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FM 6-74

DEPARTMENT OF THE ARMY FIELD MANUAL

105-mm
HOWITZER
M2A1 ON MOTOR CARRIAGE
M7B1 AND M7B2

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DEPARTMENT OF THE ARMY

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105-MM HOWITZER M2A1 ON MOTOR CARRIAGE M7B1 AND M7B2

* This manual supersedes FM 6–74, 10 July 1944, including C 1, 9 November 1944, TC 2, 19 January 1951, and TC 12, 12 March 1952.

CHAPTER 1

INTRODUCTION

1. Purpose and Scope

This manual is a guide to assist commanders in developing the sections of 105-mm howitzer motor carriage M7B1 and M7B2 firing batteries into efficient smooth-working teams that have a sense of discipline which will impel them to operate effectively under the stress of battle. This manual prescribes individual duties and section drills, inspection and maintenance drills, tests and adjustments for sighting and fire control equipment, and references to instructions for the decontamination and destruction of equipment.

2. Definitions and Terms

a. Gun. Throughout this manual the term *gun* is used generally to include howitzer.

b. Section. Tables of organization and equipment prescribe the *personnel* and *equipment* comprising each section of a battery (figs. 1 and 2). In this manual the term *section* is often used to designate *only the personnel* required to serve one gun and its equipment.

c. Front. The front of a section is the direction in which the muzzle of the gun points.

Figure 1. 105-mm howitzer motor carriage M7B1 (M7B2) and section personnel.

d. Right (Left). The direction right (left) is the right (left) of one facing the front.

e. In Battery. A gun is said to be in battery when it is in its normal firing position.

3. Description of Equipment

To avoid accidents caused by exceeding the capabilities and limitations of the motor carriage,

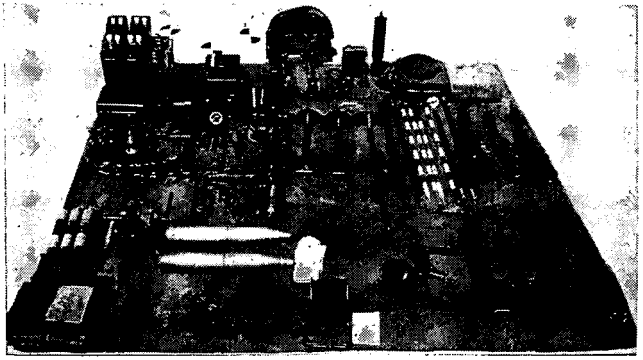


Figure 2. A method of displaying section equipment of the 105-mm howitzer motor carriage M7B1 and M7B2.

all members of the section should be familiar with the performance characteristics shown in figure 3. For further details pertaining to full-track vehicle capabilities and combat driving, see TM 21–306.

4. References

Publications pertaining to the 105-mm howitzer M2A1 on motor carriage M7B1 and M7B2 and auxiliary equipment, covering related matters not discussed in detail in this manual, are listed in the appendix.

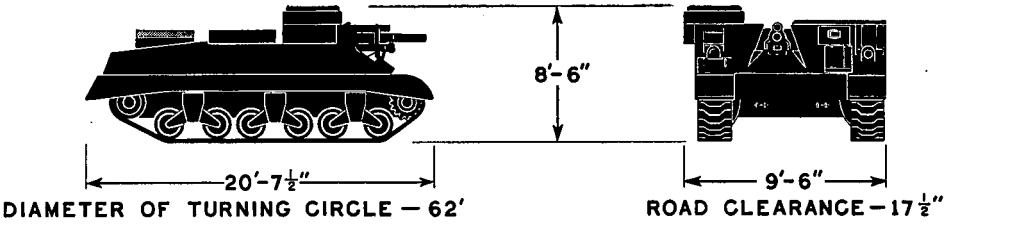


Figure 3. 105-mm howitzer motor carriage M7B1 and M7B2 performance characteristics.

CHAPTER 2

ORGANIZATION

5. Composition of the Gun Section

a. The gun section consists of section personnel, a 105-mm howitzer M2A1 (or M2) mounted on motor carriage M7B1 (or M7B2), and auxiliary equipment (fig. 1).

b. The personnel of the gun section are—

(1) A chief of section (CS).

(2) A gunner (G).

(3) An assistant gunner (No. 1).

(4) Four cannoneers, numbered from 2 through 5.

(5) A motor carriage driver (D).

c. Section equipment is listed in SNL's (app.) and the T/O&E appropriate to the weapon and unit.

6. General Duties of Personnel

a. Chief of Section. The chief of section is the noncommissioned officer in command of the section and, as such, is responsible to the battery executive for—

(1) Training and efficiency of personnel.

(2) Performance of duties listed under section drill, duties in firing, testing and

adjustment of sighting and fire control equipment, and inspection and maintenance of all section equipment including scheduled preventive maintenance on motor carriage.

(3) Observance of safety precautions.

(4) Preparation of field fortifications for protection of equipment, ammunition, and personnel.

(5) Camouflage discipline; local security; and radiological, biological, and chemical security discipline.

(6) Maintenance of the gun book.

(7) Police of the section area.

b. Gunner. The gunner is the assistant to the section chief in carrying out the duties specified in *a* above. The gunner's specific duties are prescribed in the appropriate chapters of this manual.

c. Cannoneers. Cannoneers perform duties as listed in this manual and any other duties that the chief of section prescribes.

d. Driver. The driver's primary duty is driving the motor carriage (TM 21–306). He also performs maintenance and such other duties as prescribed by this manual, by TM 9–749, or as may be assigned by the chief of section. These duties can include substituting for any member of the section in firing.

CHAPTER 3
SECTION DRILL

Section I. GENERAL

7. Objective

The objective of section drill is the attainment of efficiency: Maximum precision coupled with high speed.

8. Instructions

a. To develop maximum efficiency and to prevent injuries to personnel and equipment, the drills prescribed in this manual must be observed. Section drill should be conducted in silence except for commands and reports. The section must be drilled until reactions to commands are automatic, rapid, and efficient.

b. Mistakes are corrected immediately. Each member of the section must be impressed with the importance of reporting promptly to the chief of section any mistakes discovered after the command to fire has been given. The chief of section will report mistakes immediately to the executive.

c. Battery officers supervise the drill to insure that instructions are carried out and that maximum efficiency is obtained.

d. Duties should be rotated during training so that each member of the section can perform all

the duties within the section. In addition, battery overhead personnel not assigned specific duties during drill periods should be trained in the fundamentals of section drill in order that they will be capable of functioning efficiently with a gun section if required.

