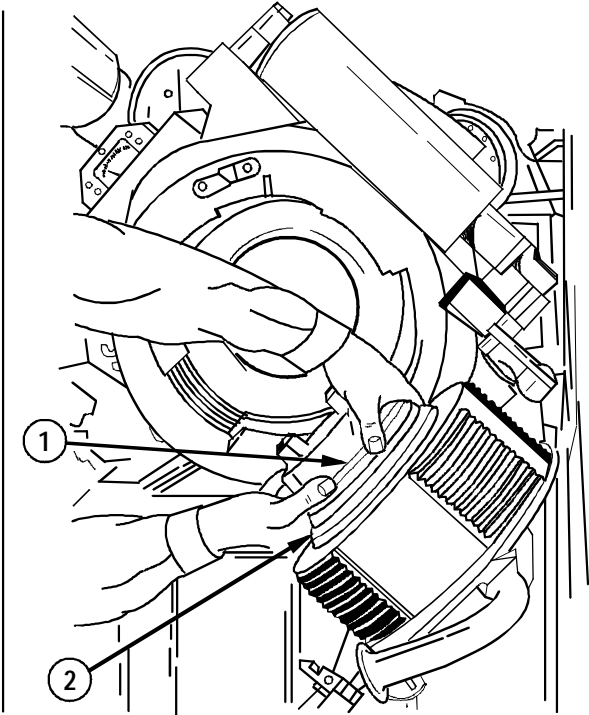
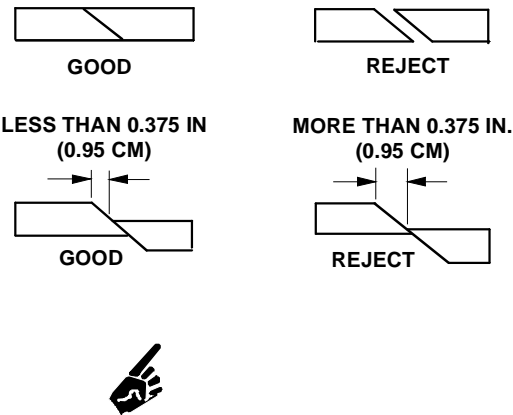
Table 3-1. Troubleshooting (cont)

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

CANNON—continued

4. BLOWBACK OCCURS AROUND BREECHBLOCK ASSEMBLY (cont)

Step 2. Check the front split ring (1) to be sure it is not cracked, bulged, broken, that there is contact at the split, and the spread on the split is no greater than 3/8 in. (0.95 cm).



Step 3. Check that the front split ring (1) is free to turn. Grasp front split ring and try to turn it in either direction.

- a. If front split ring does not turn, examine the split to ensure no foreign matter is present. Remove foreign matter from split if necessary.
- b. Turn front split ring so that the splits in front and rear split rings are 180 degrees apart. Make sure the split is not alined with a crack, gouge, or worn spot on the obturator pad (2).

**Table 3-1. Troubleshooting (cont)**

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
-------------	--------------------	-------------------

Step 4. Inspect obturator pad (p 3-26). The outside diameter of obturator pad must be smooth and show no damage.

Replace obturator pad (p 3-26) if indicated by inspection criteria.

Step 5. At next firing, check for blowback.

If blowback continues, notify unit maintenance.

**5. BREECH MECHANISM ASSEMBLY DOES NOT OPERATE FREELY.**

Step 1. Check for dirty threads on breechblock assembly or breech ring assembly.

Clean threads with CLP (item 4, appx D).

Step 2. Check for proper lubrication.

Follow lube instructions (notes 9 and 21, appx F).

Step 3. Check for damaged, dirty, or worn breech mechanism assembly components.

Disassemble breech mechanism assembly (p 3-16). Clean all parts, except obturator pad, with CLP (item 4, appx D) as necessary. Clean obturator pad with soap (item 26, appx D) and water. Replace authorized parts as necessary. For replacement of other parts, notify unit maintenance.

**RECOIL MECHANISM**

**6. OIL LEAKS FROM FRONT YOKE ASSEMBLY.**

No further inspection is required.

Notify unit maintenance.

**7. OIL RESERVE INDICATOR SHOWS OIL RESERVE HIGHER THAN 10 RESERVES OR LESS THAN 2 RESERVES.**

No further inspection is required.

Notify unit maintenance.

3-4. TROUBLESHOOTING PROCEDURES (cont)

Table 3-1. Troubleshooting (cont)

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
-------------	--------------------	-------------------

RECOIL MECHANISM—continued

8. OIL LEAKS FROM REPLENISHER CYLINDER ASSEMBLY.

No further inspection is required.

Notify unit maintenance.

9. OIL LEAKS FROM RECUPERATOR CYLINDER ASSEMBLY.

No further inspection is required.

Notify unit maintenance.

10. WEAPON DOES NOT RETURN TO BATTERY OR SLAMS INTO BATTERY.

No further inspection is required.

Notify unit maintenance, have them check recoil nitrogen pressure. If pressure is above 1350 psi, lower to 1200 psi.

NOTE

If the recoil continues to slam into battery, further troubleshooting is required. If nitrogen pressure was lowered during firing, pressure must be checked after the recoil mechanism has cooled.

If pressure is below 1100 psi, contact unit maintenance.

CARRIAGE

WARNING

If nitrogen pressure is below 800 psi, the recoil mechanism could slide out of battery and cause severe personal injury. Make sure personnel are clear of recoil path.

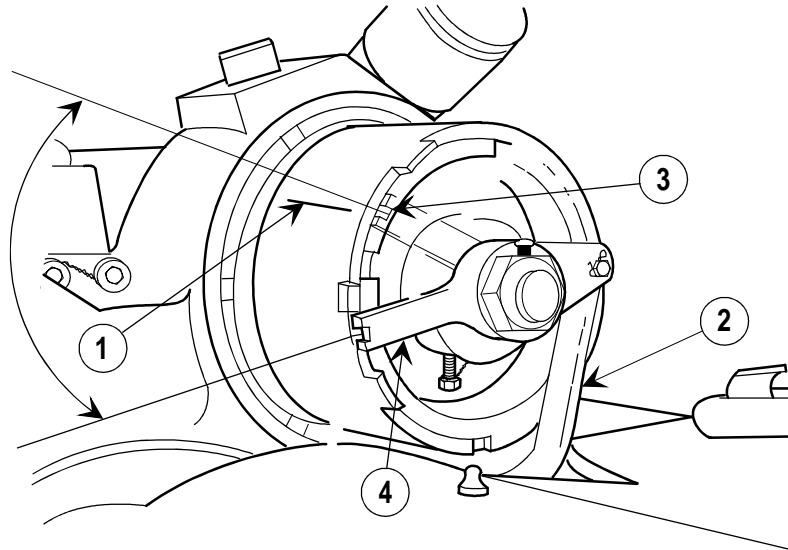
11. WEAPON IS DIFFICULT TO ELEVATE AND DEPRESS.

Check to see if there is equal effort between elevating and depressing the weapon.

- a. If there is not an equal effort between elevating and depressing the weapon, adjust the equilibrator (p 2-21).
- b. If problem continues, notify unit maintenance.

**Table 3-1. Troubleshooting (cont)**

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
-------------	--------------------	-------------------



**12. LENGTH OF RECOIL IS INCORRECT.**

- Step 1. To observe the 55-degree mark from the ground, right side of weapon, apply a chalk mark (1) on the outside diameter of the recuperator cylinder.
- Step 2. Elevate weapon to approximately 1025 mils and check for movement of the variable recoil rigid connecting link (2). The 55-degree (from vertical) scribe line (3) on end of recuperator cylinder should be within the notch on end of lever (4).

If the movement does not correspond to above description, notify unit maintenance.

**13. PLAY IN TRAVERSING HANDWHEEL EXCEEDS 1/12 TURN (3-1/8 IN. (7.94 CM)).**

No further inspection is required.

Notify unit maintenance.

**14. TOP CARRIAGE IS DIFFICULT TO TRAVERSE.**

Check for obstructions.

Notify unit maintenance.

**15. TRAVERSING MECHANISM WILL NOT HOLD TOP CARRIAGE IN CANT POSITION.**

No further inspection is required.

Notify unit maintenance.

3-4. TROUBLESHOOTING PROCEDURES (cont)

Table 3-1. Troubleshooting (cont)

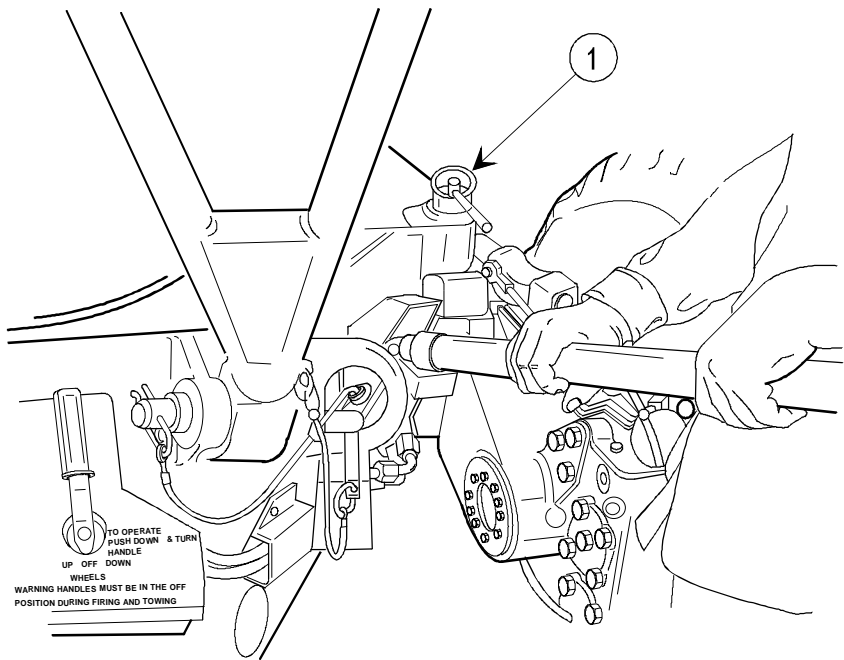
MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
-------------	--------------------	-------------------

CARRIAGE—continued

16. WHEELS WILL NOT MOVE UP OR DOWN.

Step 1. Check for engaged wheel lock handles (1).

Disengage wheel lock handle by pulling upward on wheel lock handle and turning inward.



NOTE

If both speed shift and wheel selector valves are turned to positions other than OFF, both systems will operate but at reduced speed. Make sure only the desired system is actuated to the UP or DOWN position.

If selector valves are not fully positioned to OFF, UP, or DOWN position, OHT will bypass selector valve, and wheels will not move up or down.

Step 2. Check to see if SPEED SHIFT lever (2) is in UP or DOWN position.

Lift up SPEED SHIFT lever and move to OFF position.

NOTE

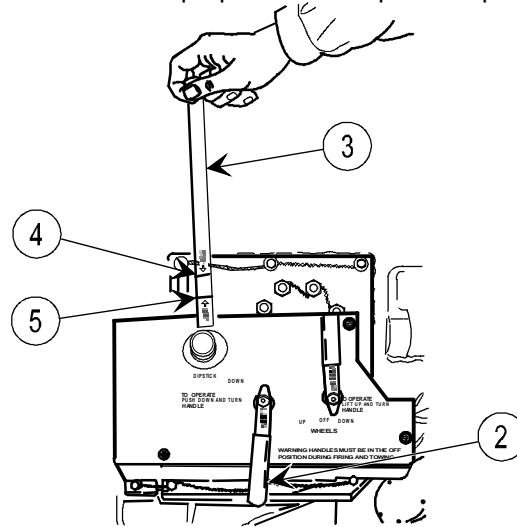
SPEED SHIFT and WHEELS lever must be in OFF position for correct fluid readings.

**Table 3-1. Troubleshooting (cont)**

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
-------------	--------------------	-------------------

Step 3. Check hydraulic fluid level in manifold assembly by unscrewing and removing dipstick (3). Hydraulic fluid must be present between FULL mark (4) and ADD mark (5).

- a. If hydraulic fluid is not between the FULL and ADD marks, fill with OHT (item 14, appx D).
- b. If hydraulic fluid is at proper level and problem persists, notify unit maintenance.



**17. WHEELS WILL NOT LOCK IN UP/DOWN POSITION.**

Step 1. Check road arm stops for buildup of foreign matter.

Clean with a rag (item 24, appx D).

Step 2. Exercise wheels up and down several times (p 2-5).

If problem continues, notify unit maintenance.

**18. WHEELS WOBBLE.**

Step 1. Check for loose wheel nuts.

Tighten wheel nuts using prime mover lug nut wrench. Notify unit maintenance to torque wheel nuts as soon as possible.

Step 2. Check for damaged wheel or hub.

If damaged, notify unit maintenance.

3-4. TROUBLESHOOTING PROCEDURES (cont)

Table 3-1. Troubleshooting (cont)

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
-------------	--------------------	-------------------

CARRIAGE—continued

19. SPEED SHIFT CYLINDER ASSEMBLY CANNOT BE EXTENDED OR RETRACTED.

NOTE

If both speed shift and wheel selector valves are turned to positions other than OFF, both systems will operate but at reduced speed. Make sure only the desired system is activated in the UP or DOWN position.

If selector valves are not fully positioned to OFF, UP, or DOWN position, OHT will bypass selector valve, and speed shift will not move up or down.

Step 1. Check to see if WHEELS lever (1) on manifold assembly is in UP or DOWN position.

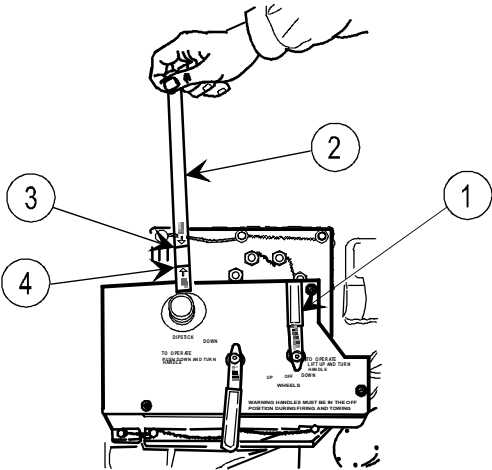
Push down WHEELS lever and move to OFF position.

NOTE

SPEED SHIFT and WHEEL levers must be in OFF position for correct fluid readings.

Step 2. Check hydraulic fluid level in manifold assembly by unscrewing and removing dipstick (2). Hydraulic fluid must be present between FULL mark (3) and ADD mark (4).

- a. If hydraulic fluid is not between the FULL and ADD marks, fill with OHT (item 14, appx D).
- b. If hydraulic fluid is at proper level and problem persists, notify unit maintenance.



**Table 3-1. Troubleshooting (cont)**

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
-------------	--------------------	-------------------

## 20. BRAKES ARE LOCKED.

- Step 1. Check to be sure the service hose assembly (1) and the emergency hose assembly (2) are hooked up as shown.

Hook up hose assemblies correctly.

- Step 2. Check to see if service and emergency air line cutout cocks on prime mover are fully open.

Open service air line cutout cock (3) and emergency air line cutout cock (4).

- Step 3. Check condition of rubber seals in hose couplings.

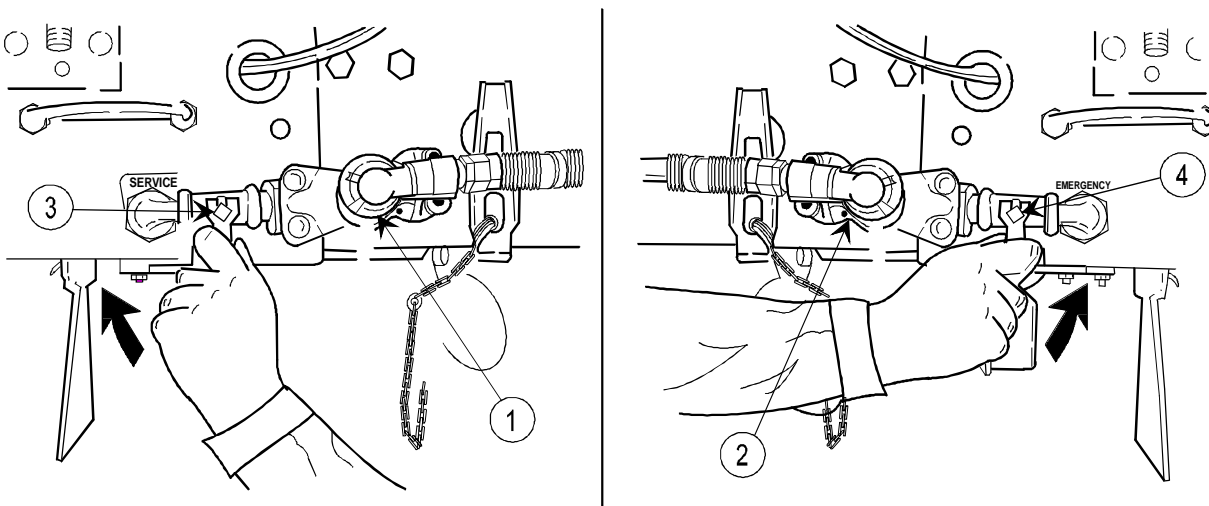
If bad, notify unit maintenance.

- Step 4. Check for inadequate air source at prime mover.

Refer to prime mover TM for corrective procedures.

- Step 5. Test brakes to see if they are still locked.

If problem continues, notify unit maintenance.

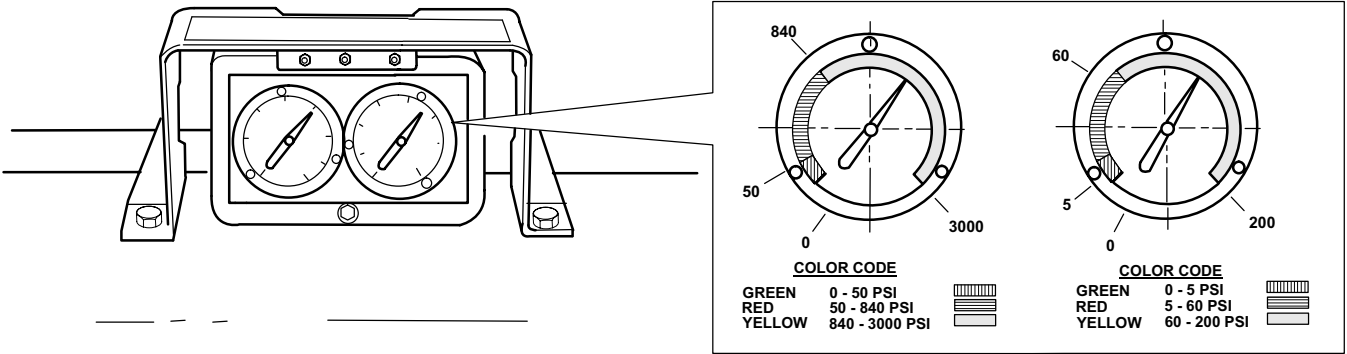


3-4. TROUBLESHOOTING PROCEDURES (cont)

Table 3-1. Troubleshooting (cont)

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
-------------	--------------------	-------------------

CARRIAGE—continued



NOTE

Under conditions stated in step 21, the indicator pin would be extended on howitzers that have not been modified.

21. BOTH GAGES INDICATE PRESSURE WITHOUT PRIME MOVER BRAKES APPLIED.

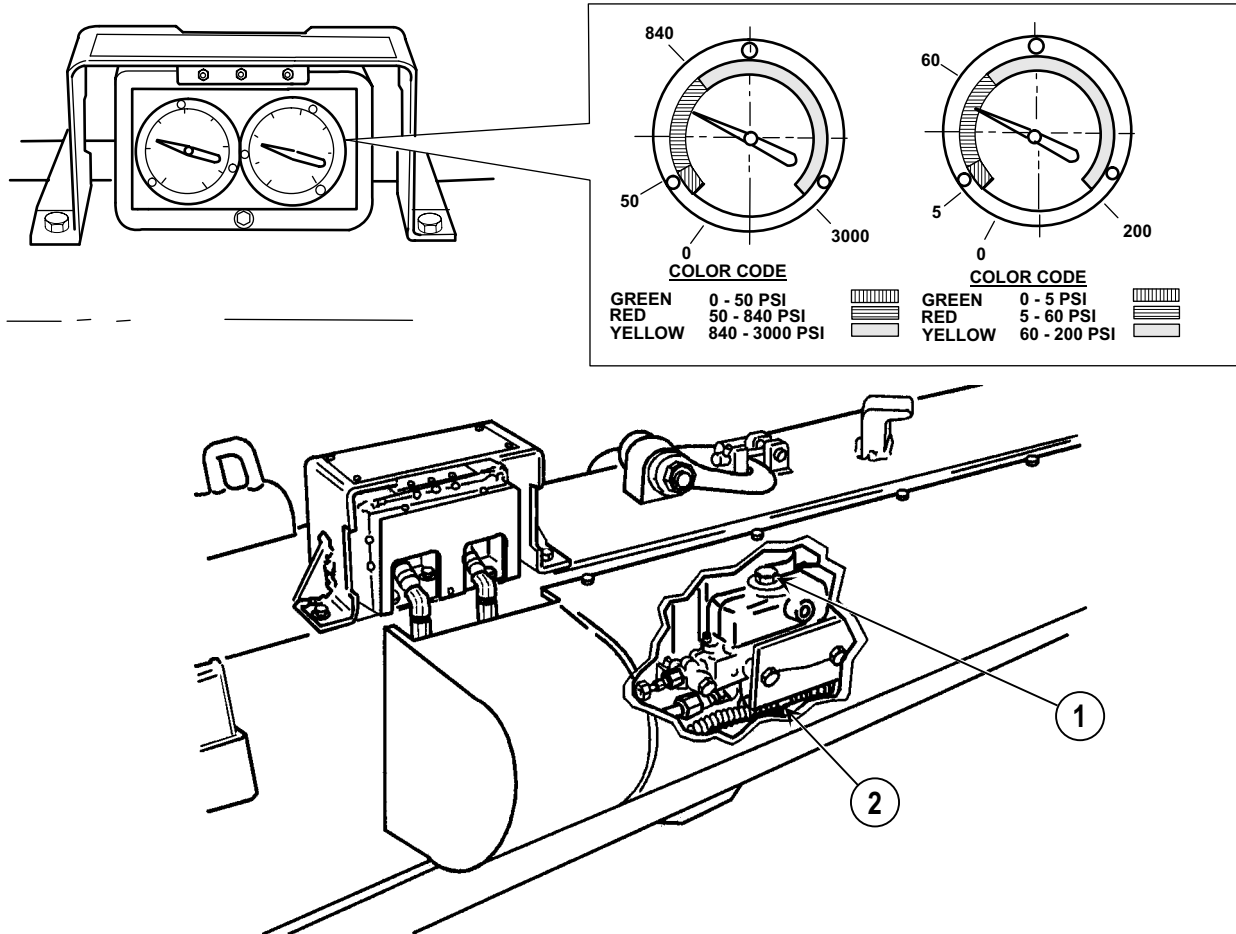
- Step 1. Check that emergency hose assembly is connected to proper coupling and that cutout cock is open.
- Step 2. Check for inadequate air source at prime mover.
- Step 3. Check for leaks in hose assemblies.

22. BRAKES ARE WEAK (GAGES ARE IN THE RED).

- Step 1. Check for inadequate air source at prime mover. Allow prime mover to charge air tanks.  
  
Refer to prime mover TM for corrective procedures if adequate pressure cannot be reached.
- Step 2. Check for low brake fluid level by removing fluid filler cap (1) from hydraulic reservoir (2). Fluid should be about 3/4 inch (1.91 cm) from top of the filling hole.  
  
If brake fluid level is low, fill as required with brake fluid (item 2, appx D).
- Step 3. Check to see that drain cock is closed.  
  
If open, close.

Table 3-1. Troubleshooting (cont)

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
-------------	--------------------	-------------------



### FIRE CONTROL EQUIPMENT

#### 23. MOISTURE IS IN FIRE CONTROL EQUIPMENT.

No further inspection is required.

Notify unit maintenance.



**WARNING**  
Put fire control equipment in plastic bag (item 1, appx D), wash hands, and follow radioactive materials procedures on inside front cover of this manual. Notify unit maintenance and the radiological safety officer.

3-4. TROUBLESHOOTING PROCEDURES (cont)

Table 3-1. Troubleshooting (cont)

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
-------------	--------------------	-------------------

FIRE CONTROL EQUIPMENT—continued

24. COUNTERS, LEVEL VIALS, OR RETICLES ARE NOT ILLUMINATED.

Step 1. Perform no further test or inspection for radioactive tritium H<sub>3</sub> illuminated equipment.  
Notify unit maintenance and the radiological safety officer.

Step 2. Check position and operation of ON/OFF delay switch on ERLS battery-powered LED illuminated equipment with red pushbutton, then recheck illumination.

If operating switch (when present) does not solve malfunction, ensure batteries are installed correctly according to the diagram on the battery box.



WARNING

Read and follow all warnings in WARNING SUMMARY.  
Pay careful attention to those about batteries.



Step 3. Replace batteries in ERLS battery-powered LED illuminated equipment and recheck.

- a. Unscrew cap on battery box.
- b. Remove battery. If battery will not slide out, use magnet in center of battery cap to remove.
- c. Replace battery according to the diagram on the battery box.
- d. Replace battery cap.

If replacing batteries does not solve malfunction, notify unit maintenance.

25. FIRE CONTROL KNOBS DO NOT TURN FREELY.

No further inspection is required.

Notify unit maintenance.

WARNING



Put fire control equipment in plastic bag (item 1, appx D), wash hands, and follow radioactive materials procedures on the inside front cover of this manual. Notify unit maintenance and the radiological safety officer.

26. COUNTER DIALS, RETICLES, OR LEVEL VIALS ARE BROKEN.

Perform no further test or inspection.

Notify unit maintenance and the radiological safety officer if equipped with non-ERLS Fire Control.

**Table 3-1. Troubleshooting (cont)**

<b>MALFUNCTION</b>	<b>TEST OR INSPECTION</b>	<b>CORRECTIVE ACTION</b>
27. FITTED PARTS OF FIRE CONTROL EQUIPMENT ARE LOOSE.		
	No further test or inspection is required.	Notify unit maintenance.
28. M1A2 COLLIMATOR RETICLE IMAGE IS NOT SHARP.		
Step 1.	Check that M137/M137A3 pantel is providing a clear image and is not dirty, wet, or fogged.	<ul style="list-style-type: none"> <li>a. Clean, if necessary, with lens cleaning compound (item 6, appx D).</li> <li>b. If cleaning does not solve the malfunction, notify unit maintenance.</li> </ul>
Step 2.	Check to see if M137/M137A3 pantel parallax shield is incorrectly positioned for best use of available light.	<ul style="list-style-type: none"> <li>a. Adjust M137/M137A3 pantel parallax shield as necessary.</li> <li>b. If adjustment does not solve the malfunction, notify unit maintenance.</li> </ul>
Step 3.	Check to see if collimator lenses are dirty, wet, or fogged.	<ul style="list-style-type: none"> <li>a. Clean, if necessary, with lens cleaning compound (item 6, appx D).</li> <li>b. If moisture or fogging is present on inside of collimator, notify unit maintenance.</li> </ul>

## Section III. MAINTENANCE PROCEDURES

### Section Index

<b>Paragraph</b>	<b>Page</b>
3-5. General.....	3-15

### 3-5. GENERAL

**a. Responsibility.** The crew, supervised by the chief of section, is responsible for crew maintenance of the M198 howitzer.

**b. Repairs.** Repairs will be limited to those listed in this manual.

**c. Tools.** Appendix B lists tools required to maintain the weapon.

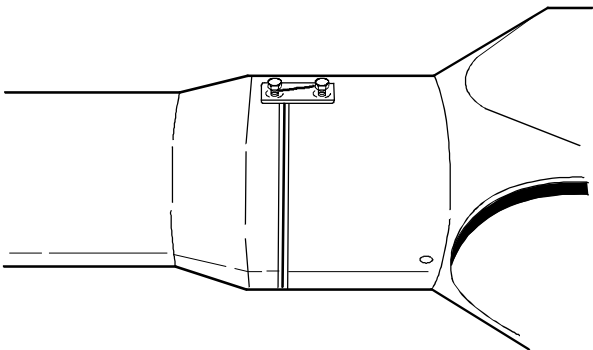
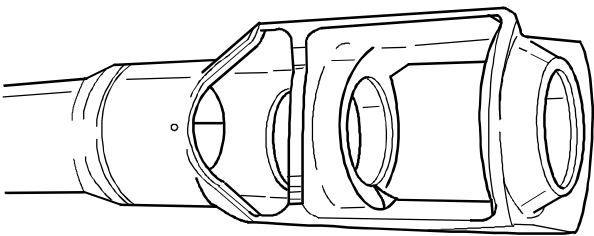
**d. Inspection and Services.** Inspect and service according to the following maintenance procedures. The PMCS table (p 2-10) lists the tasks which affect operational readiness; perform these tests in the interval indicated. In addition to the PMCS tasks, these procedures include other inspections and services which do not affect operational readiness but which keep the howitzer in top working order.

Section IV. CANNON MAINTENANCE PROCEDURES

Paragraph		Page
3-6.	Cannon Maintenance .....	3-16
3-7.	Breech Mechanism Assembly Maintenance .....	3-16
3-8.	Firing Mechanism Assembly Maintenance.....	3-17
3-9.	Firing Mechanism Block Assembly Maintenance .....	3-22
3-10.	Housing Assembly Maintenance .....	3-25
3-11.	Spindle Assembly and Parts Maintenance.....	3-26
3-12.	Breech Counterbalance Maintenance .....	3-30
3-13.	Breechblock Assembly Maintenance .....	3-30

3-6. CANNON MAINTENANCE

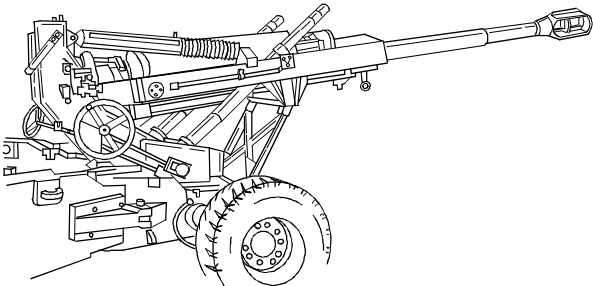
INSPECTION



Inspect for moisture, rust, corrosion, foreign matter, and presence of solid film lubricant. Clean and lubricate (notes 6, 18, and 23, appx F).

NOTE

For nonfiring periods clean and lubricate cannon tube and breech mechanism assembly weekly.



3-7. BREECH MECHANISM ASSEMBLY MAINTENANCE

SERVICING/REPAIR

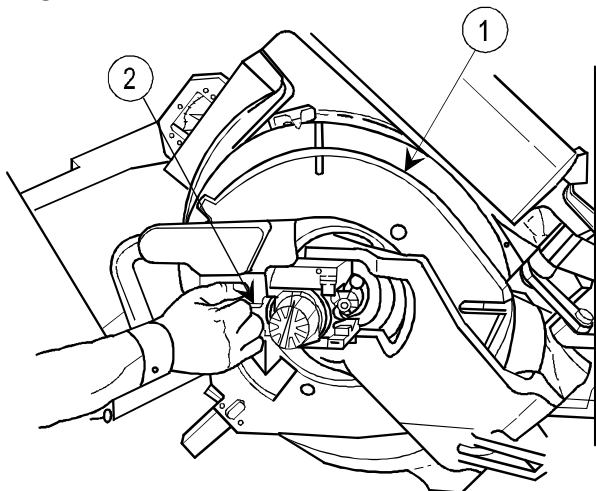
NOTE

Disassemble/reassemble for cleaning and inspecting only. Crew is authorized to replace firing mechanism and firing mechanism block assembly.

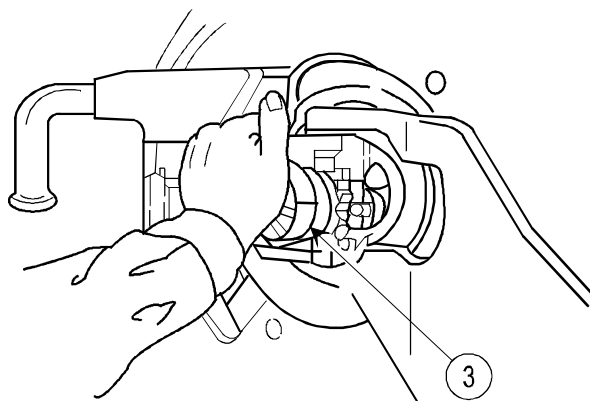
- 1 Clean any foreign material or burrs from sliding surfaces weekly. Lubricate as necessary (notes 9 and 21, appx F).
- 2 Repair by replacing authorized items (appx B).

### 3-8. FIRING MECHANISM ASSEMBLY MAINTENANCE

#### REMOVAL

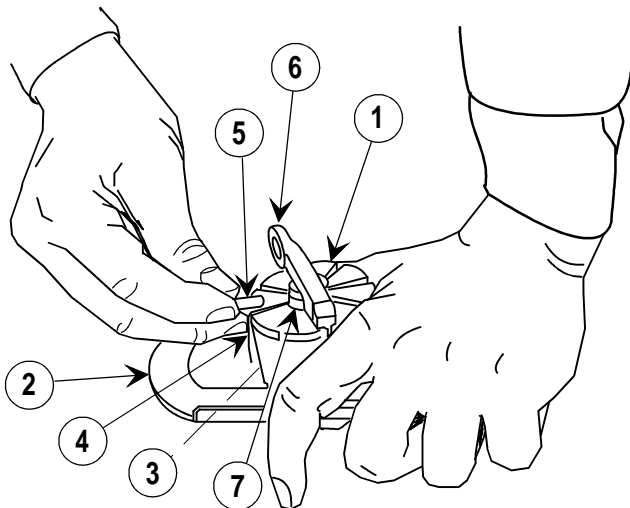


- 1 With breechblock assembly (1) closed, move firing mechanism block assembly (2) to the left.

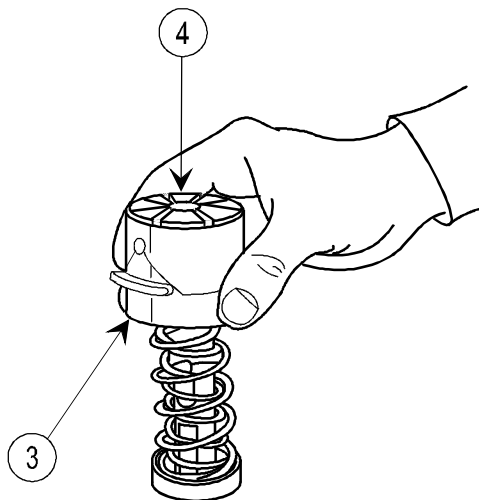


- 2 Press in on firing mechanism (3) and turn it approximately 1/4 turn clockwise to remove.

#### DISASSEMBLY



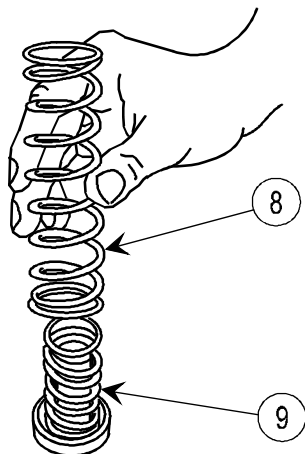
- 1 Place firing mechanism (1) on solid surface. Place M18 fuze setter wrench (2) over the case (3) and follower (4) and depress until pin (5) can be removed from lanyard lever (6) and yoke (7). Release spring tension slowly. Lift off lanyard lever.



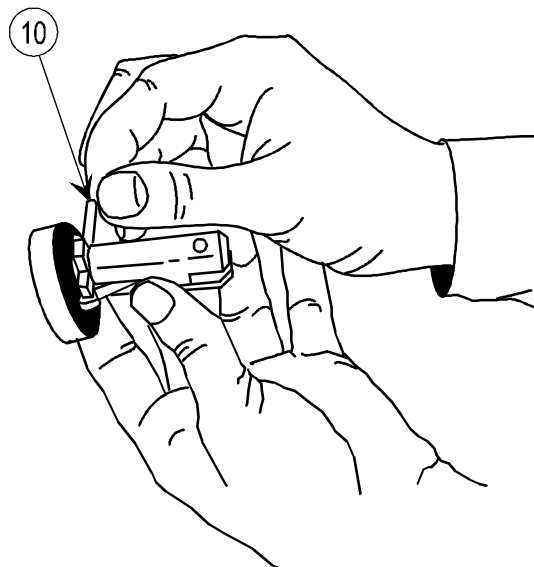
- 2 Remove and separate case (3) and follower (4).

### 3-8. FIRING MECHANISM ASSEMBLY MAINTENANCE (cont)

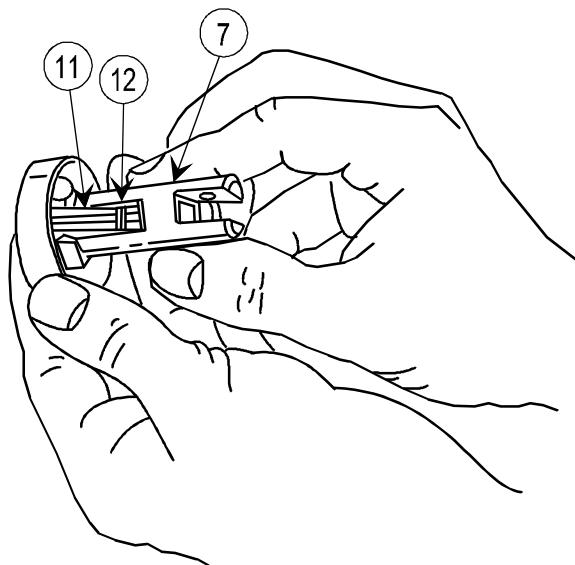
#### DISASSEMBLY (cont)



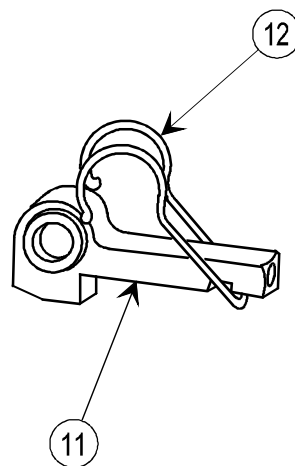
3 Remove cup spring (8) and yoke spring (9).



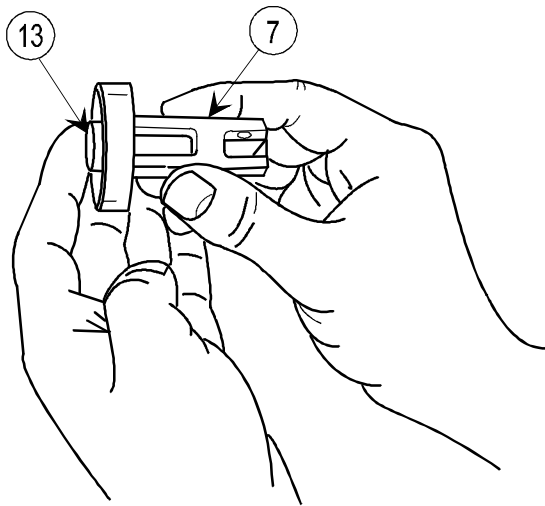
4 Remove sear pin (10).



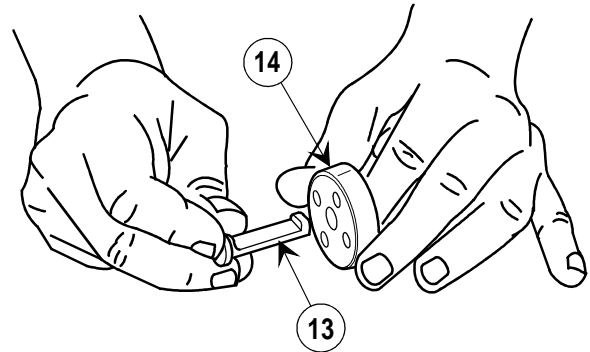
5 Remove sear (11) with firing hammer spring (12) from yoke (7).



6 Separate sear (11) and firing hammer spring (12).

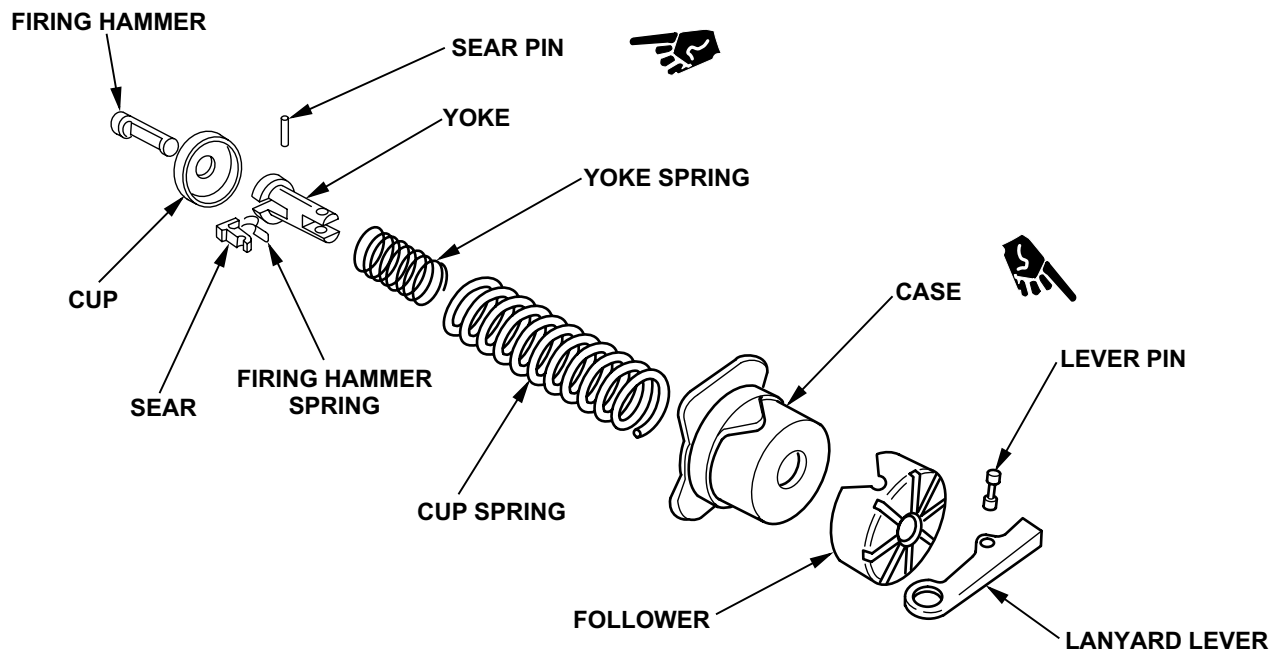


7 Remove yoke (7) from firing hammer (13).



8 Remove firing hammer (13) from cup (14).

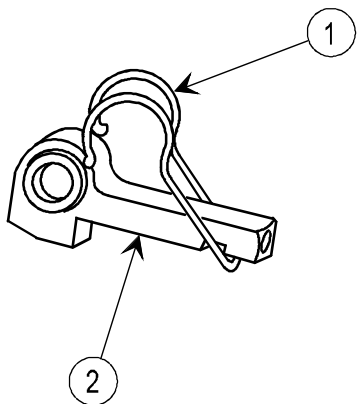
## SERVICING AND INSPECTION



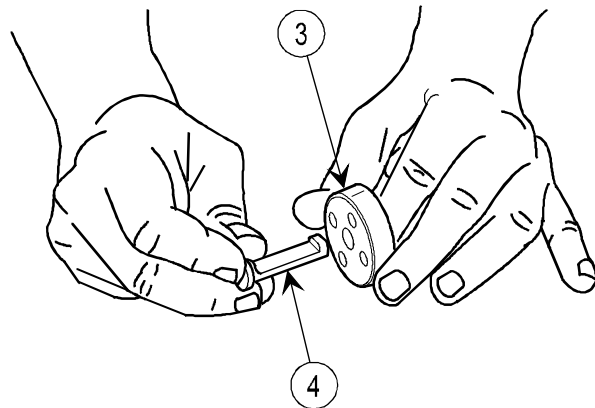
- 1 Clean and lubricate all parts (notes 11 and 34, appx F).
- 2 Inspect for damaged or worn parts. If any defective parts are found, replace entire firing mechanism assembly (item 18, appx B) and notify unit maintenance of defective assembly.

### 3-8. FIRING MECHANISM ASSEMBLY MAINTENANCE (cont)

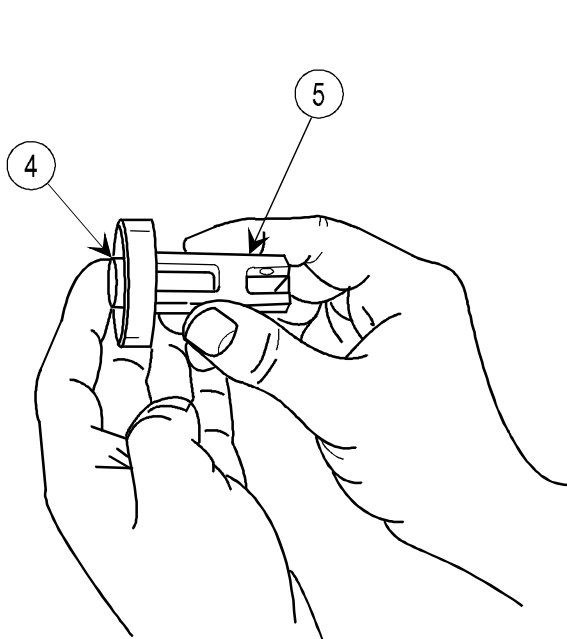
#### REASSEMBLY



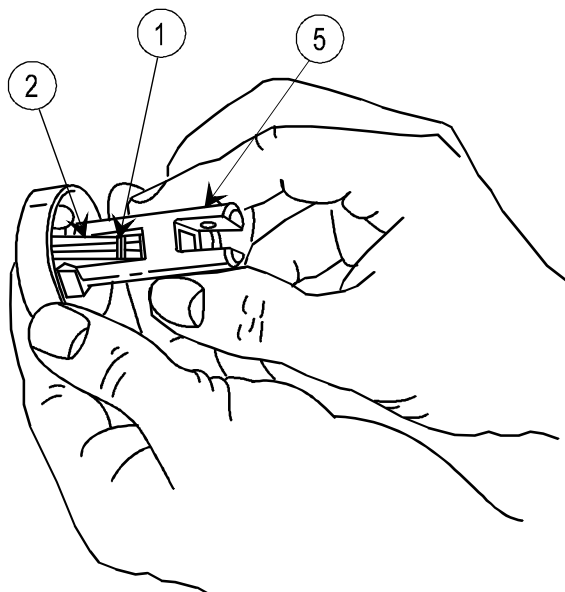
1 Put firing hammer spring (1) on sear (2).



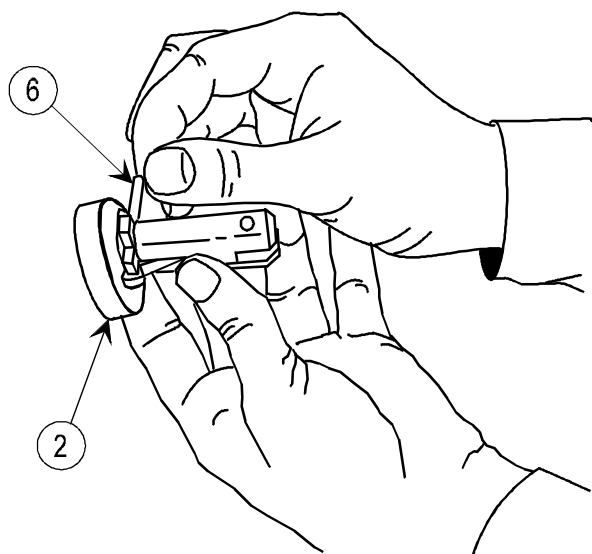
2 Place cup (3) on firing hammer (4).



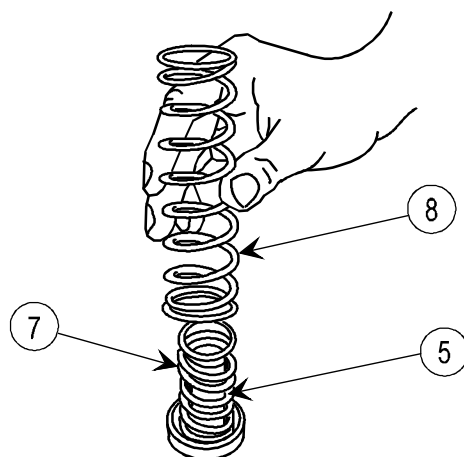
3 Place yoke (5) on firing hammer (4).



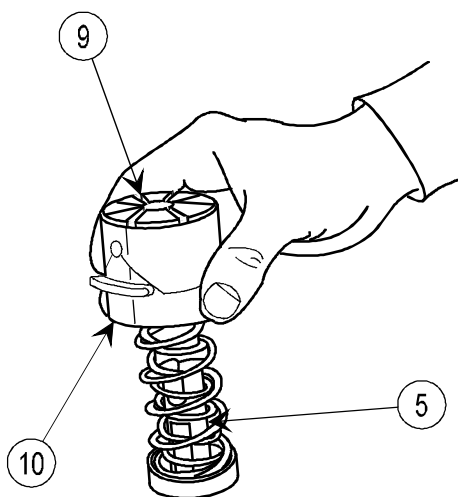
4 Place sear (2) with firing hammer spring (1) into yoke (5).



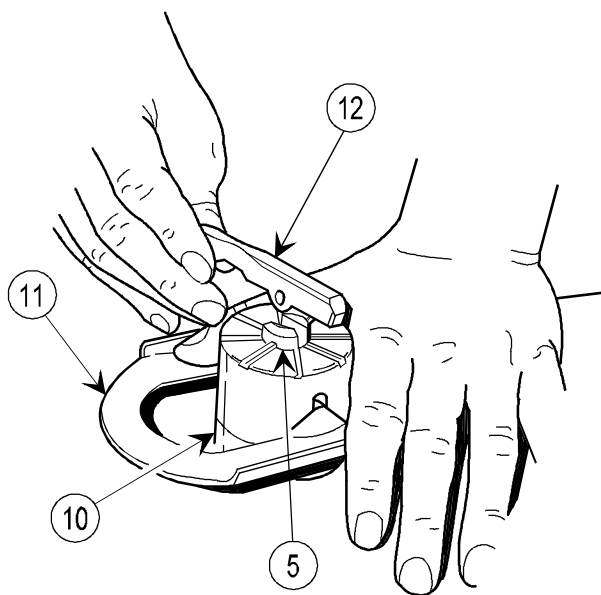
**5** Secure sear (2) with sear pin (6).



**6** Place yoke spring (7) on yoke (5), and place cup spring (8) over yoke spring.



**7** Slide follower (9) over case (10), and place over assembled yoke (5).

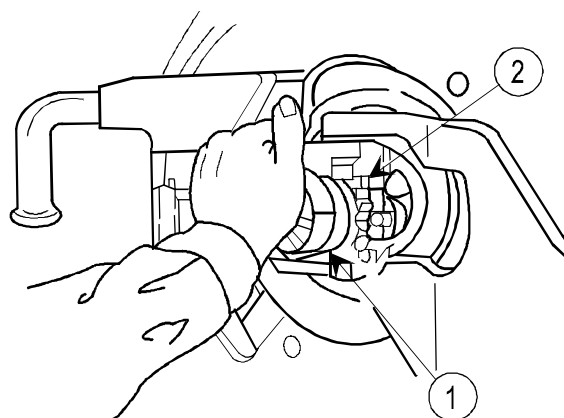
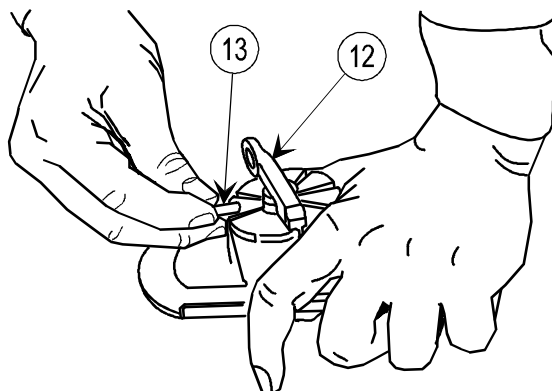


**8** With assembled parts on solid surface, put M18 fuze setter wrench (11) over case (10), depress, and hold down. Place lanyard lever (12) in yoke (5).

### 3-8. FIRING MECHANISM ASSEMBLY MAINTENANCE (cont)

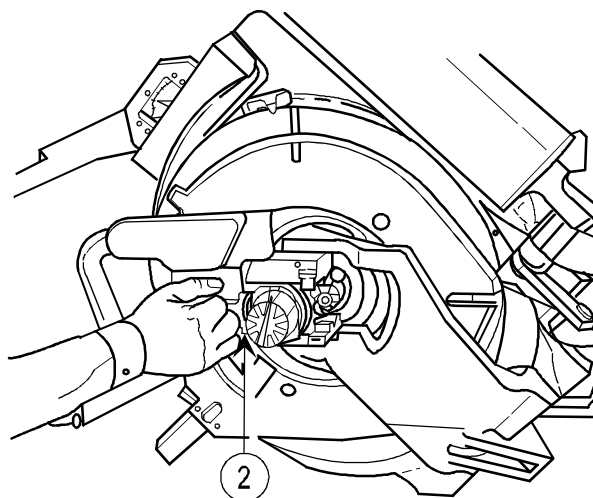
#### REASSEMBLY (cont)

- 9 Secure lanyard lever (12) with pin (13).



#### INSTALLATION

- 1 Place firing mechanism (1) in firing mechanism block assembly (2), press in, turn it 1/4 turn counterclockwise, and release.
- 2 Slide firing mechanism block assembly (2) to the right.



### 3-9. FIRING MECHANISM BLOCK ASSEMBLY MAINTENANCE

#### NOTE

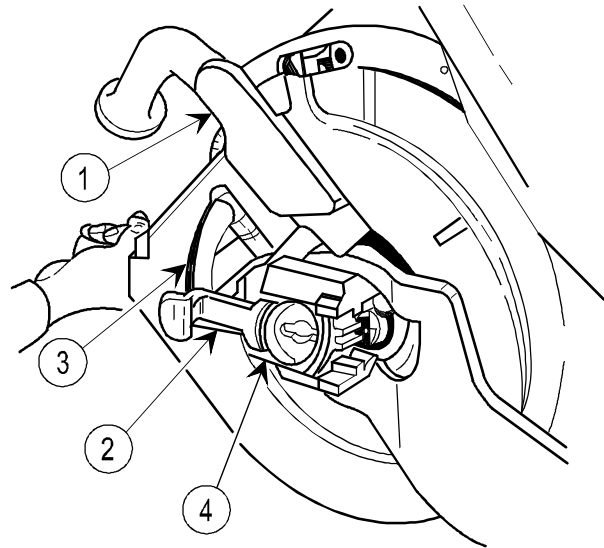
Procedures are given for cleaning and inspecting only. Crew is only authorized to replace firing pin, firing mechanism block assembly, and firing mechanism.

## REMOVAL

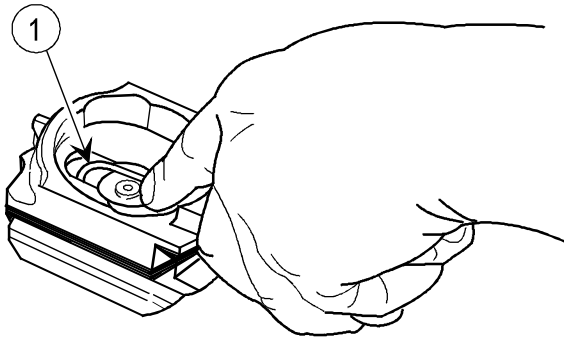
### NOTE

If only the firing pin is to be removed, do not follow steps 1 and 2.

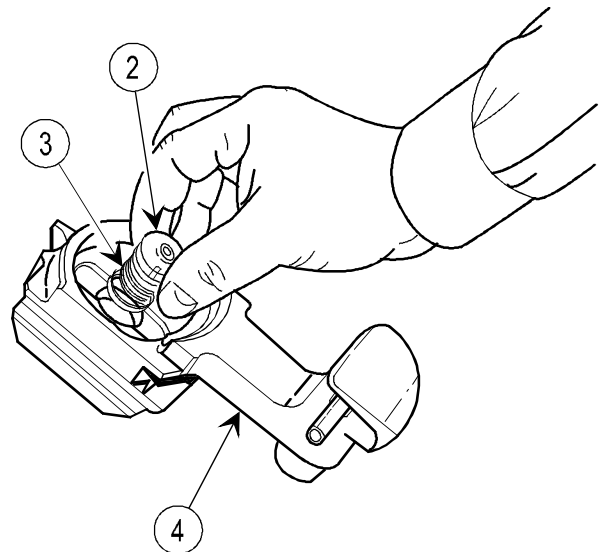
- 1 Rotate breechblock assembly (1) until slot (2) is in the horizontal position.
- 2 Pull out on spring pin (3) and slide firing mechanism block assembly (4) to the right and remove.



## DISASSEMBLY



- 1 Remove the firing pin retainer (1).

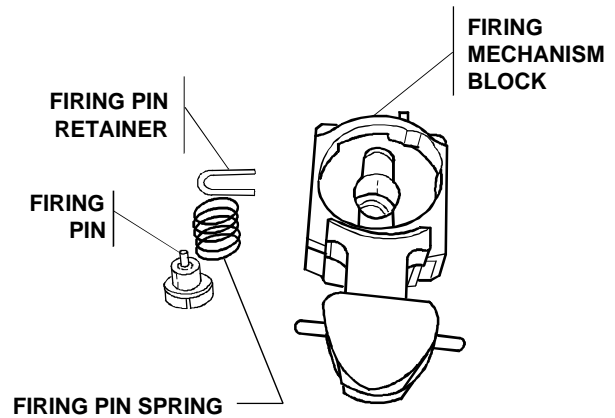


- 2 Remove firing pin (2) and firing pin spring (3) from firing mechanism block (4).

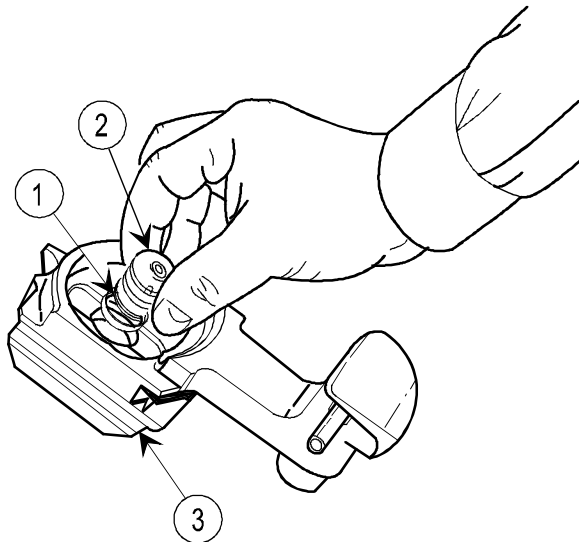
### 3-9. FIRING MECHANISM BLOCK ASSEMBLY MAINTENANCE (cont)

#### SERVICING AND INSPECTION

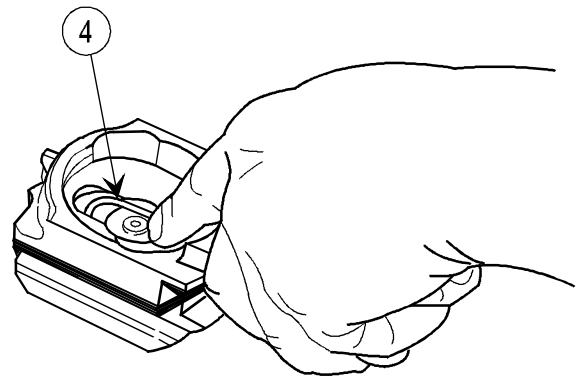
- 1 Clean and lubricate all parts (notes 10 and 35, appx F).
- 2 Inspect each part for damage. If firing pin is defective, replace (item 36, appx B). If any other parts are damaged or missing, replace entire firing mechanism block assembly (item 19, appx B).



#### REASSEMBLY

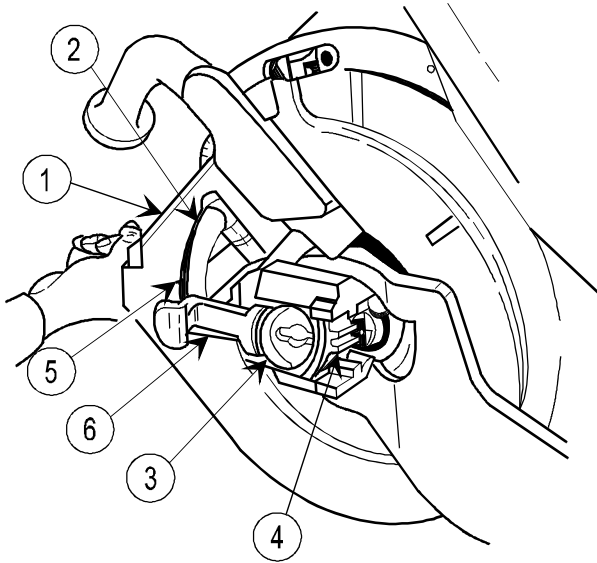


- 1 Install firing pin spring (1) and firing pin (2) into firing mechanism block (3).

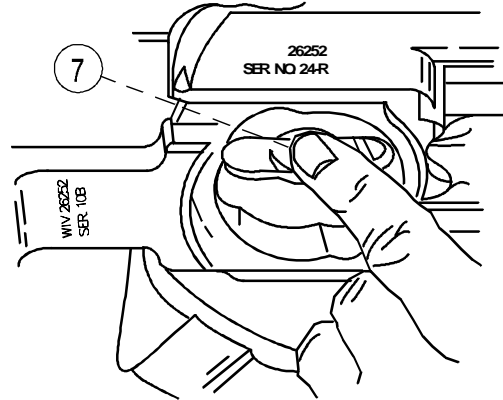


- 2 Install firing pin retainer (4).

## INSTALLATION



- 1 Rotate breechblock assembly (1) until slot (2) is in the horizontal position. Make sure extractor (3) is up against the spindle assembly (4).
- 2 Pull out on spring pin (5), install firing mechanism block assembly (6), and slide it to the left.

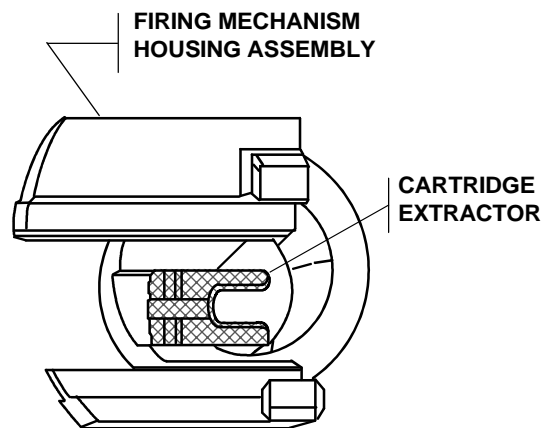


- 3 Test action of firing pin (7) by pushing in on rear of firing pin. Release firing pin; it should return with spring action.

## 3-10. HOUSING ASSEMBLY MAINTENANCE

### SERVICING AND INSPECTION

- 1 Remove housing assembly (p 3-26), and inspect for nicks, dirt, burrs, or missing parts. Notify unit maintenance if parts are missing.
- 2 Clean and lubricate all surfaces, including cartridge extractor (note 12, appx F).



### 3-11. SPINDLE ASSEMBLY AND PARTS MAINTENANCE

#### CAUTION

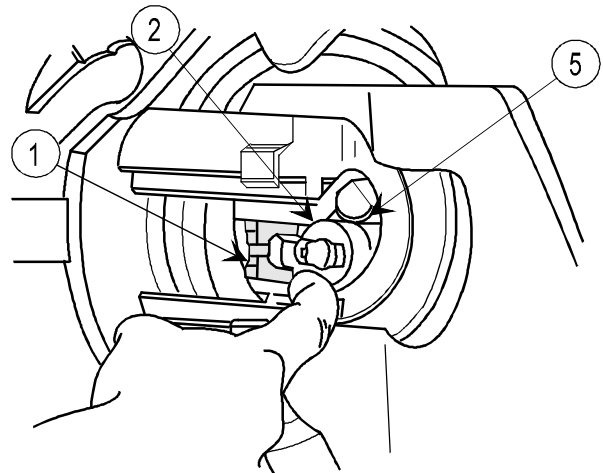
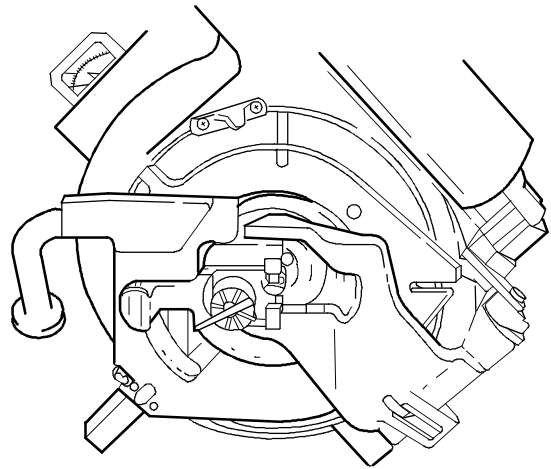
It is not advisable to park or store howitzer with the spindle assembly or parts removed. However, if local procedures dictate the removal of the spindle assembly and parts from the breechblock assembly during storage or parking, exercise caution in closing the breechblock assembly to prevent rotation beyond the fully closed position and possible breaking of the breechblock lever, as well as shearing bolts that secure cam plate to the breechblock.

#### NOTE

Remove/install for cleaning and inspecting only. Crew is only authorized to replace obturator pad and front split ring.

#### REMOVAL

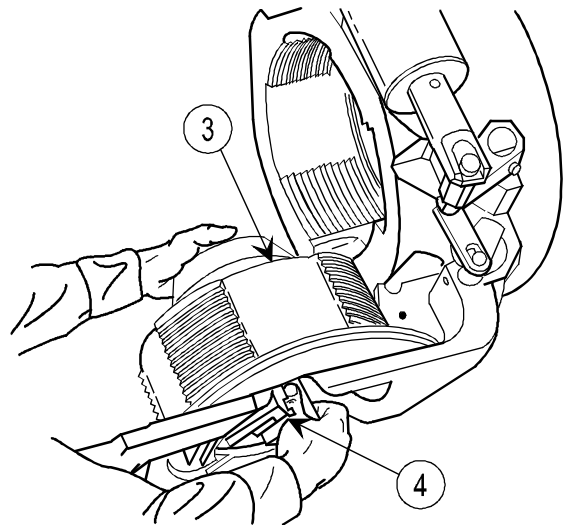
- 1 Lift cartridge extractor (1) away from spindle assembly (2) (toward you).

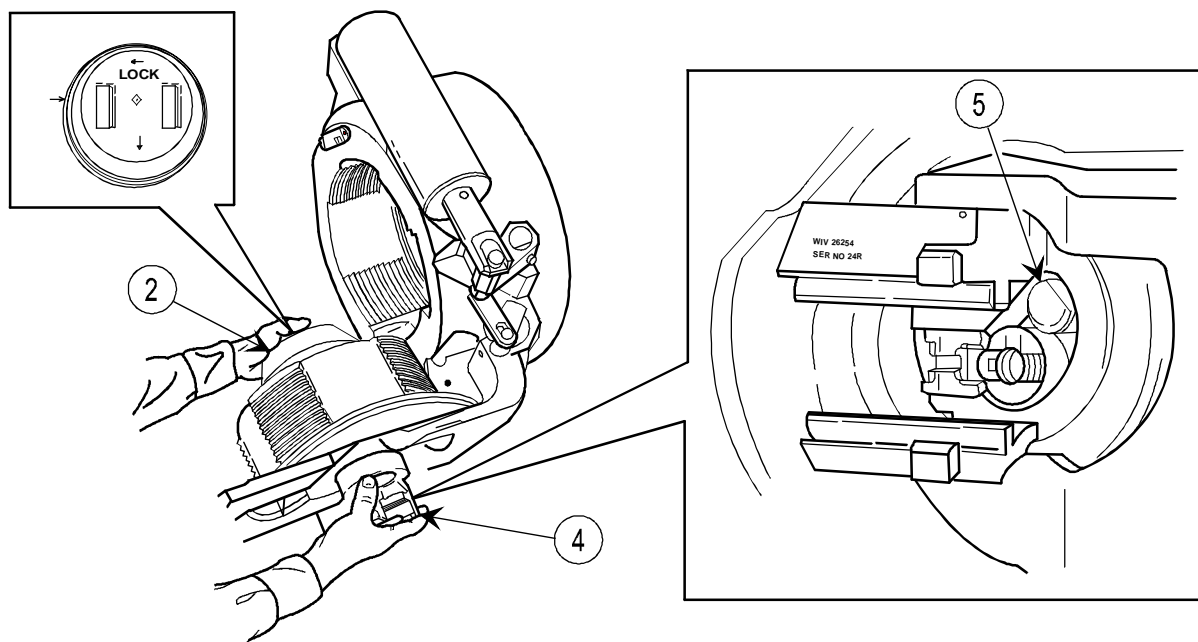


#### WARNING

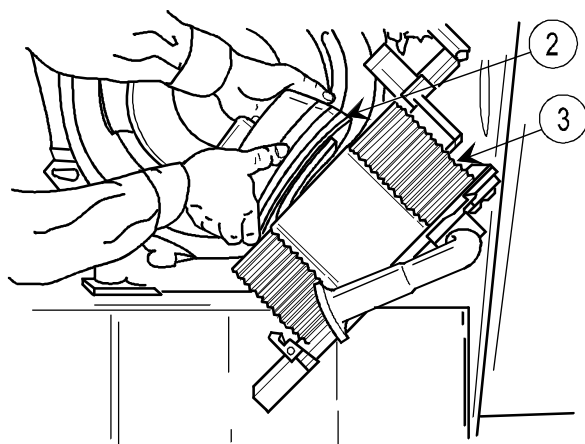
Use caution not to pinch/smash fingers when depressing/locking the plunger.

- 2 With breechblock assembly (3) open, support housing assembly (4) and depress plunger (5) in end of spindle assembly (2).

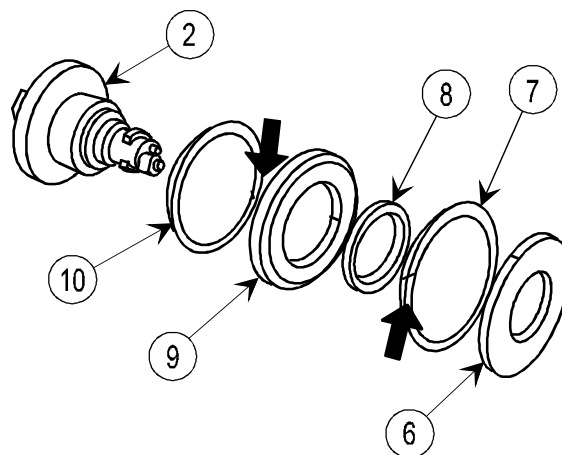




- 3** With plunger (5) depressed, continue to hold onto housing assembly (4) and turn spindle assembly (2) clockwise (opposite direction of arrow on obturator spindle assembly) until housing assembly (4) can be removed.



- 4** Lift spindle assembly (2) off breechblock assembly (3).



- 5** Remove disk (6), rear split ring (7), inner ring (8), obturator pad (9), and front split ring (10) from spindle assembly (2).

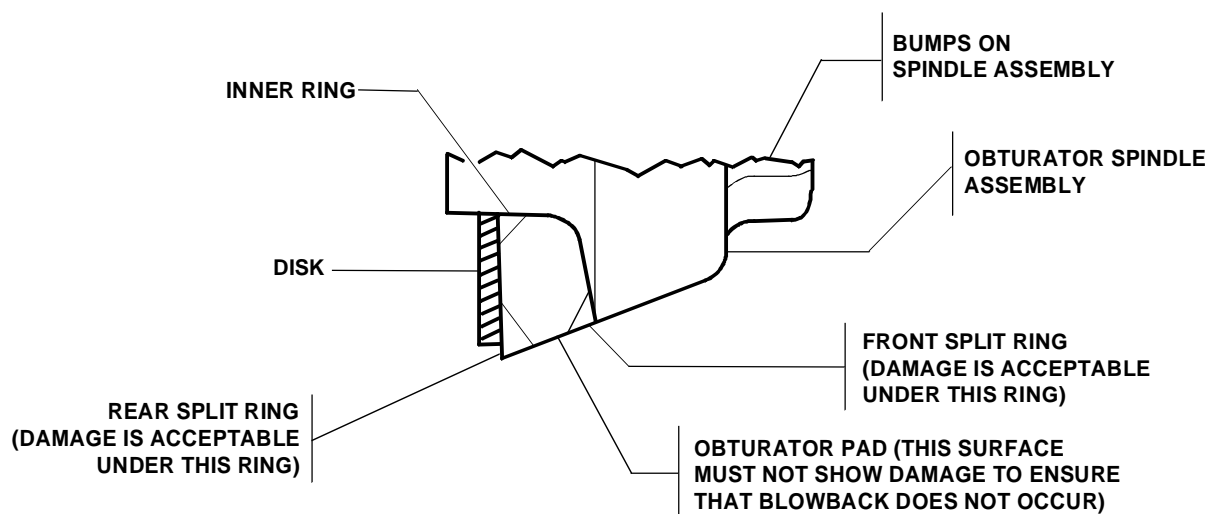
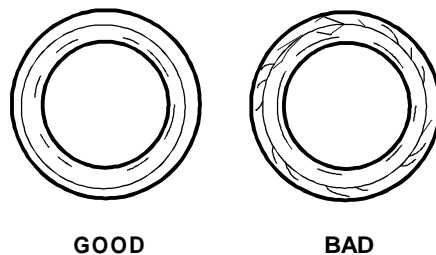
### 3-11. SPINDLE ASSEMBLY AND PARTS MAINTENANCE (cont)

#### SERVICING AND INSPECTION

##### CAUTION

Do not clean obturator pad with CLP. Use soap (item 26, appx D) and water.

- 1 Inspect obturator pad for evidence of leakage past sealing surfaces of obturator pad.



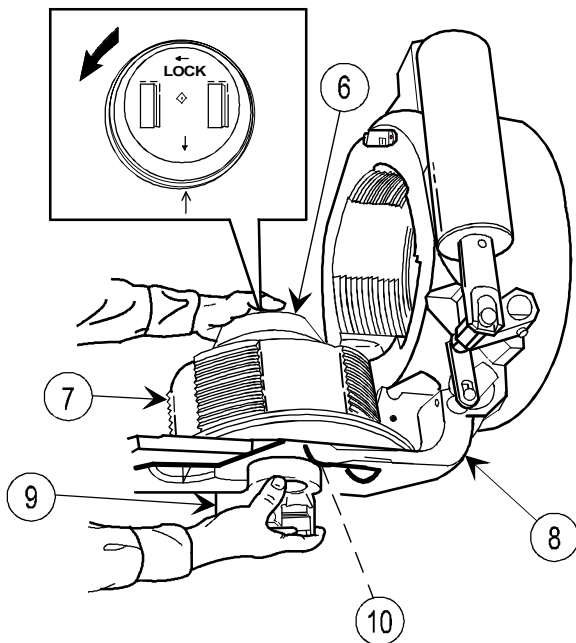
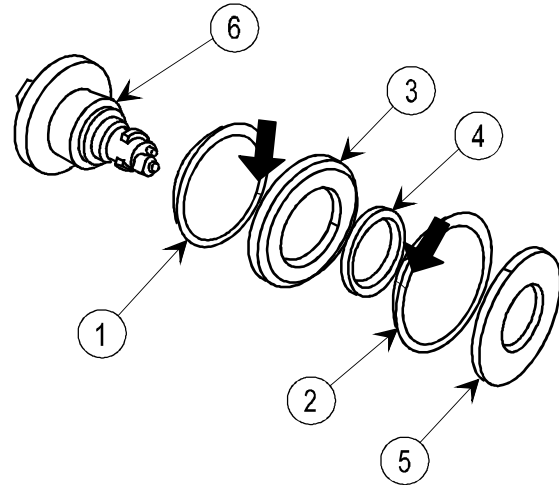
- 2 Gouges in the surface between obturator pad and split ring mating surfaces are normal and will not hinder operation unless gouging is over 50 percent of obturator pad.
- 3 If there is indication of leakage past breech ring assembly, replace obturator pad.
- 4 Inspect spindle assembly and split rings for burrs or cracks. If burrs or cracks are present, notify unit maintenance.