Section II. PRELIMINARY COMMANDS AND FORMATIONS

9. To Form the Section

a. To Fall In. The chief of section takes his post. On the command of execution the section forms in a single rank at close interval, centered on and facing the chief of section at a distance of 3 paces (fig. 4). Higher numbered cannoneers, if present, form in order between No. 5 and the driver. The chief of section may indicate in his preparatory command the place and direction the section is to form. At the first formation for a drill or exercise the caution, AS GUN SECTION(S), precedes the command. The commands are FALL IN, or 1. IN FRONT (REAR) OF YOUR GUN(S), 2. FALL IN, or 1. ON THE ROAD FACING THE PARK. 2. FALL IN. Execution is as follows: The section moves at double time and forms at close interval, at attention, guiding on the gunner (fig. 4).

b. To Call Off. The section being in formation, the command is CALL OFF. At the command, all personnel in ranks, except the gunner, execute eyes right. The section then calls off in sequence, "Gunner," "1," "2," "3," "4," "5," "Driver." As

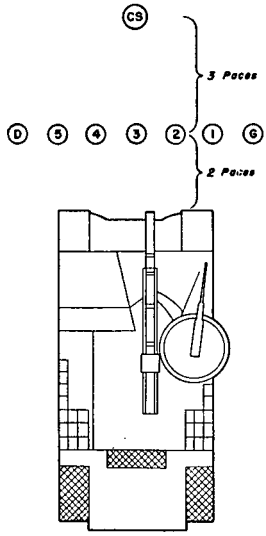


Figure 4. Gun section in formation.

each man calls out his designation he turns his head and eyes smartly to the front.

10. Posts of the Section

The command is 1. CANNONEERS, 2. POSTS. The command is general and is applicable whether the section is in or out of ranks, at a halt or marching. All movements are executed at double time and are terminated at the position of attention. Higher numbered cannoneers, if present, take posts as prescribed by the chief of section.

a. Dismounted. The section moves to posts as shown in figure 5. All personnel are 2 feet outside the tracks and facing to the front.

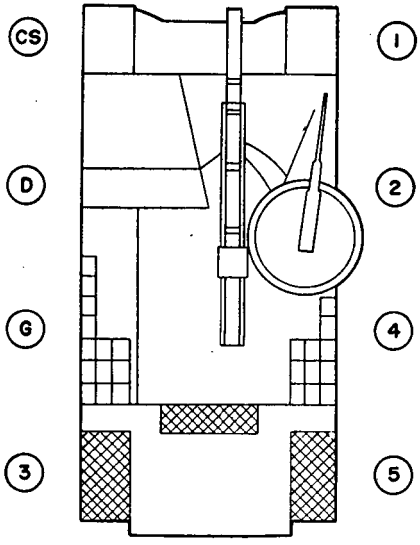


Figure 5. Posts of section, dismounted.

b. Prepared for Action. The gun having been prepared for action, posts are taken as shown in figure 6.

c. Mounted, Not Prepared for Action. The section moves to posts as shown in figure 7.

11. To Change Posts

To acquaint the members of the section with all duties and to lend variety to drill, posts should be changed frequently. The section being *in formation* the commands are 1. CHANGE POSTS, 2. MARCH, or 1. SECTION CHANGE POSTS, 2. MARCH.

a. At 1. CHANGE POSTS, 2. MARCH, all numbered cannoneers except No. 5 (or the highest

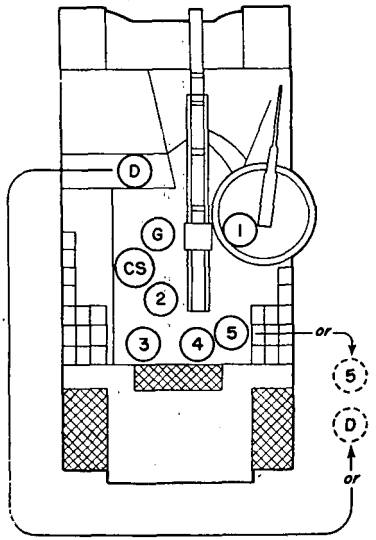


Figure 6. Posts of section, prepared for action.

numbered cannoneer) take two left steps, taking the position of the next higher numbered cannoneer. No. 5 moves at double time in rear of the section to the post of No. 1. All other members of the section stand fast.

b. At 1. SECTION CHANGE POSTS, 2. MARCH, the driver (or the leftmost man) moves at double time in rear of the section to the post of the gunner. The gunner and all other men in line take two left steps as in *a* above.

12. To Mount

The commands are 1. PREPARE TO MOUNT, 2. MOUNT, or 1. MOUNT.

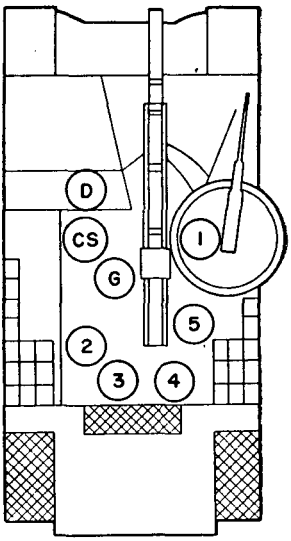


Figure 7. Section mounted.

a. At the preparatory command, the section moves at double time to positions shown in figure 5. At the command of execution, all personnel mount. On the right Nos. 2 and 4 mount first, followed by Nos. 1 and 5 respectively. On the left the driver and No. 3 mount first, followed by the chief of section and the gunner respectively. All personnel hasten to positions as shown in figure 7.

b. If any members of the section are to remain dismounted, their designation is 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.

c. If the command is 1. MOUNT, the section executes, without pausing, all that has been prescribed for the command 1. PREPARE TO MOUNT, 2. MOUNT.

13. To Dismount

The commands are 1. PREPARE TO DISMOUNT, 2. DISMOUNT, or 1. DISMOUNT.

a. At the preparatory command all members of the section stand. At the command of execution members of the section dismount in inverse order of mounting and quickly take posts as shown in figure 5.

b. If the command is 1. DISMOUNT, the section executes without pausing all that has been prescribed for the command 1. PREPARE TO DISMOUNT, 2. DISMOUNT.

14. To Fall Out

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

b. When Firing. When firing has been suspended temporarily, but it is desired to have the section remain in the vicinity of the motor carriage, the command FALL OUT is given. Men stand clear of the gun to insure that settings and laying remain undisturbed. During these periods the chief of section may direct his men to improve the position, to replenish ammunition, or to do other necessary work.

CHAPTER 4

PREPARING THE GUN FOR FIRING AND TRAVELING

Section I. PREPARATIONS FOR FIRING

15. General

The guns of a battery will ordinarily be put into position individually under the direction of the executive and chiefs of section. A stake should be driven into the ground at a point where the center of each carriage is to be placed. Another stake should be placed in the direction of fire 50 to 100 yards from the first stake, so that the driver of the motor carriage can point the tube at the far stake as he drives the vehicle into position over the first stake. Each vehicle is halted at its proper place by the chief of section. Hand signals for guiding the vehicle are found in FM 21–60, FM 25–10, and are discussed in paragraph 51.

16. To Prepare for Action

a. The gun being in position or approaching it, the command is PREPARE FOR ACTION. Duties of individuals are given in table I. Each man takes his post (fig. 6) upon completion of his duties.

Table I. Duties in Preparing for Action

Sequence	Chief of section	Gunner	No. 1 (Assistant gunner)	No. 2	No. 3	No. 4	No. 5	Driver, motor carriage
1	Commands PREPARE FOR ACTION. Supervises work of all members of the section throughout all sequences.	Unfasten and fold back breech end of cover. Move traversing and elevating handwheels if necessary to assist No. 2 in disengaging the traveling lock.		Disengages traveling lock. Remove traveling lock bracket (fig. 8) and place it on floor of motor carriage. Remove and fold breech cover and place it on rear deck.		Lays wire for intrabattery communication system from the motor carriage to the executive's control station.	Assembles aiming posts and lays them over rear of motor carriage.	Positions vehicle as directed by chief of section.
2	Checks oil index indicator rod. If necessary, adds or drains recoil oil as prescribed in TM 9-325.	Removes the panoramic telescope and elbow telescope from case. Passes elbow telescope to No. 1 and seats the panoramic telescope in the telescope mount.	Clamps .50 caliber MG in direction of probable area of responsibility for position defense. Receives elbow telescope from gunner and seats it in mount.	Assembles rammer staff to rammer head and lays it over rear of motor carriage.	Places fuze setter in convenient position.	Prepares telephone for use and checks communication.	Removes muzzle cover.	Remains at his post.
3		Sets deflection at zero, uncovers the telescope mount bubbles, and cross levels mount by centering both bubbles.	Uncovers and centers cross- and longitudinal-level bubbles of elevation quadrant. Sets angle of site at 300. Sets elevation at 200.		Spread tarpaulin on rear deck. Places ammunition assembly trough on tarpaulin.			Keeps engines running until it is determined carriage shifts will not be required in laying gun or until chief of section commands CUT ENGINES.
4		Bore sights gun if time permits.	Operates the breech mechanism and examines the breechblock, chamber, and bore, cleaning any parts requiring it (assisted by No. 2 when so directed); leaves breech open.	When so directed, assists No. 1 in cleaning the breech mechanism, chamber, and bore.	Prepare ammunition for firing.			
5	Verifies that the gun is prepared for action. Reports to executive, "Sir, No. (so-and-so) in order," or reports any defects that the section cannot remedy without delay.		Assists gunner in bore sighting if time permits.	Assists gunner and No. 1 in bore sighting if time permits.				

Table II. Duties in Preparing for Traveling

Sequence	Chief of section	Gunner	No. 1 (Assistant gunner)	No. 2	No. 3	No. 4	No. 5	Driver, motor carriage
1	Commands MARCH ORDER. Inspects chamber to see that gun is not loaded. Supervises work of all members of the section throughout all sequences.	Places gun in center of traverse. Operates traversing and elevating handwheels to assist No. 2 in engaging traveling lock.	Inspects chamber to see that gun is not loaded and closes breech after chamber is inspected by chief of section.	Replace traveling lock bracket.		Rewinds telephone wire. Stows communication equipment.	Recovers, disassembles, and secures aiming posts.	Starts engine if it is not running and checks gages.
				Engages traveling lock.				
				Obtain breech cover and place it convenient to gunner and No. 1.				
2		Sets all scales of panoramic telescope at zero, closes level covers and returns panoramic telescope and elbow telescope to case.	Removes elbow telescope and passes to gunner. Sets angle of site at 300 and closes elevation (range) quadrant level covers.	Recovers, disassembles, and secures the rammer staff and rammer head in traveling position.	Stows fuze setter and ammunition trough. Replaces powder increments of prepared unfired rounds in cartridge case, returns ammunition to containers, and folds tarp assisted by Nos. 2, 4, and 5 when available.			
3		Replace breech cover.		Assists No. 3 in returning ammunition to containers.			Replaces muzzle cover.	
						Inspect section area to make sure that no equipment is being left.		
4	Verifies that the gun is prepared for traveling. Reports to the executive, "Sir No. (so-and-so) in order," or reports any defects that the section cannot remedy without delay.		Inspects .50 caliber MG and clamps it in traveling position.			Assist No. 3 in returning ammunition to containers.		

b. The gun normally will be partially prepared for action before reaching the firing position. The duties of the cannoneers in preparing for action are the same whether moving or halted, but only such operations as are practicable are carried out while moving. Immediately after the gun is established in position, preparation for action is completed without further command.

c. If PREPARE FOR ACTION has not been ordered before the gun is established in position, the command is habitually given by the chief of section as soon as the vehicle is halted in position. If this is not desired, the caution DO NOT PREPARE FOR ACTION must be given.

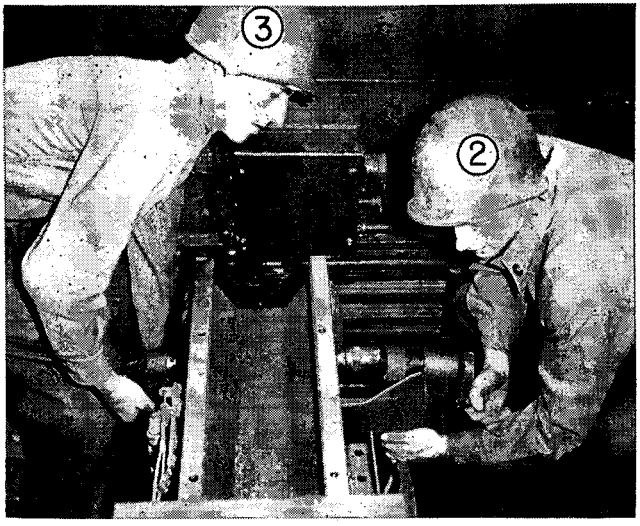


Figure 8. Nos. 2 and 3 removing traveling lock bracket.

Section II. PREPARATIONS FOR TRAVELING

17. March Order

To prepare to resume travel the command is MARCH ORDER. Duties of individuals are listed in table II. Each man takes his post (fig. 7) upon completion of his duties.

18. To Resume Firing in Another Position

a. If firing is to be resumed shortly in another position in which the gun must be immediately ready to fire, the command MARCH ORDER is not given. When a displacement is ordered, only those operations necessary for the movement of the motor carriage and the security of equipment are performed.

b. If the command MARCH ORDER is given while the equipment is partially prepared for travel as described in *a* above, the remaining operations pertaining to march order are completed.

CHAPTER 5

DUTIES IN FIRING

Section I. INDIRECT LAYING

19. Instructions

The general instructions given in paragraphs 7 and 8 on the conduct of section drill apply equally to section drill in duties in firing. For duties of the battery executive see FM 6–140.