## INSTALLATION

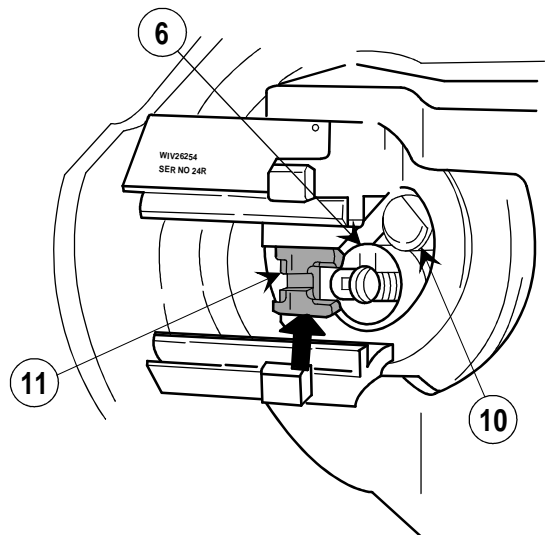
### NOTE

When installing split rings, be sure splits on front split ring (1) and rear split ring (2) are opposite (180 degrees apart).

- 1 Install front split ring (1), obturator pad (3), inner ring (4), rear split ring (2), and disk (5) on spindle assembly (6). Ensure splits on rings (1) and (2) are 180 degrees apart.



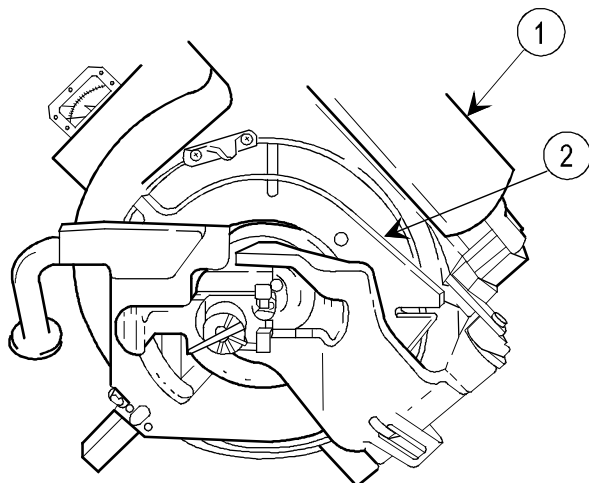
- 2 Place assembled spindle assembly (6) into breechblock assembly (7) and carrier (8) so that arrow on spindle assembly lines up with arrow on breechblock assembly.
- 3 While supporting housing assembly (9), turn spindle assembly (6) counterclockwise (in direction of arrow on spindle assembly) until plunger (10) on end of spindle assembly (6) is fully locked.



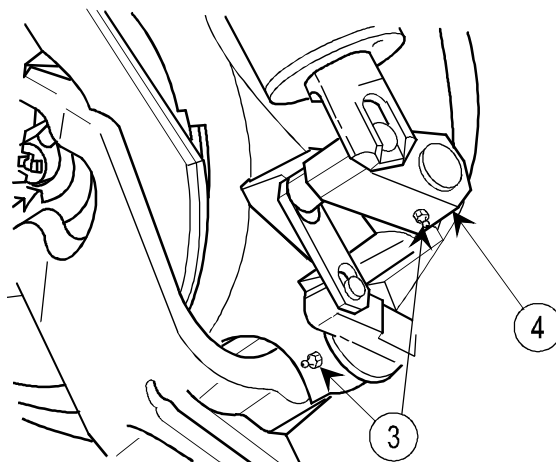
- 4 Close breechblock assembly and make sure plunger (10) on spindle assembly (6) is in the fully locked position.
- 5 Push cartridge extractor (11) toward spindle assembly (6).

### 3-12. BREECH COUNTERBALANCE MAINTENANCE

#### INSPECTION AND SERVICING



- 1 Check operation of breech counterbalance (1) by opening and closing breechblock assembly (2). Breechblock assembly should open and close with equal effort. If not, notify unit maintenance.



- 2 Lubricate two lube fittings (3) on breech hinge pin assembly (4) (note 8, appx F).

### 3-13. BREECHBLOCK ASSEMBLY MAINTENANCE

#### WARNING

Breechblock assembly weighs approximately 128 pounds (58.06 kg). Use care when removing or installing.

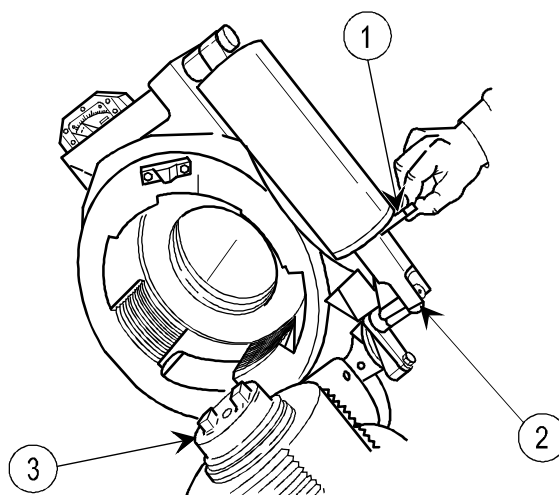
#### NOTE

Remove/install for cleaning and inspecting only.

#### REMOVAL

#### WARNING

For personal safety, ensure pin is installed in counterbalance.

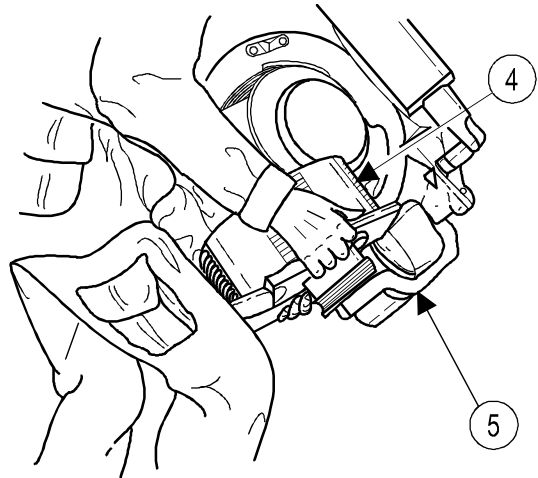


- 1 Install pin (1) (item 37, appx B) in breech counterbalance (2).
- 2 Remove spindle assembly (3).

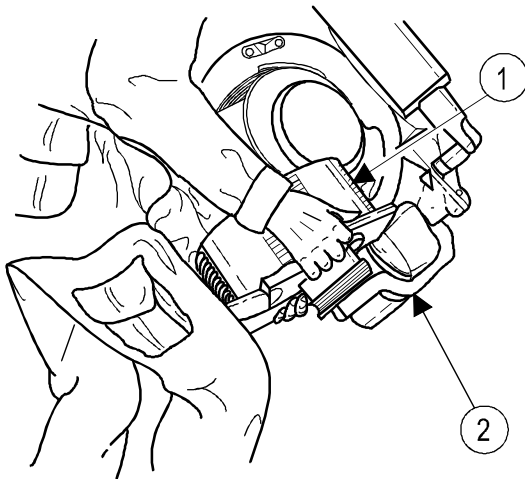
- 3 Lift breechblock assembly (4) from carrier (5) while another crewman holds down carrier by grasping inner lip of carrier. Place breechblock assembly on a solid surface.

### SERVICING AND INSPECTION

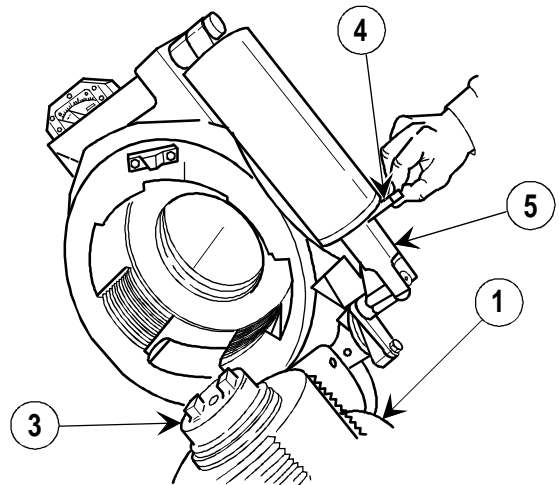
- 1 Lubricate (notes 9 and 21, appx F).
- 2 Inspect threads for burrs. Remove with crocus cloth (item 8, appx D).



### INSTALLATION



- 1 Lift breechblock assembly (1) and position on carrier (2).
- 2 Install spindle assembly (3).
- 3 Remove pin (4) from breech counterbalance (5).



- 4 After reassembling breech mechanism assembly, close and open breechblock assembly (1) to make sure it closes and opens with equal effort.

## Section V. RECOIL MECHANISM MAINTENANCE PROCEDURES

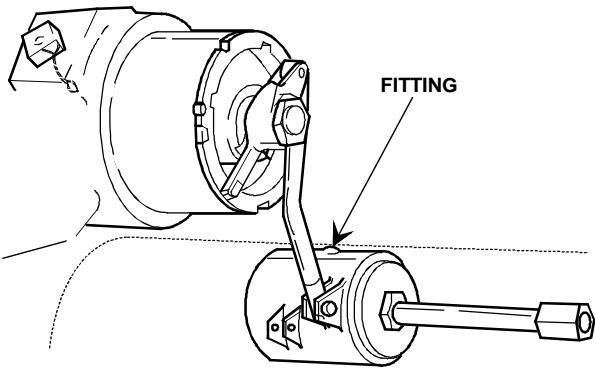
### Section Index

Paragraph		Page
3-14.	Sleeve Bearing Assembly Maintenance.....	3-32
3-15.	Recoil Mechanism Rails Maintenance .....	3-32

3-14. SLEEVE BEARING ASSEMBLY MAINTENANCE

INSPECTION AND SERVICING

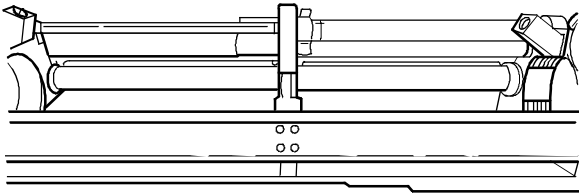
- 1 Check for broken or missing parts. If parts are broken or missing, notify unit maintenance.
- 2 Lube fitting monthly with WTR grease (item 13, appx D). Fitting can be lubed at top or bottom.



3-15. RECOIL MECHANISM RAILS MAINTENANCE

INSPECTION/SERVICING

- 1 Inspect from top to bottom for burrs, nicks, and cracks. If burred, nicked, or cracked, notify unit maintenance.
- 2 Use a rag (item 24, appx D) to clean firing residue from recoil mechanism rails



Section VI. CARRIAGE MAINTENANCE PROCEDURES

Section Index

Paragraph		Page
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3-17.	Travel Lock Assembly Maintenance .....	3-33
3-18.	Equilibrator Assembly Maintenance .....	3-34
3-19.	Cradle Assembly Maintenance.....	3-34
3-20.	Elevating Angle Drive Unit Maintenance .....	3-34
3-21.	Top Carriage Maintenance.....	3-35
3-22.	Bottom Carriage Maintenance.....	3-36
3-23.	Ram Hydraulic Pumps Maintenance .....	3-40
3-24.	Manifold Assembly Maintenance.....	3-40
3-25.	SPEED SHIFT and WHEELS Selector Valves Maintenance.....	3-41
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3-36.	Gun Tube Travel Lock Maintenance .....	3-45
3-37.	Lifting Handles Maintenance .....	3-45
3-38.	Left and Right Trails Maintenance.....	3-46
3-39.	Adapter Assembly Maintenance.....	3-46

### 3-16. CARRIAGE MAINTENANCE

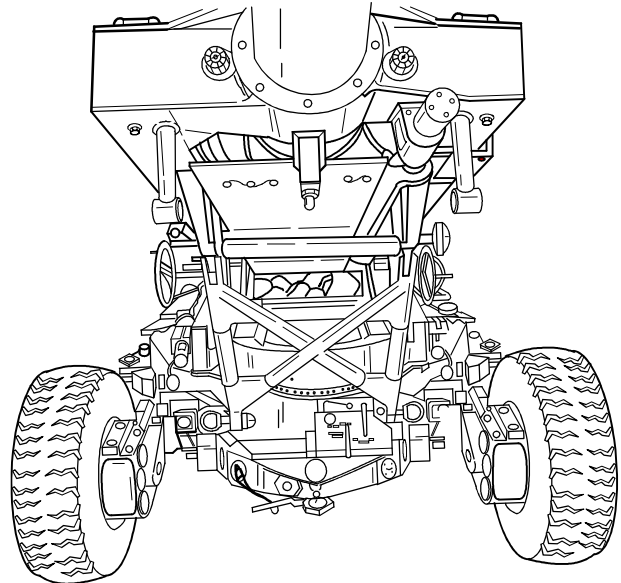
#### INSPECTION

Check carriage for any unusual or excessive noise due to improper adjustment, worn or loose parts, lack of lubricant, foreign matter, or moisture. Lubricate (appx F).

### 3-17. TRAVEL LOCK ASSEMBLY MAINTENANCE

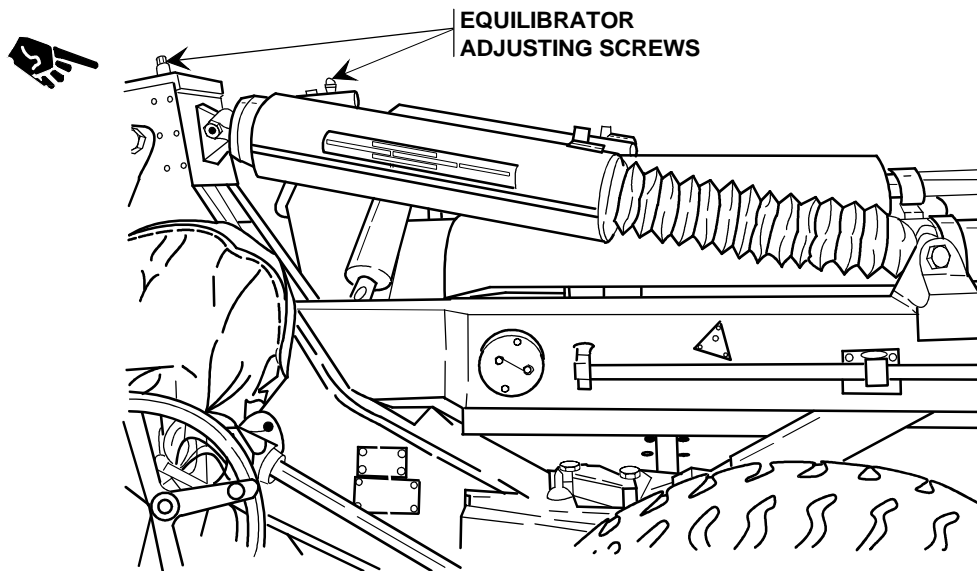
#### INSPECTION AND SERVICING

- 1 Check travel lock pin receivers for dirt, burrs, and scoring.
- 2 Clean travel lock pin receivers with rag (item 24, appx D).



### 3-18. EQUILIBRATOR ASSEMBLY MAINTENANCE

#### INSPECTION



Weekly, inspect for moisture or foreign matter in top carriage recesses around or on equilibrator adjusting screws.

### 3-19. CRADLE ASSEMBLY MAINTENANCE

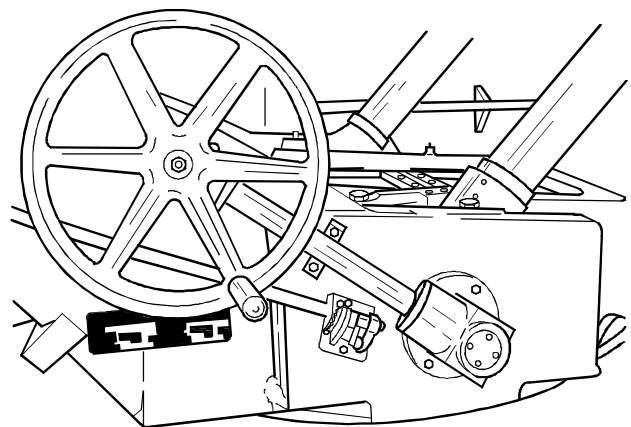
#### INSPECTION

Check for loose or missing parts. If parts are loose or missing, notify unit maintenance.

### 3-20. ELEVATING ANGLE DRIVE UNIT MAINTENANCE

#### INSPECTION

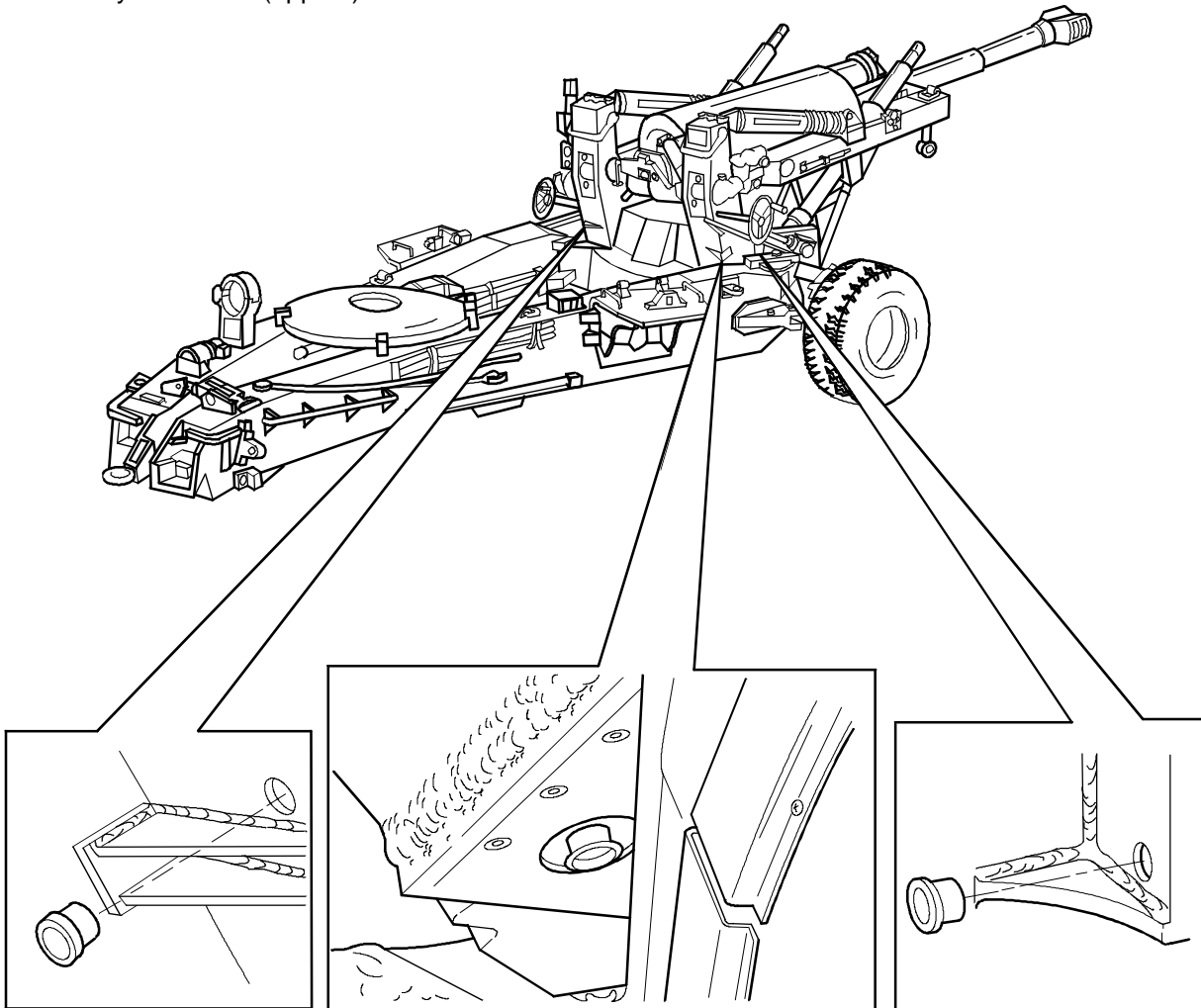
Inspect for loose or missing parts or cracks on both housings on each side. If parts are loose, missing, or cracked, notify unit maintenance.



### 3-21. TOP CARRIAGE MAINTENANCE

#### INSPECTION AND SERVICING

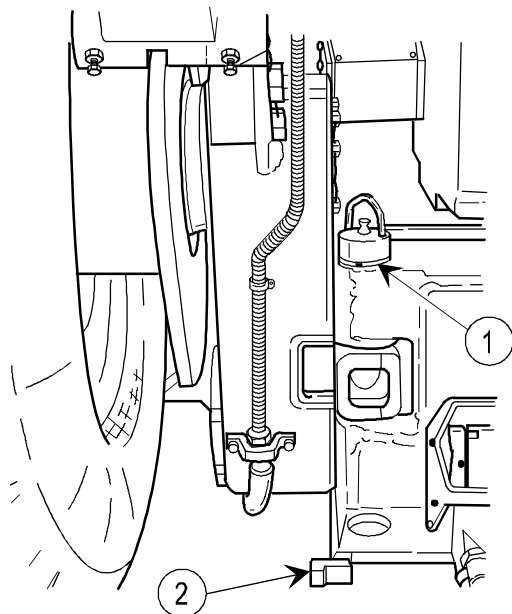
- 1 Inspect top carriage locking pin receivers for dirt, burrs, and scoring. Inspect for loose or missing parts. If parts are loose or missing, notify unit maintenance.
- 2 Service by lubrication (appx F).



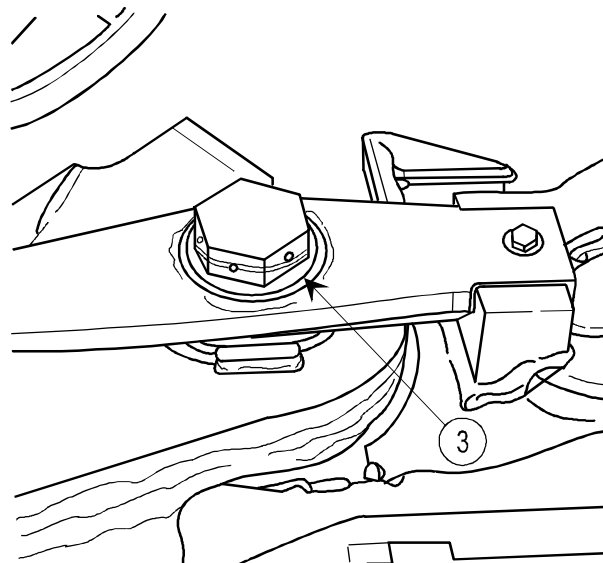
- 3 Clean top carriage locking pin receivers with rag (item 24, appx D).
- 4 Remove drain plugs and drain any accumulation of water.

## 3-22. BOTTOM CARRIAGE MAINTENANCE

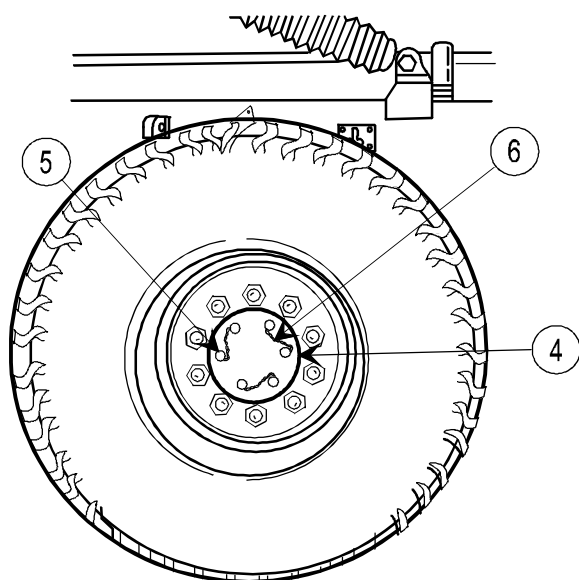
### INSPECTION



- 1 Inspect wheel lock handle receivers (1) for dirt, burrs, and scoring.
- 2 Inspect upper and lower arm assembly stops (2) for dirt and burrs.

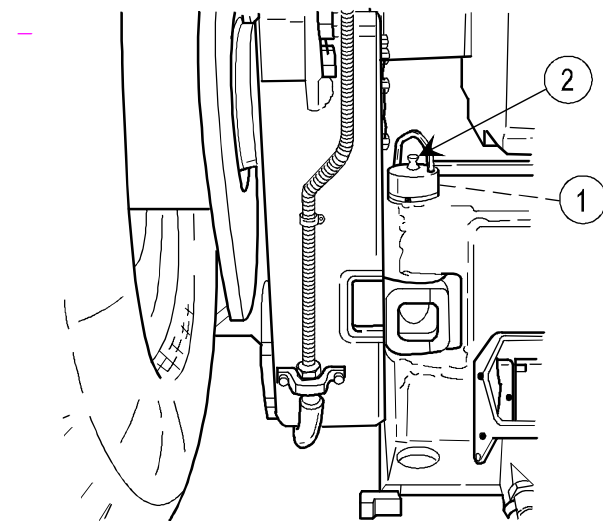


- 3 Check all areas of bottom carriage for foreign material and moisture.
- 4 Check hinge pins (3) for looseness and broken or missing lock wire.

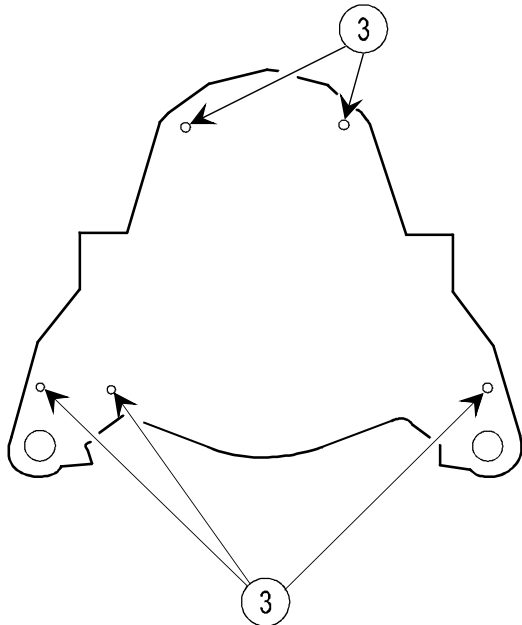


- 5 Inspect bearing cover plate (4) for loose or missing bolts (5) and missing or broken lock wire (6). If bolts are loose or missing or lock wire is broken or missing, notify unit maintenance.

### SERVICING

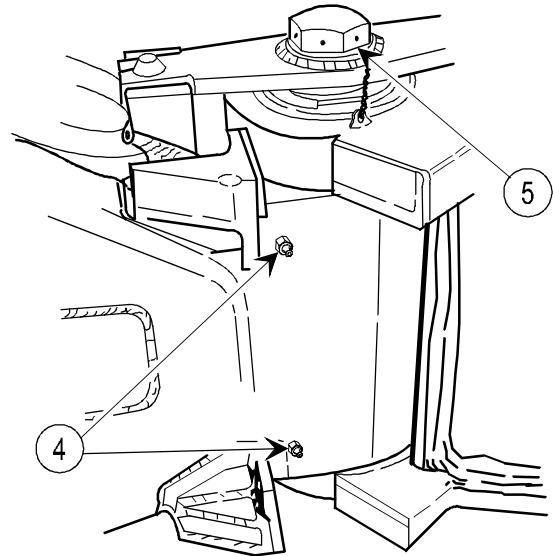


- 1 Clean wheel lock handle receivers (1) with rag (item 24, appx D).
- 2 Lubricate wheel lock handles (2) (note 31, appx F).

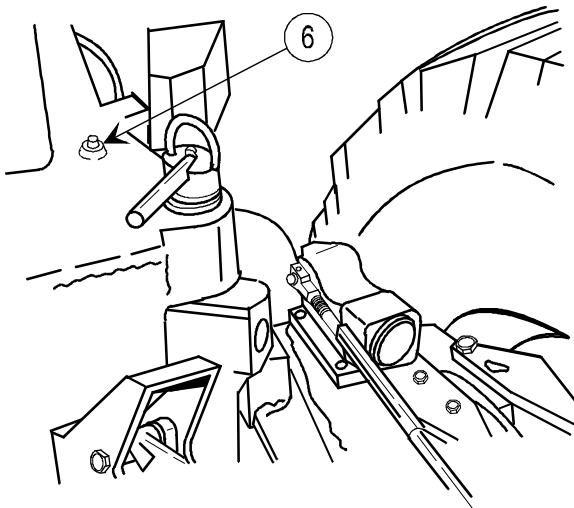


**UNDERNEATH BOTTOM CARRIAGE**

- 3 Remove drain plugs (3) and drain any moisture.



- 4 Lubricate fittings (4) to lube hinge pins (5) (note 33, appx F). Open and close trails several times to distribute WTR.



**NOTE**

Some howitzers have two axle lube fittings on each side of howitzer, one on top and a second one on the bottom of the bottom carriage. Apply grease to four fittings if applicable. To ensure full axle lubrication, cycle the wheels up and down while applying grease.

- 5 Lubricate both sides of axles at fittings (6) (note 20, appx F).

**WHEEL AND TIRES FOR EMERGENCY USE**

Truck, chassis .....	M40
Truck, chassis .....	M61
Truck, cargo .....	M54
Truck, cargo .....	M813
Truck, dump .....	M51
Truck, tractor .....	M52
Truck, medium, wrecker.....	M62
Truck, chassis .....	M139, M139C
Truck, cargo .....	M41
Howitzer, towed, 155-mm.....	M114, M114A1
Truck, series.....	M923, M939

### 3-22. BOTTOM CARRIAGE MAINTENANCE (cont)

#### WHEEL AND TIRE EMERGENCY REPLACEMENT

##### **WARNING**

The wheel and tire are heavy. To remove or install, use a hoist if available. If hoist is not available, two crewmen are required to remove or install wheel and tire. Use care to avoid injury.

##### **CAUTION**

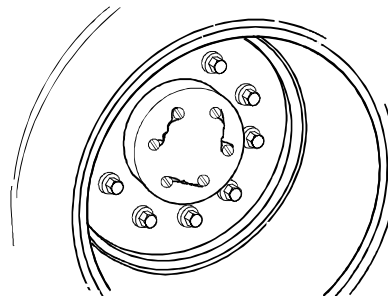
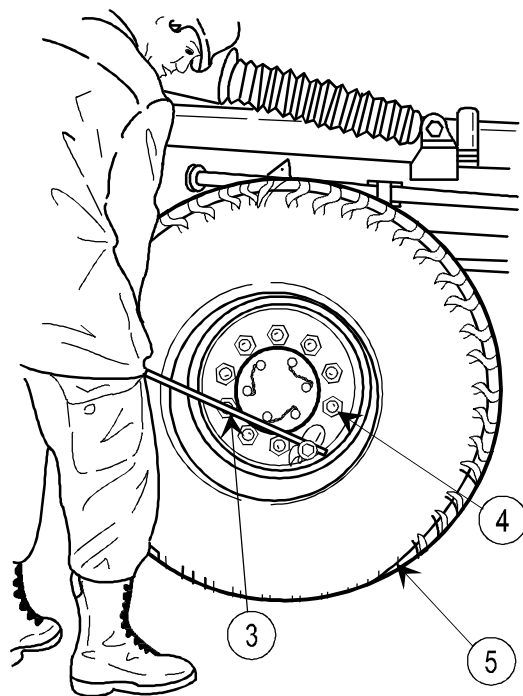
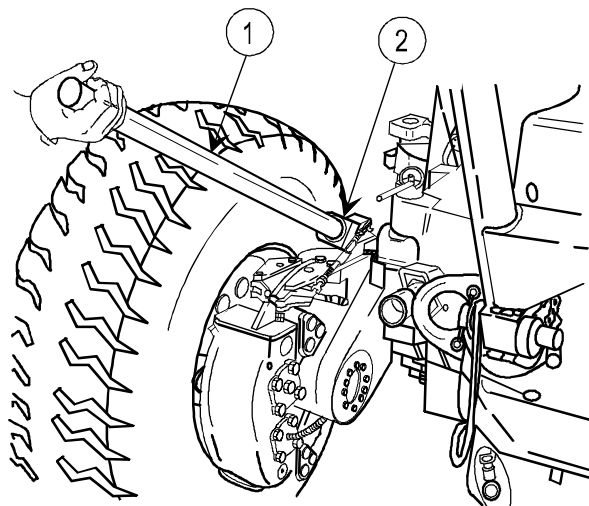
With replacement wheels and tires, the weapon will weigh 225 pounds (102.06 kg) more and will be 9 inches (22.86 cm) wider. Larger wheels may not fully retract in firing position. Wheel pits will be needed to make sure tires are not resting on ground.

#### REMOVAL

- 1 Place howitzer in firing position without spades and engage both handbrakes by inserting pump handles (1) in handbrake sockets (2) and raising up to the locked position.
- 2 Use prime mover lug nut wrench (3) to remove ten wheel nuts (4).
- 3 Remove wheel with tire (5) from howitzer.

#### INSPECTION

Check bolt holes and chamfers for cracks or defects.



## INSTALLATION

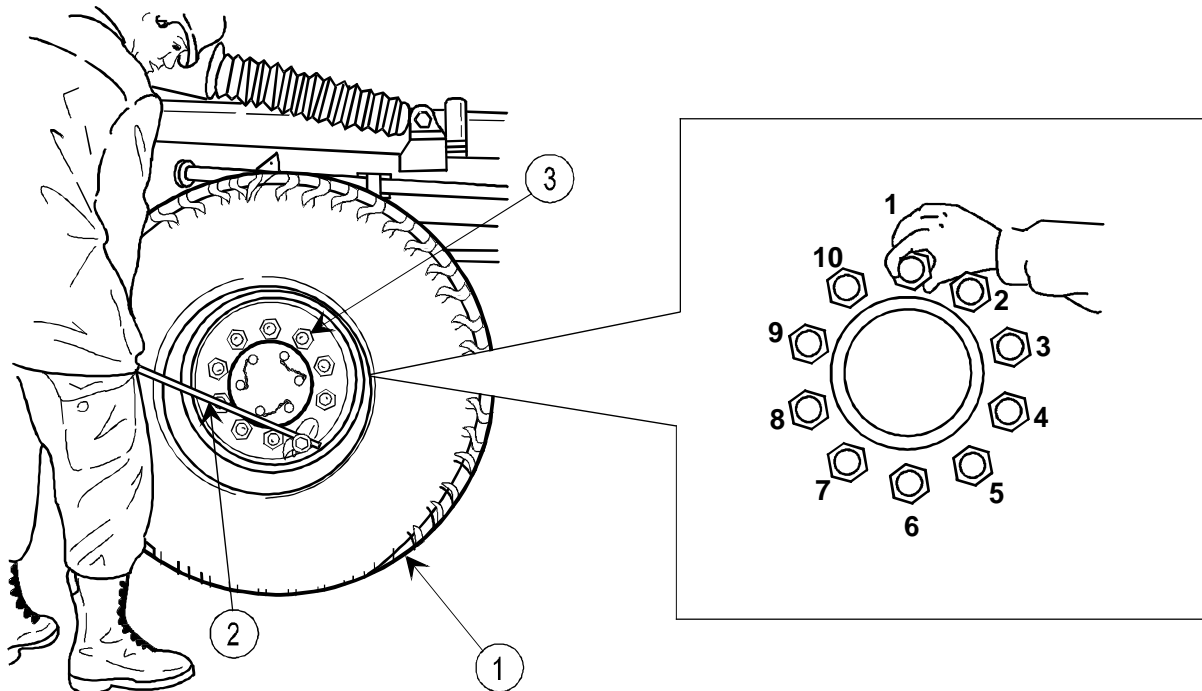
### NOTE

When using a prime mover wheel and tire as a spare, install wheel and tire so that tire valve faces in; otherwise wheel and tire will not fit properly.

When using M923 and M939 series tires as spares, the following conditions apply: use wheels in pairs; mount wheels with valve stems pointing inward; inflate tires to recommended pressure. **DO NOT TOW HOWITZER AT SPEEDS EXCEEDING 30 MPH.**

Narrow tire and wheel may be used temporarily with wide tire and wheel or bias ply tire and wheel may be used with a radial tire and wheel if all cited inflation pressures for the respective tires are met. Break in new tires at low speeds (5 mph for approximately 3 minutes) then check for proper inflation. If a combination of unmatched tires is used, **DO NOT TOW HOWITZER AT SPEEDS EXCEEDING 30 MPH.** Replace the unmatched tire at the first opportunity.

The new radial tires have two different tread designs. It is acceptable to mix these tires; however, standard practice is to use matched treads whenever possible.

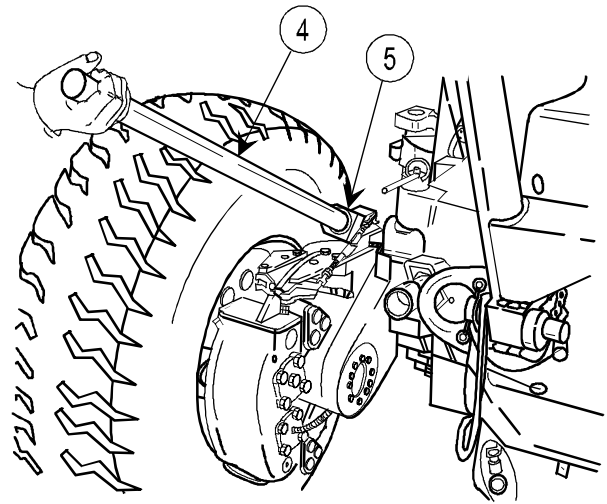


- 1** Make sure handbrakes are engaged. Install wheel with tire (1) on howitzer.
- 2** Install wheel nuts 1 and 6 fingertight, making sure nuts are properly seated in the wheel. Install remaining wheel nuts fingertight.
- 3** Using lug wrench (2) from prime mover, tighten nuts (3) as tight as possible in a crisscross pattern; i.e., 1 and 6, 2 and 7, 3 and 8, 4 and 9, and 5 and 10. Notify unit maintenance as soon as possible to torque wheel nuts.

### 3-22. BOTTOM CARRIAGE MAINTENANCE (cont)

#### INSTALLATION (cont)

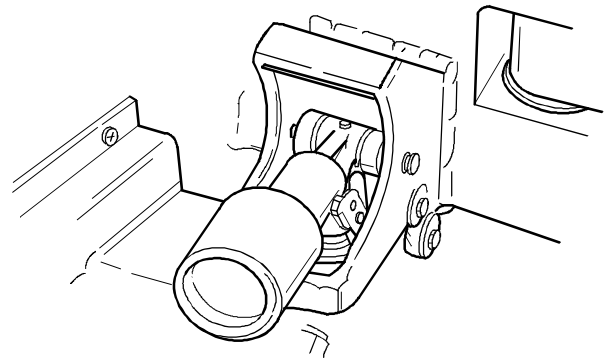
- 4 Place howitzer in travel position and release handbrakes by inserting pump handle (4) in handbrake sockets (5) and pulling down.



### 3-23. RAM HYDRAULIC PUMPS MAINTENANCE

#### SERVICING AND INSPECTION

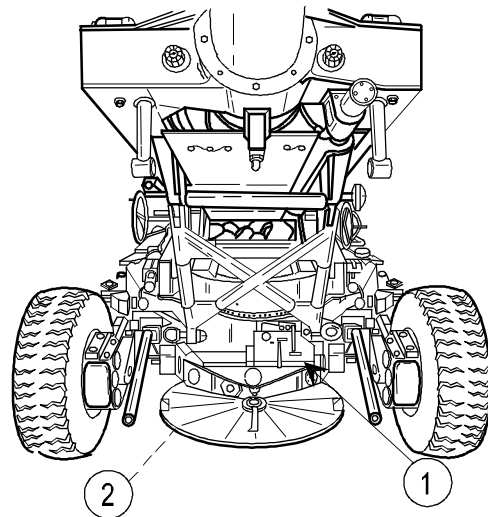
- 1 Lubricate hinge points (note 4, appx F).
- 2 Inspect for missing or broken parts. If parts are broken or missing, notify unit maintenance.



### 3-24. MANIFOLD ASSEMBLY MAINTENANCE

#### INSPECTION

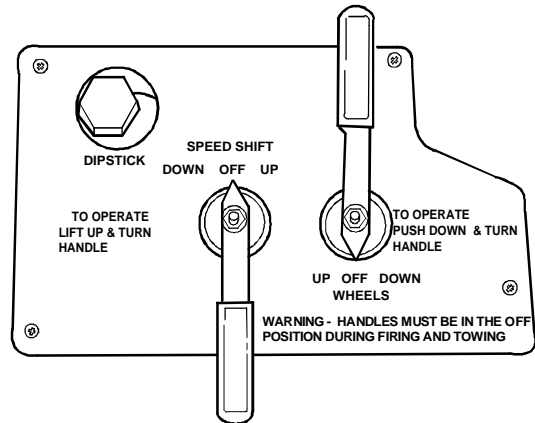
- 1 Weekly check proper operation of manifold assembly (1).
- 2 Lower and raise speed shift (2).
- 3 Lower howitzer to firing position, then raise howitzer to towed position.



### 3-25. SPEED SHIFT AND WHEELS SELECTOR VALVES MAINTENANCE

#### INSPECTION

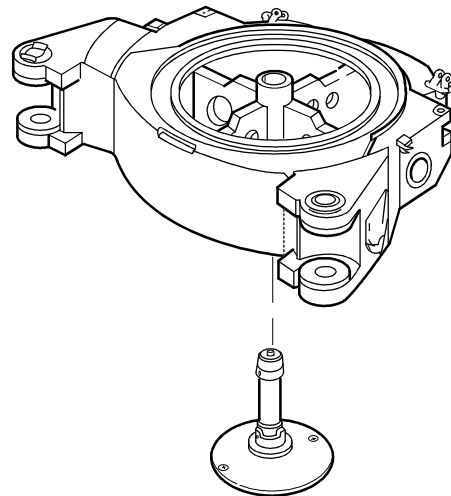
Inspect for loose, missing, or broken parts. If parts are loose, broken, or missing, notify unit maintenance.



### 3-26. SPEED SHIFT CYLINDER ASSEMBLY MAINTENANCE

#### INSPECTION

Inspect for loose, broken, or missing parts and evidence of oil leakage. If leaking oil or if parts are loose, broken, or missing, notify unit maintenance.



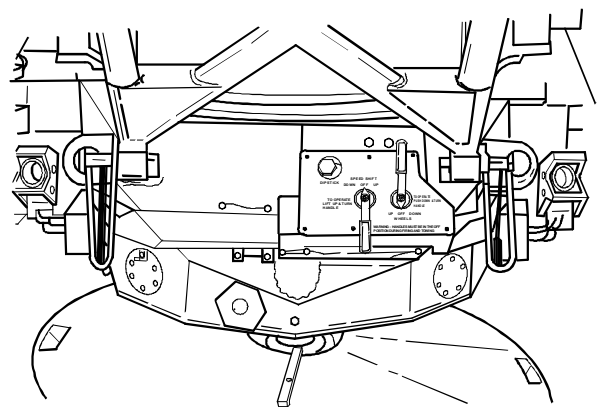
#### NOTE

SPEED SHIFT shown removed for clarity.

### 3-27. FIRING BASEPLATE MAINTENANCE

#### INSPECTION AND SERVICING

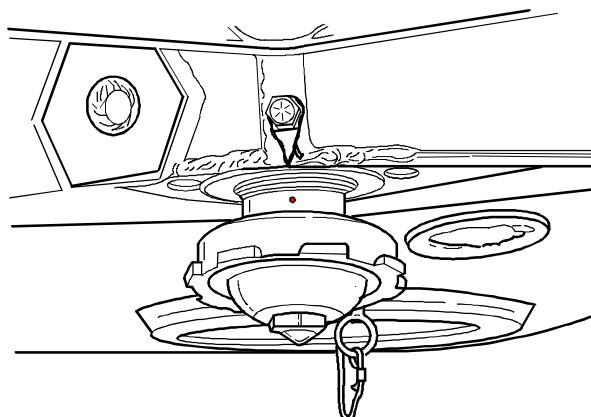
- 1 Inspect for loose dirt, broken or missing parts, and cracks that prevent the locking assembly from engaging. If parts are loose, broken, missing, or locking assembly will not engage, notify unit maintenance.
- 2 Clean firing baseplate with rag (item 24, appx D).



### 3-28. DETENT ASSEMBLY MAINTENANCE

#### INSPECTION AND SERVICING

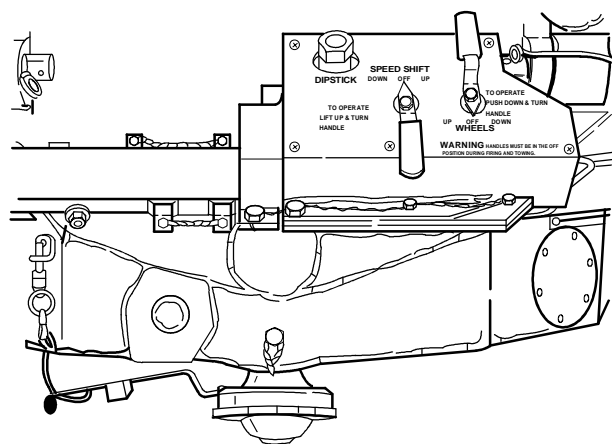
- 1 Check weekly to make sure firing base ball is free from dirt, burrs, and scoring.
- 2 Clean firing base ball weekly with rag (item 24, appx D). Do not lube the base ball.



### 3-29. LOCKING ASSEMBLY MAINTENANCE

#### INSPECTION AND SERVICING

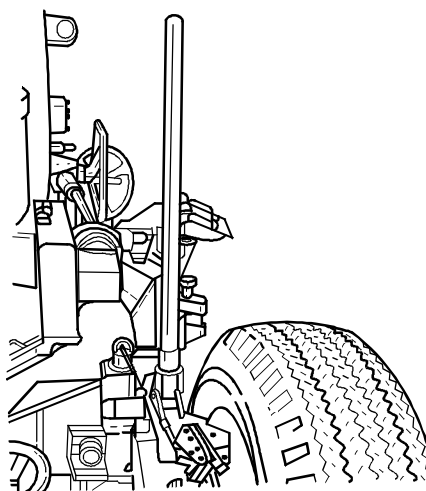
- 1 Inspect for missing or damaged parts. If parts are missing or damaged, notify unit maintenance.
- 2 Check to ensure locking assembly works properly. If not, notify unit maintenance.
- 3 Weekly clean with rags (item 24, appx D) to remove dirt.



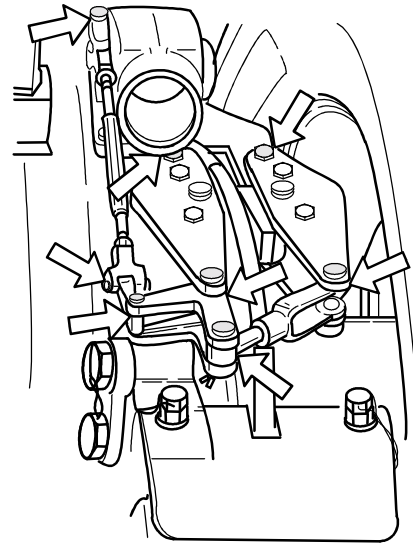
### 3-30. HANDBRAKES MAINTENANCE

#### INSPECTION AND SERVICING

- 1 Inspect for missing hardware.
- 2 Check operation by raising handle until it locks in upright position. If loose, notify unit maintenance.



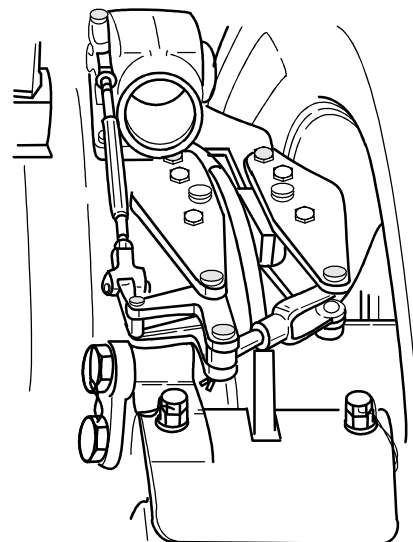
- 3 Lubricate hinge points (shaded areas) of both handbrakes (note 19, appx F).



### 3-31. HANDBRAKE ROD ASSEMBLY MAINTENANCE

#### INSPECTION

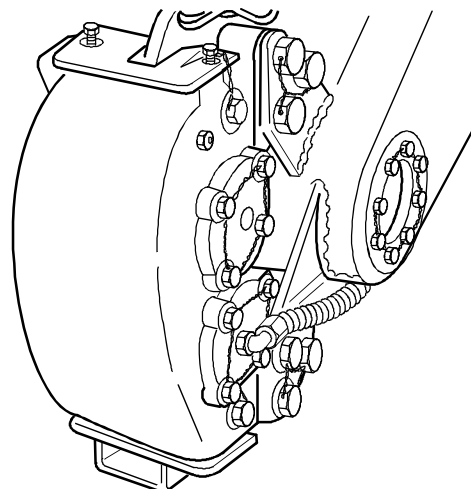
Inspect for loose or missing parts. If parts are loose or missing, notify unit maintenance.



### 3-32. BRAKE HEAD ASSEMBLY MAINTENANCE

#### INSPECTION

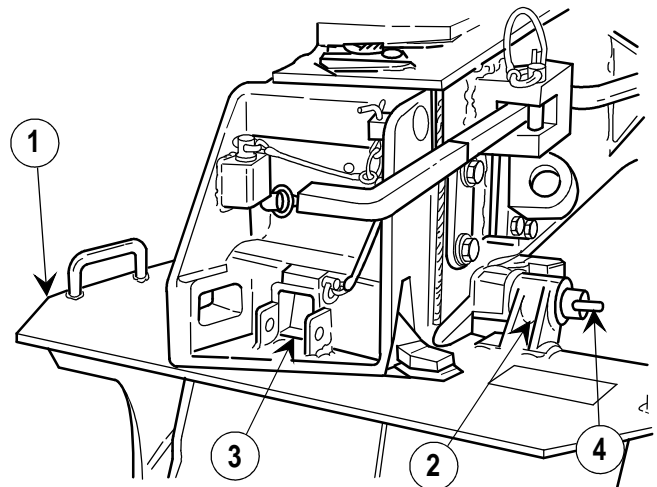
Check to ensure brake fluid is not leaking and hydraulic lines are not cracked or broken. Check for damaged or missing parts. If parts are damaged or missing, notify unit maintenance.



### 3-33. SPADES MAINTENANCE

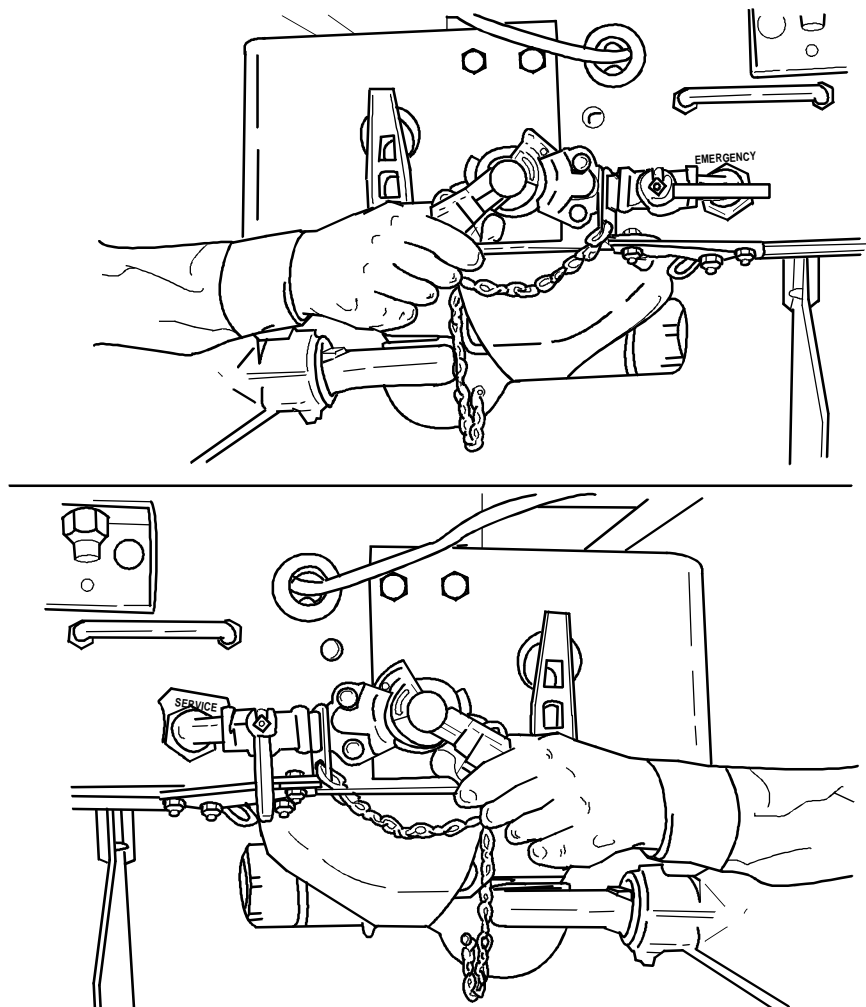
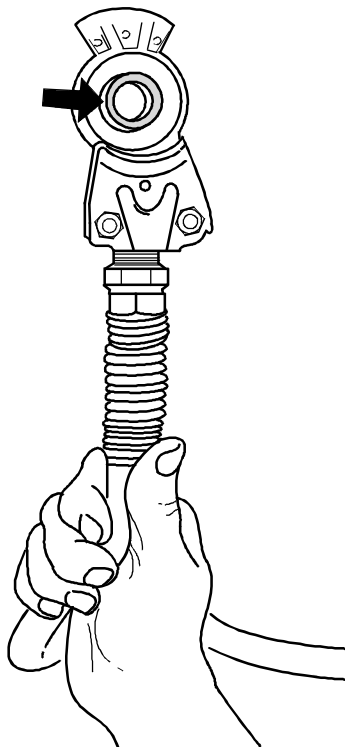
#### INSPECTION AND SERVICING

- 1 Inspect spades (1) for dirt, nicks, and burrs.
- 2 Clean spades (1) with wire brush and rag (item 24, appx D). Remove dirt from spade sockets (2) and spade key holes (3).
- 3 Lubricate spade hinge pins (4) (note 15, appx F).



### 3-34. EMERGENCY AND SERVICE HOSE ASSEMBLIES MAINTENANCE

#### INSPECTION

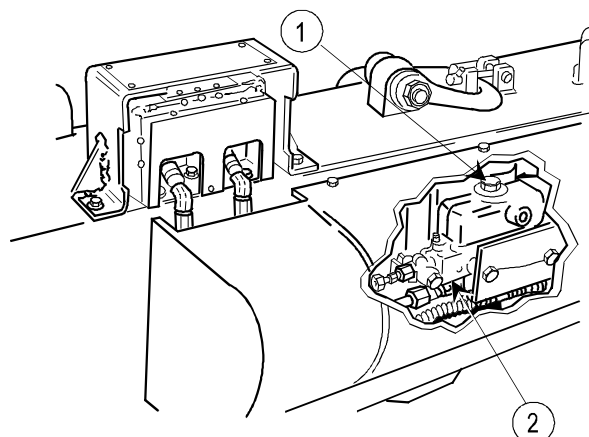


Check condition of rubber seals in hose couplings. If damaged, notify unit maintenance.

### 3-35. POWER BOOSTER ASSEMBLY MAINTENANCE

#### INSPECTION AND SERVICING

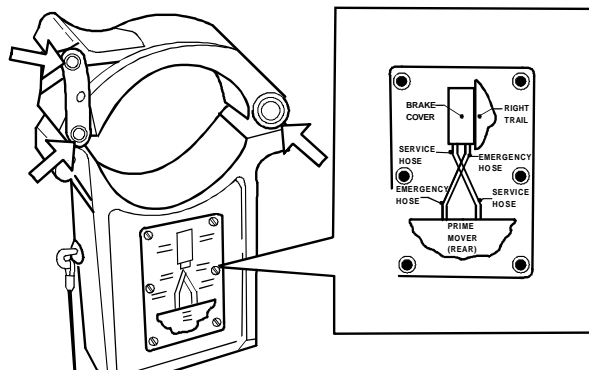
- 1 Clean dirt from around fluid filler cap (1) with a rag (item 24, appx D).
- 2 Remove fluid filler cap (1) from hydraulic reservoir (2). Brake fluid must be within 3/4 inch (1.91 cm) from top of filling hole.
- 3 Fill with silicone brake fluid, BFS (item 2, appx D), as required. Install fluid filler cap.



### 3-36. GUN TUBE TRAVEL LOCK MAINTENANCE

#### INSPECTION AND SERVICING

- 1 Inspect for loose, missing, or damaged parts. If parts are loose, damaged, or missing, notify unit maintenance.
- 2 Check mounting surface for nicks and burrs.
- 3 Lubricate hinge points (note 16, appx F).



### 3-37. LIFTING HANDLES MAINTENANCE

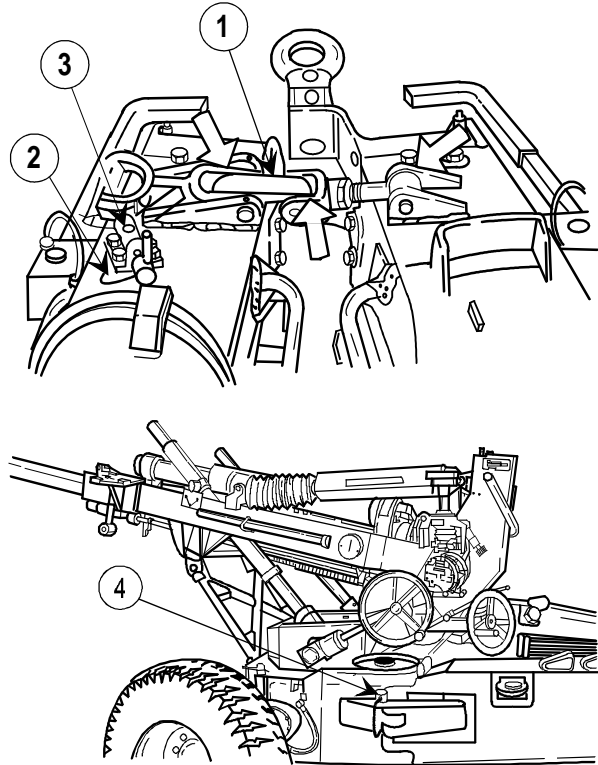
#### INSPECTION AND SERVICE

Inspect for missing or damaged parts.

### 3-38. LEFT AND RIGHT TRAILS MAINTENANCE

#### INSPECTION AND SERVICING

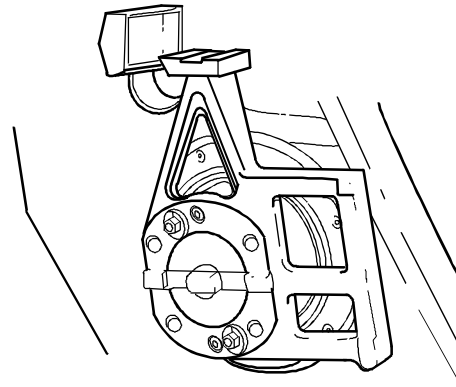
- 1 Inspect trail lock (1) and lock assembly (2) for loose, damaged, or missing parts. If parts are loose, damaged, or missing, notify unit maintenance.
- 2 Lubricate hinge points on trail lock (1) and oil cup (3) on lock assembly (2) (note 17, appx F).
- 3 Lubricate pin shaft of locking plug (4) (note 14, appx F).



### 3-39. ADAPTER ASSEMBLY MAINTENANCE

#### INSPECTION

- 1 Inspect for loose, missing, or damaged parts. If parts are loose, damaged, or missing, notify unit maintenance.
- 2 Check mounting surface for nicks and burrs.



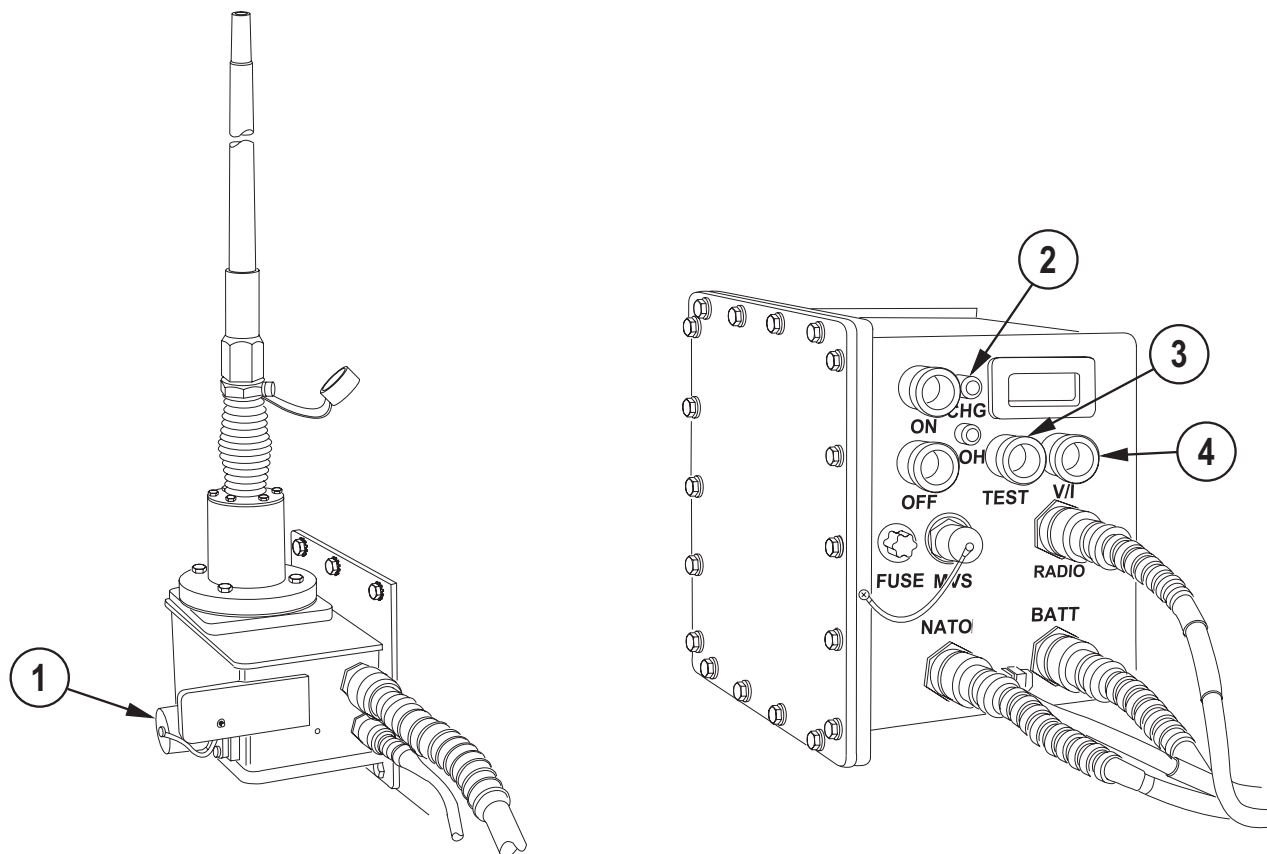
TELESCOPE AND QUADRANT  
MOUNT REMOVED FOR CLARITY

### 3-39.1 HIPE SYSTEM BATTERY CHARGING

#### NOTE

Normal charging takes more time but extends battery life. Alternate charging takes less time.

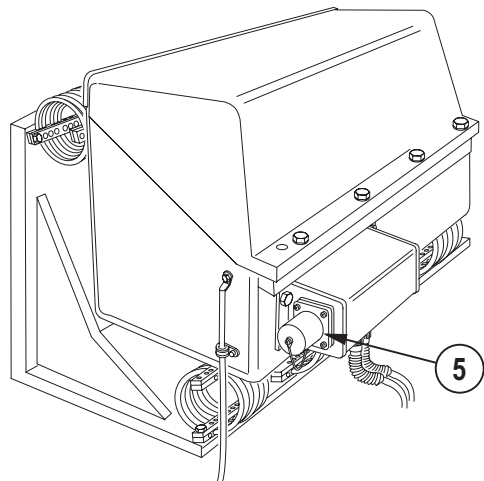
#### 1 Normal charging.



- a. Remove dust cap and attach NATO slave cable to the trail NATO connector (1).
- b. Start vehicle.
- c. Verify the PSDU green charging indicator (2) is illuminated.
  - (1) If the indicator does not illuminate, check charging current as in step d.
  - (2) If no charging current, proceed to alternate charging procedure.
- d. Allow charging to continue until the meter displays a reading of less than 1 amp when depressing the TEST (3) and V/I (4) buttons simultaneously.
- e. Remove the slave cable and install dust cap.

3-39.1 HIPE SYSTEM BATTERY CHARGING (cont)

2 Alternate charging.



- a. Remove dust cap and attach NATO slave cable to the battery box NATO connector (5).
- b. Start vehicle.
- c. Allow batteries to charge two hours.
- d. Remove the slave cable and install dust cap.

Section VII. FIRE CONTROL EQUIPMENT MAINTENANCE PROCEDURES

	Section Index	
Paragraph		Page
3-40.	M171 Telescope and M17 Fire Control Quadrant, and M172 Telescope and M18 Fire Control Quadrants Maintenance .....	3-47
3-41.	M137/M137A3 Pantel Maintenance .....	3-47
3-42.	M138 Elbow Telescope Maintenance.....	3-47



**WARNING**

When using radioactively illuminated fire control equipment, follow radiation hazard procedures on the inside front cover.

**3-40. M171 TELESCOPE AND M17 FIRE CONTROL QUADRANT, AND M172 TELESCOPE AND M18 FIRE CONTROL QUADRANTS MAINTENANCE**

**TESTING**

- 1 For testing of M17 and M18 fire control quadrants, see page 3-57.
- 2 For testing of M171 telescope and quadrant mount, see page 3-63.
- 3 For testing of M172 telescope and quadrant mount, see page 3-63.

**3-41. M137/M137A3 PANTEL MAINTENANCE**

**INSPECTION**

See PMCS, page 2-10.

**SERVICING**

- 1 Clean lens with lens paper (item 21, appx D) and lens cleaning compound (item 6, appx D).
- 2 Check function of ON/OFF delay switch. Replace batteries if required (M137A3 only).

**TESTING**

See reliability test of M137/M137A3 panoramic telescope on page 3-62 and alinement test of M171 telescope and quadrant mount and M137/M137A3 pantel, page 3-63.

**ALINEMENT**

See checking boresight alignment of M137/M137A3 pantel, using M139/M139A1 alinement device, page 2-71.

**INSTALLATION**

See page 2-71.

**3-42. M138 ELBOW TELESCOPE MAINTENANCE**

**INSPECTION**

See PMCS, page 2-10.

**SERVICING**

Clean lens with lens paper (item 21, appx D) and lens cleaning compound (item 6, appx D).

**ALINEMENT**

See boresighting M138 elbow telescope, using distant aiming point on page 2-73.

**INSTALLATION**

See page 2-73.

Section VIII. MAINTENANCE OF AUXILIARY EQUIPMENT

Paragraph	Section Index	Page
3-43.	M139/M139A1 Alignment Device Maintenance .....	3-48
3-44.	M1A2 Collimator Maintenance .....	3-48
3-45.	M14A1 Aiming Post Light Maintenance .....	3-48
3-46.	Vehicular Taillight Maintenance .....	3-49

3-43. M139/M139A1 ALINEMENT DEVICE MAINTENANCE

INSPECTION

See PMCS, page 2-10.

SERVICING

- 1 Clean lens with lens paper (item 21, appx D) and lens cleaning compound (item 6, appx D).
- 2 Check illumination. If poor or none:
  - a. Notify unit maintenance and radiological control officer (M139 only).
  - b. Replace battery if required (M139A1 only).

REPLACEMENT

Replace as necessary (see appx B).

3-44. M1A2 COLLIMATOR MAINTENANCE

INSPECTION

See PMCS, page 2-10.

SERVICING

- 1 Clean lens with lens paper (item 21, appx D) and lens cleaning compound (item 6, appx D).
- 2 Check illumination and function of ON/OFF delay switch. Replace batteries if required.

REPLACEMENT

Replace as necessary (see appx B).

3-45. M14A1 AIMING POST LIGHT MAINTENANCE

INSPECTION

Ensure M14A1 light will clamp securely to aiming post and that both red and green lights illuminate.

SERVICING

1. Clean lens with lens paper (item 21, appx D) and lens cleaning compound (item 6, appx D).
2. Check illumination and function of ON/OFF delay switch. Replace batteries if required.

REPLACEMENT

Replace as necessary (see appx B).

### 3-46. VEHICULAR TAILLIGHT MAINTENANCE

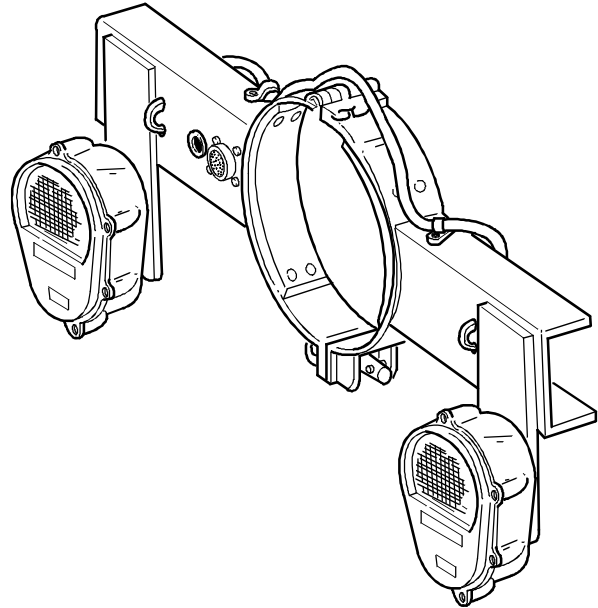
#### INSPECTION

- 1 Connect cable assembly (item 6, appx B) to prime mover.

#### NOTE

Cable assembly 12009266 must be used with vehicular taillight 12009284.

- 2 Make sure all lamps operate.



## Section IX. FIRE CONTROL ALINEMENT TESTS AND MEASUREMENTS

#### Section Index

Paragraph		Page
3-47.	Purpose .....	3-49
3-48.	Frequency .....	3-49
3-49.	Test of M1A1 Gunner's Quadrant .....	3-50
3-50.	Leveling Trunnions .....	3-57
3-51.	Testing M17 and M18 Fire Control Quadrants .....	3-58
3-52.	Reliability Test of M137/M137A3 Pantel.....	3-62
3-53.	Alinement Test of M171 Telescope and Quadrant Mount and M137/M137A3 Pantel.....	3-63
3-54.	M139/M139A1 Alinement Device Comparison Test .....	3-65

### 3-47. PURPOSE

The fire control alinement tests and measurements determine if the on-carriage fire control, gunner's quadrant, and the alinement device are in correct adjustment. Send equipment that fails these tests to unit maintenance.

### 3-48. FREQUENCY

Recommended intervals for the following tests are:

- a. Once each year if weapon is used for nonfiring training.
- b. Once every 3 months if weapon is fired.
- c. As soon as possible after extensive use.
- d. Following accidents.
- e. After traveling over extremely rough terrain.
- f. When fire control mounts have been replaced.
- g. Whenever the weapon fires inaccurately for no apparent reason.
- h. After replacement of cannon tube.

### 3-49. TEST OF M1A1 GUNNER'S QUADRANT

#### WARNING



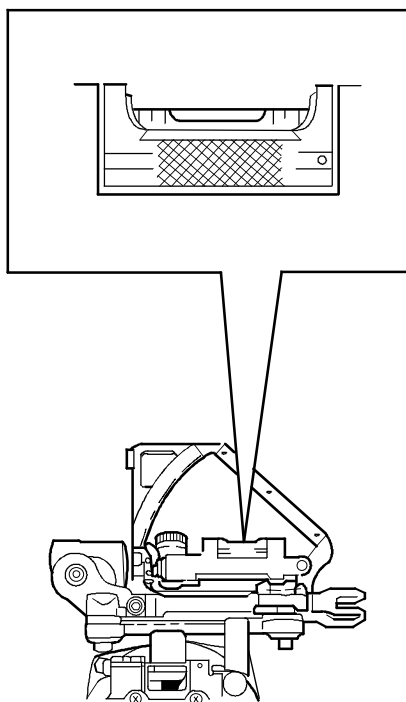
When using radioactively illuminated fire control equipment, follow radiation hazard procedures in the front of this manual.

#### NOTE

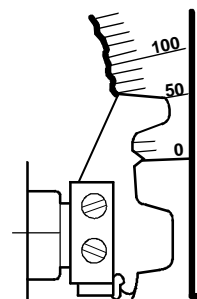
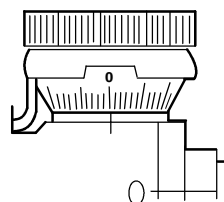
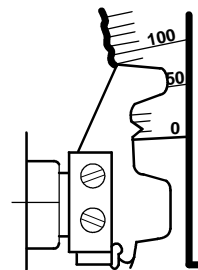
Before testing the gunner's quadrant, inspect the quadrant shoes and seats for dirt or defects.

#### MICROMETER TEST

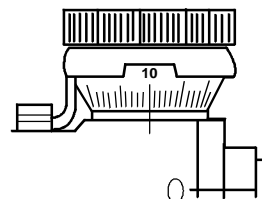
- 1 Set index at +10.
- 2 Zero the micrometer.



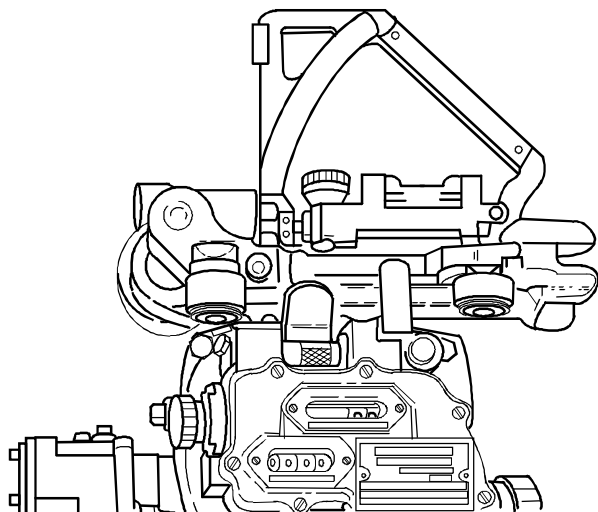
- 3 Point gunner's quadrant to muzzle end of cannon tube and elevate cannon tube to center bubble.



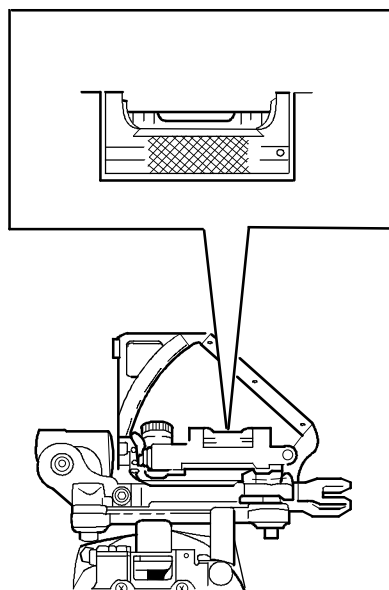
- 4 Set index at 0.



- 5 Set micrometer at 10.

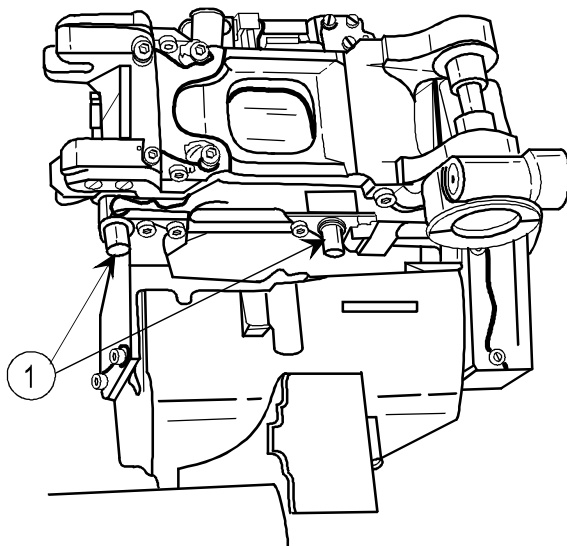


- 6 Point gunner's quadrant to muzzle end of cannon tube.



- 7 Bubble should center.
- 8 If bubble does not recenter, the micrometer is in error. Send the gunner's quadrant to unit maintenance.