20. Duties of Individuals

In general, the duties of individuals in the section in firing are as follows:

a. The chief of section supervises and commands his section and is responsible that all duties of the section are performed properly, all commands executed, and all safety precautions observed.

b. The gunner sets the announced deflection, lays for direction, and refers the gun.

c. No. 1 sets the announced site and elevation, lays for elevation, operates the breech, and fires the gun.

d. No. 2 loads the gun.

e. No. 3 operates the fuze setter and sets the fuzes.

f. No. 4 prepares charges.

g. No. 5 removes ammunition from containers.

h. The driver remains at his post, prepared to move the carriage if large shifts are expected. When direction of fire is relatively stable, he performs such maintenance on the vehicle as will not interfere with firing unless assigned other duties by the chief of section.

21. Chief of Section

a. List of Duties.

(1) To lay for elevation, assisted by No. 1, when the gunner's quadrant is used.

(2) To measure the elevation.

(3) To measure the site to the mask.

(4) To indicate to the gunner the aiming point.

(5) To follow fire commands.

(6) To indicate when the gun is ready to fire.

(7) To give the command to fire.

(8) To report mistakes and other unusual incidents of fire to the executive.

(9) To conduct prearranged fires.

(10) To record basic data.

(11) To observe and check frequently the functioning of the materiel.

(12) To assign duties when firing with reduced personnel.

(13) To verify the adjustment of the sighting and fire control equipment.

(14) To check, before they are replaced in their containers, all rounds not fired which have been prepared for firing.

(15) To control the movement of the motor carriage.

(16) To supervise use of ammunition.

b. Detailed Description of Duties.

(1) *To lay for elevation when gunner's quadrant is used.*

(*a*) The command QUADRANT (SO MUCH) indicates that the gunner's quadrant is to be used. In laying for elevation, it is usually employed only when the elevation (range) quadrant is inoperative or known to be inaccurate. The gunner's quadrant may be specified for use with assault fire or on certain destruction missions.

(*b*) Quadrant 361.8, for example, is set on the gunner's quadrant (fig. 9) as follows: The upper edge of the index plate is set opposite the 360 mark of the graduated arch on the quadrant frame and the micrometer on the index arm is turned to read 1.8. Care must be taken to use the same side of the quadrant in setting both the index plate and the micrometer knob.

(*c*) The announced quadrant having been set on the gunner's quadrant, the gun loaded, and the breechblock closed, the gunner's quadrant is set on the

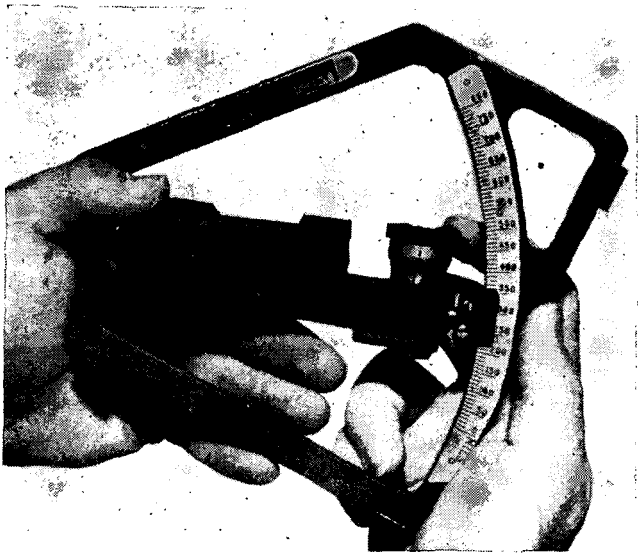


Figure 9. Setting the gunner's quadrant at 361.8.

quadrant seat on top of the breech. The words *line of fire* must be at the bottom of the quadrant and the arrow pointing toward the muzzle. The chief of section must be sure to use the arrow which appears on the same side of the quadrant as the scale which he is using. He stands squarely opposite the side of the quadrant and holds it firmly on the quadrant seat, parallel to the axis of the bore. *It is important that he take the same position and hold the quadrant in the same manner for each subsequent* setting, so that in

each case he will view the quadrant bubble from the same angle.

(*d*) The chief of section then directs No. 1 to elevate or depress the tube until the bubble is centered, being careful that the last motion is in the direction in which it is more difficult to turn the handwheel. The chief of section cautions No. 1 when the bubble is approaching the center, in order that the final centering may be performed accurately.

(*e*) Normally, special and calibration corrections will be added algebraically at the battery fire direction center and commanded as NO. (SO-AND-SO), QUADRANT (SO MUCH).

(2) *To measure the elevation.* At the command MEASURE THE ELEVATION, the gun having been laid, the chief of section directs No. 1 to center the cross-level bubble, to set the angle of site at 300, and with the elevation knob to center the elevation (range) quadrant longitudinal-level bubble. The chief of section then reads the elevation set on the elevation scale and micrometer and announces the elevation thus set as "No. (so-and-so), elevation (so much)." If the elevation quadrant is inoperative or known to be inaccurate, the elevation is measured by placing the gunner's quad-

rant on the quadrant seats of the breech ring where the chief of section, by raising and lowering the index arm and turning the micrometer knob, centers the bubble. He then reports the reading on the gunner's quadrant to the executive.

(3) *To measure site to the mask.*

(*a*) The command is MEASURE THE SITE TO THE MASK. The chief of section has No. 1 set site 300 on the angle of site scale and center the cross-level bubble. Then, sighting along the lowest element of the bore, he directs the gunner and No. 1 to operate the traversing and elevating mechanism until the line of sight just clears the crest at its highest point in the probable field of fire. He then directs No. 1 to center the longitudinal-level bubble by turning the elevation knob. No. 1 verifies that the cross-level bubble is still centered. The chief of section reads the site to the mask from the elevation scale and micrometer and reports to the executive, "No. (so-and-so), site (so much)."

(*b*) When the executive announces the minimum quadrant elevation or the minimum elevation and site for each charge, the chief of section records it in a notebook and directs No. 1 to

chalk on a convenient place the minimum quadrant elevation for each charge to be used.

(4) *To indicate to the gunner the aiming point.* Whenever an aiming point has been designated by the executive, the chief of section will make sure that he has properly identified the point in question. He will then indicate it to the gunner. If there is any possibility of misunderstanding, the chief of section will turn the panoramic telescope until the horizontal and vertical hairs are on the point designated.

(5) *To follow fire commands.* The chief of section will follow fire commands. He will repeat the commands as required.

(6) *To indicate when the gun is ready to fire.* When the executive can see arm signals of the chief of section, the chief of section will extend his right arm vertically upward as a signal that the gun is ready to fire. He gives the signal as soon as the gunner calls "Ready." When arm signals cannot be seen, the chief of section reports orally to the executive. "No. (so-and-so) ready."

(7) *To give the command to fire.* When No. 1 can see arm signals made by the chief of section, the chief of section will give the command to fire by dropping his right arm sharply to his side. When his

arm signals cannot be seen he commands orally, FIRE or NO. (SO-AND-SO) FIRE. The chief of section will not give the signal or command to fire until all cannoneers are in their proper places.