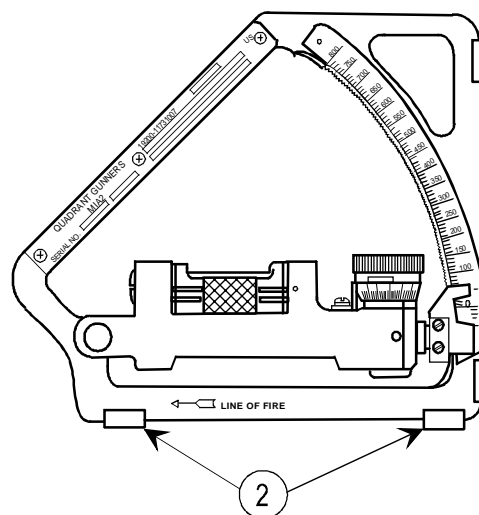
#### END-FOR-END TEST



#### NOTE

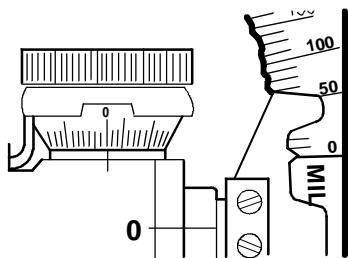
Maximum allowable tolerances are + 0.4 or - 0.4 mil.

- 1 Inspect elevation quadrant seats (1).

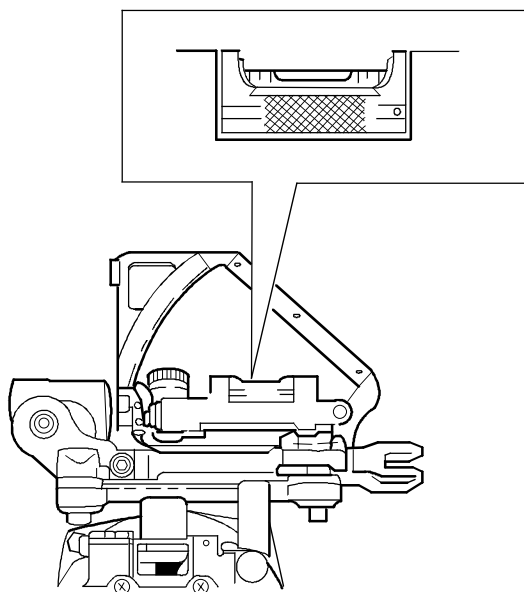


- 2 Inspect quadrant shoes (2).

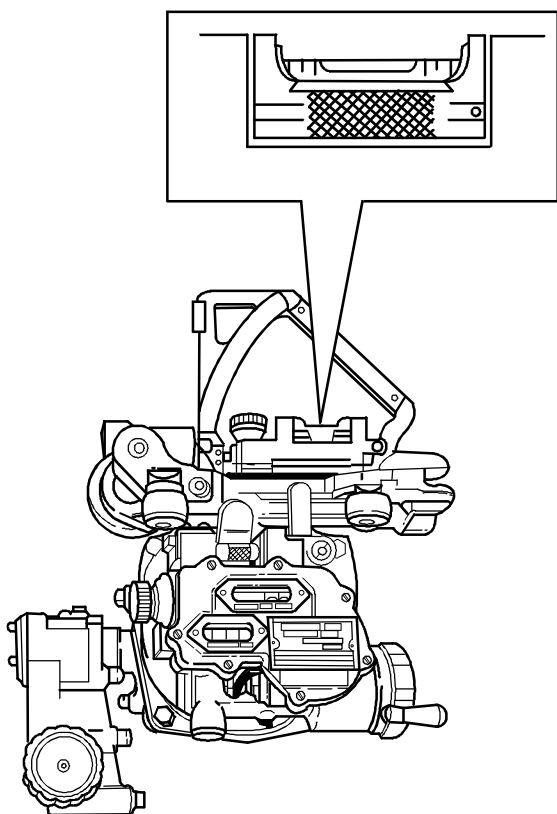
### 3-49. TEST OF M1A1 GUNNER'S QUADRANT (cont)



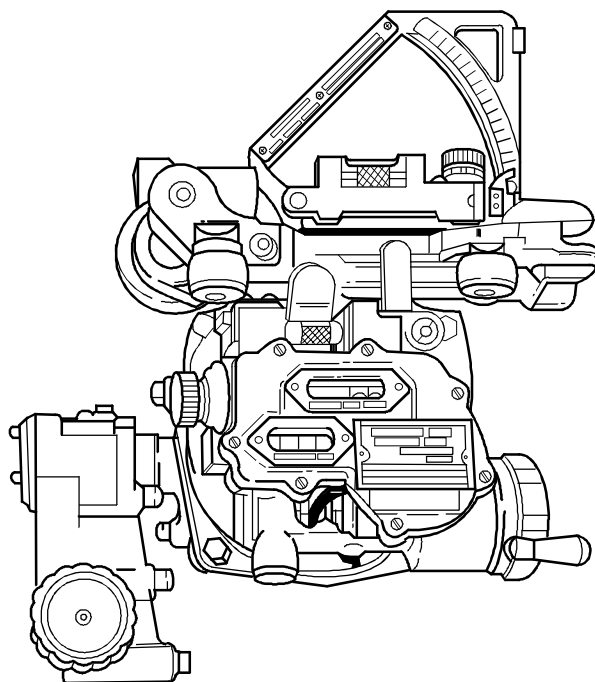
3 Zero the scales.



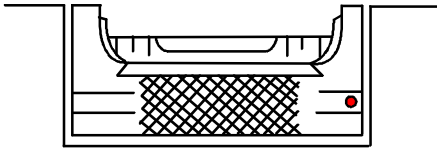
4 Point gunner's quadrant toward muzzle end of cannon tube.



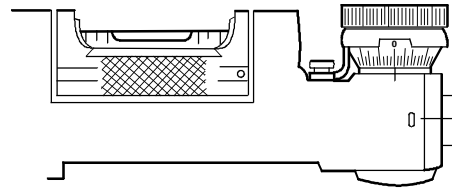
5 Elevate cannon tube to center bubble.



6 Reverse direction of gunner's quadrant.

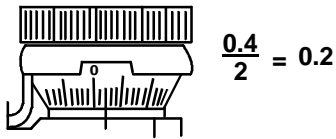


- 7 If bubble centers, test is complete. If bubble does not center, go to step 8.



- 8 Center bubble with micrometer knob. If bubble centers, go to step 9. If it does not, go to step 15.

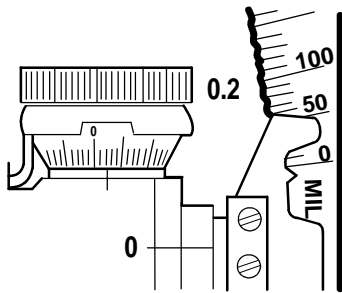
**POSITIVE CORRECTION**



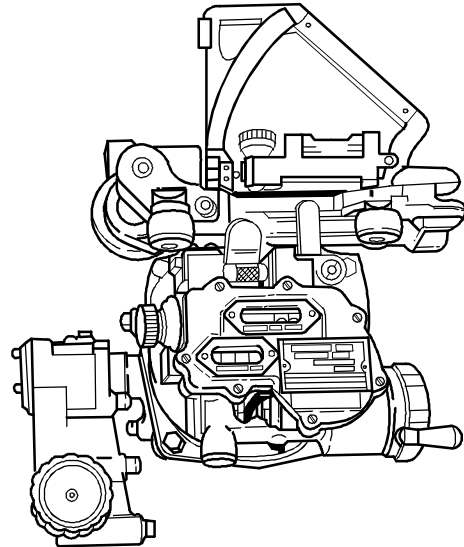
**NOTE**

Each short line on micrometer equals 0.2 mil.

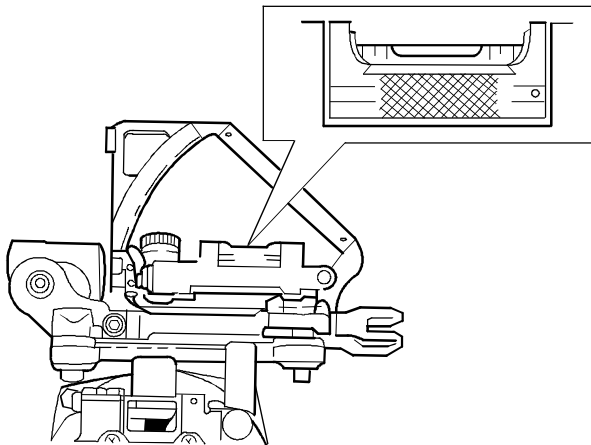
- 9 Divide micrometer reading by 2.



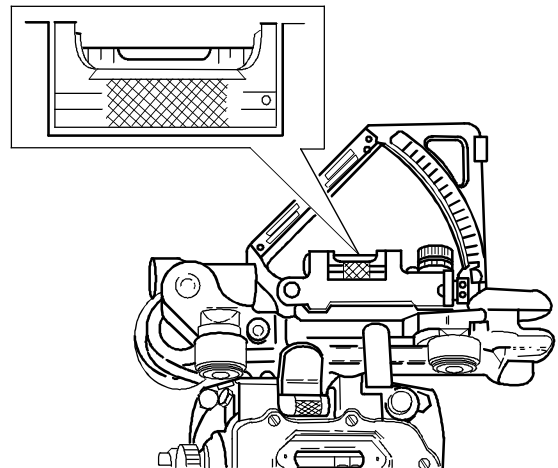
- 10 Put result on micrometer scale.



- 11 Point gunner's quadrant toward muzzle end of cannon tube.

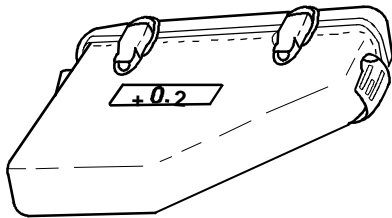


- 12 Elevate cannon tube to center bubble.



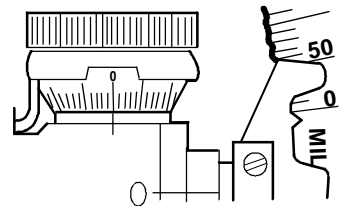
- 13 Reverse direction of gunner's quadrant. Bubble should center.

### 3-49. TEST OF M1A1 GUNNER'S QUADRANT (cont)



14 Record end-for-end correction.

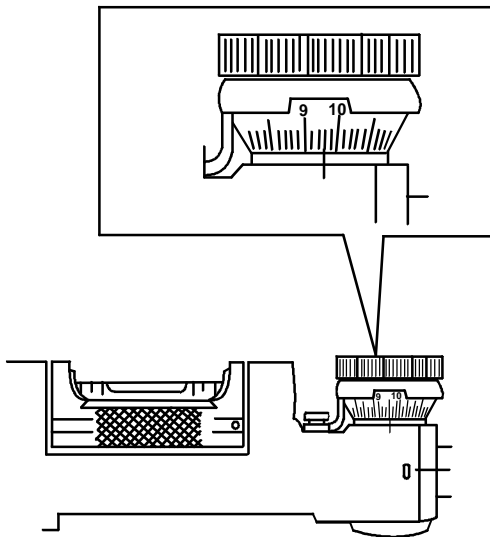
**NEGATIVE CORRECTION**  
(Bubble did not center  
at step 8.)



**NOTE**

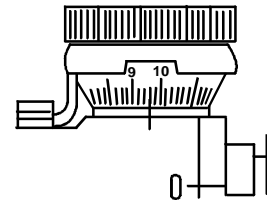
If bubble did not center at step 8, the following tests should be made:

15 Set index at -10.



16 Center bubble with micrometer knob.

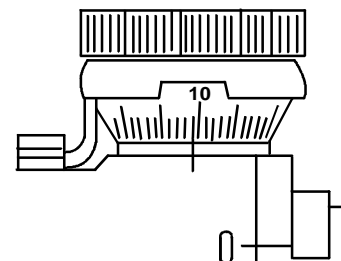
$$\begin{array}{r} 10.0 \\ + 9.6 \\ \hline 19.6 \end{array}$$



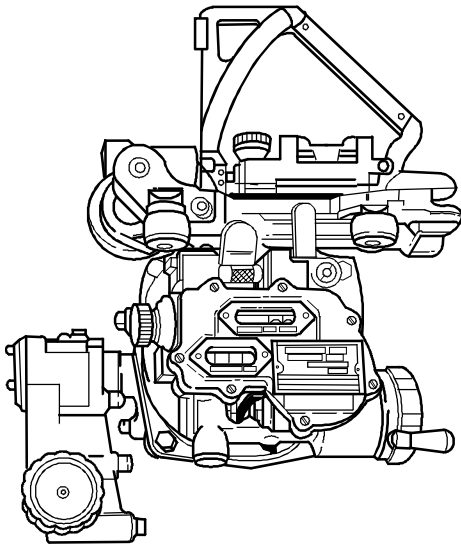
17 Add 10 to micrometer reading.

$$\frac{19.6}{2} = 9.8$$

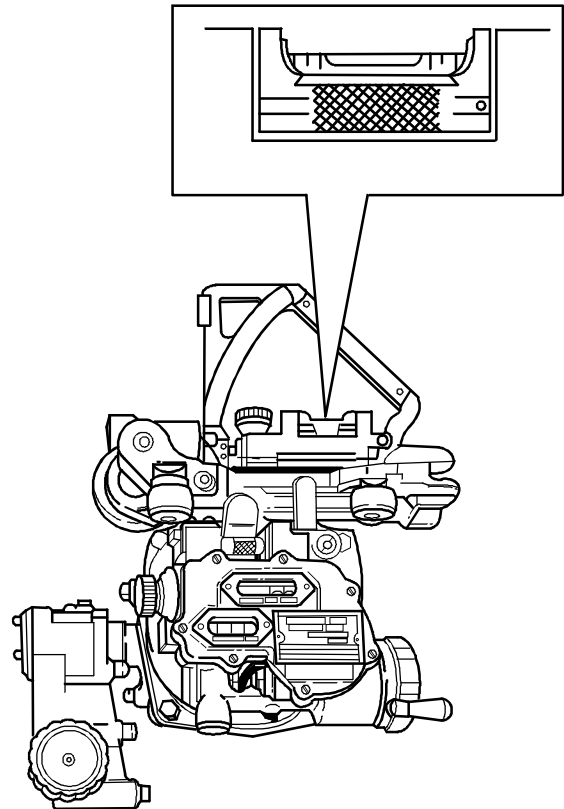
18 Divide sum by 2.



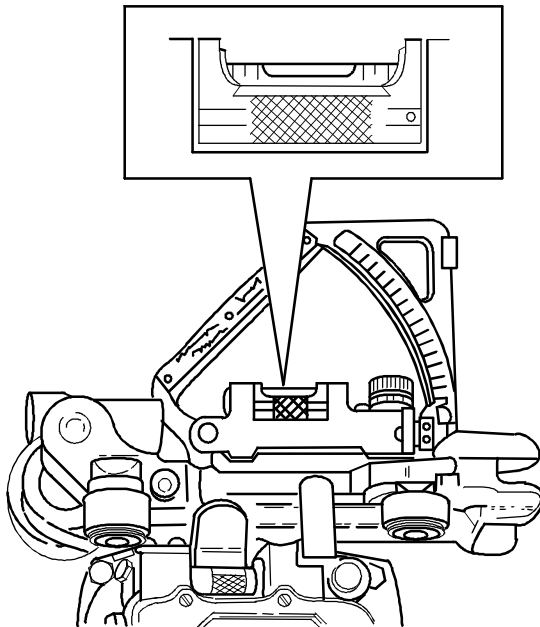
19 Place answer on micrometer scale.



- 20** Point gunner's quadrant toward muzzle end of cannon tube.



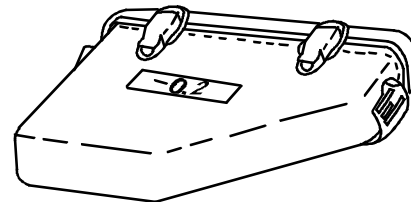
- 21** Elevate cannon tube to center bubble.



- 22** Reverse direction of gunner's quadrant. Bubble should center.

$$\begin{array}{r} 10.0 \\ - 9.8 \\ \hline 0.2 \end{array}$$

- 23** Subtract micrometer reading from 10.



- 24** Record end-for-end correction.

### 3-49. TEST OF M1A1 GUNNER'S QUADRANT (cont)

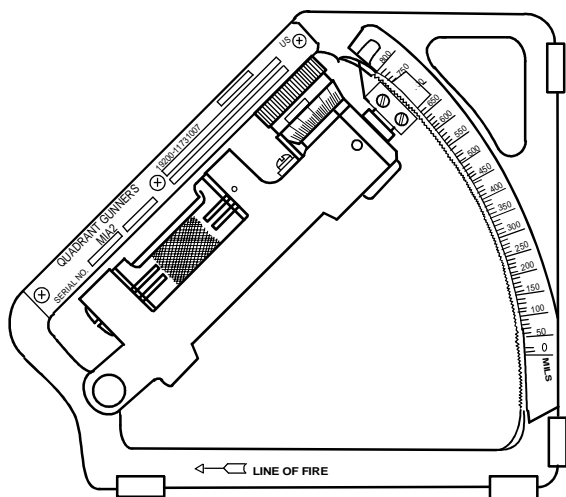
#### VERTICAL SHOE TEST

##### **WARNING**

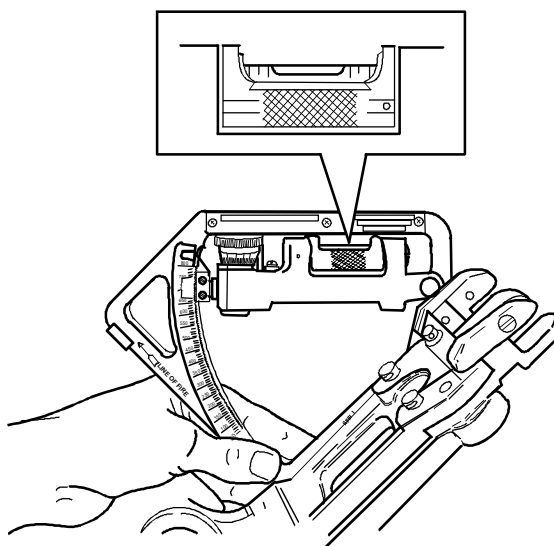
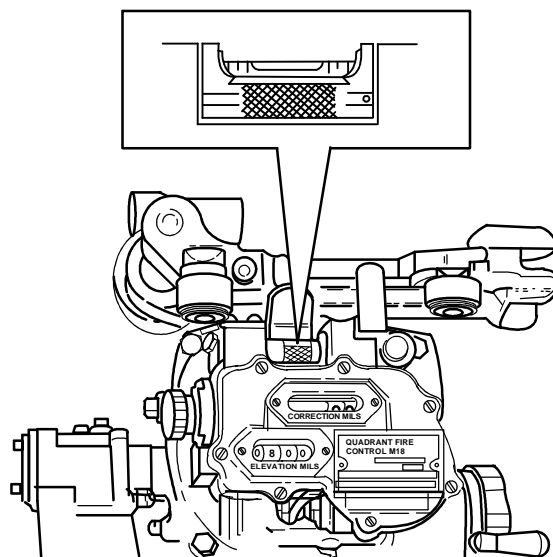
If nitrogen pressure is below 800 psi, the recoil mechanism could slide out of battery and cause severe personal injury. Make sure personnel are clear of recoil path.

High Angle 800-1600 mil scale

- 1 Set M18 quadrant to 800 mils, elevate cannon until elevation level bubble is centered, and cross level M18 quadrant as required.

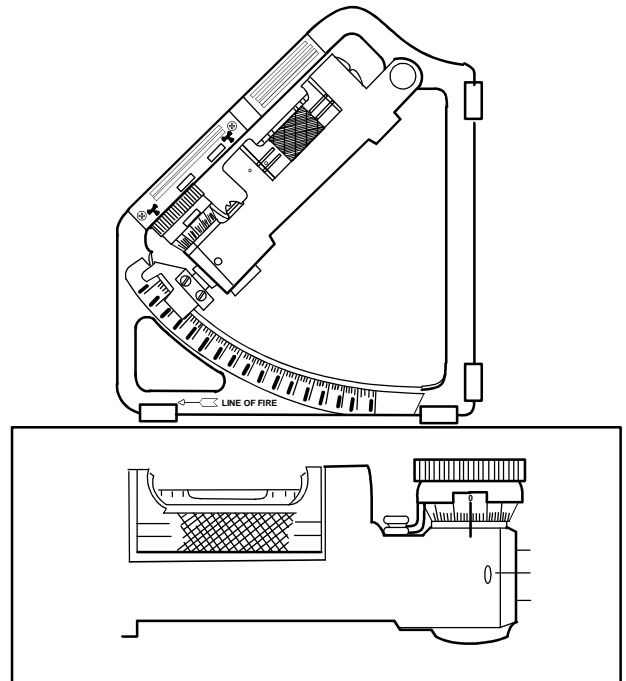


- 2 Set 800 mils on gunner's quadrant 0-800 mil coarse scale. If there is a correction factor for the horizontal shoes, set corresponding micrometer scale to correction factor; otherwise, set micrometer scale to 0.

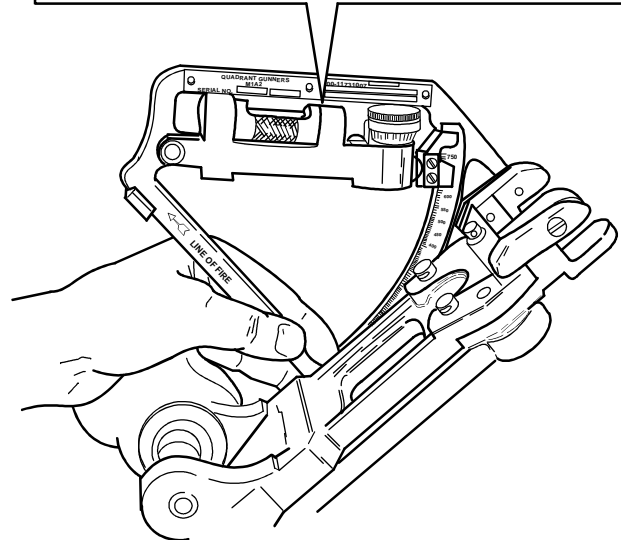


- 3 Set gunner's quadrant on M172 telescope and quadrant mount quadrant seats, with gunner's quadrant LINE OF FIRE arrow toward muzzle end of cannon tube. If gunner's quadrant level bubble is not centered, elevate or depress cannon until the bubble is centered.

- 4 Remove gunner's quadrant from M172 telescope and quadrant mount.
- 5 Set 800 mils on gunner's quadrant 800-1600 mil coarse scale.



- 6 Place gunner's quadrant vertical shoes on M172 telescope and quadrant mount quadrant seats, with gunner's quadrant LINE OF FIRE arrow toward muzzle end of cannon tube.
- 7 Center level bubble on gunner's quadrant with micrometer knob. Gunner's quadrant should read 800 mils  $\pm$  0.4 mil.
- 8 If gunner's quadrant reading deviates more than  $\pm$  0.4 mil, the gunner's quadrant is defective. Send the gunner's quadrant to unit maintenance.



### 3-50. LEVELING TRUNNIONS



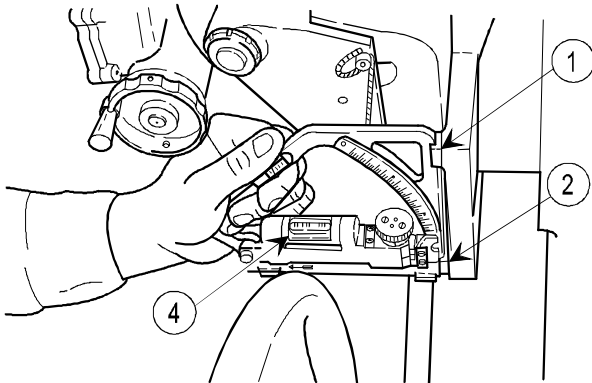
**WARNING**  
When using radioactively illuminated fire control equipment, follow radiation hazard procedures in the front of this manual.

#### NOTE

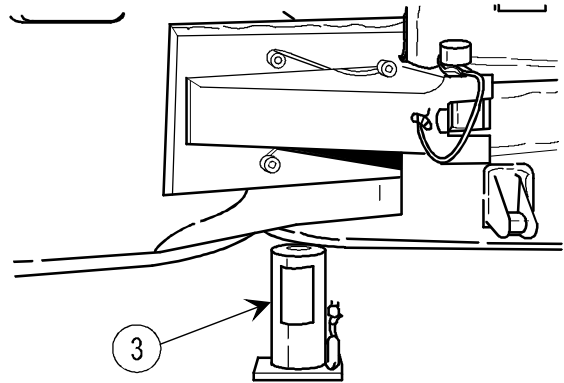
When leveling trunnions in the motor pool, it is not necessary to install spades.

- 1 Place the howitzer in firing position on a hard surface, such as concrete or asphalt, if possible; if not, place it on solid ground. If spades are installed, they do not need to be dug in.

### 3-50. LEVELING TRUNNIONS (cont)

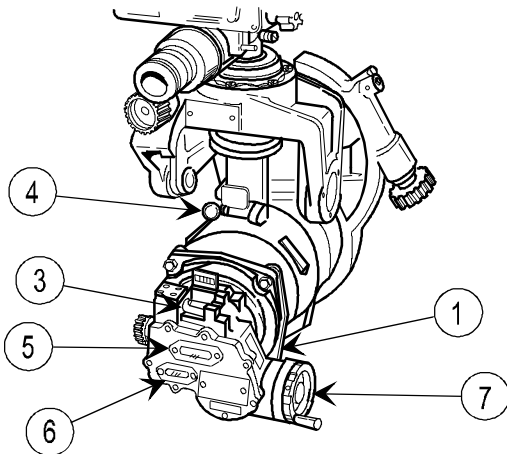


- 2 Set a pretested gunner's quadrant (1) on the cross level pads (2) with any corrections applied.



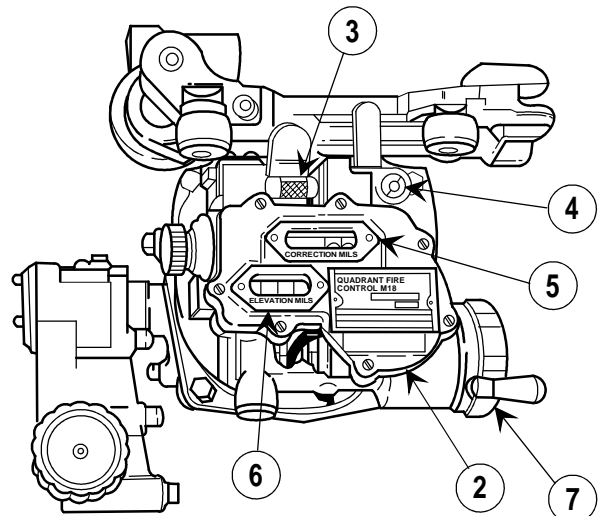
- 3 Using prime mover jack (3), jack up the howitzer on whichever side is necessary to center the gunner's quadrant bubble (4). Trunnions are now level.

### 3-51. TESTING M17 AND M18 FIRE CONTROL QUADRANTS

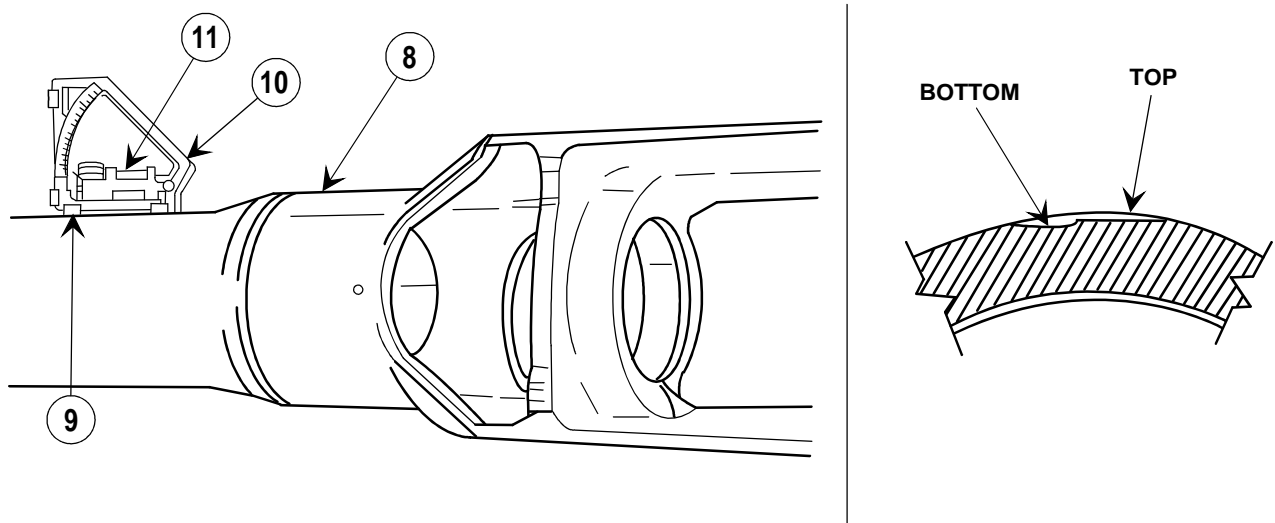


**WARNING**  
When using radioactively illuminated fire control equipment, follow radiation hazard procedures in the front of this manual.

- 1 Before starting, make sure there are no obvious defects on the M17 fire control quadrant (1) or the M18 fire control quadrant (2). Check the M17 and M18 fire control quadrants for looseness or wobble in their mounting on the trunnions. Also check that the markings on the elevation level vials (3) and cross level vials (4) are legible.



- 2 Place the howitzer in firing position on a hard surface, such as concrete or asphalt, if possible. Spades must be installed but do not need to be dug in. Trunnions must be level.
- 3 Set M17 and M18 elevation correction counters (5) to 00, and set elevation counters (6) to 0000. To eliminate backlash, rotate elevation control knob (7) with the last motion in a clockwise direction.



4 Elevate the cannon tube (8) to 0 mils, using the M17 fire control quadrant.

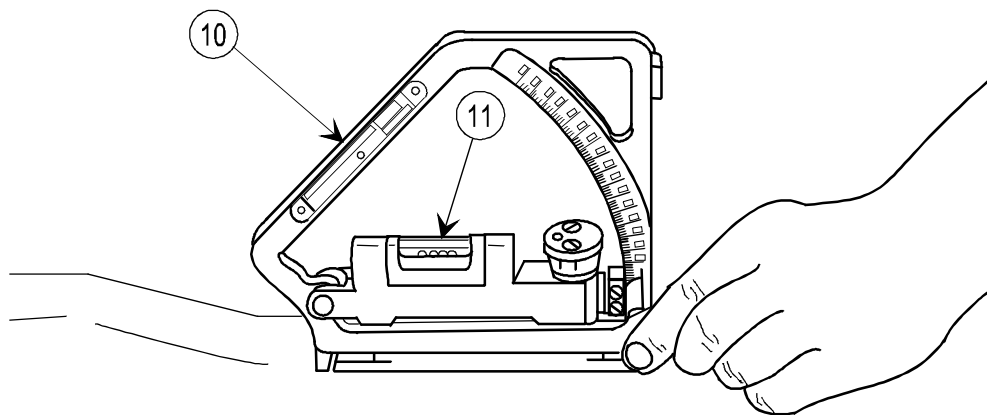
5 Ensure cannon leveling pads (9) are clean.

**NOTE**

Be sure to place gunner's quadrant on the top surface of the cannon tube leveling pad; use of the bottom surface may lead to erroneous readings.

6 Place the pretested gunner's quadrant (10), with corrections applied, on cannon leveling pads (9), aligning with edge of top surface as shown, with the LINE OF FIRE arrow pointed toward the muzzle end of cannon tube.

7 Elevate the cannon tube (8) with the elevating handwheel until the gunner's quadrant bubble (11) centers.



8 Rotate the gunner's quadrant (10) end-for-end. The gunner's quadrant bubble (11) should recenter. If the gunner's quadrant bubble does not recenter, verify the gunner's quadrant correction factor and repeat steps 5 through 7.

**NOTE**

To eliminate backlash during leveling, last motion of pitch/elevation and cross level control knobs will be in a clock-wise direction.

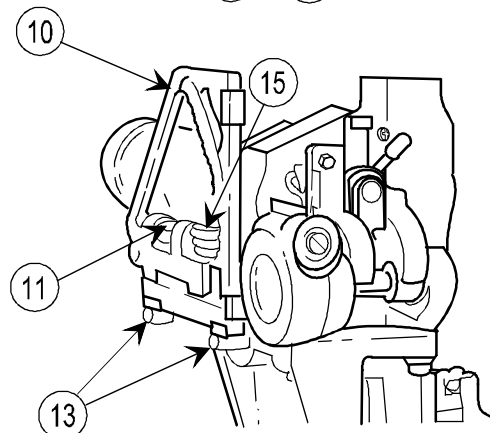
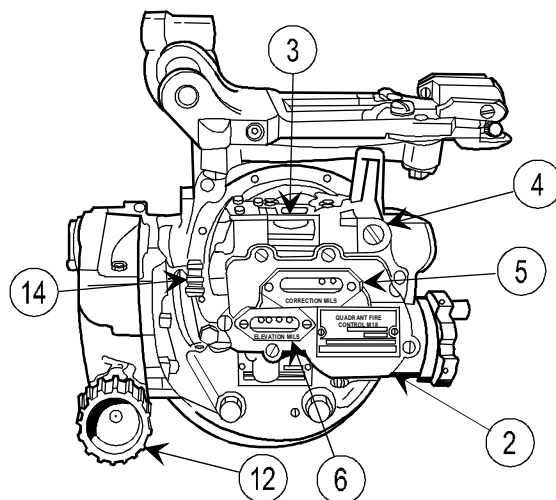
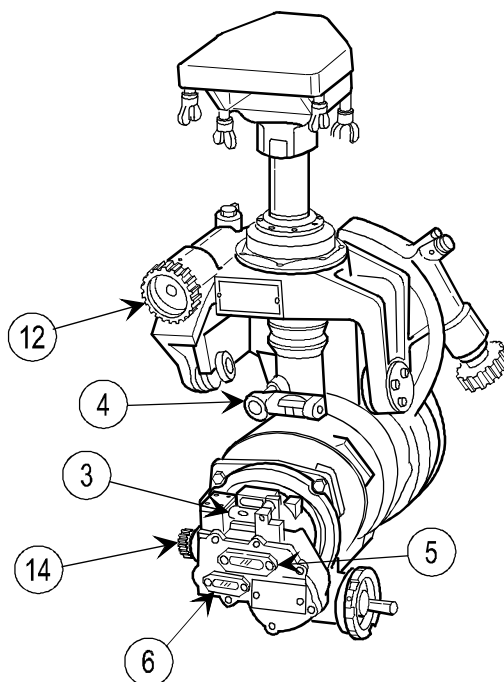
### 3-51. TESTING M17 AND M18 FIRE CONTROL QUADRANTS (cont)

- 9 Level the M17 and M18 fire control quadrants (2) by turning the cross level control knobs (12) until the cross level vials (4) center. With M17 and M18 elevation counters (6) set at 0000, the bubbles in the elevation level vials (3) should be centered. If the bubbles in the elevation level vials are not centered, either the counters or the level vials are out of adjustment. Notify unit maintenance.
- 10 With the bubbles in each elevation level vial and cross level vial still centered, place the gunner's quadrant (10) on the quadrant seats (13) with the LINE OF FIRE arrow towards the muzzle.
- 11 Center the gunner's quadrant bubble (11) and record the reading. The quadrant seats (13) are out of adjustment if the reading changes over 1 mil. Notify unit maintenance.

#### NOTE

Do not forget the gunner's quadrant correction factor when taking these readings.

- 12 Using the elevation correction knobs (14), insert a +5-mil correction in both elevation correction counters (5). The reading in each elevation counter (6) should now read 9995. Set each elevation counter back to zero. Elevate the cannon tube until the bubble in the elevation level vial (3) of the M18 fire control quadrant centers. Center the gunner's quadrant bubble (11). The micrometer (15) should show an increase of 5 mils. When the bubble in the M18 fire control quadrant elevation level vial is centered, the bubble in the M17 fire control quadrant elevation level vial (3) should center  $\pm 1$  graduation.

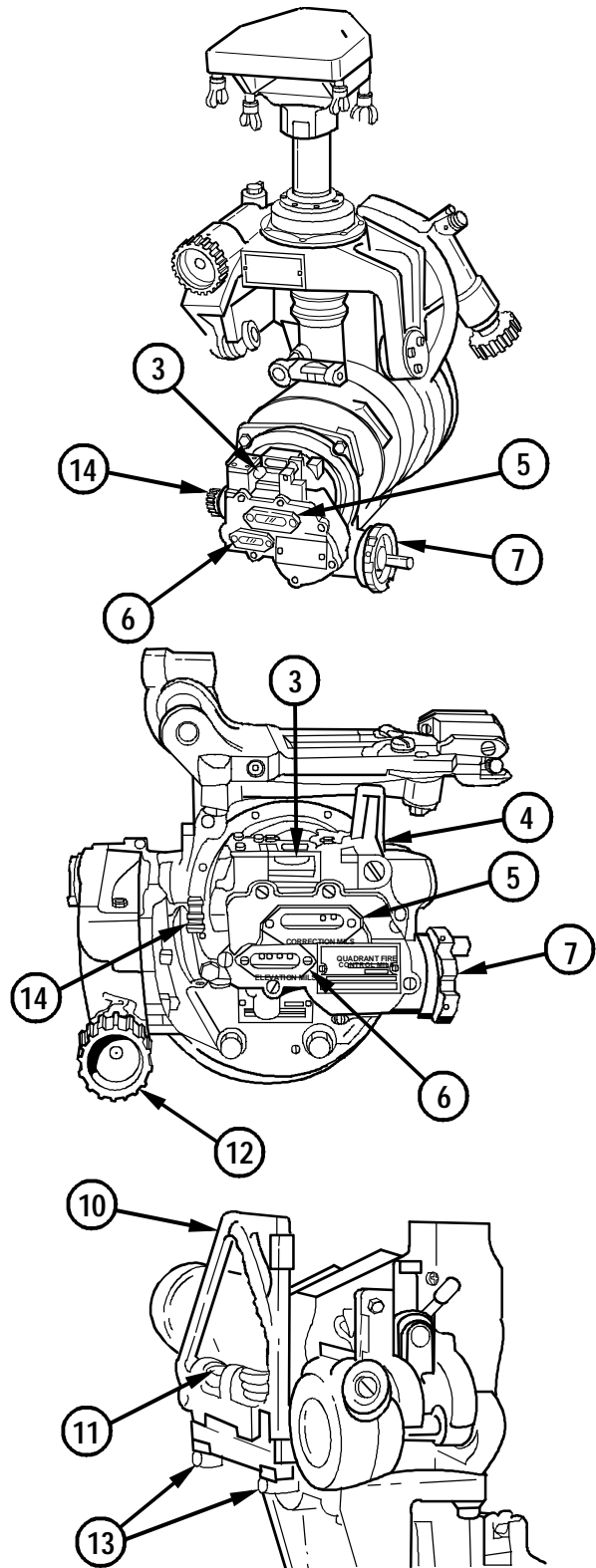


- 13 Set elevation counter (6) and elevation correction counter (5) on each fire control quadrant back to zero.
- 14 Insert corrections 10 mils at a time, up to 50 mils, on each elevation correction counter (5) and observe the following:
  - a. The reading in each elevation counter (6) should have decreased by the amount of correction applied within  $\pm 0.5$  mil.
  - b. The bubble in each elevation level vial (3) should still be centered. If either the M17 or M18 fire control quadrant does not perform properly, it is defective. Notify unit maintenance.
- 15 Return each elevation correction counter (5) to zero using elevation correction knobs (14).
- 16 Set 400 mils on each elevation counter (6) using the elevation control knobs (7).

**WARNING**

If nitrogen pressure is below 800 psi, the recoil mechanism could slide out of battery and cause severe personal injury. Make sure personnel are clear of recoil path.

- 17 Using the elevating handwheel, elevate the cannon tube to center the bubble in the elevation level vial (3) on the M18 fire control quadrant. Center the bubble in the cross level vial (4) using the cross level control knob (12). When the bubble in the M18 fire control quadrant elevation level vial is centered, the bubble in the M17 fire control quadrant elevation level vial (3) should center within  $\pm 1$  graduation.
- 18 Place 400 mils plus or minus any correction factor on the gunner's quadrant (10). Set gunner's quadrant with LINE OF FIRE arrow towards the muzzle on the quadrant seats (13). The gunner's quadrant bubble (11) should center within  $\pm 1$  mil. If not, the M18 fire control quadrant is defective. Notify unit maintenance.
- 19 Repeat steps 15 thru 17 at 900 mils. The M17 and M18 fire control quadrant tests are now completed.



### 3-52. RELIABILITY TEST OF M137/M137A3 PANTEL



#### WARNING

When using radioactively illuminated fire control equipment, follow radiation hazard procedures in the front of this manual.

#### NOTE

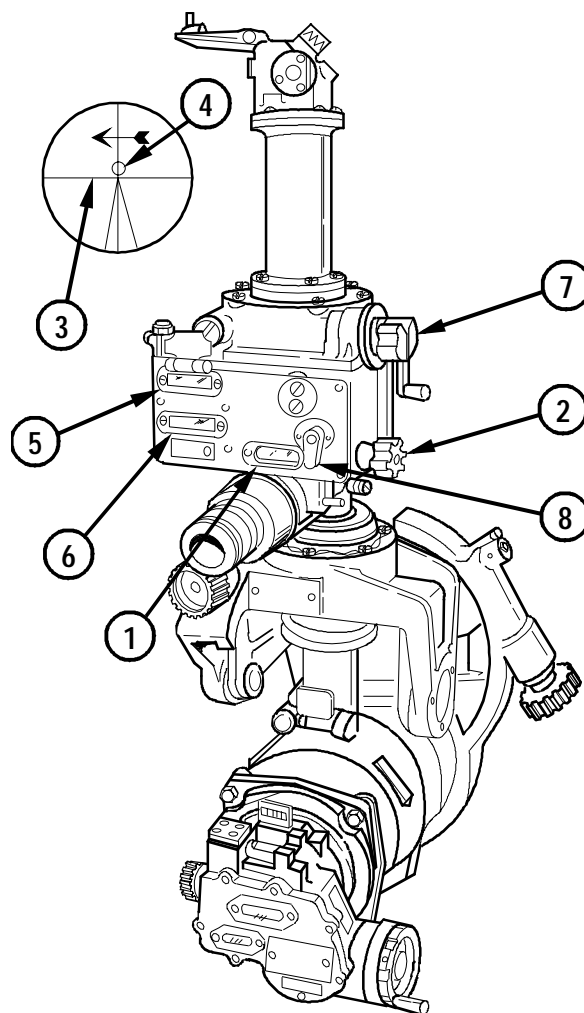
These tests are written and illustrated for the M137 pantel but also apply to the M137A3 pantel.

- 1 Level the cannon tube using the M17 fire control quadrant. Set the M137/M137A3 pantel correction counter (1) to zero using the gunner's aid knob (2).
- 2 Level the M171 telescope and quadrant mount.
- 3 Sighting through the M137/M137A3 pantel, aline the crosshairs (3) on a sharply defined aiming point (4) at least 50 to 100 meters away. (If less than 50 meters distance, use parallax shield.) Be careful not to move the crosshairs. Record the reading from the azimuth counter (5) and deflection counter (6).

#### NOTE

Eliminate backlash by making the last movement of the pantel head from left to right.

- 4 Using the azimuth knob (7), rotate the pantel head through two complete clockwise revolutions, and realign the crosshairs on the aiming point. Record the readings from the azimuth counter (5) and deflection counter (6). Be sure the last motion is from left to right.
- 5 Compare the azimuth and deflection counter readings obtained in steps 3 and 4. If the difference between the counter readings is greater than 1 mil, the M137/M137A3 pantel is defective. Notify unit maintenance.
- 6 Repeat steps 4 and 5 by rotating the pantel head counterclockwise. Be sure the last motion is from left to right.
- 7 Using gunner's aid knob (2), insert corrections 1 mil at a time, up to 50 mils, on the correction counter (1) and observe the following:
  - a. The crosshairs (3) should not move from the aiming point (4).
  - b. Reading on azimuth counter (5) should not change.



- c. The reading from the deflection counter (6) should change by the amount of correction applied.
- 8 Repeat step 7, applying corrections in the opposite direction. If the M137/M137A3 pantel does not perform as stated in step 7, it is defective. Notify unit maintenance.
- 9 Disengage the deflection clutch (8). Turn the azimuth knob (7). The deflection counter (6) should not move.
- 10 Engage the deflection clutch (8).

### 3-53. ALINEMENT TEST OF M171 TELESCOPE AND QUADRANT MOUNT AND M137/M137A3 PANTEL



#### WARNING

When using radioactively illuminated fire control equipment, follow radiation hazard procedures in the front of this manual.

#### NOTE

These tests are written and illustrated for the M137 pantel but also apply to the M137A3 pantel.

- 1 Elevate the cannon tube to 0 mils using the M18 fire control quadrant.
- 2 Level trunnions (p 3-57).

#### CAUTION

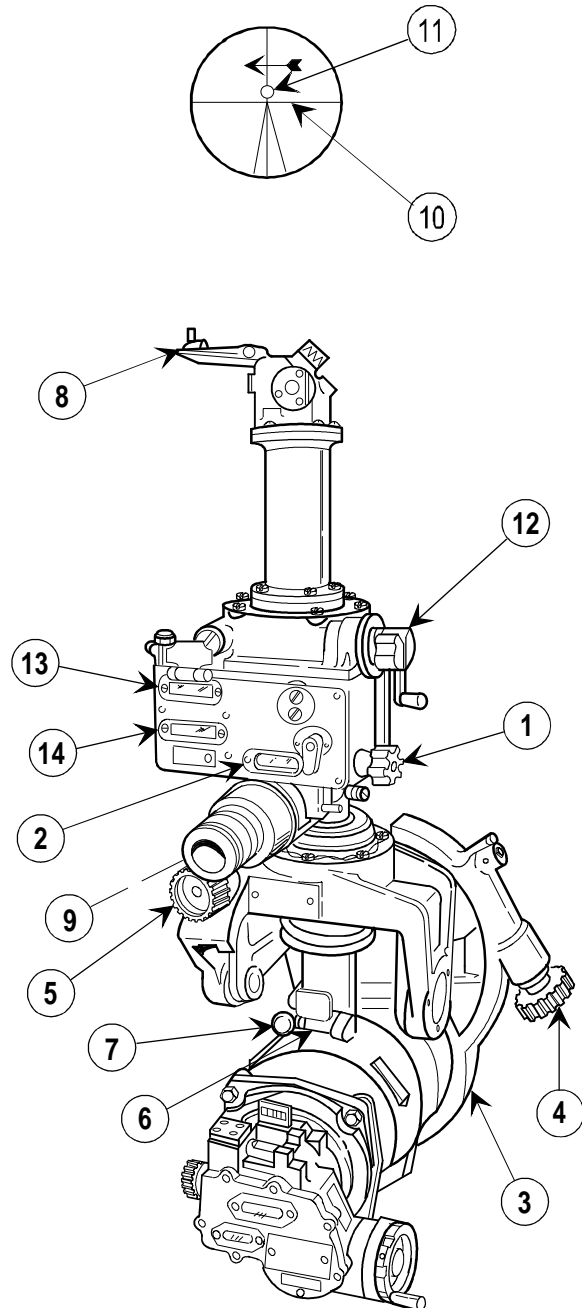
Do not disturb traverse or move the weapon for any reason when conducting this test.

- 3 Use the correction knob (1) to set the correction counter (2) on the M137/M137A3 pantel to zero.
- 4 Carefully level the M171 telescope and quadrant mount (3) by turning the pitch level control knob (4) and cross level control knob (5) until the bubbles in the pitch level vial (6) and cross level vial (7) center.
- 5 Select a stationary aiming point as far away as possible to the left side of the howitzer so that it will be visible during steps 6, 8, and 11.

#### NOTE

Eliminate backlash by making the last movement of the pantel head from left to right.

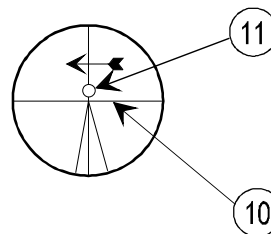
- 6 Close the parallax shield (8) and, with bubbles in pitch level vial (6) and cross level vial (7) still centered, sight through the eyepiece (9) and align the telescope crosshairs (10) on a sharply defined stationary aiming point (11) by turning the azimuth knob (12). Record the readings from the azimuth counter (13) and deflection counter (14).



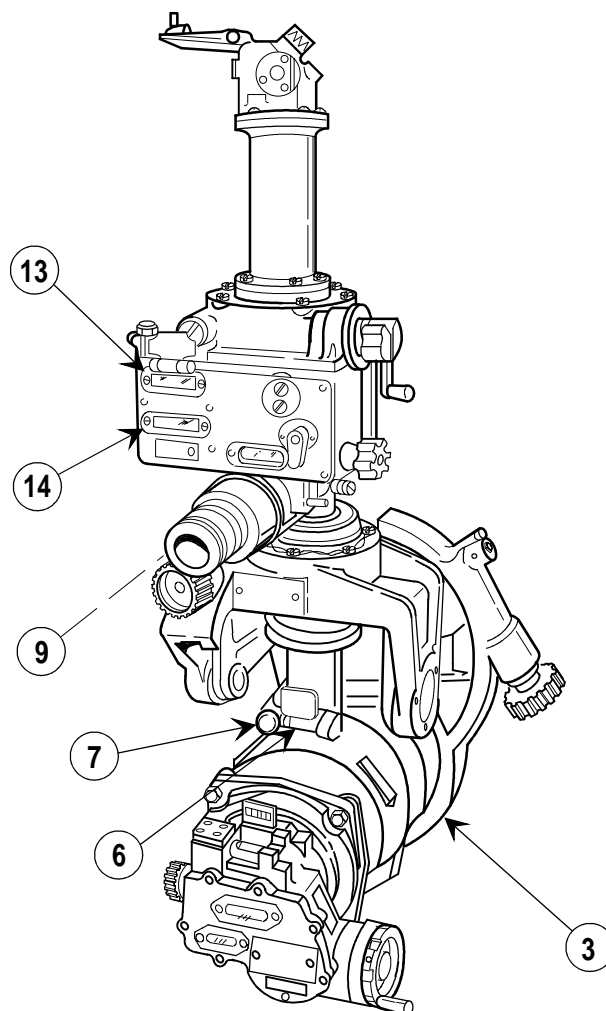
### 3-53. ALINEMENT TEST OF M171 TELESCOPE AND QUADRANT MOUNT AND M137/M137A3 PANTEL (cont)

#### WARNING

If nitrogen pressure is below 800 psi, the recoil mechanism could slide out of battery and cause severe personal injury. Make sure personnel are clear of recoil path.



- 7 Slowly elevate the cannon tube to 400 mils, and recenter the bubbles in the pitch level vial (6) and cross level vial (7) on the M171 telescope and quadrant mount (3).
- 8 Sighting through eyepiece (9), realine the crosshairs (10) on the aiming point (11). Record the readings from the azimuth counter (13) and deflection counter (14).
- 9 Compare the readings from the azimuth counter (13) and deflection counter (14) recorded in steps 6 and 8. If the difference between the readings is greater than 1 mil, the M171 telescope and quadrant mount is defective. Notify unit maintenance.
- 10 Slowly elevate the cannon tube to 900 mils and recenter the bubbles in the pitch level vial (6) and cross level vial (7).
- 11 Sighting through eyepiece (9), realign the crosshairs (10) on the same aiming point (11). Record the readings of the azimuth counter (13) and deflection counter (14).
- 12 Compare the readings of the azimuth counter (13) and deflection counter (14) recorded in steps 6 and 11. If the difference between the counter readings is greater than 3 mils at 401 to 900 mils elevation, the M171 telescope and quadrant mount is defective. Notify unit maintenance.



### 3-54. M139/M139A1 ALINEMENT DEVICE COMPARISON TEST



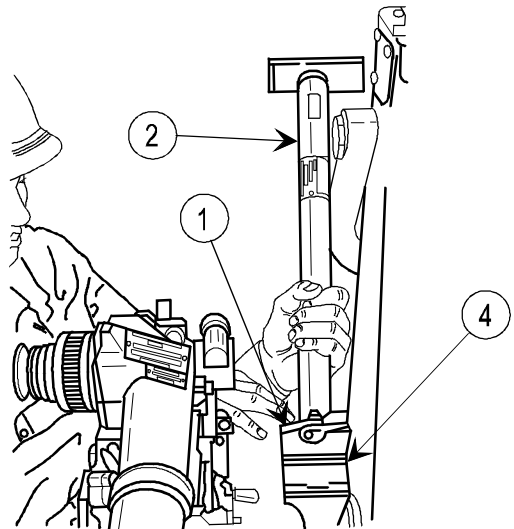
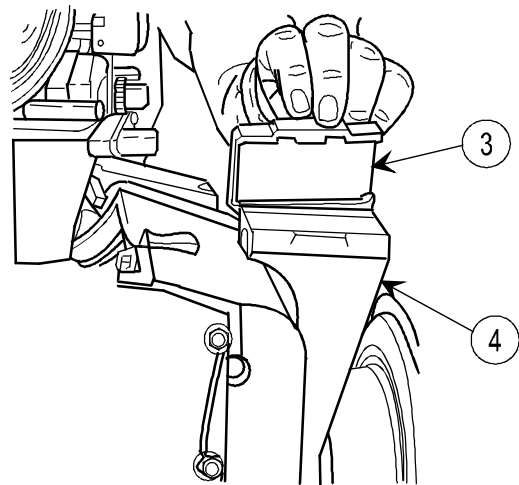
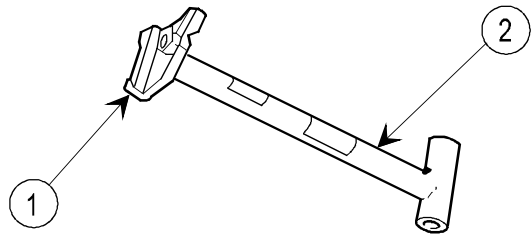
#### WARNING

When using radioactively illuminated fire control equipment, follow radiation hazard procedures in the front of this manual.

#### NOTE

These tests are written and illustrated for the M139 alinement device but also apply to the M139A1 alinement device.

- 1 Get two M139/M139A1 alinement devices from other howitzer sections.
- 2 Inspect mating surfaces (1) of the alinement device (2) for nicks, burrs, and dirt. If dirty, clean with a rag (item 24, appx D). If mating surfaces (1) are burred, notify unit maintenance. If mating surfaces are not burred, continue with test.
- 3 Remove protective cover (3) from dovetail (4) and check the surface as you did for the alinement device in step 2. Wipe dovetail clean with a rag (item 24, appx D). Notify unit maintenance to remove any nicks or burrs.
- 4 Level the cannon tube using the M18 fire control quadrant.
- 5 Install the alinement device (2). Make sure the mating surface (1) matches with dovetail (4).
- 6 Level the M171 telescope and quadrant mount.



### 3-54. M139/M139A1 ALINEMENT DEVICE COMPARISON TEST (cont)

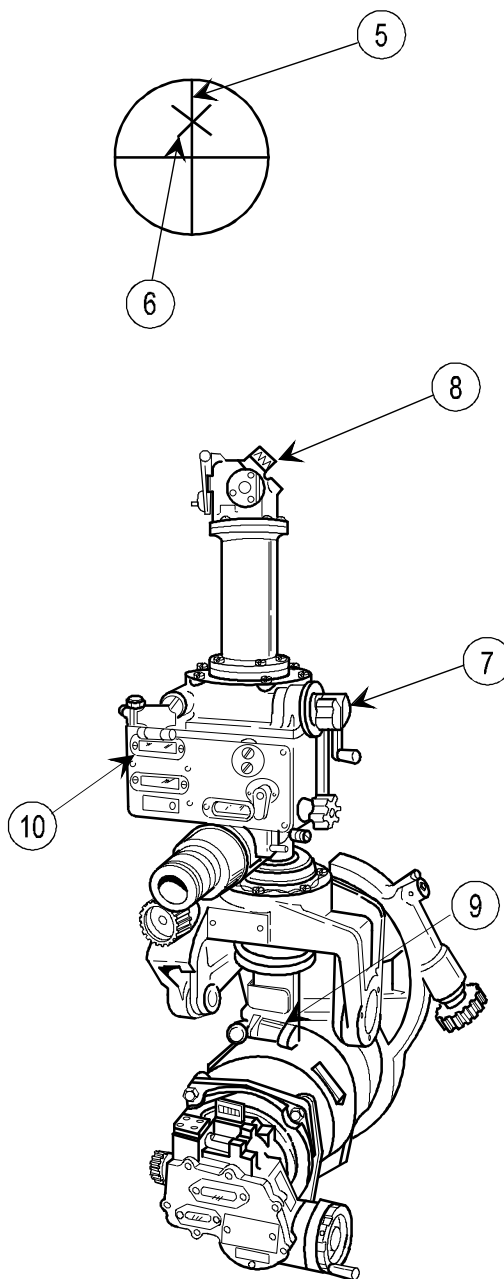
#### CAUTION

After leveling the M171 telescope and quadrant mount, be careful not to disturb the pitch level setting.

#### NOTE

Steps 7 through 12 are written and illustrated for the M137 pantel but also apply to the M137A3 pantel.

- 7 Align the crosshairs (5) of the M137/M137A3 pantel with the crosshairs (6) of the alinement device by turning azimuth knob (7). Center the crosshairs for elevation; turn the elevation knob (8). Last movement of azimuth knob should be clockwise.
- 8 With the pantel and alinement device crosshairs aligned, the bubble centered in the pitch level vial (9) of the M171 telescope and quadrant mount, and the cannon tube at zero elevation, record the reading of the pantel azimuth counter (10).
- 9 Remove the alinement device and install a second alinement device. Make sure dovetail and mating surfaces match.
- 10 Repeat steps 7 and 8 with a second and third alinement device.
- 11 Compare the three azimuth counter readings. If readings from the alinement devices fall within  $\pm 0.5$  mil of each other, the alinement devices are serviceable. Any alinement device that exceeds the  $\pm 0.5$  mil tolerance is defective. Chief of section, perform boresighting of M137/M137A3 panoramic telescope using distant aiming point. If alignment problem persists, notify unit maintenance.
- 12 Remove and return M139/M139A1 alinement devices to the other howitzer sections where they came from. Remove battery (M139A1 only) and store the one assigned to your howitzer section in original case.



CHAPTER 4  
AMMUNITION

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Section I. GENERAL

Section Index

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4-7.	Flash Reducer, M2 (T2).....	4-32.2

4-1. GENERAL

- a. Ammunition for the M199 cannon is the separate-loading type. The loading of each complete round into the cannon requires three separate operations: loading the fuzed projectile, the propelling charge, and the primer.
- b. These components are shipped separately; therefore, the cannon crew must know how to store, unpack, inspect, prepare, and load each complete round every time the weapon is fired.
- (1) The chief of section supervises the loading and the preparation duties performed by cannoneers.
- (2) The chief of section must also see that the cannoneers and driver are cross-trained in the specific duties of the care, handling, unpacking, inspection, preparation, and loading of the ammunition components in order to sustain a 24-hour operation or to operate with a reduced crew.
- c. It is planned that future ammo for all new 155mm weapons will be interchangeable. This will enable projectiles and propelling charges of one NATO nation to be fired from the 155mm weapons of all others. Current items of interchangeability are contained in chapter 5.

#### 4-1. GENERAL (cont)

##### WARNING

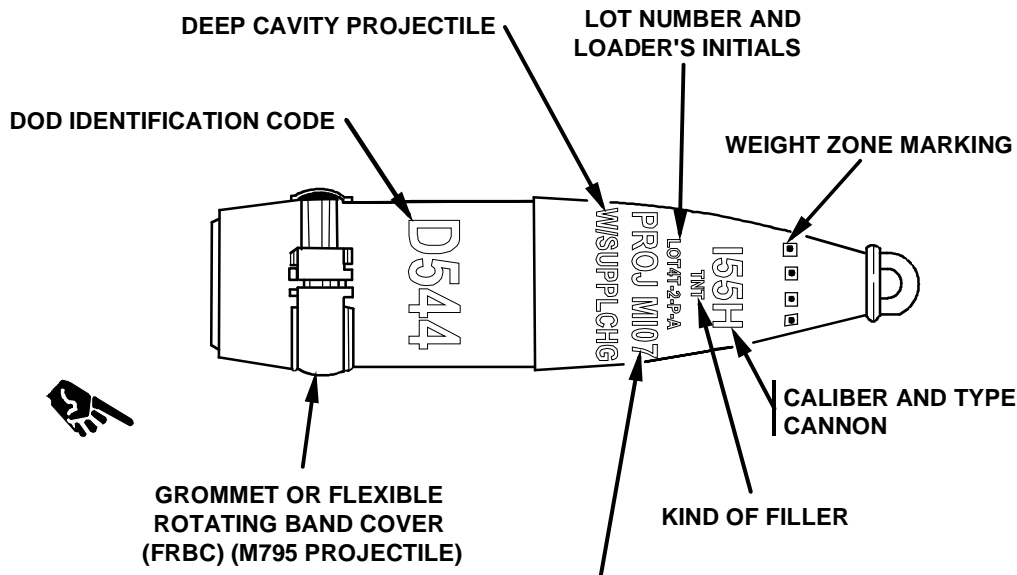
Until safety and reliability testing is completed, the use of ammo other than prescribed in this manual is prohibited.

d. Refer to page 4-76 for information about the Loose Projectile Restraint System (LPRS). The LPRS is a divider rack for securing loose unfuzed projectiles for transportation in a field artillery companion vehicle.

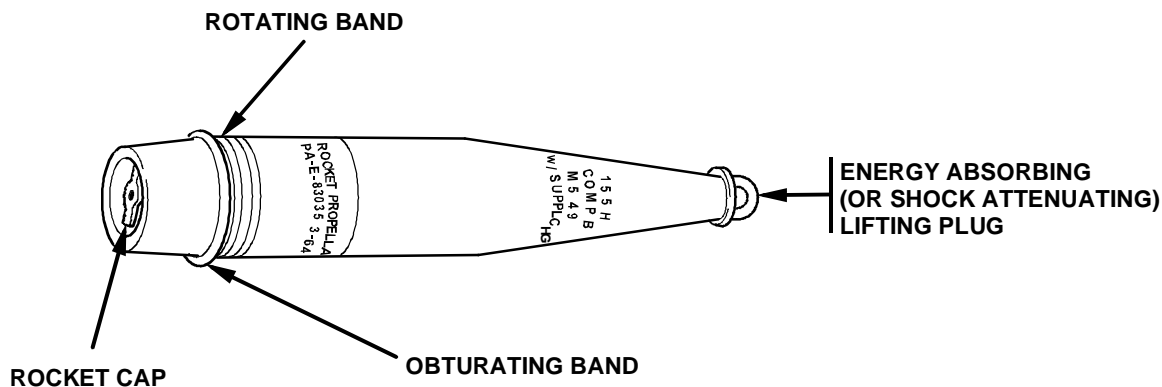
#### 4-2. IDENTIFICATION

Important information is stenciled on each projectile. New and old projectile colorings and markings are listed on page 4-3. Knowing the color coding and the meaning of the markings will aid in the rapid selection of the required projectile when firing. Know your ammunition!

##### MARKING OF THE 155-MM HE PROJECTILE



PROJECTILE, 155-MM, HERA, M549



**Table 4-1. Model Numbers and Color Coding of Projectiles**

Model Number and Type of Projectile	New Manufacture			Old Manufacture		
	Color of Projectile	No./Color of Bands	Marking	Color Of Projectile	No./Color of Bands	Marking
M107, HE, comp B and TNT filler w/and w/o suppl charge	Olive drab	None	Yellow	Olive Drab	None	Yellow
M795, HE	Olive drab	None	Yellow			
M110, agent (H, HD), w/burster	Gray	2/Green 1/Yellow <sup>2</sup>	Green	Gray	2/Green	Green
M110 (M110E1), M110A1 (M110E2), M110A2 (M110E3), smoke (WP)	Light green	1/Yellow	Red	Gray	1/Yellow	Yellow
M116, M116B1, smoke BE, (HC)	Light green	None	Black	Gray	1/Yellow	Yellow
M116A1, smoke BE, (HC)	Light green	None	Black		Not applicable	
M121A1, Agent (GB or VX), w/burster	Gray	3/Green 1/Yellow <sup>2</sup>	Green	Gray Green	GB 1/ Green VX 2/ Green	Green

<sup>2</sup>Renovated or newly manufactured (post 1976) projectiles will be marked with one green band and, if burstered, one yellow band.

## 4-2. IDENTIFICATION (cont)

**Table 4-1. Model Numbers and Color Coding of Projectiles (cont)**

Model Number and Type of Projectile	New Manufacture			Old Manufacture		
	Color of Projectile	No./Color of Bands	Marking	Color Of Projectile	No./Color of Bands	Marking
M687, agent (GB2) w/burster	Gray	1/Broken Green 1/Yellow	Dark green		Not applicable	
M449 series, HE, ICM	Olive drab	Diamonds <sup>1</sup>	Yellow	Olive drab	None	Yellow
M483A1, HE, ICM	Olive drab	Diamonds <sup>1</sup>	Yellow		Not applicable	
M864, HE, ICM, DP Extended range	Olive drab	Diamonds <sup>1</sup>	Yellow		Not applicable	
M485A1, M485A2, Illuminating	Olive drab	1/White	White	Olive Drab	None	White
M549, M549A1, HERA	Olive drab	None	Yellow		Not applicable	
M692, HE (ADAM <sup>3</sup> )	Olive drab	Tri-Angles <sup>4</sup>	(L) Yellow		Not applicable	
M731, HE (ADAM <sup>3</sup> )	Olive drab	Tri-Angles <sup>4</sup>	(S) Yellow		Not applicable	
M718/ M718A1, AT (RAAMS <sup>5</sup> )	Olive drab	Tri-Angles <sup>4</sup>	(L) Yellow		Not applicable	

<sup>1</sup>Row of yellow diamonds between nose and bourrelet of projectile.

<sup>3</sup>ADAM—Area denial artillery munition.

<sup>4</sup>Yellow triangles between the nose and bourrelet of projectile with letters S or L painted inside the triangle.

<sup>5</sup>RAAMS—Remote anti-armor mine system.

**Table 4-1. Model Numbers and Color Coding of Projectiles (cont)**

Model Number and Type of Projectile	New Manufacture			Old Manufacture		
	Color of Projectile	No./Color of Bands	Marking	Color Of Projectile	No./Color of Bands	Marking
M741/ M741A1, AT (RAAMS <sup>5</sup> )	Olive drab	Tri-Angles <sup>4</sup>	(S) Yellow		Not applicable	
M712, HEAT (Copperhead)	Black (except window area of cone)	None	Yellow		Not applicable	
M823, training (Copperhead)	Bronze	None	Black		Not applicable	
M804, practice	Blue	1/Brown	White		Not applicable	
M804A1, practice	Blue	1/Yellow	White		Not applicable	
M825, M825A1 smoke (WP)	Light green	1/Yellow	Red		Not applicable	

<sup>4</sup>Yellow triangles between the nose and bourrelet of projectile with letters S or L painted inside the triangle.

<sup>5</sup>RAAMS—Remote anti-armor mine system.

#### **4-3. AUTHORIZED PROJECTILES**

##### **WARNING**

Unauthorized assembly and use of projectile and propelling charges are extremely dangerous. Make sure projectiles are marked 155H (not G).

- a. Projectile and fuze combinations for authorized rounds are given on page 4-6.

### 4-3. AUTHORIZED PROJECTILES (cont)

Table 4-2. Authorized Projectile and Fuze Combinations

	Fuze													
	PD			MT	MTSQ				PROX			ET		MOFA
Projectiles	MK 399 <sup>7</sup> Mod 1	M557/M572	M739 Series	M565	M501 Series	M564	M577 Series	M582 Series	M728 <sup>2</sup>	M732 Series	M514 Series <sup>2,4</sup>	M762 Series	M767 Series	M782
Agent, H, HD, M110		X	X			X		X					X	X
Agent, GB, VX, M121A1 <sup>1</sup>		X	X						P	X				X
Agent, GB2, M687		X	X											X
HERA, M549/M549A1 <sup>6</sup>	X	X	X					X		X <sup>5</sup>			X	X
HE, M107 (Normal Cavity)	X	X	X			X		X		X			X	X
HE, M107 (Deep Cavity)	X	X	X			X		X	P	X	P		X	X
HE, M795	X	X	X					X		X			X	X
HE, M449 Series				X			X					X		
HE, M483A1							X <sup>3</sup>					X <sup>3</sup>		
HE, M864							X <sup>3</sup>					X <sup>3</sup>		

#### WARNING

The M728 proximity fuze shall not be used with the M203 series propelling charge. Premature malfunction could result.

<sup>1</sup>M728 and M732 fired with "VX" projectile in combat emergency only.

<sup>2</sup>The letter P shows compatibility for proximity fuzes that require removal of the supplementary charge to make room for the long intrusion fuze.

<sup>3</sup>The M483A1/M864 projectile may be used for self-registration (as a spotting round) by replacing the expulsion charge assembly with a projectile spotting charge added to the M577 series or M762 fuzes.

<sup>4</sup>USMC Training Use only. Firing limits 0°F to 120°F (-18°C to +49°C).

<sup>5</sup>Only the M732A2 fuze may be used for this combination.

<sup>6</sup>M549/M549A1 projectile may break-up upon impact with urban structures and bunkers rendering it an ineffective penetrator of these targets.

<sup>7</sup>Refer to the description of the MK399 MOD 1 fuze in paragraph 4-4.j for expected performance against MOUT targets.

**Table 4-2. Authorized Projectile and Fuze Combinations (cont)**

	Fuze													
	PD			MT	MTSQ				PROX			ET		MOFA
Projectiles	MK 399 <sup>7</sup> Mod 1	M557/M572	M739 Series	M565	M501 Series	M564	M577 Series	M582 Series	M728 <sup>2</sup>	M732 Series	M514 Series <sup>2,4</sup>	M762 Series	M767 Series	M782
Illuminating, M485 Series				X			X					X		
SMOKE, HC, Colored, BE, M116, M116B1					X									
SMOKE, HC, BE, M116A1				X			X					X		
SMOKE, WP, M110 Series		X	X			X		X					X	X
SMOKE, WP, M825/ M825A1							X					X		
HE, M692/M731 (ADAM)							X					X		
AT, M718, M718A1, M741, M741A1 (RAAM)							X					X		
PRACTICE, M804		X	X			X		X		X			X	X
PRACTICE, M804A1		X	X			X		X					X	X
HE, M898 (SADARM)							X <sup>8</sup>							

**WARNING**

Only those items listed are authorized. Firing of unauthorized propelling charge, projectile, or fuze combinations can result in critical malfunctions. Charge 1 (M3 series green bag) will not be fired in the M199 cannon. Charge 2 (green bag charge (GB)) may be used with any M100 series projectile, M449, M804, M804A1, and the M485 projectile; however, stickers may occasionally be encountered. All other projectiles, except the M795, use minimum charge 3 (GB) or charge 3 (white bag charge (WB)). M795 uses minimum charge 3 (GB) or charge 4 (WB). Firing below these charges may result in stickers.

<sup>8</sup>Use only M577A1 Fuzes DODIC NAO, NSN 1390-01-462-0661, Lot #HAT 90M033-011 with Projectile, 155mm: HE M898 (SADARM). M577A1 Fuzes are marked "M898 SADARM Compatible".

- b. Authorized projectile and propelling charge combinations are given in the following table.

### 4-3. AUTHORIZED PROJECTILES (cont)

**Table 4-3. Authorized Projectile and Propelling Charge Combinations**

	Propelling Charge																		Firing Warnings
	(GB) M3A1					(WB) M4A1 and M4A2					M119	M119A1 and M119A2	M203 and M203A1	M231 <sup>8</sup>		M232 <sup>8</sup>			
	Charge					Charge					Charge	Charge	Charge	Charge		Charge			
Projectiles	1	2	3	7,8	5	3	4	5	6	7	8	7,8 <sup>1</sup>	8	1	2	3	4	5	
M107, HE	No <sup>2</sup>	x	x	x	x	x	x	x	x	x	x	x	No	x	x	x	x	No	
M795, HE	No	No	x	x	x	No	x	x	x	x	x	x	x	x	x	x	x	No	
M110 agent (H, HD)	No <sup>2</sup>	x	x	x	x	x	x	x	x	x	x	x	No	x	x	x	x	No	M110 agent burst loaded with tetrytol cannot be stored/ fired at tempera- tures exceeding +125°F (+52°C)
M110 (M110E1), M110A1 (M110E2), M110A2 (M110E3), smoke (WP)	No <sup>2</sup>	x	x	x	x	x	x	x	x	x	x	x	No	x	x	x	x	No	M110 (M110E1) burst loaded with tetrytol cannot be stored/fired at temper- atures exceeding +125°F (+52°C)

<sup>1</sup>M119A2 charge 7 is equivalent to M119A1 charge 8. Refer to firing tables for small differences in velocity which affect range.

<sup>2</sup>Charge 1 must not be fired in the M199 cannon because of stickers. Firing at charge 2 may result in stickers occasionally.

<sup>8</sup> Do not load or fire M231 charges with M232 charges. Critical malfunction could result.

#### NOTE

PRIMER M82 is the only authorized primer to be used in the M199 cannon.

M203 series charge 8 is not equivalent to M119A1 charge 8.

M232 charge 5 is equivalent to M203 series charge 8.

**Table 4-3. Authorized Projectile and Propelling Charge Combinations (cont)**

	Propelling Charge																		Firing Warnings
	(GB) M3A1					(WB) M4A1 and M4A2					M119	M119A1 and M119A2	M203 and M203A1	M231 <sup>8</sup>		M232 <sup>8</sup>			
	Charge					Charge					Charge	Charge	Charge	Charge		Charge			
Projectiles	1	2	3	4	5	3	4	5	6	7	8	7,8 <sup>1</sup>	8	1	2	3	4	5	
																			Do not fire WP projectiles known to have been stored other than base down. Firing of such projectiles could contribute to in-bore explosions or close-in premature malfunctions
M116, M116B1, Smoke, BE (HC)	No <sup>2</sup>	x	x	x	x	x	x	x	x	No	No	No	No	x	x	x	No	No	
M116A1, Smoke, BE, HC	No <sup>2</sup>	x	x	x	x	x	x	x	x	x	No	x	No	x	x	x	x	No	
M121A1, Agent (GB or VX)	No <sup>2</sup>	x	x	x	x	x	x	x	x	x	No	x	No	x	x	x	x	No	

<sup>1</sup>M119A2 charge 7 is equivalent to M119A1 charge 8. Refer to firing tables for small differences in velocity which affect range.

<sup>2</sup>Charge 1 must not be fired in the M199 cannon because of stickers. Firing at charge 2 may result in stickers occasionally.

<sup>8</sup> Do not load or fire M231 charges with M232 charges. Critical malfunction could result.

**NOTE**

PRIMER M82 is the only authorized primer to be used in the M199 cannon.

M203 series charge 8 is not equivalent to M119A1 charge 8.

M232 charge 5 is equivalent to M203 series charge 8.

#### 4-3. AUTHORIZED PROJECTILES (cont)

**Table 4-3. Authorized Projectile and Propelling Charge Combinations (cont)**

	Propelling Charge															Firing Warnings		
	(GB) M3A1					(WB) M4A1 and M4A2					M119A1 and M119A2	M203 and M203A1	M231 <sup>8</sup>		M232 <sup>8</sup>			
	Charge					Charge					Charge	Charge	Charge		Charge			
Projectiles	1	2	3	4	5	3	4	5	6	7	7,8 <sup>1</sup>	8	1	2	3		4	5
M687 agent (GB2)	No <sup>2</sup>	No	x	x	x	x	x	x	x	x	x	No	No	No	x	x	No	Firing below charge 3 may result in stickers. <sup>3</sup>
M449, M449A1, HE, ICM	No <sup>2</sup>	x	x	x	x	x	x	x	x	x	x	No	x	x	x	x	No	
M483A1, HE, ICM	No <sup>2</sup>	No	x	x	x	x	x	x	x	x	x	No	x	x	x	x	No	Firing below charge 3 may result in stickers. <sup>3</sup>
M864, HE, ICM, extended range	No <sup>2</sup>	No	No	No	No	No	No	No	No	x	x	x	No	No	x	x	No	Firing below charge 3 may result in stickers. The M864 shall be fired to achieve ranges beyond the capabilities of the M483A1 projectile or when the M483A1 is not available. <sup>3</sup>

<sup>1</sup>M119A2 charge 7 is equivalent to M119A1 charge 8. Refer to firing tables for small differences in velocity which affect range.

<sup>2</sup>Charge 1 must not be fired in the M199 cannon because of stickers. Firing at charge 2 may result in stickers occasionally.

<sup>3</sup>For bag charges only.

<sup>8</sup>Do not load or fire M231 charges with M232 charges. Critical malfunction could result.

#### NOTE

PRIMER M82 is the only authorized primer to be used in the M199 cannon.

M203 series charge 8 is not equivalent to M119A1 charge 8.

M232 charge 5 is equivalent to M203 series charge 8.

**Table 4-3. Authorized Projectile and Propelling Charge Combinations (cont)**

	Propelling Charge															Firing Warnings		
	(GB) M3A1					(WB) M4A1 and M4A2					M119A1 and M119A2	M203 and M203A1	M231 <sup>8</sup>		M232 <sup>8</sup>			
	Charge					Charge					Charge	Charge	Charge		Charge			
Projectiles	1	2	3	4	5	3	4	5	6	7	7,8 <sup>1</sup>	8	1	2	3		4	5
M485A1, M485A2 Illuminating	No <sup>2</sup>	x	x	x	x	x	x	x	x	x	x	No	x	x	x	x	No	M485A1 and M485A2 projectiles are not reliable when fired at charges 6, 7 and 8 with fuze settings of 10 seconds or less.
M549, HERA <sup>5</sup>	No <sup>2</sup>	No	No	No	No	No	No	No	No	x	x	No	No	No	x	x	No	The M549A1 may be fired with M203 series charge, but M549 must never be fired with M203 series charge.
M549A1, HERA <sup>5</sup>	No <sup>2</sup>	No	No	No	No	No	No	No	No	x	x	x	No	No	x	x	No	
M692, HE (ADAM)	No <sup>2</sup>	No	x	x	x	x	x	x	x	x	x	No	x	x	x	x	No	Firing below charge 3 may result in stickers. <sup>3</sup>
M731, HE (ADAM)	No <sup>2</sup>	No	x	x	x	x	x	x	x	x	x	No	x	x	x	x	No	

<sup>1</sup>M119A2 charge 7 is equivalent to M119A1 charge 8. Refer to firing tables for small differences in velocity which affect range.

<sup>2</sup>Charge 1 must not be fired in the M199 cannon because of stickers. Firing at charge 2 may result in stickers occasionally.

<sup>3</sup>For bag charges only.

<sup>4</sup>Deleted.

<sup>5</sup>Do not fire the M549/M549A1 projectiles if the obturating band is missing or broken. If the band is displaced and can be repositioned and remain in the groove, the projectile can be fired.

<sup>8</sup>Do not load or fire M231 charges with M232 charges. Critical malfunction could result.

**NOTE**

PRIMER M82 is the only authorized primer to be used in the M199 cannon.

M203 series charge 8 is not equivalent to M119A1 charge 8.

M232 charge 5 is equivalent to M203 series charge 8.

#### 4-3. AUTHORIZED PROJECTILES (cont)

**Table 4-3. Authorized Projectile and Propelling Charge Combinations (cont)**

	Propelling Charge															Firing Warnings		
	(GB) M3A1					(WB) M4A1 and M4A2					M119A1 and M119A2	M203 and M203A1	M231 <sup>8</sup>		M232 <sup>8</sup>			
	Charge					Charge					Charge	Charge	Charge		Charge			
Projectiles	1	2	3	4	5	3	4	5	6	7	7,8 <sup>1</sup>	8	1	2	3	4	5	
M718, M718A1, AT (RAAMS)	No <sup>2</sup>	No	x	x	x	x	x	x	x	x	x	No	x	x	x	x	No	Firing below charge 3 may result in stickers. <sup>3</sup>
M741, M741A1, AT (RAAMS)	No <sup>2</sup>	No	x	x	x	x	x	x	x	x	x	No	x	x	x	x	No	
M712, HEAT (Copper-head)	No <sup>2</sup>	No	No	x	x	No	x	x	x	x	x	No	x	x	x	x	No	
M804, practice	No <sup>2</sup>	x	x	x	x	x	x	x	x	x	x	No	x	x	x	x	No	

<sup>1</sup>M119A2 charge 7 is equivalent to M119/M119A1 charge 8. Refer to firing tables for small differences in velocity which affect range.

<sup>2</sup>Charge 1 must not be fired in the M199 cannon because of stickers. Firing at charge 2 may result in stickers occasionally.

<sup>3</sup>For bag charges only.

<sup>8</sup> Do not load or fire M231 charges with M232 charges. Critical malfunction could result.

#### NOTE

PRIMER M82 is the only authorized primer to be used in the M199 cannon.

M203 series charge 8 is not equivalent to M119/M119A1 charge 8.

M232 charge 5 is equivalent to M203 series charge 8.

**Table 4-3. Authorized Projectile and Propelling Charge Combinations (cont)**

	Propelling Charge															Firing Warnings		
	(GB) M3A1					(WB) M4A1 and M4A2					M119A1 and M119A2	M203 and M203A1	M231 <sup>8</sup>		M232 <sup>8</sup>			
	Charge					Charge					Charge	Charge	Charge					
Projectiles	1	2	3	4	5	3	4	5	6	7	7,8 <sup>1</sup>	8	1	2	3		4	5
M825 (WP) <sup>6</sup>	No <sup>2</sup>	No	x	x	x	x	x	x	x	x	x	No	No	No	No		No	No
M825A1, WP SMOKE	No	No	x	x	x	x	x	x	x	x	x	x	x	x	x	x	No	
HE, M898 (SADARM)	NO	NO	x	x	x	x	x	x	x	x	x	x	x	x	x	x	No	
																	Firing below charge 3 may result in stickers. <sup>3</sup>	
																	Do Not fire with M232 (MACS) 5 <sup>7</sup> .	

<sup>1</sup>M119A2 charge 7 is equivalent to M119A1 charge 8. Refer to firing tables for small differences in velocity which affect range.

<sup>2</sup>Charge 1 must not be fired in the M199 Cannon because of stickers. Firing at charge 2 may result in stickers occasionally.

<sup>3</sup>For bag charges only.

<sup>6</sup>M825 projectiles (manufactured Jan 85-May 86) fired at temperatures above +110°F (43°C) (WP liquified) have resulted in flight instability and short rounds. This instability does not occur below +110°F (43°C) (WP solid).

<sup>7</sup>Do not fire M232 charge 5 in M198 howitzer. Safety Testing was not performed.

<sup>8</sup>Do not load or fire M231 charges with M232 charges. Critical malfunction could result.

#### NOTE

PRIMER M82 is the only authorized primer to be used in the M199 cannon.

M203 series charge 8 is not equivalent to M119A1 charge 8.

M232 charge 5 is equivalent to M203 series charge 8.

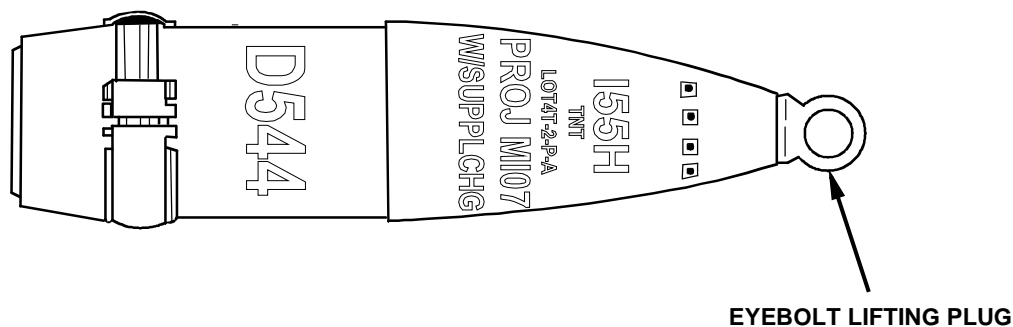
#### 4-3. AUTHORIZED PROJECTILES (cont)

c. Projectiles of current manufacture with deep fuze cavities and supplementary charges of TNT are suitable for use with the long intrusion (M728 or M514 series) or the short intrusion (M732 series) proximity fuzes. The supplementary charge must be removed when the long intrusion proximity fuze is used; it must remain in place whenever any other authorized fuze is used.

d. Deep-cavity projectiles are identified by the words, W/SUPPL CHG, marked on the projectile. Weight zones are indicated on projectiles by one or more square of the same color as the markings. Four squares indicate standard or normal weight for which no weight corrections are necessary when computing firing data. There may also be punch marks in the center of squares for night identification of weight zones by touch.

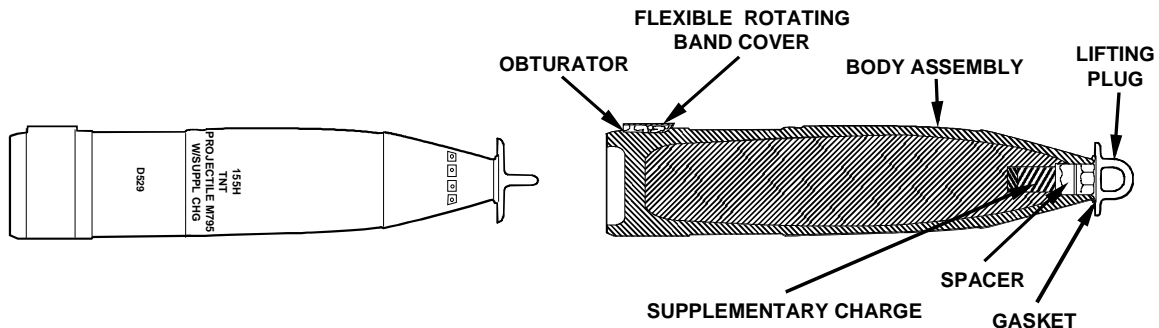
e. The authorized projectiles and their characteristics are as follows:

#### ■ M107 PROJECTILE



(1) **Projectile, 155-mm, HE, M107.** This high-explosive (HE) projectile is used primarily for blast, fragmentation, and mining. This deep- or shallow-cavity projectile consists of a steel case loaded with TNT or composition B. A point-detonating, time, or proximity fuze may be used. The M107 projectile weighs approximately 95 pounds (43.09 kg).

## M795 PROJECTILE



### (1.1) Projectile, 155-mm, HE, M795.

#### WARNING

The M795 projectile will not be fired at charge 3 (white bag (WB)). Firing at charge 3 WB may result in stickers.

#### WARNING

The M795 is not to be fired if the obturator is missing or broken as rotating band failure and short round may result. If the band is displaced and can be repositioned and remain in the groove, the projectile can be fired.

This high-explosive, shallow cavity projectile is used as a registration round for the M483A1 family of cargo munitions. It is also used for harassment and interdiction (H & I), fragmentation, mining, and blast effect. The M795 consists of 23.8 pounds (10.8 kg) of TNT explosive loaded into a 78.1 pounds (35.5 kg) body assembly. A welded rotating band encircles the high fragmentation steel HF-1 body near its base.

## M110 SERIES, M116 SERIES, OR M121A1 PROJECTILE

#### WARNING

Since the burster in H or HD ammunition is loaded with tetrytol, do not store or fire at temperatures exceeding +125°F (+52°C). Temperatures above +125°F (+52°C) will cause the tetrytol to melt and/or seep, causing premature functioning.

**(2) Projectile, 155-mm, agent, H or HD, M110.** This projectile produces a toxic effect on personnel and is also used to contaminate habitable areas. This 93-pound (42.18-kg) projectile is filled with mustard gas (H) or distilled mustard gas (HD) and has a burster charge.

#### WARNING

The M121 projectile is no longer authorized. A few M121 (basic model) projectiles with tetrytol bursters may remain in some stock piles and should not be used, as inbore explosions may result.



**(3) Projectile, 155-mm, gas persistent, VX, M121A1.** This VX gas projectile produces a toxic effect on personnel. A burster charge breaks the projectile apart. The M121A1 has a composition B filled burster. This projectile weighs approximately 100 pounds (45.36 kg).

**(4) Projectile, 155-mm, gas, nonpersistent, GB, M121A1.** This projectile is similar to the VX projectile M121A1 described above.

#### **WARNING**

The filler in white phosphorous (WP) smoke projectiles melts at +111.4°F (+44.1°C) and creates voids inside the projectile. The WP projectiles must be stored base down so that any voids are in the nose of the projectile. Do not fire WP projectiles which are known to have been stored in other than base down position. Firing of such projectiles could contribute to inbore explosions or close-in premature malfunctions.

Since the burster in the M110 and M110E1 projectiles is loaded with tetrytol, do not store or fire at temperatures above +125°F (+52°C). Temperatures above +125°F (+52°C) will cause the tetrytol to melt and/or seep, causing premature functioning. Prior to firing, inspect fuze well cup for dents in bottom surface. If dents are found or the fuze is hard to seat, do not use the round.

**(5) Projectiles, 155-mm, smoke, WP, M110 and M110E1.** The M110 and M110E1 white phosphorous (WP) smoke projectiles have a slight burning effect, but are used primarily to produce screening smoke. The projectiles are similar to the M110 gas projectile and have the same characteristics as the M107 HE projectile. Each projectile weighs approximately 98 pounds (44.45 kg).

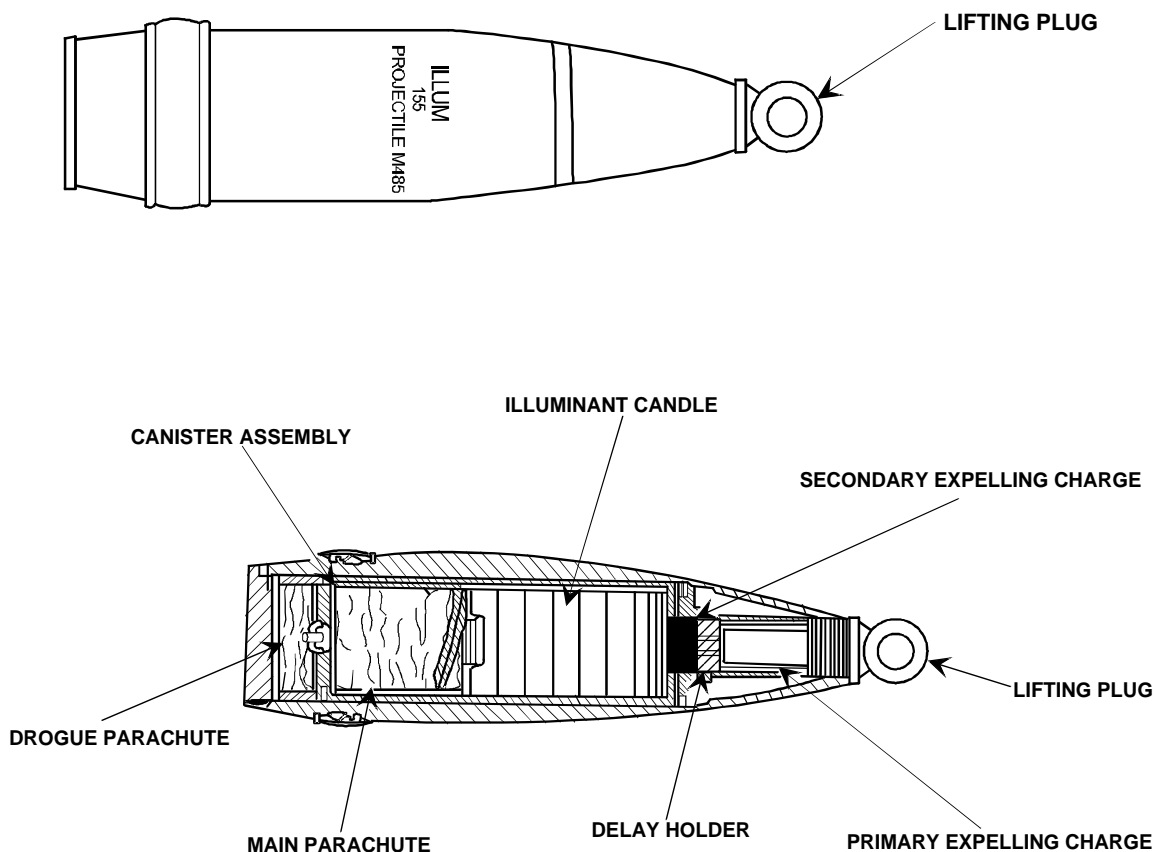
**(6) Projectiles, 155-mm, smoke, WP, M110A1 (M110E2) and M110A2 (M110E3).** These projectiles are similar to the M110 and M110E1 white phosphorous projectiles, except that the burster is loaded with composition B5. These projectiles may be stored and transported at temperatures up to +145°F (+63°C). Inspection of the fuze well cup is required before firing.

**(7) Projectiles, 155-mm, smoke, HC, M116 and M116B1.** The M116 and M116B1 smoke projectiles are used for screening, spotting, and signaling purposes and are issued with a filler of HC (white) chemical smoke mixture. These base-ejection (BE) rounds contain four smoke canisters. Each projectile weighs approximately 86 pounds (39.0 kg). These projectiles can use only the M501 series MTSQ fuze.

**(8) Projectiles, 155-mm, smoke, HC, M116A1.** The M116A1 projectile is a base-ejection type similar to the M116 and M116B1 with the exception that it uses the M565 MT and M577 series MTSQ or M762 ET fuzes, and that it has improved M1 and M2 HC (white) smoke canisters.

### 4-3. AUTHORIZED PROJECTILES (cont)

#### PROJECTILE, 155 MILLIMETER: ILLUM, M485 SERIES

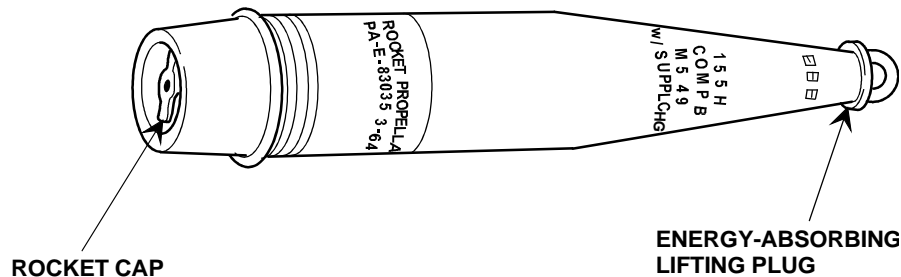


#### WARNING

The M485A1 and M485A2 projectiles can be fired with charge 2 (M3 green bag) thru 8 (M119 series charges) inclusive. These projectiles are not reliable when fired at charges 6, 7, and 8 with fuze settings of 10 seconds or less.

**(9) Projectiles, 155-mm, illuminating, M485A1 and M485A2.** These projectiles are used for battlefield illumination. Each projectile has a hollow steel body containing a primary expelling charge, a canister assembly, and a drogue parachute. The canister assembly contains a secondary expelling charge, a delay holder, a light-producing chemical, and the main parachute.

## M549 OR M549A1 PROJECTILE



### (10) Projectiles, 155-mm, HE, rocket assist, M549 and M549A1.

(a) This is a high fragmentation projectile containing a rocket motor. The protective rocket cap must be removed from the projectile before firing to increase the range over that attainable ballistically. The M549 differs from the M549A1 only in the type of explosive filler. The M549 is loaded with composition B, and the M549A1 is loaded with TNT.

#### WARNING

The M549/M549A1 is not to be fired if the obturator is missing or broken because it may result in a short round. If the band is displaced and can be repositioned and remain in the groove, the projectile can be fired. The basic M119 charge is not to be used with the M549/M549A1 projectile as its use will result in rocket motor ignition failure, causing loss of range (short rounds). Use M119A1 or M119A2 charges.

Standard procedures prohibit firing the M549/M549A1 in the rocket off mode except in combat emergencies. Remove rocket cap before loading to activate the rocket.

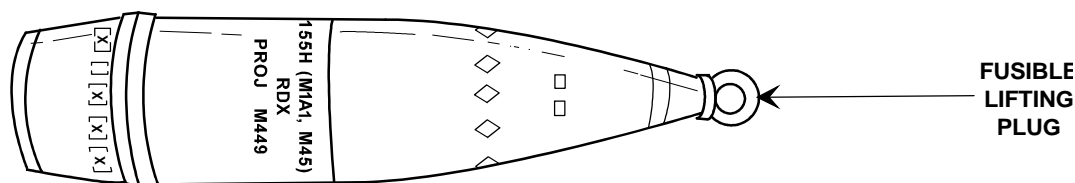
A 6000-meter safety zone is required **short** of the target because of the possibility of rocket motor non-ignition.

If fired rocket off due to emergency situation, a 6000 meter range is required **beyond** the target because of the possibility of rocket motor ignition.

(b) The M549/M549A1 projectiles have the energy-absorbing lifting plug designed to protect the projectile fuze area against accidental damage. The new plug has an oversized 3.75-inch (9.53-cm) flange. If this lifting plug is broken at the neck area, the threaded portion of the plug will remain in the projectile and the projectile cannot be fuze. No attempt should be made to extract any portion of a broken plug from a projectile; the projectile is not to be used and should be returned to supply point.

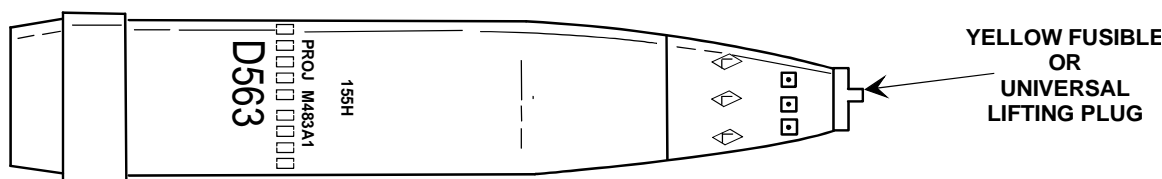
### 4-3. AUTHORIZED PROJECTILES (cont)

#### M449 SERIES PROJECTILE



**(11) Projectile, 155-mm, ICM, M449 Series.** These projectiles are improved conventional munitions (ICM) used primarily against personnel. The cargo consists of 60 M43 grenades which are ejected in flight. The fuze, having been set to function at a predetermined time, initiates the expulsion charge, ejecting the entire cargo from the rear of the projectile. The projectile spins centrifugally and disperses the grenades from the projectile line-of-flight. Upon impact with the target area, an expulsion charge is initiated which propels a high-explosive filled sphere upward 4 to 6 feet (1.22 to 1.83 m) above the impact area. The elevated sphere is detonated sending high-velocity fragments in a spherical pattern. Each projectile weighs approximately 95 pounds (43.09 kg).

#### M483A1 PROJECTILE



#### WARNING

The M483A1 projectile will not be fired below charge 3 in the M198 howitzer. Firing below charge 3 may result in stickers.

#### NOTE

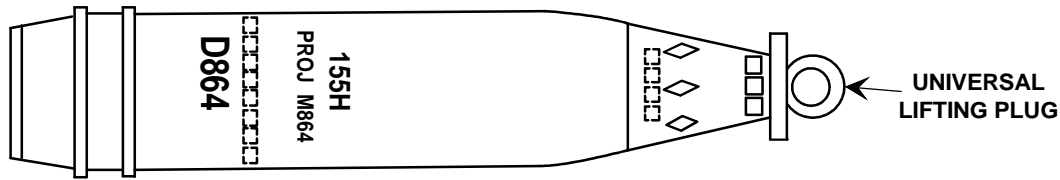
The M483A1 projectile or other projectiles using the M483A1 carrier may not be fired without the obturating band. Reposition band if it is dislodged.

**(12) Projectile, 155-mm, ICM, M483A1.** The dual-purpose ICM projectile is effective against personnel and light materiel targets. These base-ejection type projectiles consist of a steel body containing an expelling charge and 88 shaped charge grenade submissiles. This projectile weighs approximately 103 pounds (46.72 kg) and uses the M577 series MTSQ or M762 ET fuze. It can be used in the fire-for-effect mode or the registration mode.

- (a) In the fire-for-effect mode, the expelling charge ejects the 88 submissiles from the projectile during flight and they actuate on ground or target impact. A shaped charged jet is expelled downward while the body bursts into a large number of high-velocity fragments. The jet is capable of penetrating approximately 2.75 inches (6.98 cm) of homogeneous armorplate. Antipersonnel effects are obtained by fragmentation of the body.

- (b) In the self-registration mode, the expelling charge is removed, and a projectile spotting charge is attached to the time fuze and installed in the projectile. The spotting charge will cause the projectile to detonate all 88 grenades inside the projectile, causing high fragmentation in the same manner as a standard high-explosive projectile. This permits observation of projectile in relation to target. See page 4-35 for additional information on special preparation of the M483A1 projectile for use in the self-registration mode.

## M864 PROJECTILE



### NOTE

The M864 is for extended range only. Use the M483A1 projectile through the M119A2 charge (Zone 7) where applicable. The M864 shall be fired to achieve ranges beyond the capabilities of the M483A1 projectile or when the M483A1 is not available.

### WARNING

A 5000-meter safety zone is required short of the target because of the possibility of the base burner assembly non-ignition.

The M864 is not to be fired if the obturator is missing or broken because it may result in a short round. If the band is displaced and can be repositioned and remain in the groove, the projectile can be fired.

For M864 projectiles marked with three solid white circles 120 degrees apart on the ogive (above the weight zone markings), avoid hazards resulting from gaps at the base to body joint and from separation of the base from the body by following these safety procedures:

- Projectiles are to remain palletized as long as possible prior to use.
- Do not transport projectiles as loose cargo.
- Do not fire projectiles received without grommets or with evidence of dents, flattening, or gouges to the lifting plug, grommet, rotating band, or boattail area.
- Do not fire projectiles which have been dropped loose.
- Any base separations should be handled by EOD personnel.

In these specially marked M864 rounds, a gap at the base to body joint of the projectile may lead to hot propellant gases entering the round during firing and causing an inbore premature. Gaps are not detectable with a visual examination due to the presence of the obturator over the base to body joint. In addition, a separation of the base from the body of the projectile will expose M42 and M46 grenades. Arming could occur and result in injury and/or death.

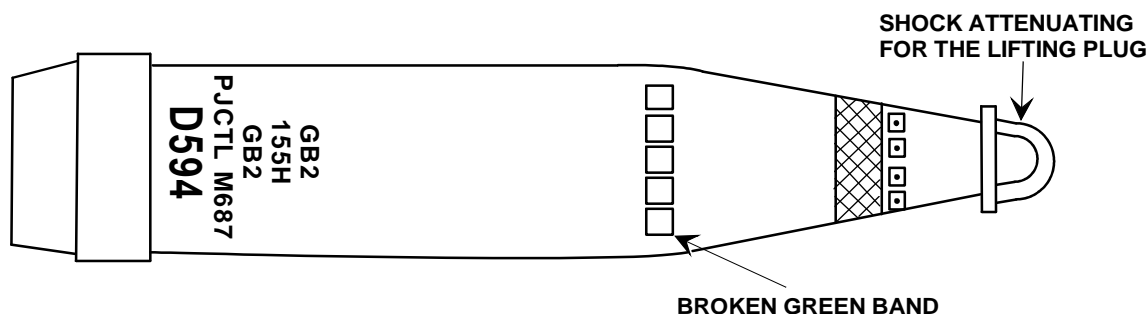
**(13) Projectile, 155-mm, Extended Range, DP, M864.** This is an extended range dual-purpose, ICM projectile. The M864 is modeled after the M483A1 projectile with the addition of a base burner unit at the projectile's base. The propellant in the base burner ignites upon firing of the projectile, producing gases which reduce the drag on the projectile and extend its range.

### 4-3. AUTHORIZED PROJECTILES (cont)

#### M864 PROJECTILE (cont)

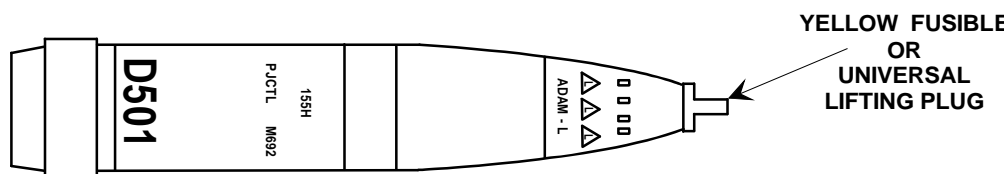
This is a base-ejection type projectile with a steel body. The expulsion charge contains 105 grams of M10 propellant. There are 72 shaped charge grenades consisting of 48 M42 grenades and 24 M46 grenades. They are effective against personnel and light materiel targets. This projectile weighs approximately 102 lbs (46.27 kg) and uses the M577 series MTSQ or M762 ET fuze. It can be used in the fire-for-effect mode or the self-registration mode.

#### M687 PROJECTILE



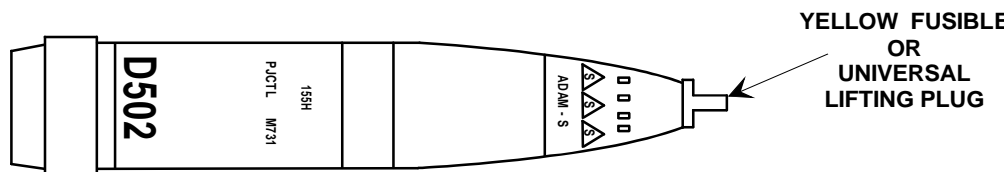
**(14) Projectiles, 155-mm, GB2, M687.** These projectiles are used to produce a toxic effect on personnel. The M687 is a binary projectile which requires assembly of the M20 canister prior to firing. The M20 canister is a separate issue item NSN 1320-00-407-8301 (D001). The M687 is assembled at the chemical ammunition supply point (CASP) per TM 3-1320-242-10 and will have a broken green band visible. If a rubber sleeve covers the broken green band, assembly of the M20 canister has not been accomplished and the projectile should not be fired.

#### M692 PROJECTILE



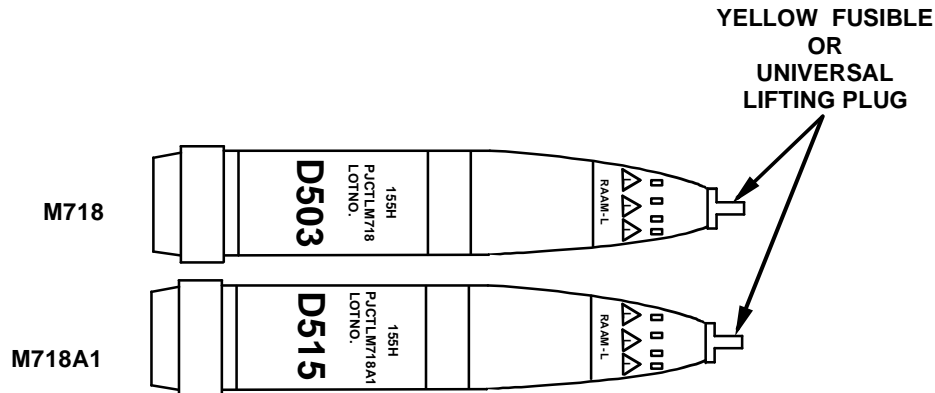
**(15) Projectile, 155-mm, HE, M692.** This high-explosive (HE) projectile is known as the area denial artillery munition (ADAM). It is painted olive drab with yellow markings. The most significant marking on the ogive is the letter "L" appearing in the triangles, and in later production "ADAM-L" on the ogive, indicating a long self-destruct time of the antipersonnel mine submunitions. The M692 is a base-ejection type projectile and uses the M577 series MTSQ or M762 ET fuze.

#### M731 PROJECTILE



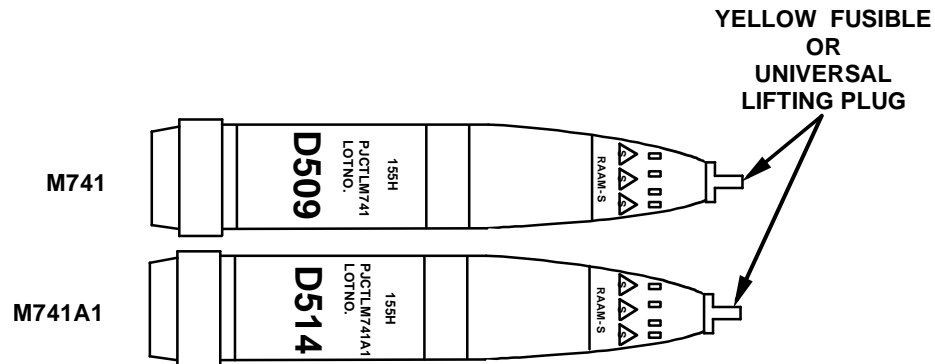
**(16) Projectile, 155-mm, HE, M731.** This projectile is like the M692 projectile, except the letter "S" appears within the yellow triangles, indicating short self destruct time of mine submunitions. This base-ejection type projectile uses the M577 series MTSQ or M762 ET fuze.

## M718/M718A1 PROJECTILE



**(17) Projectile, 155-mm, AT, remote, anti-armor mine system, M718/M718A1.** This projectile is used to deliver high-explosive antitank mines in front of enemy armored forces to deny/delay access to a particular area for a specific time period. This projectile is from the family of scatterable mines and is known as the remote anti-armor mine system (RAAMS). It is painted olive drab with yellow markings. The most significant markings are the row of yellow triangles between the nose and the bourrelet which contain the letter "L" and "RAAM-L" on the ogive that indicate the LONG self-destruct time for the submunition. This is a base-ejection type projectile and uses the M577 series MTSQ or M762 ET fuze. The M718A1 projectile contains internal changes to the submunitions and has a new DODIC (D515); however, the projectile is handled and fired the same as the basic model.

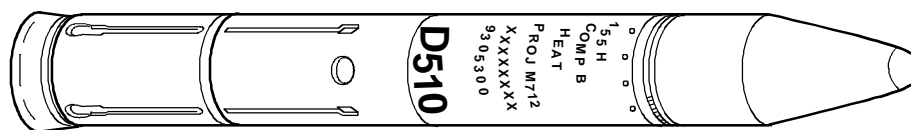
## M741/M741A1 PROJECTILE



**(18) Projectile, 155-mm, AT, remote anti-armor mine system, M741/M741A1.** This projectile is also known as the RAAMS round, and it is exactly like the M718 above except the letter "S" painted in the yellow triangles and "RAAMS-S" on the ogive are different to indicate a SHORT self-destruct time. This is a base-ejection type projectile and uses the M577 series MTSQ or M762 ET fuze. The M741A1 projectile contains internal changes to the submunitions and has a new DODIC (D514); however, the projectile is handled and fired the same as the basic model.

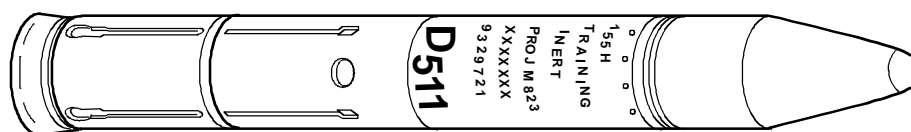
### 4-3. AUTHORIZED PROJECTILES (cont)

#### M712 PROJECTILE



**(19) Projectile, 155-mm, HEAT, M712.** This projectile is a cannon-launched guided projectile. It is a high-explosive antitank (HEAT) projectile loaded with 14.75 pounds (6.69 kg) of composition B. It is guided to its target by a laser beam directed on the target from a laser designator. The projectile has five time and code switches set by the crew prior to firing. The warhead section of the projectile contains its own base-detonating fuze (M740). The projectile is 54 inches (137.16 cm) long and weighs 138 pounds (62.60 kg). Details on use of M712 projectile begin on page 4-60.

#### M823 PROJECTILE

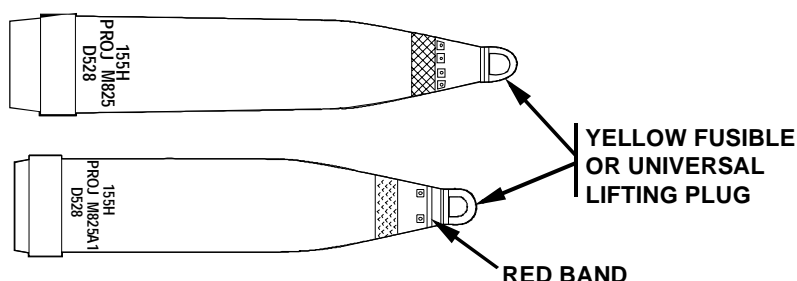


#### WARNING

The M823 projectile must not be fired. Such firing could be a hazard to personnel forward of the weapon.

**(20) Projectile, 155-mm, training, M823.** This projectile is designed to train 155-mm howitzer weapon crews in the handling and setting of the M712 projectile. It simulates the M712 in weight, center of gravity, and external appearance. It contains code and time switches which are set to simulate prefiring activity by the crew. It is shipped and stored in the same container as the M712, color coded bronze for easy identification. Details on use of M823 projectile begin on page 4-60.1.

#### M825/M825A1 PROJECTILE



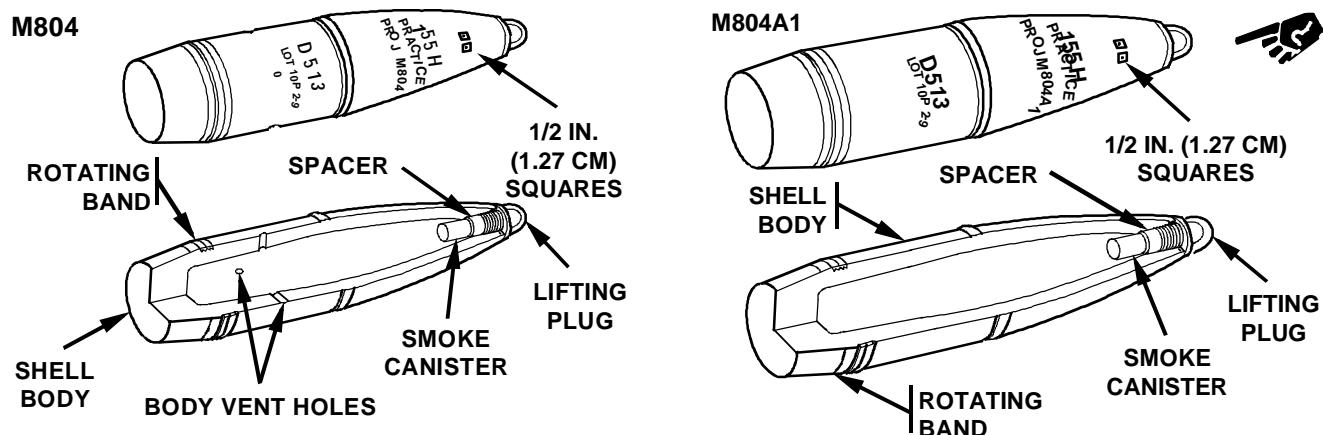
#### WARNING

White phosphorous (WP) impregnated felt wedges from the M825/M825A1 are not totally consumed when the WP burns. When the unburned felt wedges are crushed or moved, residual WP will re-ignite, posing a burn hazard. Personnel should not contact or move the unburned felt wedges.

The M825/M825A1 is not to be fired if the obturator is missing or broken as rotating band failure and short round may result. If the band is displaced and can be repositioned and remain in the groove, the projectile can be fired.

**(21) Projectile, 155-mm, smoke, WP, M825/M825A1.** The M825 projectile consists of a modified M483A1 projectile carrier with a payload of white phosphorous-impregnated felt wedges. In-flight fuze functioning ejects a canister. A burster inside the canister scatters burning wedges over the target area producing obscuring smoke. This projectile uses the M577 series MTSQ or M762 ET fuze. The M825 projectile contains an improved payload and a new base which have corrected the M825 flight instability. The restrictions imposed on the M825 do not apply to the M825A1.

## M804/M804A1 PROJECTILE



**(22) Projectile, M804/M804A1, practice.** The M804/M804A1 projectile is used in place of the M107 HE projectile in training exercises. The M804/M804A1 contains a small smoke canister in the fuze well which provides flash and smoke for visual determination of functioning. The M804/M804A1 is similar in weight and external configuration to the M107 HE projectile and can be used in training without the blast and fragmentation which accompany functioning of an M107 HE projectile. The body of the M804 contains four holes, 90 degrees apart, which serve to disperse smoke on functioning. The M804A1 does not contain any holes and has a larger smoke canister. Both projectile models are handled and fired the same way.

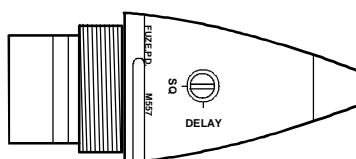
## 4-4. AUTHORIZED FUZES

Paragraphs a thru j describe the fuzes to be used with this weapon. They are in model number sequence. For additional information and more detailed descriptions and functioning of the authorized fuzes, see TM 43-0001-28.

### WARNING

The firing of a field artillery round without a fuze or with an unauthorized fuze is strictly prohibited as an inbore explosion may result.

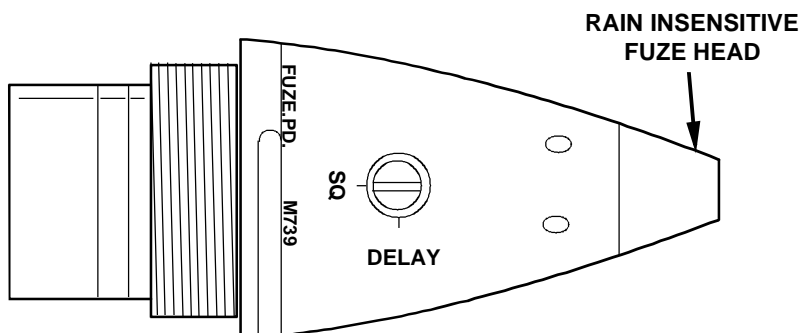
## M557 AND M572 FUZE



**a. Fuze, Point-Detonating, M557/M572.** The M557 has a selective superquick delay setscrew. It is packed set for superquick and has a booster attached. Premature functioning can occur when fuzes are fired in heavy precipitation, i.e., heavy rainfall, sleet, snow, or hail. The M572 fuze is the M557 fuze with the addition of epoxy under the windshield. It is handled, set, and fired the same as the M557 fuze.

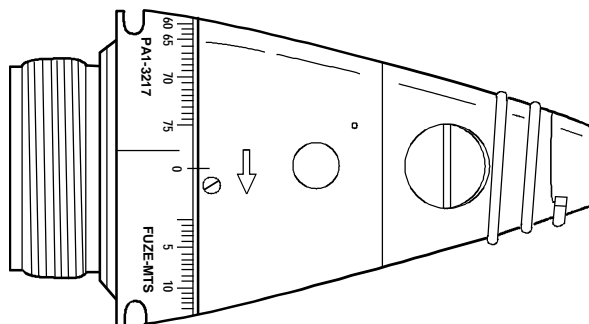
#### 4-4. AUTHORIZED FUZES (cont)

##### M739 OR M739A1 FUZE



**b. Fuze, Point-Detonating, M739 and M739A1.** These fuzes are the latest improved versions of the selective impact fuze. These fuzes have solid aluminum bodies with threaded bases. The fuzes contain a rain-insensitive screen so that the fuzes can be fired through a heavy rainstorm without premature functioning of the round of ammunition. These fuzes can be set for super-quick or delay action by turning the setscrew. The M739A1 fuze contains a new impact delay module which provides more effective functioning in the delay mode. In addition to the stamped markings, the M739A1 fuze is anodized green for positive identification of fuze model.

##### M501A1 OR M501 FUZE

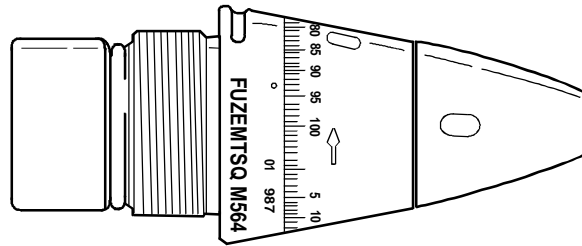


#### WARNING

Dropping or rough handling of projectiles assembled with fuze, MTSQ, M501/M501A1 may result in fuze functioning and expulsion of base plate and contents. When handling projectiles assembled with this fuze, exercise extreme care to protect the fuze from impact. Keep pull wire on fuze in place until immediately prior to firing.

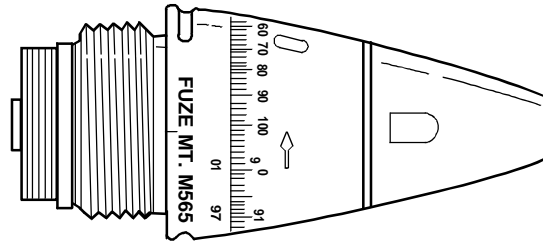
**c. Fuze, Mechanical Time and Superquick, M501A1 and M501.** The M501A1 or M501 fuze is a combination mechanical time and superquick (MTSQ) fuze with settings for time action (2 to 75 seconds) and an impact element for superquick action. It is used only with the M116 and M116B1 smoke rounds.

## M564 FUZE



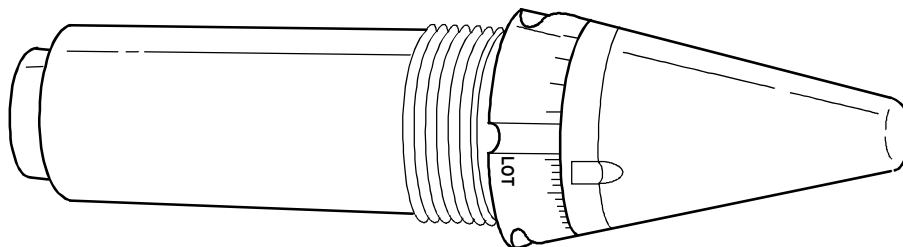
**d. Fuze, Mechanical Time and Superquick, M564.** This fuze is an improvement over the older MTSQ fuzes, because it provides a longer timing mechanism (100 seconds) for functioning at longer ranges. The date of manufacture is stamped on the fuze body before the lot number. Fuzes manufactured through 1969 must be set on 90 seconds if superquick (impact) action is desired. Setting of these fuzes between S and 2 seconds may result in functioning after approximately 2 seconds. Fuzes manufactured from 1970 on may be set as shipped on S for superquick (impact) functioning. Premature functioning of this fuze may occur downrange when the fuze is fired in heavy precipitation, i.e., heavy rainfall, sleet, snow, or hail.

## M565 FUZE



**e. Fuze, Mechanical Time, M565.** The M565 mechanical time (MT) type is similar to the M564 MTSQ fuze, except that the M565 fuze does not contain the point-detonating assembly or the booster assembly. The M565 fuze can be set from 2 to 100 seconds. Like the M564 fuze, the M565 fuze has a vernier scale to assure a setting accuracy of 0.1 second. The fuze is used with base-ejection projectiles only.

## M728 FUZE AND M514 SERIES FUZE



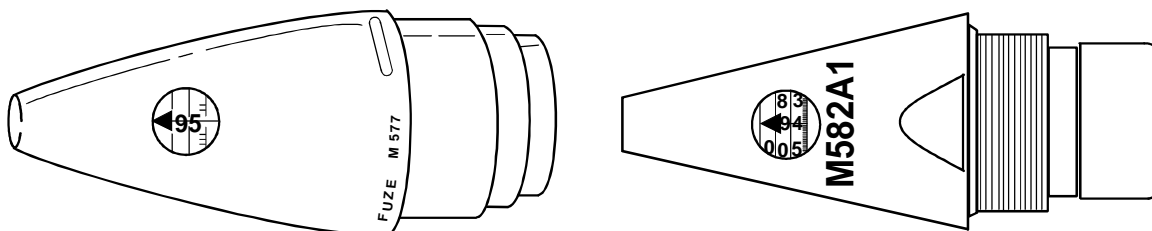
### WARNING

The M728 and M514 series fuzes are not to be used with the M203/M203A1 propelling charge.

**f. Fuze, Proximity, Variable Time, M728 and M514 Series.** These proximity variable time (VT) fuzes are used with deep-cavity projectiles and are essentially self-powered radios and transmitting units. The fuzes can be set from 5 to 100 seconds. The nose of M728 fuze has been painted (black) to reduce static electricity.

#### 4-4. AUTHORIZED FUZES (cont)

##### M577 SERIES OR M582 SERIES FUZE



M577 SERIES

M582 SERIES

#### g. Fuzes, Mechanical Time and Superquick, M577 Series and M582 Series.

##### WARNING

The M577 and M582 series fuzes, when set for a time of less than 4 seconds, will allow the rotor to release almost immediately, fully arming the fuze, which enables the fuze to explode at the set time. Any time setting of less than 2 seconds is a danger to the crew and should not be fired unless firing "KILLER JUNIOR."

(1) These fuzes have a 200-second mechanical time mechanism with three movable digital dials similar to a speedometer. Each fuze has a window through which the dials are viewed. The dials permit setting of the fuze to the nearest tenth of a second. The M577A1 and M582A1 MTSQ fuzes contain a different mechanism for point detonating action. Externally the major difference is the configuration of the wrench slots. The M577A1 and M582A1 fuzes are handled, set, and fired the same as the basic models. Early manufactured basic and A1 fuzes have black (paint finish) ogives while the later produced A1 fuze has a gold (chromate finish) ogive.

- (a) The dial closest to the fuze nose indicates the time in hundreds of seconds. (The triangle (◄) position is a nontime setting.)
- (b) The second dial indicates time in tens of seconds.
- (c) The third dial indicates the nearest second and also tenths of seconds by using the scale on the right edge of the dial.

(2) These fuzes can be set with the M35 fuze setter or a flat-tip screwdriver. The time-setting key is located on the end of the fuze nose. The desired time is set under the hairline. Detailed setting instructions are outlined in paragraph 4-11 (p 4-40).

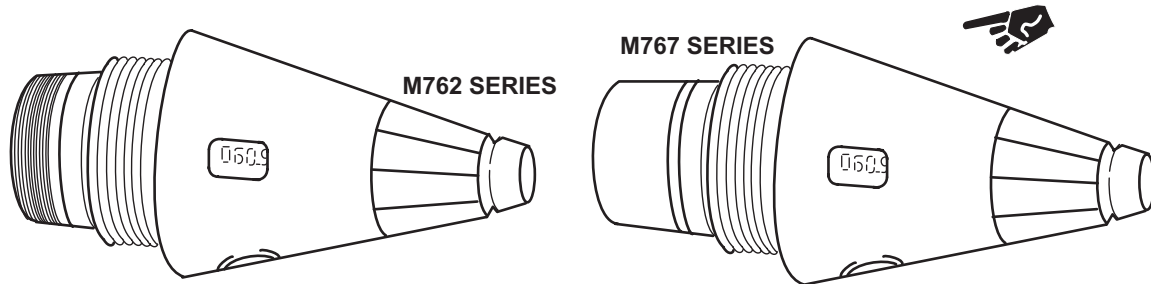
(3) The M577 series does not contain a booster and is used with base-ejection projectiles. The M582 series fuze is fitted with a booster for firing with burster-type and high-explosive projectiles. In order to minimize identification problems, current production of the M582A1 fuzes contain a white stencil "M582A1" below the window in the fuze body.

(4) The fuzes are not sensitive to rain.

(5) The M577 series fuze can be used with a spotting charge when firing the M483A1 and M864 projectiles in the self-registration mode.

(6) If M577 series/M582 series fuzes are set for time and the timing mechanism fails, the fuze may or may not function on impact.

## M762 AND M767 SERIES FUZES



### h. Fuzes, Electronic Time, M762 and M767 Series.

(1) These fuzes are powered by a reserve lithium battery. The battery is activated manually by rotating the ogive or remotely via inductive auto-set fire controls and M1155 PIAF fuse setter, see paragraph 4-11.g. An electronic subassembly contains integrated circuits that provides controls and logic for 199.9 seconds electronic timing and transmits a fire pulse signal for time function. A Liquid Crystal Display (LCD) provides a visual readout of the fuze setting, as follows:

- (a) The column closest to the base end indicates time in hundreds of seconds (the triangle (◄) position is a nontime setting).
- (b) The second column away from base end indicates time in tens of seconds.
- (c) The third column away from base end indicates time in seconds.
- (d) The fourth column (closest to nose end) indicates time in tenths of seconds.

(2) These fuzes contain an electromechanical Safe & Arming Mechanism (S&A). When set for time function, the S&A provides overhead safety by arming at 50 milliseconds before set time. For this reason, if the fuze impacts before a time setting expires, there will be no PD backup function. For PD setting, the S&A arms the fuzes at 0.45 seconds in flight. Upon impact, a crush switch assembly (contained in the ogive) senses the impact and transmits a fire signal for PD action.

(3) These fuzes can be set either by hand (rotating ogive) and depressing selector and cocking button or remotely by a weapon equipped with auto-set fire control system and M1155 PIAF fuse setter, see paragraph 4-11.g. Detailed setting instructions are outlined in paragraph 4-11. The settings can be changed as many times as required for the duration of the activated life of the battery.

(4) These fuze bodies are anodized gold. The rear portion of the ogive is coated with a gold phosphate finish. The forward portion of the ogive is brown plastic for the basic fuzes and black plastic for the M762A1 and M767A1 fuzes. The nose cap is unpainted bronze for the basic fuzes and stainless steel for the M762A1/M767A1.

(5) The M762 fuze does not contain a booster and is used with base-ejection projectiles. The M767 series fuze is fitted with a booster for firing with burster-type and high-explosive projectiles.

#### 4-4. AUTHORIZED FUZES (cont)

(6) The M762 series fuze can be used with a special spotting charge when firing the M483A1 and M864 projectiles in the self-registration mode. See page 4-35.

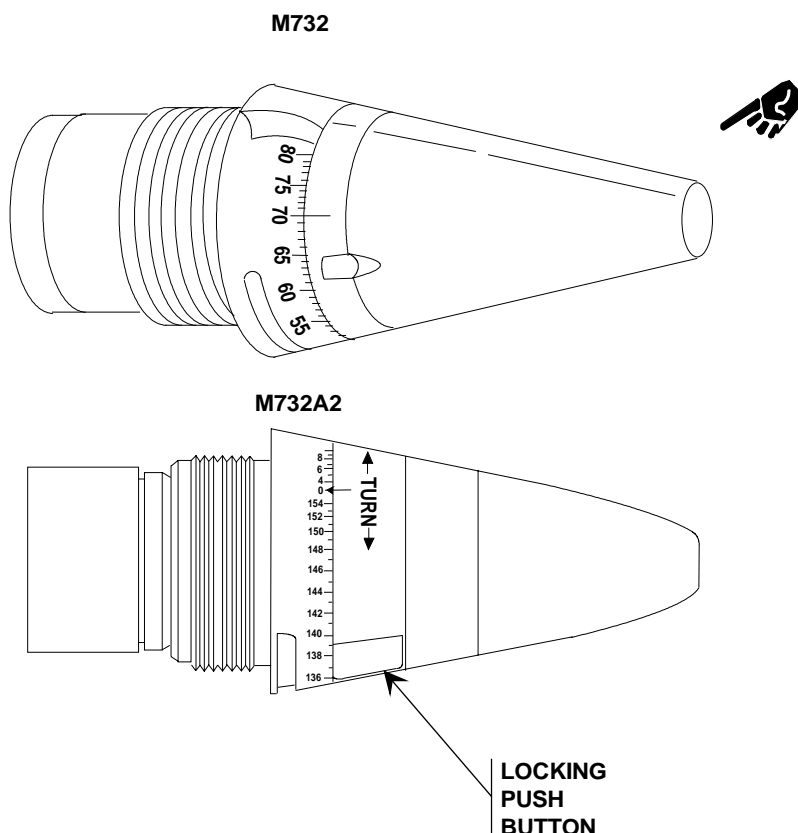
(7) If these fuzes fail in the time mode, there is no PD backup.

(8) The fuzes are not sensitive to rain.

#### NOTE

Once activated, the M762 and M767 cannot be turned off; therefore, the fuzes have approximately 15 days service life before the battery runs down and the LCD goes blank.

#### M732 SERIES FUZE

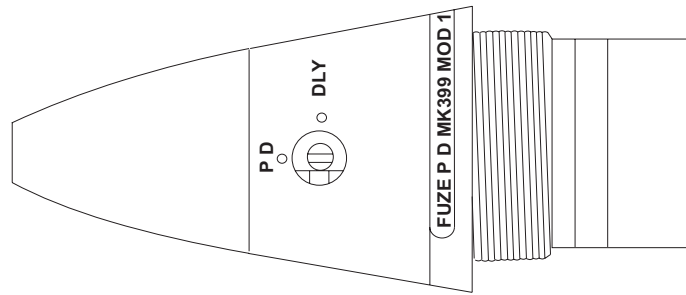


i. **Fuze, Proximity, Variable Time, M732 series.** These proximity variable time (VT) fuzes are short-intrusion fuzes of the same overall length as the standard impact or mechanical time fuze. The supplementary charge must be left in the fuze well for proper functioning of this fuze. The M732 fuze has a time ring that can be set from 0 to 150 seconds. The M732A2 fuze can be set from 4 to 156 seconds. Time settings are used to arm these fuzes 3 to 5 seconds prior to set time for proximity function. The fuzes can also function PD as an option or proximity mode back-up and are always armed for PD at 400 calibers. The M732A2 was especially designed for compatibility with rocket-assisted rounds. The M732A2 is set by simultaneously depressing two pushbuttons in the ogive and rotating the setting ring to the desired position. When the pushbuttons are released, the setting ring is locked into position.

#### NOTE


The PD setting of the M732 series VT fuzes, when fired into soft impact areas, will produce less lethality than the superquick setting of the M739 series PD fuze.

## MILITARY OPERATIONS ON URBAN TERRAIN (MOUT) PD FUZE, MK399 MOD 1



**j. Fuze, PD, MK399, MOD 1.** The MK399 MOD 1 MOUT fuze is primarily for use against urban structures (buildings) and other hard targets such as bunkers. Its primary design is for penetration of wood, brick or concrete and function inside the target. It therefore is delivered to the field set in the DLY (delay) mode to accomplish this task. The fuze has a setscrew that can be turned by a flathead screwdriver or M18 fuze wrench to select PD or DLY (delay) function. When set PD, the fuze functions superquick which is more effective in destroying walls or urban targets and bunkers, can provide a conventional PD fuze role against personnel, and is useful for spotting purposes. The fuze is assembled with a booster pellet and set on the DLY mark for shipping. This fuze is rain sensitive.

**Table 4-3.1 Summary Matrix of Expected Performance Against MOUT Targets**

Obliquity Angle 	Wood Frame				Single Brick				Triple Brick				Reinforced Concrete			
	0°	30°	45°	60°	0°	30°	45°	60°	0°	30°	45°	60°	0°	30°	45°	60°
155 mm M107/M795 low zone	M <sup>1</sup>	M <sup>1</sup>	M <sup>1</sup>	M <sup>1</sup>	G	G	G	G	G	G	M <sup>3</sup>	M <sup>3</sup>	G	G	M <sup>3</sup>	M <sup>3</sup>
155 mm M107/M795 mid zone	G	G	G	G	G	G	G	G	G	G	M <sup>3</sup>	M <sup>3</sup>	G	G	M <sup>3</sup>	M <sup>3</sup>
155 mm M107/M795 high zone	G	G	G	G	G	G	G	G	M <sup>2</sup>	M <sup>2</sup>	G	G	M <sup>2</sup>	M <sup>2</sup>	G	G
155 mm M549/A1	G	G	G	G	P <sup>1</sup>	P <sup>1</sup>	P <sup>1</sup>	P <sup>1</sup>	P <sup>1</sup>	P <sup>1</sup>	P <sup>1</sup>	P <sup>1</sup>	P <sup>1</sup>	P <sup>1</sup>	P <sup>1</sup>	P <sup>1</sup>

G - good
M - marginal
P - poor, not recommended

### NOTE

Always be prepared to use multiple rounds to defeat targets.

Obliquity angle of 0° = perpendicular to target wall.

M<sup>1</sup> - for lighter wood frame construction, at low zone, insufficient impact force may result in duds

M<sup>2</sup> - perpendicular and near perpendicular impacts against harder targets at high zone can result in functions on the wall before penetration

M<sup>3</sup> - at low and mid zones impact angles at and beyond 45 degrees can result in duds

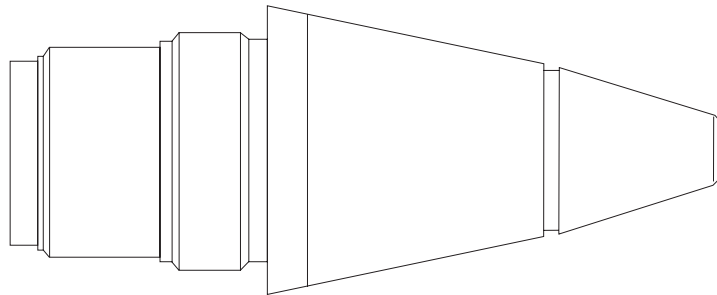
P<sup>1</sup> - RAP rounds not recommended against MOUT targets, projectile may break-up upon impact

#### 4-4. AUTHORIZED FUZES (cont)

##### FUZES, ARTILLERY, MULTI-OPTION (MOFA), M782

**k. Fuze, MOFA, M782.** These fuzes are intended for use with fragmentation (HE loaded) and burster-type projectiles. They may only be set with the M1155 Portable Inductive Artillery Fuse Setter (PIAFS) (refer to TM 9-1290-210-12&P). There are four functional modes on these fuzes: point detonating (PD), delay (DLY), variable time (VT), and time (TIME). An electronic subassembly of the fuze, containing integrated circuits, provides control and logic for 199.9 seconds of electronic timing, and transmits a fire pulse signal for time and proximity functions. The mission data transferred from the M1155 PIAFS to the fuze is confirmed by the setter and is displayed on a Liquid Crystal Display (LCD) module found on the setter.

##### MULTI-OPTION FUZE ARTILLERY (MOFA) M782



MOFA utilizes a standard M739 Safety and Arming (S&A) mechanism that is housed in a retaining cup just below the detonator block. Both setback and spin locks are used to prevent accidental arming of the S&A prior to firing. This S&A mechanism provides a safe separation distance of at least 400 calibers of projectile travel when fired (45.9 yards or 41.97 meters).

These fuzes are set by a M1155 PIAFS (refer to TM 9-1290-210-12&P). The setting can be changed as many times as required.

This fuze is not sensitive to rain.

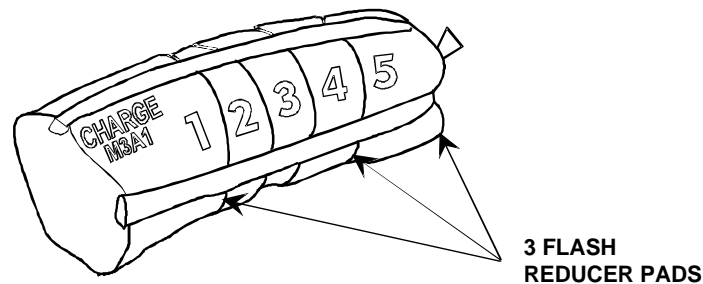
#### 4-5. PROPELLING CHARGES

The following are authorized propelling charges.

##### WARNING

Some propelling charges may have primer MK2A4 packed inside the container. This primer is not authorized for firing in the M199 cannon (M198). Do not fire the MK2A4 in these cannons. Turn them into the ammunition supply point.

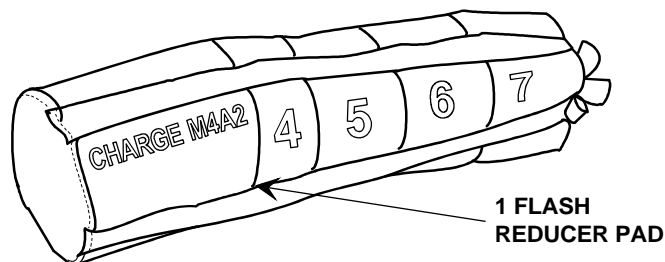
##### M3A1 PROPELLING CHARGE (GREEN BAG)



a. **Propelling Charge, M3A1.** This is a green bag charge divided into a base and four increments for firing in charges 1 thru 5. It has a flash reducer pad assembled in front of the base charge with similar 1-ounce (28.35-g) pads assembled in front of increments 4 and 5. The increment bags are tied together by cloth straps. A clean-burning igniter charge in a red cloth bag is sewn to the rear of the base section.

b. **Propelling Charge, M3.** This is a green bag charge similar to the M3A1 propelling charge, except it is not assembled with flash reducer pads, and black powder is used in the igniter pad.

##### M4A2 PROPELLING CHARGE (WHITE BAG)



c. **Propelling Charge, M4A2.** This is a white bag charge consisting of a base charge and four increments for firing in charges 3 thru 7. The increments are tied together by cloth straps. A clean-burning igniter charge in a red cloth bag is sewn to the rear of the base section. It has a flash reducer pad assembled in front of the base charge.

d. **Propelling Charge, M4A1.** The M4A1 propelling charge is identical to the M4A2 propelling charge, except that it does not contain a flash reducer, and the base igniter contains black powder instead of a clean-burning igniter charge. The M2 flash reducer may be used with this charge and is a separate item of issue.

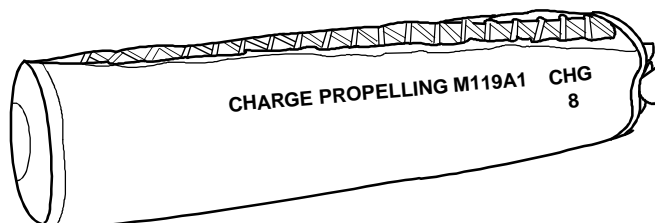
e. Deleted.

#### 4-5. PROPELLING CHARGES (cont)

##### WARNING

A central ignition core in M119A1 and M203 charges extends through the center of the charge for almost its entire length. The M119A1 and M203 charges must be stored and transported in a HORIZONTAL position so that any possibility of damage to the core in the form of cracks or splits is eliminated. The M119 charge is not to be used when firing M549/M549A1 projectile.

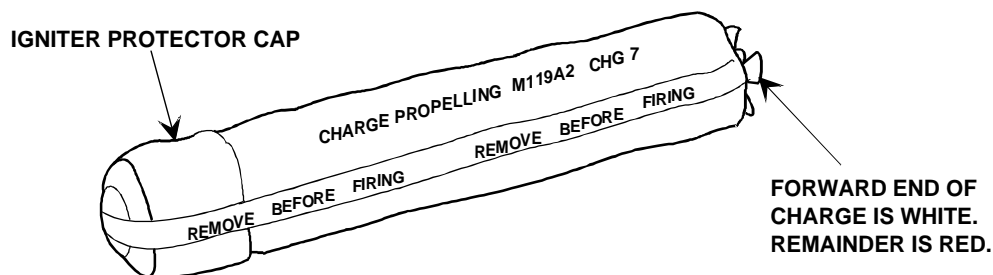
#### M119A1 PROPELLING CHARGE (WHITE BAG)



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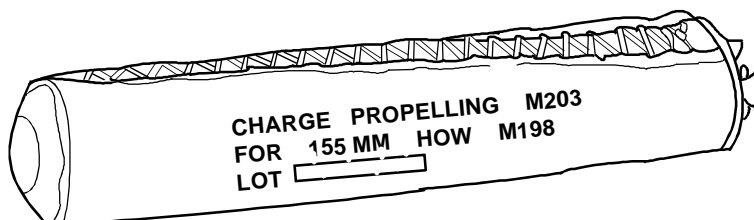
g. **Propelling Charge, M119A1.** This charge is identical in appearance to the M119 propelling charge. It is a single charge 8. It contains some design improvements including a modified flash reducer. The modified flash reducer allows firing of this charge with the M549 and M549A1 projectiles. A pull strap has also been added to the M119A1 charge, which provides easier removal from the metal container. This pull strap must be removed from the charge before loading into the weapon tube.

#### M119A2 PROPELLING CHARGE



h. **Propelling Charge, M119A2.** This charge differs in appearance from the M119A1 in that it has no lacing jacket and the charge bag is red. It is a base ignited zone 7 charge with an igniter pad sewn on the base and a flash reducer which lines the side of the charge. Like the M119A1, it can be fired with the M549/M549A1 projectile. The igniter protector cap and tie strap must be removed prior to firing the charge. The M119A2 zone 7 is equivalent to the M119A1 zone 8 charge.

#### M203 PROPELLING CHARGE (RED BAG)



### WARNING

When firing the M203 charge (red bag) or M203A1 charge the following restrictions must be observed:

- a. Foam earplugs must be properly worn.
- b. No more than 12 rounds should be fired in a given 24 hour period by any one crew or one individual crew member. If more than 12 M203 series charges are fired, all personnel must stand 25 feet (7.62 m) or more behind rear of cannon and a 25-foot (7.62-m) lanyard must be used.
- c. A 55-inch (1.397-m) clearance must exist between breech and ground along the recoil path prior to firing at elevations in excess of 800 mils.
- d. Allowable Number of Rounds Per 24-hour Period - By Charge (with hearing protection).

M203	Series — 12
M119	Series — 32
M4	Series — 144
M3	Series — 1000

### NOTE

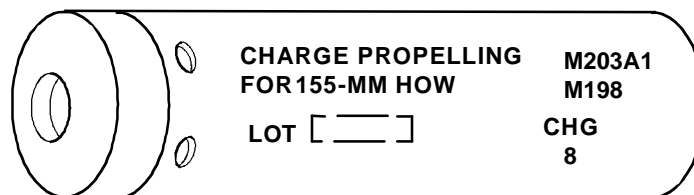
These recommended limits are mutually exclusive; e.g., 12 rounds M203 series, or 32 rounds M119 series, or 144 rounds M4 series, or 1000 rounds M3 series per 24 hour continuous time period.

i. **Propelling Charge, M203.** The M203 propelling charge is a charge 8 propelling charge developed for extended range in long-tube (M199) 155-mm howitzers. This red bag charge consists of one increment with an igniter bag sewn on its base, a central core igniter extending through the center of the charge, and a flash reducer in front of the charge. The entire length of the charge is encased in a tight-fitting lacing jacket for added strength and stability.

### NOTE

Early production of M203 charges are marked charge 8S (i.e., super). Later production M203 charges are marked charge 8. The charges are ballistically equivalent and should be identified as charge 8 red bag.

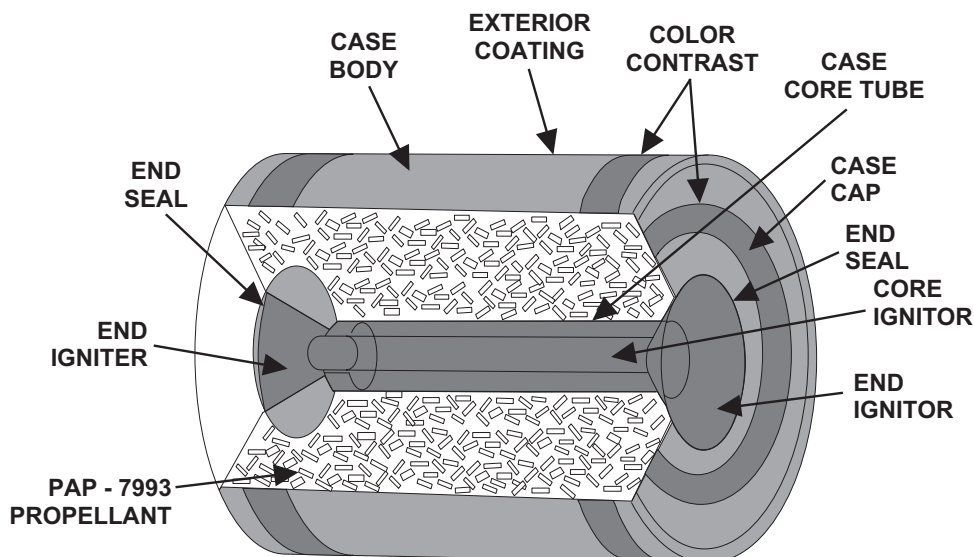
### M203A1 PROPELLING CHARGE



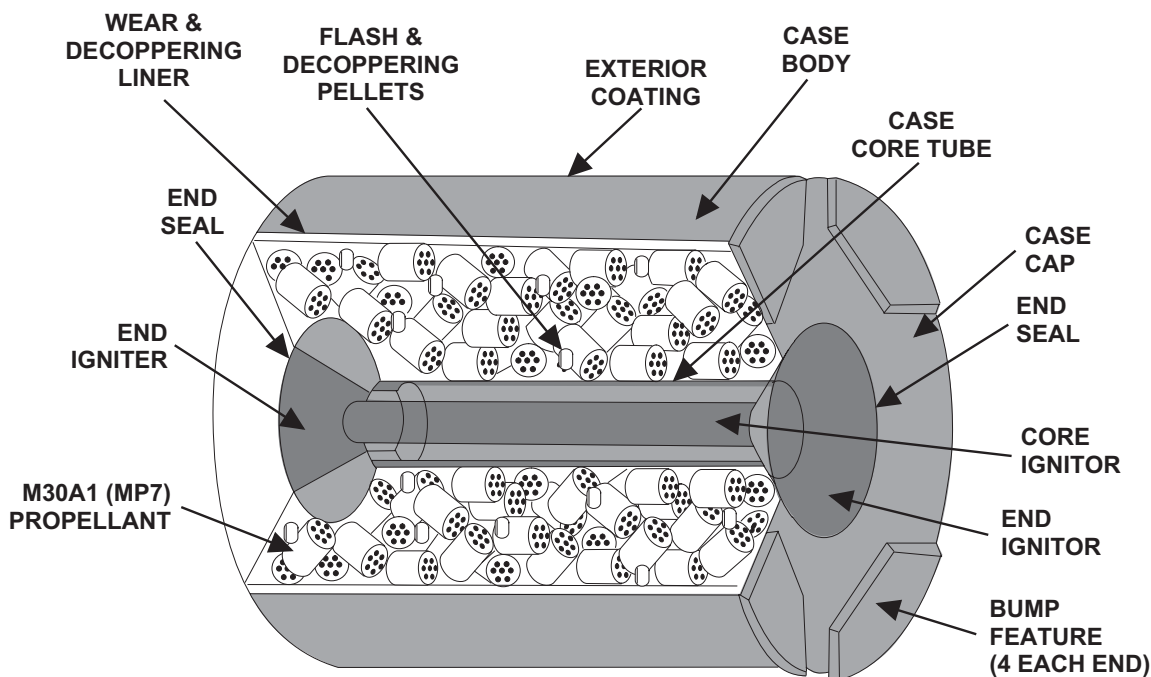
j. **Propelling Charge, M203A1.** The M203A1 propelling charge like the M203 is a charge 8 propelling charge developed for extended range in long-tube (M199) 155-mm howitzers. This charge consists of one increment of stick propellant and a base igniter pad encased in a full length rigid combustible cartridge case. The charge also contains a wear reducing additive and a lead foil decoppering agent. The M203A1 charge 8 is ballistically equivalent to the M203 red bag charge 8.

## 4-5. PROPELLING CHARGES (cont)

### M231 and M232 Propelling Charge: MACS (Modular Artillery Charge System)



**k. Propelling Charge, M231.** The M231 propelling charge is comprised of a green-colored, coated, nitrocellulose-based combustible case with black markings and black bands. This charge is bi-directional (can be loaded in either direction). The M231 is fired in increments of 1 or 2 for charges 1 and 2.

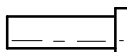


**l. Propelling Charge, M232.** The M232 propelling charge is comprised of a tan-colored, coated, nitrocellulose-based combustible case with black markings. This charge is bi-directional (can be loaded in either direction). Each end has four raised 1/8-inch bumps. The M232 is fired in increments of 3 through 5 for charges 3 through 5.

#### 4-6. PRIMER, M82

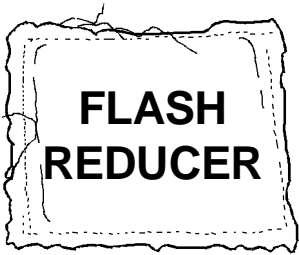
##### **WARNING**

The M82 is the only primer authorized for firing in M199 cannon (M198). DO NOT FIRE THE MK2A4 IN THESE CANNONS. TURN THEM INTO THE AMMUNITION SUPPLY POINT.



The primer, which is loaded separately from the projectile, is inserted into the primer chamber. When the cannon is fired, the firing pin strikes the primer, which in turn ignites the charge, propelling the projectile forward.

4-7. FLASH REDUCER, M2 (T2)



The flash reducer pads serve to limit breech flashback, as well as muzzle flash and blast overpressure. This flash reducer consists of a red cotton cloth bag 4 inches (10.16 cm) square, containing black powder and potassium sulfate or potassium nitrate. The M2 flash reducer, which is a separate item of issue, may be used with the M4A1 propelling charge if flash reduction is desired. In preparing an M4A1 white bag propelling charge for firing, one flash reducer is added in front of the base charge and one in front of each increment used.

Section II. PREPARATION FOR FIRING

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4-8. GENERAL

NOTE

Ammunition components are handled by cannoneers.

- a. **Temperature Limits.** Unless otherwise specified, observe the following temperature limits when firing:

WARNING

To ensure that the projectile upper temperature limit stays below +125°F (+52°C), it must be shaded when the weather is expected to be hot, i.e., the outside temperature is expected to exceed +100°F (+38°C) during the day.

- (1) Lower limit is -40°F (-40°C).
- (2) Upper limit is +125°F (+52°C).

**b. Temperature Check Procedures for MACS, M231 and M232.**

**NOTE**

Temperature will be taken using the standard issue M1A1 powder thermometer. The operating temperature of MACS is -50°F through +120°F.

- (1) Lift the edge of the red seal on either end of the increment and peel the seal back.

**WARNING**

Do not jab the round end igniter bag with thermometer or any other object that may be used to break through the edge of the red seal. Black powder is impact sensitive and forceful impact of the bag may cause an accidental ignition.

**NOTE**

Do not puncture the combustible case since this makes the increment defective.

- (2) Lift the edge of the igniter bag and insert the powder thermometer under the cloth igniter bag and down along the inside of the center core.
- (3) The thermometer must stay in the increment until the temperature stabilizes.