(8) *To report mistakes and other unusual incidents of fire to the executive.* If for any reason the gun cannot be fired, the chief of section will promptly report that fact to the executive and the reasons therefor; for example, "No. (so-and-so) out, misfire." Whenever it is discovered that the gun has been fired with a mistake in laying, the chief of section will report that fact at once; for example, "No. (so-and-so) fired 40 mils right." Whenever the gunner reports that the aiming posts are out of alinement with the sight and that the misalinement is due to the displacement of the carriage, the chief of section will report that fact and request permission to realine them. Likewise, he promptly reports other unusual incidents that affect the service of the gun.

(9) *To conduct prearranged fires.* Whenever the execution of prearranged fires is ordered, the chief of section will conduct the fire of his section in conformity with the prescribed data.

(10) *To record basic data.* The chief of section will record data of a semipermanent

nature in a notebook. This includes such information as minimum elevations; aiming points used and their deflections; prearranged fires when section data sheets are not furnished; safety limits in elevation and deflection; number of rounds fired, with the date and hour; and calibration and special corrections when appropriate.

(11) *To observe and check functioning of the materiel.* The chief of section closely observes the functioning of all parts of the materiel during firing. Before the gun is fired, he makes sure that the recoil mechanism contains the proper amount of oil; thereafter he carefully observes the functioning of the recoil system. He promptly reports to the executive any evidence of malfunctioning (TM 9–325). If the gun returns to battery with a shock, an over supply of recoil oil is indicated; if the gun over recoils or does not return to battery, an insufficient amount of recoil oil is indicated. Correct recoil oil pressure exists when the end of the oil index indicator rod is flush with the front face of the recuperator cylinder front head. Whenever the amount of reserve oil is less than that prescribed, the index indicator rod recedes into the oil index recess. If the oil reserve pressure is ex-

cessive, the oil index is mechanically unable to indicate this excess condition due to the construction of the mechanism indicator. This condition necessitates extreme care in establishing the correct oil reserve.

(12) *To assign duties when firing with reduced personnel.* Whenever the personnel serving the gun is temporarily reduced in numbers below that indicated in this manual, the chief of section will make such redistribution of duties as will best facilitate the service of the gun. Loss of cadremen, various details, and casualties will necessitate section operation with a reduced number of personnel to the extent that it is almost normal for cannoneers to double up on duties. Around-the-clock firing will require the chief of section to divide the section into shifts to provide for relief. Two possible sets of duty combinations are—

(*a*) *Section of 5 men.*

1. Chief of section and gunner.

2. No. 1 (no other duty).

3. Nos. 2 and 3.

4. Nos. 4 and 5.

5. Driver.

(*b*) *Section of 4 men.*

1. Chief of section and gunner.

2. No. 1 (no other duty).

3. Nos. 2, 3, and 4.

4. No. 5 and driver.

(13) *To verify the adjustment of sighting and fire control equipment.* See paragraphs 53 through 65 and TM 9–325 for detailed instructions on testing and adjusting sighting and fire control equipment.

(14) *To check, before they are replaced in their containers, all rounds not fired which have been prepared for firing.* The chief of section personally checks, before they are replaced in their containers, all rounds not fired that have been prepared for firing, to see that all seven powder increments are present in proper condition, that they are assembled in proper numerical order, and that they are of the same lot number. He also checks to see that the lot number on the ammunition corresponds to the lot number on the container.

(15) *To control movement of the motor carriage.* When it is necessary to move the motor carriage, the chief of section instructs the drive to start the engines. He then controls the displacement of the motor carriage by voice, interphone, or hand signals.

(16) *To supervise use of ammunition.* The chief of section supervises control and use of proper lot numbers of ammunition as directed by the battery executive.

22. Gunner

a. List of Duties.

(1) To center the level bubbles on the panoramic telescope mount.

(2) To lay the gun for direction.

(3) To aline the aiming posts.

(4) To set a common deflection on a common aiming point or on aiming posts after the gun has been laid.

(5) To set or change the deflection.

(6) To apply special corrections for deflection.

(7) To refer the gun.

(8) To make corrections for aiming post displacement.

(9) To call "Ready."

b. Detailed Description of Duties.

(1) *To center the level bubbles on the panoramic telescope mount.* The gunner centers the level bubbles on the telescope mount as part of all operations that involve the use of the panoramic telescope. These bubbles are centered prior to using the telescope and the level of the mount is verified before firing ((9) below). For direct fire using the two-man, two-sight system (pars. 34–35) the gunner centers the cross-level bubble only.

(2) *To lay the gun for direction.*

(*a*) The gun being in position but not laid for direction, the gunner zeros the sight by the following operations:

1. Alines the azimuth micrometer index (gunner's aid) with the right (fixed) index (fig. 10).

2. Loosens the slipping azimuth micrometer scale locking nut by turning

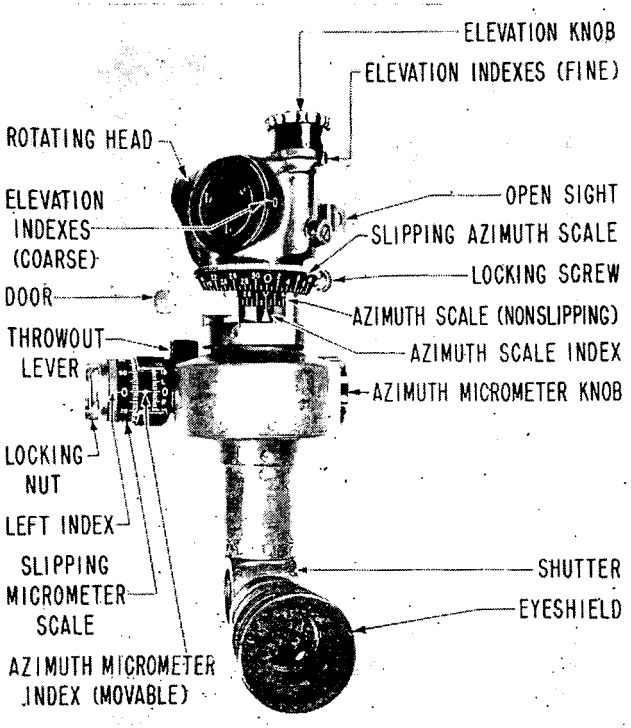


Figure 10. Panoramic telescope M12A7-series.

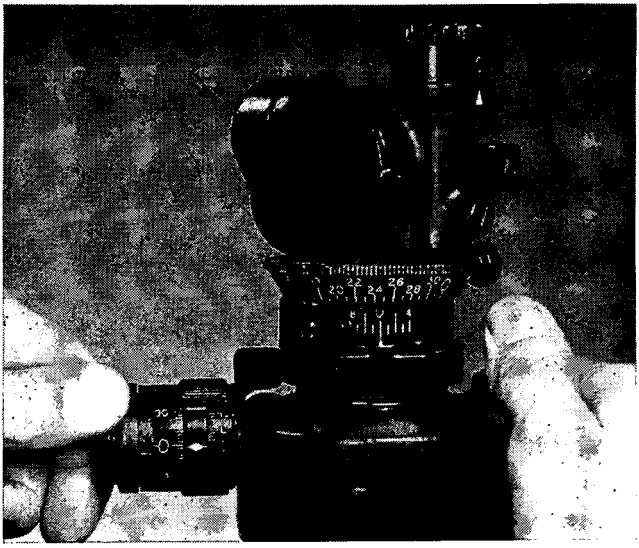


Figure 11. Loosening azimuth micrometer scale locking nut.

it counterclockwise (fig. 11) firmly holding the azimuth micrometer knob with his right hand.

3. Slips the slipping azimuth micrometer scale until its zero is alined with the left index (fig. 12) and tightens the locking nut.

4. Turns the azimuth micrometer knob so that the left index and zero of the slipping micrometer are alined with the zero of the gunner's aid and right index (fig. 10).

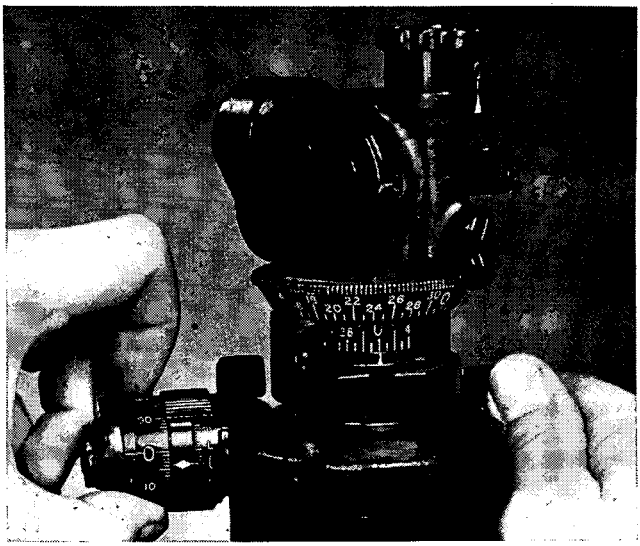


Figure 12. Alining the zero of the slipping micrometer with the left index.

5. Opens the door and with the azimuth micrometer knob or rotating head sets the nonslipping azimuth scale at zero (fig. 13) and closes the door.
6. Loosens the slipping azimuth scale locking screw; moves the slipping azimuth scale until its zero coincides with the index on the outside of the door (fig. 14).
7. Tightens the locking screw and verifies the zero readings. (With the sight thus zeroed the gunner, in indirect fire, will habitually set and

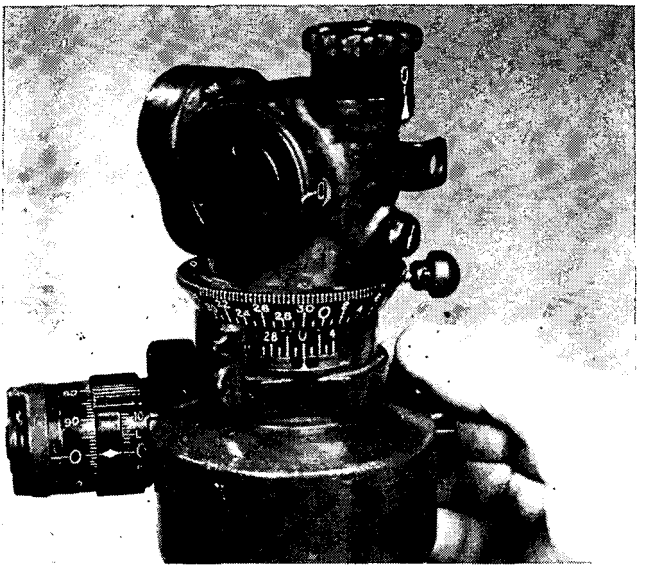


Figure 13. Turning the nonslipping azimuth scale to zero.

read deflections on the slipping azimuth scale at the index on the door, setting and reading the last two digits of the deflection on the azimuth micrometer.)

(*b*) The executive commands AIMING POINT THIS INSTRUMENT, NO. (SO-AND-SO) DEFLECTION (SO MUCH). The gunner sets the deflection for his gun on the panoramic telescope by disengaging the throw out lever and turning the rotating head to the announced hundred mil gradu-

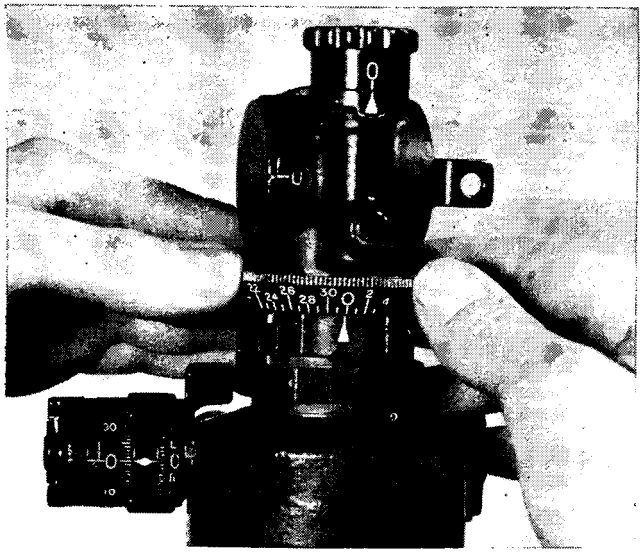


Figure 14. Slipping zero of the slipping azimuth scale to index on door.

ation. He releases the throw out lever and turns off the last two digits of the deflection on the azimuth micrometer scale, using the azimuth micrometer knob. He then traverses the gun until his line of sight through the telescope is on the executive's aiming circle. He checks to insure that his bubbles are level and announces, "No. (so-and-so) ready for recheck." As additional deflections are announced by the executive he sets them on the sight and traverses the gun so that

the vertical hair of the reticle is on the aiming circle. When the executive announces, "No. (so-and-so) is laid," the tube is orientated and should not be traversed except on order of the executive.