**c. Packing and Unpacking Ammunition Components.** Retain packing materials for repackaging, as required.

**WARNING**

The M82 primer is the only authorized primer to be used in the M119 cannon. Do not use the MK2A4 primer in these tubes. The propellant may not ignite.

- (1) The M3 series propelling charges are packed two per metal container, with or without the MK2A4 primer. The M4 series, M119, M119A1, M119A2, M203 and M203A1 propelling charges are packed one per metal container.

- (2) The M231 is packed with four increments (two per extraction sleeve) in each metal container and the M232 is packed five per metal container. Increments in extraction sleeves that are not full will be combined to reduce the number of partially loaded containers. These increments will be repacked into their correct type of extraction sleeve and the repacked sleeves returned to their correct container (correct type and lot number) using the following procedures:

**NOTE**

Unused MACS increments should not be destroyed. They should be repacked, and either fired or turned back in.

- (a) Place one of the end cushions into the end of the extraction sleeve and lock in place using the velcro strap.
- (b) Slide the correct amount of charges (two for the M231 and five for the M232) into the open end of the extraction sleeve.
- (c) Slide the separators between the charges, making sure they slide all the way in. The bumps on the M232 must be aligned for the separators to slide all the way in.
- (d) Place second cushion into the open end of the sleeve and lock in place using the second velcro strap.

(e) Slide extraction sleeve with charges into the container and close.

(f) Mark partially loaded containers so that they are not turned in as empty.

(3) The M82 primers are packed one per waterproof bag. Primers are ready for firing when unpacked and should be protected from blows that might cause accidental functioning.

(4) The M2 (T2) flash reducers are packed 200 per metal container (four containers, 800 flash reducers per wooden box).

(5) Fuzes are generally packed in metal boxes. The metal boxes are then packed in wooden boxes.

(6) Refer to page 4-61 for Unpacking and Inspection procedures for the M712 Copperhead (HEAT) and M823 Training projectiles.

d. **Procedures.** Inspect ammunition components and verify item identification.

#### **WARNING**

Inspect your ammunition. Failure to accomplish required inspections can result in unnecessary malfunctions.

#### **CAUTION**

Do not use axes, crowbars, etc., which may damage ammunition or packaging.

(1) Unpack ammunition and perform inspections indicated in paragraph 4-18.

(2) Return all defective ammunition to ammunition supply point.

### **4-8.1. GROMMETS**

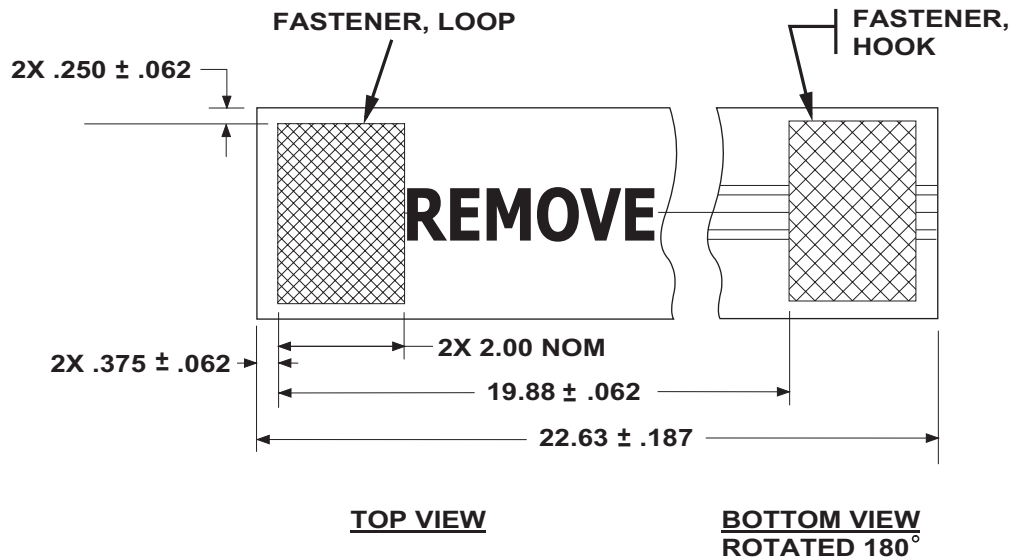
Plastic grommets provide protection to projectile rotating bands and obturators. One kind of grommet consists of glass filament, wound and impregnated with polyester. Another kind of grommet is made of polycarbonate. In order to remove the polycarbonate grommet from the projectile, the grommet fastener has to be pulled outward to release the tension which holds the grommet around the projectile body. When installing the polycarbonate grommet, slide the grommet over the projectile until it rests on the rotating band area, then close and push the fastener until it locks.

### **4-8.2. FLEXIBLE ROTATING BAND COVER (FRBC)**

a. **General.** The FRBC, as well as the grommet, is used to protect the rotating band of artillery projectiles from corrosion, dirt, and damage during transportation, handling, and storage. The FRBC can be discarded or replaced in the event of NBC contamination. The FRBC consists of a cloth band with hook and loop attachable ends. Once the FRBC is wrapped around the projectile rotating band, the two ends are pulled until it is tight against the rotating band. The FRBC is then closed by pressing the loop end against the hook end of the fastener with the words "REMOVE BEFORE FIRING" visible in the upright position.

**b. Replacement.** The FRBC should be replaced if any of the following situations occur:

- (1) The FRBC does not stay on firmly with sufficient resistance to opening.
- (2) The FRBC exhibits cuts that expose the rotating band.
- (3) The FRBC marking is unreadable due to age and wear.



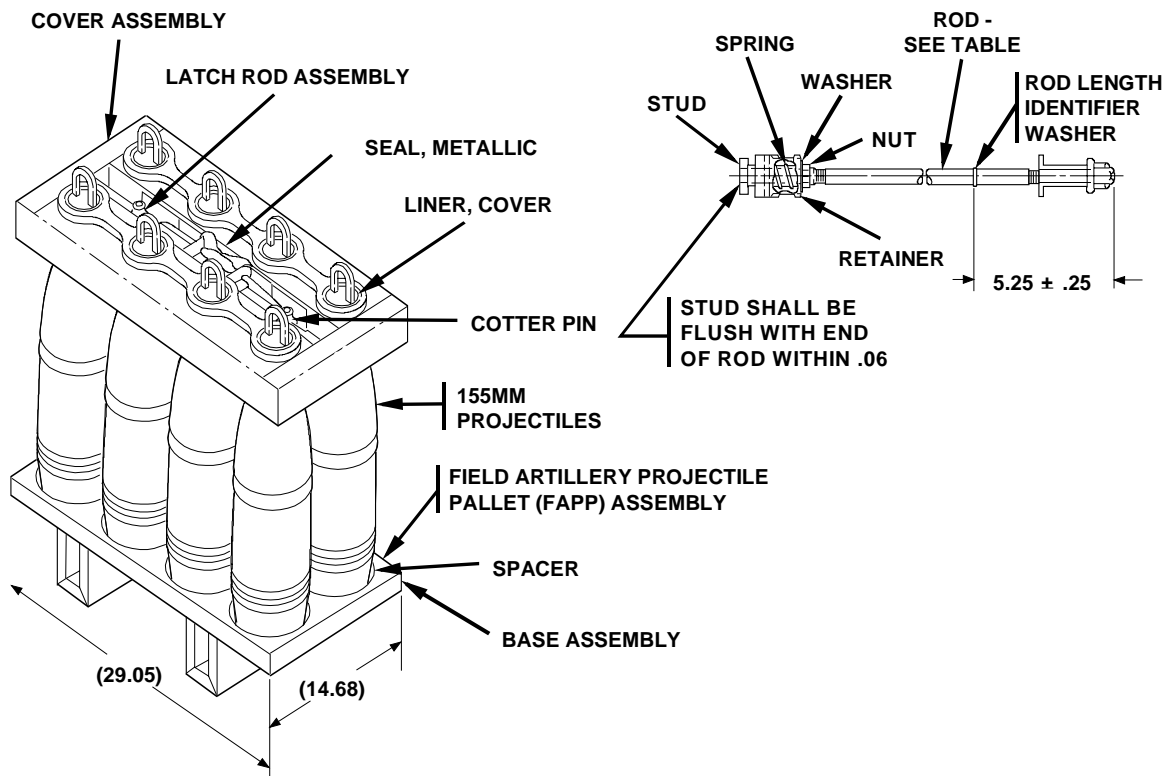
#### 4-8.3. FIELD ARTILLERY PROJECTILE PALLET (FAPP)

**a. General.** The FAPP is a NBC decontaminable, non-flammable, reusable metal pallet. It allows for easy repalletization in the field with no special tools required. The FAPP consists of a steel pallet base, steel pallet cover, and two adjustable rods that hold the cover to the base. The two adjustable rods hold the FAPP securely without any banding needed. There are plastic spacers under the base of the projectile and on top of the lifting plug to prevent abrasion. The FAPP holds up to eight 155-mm projectiles, with a minimum of two projectiles, and it accommodates both the plastic grommet and the flexible rotating band cover (FRBC) for rotating band protection. Before loading the FAPP with projectiles, the latch rods must be assembled to the pallet base. The center of the pallet is loaded first to avoid tipping. Once the FAPP is loaded, the pallet cover with the handles in open position is placed over the projectiles. The pallet cover is then closed by pushing the handles down into the locked position.

**b. Instructions.** Complete instructions for assembling, loading, and unloading the FAPP are found in TM 9-1300-251-20&P and TM 9-1300-251-34&P.



PROJECTILE	ROD LENGTH	BASE SPACERS
M107, M110 SERIES, M449 SERIES, M485A1, M804 SERIES	24.5 in. (62.2 cm)	5.5 in. (14.0 cm) wide - Green
M795	30 in. (76.2 cm)	5.9 in. (15.0 cm) wide - Black
M549 SERIES	31.5 in. (80.0 cm)	5.5 in. (14.0 cm) wide - Green
M483A1, M692, M718, M731, M741, M864, M898	32 in. (81.3 cm)	5.9 in. (15.0 cm) wide - Black



## 4-9. PREPARATION FOR FIRING

Preparation for firing the four components of a complete round of 155-mm ammunition requires efficient teamwork among the cannoneers. They must quickly and accurately select, unpack, inspect, and prepare the correct primer, propellant, projectile, and fuze from the fire commands received by the howitzer section. The chief of section must thoroughly cross-train the entire crew so that any crewman can perform any or all of the duties required of any other members.

**a. Primer, M82.** Do not open moisture protective bag until ready to use the primer. Cannoneer no. 1 loads the primer.

**b. Propelling Charges.** Propelling charges come packed in hermetically sealed metal containers. There is one complete charge in each container of the M4 series, M119 series, and the M203 series propellants. The M3 series green bag charges are packed with two complete charges in each metal container. Check for the following when preparing the propellant for firing:

(1) Select the right charge announced in the fire command.

(2) Unpack the charge from the metal container, and inspect the charge for torn cloth, loose powder grains, or discoloration of the cloth bags.

(3) For M203A1 propelling charge only, pull pull-straps until the buttons on the base igniter assembly clear the mouth of the container. Grasp charge around the buttons and pull charge out of the container supporting it along its length to avoid dropping the charge. Charges which have severely crushed or distorted cases and/or contain missing or broken propellant are not to be fired.

(4) Remove the igniter cap and inspect the red igniter pad. The pad should not be torn or wet. The igniter powder grains are highly hygroscopic (will absorb moisture); the grains could stick together, which could cause misfires. The igniter powder grains should move freely inside the pad to show that they are not stuck together.

(5) Check the smell of the powder charge and its container. There should not be a sour, acid smell as this indicates the charge was previously wet. There should be a sweet, ether-like smell, indicating that the charge is fresh.

(6) Remove any excess powder increments (those increments with a higher number than called for in the fire command), and retighten the tie straps so that all powder increments are secure, with the highest numbered charge (per fire command) on top.

(7) Place the unused powder increments in a secure container and dispose of them later by burning under the supervision of an officer.

**c. Modular Artillery Charge System (MACS).** The MACS propelling charges are combustible case type charges that are packed in hermetically sealed metal containers. The M231 MACS is packed with four modules (two per extraction sleeve) in each metal container. The M232 MACS is packed with five modules in each metal container. Check for the following when preparing the propellant for firing:

(1) Select the right charge announced in the fire command.

(2) Unpack the charges from the metal container by pulling on the velcro strap removing the sleeve with the MACS enclosed from the container. Remove separator assembly by pulling on the connecting strap. Open the velcro strap and remove end cushions from either end of the sleeves. Push the needed amount of MACS from the opposite end of the sleeve through the now open end of the sleeve. Charges that are severely crushed, distorted, or broken are not to be fired.

(3) Check the red mylar seals on the end of the charges. If the seal is torn, punctured or missing, inspect the igniter bag. The pad should not be torn or wet. The igniter powder grains are highly hygroscopic (will absorb moisture); the grains will stick together, which could cause misfires. The igniter powder grains should move freely inside the pad to show that they are not stuck together.

(4) Unused MACS charges are repacked for later use.

d. **Projectile.** Projectiles for this howitzer normally come packed eight to the pallet, with the top and bottom of the wood pallets banded together or metal pallets (FAPP) secured together with adjustable rods. Each projectile has a lifting plug and a grommet or flexible rotating band cover (FRBC) attached for protection during handling and shipping activities. See paragraph 4-28 for the LPRS, which is an optional system for securing loose, unfuzed projectiles for transportation.

**WARNING**

Do not remove the grommet or flexible rotating band cover (FRBC) from the projectile until it is ready to be fired. If the grommet or FRBC has been removed and the projectile is not fired, the grommet or FRBC should be replaced. Handling or transporting projectiles without a grommet or FRBC is likely to cause damage to the obturator band as well as to the rotating band.



**NOTE**

These procedures apply to all projectiles, except for the M483A1 and M864 projectiles when fired in the self-registration mode.

**(1) Preparation of projectiles.** Select the right projectile announced in the fire commands and prepare it for firing as follows:

**(a)** Inspect and clean projectile.

1. Verify that the projectile is the type designated by the fire commands.

**NOTE**

A projectile with a burred rotating band will be put aside until the burrs can be removed with a file.

2. Remove the grommet or flexible rotating band cover (M795 projectile) and examine the rotating band to ensure that it is free from all dirt and burrs.
3. Remove the eyebolt lifting plug and gasket and examine the fuze well for leaks or damage to the filler. If any high-explosive filler residue clings to the threads of the fuze well, the round is rejected and another one is used to complete the fire mission.

**WARNING**

Dirt or grease left on the projectile rotating band could cause failure of the projectile to seat properly in the forcing cone. Firing an unseated projectile could result in an inbore explosion causing injury or death.

**NOTE**

Any sand, dirt, oil, or grease left on the projectile will cause wear, scratches, or gouges in the bore.

4. Examine the entire projectile for defects and check to see that the projectile is not damaged or corroded and is free of dirt, grease, sand, and oil. Slight rust on the projectile is acceptable.

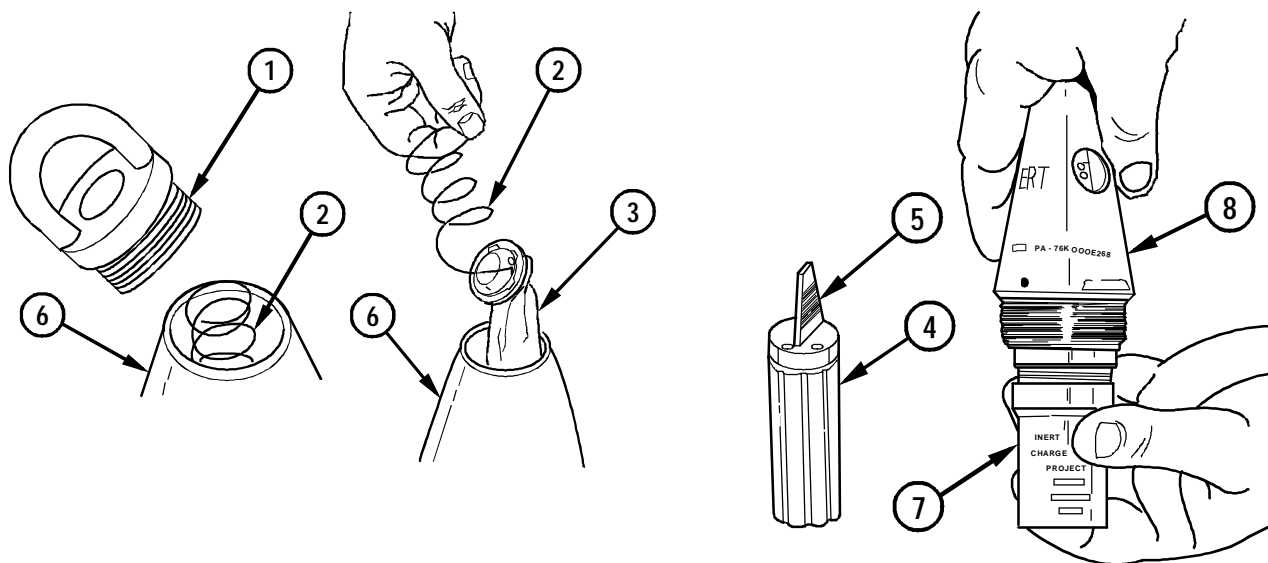
**(b)** Hold the projectile upright for fuzing and fuze setting.

**(2) Special preparation of the M483A1 and M864 projectiles for use in the self-registration mode.**

When the command for use of the M483A1 or M864 ICM projectile includes the self-registration mode, the expulsion charge inside the nose of the projectile must be removed and a projectile spotting charge threaded on to the fuze as follows:

## 4-9. PREPARATION FOR FIRING (cont)

### EXPULSION CHARGE ASSEMBLY — REMOVAL



(1) Remove the fusible or universal lifting plug (1) with attached gasket. When the lifting plug is removed, the compressed coiled pull-wire (2) on the bagged expulsion charge assembly (3) will expand and protrude beyond the fuze well of the projectile ogive. If the projectile is assembled with the cylindrical plastic expulsion charge assembly (4), the tab (5) will pop up.

(2) Remove the bagged expulsion charge assembly (3 or 4) by grasping and firmly pulling the pull-wire (2) or tab (5). Set charge assembly aside for disposition. Visually inspect the fuze well (6) for loose grains of propellant or other foreign material. Remove any loose material.

#### WARNING

When screwing the projectile spotting charge (7) on to rear of the M577 series fuze or M762 fuze (8) ensure that shoulder of projectile spotting charge is seated squarely against shoulder of fuze. An improperly seated charge could cause a malfunction.

#### CAUTION

When assembling projectile spotting charge to fuze, exercise care to avoid damaging threads. If binding occurs, consider charge unserviceable and report it for disposition. If binding has occurred, reinspect fuze to assure it is still serviceable.

(3) Obtain an M577 series fuze or an M762 fuze (8) and a projectile spotting charge (7). (1320-00-171-0760 D003)

(4) If firing the M483A1 or M864 projectile in the self-registration mode, screw the projectile spotting charge (7) handtight onto the M577 series fuze or M762 fuze (8) (left-hand thread).

## 4-10. FUZES

**a. General.** The four basic types of fuzes are: impact, mechanical time, electronic time, and proximity variable time (VT) fuzes. On the command, FUZE (type of fuze), cannoneer no. 2 must select the right type, unpack, inspect, and install it in the projectile, and set it as commanded (TIME, SUPERQUICK, DELAY).

**b. Lifting Plug Removal.**

**WARNING**

Do not use a projectile with explosive on the threads or evidence of explosive powder seepage. It could cause detonation of the projectile if fired.

(1) Remove plug and inspect the filler beneath the plug.

(2) Inspect the cavity and projectile threads for damage. Remove loose material from cavity. If any high explosive is found stuck to the threaded portion of the projectile throat, do not fire.

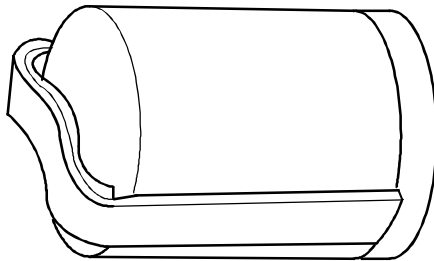
**WARNING**

Do not use the M549/M549A1 projectile if the lifting plug has been broken. Do not attempt to extract any portion of the plug from the fuze well of the projectile. Return projectile to the supply point.

Do not fire point-detonating (PD), mechanical time and superquick (MTSQ), electronic time (ET), or the short intrusion variable time (VT) fuzes in a deep-cavity projectile without the supplementary charge as an inbore explosion may result.

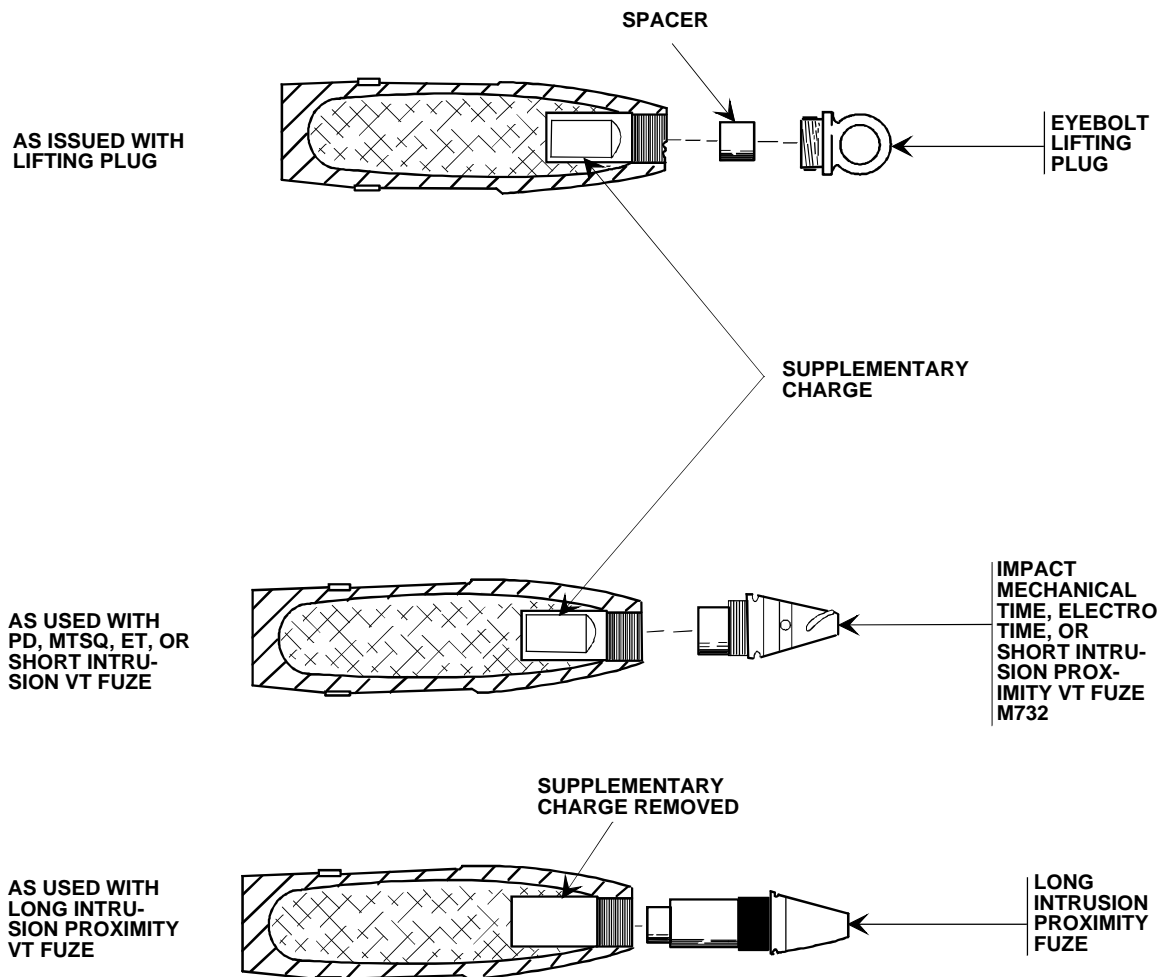
Do not attempt to remove supplementary charge by any means other than the lifting loop. Use of screwdrivers or other tools to remove the charge by force is dangerous.

**c. Supplementary Charge.** For the long intrusion proximity fuze firings, remove supplementary charge by means of its lifting loop. If the charge cannot be removed by its lifting loop, either fire with a short intrusion VT, PD, ET, or MTSQ fuze or dispose of the round.



## 4-10. FUZES (cont)

### TYPICAL DEEP-CAVITY PROJECTILES



**d. Fuze Assembly.** The following procedures apply to all fuzes. Paragraph (2) contains special instructions for the M577 series fuzes.

- (1) Assembly of fuze to projectile.

#### WARNING

When tightening fuze to projectile, do not hammer on fuze setter wrench or use extension handle on fuze setter wrench. Do not stake fuze to projectile under any circumstances. Shocks transmitted to a fuze during assembly may cause a malfunction.

- (a) Screw fuze in by hand. If binding occurs, inspect fuze cavity and threads of both fuze and projectile. Reject whichever is at fault.

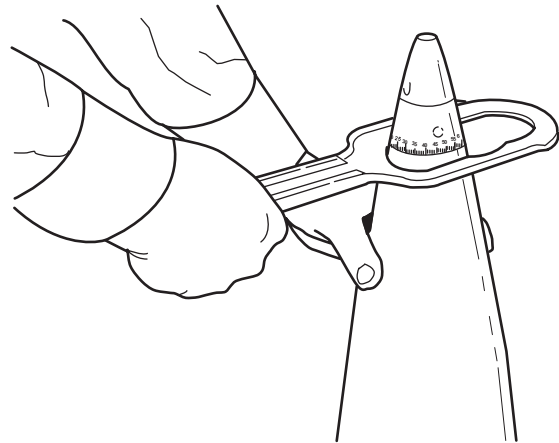
**WARNING**

Rounds fired without a fuze or with improperly seated fuzes may result in premature functioning.

**NOTE**

For long intrusion proximity fuzes with a gap between the fuze shoulder and projectile, either replace the supplementary charge and fire with impact PD, MTSQ, ET, or short intrusion VT fuze or dispose of round.

- (b) After assembling fuze by hand, back fuze off 1/4 turn. Using the M18 fuze setter wrench, tighten fuze to projectile with a sharp snap of the wrench so that the fuze shoulder is seated firmly against the projectile nose.



- (c) Deleted.

(2) Special preparation for the M577 Series fuze. Inspect the fuze setting. The fuze will be considered unserviceable if the setting is not between ◀ 93.5 and ◀ 95.5, the fuze shows signs of damage, or the window is blackened or sooty inside.

**WARNING**

When screwing the projectile spotting charge on to the rear of the M577 series fuze, ensure that the shoulder of the projectile spotting charge is seated squarely against the shoulder of the fuze. An improperly seated charge could cause a malfunction.

**CAUTION**

When assembling the projectile spotting charge to a fuze, be careful not to damage threads. If binding occurs, consider the charge unserviceable and report it for disposition. If binding has occurred, reinspect the fuze to ensure it is still serviceable.

## 4-11. FUZE SETTING

The following procedures apply to all authorized fuzes. Fuze-setting tools and procedures are listed in table 4-4.

**Table 4-4. Fuze, Fuze-Setting Tools, and Procedures**

Fuze											
MOFA	PD			MT		MTSQ		Prox	ET		
M782	M557 and M572	M739 Series	MK399 MOD1	M565	M564	M501 Series	M577/ M582 Series	M732/ M728/ M514	M762/ M767 Series	Setter	Procedure Number/ Page Number
	X	X	X							Fuze-setter wrench, M18	1/4-40
								X		M27	2/4-41
				X	X					M34	3/4-42
							X			M35	4/4-45
						X				M27	5/4-47
									X	By hand or M1155	6/4-48
X										M1155	7/4-48.1

**a. Procedure Number 1, Fuzes, M557, M572, M739 series, and MK399 MOD 1.**

**NOTE**

Point-detonating (PD) fuzes with superquick (SQ) or delay functioning are shipped for SQ action. The MK399 MOD 1 MOUT fuze is shipped set on DLY (delay) mark.

**(1)** If superquick action is desired, check the setting to make sure it is set at SQ or PD mark.

**(2)** To set fuzes for delay action, use screwdriver end of the M18 fuze-setter wrench or similar tool and turn slot 1/4 turn to align with index mark indicating DELAY (or DLY on MK399 MOD 1 fuze).



**b. Procedure Number 2, Fuzes, M728, M514 Series, and M732 Series.**

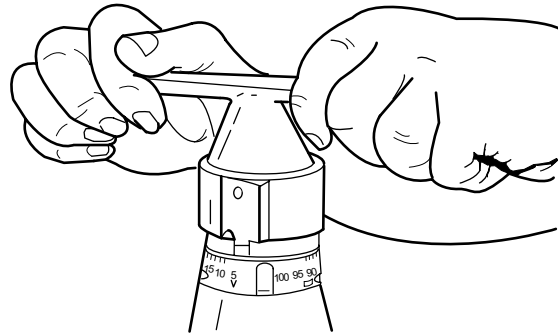
**CAUTION**

Plastic nose cones rotate with index mark. Damage to plastic will produce duds. However, since there is no backlash, fuze setting can be accomplished or changed one or more turns with no harmful effect. If counterclockwise rotation is used, be sure that the fuze has not come loose from the projectile.

**NOTE**

M514 series and M728 fuzes are shipped with the index mark on the nose cone set at 10 seconds. M732 series fuze is shipped with the index mark aligned with PD. The M514 and M514B1 fuzes are shipped with the index mark aligned with "S". The M514A1 fuze is shipped with the index mark aligned with the shipping line (long, vertical arrow).

(1) The fuze is set when the index line at base of nose cone is aligned with the time, in seconds, engraved on base of fuze.



**NOTE**

Rotation of the M732 series fuze nose cone has been experienced at top zones (not a safety hazard). If this occurs when M732 series is set on time for proximity function, PD function might occur instead. In such instances, set the fuze to a time of 10 seconds less than the time of flight for proximity function. If this occurs when M732 series fuze is set on PD mark proximity functioning may occur instead of impact functioning. In such instances, set the fuze to a time equal to the time of flight plus 10 seconds for impact function. The PD setting of the M732 series VT fuze when fired into soft impact areas will be less deadly than the superquick (SQ) setting of the M739 series PD fuze.

(2) To set fuze for proximity action, rotate nose cone with the M27 fuze setter, normally in clockwise direction while looking down on the nose of the fuze, until the index mark coincides with the announced time. The fuze setting can be changed one or more times with no harmful effects.

(3) For impact functioning of the M514 series/M728 fuzes, set fuzes to 90 seconds (100 second line for flight time exceeding 85 seconds). The M732 series fuze remains set on PD for impact function.

#### 4-11. FUZE SETTING (cont)

##### WARNING

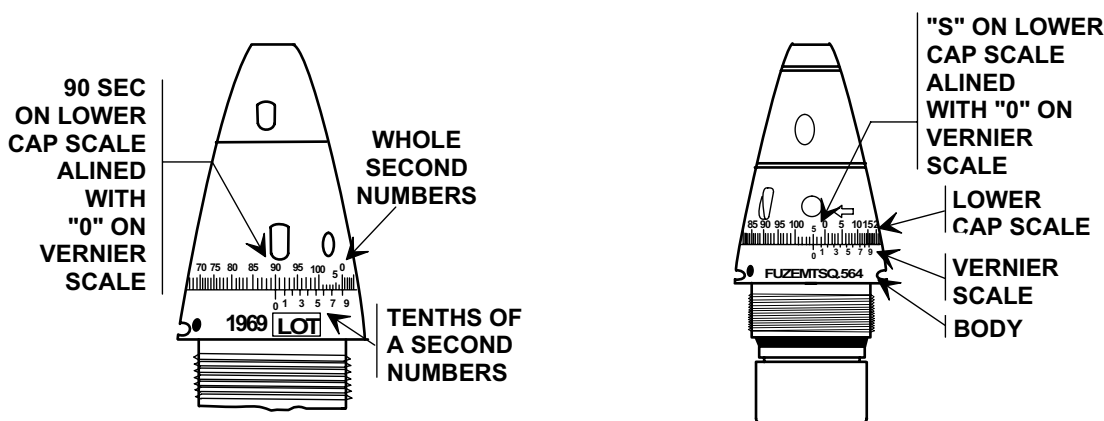
Do not fire projectile unless fuze is fully seated. Inbore explosion may result.

(4) Firing temperature limits for M728 and M732 proximity fuzes are -40° to +140°F (-40° to +60°C) and 0° to +120°F (-18° to +49°C) for M514 series fuzes.

##### NOTE

Do not attempt to set the fuze until just before firing.

c. **Procedure Number 3, Fuzes, M565 and M564.** The following procedures include instructions for setting the fuze for superquick (impact) action and airburst (time) and for meeting safety requirements. If the M564 fuze is to be fired for superquick action (impact) only, first check the year of manufacture stamped on the fuze body, then follow instructions below, as appropriate.



##### WARNING

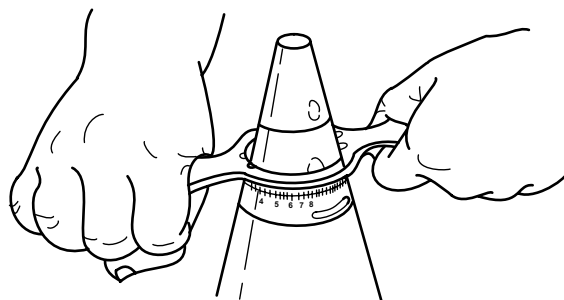
To avoid accidental functioning of PD element in M564 fuze, do not drop, roll, or strike the fuze under any circumstances (packaged, unpackaged, or assembled to the projectile).

##### NOTE

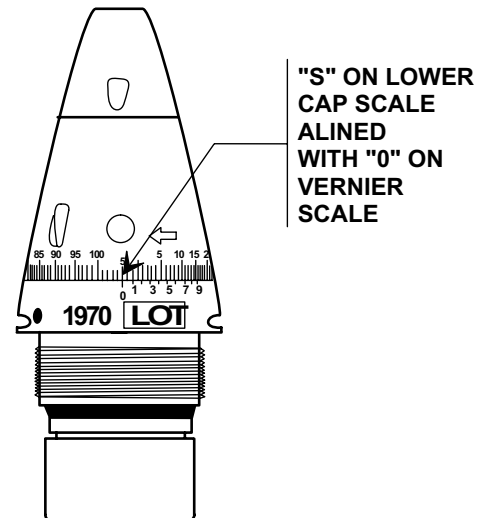
Do not attempt to set fuze until just before firing.

(1) Setting the M564 fuze for superquick (impact) action. M564 fuzes manufactured before January 1970 must be set on 90 seconds if superquick (impact) action is desired. M564 fuzes manufactured from January 1970 on should be set on "S" for superquick action. The year of manufacture is stamped on the M564 fuze body. These fuzes are shipped with the "S" on the lower cap scale alined with the "O" on the vernier scale.

(a) M564 fuzes manufactured prior to January 1970. Use M34 fuze setter to rotate the lower cap in the direction of the arrow (clockwise) from shipping "S" position until the 90-second position on the lower cap scale is alined with the "O" on the vernier scale.



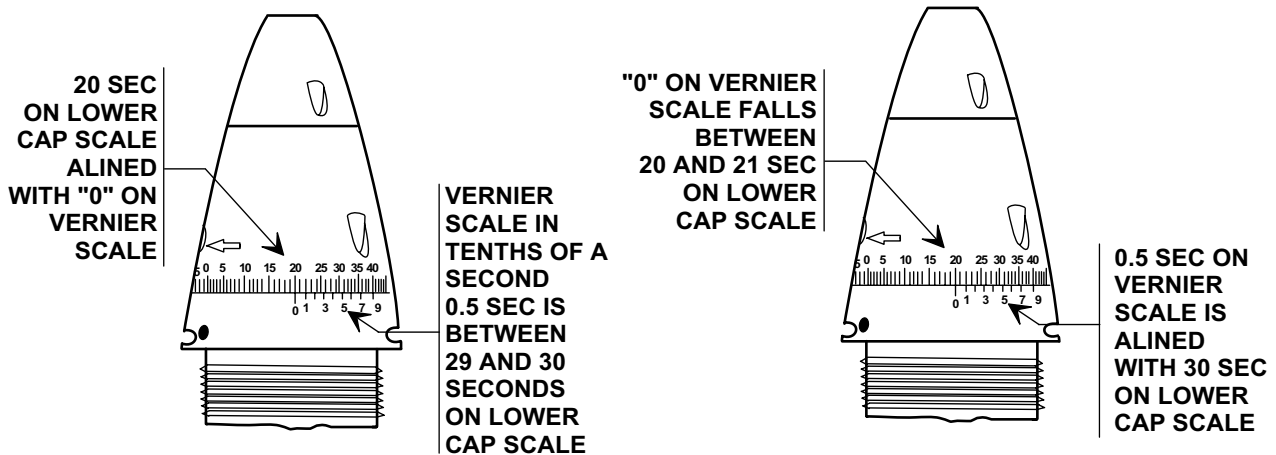
(b) M564 fuzes manufactured in January 1970 and later. Set the fuze on "S" as shipped for superquick action. Always be sure the "S" on the lower cap scale is aligned with the "O" on the vernier scale.



## (2) Setting M564 and M565 fuzes for airburst (time).

### WARNING

Incorrect settings of MT and MTSQ fuzes can and have resulted in down-range premature malfunctions. The safety of personnel located down-range of a weapon firing MT and MTSQ fuzes (between the weapon and intended target) is in the hands of the gun crew personnel assigned the job of setting the fuzes.

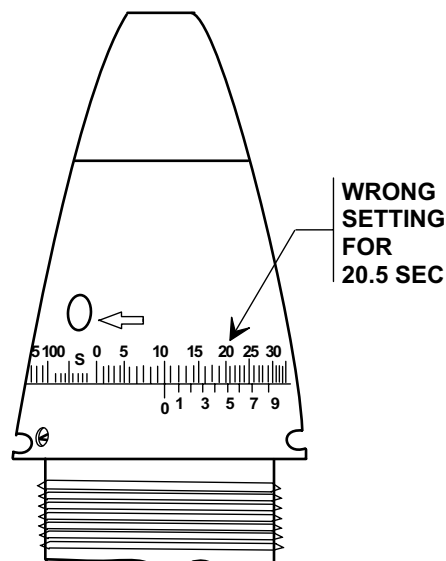


(a) To set the M564 and M565 fuzes for a whole-second time setting, use the M34 fuze setter to rotate the lower cap in the direction of the arrow (clockwise) until the desired whole number of seconds (e.g., 20.0 seconds) on the lower cap scale is aligned with the "O" mark engraved on the vernier scale.

(b) To set the M564 and M565 fuzes for a tenth of a whole second (e.g., 20.5 seconds), use the M34 fuze setter to set the fuze for the whole seconds on the lower cap scale. (In this case, the whole is 20 seconds.) Next, find the desired tenth of a second mark on the vernier scale.

**4-11. FUZE SETTING (cont)**

Continue to slightly rotate the lower cap in the direction of the arrow (clockwise) until the adjacent upper right graduation on the lower cap scale is aligned with the desired tenth of a second mark on the vernier scale. (The 0.5-second mark is now aligned with the 30-second mark on the lower scale).

**NOTE**

The whole second fuze setting is always indicated by the position of the "O" on the vernier scale. Each vertical mark on the lower cap scale (movable portion of fuze) represents one whole second of time. For other than whole-second settings, the "O" on the vernier scale (nonmovable portion of the fuze) must always be to the right of the whole-second portion of the desired fuze setting and between the whole-second portion of the desired fuze setting and the next one whole-second vertical mark. For example, for a setting of 20.5 seconds, the "O" on the vernier scale is to the right of the 20-second mark and midway between the 20- and 21-second marks on the lower cap scale.

An incorrect fuze setting for 20.5 seconds is shown above. If a fuze is set in this way for 20.5 seconds firing, the fuze is actually set on and will function at 10.5 seconds. This would cause the fuze to function earlier than desired.

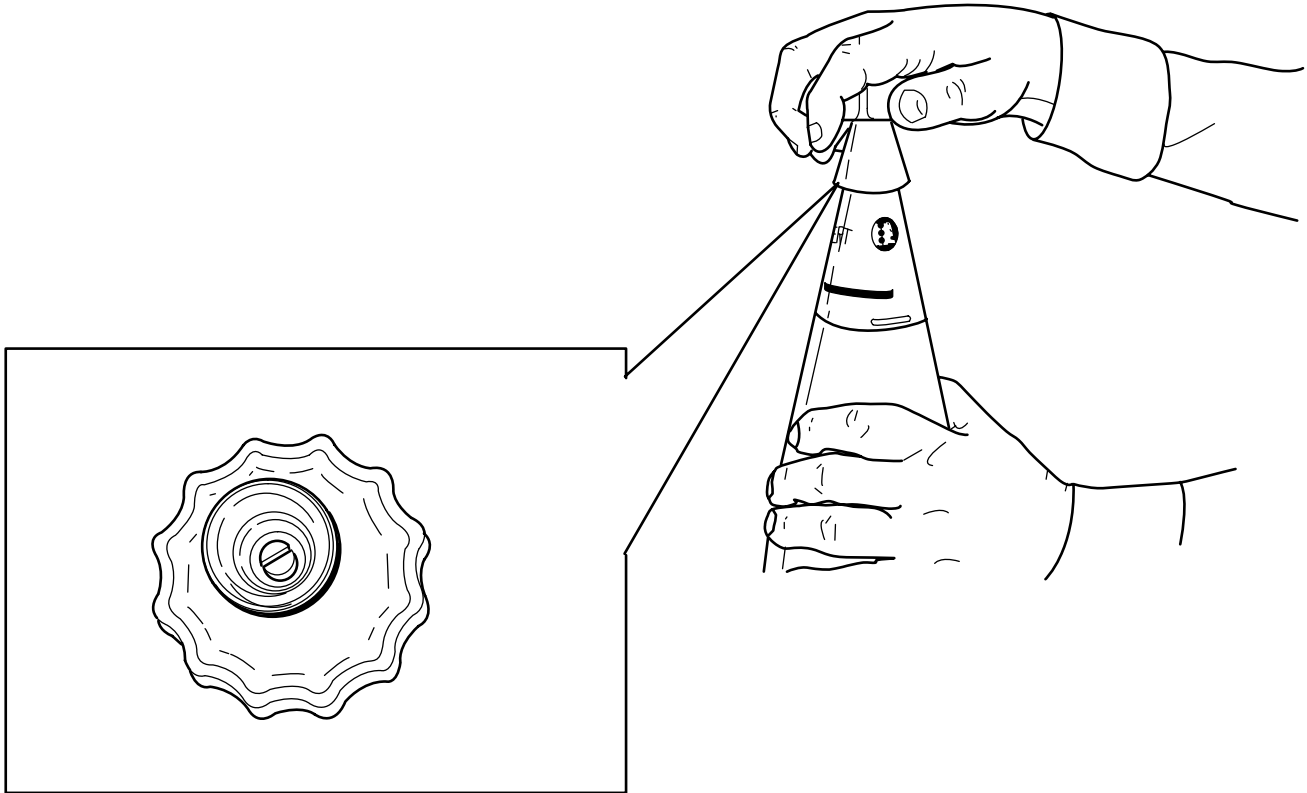
Do not attempt to set the fuze until just before firing.

**(3) Resetting fuze.** If you miss the setting, use the M34 fuze setter and turn the lower cap in the opposite direction (counterclockwise) 2 or 3 seconds below the desired setting. Then rotate the lower cap in the direction of the arrow (clockwise) and set the fuze on the correct time. This can also be done by turning the lower cap in the direction of the arrow (clockwise) all the way around (additional turn) to obtain the desired setting. Always make the final setting from low to high numbers.

**(4) Fuzes not fired.** If the fuze is prepared for firing but not fired, reset the fuze, using M34 fuze setter, by turning the lower cap in the direction of the arrow (clockwise) until the "S" mark on the fuze lower cap scale is in line with the "O" mark on the vernier scale.

(5) Fuzes fired in heavy precipitation. If M564 fuzes are fired in heavy precipitation (heavy rainfall, sleet, snow, or hail), occasional down-range premature functioning may occur. The precipitation necessary to cause malfunctioning is comparable to a heavy downpour which occurs during a summer thundershower. The premature rate will vary with the charge fired and the density of the precipitation.

d. **Procedure Number 4, Fuzes, M577 Series and M582 Series.** The slotted setting key on the nose of the fuze is used for setting the fuze in the following steps.



(1) Press the open end of the M35 fuze setter against the setting key.

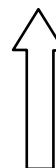
(2) Turn the knob handle of the fuze setter counterclockwise, as viewed from the nose end, until the fuze-setter blade engages fuze-setting key slot. The hairline in the window is used for all settings.

#### NOTE

The M577 series or M582 series fuze is set to the desired time by rotating the fuze setter in a counterclockwise direction. To return to shipping and storage setting, the fuze setter must be rotated in a clockwise direction.

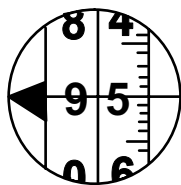
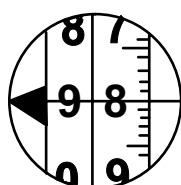
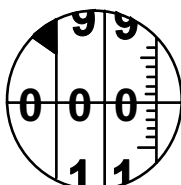
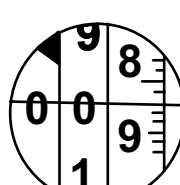
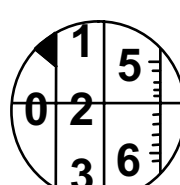
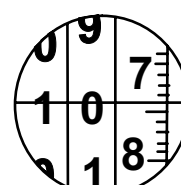
**4-11. FUZE SETTING (cont)****COUNTER-  
CLOCKWISE****SHIPPINGANDSTORAGE**

SETTING(◀ 93.5 TO ▶95.5).....1/4TURN  
 PDSETTING(▶98).....1/4TURN  
 000SECONDS .....1/4TURN  
 200SECONDS.....20TURNS

**CLOCKWISE****CAUTION**

Do not attempt to set these fuzes below ▶93.5 when setting them in the clockwise direction or above 200 seconds when setting them in the counterclockwise direction. The settings of 000 and/or 200 are not authorized service settings.

- (3) When setting the fuze for PD action (superquick), start with the shipping and storage position (safe) (▶93.5 to ▶95.5); then turn counterclockwise to ▶98.0 for PD action under the hairline window.

**FUZE-SETTING SEQUENCE****ASTORE(SAFE)****BPD****C000.0****D8.7****E25.5****F107.4**

- (4) To set the fuze for mechanical time action, turn the fuze setter counterclockwise from safe position (▶93.5 to ▶95.5) past PD (▶98.0), until the triangle (▶) moves off the hairline. This action occurs near a 000 setting. Continue to turn the fuze setter counterclockwise until the desired time appears under the hairline. Maintain a very light turning force against the fuze setter while reading the setting. The sequence is illustrated above for settings of 8.7, 25.5, and 107.4.

- (5) To set a lower time on a fuze already set, reseal fuze setter and turn clockwise (numbers get smaller) to a setting at least 1 second lower than the required setting (for example, at least 24.5 for 25.5). Reverse direction to counterclockwise (numbers get larger), and set required time under the hairline.

- (6) To return fuze to the shipping and storage (safe) position, turn the fuze setter clockwise (numbers get smaller) until 000 is passed, and continue to turn until setter stops turning freely. This point should be past the PD setting (▶98.0) and between ▶95.5 and ▶93.5. Notice that the triangle has reappeared in the window. Do not apply excessive force on the fuze setter after it has stopped turning and the setting is between ▶95.5 and ▶93.5. Return the fuze to the reusable fuze container. The fuze is considered unserviceable after being out of the container for more than 30 days.

(7) For special preparation for M577 series fuze, perform the following procedure. Inspect the fuze setting. Consider the fuze unserviceable if the setting is not between 93.5 and 95.5, the fuze shows signs of damage, or the window is blackened or sooty inside.

(8) Firing temperature limits for M577 series and M582 series MTSQ fuzes are -35°F to +145°F (-37°C to +63°C).

**e. Procedure Number 5, Fuze, M501 Series.**

**WARNING**

Exercise extreme care when handling an M501 series fuzed projectile. Mishandling or dropping could cause the fuze to function, expelling the base plate and contents. When handling a projectile assembled with this fuze, exercise extreme care to protect the fuze from impact. Keep pull wire on fuze in place until immediately prior to firing.

**CAUTION**

Do not use fuzes with cocked or loose lower caps. Mark such fuzes "defective" and return them to the ammunition supply point.

**NOTE**

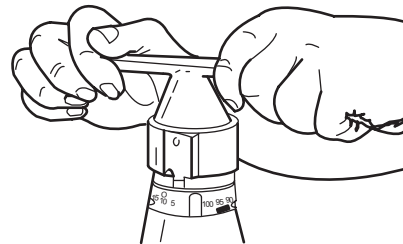
The M501 series fuzes are shipped with the index mark on the lower cap alined with the S engraved on the base.

**(1) Time setting.**

(a) Check fuzes for cocked or loose lower caps.

(b) To remove safety wire before setting, pull end of wire from hole in lower cap, sliding wire off end of fuze.

(c) With the M27 fuze setter, set fuze by rotating lower cap to desired time in counter-clockwise direction or in direction of arrow marked on lower cap. The fuze is properly set when the index mark on the lower cap is alined with desired time, in seconds, engraved on the base.



(d) If the round is not fired after the fuze is set, reset the fuze to the safe (S) position and place the safety wire in its proper position.

**(2) Impact setting.** To obtain impact functioning of the M501 series MTSQ fuze, leave the S (shipping mark) alined with the index mark on the base or set the graduated time ring so that the time setting is greater than the time of flight. Remove the safety wire (pull free end of wire off and out of hole) before firing or setting the fuze.

#### 4-11. FUZE SETTING (cont)

f. **Procedure Number 6, Fuzes M762 and M767 Series.** Set these fuzes with M1155 PIAF fuze setter (see paragraph g), by hand, or remotely by a weapon equipped with auto-set fire control system, as follows:

##### CAUTION

Do not activate these fuzes unless they will be fired before 15 days elapse. Once activated, these fuzes have a service life of approximately 15 days before the battery runs down. Check if LCD is active to determine if fuze is still settable.

(1) Setting by hand:

##### CAUTION

If the LCD display is blank or shows other displays than indicated after completing steps (a) and (b), the fuze is considered unserviceable and should not be fired.

##### NOTE

The M762 or M767 fuze ogive will rotate only clockwise (as viewed from nose end). If a desired digit was passed, continue rotating clockwise until the desired digit appears again. The ogives of the M762A1 and M767A1 can be rotated bi-directionally to provide quicker manual setting.

- (a) Rotate ogive clockwise at least one quarter revolution to activate the battery. The LCD window will display ◀88.8 indicating that all segments are operating as a visual safety check.
- (b) Depress the thumb operated cocking and selector button to clear the LCD display. The LCD window will display — — — — ensuring that no segments are stuck.
- (c) Depress the thumb operated cocking and selector button a second time; the LCD window will display 000.0. The cursor under the zero in the hundreds of seconds column indicates that this column is ready to be set.

##### NOTE

The hundreds of seconds column can display 0.1 or ◀ (blank space for the M762A1 or M767A1) while the tens of seconds, seconds, and tenths of seconds columns each can display 0 through 9.

- (d) Each column is set independently. Depress and release the selector button as required to move the cursor to the desired column. At the desired column, keep the selector button depressed and rotate the ogive to select the desired digit or ◀. Release the selector button and depress again to move cursor to the next column to continue setting.
- (e) For M762 or M767 PD, set the fuze to ◀98.0. Any other setting would result in a dud.
- (f) For M762A1 or M767A1, place the cursor in the hundreds digit and rotate the ogive until the \_ (underline) is selected. At this point, the fuse will be set to the point detonating setting and the display will be "\_Pd".
- (g) The following are examples of fuze settings.



M762A1/M767A1	M762/M767				
-PD	◀88.0	000.8	007.3	040.1	169.0
	PD	0.8 SECONDS	7.3 SECONDS	40.1 SECONDS	169 SECONDS

- (h) When fuze setting is completed and selector button is released, the ogive can be rotated without changing the fuze setting.
- (i) The settings can be changed as many times as required for the duration of the activated life of the battery.

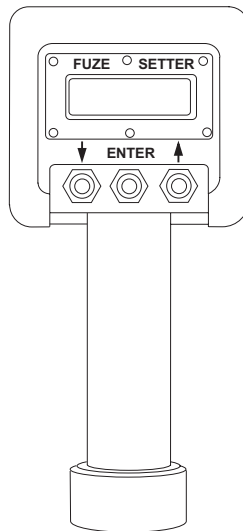
(2) Auto setting is accomplished via an inductive data link between the fuze and a weapon equipped with an auto-set fire control system. The desired fuze setting is input in the setter console and the transmit button is depressed. The fuze will be remotely activated and set and the console will display the actual fuze setting as a safety feature.

(3) To return fuze to the shipping and storage configuration, reset the fuze to ◀88.8. These fuzes should be segregated and used first in subsequent firings.

(4) Firing temperature limits for M762 and M767 ET series fuzes are -45°F to 145°F (-43°C to 63°C).

**g. Procedure Number 7, Fuze M782.** This fuze cannot be set by hand but can only be set inductively by the M1155 Portable Inductive Artillery Fuze Setter (PIAFS).

The M1155 PIAFS is a lightweight, hand-held device consisting of a cylindrical handle that houses the batteries that power the device, and a base with a fuze seating area in the back and a display window on the front face. Under the display window are three buttons, and between the buttons and the display window are three indicators or labels for the buttons. The right button is the ↑ button, the center button below the word **ENTER** is the ENTER button, and the left button is the ↓ button. The ↑ and ↓ buttons will scroll the cursor, which is the arrow (→) to the left of the items in the menu, up or down in the display window.



The M1155 PIAFS is designed to permit artillery units to set M762, M767, and M782 series artillery fuzes, and will decrease the time needed to set these fuzes and reduce time setting errors on fuzes equipped with inductive setting features. The M1155 PIAFS seats on compatible fuzes and sets the fuzes to their required operational parameters by electrical induction. Once the M1155 PIAFS is set to the correct fuze, mode and time, it is placed on the fuze to be set and the ENTER button is pressed. The display should then read "FUSE SET – OK".

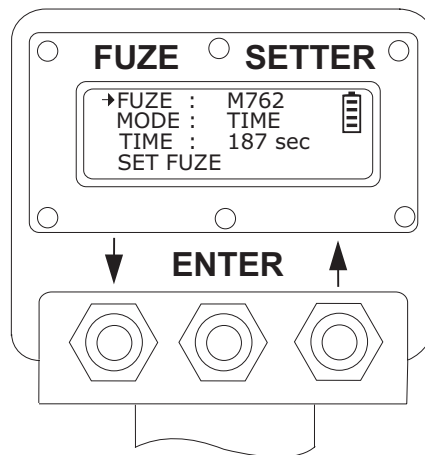
#### NOTE

When the setter is first initialized it displays the Fuze Menu. Afterwards it remembers where it was last and displays the Fuze Setting Menu with the last fuze set.

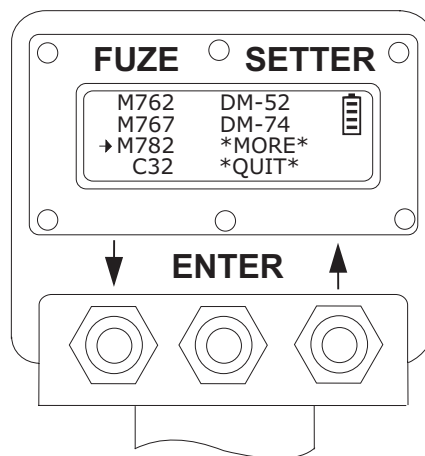
#### 4-11. FUZE SETTING (cont)

(1) Setting for Point Detonating (PD) mode:

(a) Press the ENTER button to turn on the setter. The last used fuze setting menu will be displayed.

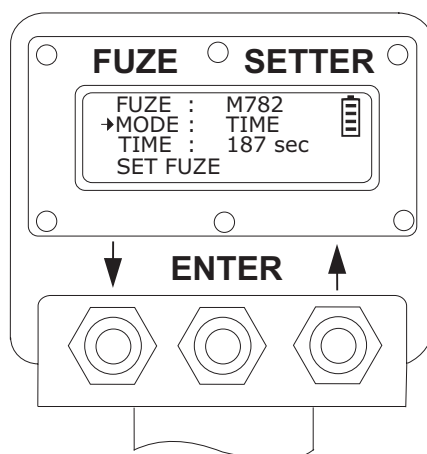


(b) Press the ↑ button or ↓ button if necessary to move the cursor ( → ) to align with **FUZE** and then press the ENTER button. The Fuze Menu appears.



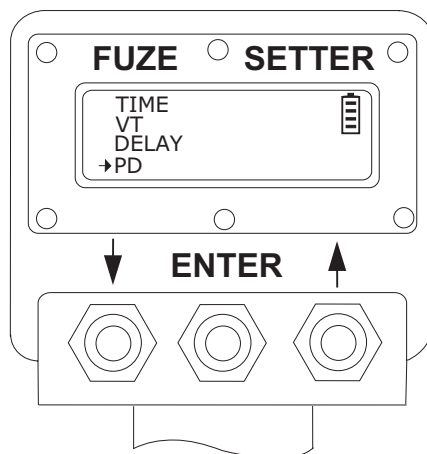
(c) Press the ↑ button or ↓ button as necessary to move the cursor ( → ) to align with **M782** and press the ENTER button. The Fuze Setting Menu appears with the cursor aligned with **MODE**.

### Fuze Setting Menu



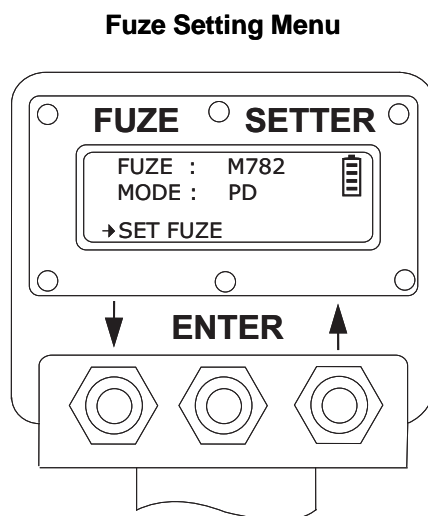
- (d) Press the ENTER button. The Mode Menu for the M782 fuze appears.

### Mode Menu (for the M782 Fuze)



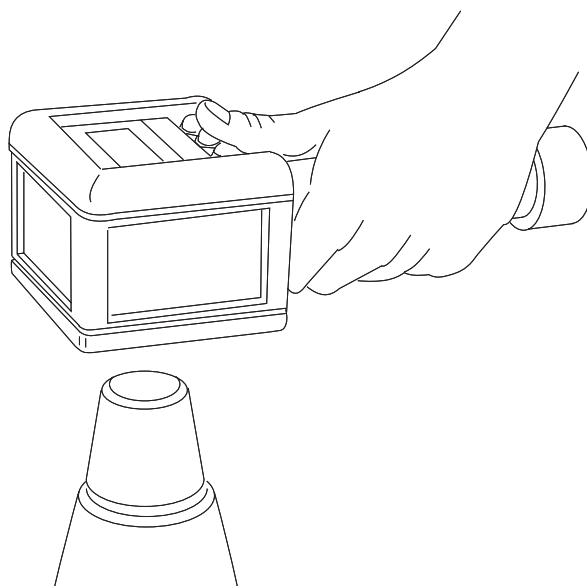
- (e) Press the ↑ button or ↓ button as necessary to move the cursor ( → ) to align with **PD** and press the ENTER button. The Fuze Setting Menu appears with the cursor aligned with **SET FUZE**.

#### 4-11. FUZE SETTING (cont)



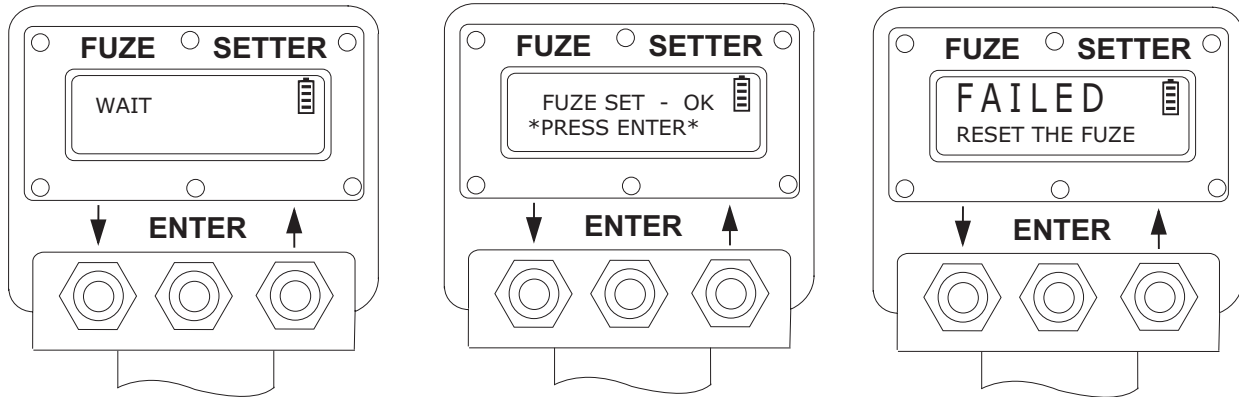
- (f) Place the setter on the fuze and press the ENTER button.

#### Placing the Fuze Setter



(g) The setter will attempt to set the fuze. After the **WAIT** message is briefly displayed, either the **FUZE SET - OK** message will be displayed, which means that the fuze has been set, or the **FAILED** message will be displayed, which means the fuze has not been set. If the **FAILED** message appears, try setting another fuze. If both fuzes do not accept the setting then replace the fuze setter and retry setting the fuzes.

#### Setting the Fuze

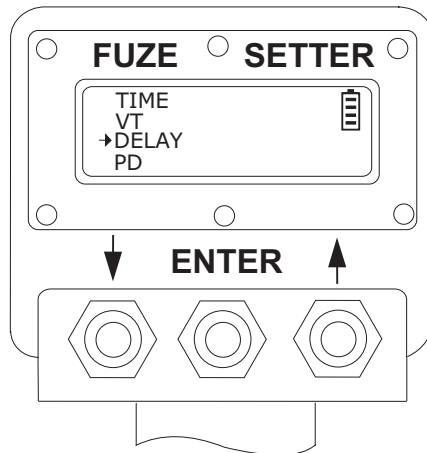


(2) Setting for Delay (DLY) mode:

#### NOTE

The setting procedures for the Delay mode are the same as those for Point Detonating (PD) mode except at step e. the cursor (→) is to be aligned with **DELAY** instead of **PD**.

#### Mode Menu (for the M782 Fuze)

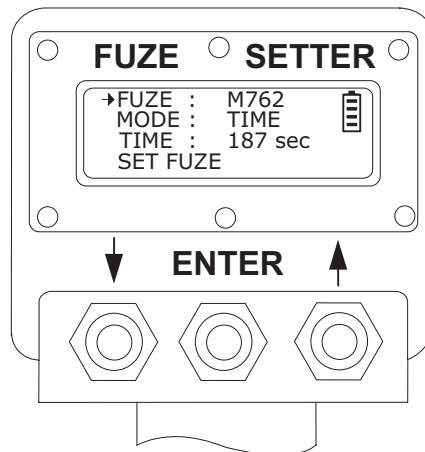


#### 4-11. FUZE SETTING (cont)

(3) Setting for Variable Time (VT) mode:

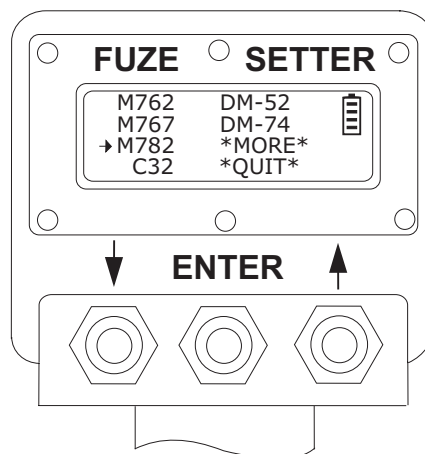
- (a) Press the ENTER button to turn on the setter. The last used fuze setting menu will be displayed.

**Fuze Setting Menu**



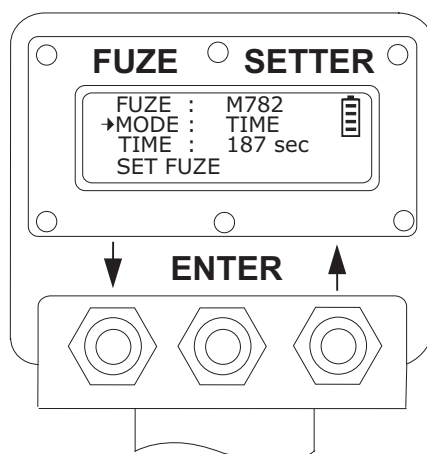
- (b) Press the ↑ button or ↓ button if necessary to move the cursor (→) to align with **FUZE** and then press the ENTER button. The Fuze Menu appears.

**Fuze Menu**



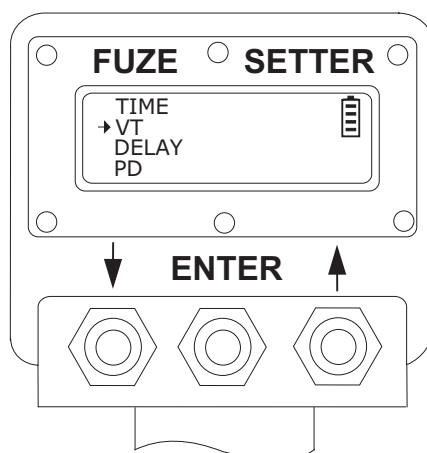
- (c) Press the ↑ button or ↓ button as necessary to move the cursor (→) to align with **M782** and press the ENTER button. The Fuze Setting Menu appears with the cursor aligned with **MODE**.

### Fuze Setting Menu



- (d) Press the ENTER button. The Mode Menu for the M782 fuze appears.

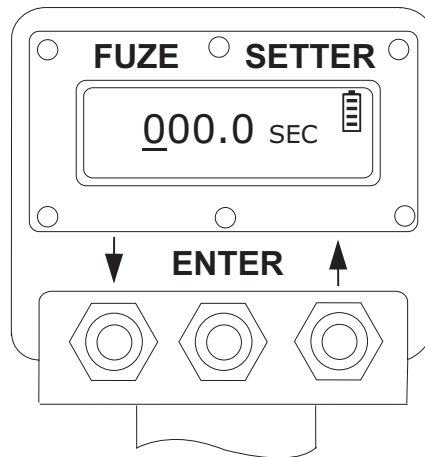
### Mode Menu (for the M782 Fuze)



- (e) Press the ↑ button or ↓ button as necessary to move the cursor (→) to align with VT and press the ENTER button. The Time Menu appears with a line under the hundreds-of-seconds position.

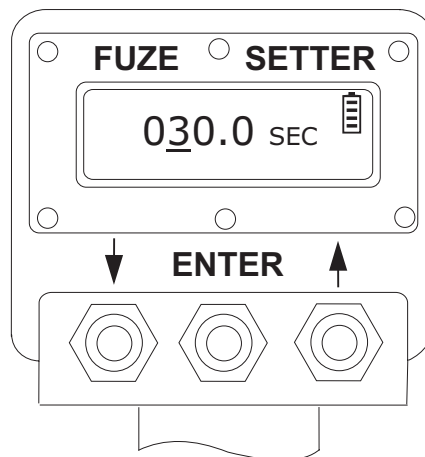
#### 4-11. FUZE SETTING (cont)

##### Variable Time Menu (for the M782 Fuze)



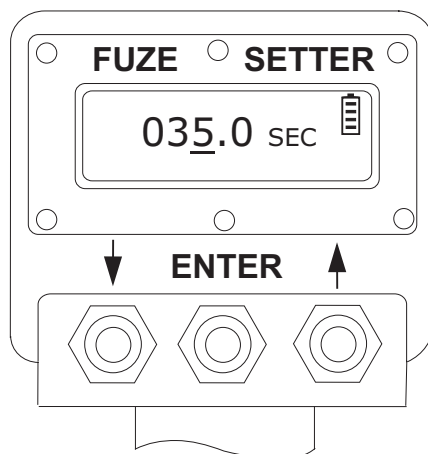
(f) Press the ↑ button or ↓ button to toggle between **0** and **1** for the hundreds-of-seconds digit and press the ENTER button. The underline will move to the tens-of-seconds position.

##### Variable Time Menu (for the M782 Fuze)



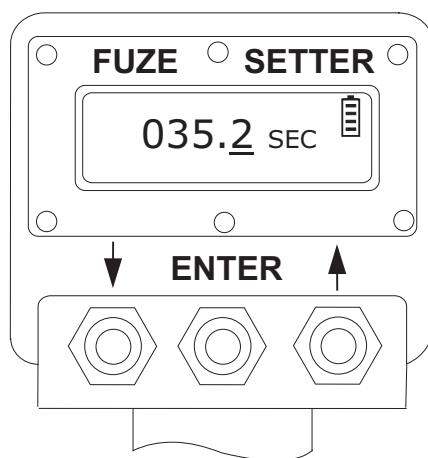
(g) Press the ↑ button or ↓ button to choose the desired number between **0** and **9** for the tens-of-seconds digit and press the ENTER button. The underline will move to the seconds position.

**Variable Time Menu (for the M782 Fuze)**



(h) Press the ↑ button or ↓ button to choose the desired number between **0** and **9** for the seconds digit and press the ENTER button. The underline will move to the tenths-of-seconds position.

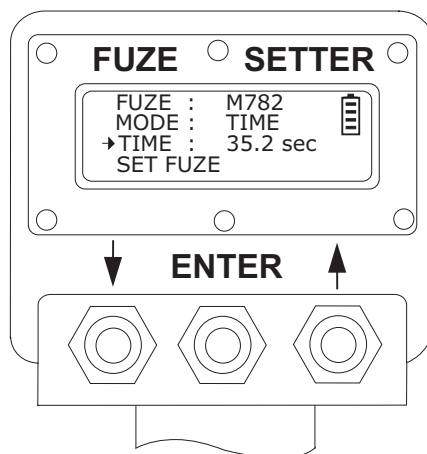
**Variable Time Menu (for the M782 Fuze)**



(i) Press the ↑ button or ↓ button to choose the desired number between **0** and **9** for the tenths-of-seconds digit and press the ENTER button. The Fuze Setting Menu appears with the cursor (→) aligned with **TIME** showing the set time.

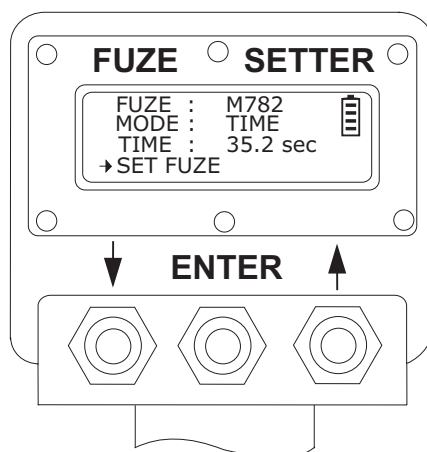
#### 4-11. FUZE SETTING (cont)

**Fuze Setting Menu**



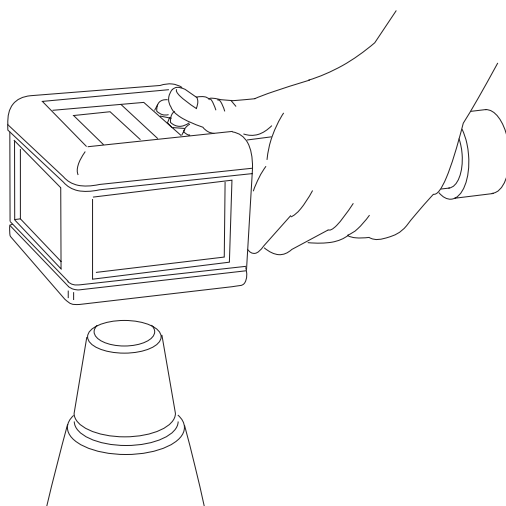
- (j) Press the ↓ button to move the cursor (→) to align with **SET FUZE**.

**Fuze Setting Menu**



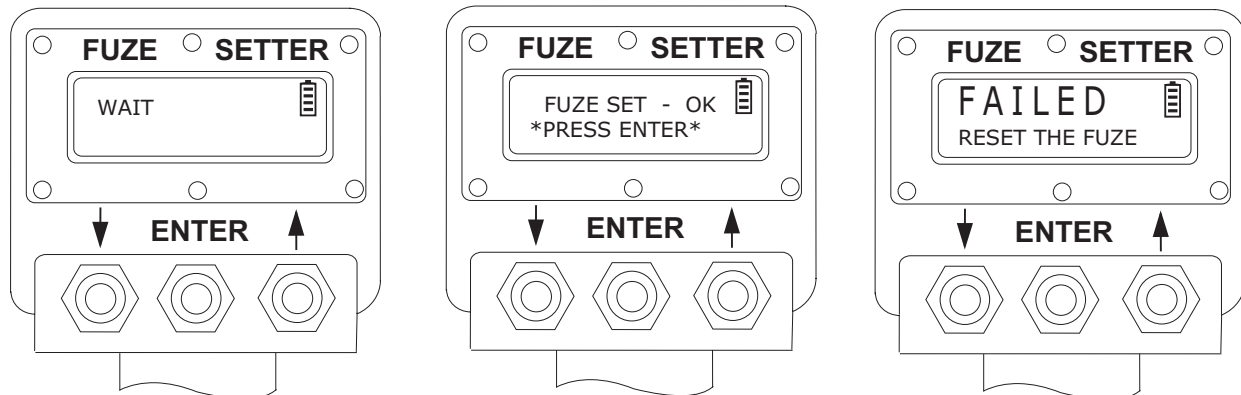
- (k) Place setter on the fuze and press the ENTER button.

### Placing the Fuze Setter



- (I) The setter will attempt to set the fuze. After the **WAIT** message is briefly displayed, either the **FUZE SET - OK** message will be displayed, which means that the fuze has been set, or the **FAILED** message will be displayed, which means the fuze has not been set. If the **FAILED** message appears, try setting another fuze. If both fuzes do not accept the setting then replace the fuze setter and retry setting the fuzes.

### Setting the Fuze



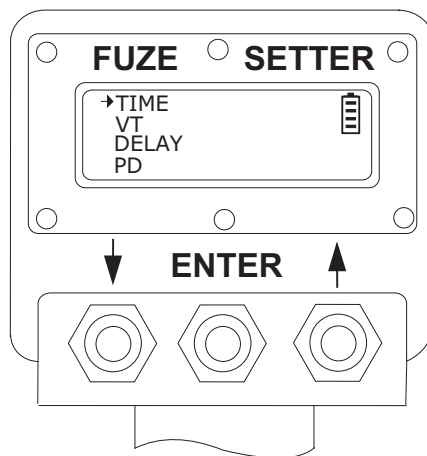
#### 4-11. FUZE SETTING (cont)

(4) Setting for Time mode:

**NOTE**

The setting procedures for the Time mode are the same as those for Variable Time (VT) mode except at step e. the cursor ( → ) is to be aligned with **TIME** instead of **VT**.

**Mode Menu (for the M782 Fuze)**



(5) Firing temperature for the M782 fuze is -45° F to +145° F (-43° C to +63° C).

## 4-12. PROPELLING CHARGE PREPARATION

### WARNING

Under no circumstances will green bag and white bag charges be assembled together for firing. Critical malfunction could result.

**a. Propelling Charges, M3 Series and M4 Series.** M4A2 and M4A1 white bag charges can be expected to perform within design limits at charges 5 through 7. However, large dispersions may result when these charges are fired at charges 3 and 4. It is recommended that M3A1 or M3 green bag charges be used instead of white bag charges at charges 3 and 4. If green bag charges are not available, use white bag charges, although range dispersions may result.

(1) If required, remove excess increments from charge, and retighten excess strap by twisting and securing ends under straps.

### NOTE

Using the M2 flash reducer to reduce muzzle flash is optional, except when TB 9-1300-385-1 or TB 9-1300-385-2 restricts a specific propelling charge lot to use only with flash reducer. The M4A2 propelling charge has a flash reducer assembled in front of the base charge (increment number 3) at the time of manufacture and does not require use of the M2 flash reducer.

(2) In preparing the M4 or M4A1 white bag charge, one M2 flash reducer should be added in front of each increment used. Untie the charge and insert the proper number of M2 flash reducers (i.e., one flash reducer added in front of the base charge and each increment used). Then retie with two interlapping square knots.

**b. Propelling Charges, M119, M119A1 and M119A2.** The M119 and M119A1 are a one-increment, charge 8 white bag propelling charges and are shipped ready for firing. After unpacking and inspection, the only preparation required is removal of the igniter protector cap. This charge is not used in lieu of charge 7, M4 series white bag. M119A2 is a one-increment, charge 7, red bag, propellant charge, shipped ready for firing. M119A2 charge 7 is equivalent to M119/M119A1 white bag charge 8 except for small differences in velocity.