(3) *To aline the aiming posts.* The gun having been laid as in (2) above the executive may command, AIMING POINT, AIMING POSTS, DEFLECTION 2600, REFER. At this command the gunner sets the panoramic telescope at deflection 2600 and, with hand signals, directs No. 5 in the alinement of the posts with the vertical hair of the sight reticle (fig. 15). If, because of the nature of the terrain, the posts cannot be set out at deflection 2600, the gunner turns the azimuth micrometer knob until the slipping azimuth scale is on another even hundred mil graduation. He alines the posts at this new deflection. The chief of section reports the altered deflection to the executive: "No. (so-and-so) aiming posts at (so many hundred), 2600 in lake (or other reason)." The executive will then command NO. (SO-AND-SO), DEFLECTION 2600, REFER. At this command the gunner loosens the slipping azimuth scale locking screw and moves the slipping azimuth scale to deflection 2600 (fig. 16). He then tightens the

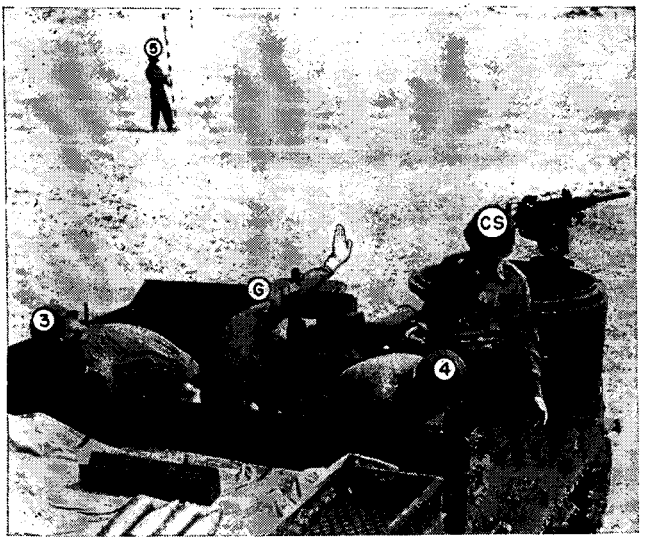


Figure 15. Alining aiming posts.

locking screw and verifies the adjustment.

(4) *To set a common deflection on a common aiming point after the gun has been laid.* The battery having been laid, the executive may command, AIMING POINT, CHURCH STEEPLE, REFER. At this command, without moving the tubes, the gunners of all guns turn their sights to the aiming point designated and report the deflections to the executive. The executive then commands, COMMON DEFLECTION 2600. At this command each gunner loosens the locking screw

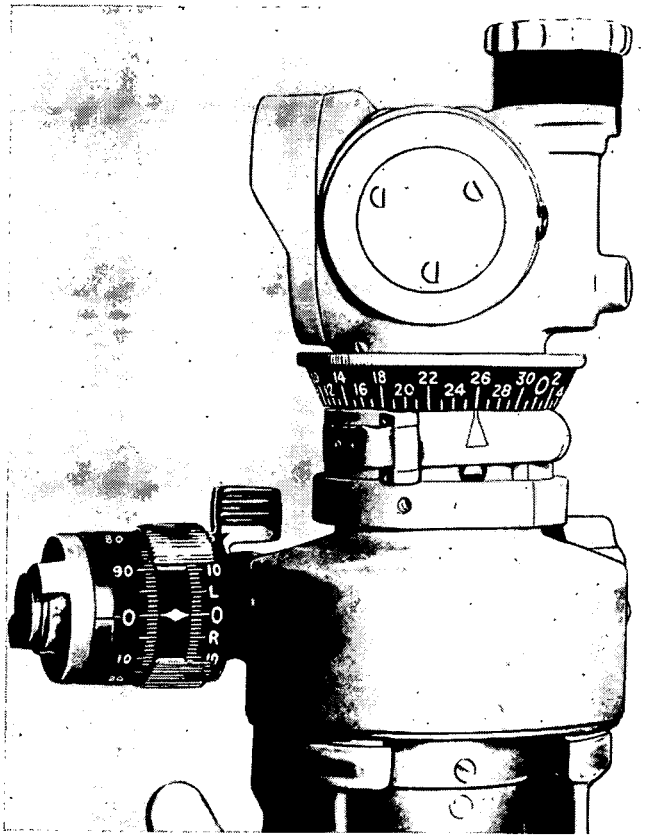


Figure 16. Common deflection 2600.

of the slipping azimuth scale and moves the scale until 2600 is in coincidence with the index on the door. The gunners then unlock the slipping azimuth micrometer scale locking nut, move the

slipping azimuth micrometer scale to zero, tighten the locking nut, and verify that the zero is in coincidence with the index and that the line of sight is still on the aiming point.

(5) *To set or change the deflection.* The command is DEFLECTION (SO MUCH). If, for example, the command is DEFLECTION 2483, the gunner disengages the throw out lever with his left thumb and turns the rotating head of the sight to 24 (2400). He releases the throw out lever and with right hand turns off the remaining 83 mils on the micrometer scale. He then traverses the gun until the vertical hair of the telescope reticle is on the aiming post, being careful that the last motion is such as to cause the vertical hair to approach the aiming point from the left.

(6) *To apply special corrections for deflection.* The gunner applies special corrections to the announced deflection for his gun by moving the movable azimuth micrometer index the proper amount and direction. For example, the executive commands SPECIAL CORRECTIONS, DEFLECTION 2665, NO. 1 LEFT 10. The gunner on No. 1 gun first sets off the announced deflection, then moves the azimuth micrometer index (gunner's aid) upward 10 mils. He then resets

the announced deflection at the index in its new position. Subsequent deflections, which are set on the azimuth micrometer scale, will be increased 10 mils automatically. The *special correction* is left on the gunner's aid until completion of the mission or until a new special correction is announced. The new special correction is set off as commanded and is *not* applied algebraically by the gunner.

(7) *To refer the gun.* The command from the executive is AIMING POINT THIS INSTRUMENT (OR OTHER POINT), REFER. Without disturbing the laying of the gun the gunner turns only the sight until, with bubbles level, the vertical hair of the reticle is on the point designated. He then reports the deflection to the executive: "No. (so-and-so) deflection (so much)."

(8) *To make correction for aiming post displacement.* For details of correcting for aiming post displacement see paragraph 43.

(9) *To call "Ready."* The gun having been laid for direction and No. 1 having called "Set," the gunner verifies the laying, moves his head clear of the telescope, and calls "Ready" to indicate that the gun is ready to be fired.

23. No. 1

The No. 1 cannoneer is the assistant gunner (par. 5*b*).

a. List of Duties.

(1) To set the site.
(2) To apply special corrections for site.
(3) To set the elevation.
(4) To lay for elevation.
(5) To open and close the breech.
(6) To call "Set."
(7) To fire the gun.
(8) To use the rammer.
(9) To man the machine gun.

b. Detailed Description of Duties.

(1) *To set the site.*

(*a*) When site is to be used, the initial series of fire commands for opening fire will contain the command for site. The command is, for example, SITE 305. For subsequent rounds, the site setting is changed by a new command SITE (SO MUCH) (fig. 17).