**c. Propelling Charge, M203 and M203A1.** The M203 series is a one-increment, charge 8 propelling charge for the M199 cannon. After unpacking and inspection, the only preparation required is removal of the igniter protector cap.

**d. Propelling Charge, M231 or M232 (MACS).** The M231 contains four charges (two per extraction sleeve) in each metal container and the M232 contains five charges per metal container. There is no other preparation needed after unpacking and inspecting the MACS.

#### 4-13. LOADING AND FIRING

##### WARNING

Observe all precautions in FM 6-40, AR 385-63, and FM 6-50 particularly limitations regarding overhead fire in training and combat.

Do not fire M110 series WP projectiles which are known to have been stored in other than the base down position. Firing of such projectiles could contribute to inbore explosions or close-in premature malfunctions.

Do not load or fire artillery ammunition without the authorized fuze. Firing of such rounds without fuzes or with unauthorized fuzes could result in in-bore prematures and other hazardous conditions.

Do not load or fire round if the fuze is not fully seated.

Firing of the M557, M572, and M564 fuzes during heavy precipitation (heavy rainfall, sleet, snow, or hail) may result in occasional down-range prematures. The amount of precipitation necessary to cause functioning is comparable to the heavy downpour which occurs during a summer thunderstorm.

Do not fire proximity-fuzed ammunition at targets closer than 750 meters to friendly troops.

Firing the M110 series, M449, M485, or M804 projectiles at charge 2 may occasionally result in stickers.

Do not assemble M3 series green bag charges with M4 series white bag charges. Critical malfunction could result.

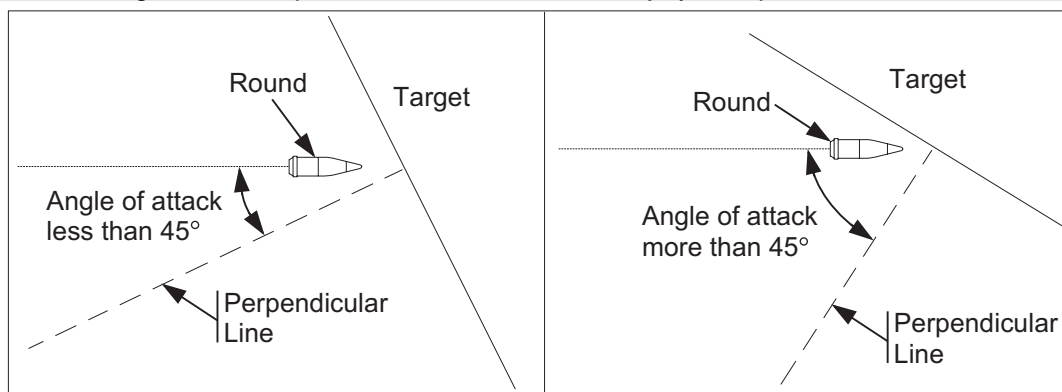
Do not load or fire M231 charges with M232 charges. Critical malfunction could result. Do not load or fire more than two M231 charges or less than three M232 charges.

Do not fire M232 charge 5 propelling charge in any cannon that has not had a M199 Cannon Breech Modification Kit installed unless a combat emergency exists. Cannons that have the Modification Kit installed will have a stamped, paint filled, letter M visible on the breech housing and firing mechanism block and will also utilize a M49 Firing Mechanism.

Do not fire M549/M549A1 projectiles if obturating band is missing or broken. Separation of the projectile and rocket motor may occur. (If the band is displaced and can be repositioned and remain in the groove, projectile can be fired).

MK 399 MOD 1 fuzes set in the delay mode perform more effectively if the angle of attack (the angle between the round and the perpendicular line of the target) is less than 45 degrees. Angles of attack higher than 45 degrees will result in decreased effectiveness and increase the likelihood of unexploded ordnance in the battlefield.

If a projectile fired with MK 399 MOD 1 fuze impacts a substantial object, a high order detonation may occur even if the object is within the 400 caliber minimum arming distance, which could result in damage to the weapon and/or death or serious injury to unprotected crew members.



Do not fire M864 projectile if the outer weather seal is damaged (punctured, torn, or peeling) to the extent that moisture can enter the base burner assembly. A loss in range (short round) may result. Return projectile to supply point.

For M864 projectiles marked with three solid white circles 120 degrees apart on the ogive (above the weight zone markings), observe the following warnings:

- Do not fire the M864 if it has been dropped or if it shows evidence of dents, flattening, or gouges to the lifting plug, grommet, rotating band, or boattail area.
- Do not fire the M864 if it has been delivered without the grommet.
- If during handling and/or loading the M864 base separates, call EOD personnel.

Do not fire the M864 if the obturator is missing or broken because it may result in a short round. If the band is displaced and can be repositioned and remain in the groove, the projectile can be fired.

- a. Make sure the round is clean and the fuze is present and fully seated.

**WARNING**

Firing a round with an obstruction in the cannon tube can cause an in-bore premature.

- b. Make sure there are no obstructions in the cannon tube.
- c. Check the firing mechanism to see that the primer expended in previous firing has been removed.
- d. Remove grommet or flexible rotating band cover (M795 projectile) from projectile.

**WARNING**

Never load a propelling charge into the chamber by increments. Only fully assembled charges will be used. Critical malfunction could result.

- e. Load fuze projectile into cannon and ram it solidly into the forcing cone of the cannon tube. Round must remain wedged into the forcing cone at all angles of elevation.
- f. Remove the igniter protective cap from the propelling charge and load the propelling charge into the cannon chamber with igniter end (red bag) toward the breechblock assembly.

**WARNING**

Never close the breechblock assembly unless you can see the red igniter bag on the base of the propelling charge. Misfires, hangfires, erratic performance, or other critical malfunction could result.

- g. Close and lock the breechblock assembly.

**WARNING**

Don't force primer into primer chamber. If primer will not go in, chamber is probably dirty. Forcing primer into primer chamber may cause primer to prematurely ignite powder charge which will cause the howitzer to recoil prematurely and cause serious injury to crew.

Never insert primer in primer cavity unless breechblock assembly is closed and locked. Ignition of the propelling charge with the breechblock assembly not fully closed presents a critical hazard to the crew.

#### 4-13. LOADING AND FIRING (cont)

h. Insert primer and move firing mechanism block assembly to firing position and fire on command of the chief of section.

#### 4-14. AFTER FIRING

a. Open the breechblock assembly and secure in the fully open position.

b. Wipe face of spindle assembly after each round and swab the powder chamber, making sure that all burning fragments of powder charge are removed from powder chamber. Look through the cannon tube. If the cannon tube is clear, announce, BORE CLEAR.

c. All ammunition fired must be recorded by charge number, type, and total number of each fired, and entered on DA Form 2408-4.

#### 4-15. AMMUNITION PREPARED FOR FIRING, BUT NOT FIRED

##### WARNING

The projectiles and fuzes that have been rammed and then removed from the cannon tube will not be reloaded or fired, with the exception of M712 Copperhead extracted from a cold cannon tube. Put these aside for turn-in.

a. Using applicable fuze setter and procedure (p 4-40), reset the fuzes of the projectiles prepared for firing, but not rammed. Reset time fuzes to safe; reset VT fuzes to initial setting at which they were shipped; reset point detonating fuzes to SQ or PD. All M762 and M767 ET fuzes that have been activated and not fired should be reset to 88.8, segregated, and used first in subsequent firings. When the battery runs down on an activated M762/M767 fuze, the LCD goes blank. These fuzes are unserviceable and should be packed separately, marked unserviceable, and turned in to the ammunition supply point (ASP). To determine if an M762/M767 fuze has been activated and run down, gently attempt to turn the ogive clockwise by hand without depressing the selector button. If the ogive turns easily, the fuze has been activated; a fuze that has not been activated should resist the applied torque. Replace safety wires in those fuzes so furnished.

b. Disassemble fuze from projectile and repack in original packing. When a long intrusion proximity fuze is removed from the projectile, replace the supplementary charge in the projectile before assembling the spacer and the correct type of lifting plug.

##### NOTE

Be sure the correct type of lifting plug is used. (For example, energy-absorbing or shock-attenuating lifting plug for M549 series projectiles, yellow fusible or universal lifting plug for M483 series projectiles, and standard eyebolt lifting plugs for other projectiles.)

c. Replace grommet or flexible rotating band cover (M795 projectile) over rotating band.

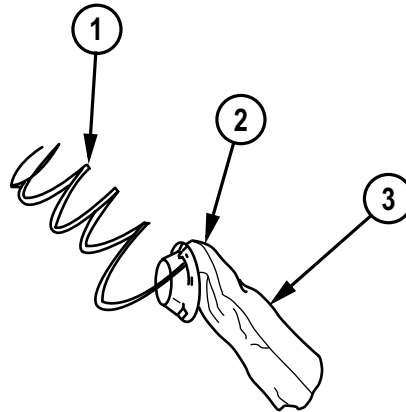
d. Restore propelling charges to original condition. Make sure all zones (increments) are present, tied, in proper order, in good condition, of the proper lot number, and that igniter caps are replaced.

e. Replace fuzes, primers, and flash reducers in original packing.

f. Make sure the lot number of the ammunition corresponds with the lot number on the container.

g. If rocket cap was removed from the M549/M549A1 HERA projectile, replace cap and tighten handtight.

- h. Return all projectiles to shaded and protected storage regardless of weather.
- i. Special instructions for the M712 projectile are found on page 4-60.1.
- j. Special instructions for the M483A1 and M864 ICM projectile are as follows:



## EXPULSION CHARGE ASSEMBLY INSTALLATION

### WARNING

Use no other lifting plug except the fusible or universal plug removed from this projectile, because it is designed for safe release of pressure inside the projectile in case of fire during storage or shipping actions.

- (1) Wind the pull-wire (1) under four tabs (2) on the cover of the expulsion charge assembly (3) (1-1/2 turns for proper engagement).
- (2) Deleted.
- (3) Deleted.

## Section III. MAINTENANCE

### Section Index

Paragraph		Page
4-16.	Handling .....	4-53
4-17.	Care.....	4-54
4-18.	Maintenance.....	4-54
4-19.	Storage.....	4-59

### 4-16. HANDLING

### WARNING

Keep fire and flammable materials out of the ammunition area. There will be no smoking in the vicinity of ammunition.

Shield all ammunition from high temperatures (e.g., direct rays of the sun). When the outside temperature is expected to reach +100°F (+38°C), failure to shade the projectiles could result in damage to materiel and loss of life.

#### 4-16. HANDLING (cont)

- a. Do not expose ammunition and components containing explosives to extreme temperatures. Do not expose to direct sunlight, flame, or other sources of heat.
- b. Do not expose unpacked propelling charges and fuzes to rain, excessive humidity, or ground moisture.
- c. Protect the rotating band and the obturator band by keeping the grommet or flexible rotating band cover (M795 projectile) on the projectile while it is being handled and transported.
- d. Prevent rough handling of projectiles and fuzes. Do not strike projectiles together and do not offload ammunition by dropping projectile on top of projectile.
- e. Protect fuzes, primers, and flash reducers at all times from foreign matter and impact. A drop of 4 feet (1.22 m) may cause the electrolyte vial in a VT fuze battery to break, thus causing a dud.
- f. Do not disassemble fuzes.

#### 4-17. CARE

- a. Ammunition is packed to withstand conditions ordinarily encountered in the field. Keep packing boxes from becoming broken or damaged.
- b. Since ammunition is impaired by moisture, frost, extreme temperatures, and foreign matter (mud, oil, etc.), observe the following:
  - (1) Do not break the moisture-resistant seal on the container until ammunition is to be used.
  - (2) Shield all ammunition from high temperatures (e.g., the direct rays of the sun). When covering projectiles to provide this shield, cover with a tarpaulin. Ensure 18 in. (46 cm) of air space over and 6 in. (15 cm) of air space on the sides to allow free air flow necessary to keep projectiles cooler in hot weather.
  - (3) Refer to page 4-60.1 for information regarding maintenance of the M712 Copperhead (HEAT) projectile.

#### 4-18. MAINTENANCE

##### WARNING

Alteration of loaded ammunition or components is prohibited. Unauthorized modification of ammunition could cause critical malfunction.

##### NOTE

Proper performance of ammunition maintenance procedures when ammunition is received by using units assures that ammunition on hand is kept ready for use.

##### a. General.

- (1) Inspect ammunition packaging daily. Open boxes or containers which show evidence of contamination or deterioration and inspect ammunition. Do not open sealed boxes or containers unless defective ammunition is suspected.

**NOTE**

Procedures for preparing the M712 projectile (Copperhead) for firing begin on page 4-60.1, as well as the care, maintenance, inspection, unpackaging, and repackaging of this projectile.

(2) Inspect unpackaged ammunition and explosive components daily.

(3) Wipe off wet or dirty ammunition at once. Remove light corrosion. Do not polish ammunition to make it look better.

(4) Consider ammunition unserviceable if it has severe rust or propellant contamination, particularly moisture. Do not use except in an emergency.

(5) When repackaging ammunition, put it back into the original containers. If other packing material must be used, the old markings should be transferred to the new containers.

(6) See paragraph 4-28 for the LPRS, which is an optional system for securing loose unfuzed projectiles for transportation.

**b. Projectiles.**

(1) Visually inspect projectiles for the following defects:

(a) Projectiles without grommets or flexible rotating band covers (FRBC) (M795 projectile) on; if missing grommet or FRBC, replace immediately.

(b) Distorted, out of round, or damaged body.

(c) Dirt or other foreign material.

(d) Seepage of explosive filler.

(e) Rust through projectile baseplate.

(2) Clean dirt or foreign material from projectile by wiping with a damp rag (item 24, appx D).

(3) Return defective projectiles to ammunition supply point.

(4) Inspect the M549/M549A1 projectile for the following:

(a) Missing or broken obturating bands. The projectile cannot be used if the obturating band is broken or missing. Return projectile to the supply point.

(b) Broken energy-absorbing lifting plugs. When the lifting plug is broken, the threaded area will remain in the projectile. Do not attempt to extract any portion of the broken plug. Return the projectile to the supply point.

(5) The M483A1 projectile can be used if the obturating band is missing or broken. Remove and discard broken obturating bands.

(6) Inspect the M864 projectile for the following:

(a) Missing or broken obturating bands. The projectile cannot be used if the obturating band is broken or missing. Return projectile to the supply point.

(b) Damaged (torn, punctured or peeling) weather seal. The projectile cannot be used if the weather seal is damaged. Return projectile to the supply point.

#### **4-18. MAINTENANCE (cont)**

(7) Inspect specially marked M864 projectiles with three solid white circles 120 degrees apart on the ogive (above the weight zone markings) for the following:

(a) Projectiles that have not been palletized. Projectiles that have been transported as loose cargo. These conditions can cause gaps or separation at the base to body joint resulting in a hazard. Return projectile to the supply point.

(b) Projectiles showing dents, flattening, or gouges to the lifting plug, grommet, rotating band, or boattail area. These conditions can cause gaps or separation at the base to body joint resulting in a hazard. Return projectile to the supply point.

##### **c. Propelling Charge, M3 and M4 Series.**

(1) Visually inspect propelling charges for the following defects:

- (a) Loose tie straps, allowing separation of the charge into increments.
- (b) Missing increment, extra increment, or incorrect sequencing (order) of increments.
- (c) Increment bags torn or damaged to the extent that black powder or propellant spills out.
- (d) Wet propelling charge.
- (e) Missing or damaged red igniter pad on base of charge.

(2) Charges requiring retying may be retied as follows:

- (a) Assemble increments in correct order.
- (b) Tie the four tie straps over top of charge.

(3) Return all defective charges to the ammunition supply point.

##### **d. Propelling Charges M119, M119A1, M119A2, M203, M203A1, M231 and M232.**

(1) Visually inspect propelling charges M119, M119A1, M119A2, M203, M203A1, M231 and M232 for the following defects:

##### **NOTE**

Flash reducer is sewn into sides of charge bag on M119A2 charge.

- (a) Missing flash reducer.
- (b) Charge bag ripped or damaged or combustible cases broken to the extent that propellant can escape.
- (c) Black powder leaking from base igniter pad.
- (d) Base igniter pad not centered with respect to outer diameter of charge, both ends for the M231 and M232 charges.
- (e) Evidence of broken or damaged central igniter tube (M119, M119A1, M203, M231 and M232 only).
- (f) Combustible case for M231 and M232 charges with cut or puncture through case wall.

- (g) Combustible case for M231 and M232 charges with uneven cap (crooked, tilted or slanted).
- (h) Combustible case for M231 and M232 charges that cannot be replaced into its sleeve due to exterior damage.
- (i) Tie straps not tight over forward end of charge.
- (j) Lacing jacket not secure on charge (M119A1 and M203 only).
- (k) Cord missing or broken on lacing jacket (M119A1 and M203 only).
- (l) Crushed or distorted cases or with missing/broken propellant in M203A1 charges.
- (2) If tie straps are loose, retighten the straps at the forward end of the charge.
- (3) Return all defective charges to the ammunition supply point.

**e. Fuzes.**

- (1) Inspect fuzes for the following defects:
  - (a) Damage to body or threads.
  - (b) Loose components.
- (2) Return defective fuzes to ammunition supply point.

**f. Ammunition or Components of Ammunition Prepared for Firing but Not Rammed.**

- (1) Return such ammunition to the original condition and packing. Mark appropriately, and use first in subsequent firings to keep stocks of open packings to a minimum.
- (2) Replace the grommet or flexible rotating band cover (M795 projectile) in those projectiles that were not fired.
- (3) Reassemble the supplementary charge and the correct type of lifting plug (with gasket and spacer) to the projectile to restore it to its original condition. Return fuzes to original condition. Return fuzes to original packing. In reassembling the components, make certain the supplementary charge is properly inserted (felt pad end innermost).
- (4) Remove the projectile spotting charge from the M577 series or M762 fuze and replace the expulsion charge assembly and fusible or universal lifting plug with gasket to the M483A1 or M864 projectiles. Replace rocket cap in M549 and M549A1 projectiles.
- (5) Reassemble propelling charges prepared for firing and not used. Replace in original containers as follows:
  - (a) If increment was removed, reinstall and retie.
  - (b) Replace igniter protective cap.
  - (c) Repack charge in container (igniter end first), and close and secure container.
  - (d) Mark container appropriately, and use charge first in subsequent firings.

**g. Unserviceable Ammunition.**

- (1) Conspicuously mark unserviceable ammunition or explosive components UNSERVICEABLE and return to ammunition supply personnel for disposition.

#### 4-18. MAINTENANCE (cont)

(2) Repackage ammunition in original containers. If original container is unsuitable, use available material and transfer all markings. All layers of packing must be conspicuously marked UNSERVICEABLE.

##### h. Excess Explosive Components.

(1) Pack supplementary charges removed from projectiles prior to assembling long intrusion proximity fuzes in containers from which proximity fuzes were removed.

(2) Properly mark container and return it to ammunition supply personnel for disposition.

(3) Destroy any unused powder increments or expelling charges left over after round has been fired by burning them in a safe place.

##### i. Destroying Powder Increments.

###### NOTE

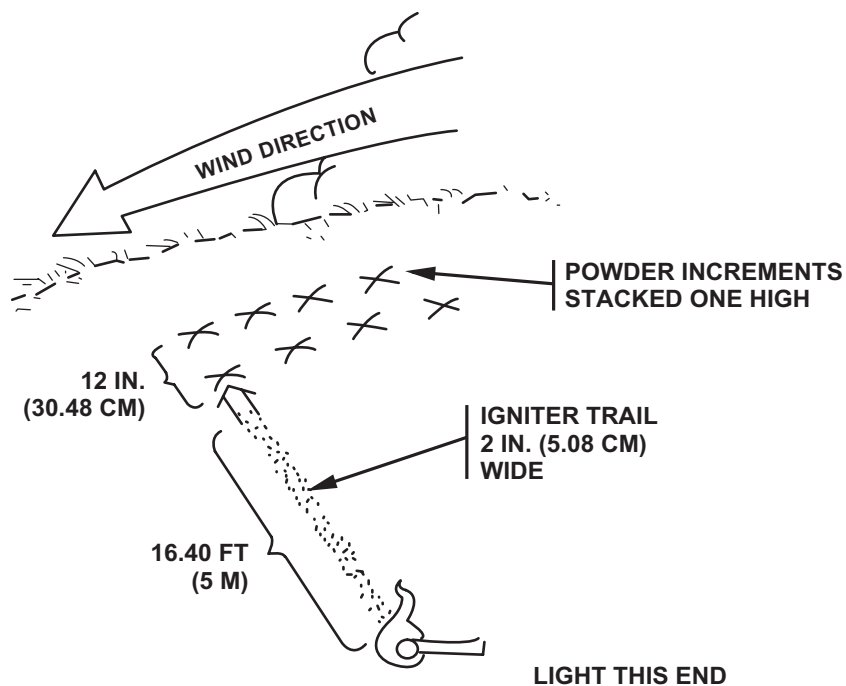
Unused MACS increments should not be destroyed. They should be repacked, and either fired or turned back in.

(1) Locate proper burning area. Area should be 200 feet (60.96 meters) from any combustible material.

(2) Ensure proper firefighting equipment and personnel are present.

(3) Lay out powder increments parallel to wind direction in 12 inch (30.48 centimeters) wide column.

(4) Lay out an igniter trail at the downwind end of the line of increments by opening one powder bag and making a trail of powder at 90 degrees to the powder increments. The igniter trail should be approximately 16.40 feet (5 meters) long and 2 inches (5.08 centimeters) wide. See diagram below.



(5) Light the end of the igniter trail, then move away from the powder increments.

(6) While powder is burning, be alert for sparks or burning fragments caught by the wind.

(7) When powder is through burning, be sure all flames are extinguished and no smoldering ashes remain. BE SURE ASHES ARE COMPLETELY BURNED.

**j. Destroying MACS Charge Increments.**

(1) Locate proper burning area. Area should be 164 feet (50 meters) from any combustible material.

(2) Ensure proper firefighting equipment and personnel are present.

(3) Prepare MACS propelling charge increments for field destruction:

(a) Peel off both red Mylar covers, exposing igniter end bags.

(b) Remove igniter bags from charge increment (locate ribbon tying bags together and cut, taking care not to cut into bags).

(c) Use one charge increment to make igniter trail. If one increment is cracked, break it open and use propellant to make igniter trail.

(d) If no charge increments are cracked, roll one charge increment on the ground, exerting a downward pressure on the joint of the case base and case body. This should break the joint and the exposed propellant can be poured out and used to make the igniter trail.

(4) Lay out MACS propelling charge increments parallel to wind direction in 12 inch (30.48 centimeter) wide column (columns of two increments) and lay the removed igniter bag components among the increments.

(5) Lay out an igniter trail at the downwind end of the line of increments by either breaking open one increment or by using a cracked or broken increment and making a trail of propellant at 90 degrees to the increments. The igniter trail should be approximately 16.40 feet (5 meters) long and 2 inches (5.08 centimeters) wide. See diagram.

(6) Light the end of the igniter trail, then move away from the MACS propelling charge increments.

(7) While increments are burning, be alert for sparks or burning fragments caught by the wind.

(8) When increments are through burning, be sure all flames are extinguished and no smoldering ashes remain. BE SURE ASHES ARE COMPLETELY BURNED.

**4-19. STORAGE**

**WARNING**

Ammunition exposed directly to sunlight, or in unventilated containers, enclosures, shelters, freight cars, closed vehicles, and similar structures exposed to direct sunlight may reach temperatures exceeding upper storage limits. Avoid exposure of ammunition components to direct sunlight. Do not store ammunition assembled with tetrytol-loaded bursters (i.e., projectiles, 155-mm: smoke, WP, M110; gas, H and HD, persistent, M110) at temperatures exceeding +125°F (+52°C).

**a. Temperature Limits.**

(1) Except as otherwise specified, observe the following limits:

#### 4-19. STORAGE (cont)

- (a) Lower limit is -80°F (-62°C) for period of not more than 3 days.
- (b) Upper limit is +160°F (+71°C) for periods of not more than 4 hours per day.

##### WARNING

Do not fire M110 white phosphorous rounds which are known to have been stored in other than base down position. Firing of such projectiles could contribute to inbore explosions or close-in premature malfunctions.

(2) Store or transport projectiles containing WP at a temperature below the melting point of the WP filler (+111.4°F (+44°C)). If this is not practicable, store or transport such projectiles on their bases so that, should the WP filler melt, it will resolidify with the void in the nose of the projectile. This restriction does not apply to the M825/M825A1 WP projectiles.

(3) Protect proximity fuzes and proximity rounds from long exposure in high humidity. Store M728 fuze in temperatures between -65°F (-54°C) and +145°F (+63°C); store M732 series fuze in temperatures between -60°F (-51°C) and +160°F (+71°C); and store M514 series fuze in temperatures between -30°F (-34°C) and +130°F (+54°C).

##### WARNING

Do not store ammunition under trees or near tall buildings that attract lightning. When ammunition must be stored in the open, select a storage site free of power lines, electric cables, and flammable materials. Sites should not be adjacent to reservoirs, water mains, etc. Do not store ammunition near a large concentration of personnel.

**b. Sites.** Store ammunition in the firing area so that it is protected against accidental explosions. Sites should be level and well drained.

**c. Provisions.**

##### NOTE

A hardstand of blacktop or gravel and sand is preferable to excessive use of dunnage.

(1) Use heavy, well supported dunnage to keep bottom tier of stack off the ground and to prevent it from sinking into the ground.

(2) Allow at least 6 inches (15.24 cm) of space beneath the pile for air circulation. Dig trenches to prevent water from flowing under pile.

(3) Provide nonflammable covers (e.g., tarpaulin) for all ammunition. Maintain air space of approximately 18 in. (45.72 cm) between cover and ammunition. Keep cover at least 6 in. (15.24 cm) from pile on ends and sides for air circulation.

(4) Store M110 series and WP projectile rounds nose up; this does not apply to the M825 WP projectile.

(5) Store ammunition and primer containers with the top side up. Labels or markings on boxes and containers indicate which side should be up.

## SECTION IV. M712 HEAT, CANNON-LAUNCHED, GUIDED PROJECTILE AND M823 TRAINING PROJECTILE (COPPERHEAD)

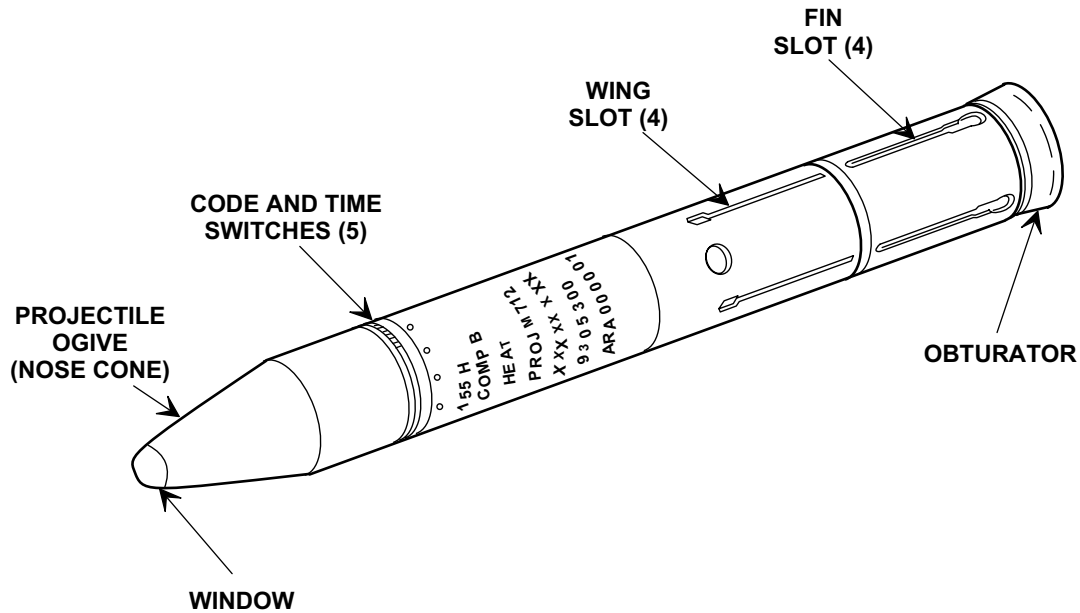
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### 4-20. DESCRIPTION

a. M712 cannon-launched, guided projectile is a terminally guided system launched from the M198 howitzer into a ballistic trajectory. During flight, the target is illuminated by a laser beam from a laser designator. An onboard computer continuously refines the terminal trajectory and provides guidance to the control surfaces, causing the round to home in on stationary or moving hard-point targets. The M712 projectile is fired in the same manner as conventional projectiles.





#### WARNING

The M823 training projectile must not be fired. Such firing could be a hazard to personnel forward of the weapon.

**b.** The training round for M712 projectile is M823 projectile. The M823 projectile is designed to train 155-mm howitzer weapon crews in the handling and setting of the M712 projectile. It simulates the M712 in weight, center of gravity, and external appearance. It contains code and time switches which are set to simulate prefiring activity by the crew; however, it does not have the wings or fins. It is shipped and stored in the same container as the M712 projectile and color coded for easy identification. The containers for both the M712 and M823 projectiles are forest green. Marking for the M712 is yellow; for the M823 it is white. Bronze patches at container ends also identify the M823 projectile inside.

#### 4-21. UNPACKAGING AND INSPECTION

#### WARNING

If exuded composition B is observed on the projectile or in the container during the unpackaging and inspection operations, move the projectile to a safe area and notify EOD for disposal.

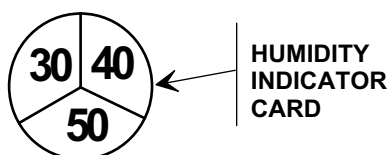
#### NOTE

Unless the unpackaged M712 projectile is to be fired immediately, it must be protected from the elements (by means of protective bag) as described below. Do not let an unpackaged M712 projectile sit out unprotected.

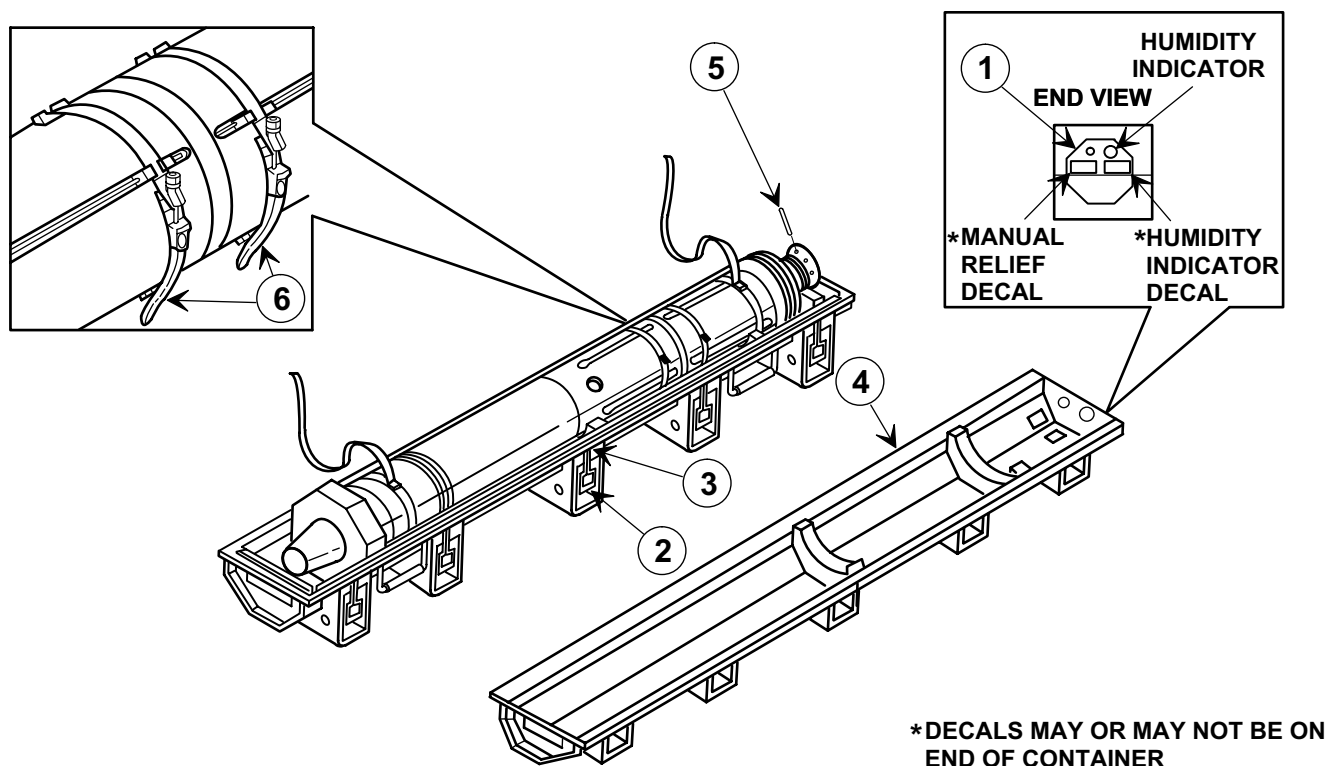
## 4-21. UNPACKAGING AND INSPECTION (cont)

### a. Unpackaging.

(1) A humidity indicator is located in the aft end of the container. The indicator card is the pie-sector type (the M823 training round has a card that resembles the card for the M712 projectile, but "DUMMY CARD" is printed on its face. These procedures apply only to the M712 projectile).



(2) Open only those containers whose humidity indicator card shows under 40 percent relative humidity (40 percent sector must be colored blue, 30 percent sector may be blue or pink), and only when a fire mission is planned or anticipated. If the 40 percent humidity section is pink, turn complete item in to battalion ammunition section. Keep all packaging materials in the container. A protective bag is provided inside each container. When mission requirements dictate a need, the M712 projectile may be removed from the shipping and storage container and placed in the protective bag. The protective bag will protect the round against direct effects of water, sunlight, dirt, and debris. However, it will not protect the round from the elements for more than 30 days at a time. Repackage unfired projectiles within 30 days and turn in to battalion ammunition section. Projectiles must be repackaged for vehicular transportation. Unpackage the M712 projectile from its container as follows:



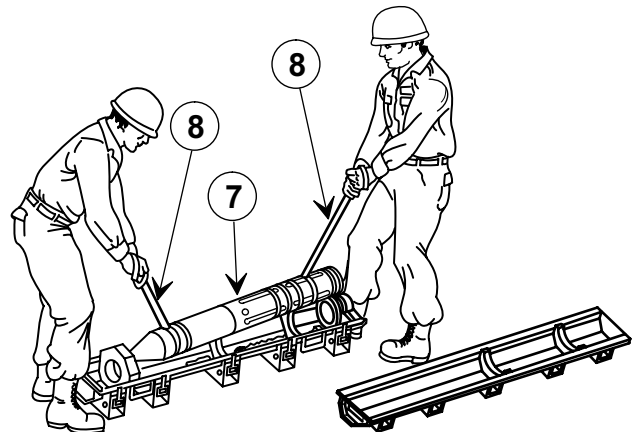
**CAUTION**

Before unpackaging round from container, make a quick visual inspection of the projectile for obvious damage or other conditions that would prevent use. If projectile appears unuseable, replace container cover, close latches, and return to battalion maintenance.

- (3) Using a screwdriver or equivalent tool, break and remove metallic seal wires (if present) located on center latch on both sides of container.
- (4) Depress manual relief valve (1).
- (5) Release container latches (2), starting at the manual relief valve (aft) end, in pairs. Pull latch handles all the way up, remove barrel nut (T-bolt) (3) from recess in cover, and then push down all the way.
- (6) Separate cover (4) from container body and place upside down on ground alongside the body.
- (7) Partially pull torquing rod (5) from rear end of tension mechanism.
- (8) Turn torquing rod counterclockwise to release tension, then spin tension mechanism by hand until it stops.
- (9) Open stainless steel fin and wing preload bands (6), remove and place in container.

**CAUTION**

Do not let the projectile touch the ground or lay in water. Projectile may be placed on a tarpaulin or may be put down across the top of the open container. Water, dirt, or other materials entering projectile through wing/fin slots may cause projectile to fail during flight. Do not touch or grasp ogive when handling and loading projectile.



- (10) Carefully remove projectile (7) from container by lifting it up and to the rear, using lifting straps (8) provided on the projectile.
- (11) Place the projectile on a clean, dry surface. The projectile should be shielded from direct sunlight, rain, dirt, and other debris.
- (12) Remove lifting straps (8), and place them in the container.
- (13) Spin tension mechanism several turns clockwise by hand to avoid interference of torquing rod with cover when container is closed.
- (14) Replace cover on container body.
- (15) Starting on the end opposite the humidity indicator, straddle container, place T-bolts in cover recesses, and close corresponding left and right side latches at the same time in pairs, until all 10 latches are closed.

#### 4-21. UNPACKAGING AND INSPECTION (cont)

(16) Keep the container and all packing materials for reuse or return complete container to battalion ammunition section. Covers and bodies of containers form a set. Do not separate or mix covers and bodies.

**b. Inspection of M712 Projectile.** Perform the following inspections immediately after the projectile is unpackaged from its container. If a projectile is found to be unserviceable as a result of damage or other defects as described below, repackage the projectile in its original container, and return to battalion ammunition section. Attach a tag describing the defects.

(1) Inspect the window area of the nose cone to make sure that it is clean and that there are no cracks, fogging, indications of moisture on the inside of the window, or other damage. Clean a dirty window, using a clean wiping rag (item 24, appx D). Reject a projectile as unserviceable for any of the following reasons:

- (a) Window cannot be properly cleaned.
- (b) Window shows signs of fogging or has moisture on the inside.
- (c) Window is cracked, broken, or badly gouged.

(2) Inspect code and time switches to make sure that they are free of dirt and that all numbers and index marks are legible. Remove dirt, using a clean wiping rag (item 24, appx D). Reject a projectile as unserviceable for any of the following reasons:

- (a) Missing or broken switch dials.
- (b) Switch dials cannot be properly cleaned to make numbers and index marks legible.
- (c) Switches cannot be rotated freely when the firing codes are being set into the projectile. Turn switches, using a screwdriver or the tang end of the M18 fuze-setter wrench, to check switches turn. A click should occur at each number.

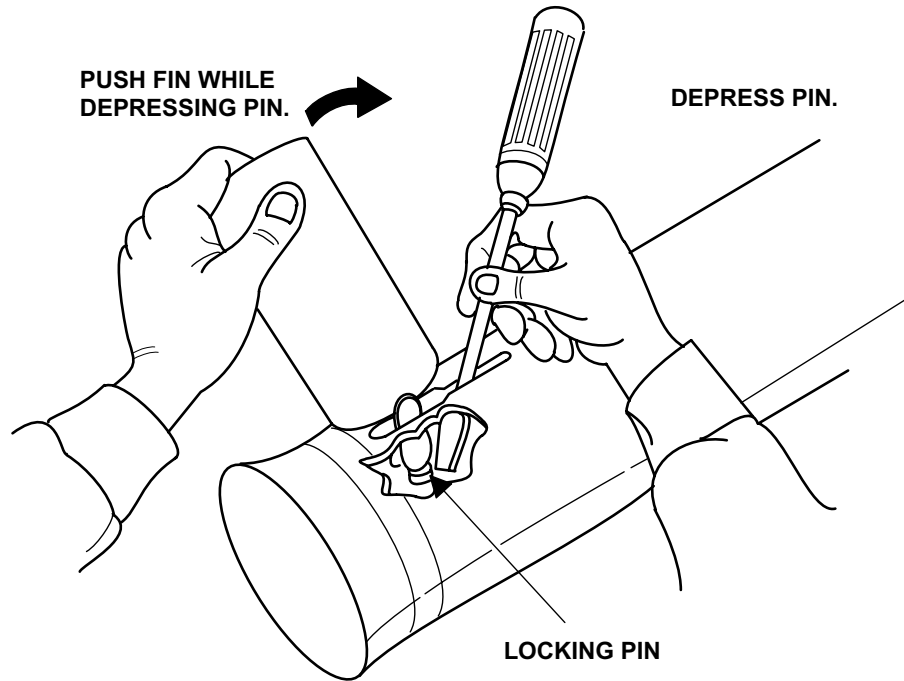
(3) Reject a projectile as unserviceable if the obturator has a crack or large gouge.

(4) Inspect wing and fin slots to make sure there is no dirt, debris, or other foreign matter in the slots. Reject as unserviceable if foreign material cannot be removed.

(5) Inspect fins to make sure that they are not in extended position. If they are, perform either (a) or (b) below to relatch fins. Reject projectile as unserviceable if fins cannot be relatched.

(a) If fin is only part way out, gently push fin back into its slot until it locks in place.

(b) If fin is locked in extended position, insert a small screwdriver, knife blade, or similar tool to fin slot as shown. Depress locking pin with tool, and push fin forward at the same time to lock fin in retracted position.



(6) Inspect the overall projectile to make sure that there is no caked-on dirt, excessive corrosion, loose or missing items such as screws or access covers or other damage. Remove dirt, minor corrosion, and foreign matter using a clean, soft cloth (item 9, appx D) or tissue. Inspect for loose or missing screws. If any splice screw or access cover screw is loose, attempt to make it finger tight, turning by hand. Reject a projectile as unserviceable if there is excessive corrosion or screws missing on access cover. Minor corrosion, minor gouges, burrs on metal projectile body, and/or missing splice screws are acceptable. Screws slightly above flush are acceptable after tightening.

**c. Inspection of M823 Projectile.** Since the M823 projectile will be reused many times, it will be rejected only for the following reasons:

- (1) Nose cone is cracked or broken.
- (2) One or more switches cannot be rotated or will not stay set to a number.

(3) Severe damage to projectile body which could prevent it from being rammed or extracted and cause damage to the interior of the gun tube.

- (4) Badly damaged or worn obturator which results in fallback.
- (5) Damaged base which prevents proper extraction.

## 4-22. PREPARATION FOR FIRING

### WARNING

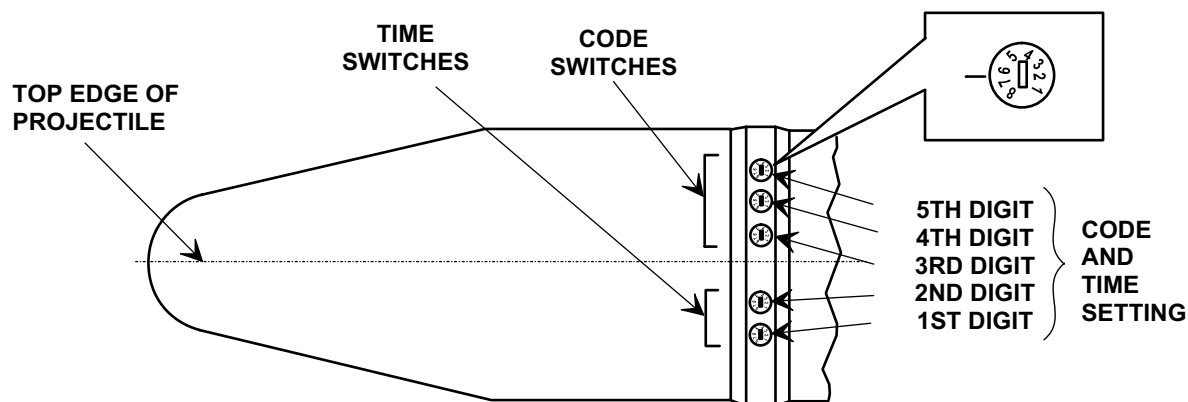
Forcing cone in the gun tube must be free of oil and grease before ramming. Oil or grease may permit projectile fallback.

After extracting an M712 projectile from a hot gun tube, forcing cone must be cleaned of melted plastic. Failure to do so may result in projectile fallback. Cleaning may be accomplished by firing another 155-mm round if mission requirements permit or firing a propelling charge alone.

### NOTE

For training purposes, the M823 training projectile will be used instead of the M712 projectile. All operational procedures which apply to the M712 also apply to the M823 projectile. However, no live propelling charges are to be used with the M823 training round.

- a. Unpackage and inspect M712 or M823 projectile (para 4-21, p 4-61).
- b. Make sure that the extractor assembly is set up and ready for use as described in paragraph 4-24 (p 4-67).



### NOTE

Be sure to set switches in correct sequence. Always set first switch on left (looking from base of projectile toward nose) first, then the next switch to the right, etc., until all five switches have been set.

A noticeable click should occur at each number on the switch. This click may be heard and/or felt.

- (1) Rotate switch at least one complete turn, either clockwise or counterclockwise.
- (2) Continue turning switch past correct number and toward the next adjacent number (but stop before reaching next number).
- (3) Turn switch back the other way and set on correct number. Be sure that number on switch is centered on scribe line.

c. After unpackaging the round, set the code and time switches, using a screwdriver or the tang end of the M18 fuze setter wrench. The fire direction center announces this setting in the fire command in the same place as they usually send "time" for time or VT fuzes. This switch setting will always have five numbers. Switches will be set from left to right as seen when facing the nose of the projectile from the base of the round. The switches are circular dials that can be rotated clockwise or counterclockwise as many times as required without damaging the switches. The appropriate number on the switch must be centered on the scribe line.

d. Set the elevation of the gun tube between 250-500 mils for loading the projectile.

#### **WARNING**

The M712 projectile is not adaptable for use with the current loading tray. Damage to projectile or injury to personnel could occur.

e. Carry the prepared projectile to the howitzer. Recheck the nose cone window and obturator cleanness. If necessary, they are wiped clean, using a clean wiping rag (item 24, appx D).

f. Visually recheck code and time switches. If numbers are not centered on scribe lines or correct numbers have not been set, set them now following procedures in paragraph c (above). Verify that the steel fin and wing retainer clamps have been removed. If the clamps have not been removed, remove before ramming the round.

g. Insert the M712 projectile into the powder chamber. Ramming and firing of M712 projectile is the same as for all other ammunition in this manual.

### **4-23. MISFIRE AND CHECK FIRING PROCEDURES**

The precautions and actions associated with misfires and checkfires are the same for the M712 projectile as for other projectiles in this manual.

### **4-24. OPERATION OF EXTRACTOR TOOL ASSEMBLY FOR PROJECTILES M712 AND M823**

a. **General.** The extractor assembly is used to remove the M712 or M823 projectile from the weapon. The following procedures include setting up the extractor assembly in preparation for use and breakdown procedures for stowage.

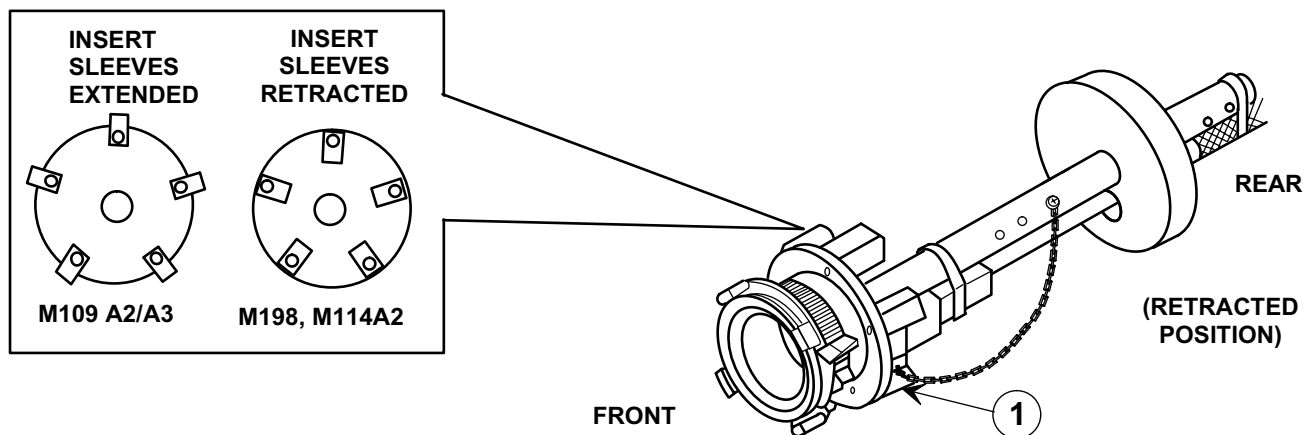
#### **b. Setup for Use.**

- (1) Get extractor assembly from wooden packing box.

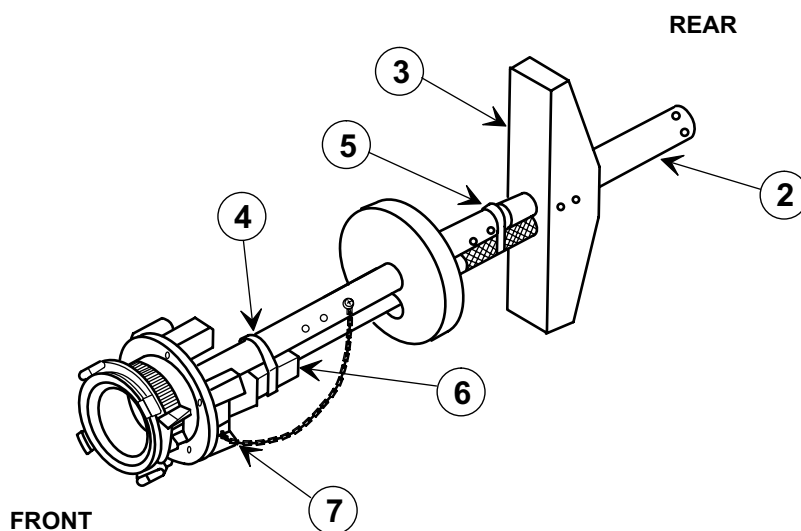
#### **NOTE**

The 16-inch socket wrench extension will initially be found in the BII box. This extension should be relocated into the box containing the extractor and retained there.

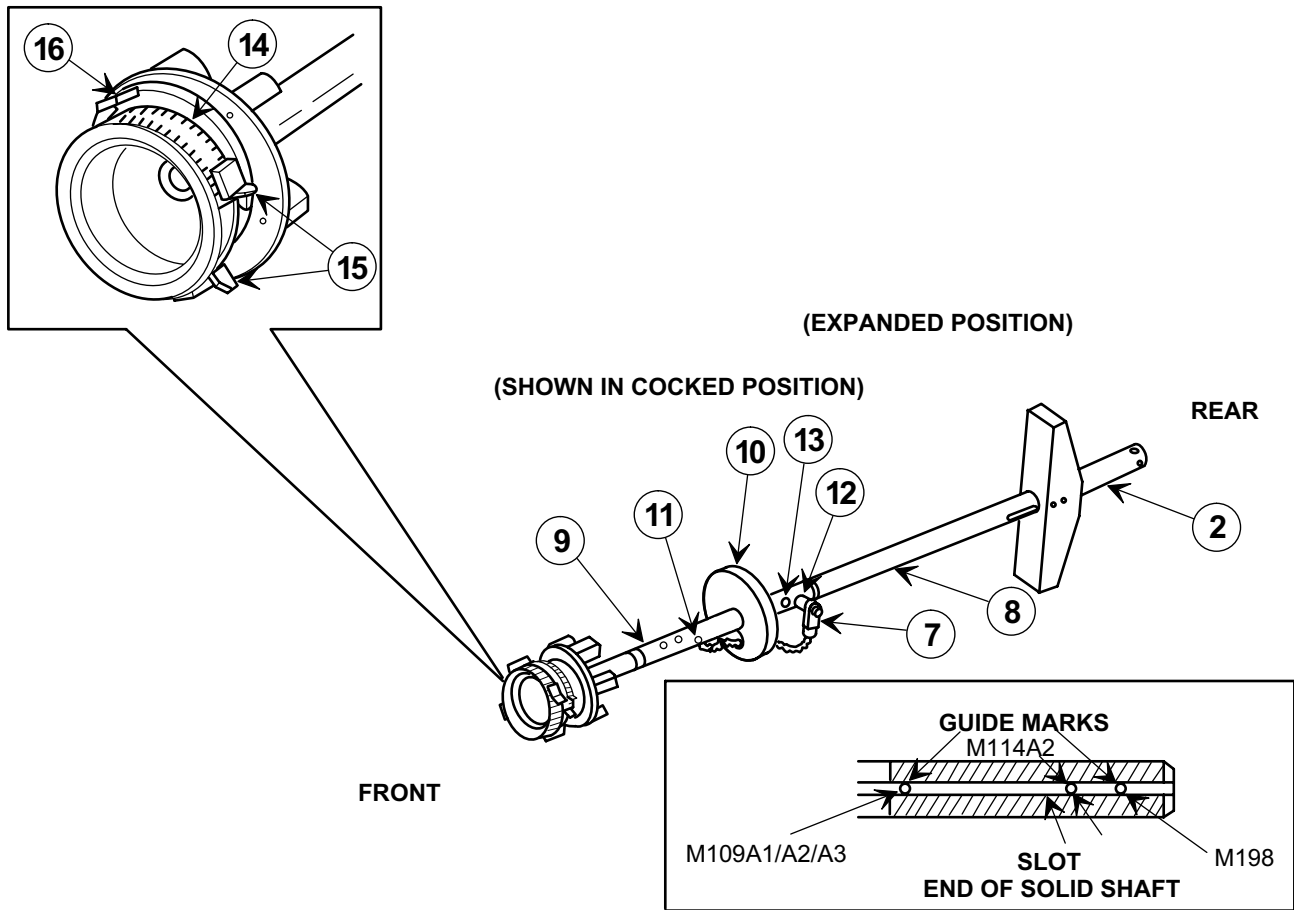
#### 4-24. OPERATION OF EXTRACTOR TOOL ASSEMBLY FOR PROJECTILES M712 AND M823 (cont)



(2) Inspect to make sure that the five insert sleeves (1) on the extractor assembly are retracted for use with an M198 howitzer as shown.



- (3) While standing at the rear, loosen drive nut (2) clockwise to farthest white mark.
- (4) Move brace (3) back.
- (5) Loosen two strap assemblies (4 and 5).
- (6) Remove ratchet (6).
- (7) Disengage locking pin (7).



**(8)** Extend telescoping solid and hollow shafts (8 and 9) until hole (12) in solid shaft (8) aligns with farthest hole in hollow shaft (9).

**(9)** Move alignment support (10) forward, midway between locking pin chain screw (11) and two holes (12 and 13) at end of the hollow shaft (9).

**(10)** Guide the locking pin (7) through the slot in alignment support (10).

**(11)** Insert locking pin (7) completely through both shafts (8 and 9) as shown.

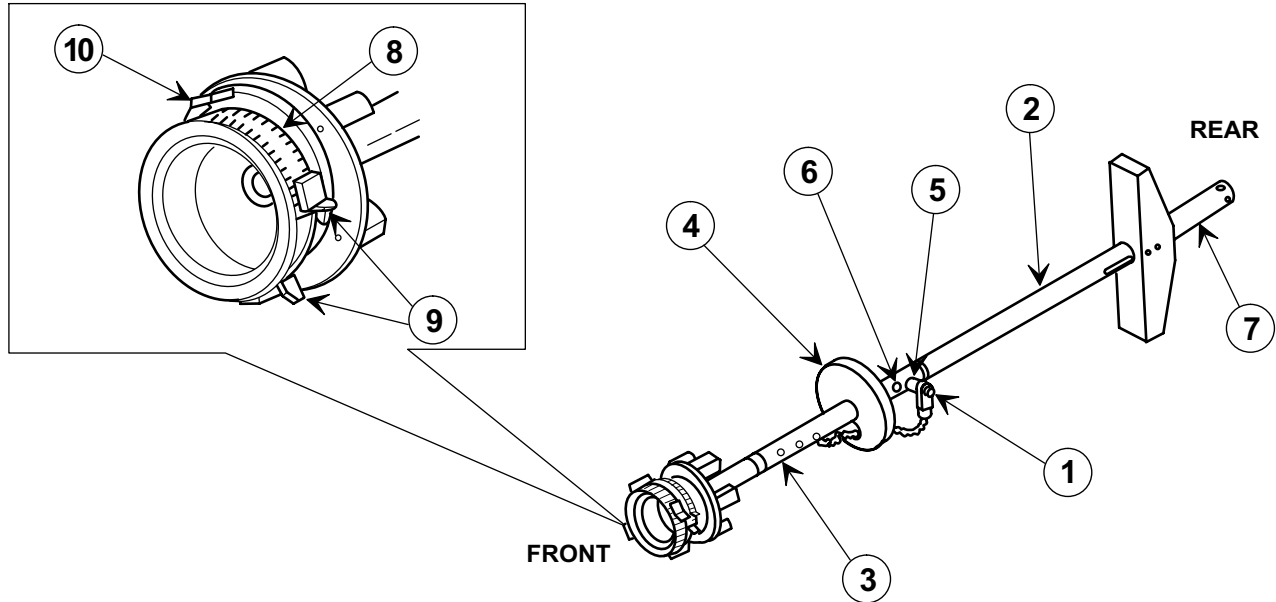
**(12)** Turn drive nut (2) counterclockwise until forward edge aligns with guide mark (white) on solid shaft (8). Use rear mark for M198 howitzer. (The forward mark is for use with M109A2/A3 howitzers, middle mark is for use with M114A2 howitzers).

**(13)** Cock extractor assembly as follows:

**(a)** Compress expansion ring (14) by squeezing tabs (15) together.

**(b)** Align cutout in retaining ring (16) with tabs (15) on expansion ring (14), and slide retaining ring forward over expansion ring.

#### 4-24. OPERATION OF EXTRACTOR TOOL ASSEMBLY FOR PROJECTILES M712 AND M823 (cont)



**c. Setup for Use Under Conditions of Poor Visibility.** If the extractor assembly is being expanded under conditions of poor visibility, the alinement hole and shaft detent may be used as described below.

(1) Disengage locking pin (1), and pull solid shaft (2) from hollow shaft (3).

(2) Move alinement support (4) forward of the two holes (5 and 6) in hollow shaft (3).

(3) Guide locking pin (1) through the slot in alinement support (4).

(4) Insert locking pin (1) in the alinement hole (6) (second hole from end of hollow shaft).

(5) Insert solid shaft (2) in hollow shaft (3), and rotate until alinement detent in end of solid shaft rests against locking pin (1).

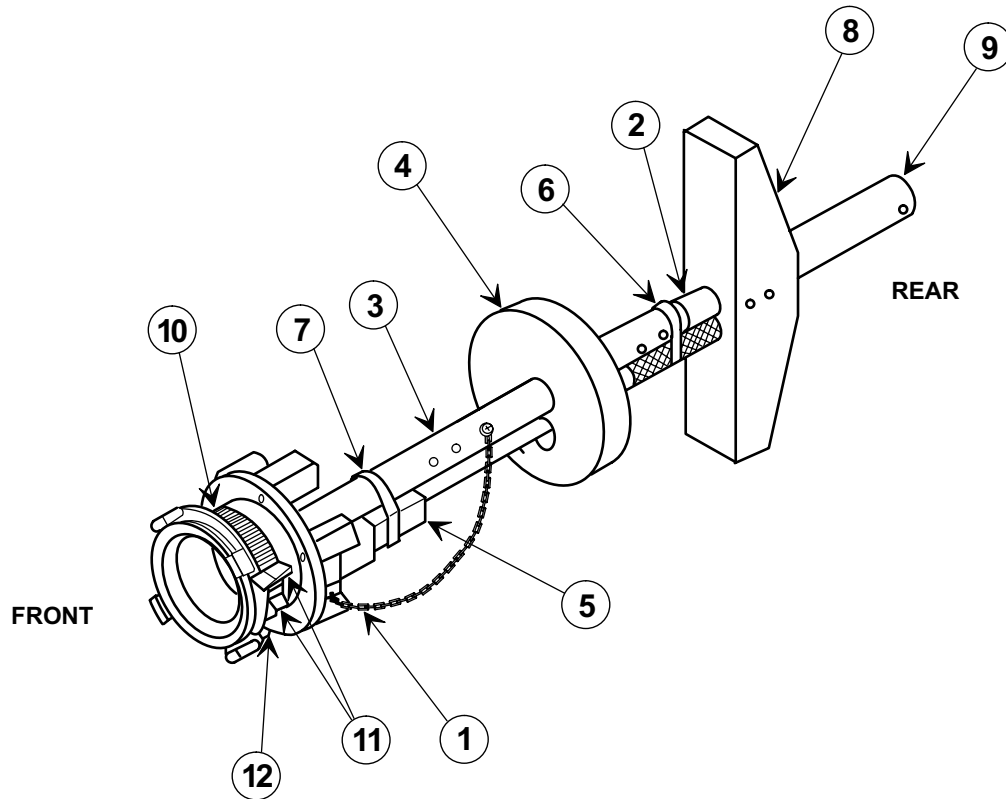
(6) While holding both shafts to prevent them from turning or sliding, remove locking pin (1) from alinement hole (6); and insert locking pin completely through farthest hole (5) to lock both shafts in extended position.

(7) Turn drive nut (7) counterclockwise until forward edge alines with guide mark (white) on solid shaft (2). Use rear mark for M198 howitzer. (The forward mark is for use with M109A2/A3 howitzers, middle mark is for use with M114A2 howitzers).

(8) Cock extractor assembly as follows:

(a) Compress expansion ring (8) by squeezing tabs (9) together.

(b) Aline cutout in retaining ring (10) with tabs (9) on expansion ring (8), and slide retaining ring forward over expansion ring.



**d. Breakdown for Stowage.**

- (1) Disengage locking pin (1), and compress telescoping solid and hollow shafts (2 and 3) to retracted position.
- (2) Guide locking pin (1) through slot in alinement support (4).
- (3) Insert locking pin (1) completely through solid shaft (2) and hollow shaft (3).
- (4) Remove ratchet (5) and extension, and guide ratchet handle through the slot in alinement support (4).
- (5) Strap ratchet (5) to hollow shaft (3), using the strap assemblies (6 and 7) provided.
- (6) Slide brace (8) forward until it touches end of ratchet handle. Turn drive nut (9) counterclockwise until brace (8) is held firmly against ratchet handle.
- (7) Check to see if extractor assembly is cocked. If it is not cocked, perform the following:
  - (a) Compress expansion ring (10) by squeezing tabs (11) together.
  - (b) Aline cutout in retaining ring (12) with tabs (11) on expansion ring (10), and slide retaining ring forward over expansion ring.
- (8) Stow extractor assembly and extension in wooden packing box.

## 4-25. UNLOADING AN M712 OR M823 PROJECTILE

### CAUTION

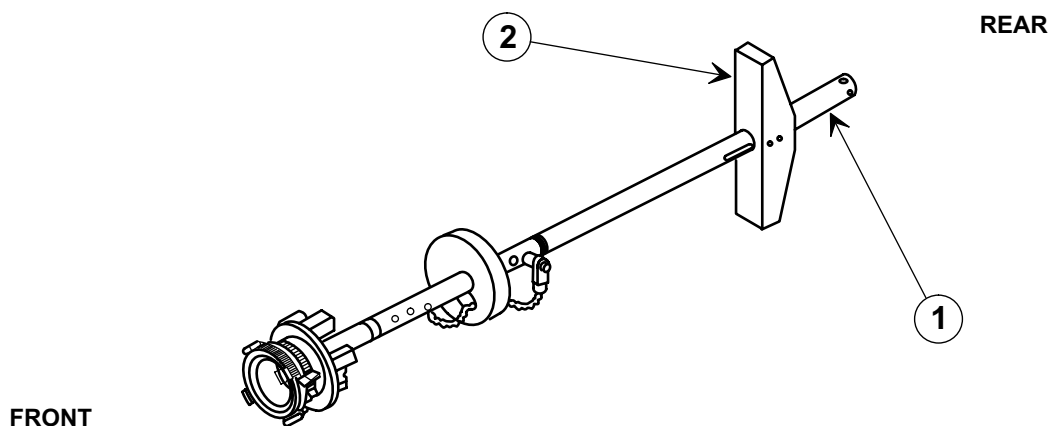
Do not use bell rammer to unload the M712 or M823 projectile.

#### a. Removal of Primer and Propelling Charge.

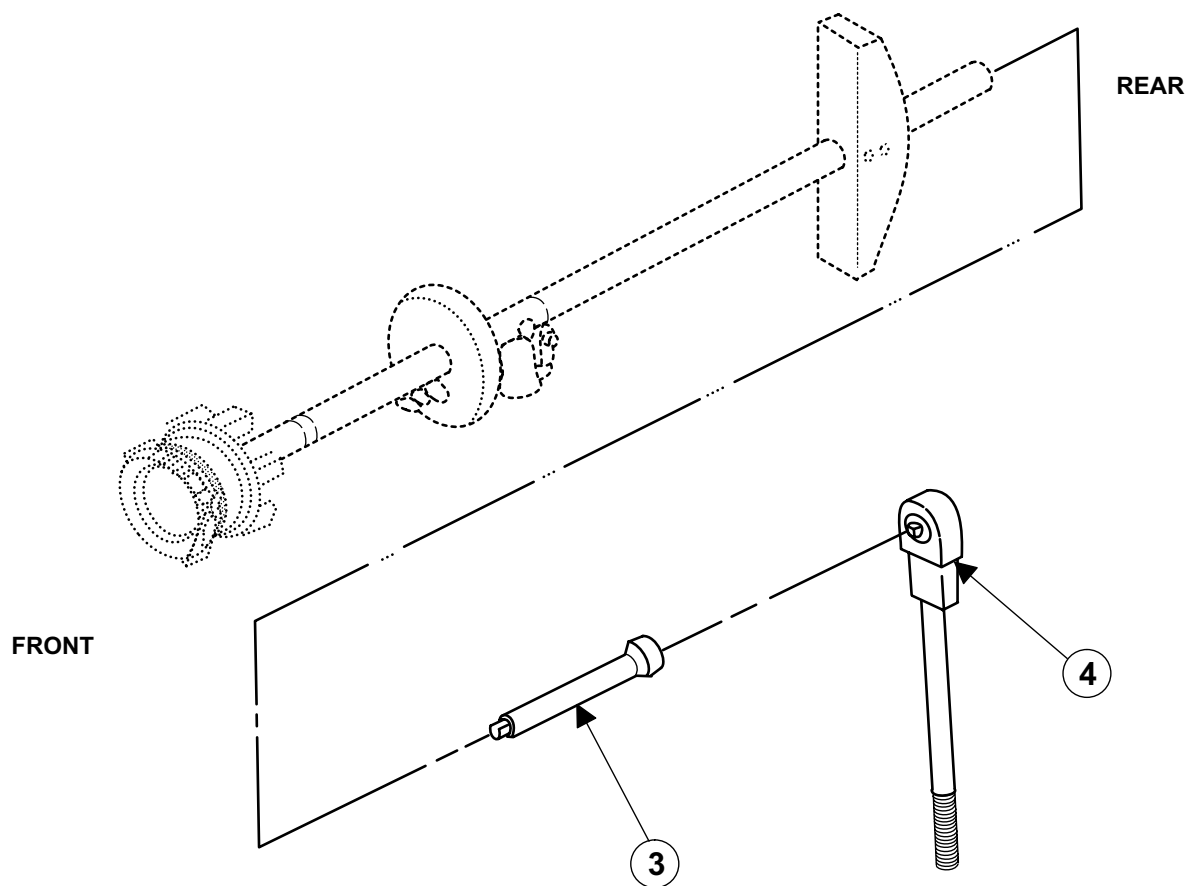
- (1) Remove primer and propelling charge as prescribed in this manual.
- (2) Elevate/depress gun tube to approximately 300 mils.

#### b. Unloading M712 and M823 Projectile. Unload M712 or M823 projectile following the steps listed below.

- (1) Obtain extractor assembly.
- (2) Check to see if extractor assembly is cocked. If expansion ring is cocked, proceed to (3) below; otherwise, cock extractor assembly as follows:
  - (a) Compress expansion ring by squeezing tabs together.
  - (b) Align cutout in retaining ring with tabs on expansion ring, and slide retaining ring forward over expansion ring.
- (3) Insert extractor assembly through breech ring assembly until forward end makes contact with base of projectile. Push extractor assembly firmly against projectile until expansion ring is seated in the base of the projectile. Pull on extractor assembly to make sure that it is engaged with projectile. If extractor assembly did not engage, remove it from gun tube and repeat procedures in steps (2)(a) and (b) and this step.



- (4) Turn extractor drive nut (1) counterclockwise by hand until brace (2) touches and is centered across face of breech ring assembly.



**(5)** Insert socket wrench extension (3) into ratchet (4). Connect ratchet to end of drive nut. Set ratchet to OFF, and turn ratchet counterclockwise until projectile is pulled free of forcing cone. Remove ratchet and socket wrench extension from drive nut.

**(6)** Let projectile and extractor assembly slide slowly out of gun tube until base of projectile has passed through breech ring assembly. Projectile will have to be raised slightly to pass obturator over Swiss groove.

**(7)** Release extractor assembly by squeezing tabs on expansion ring.

**(8)** Remove the projectile from howitzer, being careful not to strike plastic nose cone, and repackage the projectile. If the projectile has been unloaded from a hot gun tube, remove it to a safe distance from personnel, and notify EOD for disposal.

#### 4-26. M712 AMMUNITION PREPARED FOR FIRING, BUT NOT FIRED

**a. General.** M712 projectiles that have been unpackaged (in accordance with paragraph 4-21.a) but not fired, will be repacked within 30 days and returned to battalion ammunition section for further disposition. Long exposure of the projectile to sunlight and other elements may cause it to fail. Code and time switch settings made during preparation need not be reset. A projectile that has been unloaded from a weapon as a result of a misfire or checkfire will be repackaged as described below.

##### NOTE

An M712 projectile which has been rammed and extracted from a cold tube may be used.

**b. Repackaging Projectile.** Repackage the M712 projectile as follows:

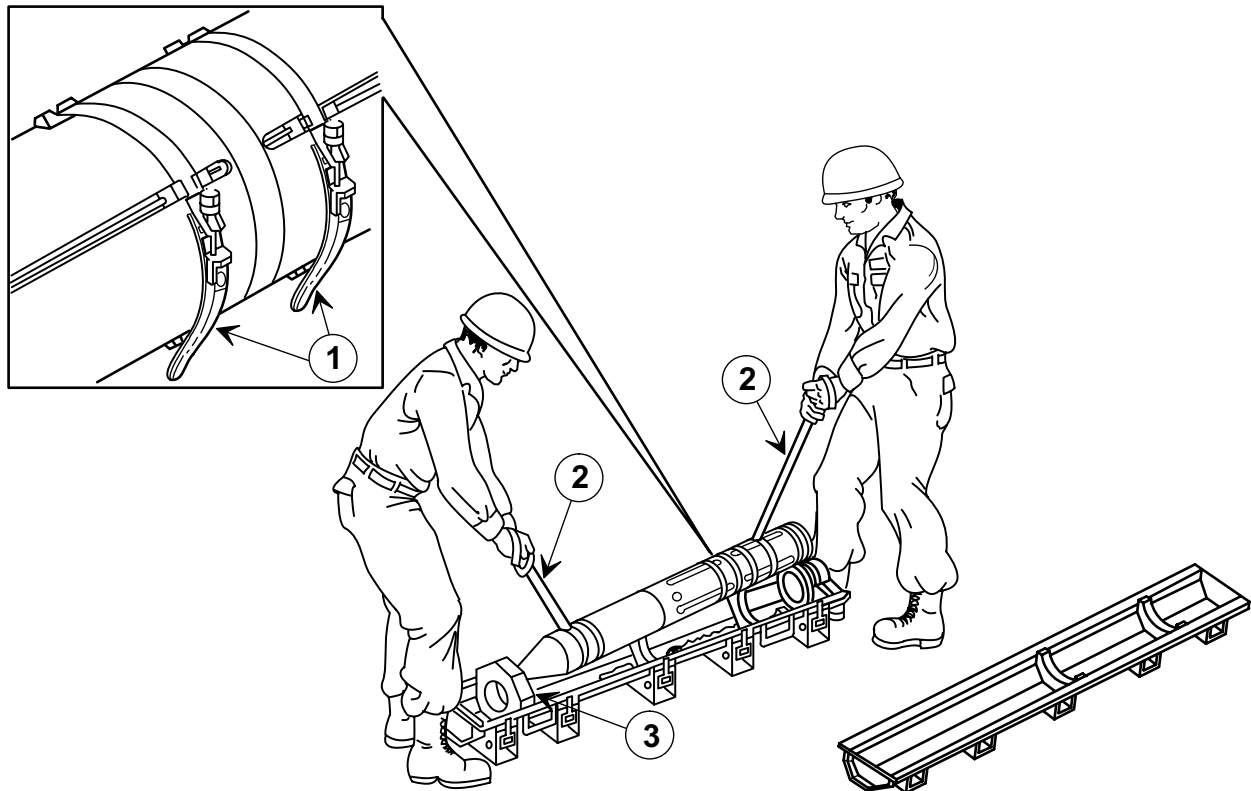
(1) Using wiping rag (item 24, appx D), wipe all loose dirt and moisture from projectile.

(2) Locate original container. If container has become unserviceable, replace it. If original container cannot be found or has been replaced for unserviceability, make sure that markings on replacement container match markings on projectile. If not, return to battalion ammunition section for remarking.

(3) Install projectile into container as follows:

(a) Check red decals, stamp, or stencil (if present) at nose end of container halves to assure numbers on decals match.

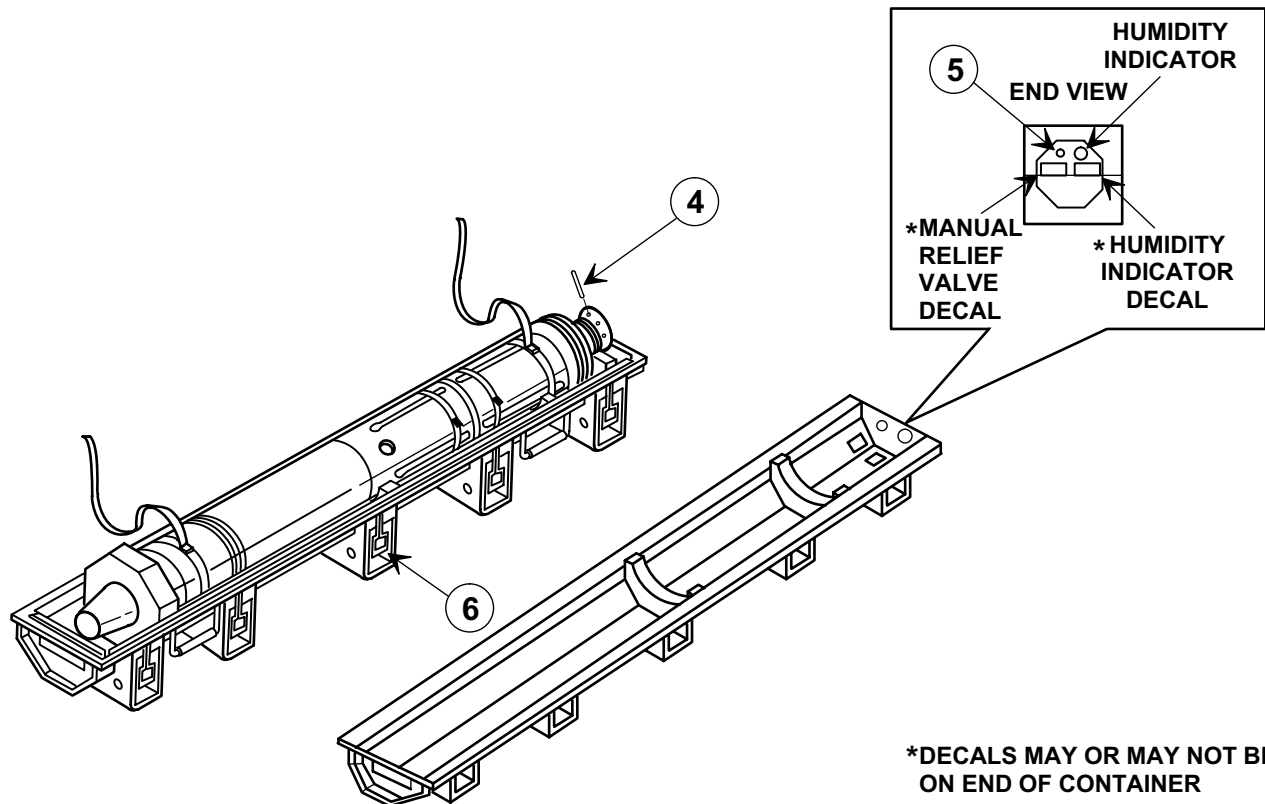
(b) Open container, and remove lifting straps. Also remove fin and wing preload bands.



**CAUTION**

Make sure that all four fin and wing preload bands securely engage fins and wings.

- (c) Install fin and wing preload bands (1) on projectile.
- (d) Install lifting straps (2) on projectile.
- (e) Spin tension mechanism counterclockwise by hand until it stops.
- (f) Lift projectile, and position over opened container.
- (g) Carefully lower projectile, guiding nose cone into retainer ring (3) in the container.



(h) Using torquing rod (4), turn tension mechanism clockwise as far as possible to snug projectile into the retainer ring. Position rod in holes so thread is horizontal (or as close as possible). This is required toward interference with the cover stops inside the cover.

(i) Be sure that desiccant and protective bag are placed inside container.

(j) Place container cover on container body in such a manner that the inside cradles are aligned and the manual relief valve (5) and the humidity indicator card are at the rear end of the container.

(k) Starting on the end opposite the humidity indicator card, straddle container, place T-bolts in cover recesses, and close corresponding left and right side latches (6) at the same time in pairs.

4-27. M712 PROJECTILE MAINTENANCE

Humidity indicators on package M712 Projectiles must be monitored for humidity every 90 days, as a minimum. If relative humidity in the container is 40 percent or greater (40 percent sector of humidity indicator card is not blue), follow instructions in paragraph 4-21.

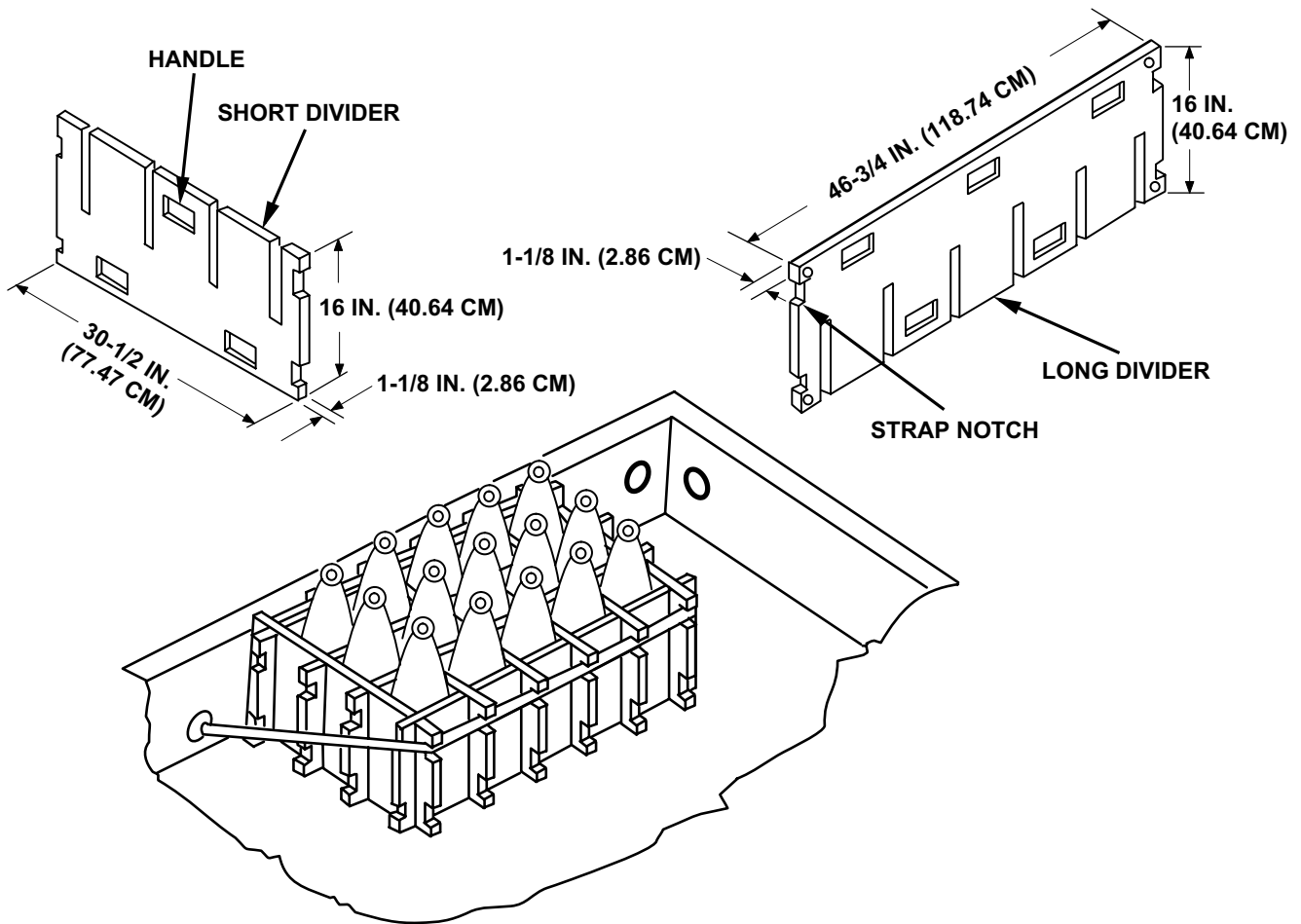
SECTION V. HANDLING

Section Index

Paragraph	Page
4-28. Loose Projectile Restraint System (LPRS) .....	4-76

4-28. LOOSE PROJECTILE RESTRAINT SYSTEM (LPRS)

- a. **General.** The LPRS is a divider rack that provides a fast, simple method of securing "loose" unfuzed projectiles for transportation in a field artillery companion vehicle. The rack restrains projectiles from excessive longitudinal and lateral movement and from contact with other projectiles. The rack is easily assembled, using a quantity of short and/or long plastic dividers that fit together. Projectiles are then placed vertically in the rack, with the base of each projectile resting on the floor of the vehicle. The assembly is then secured to the sidewall of the vehicle by means of cargo tiedown straps. After use, the rack may be disassembled and stored for reuse.
- b. **Use of LPRS.** Use of LPRS is optional. Appendix D, Expendable/Durable Supplies and Materials List, lists LPRS components.
- c. **Instructions.** Complete instructions for use of the LPRS are found in TM 9-2590-210-10, Loose Projectile Restraint System (LPRS) for use with Field Artillery Companion Vehicles.





## CHAPTER 5

### FOREIGN AMMUNITION (NATO)

#### Chapter Index

Paragraph	Page
5-1. General.....	5-1
5-2. Authorized Projectiles.....	5-1
5-3. Authorized Fuzes.....	5-5
5-4. Authorized Propelling Charges.....	5-6

#### 5-1. GENERAL

a. Agreements between the United States and NATO allies have established the interoperability of weapon systems and ammunition of the nations. The agreements enable the safe and effective firing of major types of ammunition of the same size from the same compatible size and type weapon of the NATO armies.

b. The following pages cover only authorized German (GE), United Kingdom (UK), Canadian (CA), Netherlands (NL), French (FR), Norwegian (NO), Italian (IT), Danish (DA), Greek (GR), or Belgian (BE) 155-mm components. If a munitions item has not yet been authorized, it is because either it has not yet been determined to be safe to fire, or it has been determined that the munitions item cannot be safely fired from the US weapon system.

#### WARNING

Only under emergency combat conditions will zone 1 of the M3A1 and DM62 propelling charge be fired from the M199 cannon tube of the M198 howitzer weapon system.

Do not mix US, GE, UK, CA, NL, FR, NO, IT, DA, GR, or BE components (i.e., projectile, propelling charge, flash reducer, fuze). Fire only all components from one nation, except GE primer DM191A1. GE must use DM191A1 when firing US, GE, UK, CA, NL, NO, IT, DA, GR, or BE 155-mm munitions.

#### NOTE

At the conclusion of any training exercise, ammunition drawn from a NATO nation and not fired should be returned to the troops of the NATO nation from whom it was obtained.

#### 5-2. AUTHORIZED PROJECTILES

a. The following GE munitions are authorized for use in M198 howitzers:

Projectile .....	155-mm, HE, DM21 (TNT-loaded only)
Charge, propelling.....	Green bag, DM62, zones 1-5
Charge, propelling.....	White bag, DM42B1, zones 3-7
Fuze .....	Point-detonating, DM211
Primer.....	Use only US M82 primer
	Do not use GE DM191A1 primer

**5-2. AUTHORIZED PROJECTILES (cont)**

**b.** The following UK munitions are authorized for use in M198 howitzers:

Projectile .....	155-mm, HE, M107 (TNT-loaded only)
Charge, propelling.....	Green bag, M3A1, zones 1-5
Charge, propelling.....	White bag, M4A2, zones 3-7
Fuze .....	Point-detonating, M557, L85A2
Primer.....	M82

**c.** The following CA munitions are authorized for use in M198 howitzers:

Projectile .....	155-mm, HE, M107
Charge, propelling.....	M3 <sup>1</sup> , M3A1, M4A1 <sup>1</sup> , M4A2
Fuze .....	Point-detonating, M557, M564
	Proximity, M514A1
Primer.....	M82

**d.** The following NL munitions are authorized for use in M198 howitzers:

Projectile .....	155-mm, HE, M107, M107C1 <sup>2</sup> (TNT-loaded only)
Charge, propelling.....	M3C1 <sup>2</sup> , M4C3 <sup>2</sup> , M4A1 <sup>1</sup>
Fuze .....	Point-detonating, M557, M557C1 <sup>2</sup>
Primer.....	M82, M82C1 <sup>2</sup>

**e.** The following FR munitions are authorized for use in M198 howitzers:

Projectile .....	155-mm, HE, M107
Charge, propelling.....	Green bag, M3 <sup>1</sup> , zones 1-5
Charge, propelling.....	White bag, M4A1 <sup>1</sup> , zones 5-7
Fuze .....	Point-detonating, M557
Primer.....	Use US M82 only, not MK2A4

**NOTE**

FR troops must use MK2A4 primer in FR F3 AMSP weapon.

**f.** The following NO munitions are authorized for use in M198 howitzers:

**WARNING**

Do not fire M107 projectiles when lot number starts with RA.

Interchange firings will be with TNT-loaded M107 projectiles only.

<sup>1</sup>These charges do not have flash reducers.

<sup>2</sup>NL manufacture

**f. (cont)**

Projectile ..... 155-mm, HE, M107 (TNT-loaded only)  
 Charge, propelling ..... Green bag, M3A1, zones 1-5  
 Charge, propelling ..... White bag, NM23 (same as US M4A2), zones 3-7  
 Fuze ..... Point-detonating, M557  
 Primer ..... M82

**NOTE**

Except as noted above, preparation for firing GE, UK, CA, NL, FR, NO, IT, DA, GR, and BE munitions in US weapons system (preparation for firing, precautions during firing, misfire procedures, etc.) are contained in chapters 2 and 4 of this manual.

**g.** The following IT munitions are authorized for use in M198 howitzers:

Projectile ..... 155-mm, HE, M107 (TNT-loaded only)  
 Charge, propelling ..... Green bag, M3A1, zones 1-5  
 Charge, propelling ..... White bag, M4A2, zones 3-7  
 Fuze ..... Point-detonating, M557, MTSQ, M564  
 Primer ..... M82

**h.** The following DA munitions are authorized for use in M198 howitzers:

Projectile ..... 155-mm, HE, M107 (TNT-loaded only)  
 Charge, propelling ..... Green bag, M3<sup>1</sup>, M3A1, zones 1-5  
 Charge, propelling ..... White bag, M4A1<sup>1</sup>, M4A2, zones 3-7  
 Fuze ..... Point-detonating, M557C1, MTSQ, M564  
 Primer ..... M82

**i.** The following GR munitions are authorized for use in M198 howitzers:

Projectile ..... 155-mm, HE, M107, M107B2 (TNT-loaded only)  
 Charge, propelling ..... Green bag, M3<sup>1</sup>, M3A1, zones 1-5  
 Charge, propelling ..... White bag, M14A1<sup>1</sup>, M4A2, zones 3-7  
 Fuze ..... Point-detonating, M557, MTSQ, M564  
 Primer ..... M82

**j.** The following BE munitions are authorized for use in M198 howitzers:

Projectile ..... 155-mm, HE, M107 (TNT-loaded only)  
 Charge, propelling ..... Green bag, M3A1, zones 1-5  
 Charge, propelling ..... White bag, M4A2, zones 3-7  
 Fuze ..... Point-detonating, M557, MTSQ, M564  
 Primer ..... M82

<sup>1</sup>These charges do not have flash reducers.

k. The following US munitions are authorized for use in GE M109, UK M109, CA M109, NL M109, FR F3 AM, and NO M109G and M114 series weapon systems:

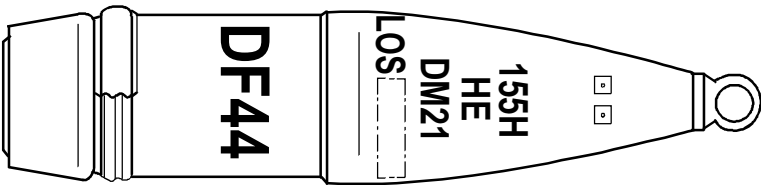
**NOTE**

During training exercises, give either TNT- or Comp B-loaded 155-mm, HE, M107 projectiles to UK, NL, and FR troops.

Projectile .....	155-mm, HE, M107
Charge, propelling .....	Green bag, M3A1, zones 1-5
Charge, propelling .....	White bag, M4A2, zones 3-7
Primer .....	M82 (GE use DM191A1; FR F3 AM use MK244)

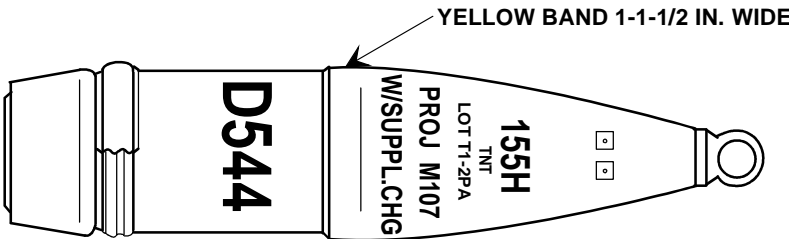
I. The authorized projectiles and their characteristics are as follows:

**DM21 PROJECTILE**



(1) **Projectile, 155-mm, HE, DM21 (GE).** This high explosive projectile is used for blast effect, fragmentation, and mining. The projectile is a hollow steel shell filled with TNT. Point-detonating fuze is used with this projectile. A supplementary charge of 0.3 lb (0.136 kg) TNT is sealed in an aluminum container placed in the fuze cavity of the projectile. The projectile weighs approximately 92.0 lb (41.7 kg).

**M107 PROJECTILE**



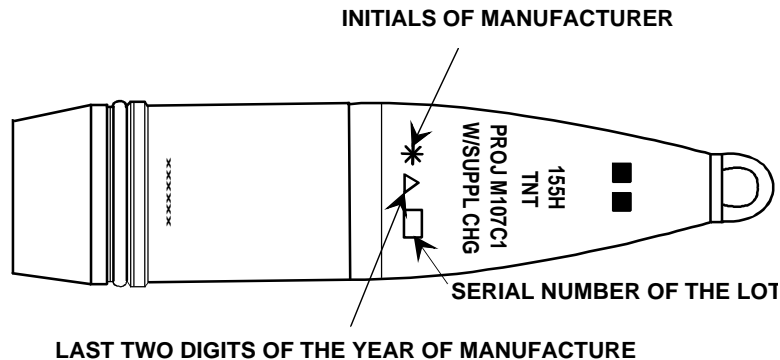
(PROJECTILES, AS MANUFACTURED,  
DO NOT HAVE THIS BAND. IT IS ADDED  
ONLY WHEN PROJECTILE IS RENOVATED (UK ONLY).)

**(2) Projectile, 155-mm, HE, M107 (Normal and Deep Cavity) (UK, CA, and NL).** This high explosive projectile is used for blast effect, fragmentation, and mining. The projectile is a hollow steel shell filled with TNT. Point-detonating fuze is used with this projectile. A supplementary charge of 0.3 lb (0.136 kg) TNT is sealed in an aluminum container placed in the fuze cavity of this projectile. The projectile weighs approximately 92.3 lb (41.9 kg).

**NOTE**

With the exception of a yellow hazard band around the body of renovated projectiles, these UK munitions are identical to US munitions.

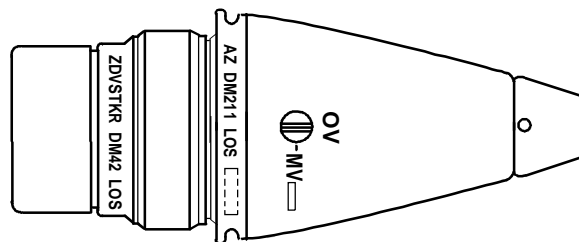
**M107C1 PROJECTILE**



**(3) Projectile, 155-mm, HE, M107C1 (NL).** This high explosive projectile is used for blast effect, fragmentation, and mining. The projectile is a hollow steel shell filled with TNT. Point-detonating, time, or proximity (deep cavity only) fuzes may be used. The projectile weighs approximately 92.3 lb (41.9 kg).

**5-3. AUTHORIZED FUZES**

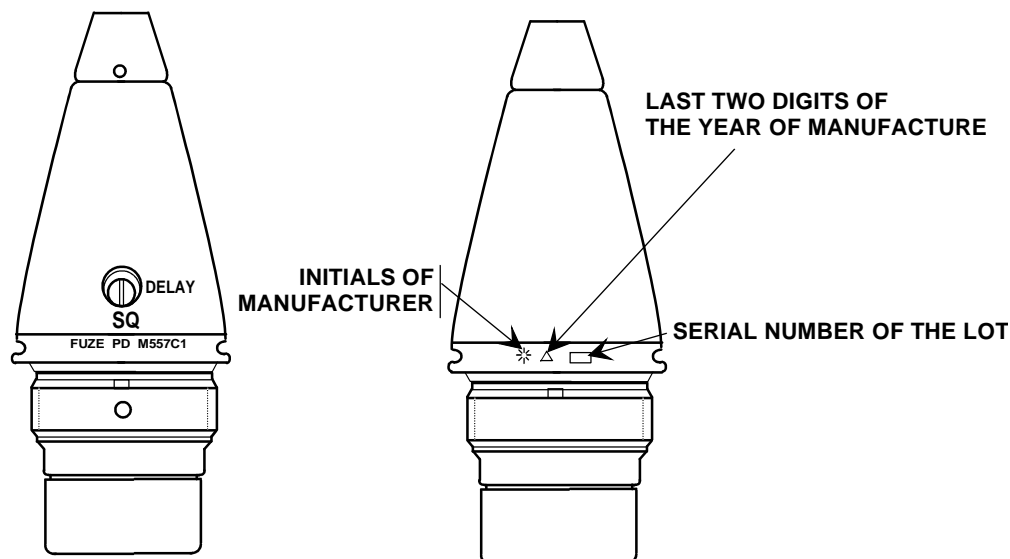
**DM211 FUZE**



**a. Fuze, Point-Detonating, DM211 (GE and NO).** The DM211 fuze has a superquick (SQ) element in the head consisting of a firing pin, firing pin support, and detonator. The fuze body contains a delay plunger assembly and a selective setting device for superquick or delay action. The DM211 fuze is similar to the US fuze M557.

### 5-3. AUTHORIZED FUZES (cont)

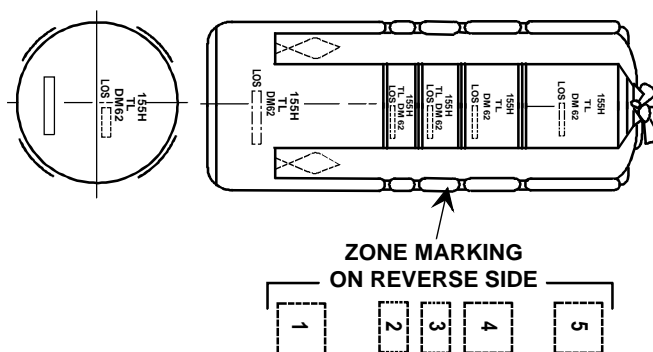
#### M557C1 FUZE



b. **Fuze, Point-Detonating, M557C1 (NL).** The M557C1 fuze is a selective superquick or 0.05-second delay impact fuze. The M557C1 fuze is a US M557 fuze with booster M125C1 of Italian manufacture. This booster is the same design as the US M125A1 except that it is fitted with a setback pin which locks one of the spin locks.

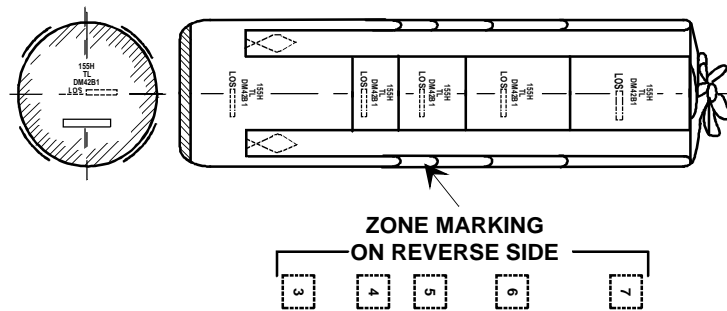
### 5-4. AUTHORIZED PROPELLING CHARGES

#### DM62 PROPELLING CHARGE



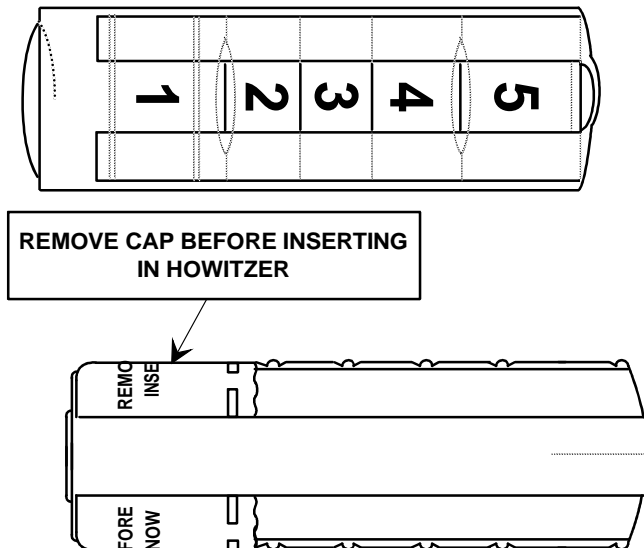
a. **Propelling Charge, DM62 (GE).** This is a green bag charge consisting of a base charge and four unequal increments loaded in cloth bags for firing in zones 1 thru 5. The bags are fastened together with four cloth straps sewn to the base tied on top of increment no. 5. The clean-burning igniter in a red or brown cloth bag is sewn to the rear of the base charge.

## DM42B1 PROPELLING CHARGE



**b. Propelling Charge, DM42B1 (GE).** This is a white bag charge consisting of a base charge and four unequal increments loaded in cloth bags for firing in zones 3 thru 7. The increments are connected by four cloth tapes sewn to the base and tied on top of increment no. 7. The clean-burning igniter in a red or brown cloth pad is sewn to the bottom of the base charge. A flash reducer pad is assembled at the front end of the base charge.

## M3C1 PROPELLING CHARGE



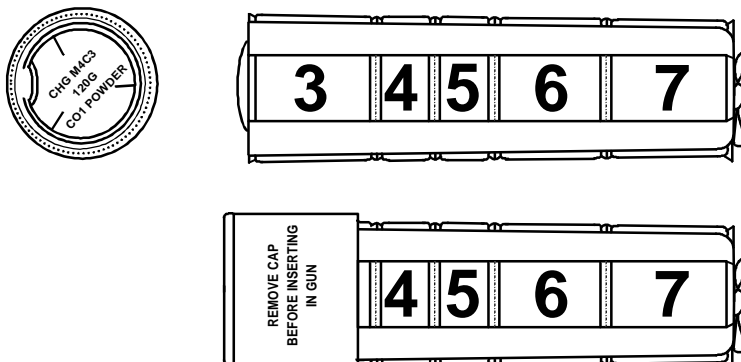
### NOTE

Lot number of assembled propellant charge is shown on the base charge and all supplemental charges.

**c. Propelling Charge, M3C1 (NL).** This is a green bag charge consisting of a base charge and four unequal increments loaded in cloth bags for firing in zones 1 thru 5. The bags are fastened together with four cloth straps sewn to the base and tied on top of increment no. 5. It has a flash reducer pad in front of the base charge and two flash reducer pads in front of increments no. 4 and 5. The clean-burning igniter in a red cloth bag is sewn to the rear of the base charge.

## 5-4. AUTHORIZED PROPELLING CHARGES (cont)

### M4C3 PROPELLING CHARGE



#### NOTE

Lot number of assembled propellant charge is shown on the base charge and all supplemental charges.

**d. Propelling Charge, M4C3 (NL).** This is a white bag charge consisting of a base charge and four unequal increments loaded into cloth bags for firing in zones 3 thru 7. The increments are connected by four cloth tapes sewn to the base and tied on top of increment no. 7. The clean-burning igniter in a red cloth pad is sewn to the bottom of the base charge (increment no. 3). A flash reducer pad is assembled at the front of the base charge (increment no. 3).

# CHAPTER 6

## DEMOLITION OF MATERIEL TO PREVENT ENEMY USE

### Chapter Index

Paragraph		Page
6-1.	General.....	6-1
6-2.	Destruction of Fire Control Equipment .....	6-2
6-3.	Destruction of the M199 Cannon and M39 Carriage.....	6-2
6-4.	Destruction of Pneumatic Tires .....	6-4

### 6-1. GENERAL

**a.** If subject to capture or abandonment in the combat zone, the M198 howitzer will be destroyed only when, in the judgement of the unit commander, such action is necessary in accordance with orders or policy of the Army Commander.

**b.** The information which follows is for guidance only. Certain procedures require the use of demolition charges and incendiary grenades which may not be authorized items for the using organization. The issue of these and related materials and the conditions under which the howitzer will be destroyed are command decisions, according to the tactical situation. Destruction of essential parts followed by burning will usually be enough to make the materiel useless. Selection of the particular method of destruction requires imagination and resourcefulness in using the facilities at hand under the existing conditions. Time is critical. The most applicable means of destruction are as follows:

Mechanical .....	Requires axe, pick mattock, sledge, crow bar, or similar implement.
Demolition .....	Requires suitable explosives or ammunition.
Burning .....	Requires gasoline, oil, incendiary grenades, or other flammables.
Gunfire .....	Includes artillery, machine guns, rifles using rifle grenades, and launchers using antitank rockets. Under some circumstances, hand grenades may be used.

**c.** If the howitzer is to be destroyed, the materiel must be so badly damaged that it cannot be restored to a usable condition in the combat zone either by repair or cannibalization. Adequate destruction requires that all parts essential to the operation of the materiel, including essential spare parts, be destroyed or damaged beyond repair. However, when lack of time and personnel prevents destruction of all parts, priority is given to the destruction of those parts most difficult to replace. Equally important, the same essential parts must be destroyed on all like materiel so that the enemy cannot construct one complete unit from several damaged ones.

**6-1. GENERAL (cont)**

d. If destruction is ordered, these procedures should be followed.

(1) Select a point of destruction that will cause the greatest obstruction to enemy movement and also prevent hazard to friendly troops from fragments or ricocheting projectiles.

(2) Observe appropriate safety precautions.

**6-2. DESTRUCTION OF FIRE CONTROL EQUIPMENT**

All fire control equipment, especially such items as telescopes, gunner's quadrants, binoculars, and similar items, is costly, difficult to replace, yet relatively light. It should be conserved and evacuated whenever practicable. If evacuation is impracticable, the equipment will be destroyed completely. The preferred means of destruction of radioactively illuminated fire control is by demolition, burning, or gunfire. If by demolition, miscellaneous fire control components may be placed on or near auxiliary charges. Small charges should be placed at the main fire control attachment points. If the tactical situation mandates mechanical destruction, primary attention should be given to lenses, control knobs, mounting surfaces, and counters. After destruction, personnel should immediately wash with soap (item 26, appx D) and water. Firing tables and other flammable items will be burned.

**6-3. DESTRUCTION OF THE M199 CANNON AND M39 CARRIAGE**

If time, personnel, and materials are available, the destruction of the complete towed weapon should be accomplished by means of demolition materials, burning, or gunfire. If time, personnel, or materials are limited, priority should be given to the destruction of the cannon. Pneumatic tires should be destroyed as described on page 6-4.

**a. Method No. 1. Destruction with Demolition Charges.**

(1) For simultaneous detonation, prepare and place demolition charges (1-lb (0.45-kg)) TNT blocks (or equivalent with the necessary detonating cord) as indicated below:

<b>Charge</b>	<b>Location of Charge</b>
2-lb (0.91-kg) .....	Insert charge into cannon tube.
2-lb (0.91-kg) .....	Place charge next to recoil mechanism.
2-lb (0.91-kg) .....	Place charge on carriage next to left wheel and spindle.
2-lb (0.91-kg) .....	Place charge on carriage next to right wheel and spindle.

(2) Connect the charge for simultaneous detonation with detonating cord.

(3) Detonate the charges. For complete details on the use of demolition materials and methods of priming and detonating demolition charges, refer to TM 750-244-7. Training and careful planning are essential. The danger zone is approximately 250 meters (273 yd).

Elapsed time: About 10 minutes.

**b. Method No. 2. Destruction by Burning.****WARNING**

Do not strike equilibrators or recoil mechanism parts as they could explode and injure personnel.

**(1) With combustible materials.**

**(a)** Using an axe, pick mattock, sledge, or similar implement, smash the brake lines, hydraulic lines, fire control equipment handwheels, and ball screws.

**(b)** Destruction of essential parts, followed by burning in an intense fire, will usually make the cannon and carriage useless. Since the cannon and carriage are almost entirely metal, except for pneumatic tires, enough quantities of combustibles should be used to ensure a very hot fire.

**(c)** If explosive ammunition is available, place the unpacked ammunition on and above the cannon and carriage.

**(d)** Pour gasoline or oil over the combustible material.

**WARNING**

Cover must be taken without delay since an early explosion of the explosive ammunition may be caused by the fire. If explosive ammunition is present, the danger area is 250 meters (273 yd).

**(e)** Ignite by means of an incendiary grenade fired from a safe distance, by a burst from a flame thrower, by a combustible train of suitable length, or by other appropriate means. Take cover immediately.

Elapsed time: About 6 minutes.

**(2) With incendiary grenades.** If large quantities of combustibles are not available, use incendiary grenades as follows:

**WARNING**

Each roll of time blasting fuze must be tested shortly before use. The rate of burning will vary for the same or different roll under different atmospheric and/or climatic conditions, from a burning time of 30 seconds or less per foot to 45 seconds or more per foot.

Time blasting fuzes shall be of sufficient length to allow personnel enough time to safely leave the cannon and carriage after igniting the fuzes.

**(a)** Insert two incendiary grenades end-to-end in the muzzle of the cannon tube. The two grenades will be ignited by means of a third grenade fitted with a length of time blasting fuze. The metal from the grenades will fuse with the tube.

### 6-3. DESTRUCTION OF THE M199 CANNON AND M39 CARRIAGE (cont)

(b) Place the fourth and fifth grenades on the carriage; the first next to the left wheel and spindle and the second next to the right wheel and spindle. The two grenades will be ignited by a sixth grenade fitted with a length of time blasting fuze.

(c) Place a seventh grenade next to the recoil mechanism. This grenade will be ignited by an eighth grenade fitted with a length of time blasting fuze.

Elapsed time: About 5 minutes.

#### WARNING

Firing artillery at ranges of 460 meters (421 yd) or less should be from cover. Firing rifle grenades or antitank rockets should be from cover.

c. **Method No. 3. Destruction by Gunfire.** This method cannot be relied upon to destroy the same parts of all cannons and carriages or to produce the same degree of destruction. Fire on the cannons and carriages, using nearby artillery, machine guns, rifles using rifle grenades, or launchers using antitank rockets. Although one well-placed direct hit may render the cannon and carriage temporarily useless, several hits are usually required for complete destruction.

Elapsed time: About 5 minutes.

### 6-4. DESTRUCTION OF PNEUMATIC TIRES

An attempt must always be made to destroy pneumatic tires, even if time will not permit destruction of the remainder of the carriage. Destroy tires with incendiary grenades in conjunction with the destruction of the weapon.

#### a. Method No. 1. Destruction by Incendiary Grenades.

#### WARNING

Do not use WP (white phosphorous) grenades to destroy the tires. WP grenades burst and throw the burning white phosphorous particles as far as 30 meters (27 yd).

(1) Ignite an incendiary grenade under each tire.

(2) When this method is combined with the destruction of materiel by means of demolition materials, the detonation of demolition charges should be delayed until the incendiary fires are well started to avoid the possibility of the flames being extinguished by the blast of the explosion.

Elapsed time: About 2 minutes.

b. **Method No. 2. Destruction by Slashing.** If tires are inflated, use care to prevent injury should the tire blow out while being slashed. Whenever practicable, deflate the tires before slashing.

Elapsed time: About 3 minutes.

## APPENDIX A REFERENCES

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### A-1. SCOPE

This appendix lists all forms, field manuals, technical manuals, technical bulletins, and miscellaneous publications referenced in this manual.

### A-2. FORMS

Equipment Inspection and Maintenance Worksheet .....	DA Form 2404
Hand Receipt/Annex Number .....	DA Form 2062
Product Quality Deficiency Report .....	SF 368
Quality Deficiency Report .....	MCO 4855.10
Recommended Changes to Equipment Technical Manuals .....	DA Form 2028-2
Recommended Changes to Publications and Blank Forms .....	DA Form 2028
Weapon Record Data .....	DA Form 2408-4

### A-3. FIELD MANUALS

Army Helicopter External Load Operations .....	FM 55-450-1
Basic Cold Weather Manual .....	FM 31-70
First Aid for Soldiers .....	FM 21-11
NBC Decontamination .....	FM 3-5
Nuclear, Biological, and Chemical Decontamination .....	FM 3-3
Northern Operations .....	FM 31-71
Operation and Maintenance of Ordnance Materiel in Cold Weather (0° to -65°F) .....	FM 9-207
Tactics, Techniques, and Procedures Manual for Field Artillery Cannon Gunnery .....	FM 6-40

### A-4. TECHNICAL MANUALS

Army Ammunition Data Sheets for Artillery Ammunition: Guns, Howitzers, Mortars, Recoilless Rifles, Grenade Launchers and Artillery Fuzes .....	TM 43-0001-28
Direct Support and General Support Maintenance Manual, Artillery Ammunition for Guns, Howitzers, Mortars, Recoilless Rifles, and 40MM Grenade Launchers .....	TM 9-1300-251-34&P

## A-4. TECHNICAL MANUALS (cont)

Hand Receipt Manual Covering Components of End Item (COEI), Basic Issue Items (BII), and Additional Authorization List (AAL), For Howitzer, Medium, Towed: 155 MM, M198 .....	TM 9-1025-211-10-HR
Marine Corps Equipment Record Procedures .....	TM 4700-15/1
Operator and Unit Maintenance Manual for Fuze Setter: Portable, Inductive, Artillery, XM1155 (PIAFS) .....	TM 9-1290-210-12&P
Operator, Unit, Direct Support, and General Support Maintenance Manual Including Repair Parts and Special Tools List Through Depot Level for Conventional Muzzle Velocity System M94 and, Communication Adapter (MCA).....	TM 9-1290-364-14&P
Operator's Manual: Loose Projectile Restraint System (LPRS) for use with Field Artillery Companion Vehicles .....	TM 9-2590-210-10
Operator's Manual: Projectile, 155-Millimeter: GB2, M687 .....	TM 3-1320-242-10
Operator's Manual: Radio Set, AN/PRC-68 .....	TM 11-5820-882-10
Operator's, Organizational, Direct Support, and General Support Maintenance Manual for Evaluation of Cannon Tubes .....	TM 9-1000-202-14
Operator's and Organizational Maintenance Manual for Computer Groups, Gun Direction, OL-200/Gyk-29(v).....	TM 11-7440-283-12-1
Operator's and Organizational Maintenance Manual for Data Display Groups, Gun Direction, OD-144(v)/Gyk-29(v) and OD-144(v)3/Gyk-29(v) .....	TM 11-7440-283-12-2
Operator's Manual for SINCGARS ICOM Ground Combat Net Radio .....	TM 11-5820-890-10-8
Painting Instructions for Army Materiel.....	TM 43-0139
Procedures for Destruction of Equipment in Federal Supply Classifications 1000, 1005, 1015, 1020, 1025, 1030, 1055, 1090, and 1095, To Prevent Enemy Use.....	TM 750-244-7
SINCGARS ICOM Ground Radios Used with Automated Net Control .....	TM 11-5820-10-6
Unit Maintenance Manual, Artillery Ammunition for Guns, Howitzers, Mortars, Recoilless Rifles, and 40MM Grenade Launchers .....	TM 9-1300-251-20&P

## A-5. TECHNICAL BULLETINS

Munitions: Permanently Suspended as Restricted .....	TB 9-1300-385-2
Munitions: Suspended or Restricted .....	TB 9-1300-385-1

## **A-6. MISCELLANEOUS PUBLICATIONS**

Army Logistics Readiness and Sustainability .....	AR 700-138
Army Medical Department Expendable/Durable Items .....	CTA 8-100
Expendable Items (except Medical, Class V, Repair Parts, and Heraldic Items).....	CTA 50-970
The Army Integrated Publishing and Printing Program.....	AR 25-30
The Army Maintenance Management System (TAMMS).....	DA PAM 738-750



## APPENDIX B

### COMPONENTS OF END ITEM AND BASIC ISSUE ITEMS LISTS

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#### Section I. INTRODUCTION

##### B-1. SCOPE

This appendix lists integral components of end item and basic issue items for the M198 howitzer to help you inventory items required for safe and efficient operation.

##### B-2. GENERAL

These Components of End Item and Basic Issue Lists are divided into the following sections:

**a. Section II. Components of End Item.** This listing is for informational purposes only, and is not authority to requisition replacements. These items are part of the end item, but are removed and separately packaged for transportation or shipment. As part of the end item, these items must be with the end item whenever it is issued or transferred between property accounts. Illustrations are furnished to assist you in identifying the items.

**b. Section III. Basic Issue Items.** These are the minimum essential items required to place the M198 howitzer in operation, to operate it, and to perform emergency repairs. Although shipped separately packaged, BII must be with the M198 howitzer during operation and whenever it is transferred between property accounts. The illustrations will assist you with hard-to-identify items. This manual is your authority to request/requisition replacement BII, based on TOE/MTOE authorization of the end item.

##### B-3. EXPLANATION OF COLUMNS

The following provides an explanation of columns found in the tabular listing.

**a. Column (1)–Illustration Number (Illus Number).** This column indicates the number of the illustration in which the item is shown.

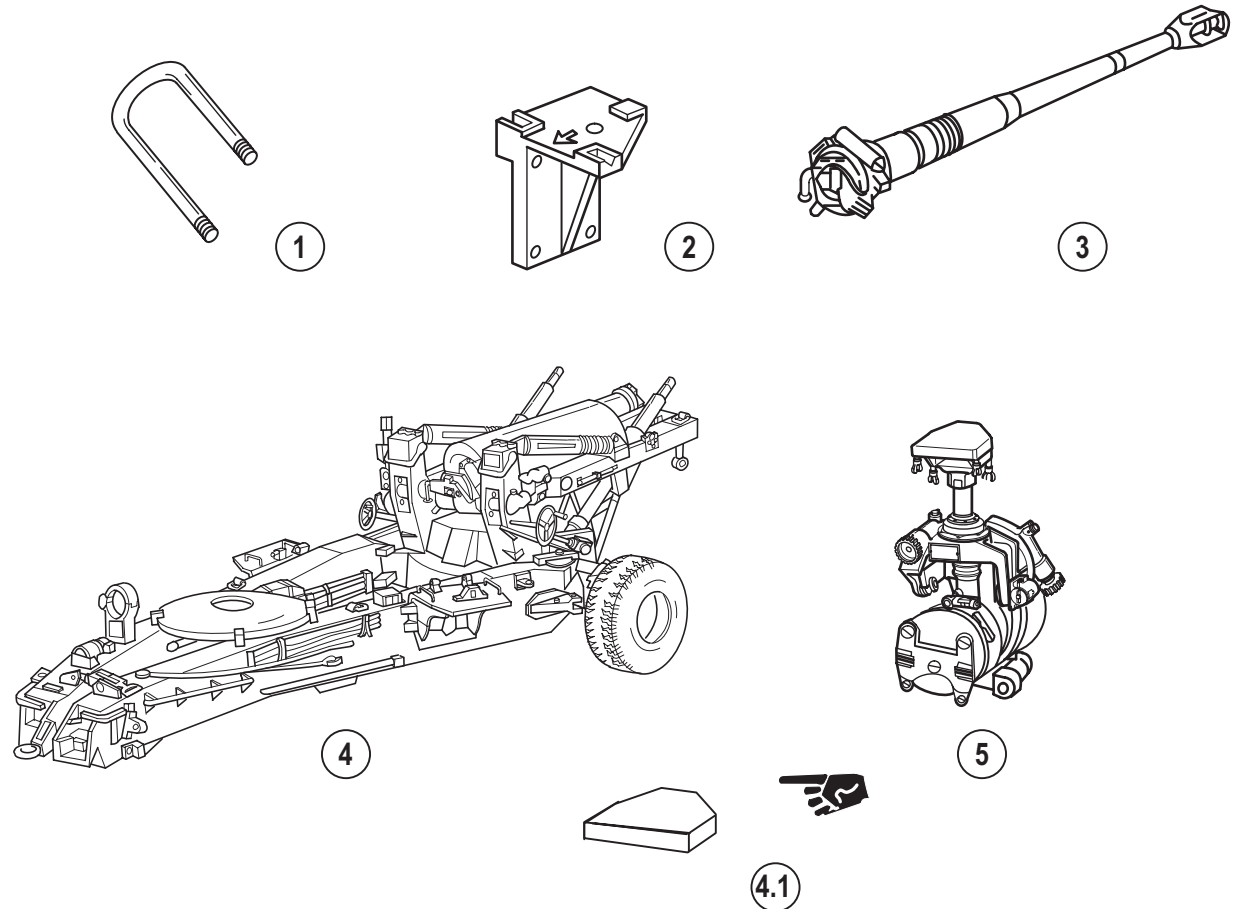
**b. Column (2)–National Stock Number.** Indicates the National stock number assigned to the item and which will be used for requisitioning purposes.

**c. Column (3)–Description.** Indicates the Federal item name and, if required, a minimum description to identify and locate the item. The last line for each item indicates the CAGEC (in parentheses) followed by the part number.

**d. Column (4)–Unit of Measure (U/M).** Indicates the measure used in performing the actual operational/maintenance function. This measure is expressed by a two-character alphabetical abbreviation (e.g., ea, in., pr).

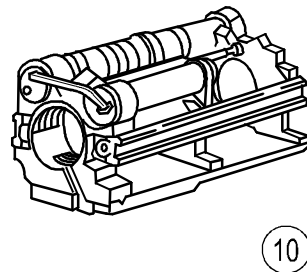
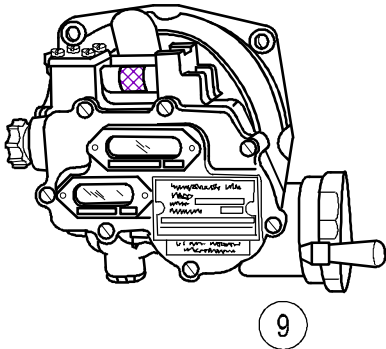
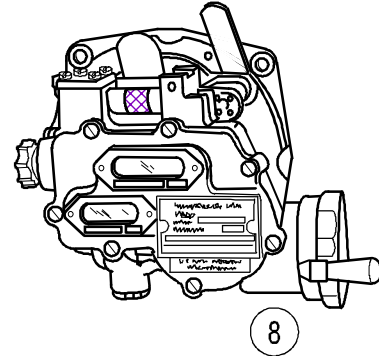
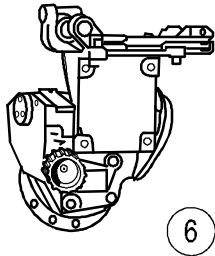
**e. Column (5)–Quantity required (Qty rqr).** Indicates the quantity of the item authorized to be used with/on the equipment.

Section II. COMPONENTS OF END ITEM



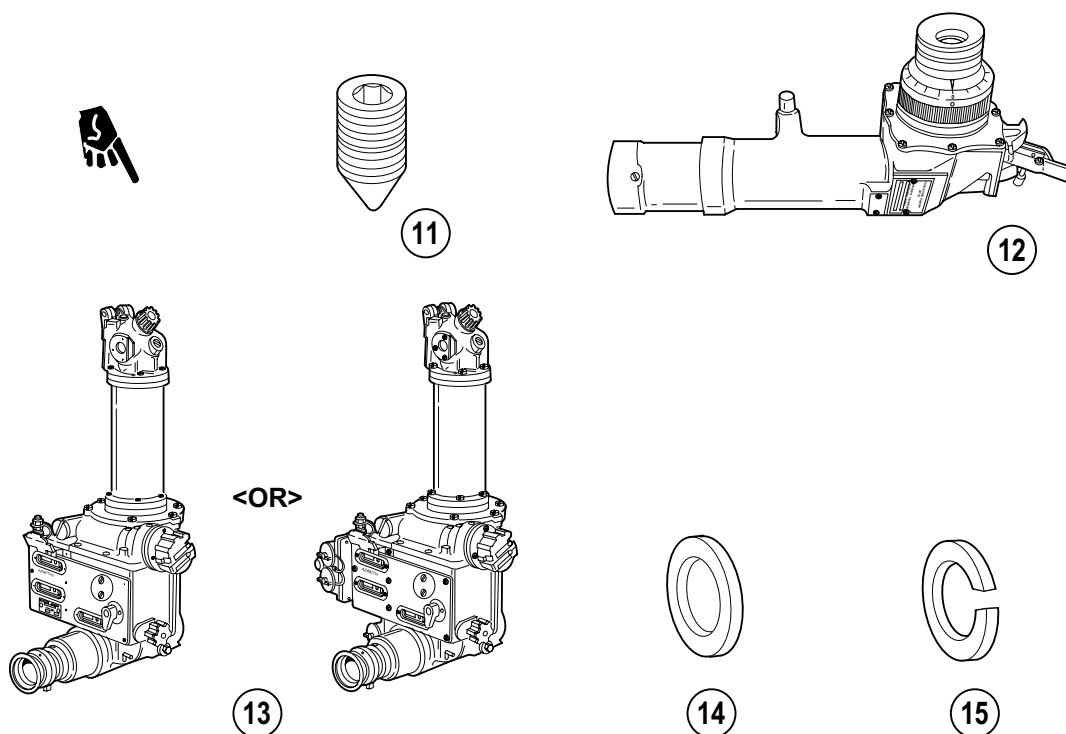
(1) Illus Number	(2) National Stock Number	(3) Description CAGEC and Part Number	Usable On Code	(4) U/M	(5) Qty rqr
1	5306-01-124-0246	BOLT, U (19200) 11785077		EA	2
2	1290-01-127-7817	BRACKET, ANTENNA MOUNTING (19200) 11785076		EA	1
3	...	CANNON, M199 (19206) 11578880		EA	1
4	...	CARRIAGE, M39 (19204) 12007600		EA	1
4.1	5340-01-042-1330	COVER, ACCESS (19200) 11727830		EA	1
5	1240-01-039-7273	MOUNT, TELESCOPE AND QUADRANT, M171 (19200) 11727800		EA	1

## Section II. COMPONENTS OF END ITEM (cont)



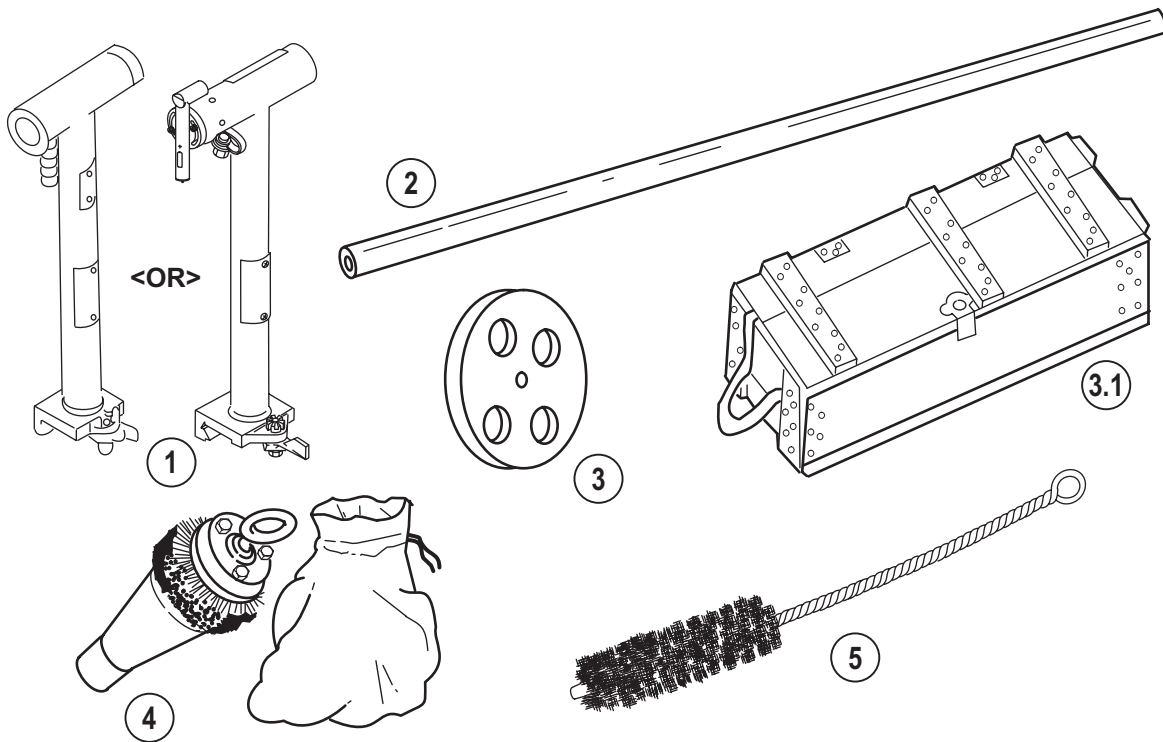
(1) Illus Number	(2) National Stock Number	(3) Description CAGEC and Part Number	Usable On Code	(4) U/M	(5) Qty rqr
6	1240-01-037-7290	MOUNT, TELESCOPE AND QUADRANT, M172 (19200) 10554823		EA	1
7	5310-00-965-1800	NUT, PLAIN, HEXAGON (96906) MS51971-4		EA	4
8	1290-01-037-7289	QUADRANT, FIRE CONTROL, M18 (19200) 11729525		EA	1
9	1290-01-037-3883	QUADRANT, FIRE CONTROL, M17 (19200) 11729530		EA	1
10	1025-01-094-3333	RECOIL MECHANISM, 155-MM HOWITZER, M45 (19200) 12007800		EA	1

## Section II. COMPONENTS OF END ITEM (cont)



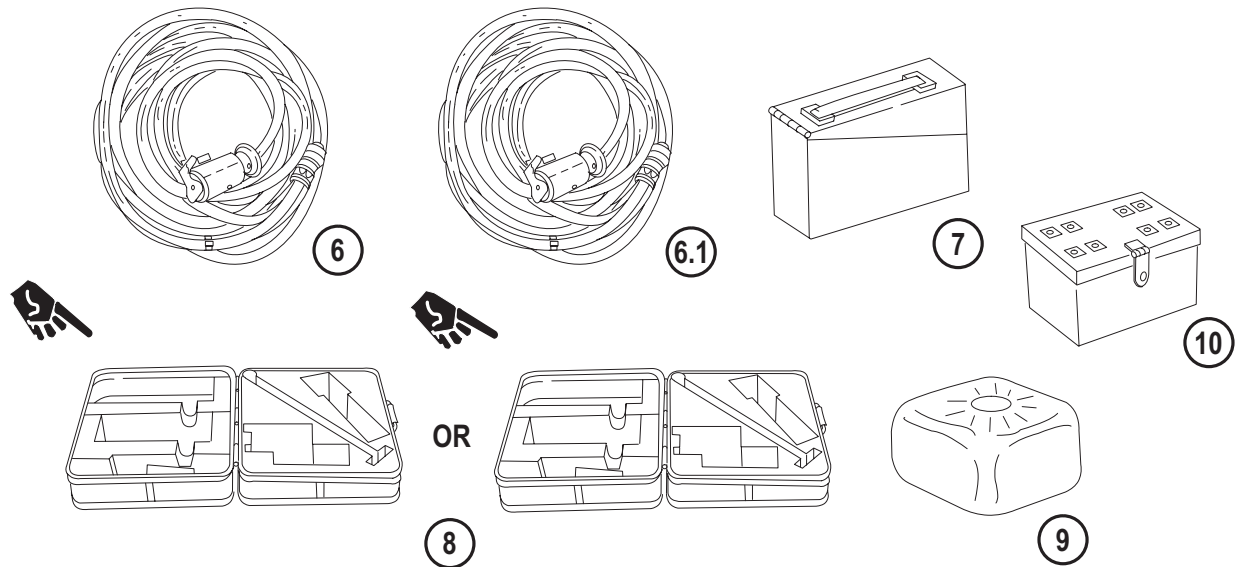
(1) Illus Number	(2) National Stock Number	(3) Description CAGEC and Part Number	Usable On Code	(4) U/M	(5) Qty rqr
11	5305-00-928-2367	SETSCREW (96906) MS51021-86		EA	2
12	1240-01-038-0530	TELESCOPE, ELBOW, M138 (19200) 11741626		EA	1
13	1240-01-038-0531	TELESCOPE, PANORAMIC, M137 (19200) 11741101 OR 1240-01-483-6100 TELESCOPE, PANORAMIC, M137A3 (19200)		EA	1
14	5610-00-595-6057	WASHER, FLAT (96906) MS15795-815		EA	4
15	5310-00-973-8786	WASHER, LOCK (96906) MS35338-142		EA	4

### Section III. BASIC ISSUE ITEMS



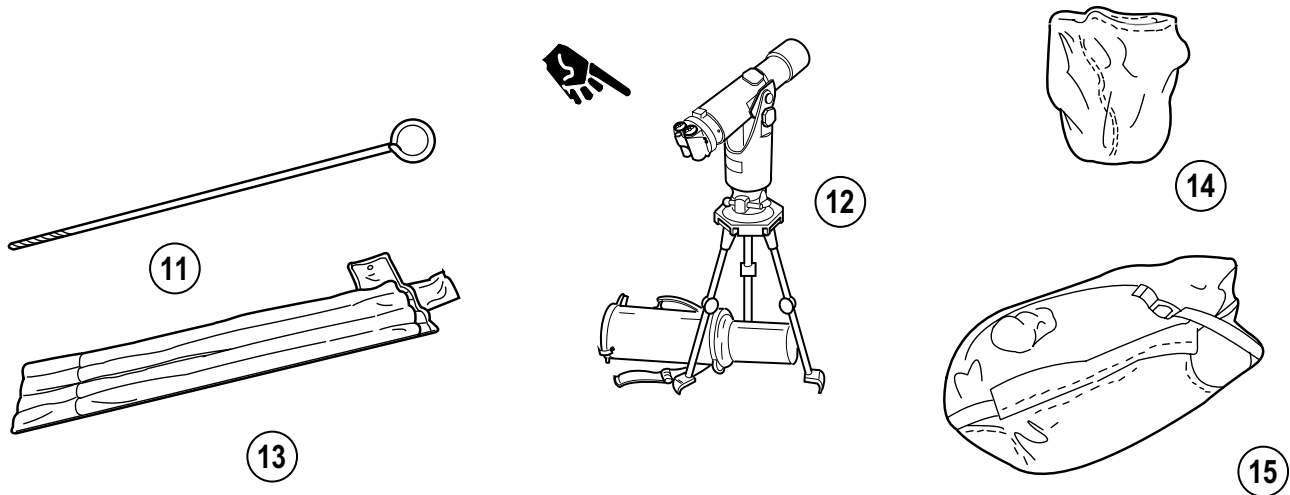
(1) Illus Number	(2) National Stock Number	(3) Description CAGEC and Part Number	Usable On Code	(4) U/M	(5) Qty Rqr
1	4931-01-048-5834	ALINEMENT DEVICE, M139 (19200) 11741648-1		EA	1
		OR			
	4931-01-472-6621	ALINEMENT DEVICE, M139A1 (19200)			
2	5120-00-617-0995	BAR, WEAPONS HANDLING (19204) 6170995		EA	2
3	4933-01-152-2902	BORESIGHT, BREECH (19200) 10544480		EA	1
3.1	1025-01-174-3990	BOX, PACKING (for EXTRACTOR TOOL ASSEMBLY for PROJ M712 and M823) (19200) 9331729		EA	1
4	1025-01-196-2176	BRUSH AND BAG ASSEMBLY (27412) 155-110-401		EA	1
5	4933-00-730-7183	BRUSH, CLEANING, PRIMER (19206) 7307183		EA	1

### Section III. BASIC ISSUE ITEMS (cont)



(1) Illus Number	(2) National Stock Number	(3) Description CAGEC and Part Number	Usable On Code	(4) U/M	(5) Qty Rqr
6	6150-01-210-3671	CABLE ASSEMBLY, SPECIAL PURPOSE ELECTRICAL (19200) 12009266		EA	1
6.1	6150-01-310-1829	CABLE, SLAVE (50-FOOT) (for howitzers modified with HyPAK only)		EA	1
7	1025-01-114-0059	CASE, FIRING MECHANISM (19200) 9332579		EA	1
8	1240-01-040-6977	CASE, TELESCOPE (19200) 11746386 OR CASE, TELESCOPE (19200)		EA	1
9	1025-01-232-6822	CHAMBER SWAB (27412) 155CS		EA	1
10	1240-00-654-6089	CHEST, OPTICAL SPOTTING (19200) 6546089		EA	1

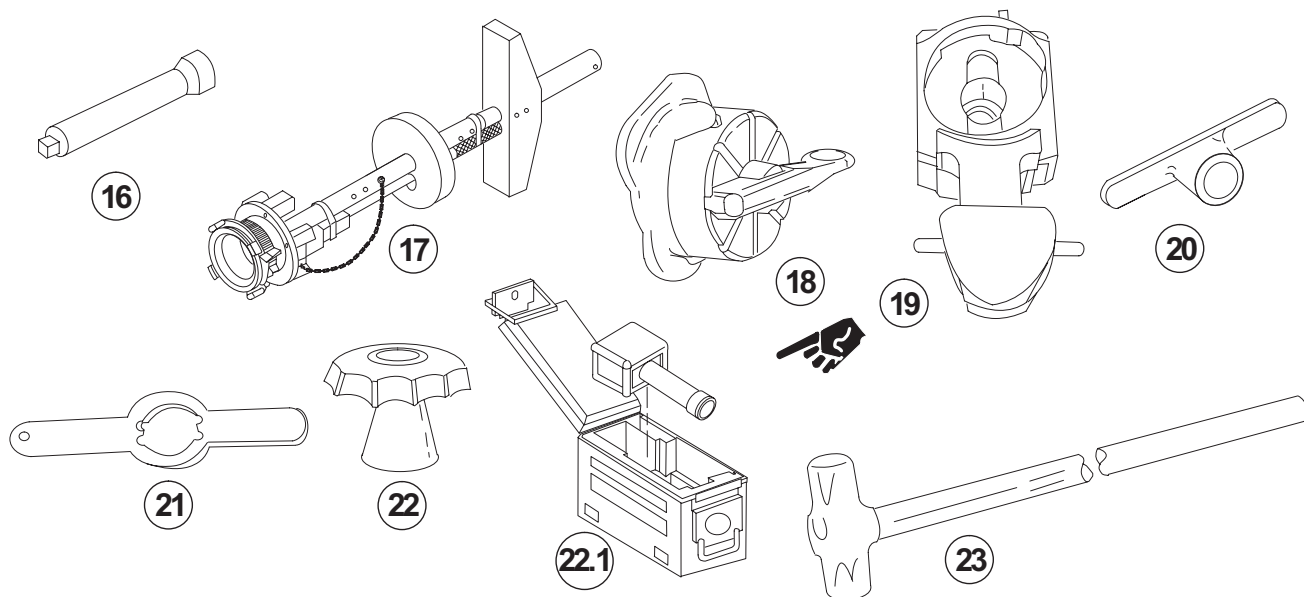
### Section III. BASIC ISSUE ITEMS (cont)



(1) Illus Number	(2) National Stock Number	(3) Description CAGEC and Part Number	Usable On Code	(4) U/M	(5) Qty Rqr
11	4933-00-601-9667	CLEANING TOOL, VENT (19206) 6019667		EA	1
12	1240-01-465-5452	COLLIMATOR, INFINITY, AIMING REFERENCE, M1A2 (19200) 12984644		EA	1
13	1290-00-653-7993	COVER, AIMING POST, M401 (19200) 6537993		EA	1
14	1025-01-038-6060	COVER, BREECH (19206) 11578964		EA	1
15	1240-01-042-7989	COVER, FIRE CONTROL (19200) 11729566		EA	2

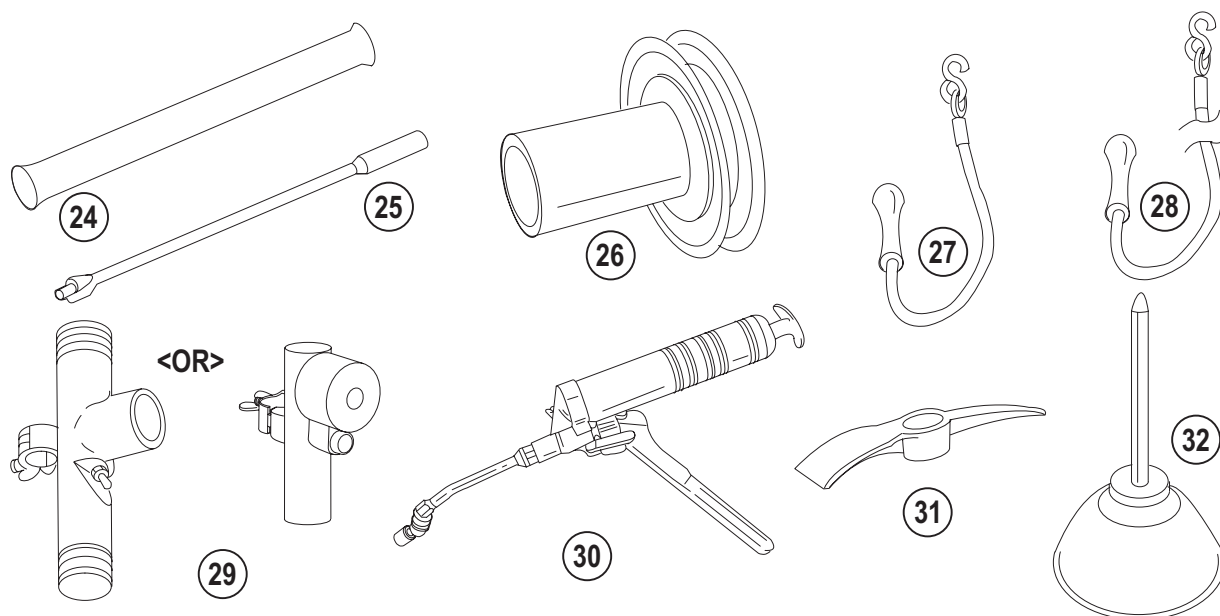


### Section III. BASIC ISSUE ITEMS (cont)



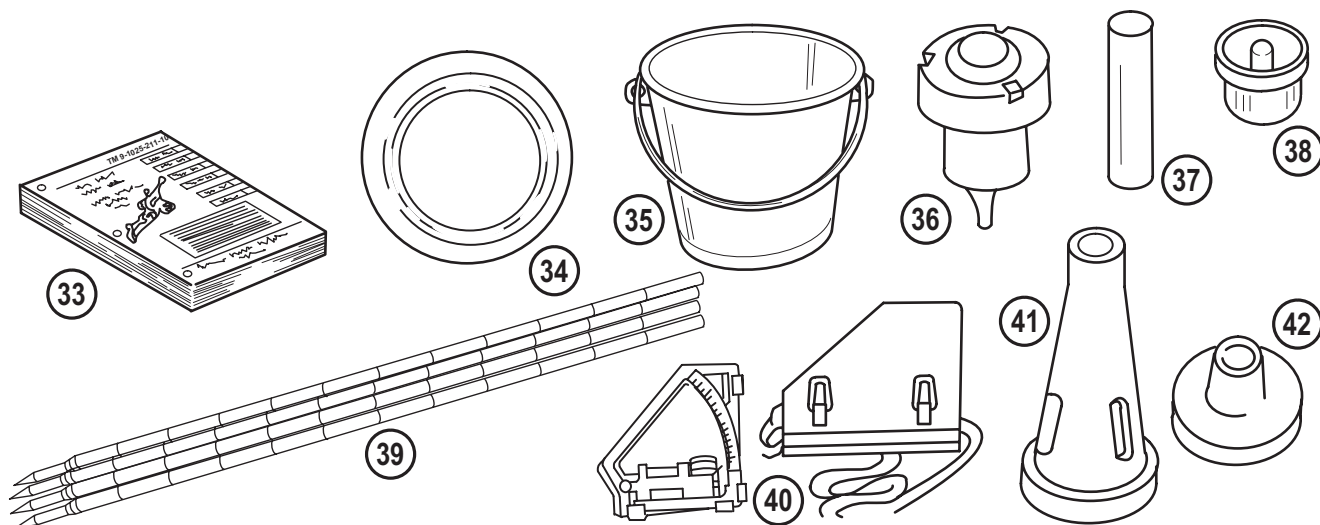
(1) Illus Number	(2) National Stock Number	(3) Description CAGEC and Part Number	Usable On Code	(4) U/M	(5) Qty rqr
16	5120-00-227-8079	EXTENSION, SOCKET WRENCH: 16 in. (40.64 cm) lg (55719) L122		EA	1
17	1025-01-082-3586	EXTRACTOR TOOL ASSEMBLY FOR PROJECTILE M712 AND M823 (19200) 9305465		EA	1
18	1025-00-895-9182	FIRING MECHANISM ASSEMBLY (19206) 8767203		EA	1
19	1025-01-031-7194	FIRING MECHANISM BLOCK ASSEMBLY (19206) 11578909		EA	1
20	1290-00-764-7761	FUZE SETTER, M27 (19200) 7647761		EA	1
21	1290-00-078-4367	FUZE SETTER, M34 (19200) SK87038		EA	1
22	1290-00-201-3507	FUZE SETTER, M35 (19200) 11729019		EA	1
22.1	1290-01-480-1390	FUZE SETTER, M1155 (19200) 12994059		EA	1
23	5120-00-265-7462	HAMMER, HAND: 6 lb (90172) 41796		EA	1

### Section III. BASIC ISSUE ITEMS (cont)



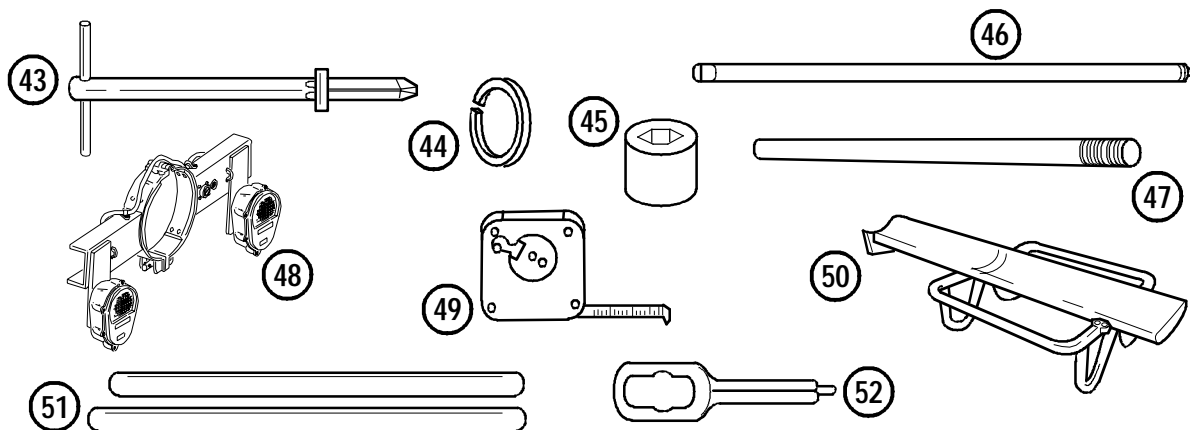
(1) Illus Number	(2) National Stock Number	(3) Description CAGEC and Part Number	Usable On Code	(4) U/M	(5) Qty rqr
24	5120-00-288-6574	HANDLE, MATTOCK-PICK (19207) 11677021		EA	1
25	5120-00-236-7590	HANDLE, SOCKET WRENCH (81348) GGG-W-641		EA	1
26	1030-00-859-4511	HOLDER, CHAMBER SWABBING SPONGE (19206) 8765688		EA	1
27	1095-00-600-6780	LANYARD, FIRING (6-FOOT LENGTH) (19206) 6006780		EA	1
28	1095-01-129-4672	LANYARD, FIRING (25-FOOT LENGTH) (19206) 11579739		EA	1
29	1290-01-148-4821	LIGHT, AIMING POST, M14 (19200) 11785401		EA	2
		OR			
	1240-01-487-6058	LIGHT, AIMING POST, M14A1 (19200)			
30	4930-00-253-2478	LUBRICATING GUN, HAND (36251) 1142		EA	1
31	5120-00-243-2395	MATTOCK (19207) 11677022		EA	1
32	4930-00-537-8977	OILER, HAND (81348) GGG0591		EA	1

### Section III. BASIC ISSUE ITEMS (cont)



(1) Illus Number	(2) National Stock Number	(3) Description CAGEC and Part Number	Usable On Code	(4) U/M	(5) Qty Rqr
33		OPERATOR'S MANUAL (TM 9-1025-211-10)		EA	1
34	1025-01-012-8271	PAD, OBTURATOR (19206) 11578862		EA	1
35	7240-00-160-0455	PAIL, UTILITY (9C665) 514		EA	1
36	1025-01-038-5608	PIN, FIRING (19206) 11578911		EA	1
37	5315-01-033-5417	PIN, GROOVED HEADLESS (19206) 11579233		EA	1
38	1025-00-566-3789	PLUG, MUZZLE (19206) 7309257		EA	1
39	1290-00-535-7617	POST, AIMING, M1A2 (19200) 7687114		EA	2
40	1290-00-891-9999	QUADRANT, FIRE CONTROL, GUNNER'S M1A1 (19200) 7197156		EA	1
41	1025-00-860-5443	RAMMER, ARTILLERY (19206) 8767210		EA	1
42	1030-00-730-7416	RAMMER, LOADING (19206) 7307416		EA	1

### Section III. BASIC ISSUE ITEMS (cont)



(1) Illus Number	(2) National Stock Number	(3) Description CAGEC and Part Number	Usable On Code	(4) U/M	(5) Qty Rqr
43	5110-01-026-5253	REAMER, HAND (19206) 11578743		EA	1
44	1025-01-038-1192	RING, SPLIT, FRONT (19206) 11578961		EA	1
45	5120-00-935-7422	SOCKET (81343) AS954		EA	1
46	1025-00-563-7232	STAFF SECTION, CLEANING, ARTILLERY (4-FOOT) (19206) 7309228		EA	8
47	1025-01-044-2587	STAFF SECTION, CLEANING, ARTILLERY (2-FOOT) (19206) 11579227		EA	1
48	6220-01-213-2430	TAILLIGHT, VEHICULAR (19200) 12009284		EA	1
49	5210-00-081-4719	TAPE, MEASURING (81348) GGG-T-106		EA	1
50	1025-01-038-7220	TRAY, LOADING, AMMUNITION (19204) 12008946		EA	1
51	4710-01-038-3067	TUBE, METALLIC (19204) 12007803		EA	2
52	4933-00-723-1161	WRENCH, FUZE-SETTER, COMBINATION, M18 (19206) 7231161		EA	1

## APPENDIX C ADDITIONAL AUTHORIZATION LIST

### Section I. INTRODUCTION

#### C-1. SCOPE

This appendix lists additional items you are authorized for the support of the M198 howitzer.

#### C-2. GENERAL

This list identifies items that do not have to accompany the M198 howitzer and that do not have to be turned in with it. These items are all authorized to you by CTA, MTOE, TDA, or JTA.

#### C-3. EXPLANATION OF LISTING

National stock numbers, descriptions, and quantities are provided to help you identify and request the additional items you require to support this equipment.

### Section II. ADDITIONAL AUTHORIZATION LIST

(1) NATIONAL STOCK NUMBER	(2) DESCRIPTION		(3)	(4)
	CAGEC & PART NUMBER	USABLE ON CODE	U/M	QTY AUTH
5340-00-860-5446	BELT, PRIMER (19206) 8767215		EA	V
8020-00-262-9099	BRUSH, ARTIST'S (81348) H-B-118		EA	V
7920-00-291-5815	BRUSH, WIRE, SCRATCH (81348) H-B-178		EA	V
5140-00-653-4198	CHEST, TOOL (19204) 6534198		EA	V
5340-01-042-1330	COVER, PLASTIC (19200) 11727830		EA	1
5110-00-156-0054	FILE, HAND (81348) GGG-F-325		EA	V

## SECTION II. ADDITIONAL AUTHORIZATION LIST (CONT)

(1) NATIONAL STOCK NUMBER	(2) DESCRIPTION  CAGEC & PART NUMBER      USABLE ON CODE	(3)  U/M	(4)  QTY AUTH
5120-00-061-8543	HAMMER, HAND (81348) GGG-H-86	EA	V
5110-00-263-0349	HANDLE, FILE, WOOD (81348) NN-H-00106	EA	V
1025-01-210-3687	JACK STAND ASSEMBLY 12009295	EA	1
1025-01-210-3688	LUNETTE HITCH ASSEMBLY 12009299	EA	1
1025-01-473-8886	NITROGEN INTENSIFIER (1MV66) KJ1000	EA	1
1025-01-473-7710	OIL TRANSFER SYSTEM (1MV66) KJ4000	EA	1
5120-00-223-7397	PLIERS, SLIP-JOINT (81348) GGG-P-471	EA	V
5120-00-278-1283	SCREWDRIVER, FLAT-TIP (81348) GGG-S-121	EA	V
6685-00-344-4603	THERMOMETER, SELF-INDICATING BIMETALLIC (81349) MIL-T-36186	EA	1
6675-00-240-1881	TRIPOD, SURVEYING (81349) MIL-T-11674	EA	1
1025-01-476-8964	WHEEL, BOGEY (19200) 12009390	EA	1

## APPENDIX D EXPENDABLE/DURABLE SUPPLIES AND MATERIALS LIST

### Section I. INTRODUCTION

#### D-1. SCOPE

This appendix lists expendable supplies and materials you will need to operate and maintain the M198 howitzer. This listing is for informational purposes only and is not authority to requisition the listed items. These items are authorized to you by CTA 50-970, Expendable/Durable Items (Except Medical, Class V, Repair Parts, and Heraldic Items), or CTA 8-100, Army Medical Department Expendable/Durable Items.

#### D-2. EXPLANATION OF COLUMNS

**a. Column (1)–Item Number.** This number is assigned to the entry in the listing and is referenced in the narrative instructions to identify the material (e.g., "Use cleaning compound (item 5, appx D)").

**b. Column (2)–Level.** This column identifies the lowest level of maintenance that requires the listed item.

C - Operator/Crew

**c. Column (3)–National Stock Number.** This is the National stock number assigned to the item; use it to request or requisition the item.

**d. Column (4)–Description.** Indicates the Federal item name and, if required, a description to identify the item. The last line for each item indicates the Commercial and Government Entity Code (CAGEC) in parenthesis followed by the part number.

**e. Column (5)–Unit of Measure (U/M).** Indicates the measure used in performing the actual maintenance function. This measure is expressed by a two-character alphabetical abbreviation (e.g., ea, in., pr). If the unit of measure differs from the unit of issue, requisition the lowest unit of issue that will satisfy your requirements.

### SECTION II. EXPENDABLE/DURABLE SUPPLIES AND MATERIALS LIST

(1) ITEM NUMBER	(2) LEVEL	(3) NATIONAL STOCK NUMBER	(4) DESCRIPTION	(5) U/M
1	C	8105-00-269-4662	BAG, PLASTIC: waterproof and greaseproof (81349) MIL-B-117D 20 x 25, std pkg 100	EA
1.1	C	6135-01-301-8776	BATTERY, LITHIUM (Li-SOCl <sub>2</sub> ) Size "AA" Tadiran (4J947) P/N TL-2100/S	EA
1.2	C	6135-01-456-2924	BATTERY, LITHIUM (Li-SOCl <sub>2</sub> ) Size "C" Cell Tadiran (4J947) P/N TL-2200	EA

## Section II. EXPENDABLE/DURABLE SUPPLIES AND MATERIALS LIST (cont)

(1) ITEM NUMBER	(2) LEVEL	(3) NATIONAL STOCK NUMBER	(4) DESCRIPTION	(5) U/M
2	C	9150-01-059-2586 9150-01-102-9455	BRAKE FLUID, SILICONE, AUTOMOTIVE: (BFS) (81348) MIL-B-46176 1-gal. (3.79-l) metal container 1-gal. (3.79-l) plastic container	CN CN
3	C	7510-00-223-6701	CHALK, MARKING (81348) SS-C-255 Gross (144)	EA
4	C	9150-01-053-6688 9150-01-054-6453	CLEANER, LUBRICANT AND PRESERVATIVE: grade 2 (CLP) (81349) MIL-L-63460 1-gal. (3.79-l) bottle 1-pt. (0.47-l) can	GL CN
5	C	6850-00-597-9765	CLEANING COMPOUND: liquid form (81349) O-C-1889	GL
6	C	6850-00-227-1887	CLEANING COMPOUND, OPTICAL LENS (81349) MIL-C-43454 1 qt. (0.95 l)	QT
7	C		CLEANING COMPOUND: rifle bore cleaner (RBC) (81349) MIL-C-372 1-gal. (3.79-l) can	CN
8	C	5350-00-268-3116 5350-00-221-0872	CLOTH, ABRASIVE: crocus (81348) P-C 458 2 wide x 50 yd (45.72 m) 9 x 11 sh, 50 sh sleeves	EA EA
9	C	8305-00-222-2423	CLOTH, CHEESECLOTH: cotton (81348) CCC-C-440	YD
10	C	1025-01-311-3770	CLOTH, CLEANING, SLEEVE: (27412) 155/203-140	BX
11	C	4020-00-242-4072	CORD, FIBROUS: 0.045 diam, natural (81349) MIL-C-7515	LB

## Section II. EXPENDABLE/DURABLE SUPPLIES AND MATERIALS LIST (cont)

(1) ITEM NUMBER	(2) LEVEL	(3) NATIONAL STOCK NUMBER	(4) DESCRIPTION	(5) U/M
12	C	8135-00-052-9070	CUSHIONING MATERIAL type 1, class II (81348) MIL-P-26514 48 x 24 x 4	SH
13	C	9150-00-944-8953 9150-00-935-5851 9150-00-181-7724	GREASE, AIRCRAFT: general purpose (GPG) wide temperature range (WTR) (81349) MIL-G-81322 1 lb (0.45 kg) 5 lb (2.27 kg) 8 oz (226.8 g)	LB LB TU
14	C	9150-00-935-9807 9150-00-935-9808	HYDRAULIC FLUID, PETROLEUM BASE PRESERVATIVE: (OHT) (81349) MIL-PRF-6083F 1-qt (0.95-l) container 1-gal (3.79-l) container	CN CN
15	C	1025-01-196-2172	KIT, ARTILLERY CLEANING (59678) SK1-84JS	EA
16	C	8010-01-070-0922	LACQUER, ACRYLIC: camouflage, lusterless, type II (81348) MIL-L-52909 1-pt (0.47-l) can	CN
17	C	9150-01-374-2021 9150-00-231-6689 9150-00-231-9062	LUBRICATING OIL, GENERAL PURPOSE: special preservative (PL-S) (81348) VV-L-800 16 oz (453.6 g) bottle w/trigger sprayer 1 qt (0.95 l) 5 gal (18.93 l)	OZ QT GL
18	C	8010-01-141-2419	PAINT, BLACK (CARC) (81349) MIL-C-46168	KT
19	C	8010-01-160-6744	PAINT, BROWN (CARC) (81349) MIL-C-46168	KT
20	C	8010-01-160-6741	PAINT, GREEN (CARC) (81349) MIL-C-46168	KT
21	C	6640-00-663-0832	PAPER, LENS: tissue sheet, type 1 (81348) NNN-P-40	EA

## Section II. EXPENDABLE/DURABLE SUPPLIES AND MATERIALS LIST (cont)

(1) ITEM NUMBER	(2) LEVEL	(3) NATIONAL STOCK NUMBER	(4) DESCRIPTION	(5) U/M
22	C	8010-00-935-7080	PRIMER COATING (81349) MIL-P-23377	KT
23	C	8010-01-193-0516	PRIMER COATING (CARC) (81349) MIL-P-53022	KT
24	C	7920-00-205-1711	RAG, WIPING: cotton (81348) DDD-R-30 50 lb (22.68 kg)	BE
25	C	8010-00-181-7568	REMOVER, PAINT (CARC) (61102) TURC05469	GL
26	C	8520-00-228-0598	SOAP, TOILET: liquid (81348) P-S-624 6 gal (22.71 l)	CN
<b>NOTE</b> Items 27 thru 32 are applicable to the Loose Projectile Restraint System (LPRS) only.				
27	C	2590-01-223-2944	DIVIDER, AMMUNITION (LONG: (LPRS)), 155mm (28620) AC200000403	EA
28	C	2590-01-223-2945	DIVIDER, AMMUNITION (SHORT: (LPRS)), 155mm (28620) AC200000402	EA
29	C	2590-01-223-2949	RACK, AMMUNITION, STOWAGE 15 round, (LPRS), 155mm (28620) AC200000400	EA
30	C	5340-00-980-9277	STRAP, WEBBING: 1.75 in. w (19207) 10900880	EA
31	C	5340-01-089-4997	STRAP, WEBBING (19207) 11669588	EA
32	C	1670-00-725-1437	TIE DOWN, CARGO, AIRCRAFT: nylon, 1.719 in. w, type CGU1B (81349) MIL-T-27260	EA
33	C	6135-00-120-1020	BATTERY (1) Nonrechargeable 1.5 V No. BA-30 type, pkg of 24 (96906) MS75059	EA

## APPENDIX E

### STOWAGE AND SIGN GUIDE FOR COMPONENTS OF END ITEM, BASIC ISSUE ITEMS, AND APPLICABLE ADDITIONAL AUTHORIZATION LIST ITEMS

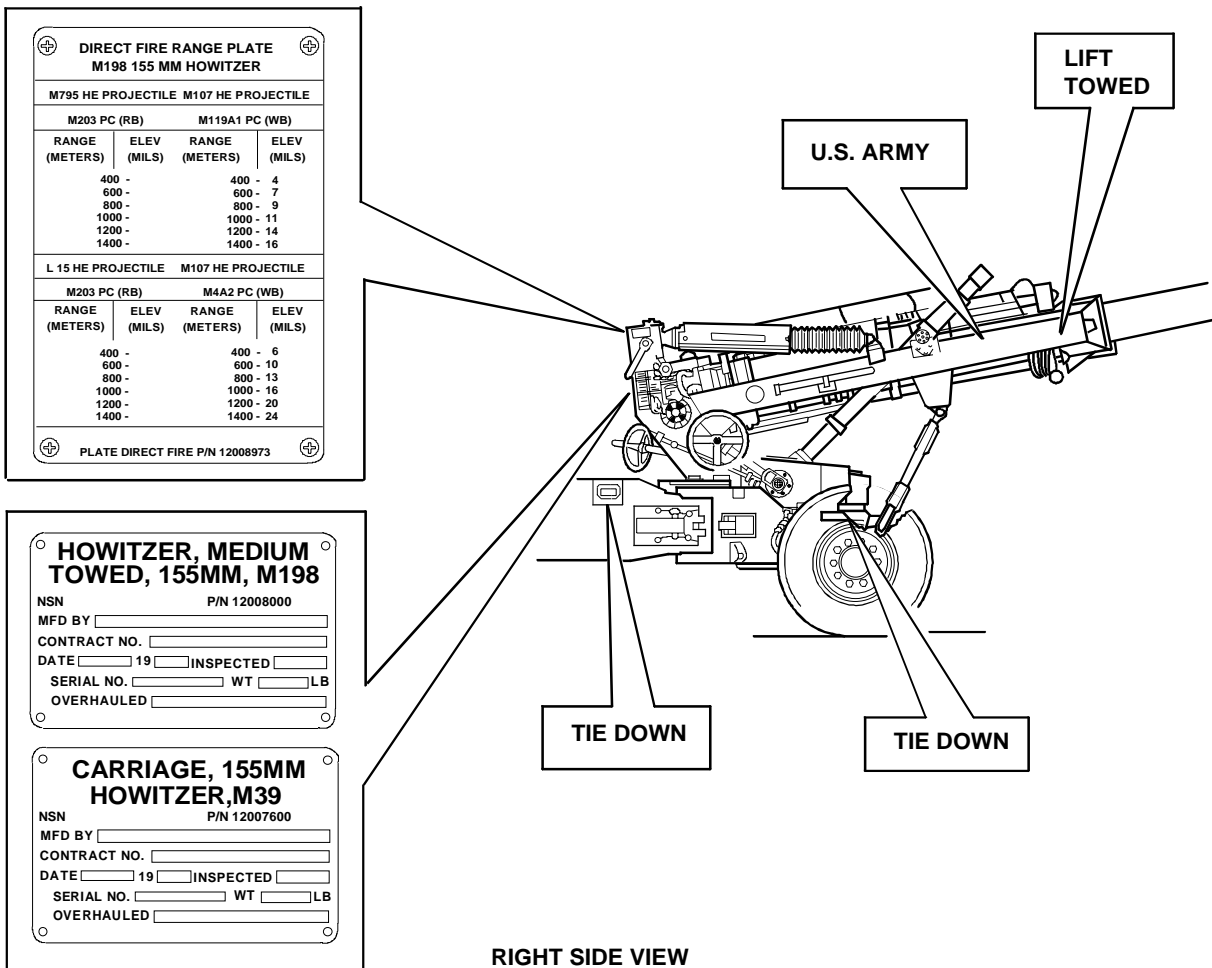
#### E-1. SCOPE

This appendix shows the locations for stowage of equipment and materiel required to be carried on the M198 howitzer.

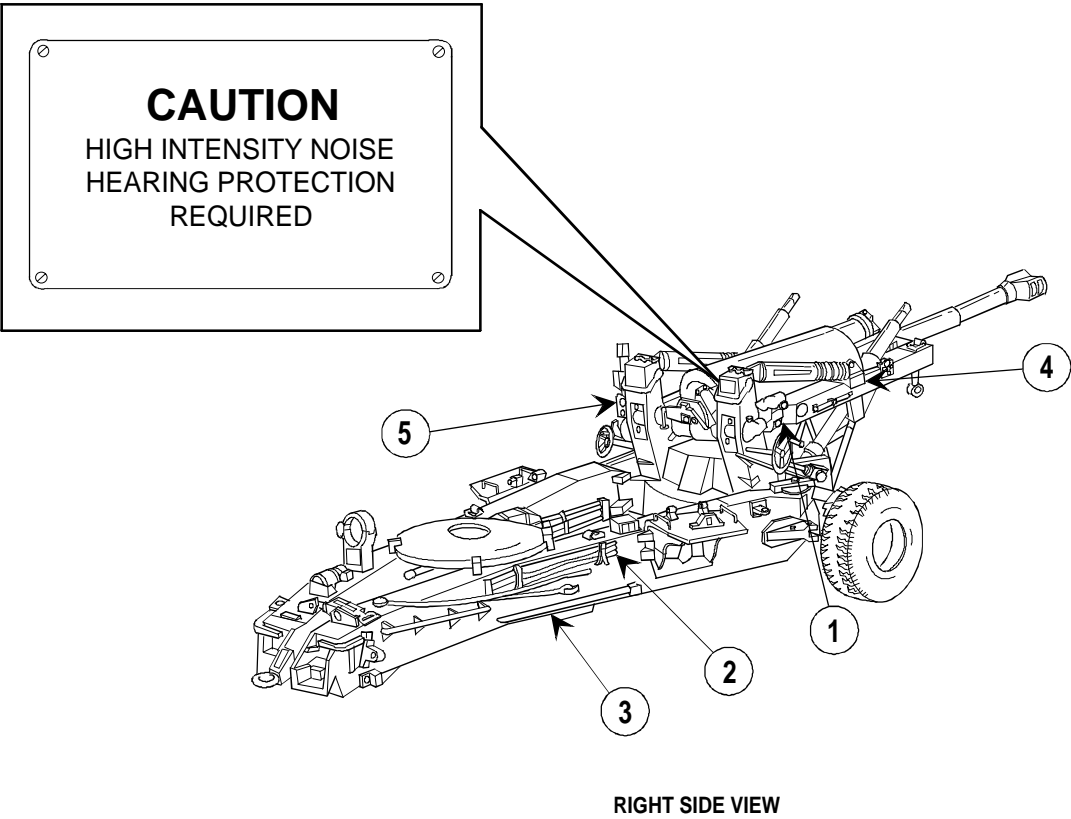
#### E-2. GENERAL

Locations of components of end item which remain attached to the M198 howitzer during operation and storage are shown on pages 1-5 thru 1-14. Other components of end item and basic issue items mounted or stowed on the M198 howitzer are shown in this appendix. Items not shown are stowed in the prime mover or the ammunition truck. Additional authorization list items are stowed at the discretion of the chief of section.

#### STOWAGE AND SIGN GUIDE

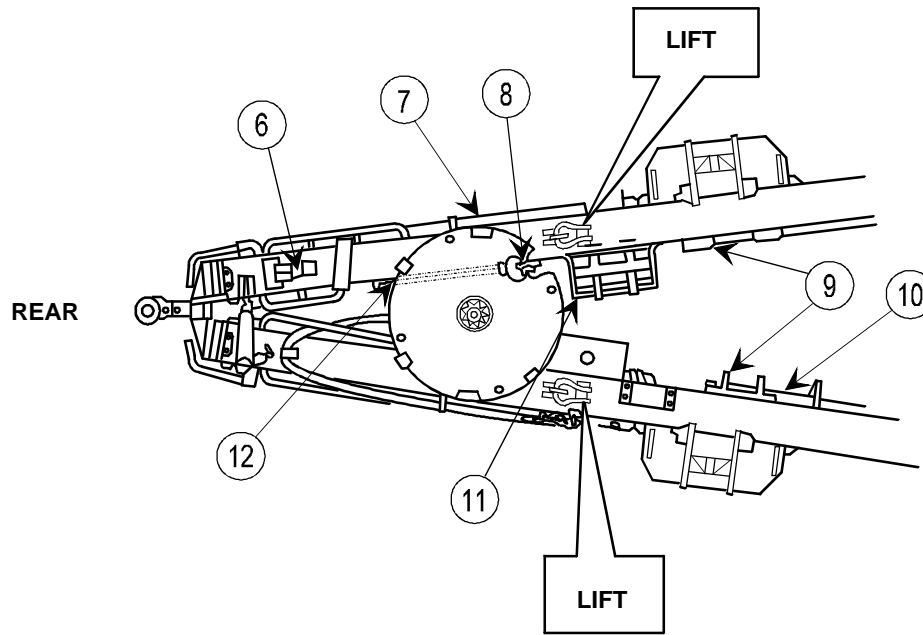


STOWAGE AND SIGN GUIDE (cont)



NO.	STOWAGE PLAN
	ITEM
1	M172 Telescope and Quadrant Mount M18 Fire Control Quadrant
2	M1A2 Aiming Posts M401 Aiming Post Cover
3	Weapons Handling Bars
4	Metallic Tubes (Pump Handles)
5	M171 Telescope and Quadrant Mount M17 Fire Control Quadrant

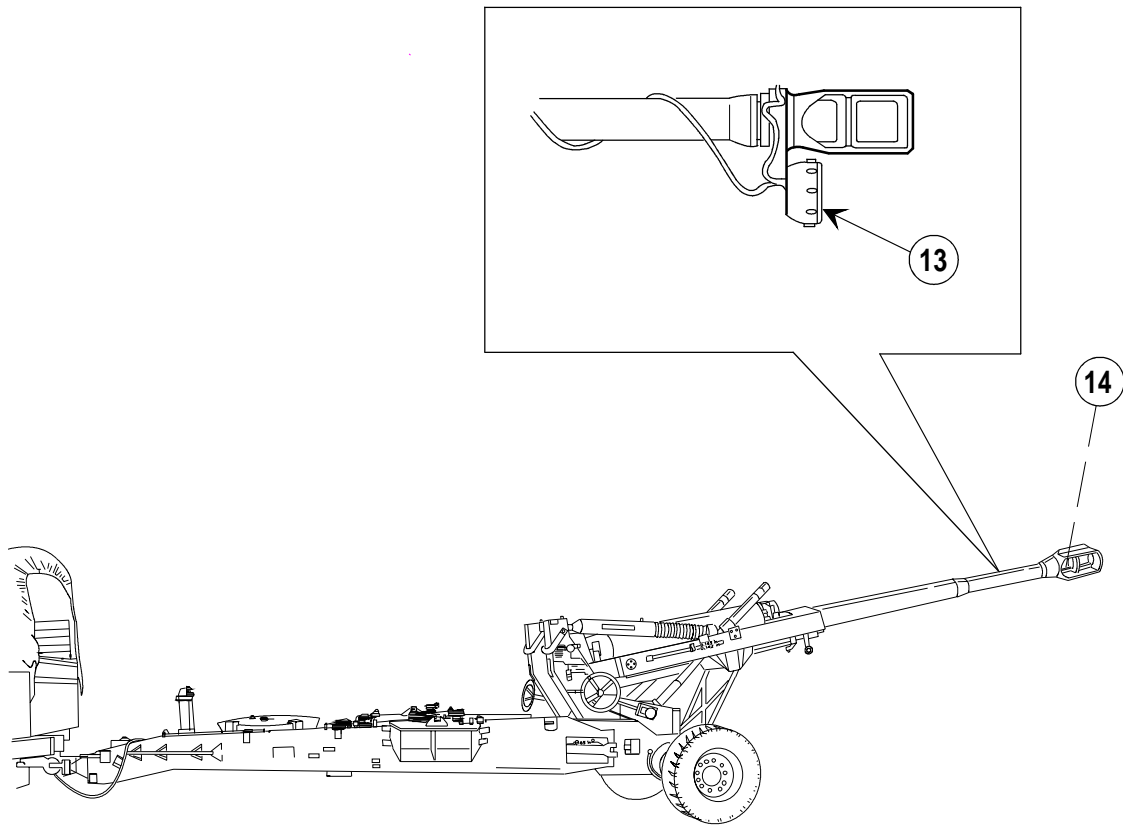
# STOWAGE AND SIGN GUIDE (cont)



TOP VIEW

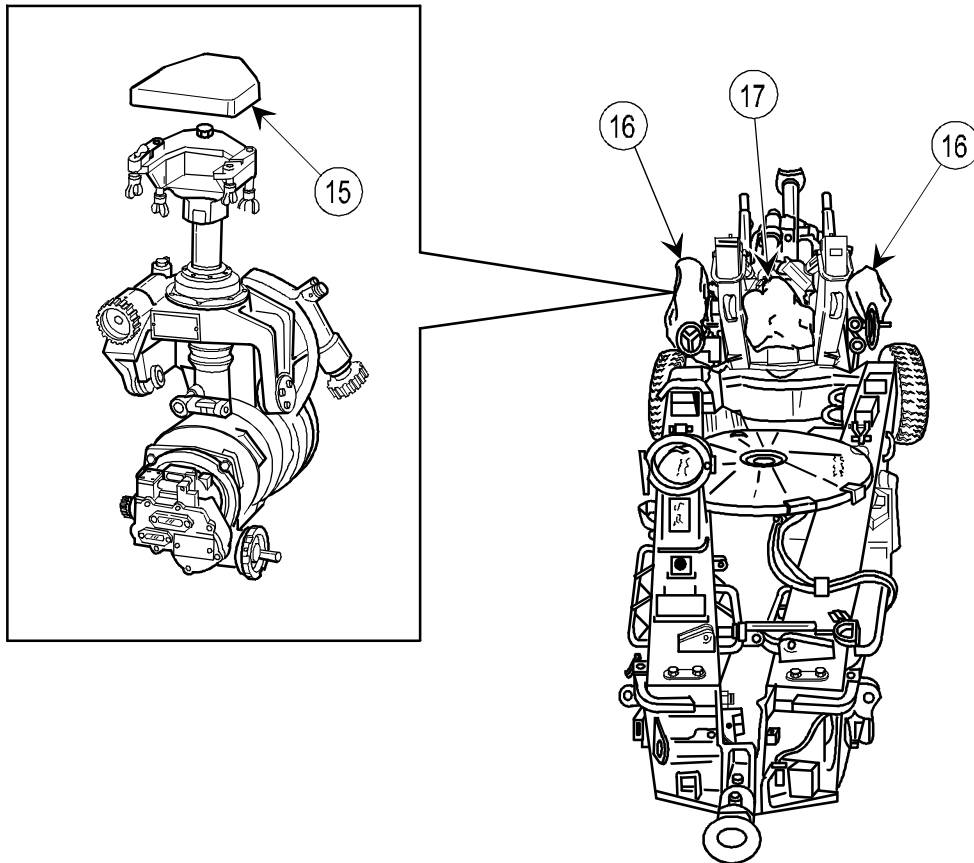
NO.	STOWAGE PLAN
	ITEM
6	Artillery Rammer (Bell Rammer)
7	Hand Hammer
8	Loading Rammer
9	Cleaning Staff Sections
10	Ammunition Loading Tray
11	Telescope Carrying Case M139/M139A1 Alinement Device, M137/M137A3 Panoramic Telescope, and M138 Elbow Telescope
12	Mattock with Handle

STOWAGE AND SIGN GUIDE (cont)



NO.	STOWAGE PLAN
	ITEM
13	Vehicular Taillight Special Purpose Cable Assembly
14	Muzzle Plug

**STOWAGE AND SIGN GUIDE (cont)**



**REAR VIEW**

NO.	STOWAGE PLAN
	ITEM
15	Protective Cover
16	Fire Control Covers
17	Breech Cover



## APPENDIX F

### LUBRICATION INSTRUCTIONS

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#### NOTES

Lubrication instructions in this appendix are mandatory.

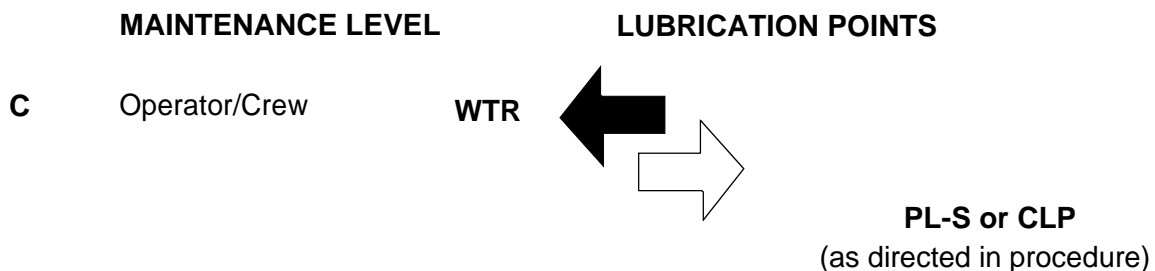
For this manual only (ARMY TM 9-1025-211-10, MARINE CORPS TM 08198A-10/1), appendix F supersedes LO 9-1025-211-13, dated 22 January, 1991.

Intervals based on normal operation. You should lube more during constant use and lube less during inactive periods. Relubricate after washing, fording (fresh or salt water) or contact with salt water spray. Clean fittings before lubricating. Clean parts with cleaning compound. Dry before lubricating. DO NOT overlubricate; wipe off excess lubricant.

Dotted lines indicate lubrication points on both sides of the equipment. The level of maintenance responsible for each lube instruction is shown, and this appendix is divided into three sections based on lubrication intervals (DAILY, WEEKLY, and MONTHLY). An overall view showing lubrication points precedes each set of detailed notes for each interval.

Daily lubing means once each day after weapon has been fired.

#### KEY



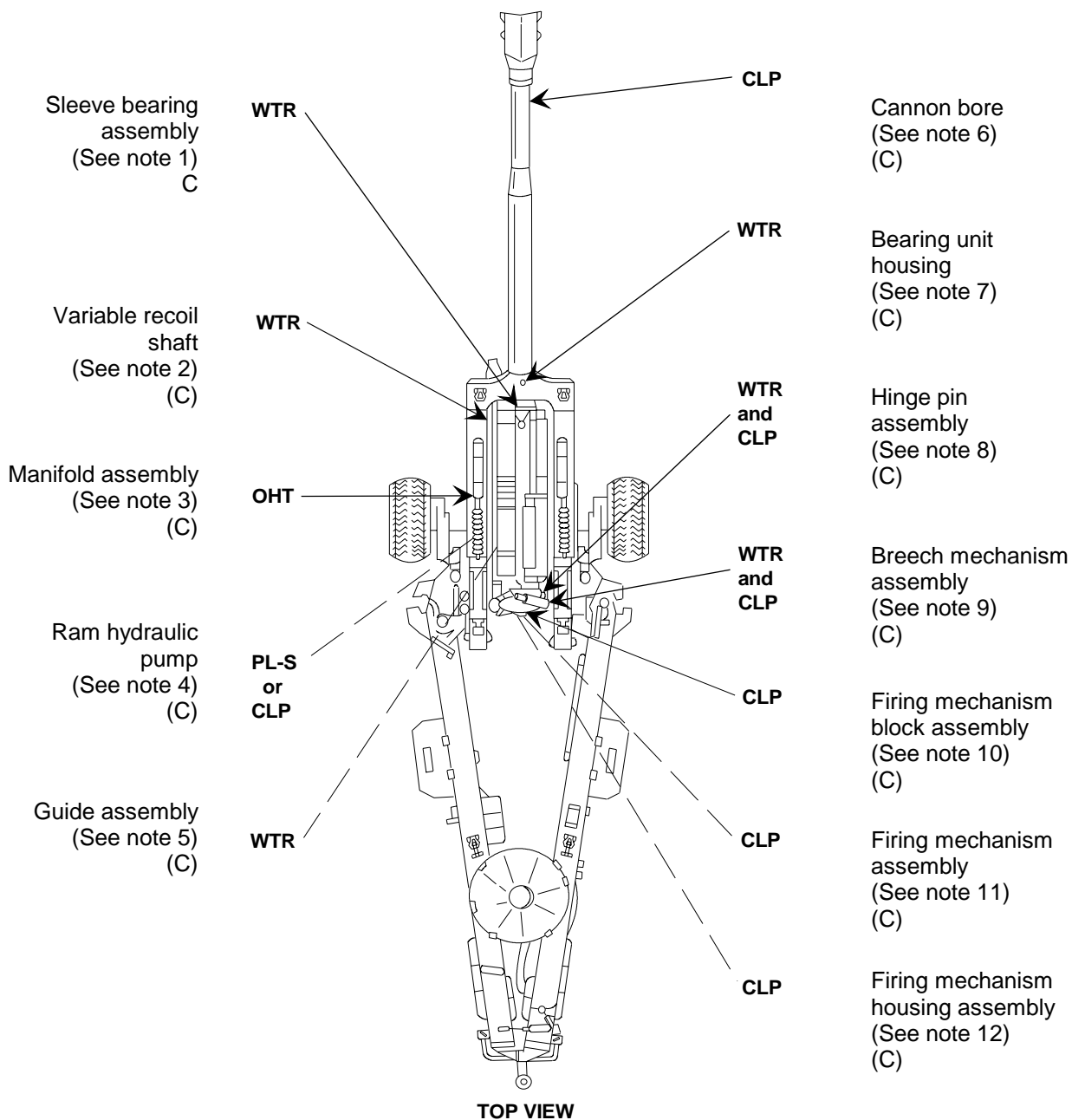
#### LUBRICANTS

<b>CLP</b>	Cleaner, Lubricant and Preservative, MIL-L-63460
<b>WTR</b>	Grease, Aircraft, General Purpose, Wide Temperature Range, MIL-G-81322
<b>PL-S</b>	Lubricating Oil, General Purpose, Special Preservative, VV-L-800
<b>BFS</b>	Brake Fluid, Automotive, Silicone, MIL-B-46176
<b>OHT</b>	Hydraulic Fluid, Petroleum Base, MIL-H-6083
<b>GMD</b>	Grease, Molybdenum Disulfide, MIL-G-21164

# DAILY

## LUBRICANT

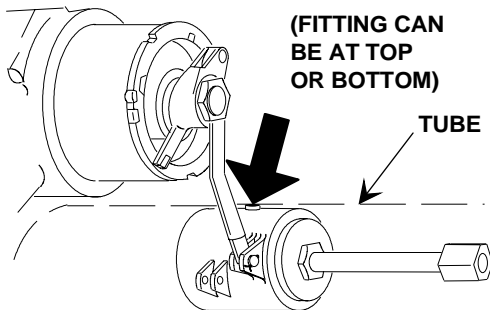
## LUBRICANT



## DAILY NOTES

### NOTE 1

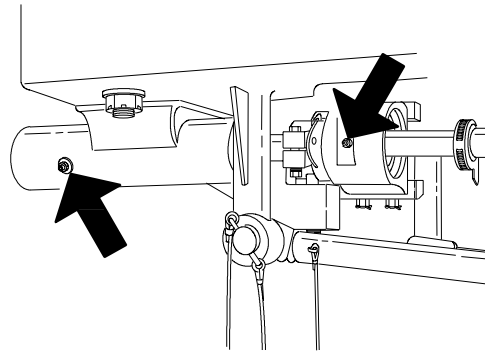
#### SLEEVE BEARING ASSEMBLY (C)



Lube with WTR.

### NOTE 2

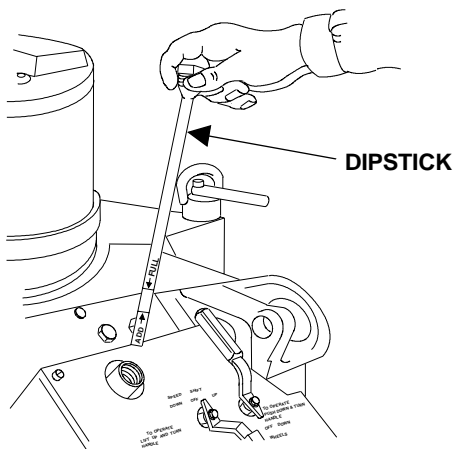
#### VARIABLE RECOIL SHAFT (C)



Lube with WTR.

### NOTE 3

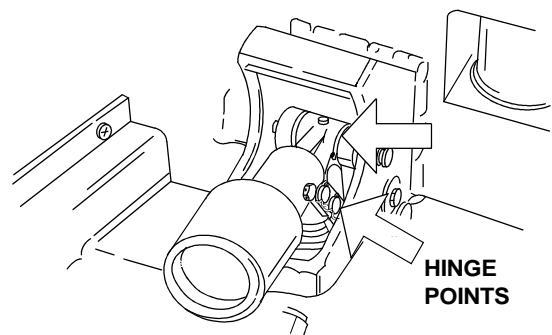
#### MANIFOLD ASSEMBLY (C)



Check OHT level at DIPSTICK and fill as required.

### NOTE 4

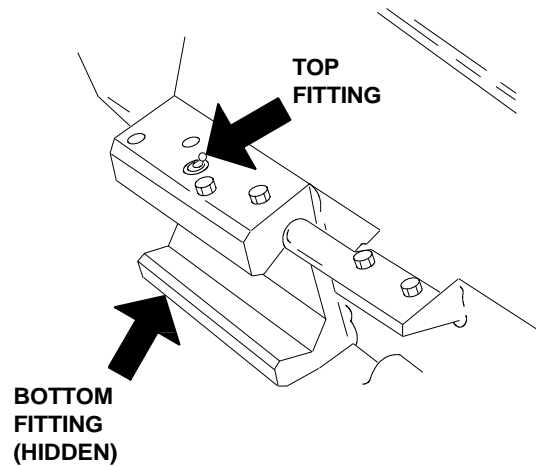
#### RAM HYDRAULIC PUMP (C)



Apply PL-S or CLP to HINGE POINTS.

**DAILY NOTES (cont)**  
**NOTE 5**

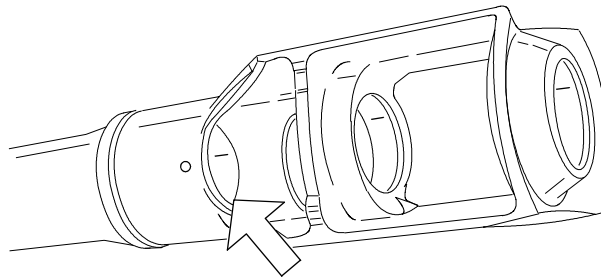
GUIDE ASSEMBLY (C)



Lube four fittings with WTR. (Cannon and recoil mechanism removed for clarity.)

**NOTE 6**

CANNON BORE (C)



**NOTE**

The new nylon bore brush is flexible enough that a scrubbing action (back and forth motion) can be used to clean the cannon tube. Work on short sections of the cannon tube (approx 2 ft (0.6 m)) starting at the breech and working toward the muzzle following either kit instructions or using CLP without the kit. Whichever method is used, cleaning begins immediately after firing is completed and continues until all steps are performed.

For non-firing periods, the cannon tube and breech mechanism are cleaned and lubricated on a weekly basis.

If using CLP without kit, proceed as follows:

**ON DAY OF FIRING:**

Attach bore brush assembly to rammer staff. Inspect breech and tube and clear obstructions.

**NOTE**

Shake (mix) CLP well before each use.

Apply 1 to 2 ounces of CLP to bore brush and thoroughly wet punch cannon bore three times. Wrap clean wiping rags around bore brush and dry punch the bore two times. Wrap clean wiping rags around bore brush, soak with CLP, and punch cannon bore one time.

**DAILY NOTES (cont)**

**NOTE 6 (cont)**

**ON DAY AFTER FIRING:**

Wrap bore brush with clean wiping rags and dry punch tube once forward and once back. Wrap bore brush with clean wiping rags and pour on 2 ounces of CLP and wet punch entire tube once forward and once back. Repeat last step with 2 more ounces of CLP.

OR

If using the artillery cleaning kit, proceed as follows:

**ON DAY OF FIRING:**

Attach nylon bristle bore brush assembly to rammer staff. Inspect breech and tube and clear obstructions. Wet punch the tube as follows:

**NOTE**

Shake (mix) CLP well before each use.

Pour 1/4 of the premeasured bottle (3.5-ounce (99.225 g) bottle) of CLP onto brush and punch tube once forward and once back.

Pour second 1/4 of the premeasured bottle of CLP onto brush and scrub back and forth the entire length of the tube.

Repeat above step with third 1/4 of the premeasured bottle of CLP.

Pour final 1/4 of the premeasured bottle of CLP onto the brush. Wet punch the entire length of the tube once forward and once back.

**ON DAY AFTER FIRING:**

Attach nylon bristle bore brush assembly to rammer staff. Wet punch the tube following the procedures for DAY OF FIRING above.

Wrap the brush with a new disposable cleaning sleeve and dry punch the entire length of the tube once forward and back. Remove and dispose of the sleeve.

Wrap the brush with a new disposable cleaning sleeve and pour on 1/2 of the premeasured bottle of CLP. Wet punch the entire length of the tube once forward and once back. Remove and dispose of the sleeve.

Repeat above step with the last 1/2 of the premeasured bottle of CLP.

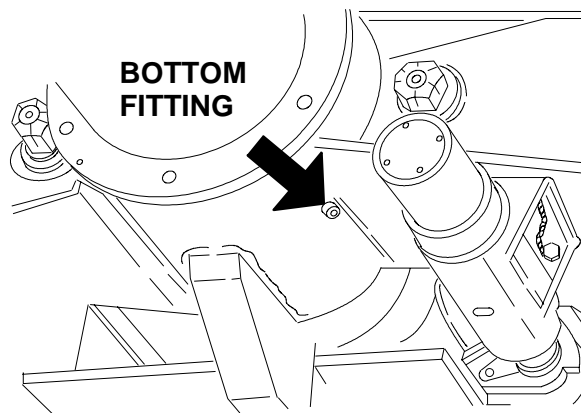
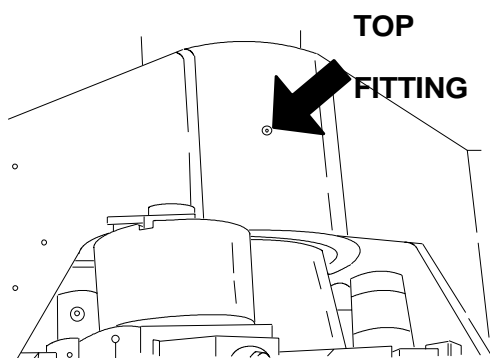
**NOTE**

If the tube has not been previously cleaned with CLP and there is a heavy buildup of coppering or carbon deposits, or severe heat cracking, it may be necessary to repeat cleaning instructions until the tube has been thoroughly cleaned with CLP.

**DAILY NOTES (cont)**

**NOTE 7**

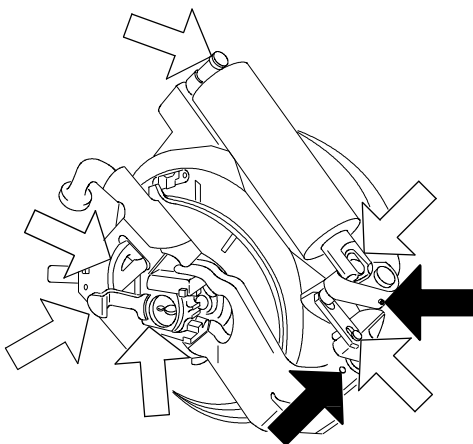
**BEARING UNIT HOUSING (C)**



Lube with WTR.

**NOTE 8**

**HINGE PIN ASSEMBLY (C)**



Apply WTR to two lube fittings and CLP to all surfaces.

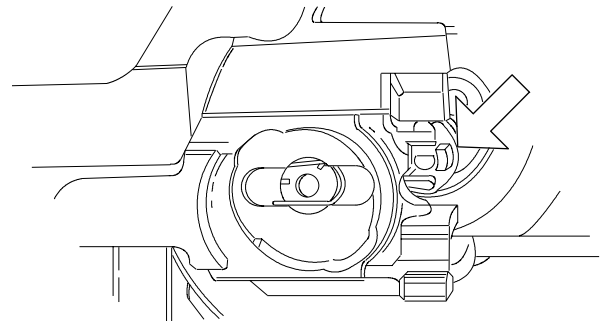
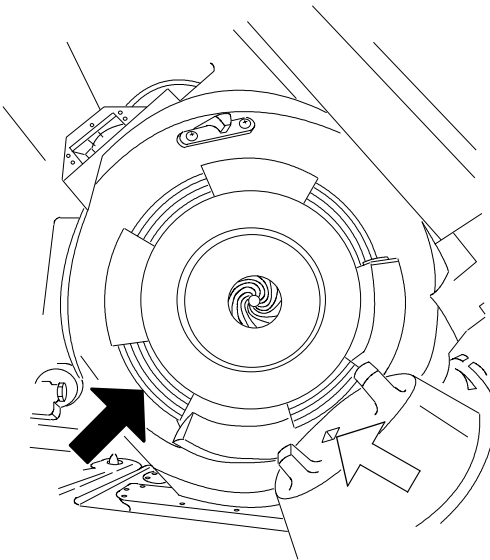
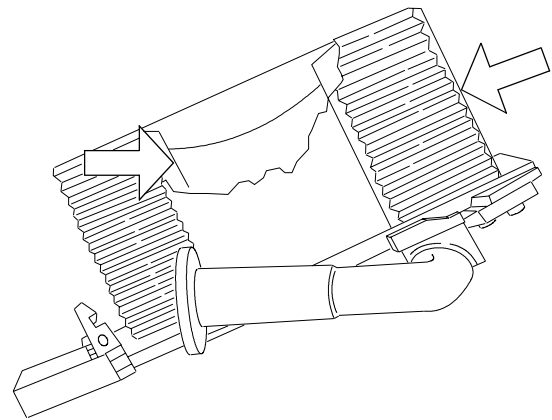
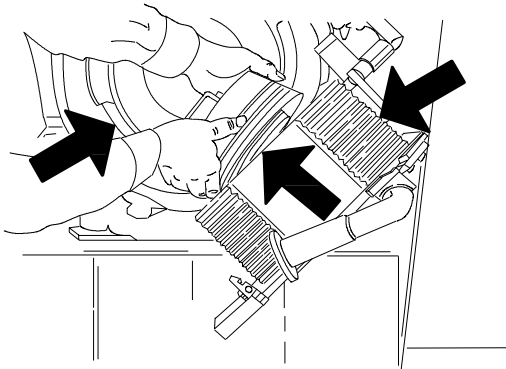
**DAILY NOTES (cont)**

**NOTE 9**

**BREECH MECHANISM ASSEMBLY (C)**

**NOTE**

The breech mechanism assembly may be cleaned and lubricated using the artillery cleaning kit or using CLP without the kit. Whichever method is used, cleaning begins immediately after firing is completed.



**CAUTION**

DO NOT clean obturator pad with CLP.

### DAILY NOTES (cont)

#### NOTE 9 (cont)

If using CLP without kit, proceed as follows:

Remove and disassemble obturator spindle assembly, and clean obturator pad with soap and water. Clean remaining parts with CLP. Wipe clean and reapply a light coat of CLP. Soak a small piece of wiping rag or primer vent brush with CLP and thoroughly clean primer cavity and vent hole. With a dry wiping rag, wipe primer cavity and vent hole clean, and leave dry. Coat breechblock assembly with CLP and let stand for 10 to 15 minutes. Wipe or brush breechblock assembly clean and apply a light coat of CLP to all metal surfaces. Apply WTR on all threaded surfaces and between breechblock assembly and disk of obturator spindle assembly.

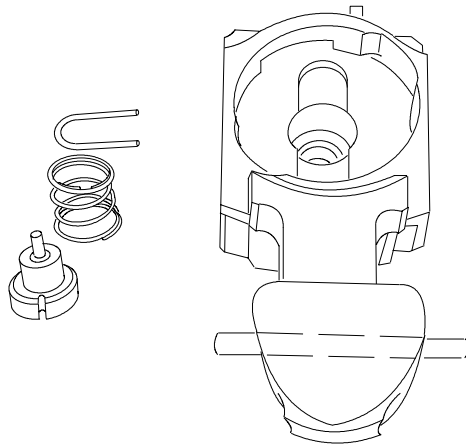
OR

If using the artillery cleaning kit, proceed as follows:

Remove and disassemble obturator spindle assembly, and clean obturator pad with soap and water. Using the trigger sprayer bottle (liter size) of CLP, thoroughly wet all breech components with CLP. Let soak for 10 to 15 minutes and then wipe off. Reapply a light coat of CLP. Spray all exposed metal surfaces with CLP. Apply CLP to primer vent and thoroughly brush with primer vent brush. Apply WTR on all threaded surfaces and between breechblock assembly and disk of obturator spindle assembly.

#### NOTE 10

##### FIRING MECHANISM BLOCK ASSEMBLY (C)

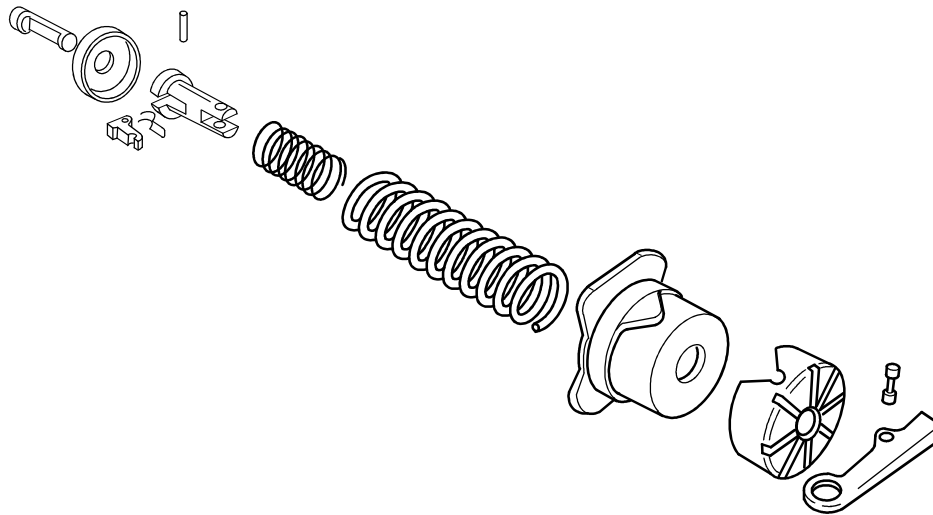


Remove, disassemble, and clean all parts with CLP. Let stand for 10 to 15 minutes. Wipe dry and apply a light coat of CLP.

**DAILY NOTES (cont)**

**NOTE 11**

**FIRING MECHANISM ASSEMBLY (C)**

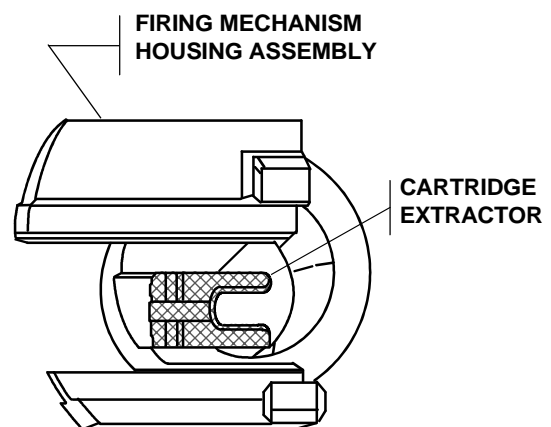


Remove and disassemble firing mechanism assembly, clean with CLP, wipe dry, and apply a light coat of CLP to all parts.

**NOTE 12**

**HOUSING ASSEMBLY (C)**

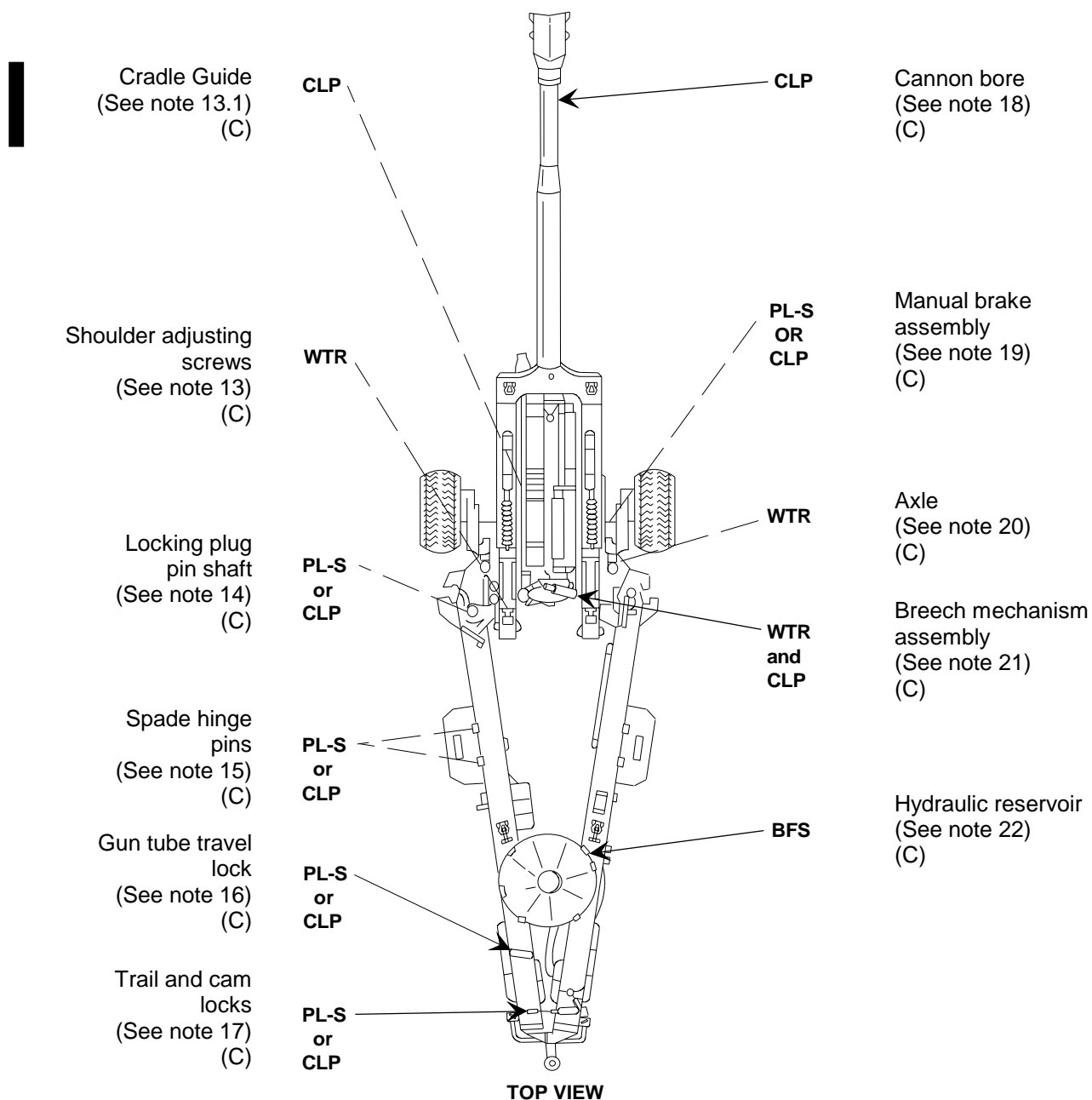
Clean with CLP, wipe dry, and apply a light coat of CLP to all parts.



# WEEKLY

LUBRICANT

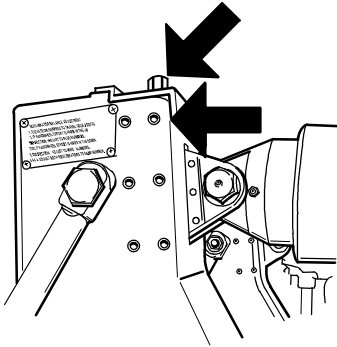
LUBRICANT



## WEEKLY NOTES

### NOTE 13

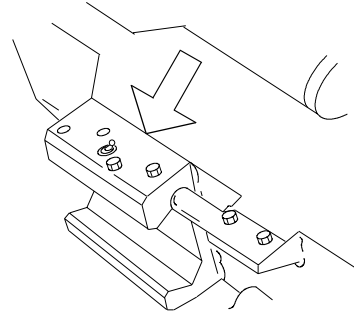
#### SHOULDER ADJUSTING SCREWS (C)



Apply WTR to pin shaft on slide assembly guide (unmodified howitzers only).

### NOTE 13.1

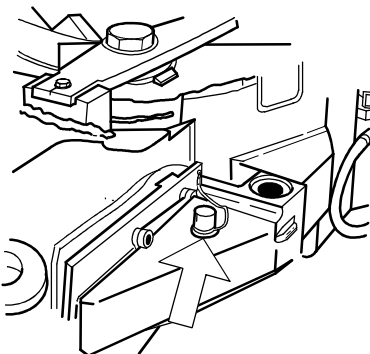
#### CRADLE GUIDE ASSEMBLY (C)



Apply CLP only between the guide assembly and the cradle assembly.

### NOTE 14

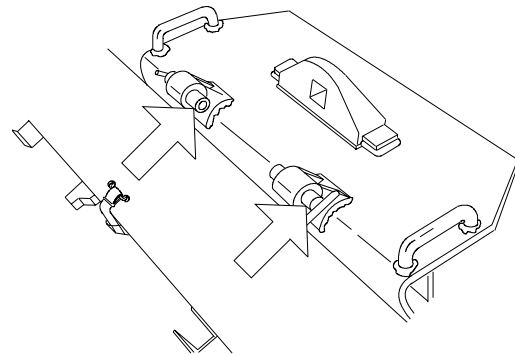
#### LOCKING PLUG PIN SHAFT (C)



Apply PL-S or CLP to pin shaft of locking plug.

### NOTE 15

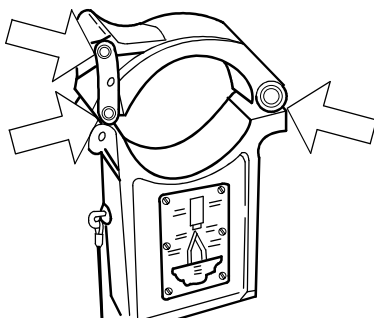
#### SPADE HINGE PINS (C)



Wipe with PL-S or CLP.

### NOTE 16

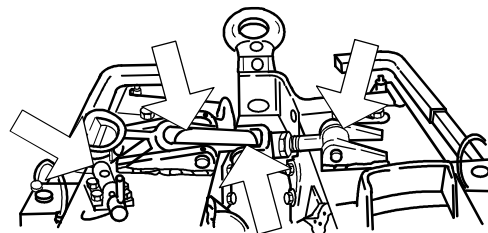
#### GUN TUBE TRAVEL LOCK (C)



Apply a couple drops of PL-S or CLP on all hinge points.

### NOTE 17

#### TRAIL AND CAM LOCKS (C)

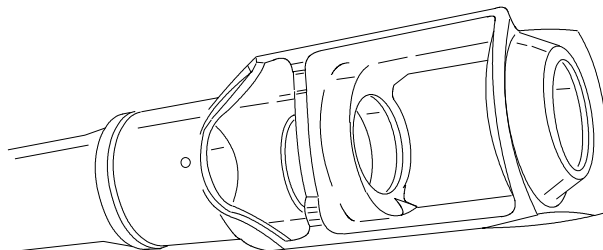


Apply a couple drops of PL-S or CLP to all joints on trail lock and oil cup on cam lock.

## WEEKLY NOTES (cont)

### NOTE 18

#### CANNON BORE (C)



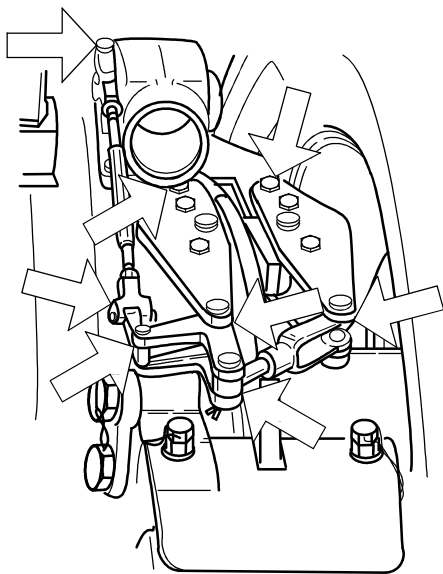
When weapon is not being fired, clean cannon bore with CLP, wipe dry, recoil with CLP, and install muzzle plug.

OR

Inspect cannon bore for cleanness and corrosion. If required, dry punch bore with clean wiping rag, then wet punch bore with wiping rags soaked with CLP.

### NOTE 19

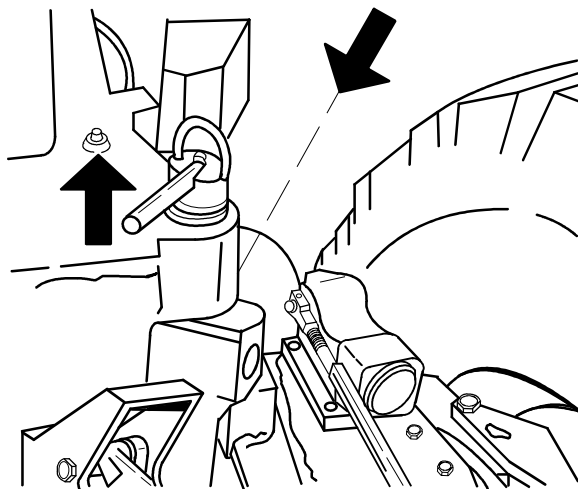
#### MANUAL BRAKE ASSEMBLY (C)



Apply a couple drops of PL-S or CLP on hinge points (both sides).

### NOTE 20

#### AXLE (C)



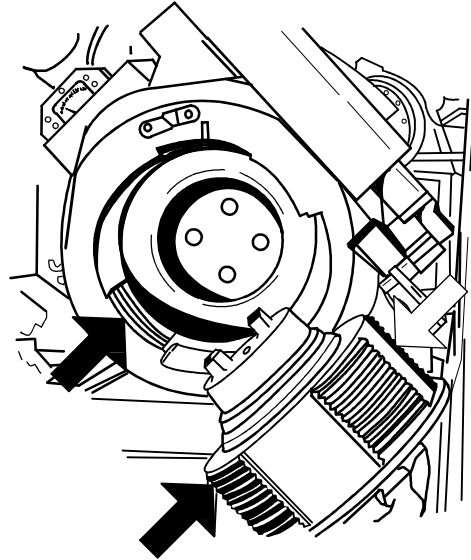
Place howitzer on firing platform and raise wheels to full up position. Lube with WTR (both sides). While applying WTR to axle, cycle the wheels through the down and up cycles. Some howitzers have two axle lubrication fittings on each side of the howitzer, one on top and a second on the bottom of the bottom carriage. Apply grease to four fittings if applicable. To ensure full axle lubrication, cycle the wheels up and down while applying grease.

## WEEKLY NOTES (cont)

### NOTE 21

#### BREECH MECHANISM ASSEMBLY (C)

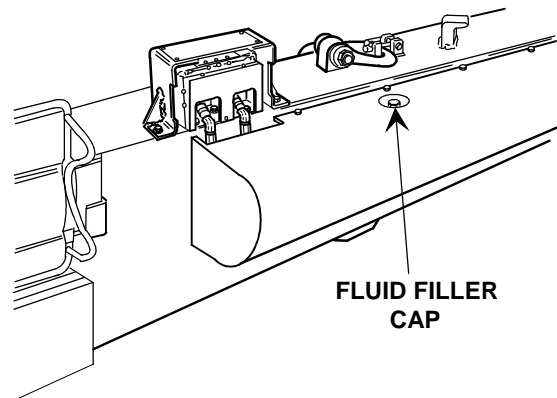
Remove breechblock assembly from carrier, clean with CLP, and wipe dry. Lube with CLP. Apply WTR to threads of breech and breechblock assembly.



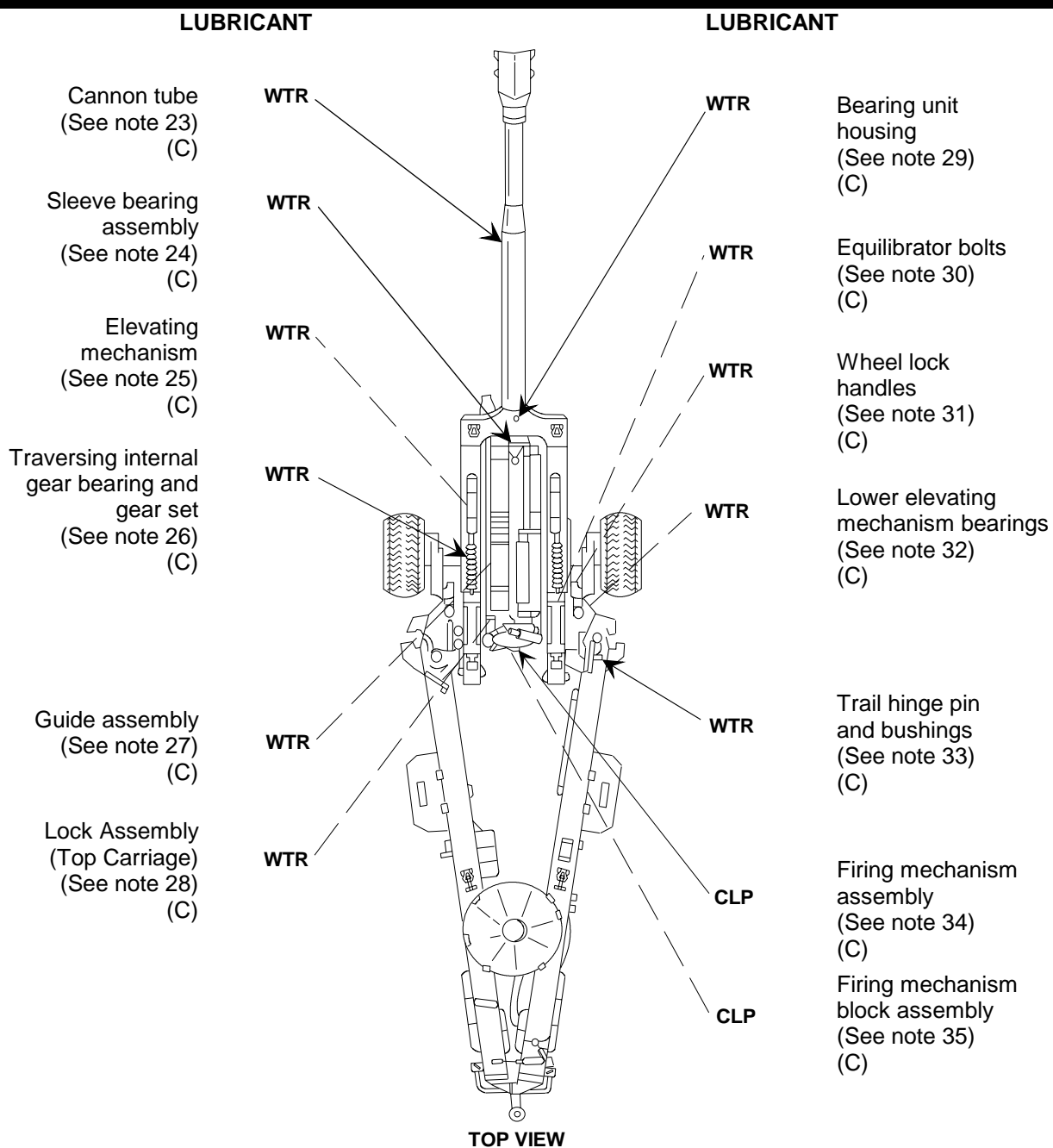
### NOTE 22

#### HYDRAULIC RESERVOIR (C)

Remove FLUID FILLER CAP and fill with BFS to within 3/4 inch (1.90 cm) from top of filling hole.



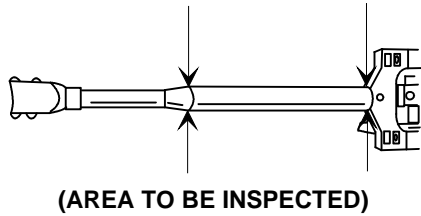
# MONTHLY



## MONTHLY NOTES

### NOTE 23

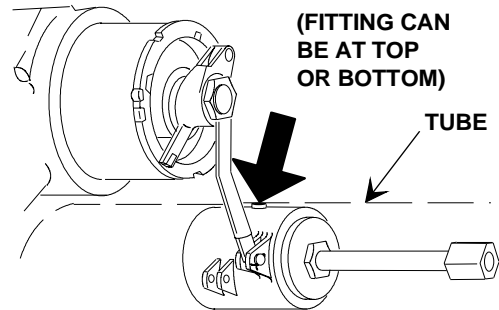
#### CANNON TUBE (C)



Inspect cannon tube for presence of dark film lubricant. If loose or flaking, clean only affected areas with a crocus cloth. Apply WTR to exposed areas where the dry film lubricant was removed or is missing.

### NOTE 24

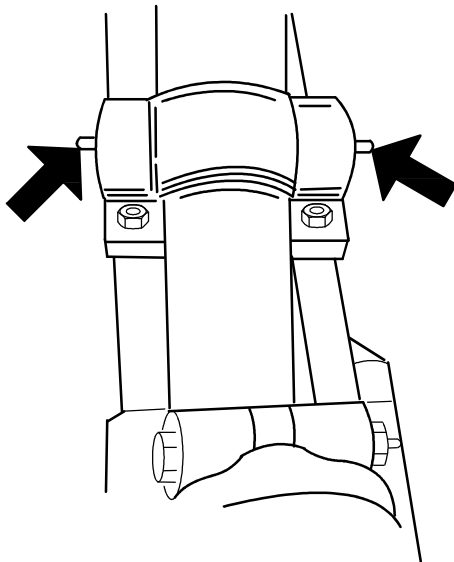
#### SLEEVE BEARING ASSEMBLY (C)



Lube with WTR.

### NOTE 25

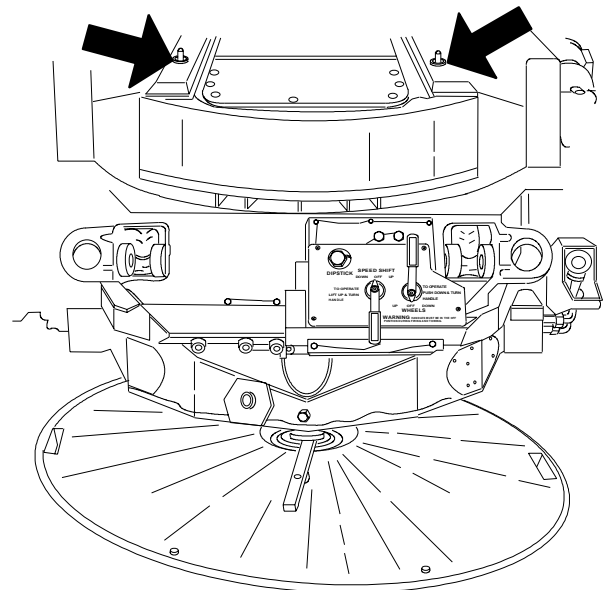
#### ELEVATING MECHANISM (C)



Lube with WTR (both sides).

### NOTE 26

#### TRAVERSING INTERNAL GEAR BEARING AND GEAR SET (C)



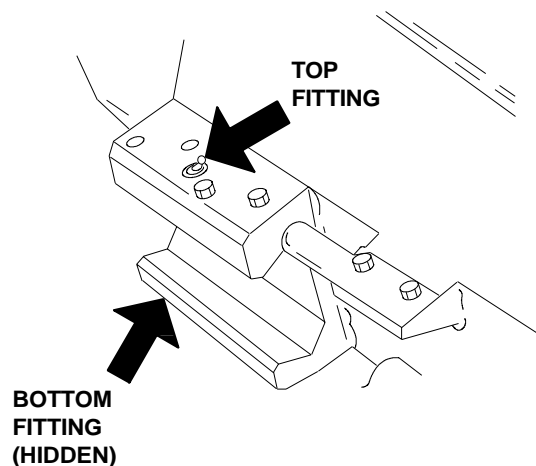
Lube with WTR while traversing.

### MONTHLY NOTES (cont)

#### NOTE 27

##### GUIDE ASSEMBLY (C)

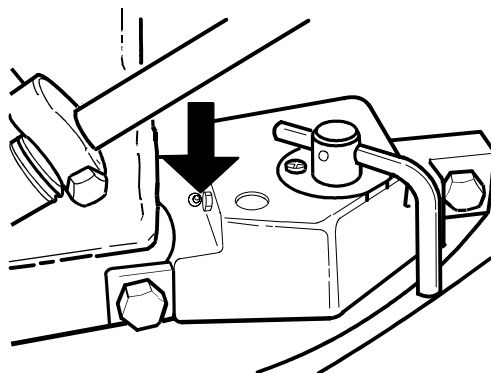
Lube four fittings with WTR. (Cannon and recoil mechanism removed for clarity.)



#### NOTE 28

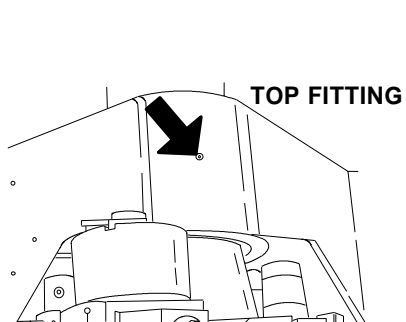
##### LOCK ASSEMBLY (TOP CARRIAGE) (C) (modified howitzer only)

Lube fittings with WTR.

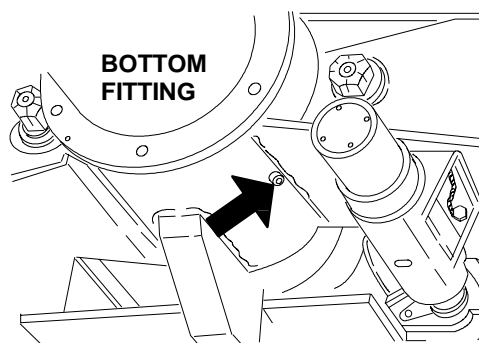


#### NOTE 29

##### BEARING UNIT HOUSING (C)



Lube with WTR.

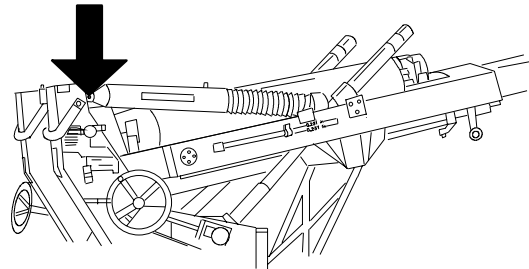


**MONTHLY NOTES (cont)**

**NOTE 30**

EQUILIBRATOR BOLTS (C)

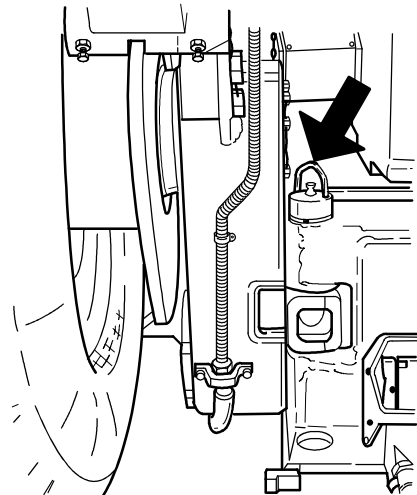
Lube with WTR (both sides).



**NOTE 31**

WHEEL LOCK HANDLES (C)

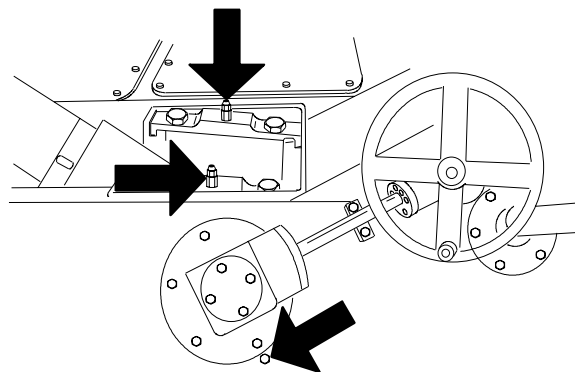
Lube sparingly with WTR (both sides).



**NOTE 32**

LOWER ELEVATING MECHANISM  
BEARINGS (C)

Lube with WTR (both sides).

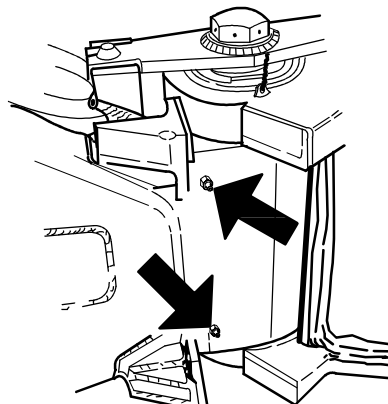


## MONTHLY NOTES (cont)

### NOTE 33

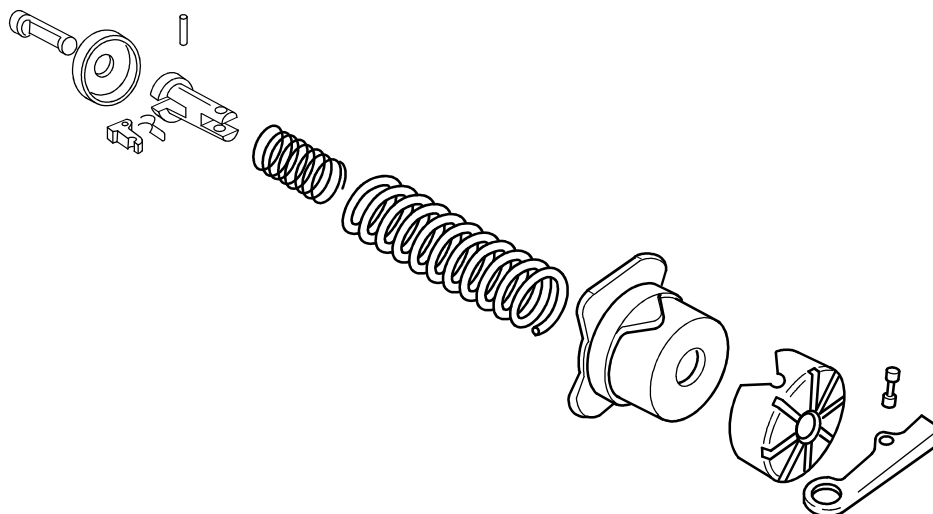
#### TRAIL HINGE PIN AND BUSHINGS (C)

Lube with WTR (both sides). Open and close trails several times to distribute WTR.



### NOTE 34

#### FIRING MECHANISM ASSEMBLY (C)

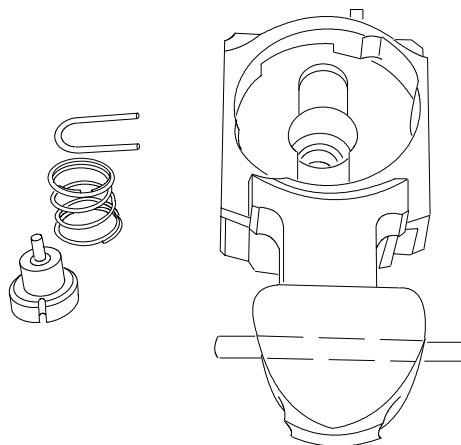


Remove and disassemble firing mechanism assembly, clean with CLP, wipe dry, and apply a light coat of CLP to all parts.

### NOTE 35

#### FIRING MECHANISM BLOCK ASSEMBLY (C)

Remove, disassemble, and clean all parts with CLP. Let stand for 10 to 15 minutes. Wipe dry and apply a light coat of CLP.



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**By Order of the Secretary of the Army:**


**CARL E. VUONO**  
General, United States Army  
Chief of Staff

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# METRIC CHART

## THE METRIC SYSTEM AND EQUIVALENTS

### LINEAR MEASURE

1 Centimeter = 10 Millimeters = 0.01 Meters = 0.3937 Inches  
1 Meter = 100 Centimeters = 1000 Millimeters = 39.37 Inches  
1 Kilometer = 1000 Meters = 0.621 Miles

### WEIGHTS

1 Gram = 0.001 Kilograms = 1000 Milligrams = 0.035 Ounces  
1 Kilogram = 1000 Grams = 2.2 Lb  
1 Metric Ton = 1000 Kilograms = 1 Megagram = 1.1 Short Tons

### LIQUID MEASURE

1 Millileter = 0.001 Liters = 0.0338 Fluid Ounces  
1 Liter = 1000 Milliliters = 33.82 Fluid Ounces

### SQUARE MEASURE

1 Sq Centimeter = 100 Sq Millimeters = 0.155 Sq Inches  
1 Sq Meter = 10,000 Sq Centimeters = 10.76 Sq Feet  
1 Sq Kilometer = 1,000,000 Sq Meters = 0.386 Sq Miles

### CUBIC MEASURE

1 Cu Centimeter = 1000 Cu Millimeters = 0.06 Cu Inches  
1 Cu Meter = 1,000,000 Cu Centimeters = 35.31 Cu Feet

### TEMPERATURE

$5/9 (^{\circ}\text{F} - 32) = ^{\circ}\text{C}$   
212° Fahrenheit is equivalent to 100° Celsius  
90° Fahrenheit is equivalent to 32.2° Celsius  
32° Fahrenheit is equivalent to 0° Celsius  
 $9/5 \text{ C}^{\circ} + 32 = \text{F}^{\circ}$

## APPROXIMATE CONVERSION FACTORS

TO CHANGE	TO	MULTIPLY BY
Inches .....	Centimeters .....	2.540
Feet .....	Meters .....	0.305
Yards .....	Meters .....	0.914
Miles .....	Kilometers .....	1.609
Square Inches .....	Square Centimeters .....	6.451
Square Feet .....	Square Meters .....	0.093
Square Yards .....	Square Meters .....	0.836
Square Miles .....	Square Kilometers .....	2.590
Acres .....	Square Hectometers .....	0.405
Cubic Feet .....	Cubic Meters .....	0.028
Cubic Yards .....	Cubic Meters .....	0.765
Fluid Ounces .....	Milliliters .....	29.573
Pints .....	Liters .....	0.473
Quarts .....	Liters .....	0.946
Gallons .....	Liters .....	3.785
Ounces .....	Grams .....	28.349
Pounds .....	Kilograms .....	0.454
Short Tons .....	Metric Tons .....	0.907
Pound-Feet .....	Newton-Meters .....	1.356
Pounds per Square Inch .....	Kilopascals .....	6.895
Miles per Gallon .....	Kilometers per Liter .....	0.425
Miles per Hour .....	Kilometers per Hour .....	1.609

TO CHANGE	TO	MULTIPLY BY
Centimeters .....	Inches .....	0.394
Meters .....	Feet .....	3.280
Meters .....	Yards .....	1.094
Kilometers .....	Miles .....	0.621
Square Centimeters .....	Square Inches .....	0.155
Square Meters .....	Square Feet .....	10.764
Square Meters .....	Square Yards .....	1.196
Square Kilometers .....	Square Miles .....	0.386
Square Hectometers .....	Acres .....	2.471
Cubic Meters .....	Cubic Feet .....	35.315
Cubic Meters .....	Cubic Yards .....	1.308
Milliliters .....	Fluid Ounces .....	0.034
Liters .....	Pints .....	2.113
Liters .....	Quarts .....	1.057
Liters .....	Gallons .....	0.264
Grams .....	Ounces .....	0.035
Kilograms .....	Pounds .....	2.205
Metric Tons .....	Short Tons .....	1.102
Newton Meters .....	Pound Feet .....	0.738
Kilopascals .....	Pounds per Square Inch .....	0.145
Kilometers per Liter .....	Miles per Gallon .....	2.354
Kilometers per Hour .....	Miles per Hour .....	0.621