(*b*) To set the site, No. 1 turns the angle of site micrometer knob until the announced site is shown. The site is indicated by a scale graduated in hundreds of mils from 0 to 6 and a micrometer scale graduated from 0 to 100 mils. A site of 300 is horizontal. No. 1 first sets the index in the proper

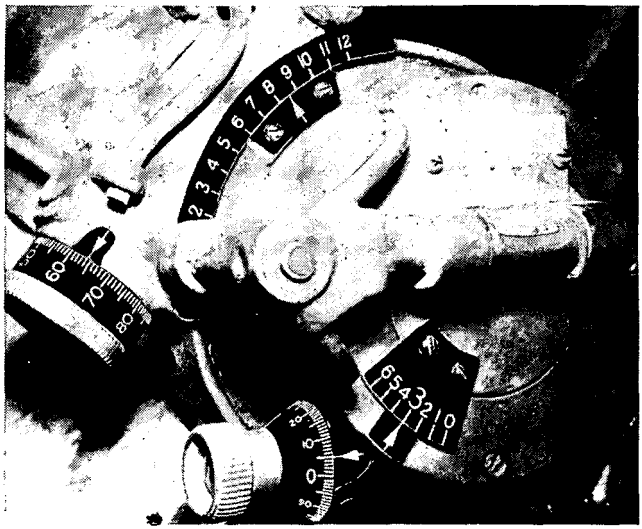


Figure 17. Site 305.

section of the scale in hundreds of mils and then sets the units on the micrometer scale. The last motion in setting the site should be in the direction of increasing site.

(2) *To apply special corrections for site.* During any mission when special corrections for site are announced, No. 1 adds algebraically the site correction announced for his gun to each site commanded. For example, the executive commands SPECIAL CORRECTIONS, SITE 310, NO. 1 DOWN 2, NO. 2 DOWN 3, etc.; 308 is set on the site scale of

No. 1 gun; 307 is set on the site scale of No. 2 gun, etc. Special site corrections should be marked in chalk on a convenient place inside the compartment.

(3) *To set the elevation.* To set an elevation, No. 1 sets the site and then sets the announced elevation on the elevation scale. No. 1 grasps the elevating knob and turns it until the announced elevation is shown, making sure that the last movement is in the direction of increasing elevation.

(4) *To lay for elevation.* No. 1 turns the cross-leveling worm knob and centers the cross-level bubble. Having performed the duties described in (1), (2), and (3) above, he turns the elevating handwheel and elevates or depresses the tube until the longitudinal-level bubble is centered making sure that his eye is directly opposite the bubble and that the last movement is in the direction in which it is most difficult to turn the handwheel.

(5) *To open and close the breech.*

(*a*) *To open the breech.* No. 1 grasps the breech operating lever handle with his left hand, depresses the handle to release the catch, and draws it toward him and to the rear, opening the breech.

(*b*) *To close the breech.* No. 1 grasps the breech operating handle with his left

hand and pushes it forward and away from him until the breech is closed and the latch is engaged. When the breech is fully closed the latch is automatically engaged.

(6) *To call "Set."* No. 1 calls "Set" when the gun has been loaded, the breech closed, and the gun laid for elevation.

(7) *To fire the gun.* At the chief of section's signal or command NO. (SO-AND-SO) FIRE (par. 21*b*(7)), No. 1 grasps the lanyard with his right hand and pulls. After firing he releases the lanyard and opens the breech. For action in case of misfire, see paragraph 85.

(8) *To use the rammer.* Normally the rammer components will be handled by No. 1. The rammer staff is used to extract cartridge cases that cannot be ejected by the extractor. To extract a cartridge case, No. 1 inserts the rammer staff in the bore, and lightly taps the bottom of the inside of the case until it is loosened and can be pushed out of the chamber. No. 2, standing at the breech, receives the cartridge case in both hands. To extract an unfired round, the procedure described in paragraph 47 will be followed.

(9) *To man the machine gun.* The machine gun will be manned by No. 1 when the

motor carriage is traveling and when directed by the chief of section.

24. No. 2

a. List of Duties.

(1) To load the gun.

(2) In volley fire, to call out the number of the round and the announced elevation.

(3) When the breech is opened, to inspect the chamber and bore to insure that they are clear.

(4) To dispose of used cartridge cases.

b. Detailed Description of Duties.

(1) *To load the gun.* No. 2 grasps the round with his right hand at the base of the cartridge case and his left hand in front of the rotating band. He then faces the breech and, after an elevation or quadrant has been announced, inserts the round in the breech and *pushes it home* with his right fist (fig. 18). It is extremely important that he use his fist, to guard against getting his fingers crushed by the closing breechblock. No. 2 will be particularly careful to avoid striking the fuze against any portion of the gun. A round to be loaded will be held well out of the path of the recoil until the tube is again in battery.

(2) *To call out the number of the round and the announced elevation in volley fire.* To insure firing the correct number of

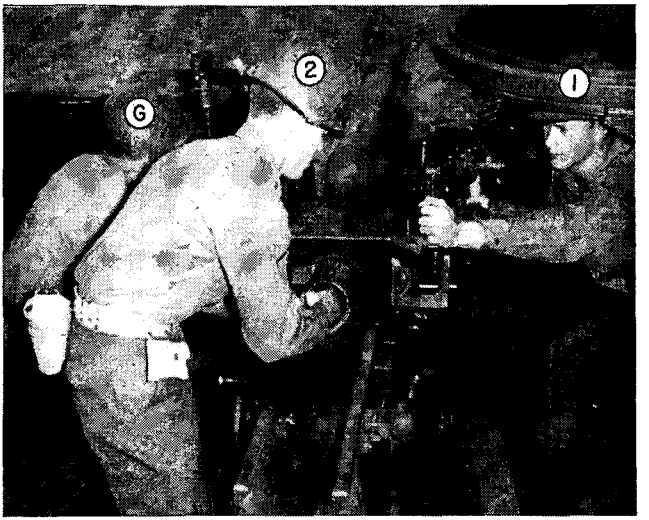


Figure 18. No. 2 loading the gun.

rounds in volley fire, No. 2 calls out the number of the round and the elevation as he finishes loading the projectile. As he finishes loading the last round, he adds, "Last round." For example, when two rounds are to be fired at elevation 480, he calls out, "Second and last round, 480." He should not speak louder than is necessary to insure his being heard by the members of his own section.

(3) *To inspect the chamber and bore when the breech is open to insure that they are clear.* No. 2 will inspect the chamber and bore after each round is fired to make certain that the chamber is clear

and that the bore is free of residue from the charge. He calls out "Bore clear" if it is clear.

(4) *To dispose of used cartridge cases.* No. 2 will throw used cartridge cases over the right side of the motor carriage.

25. No. 3

a. List of Duties.

(1) To assemble rounds assisted by No. 4.

(2) To fuze or change fuzes of projectiles.

(3) To set the fuze setter.

(4) To set fuzes.

(5) To apply special corrections for his gun to fuze settings.

(6) To replace ammunition in containers assisted by No. 5.

b. Detailed Description of Duties.

(1) *To assemble rounds.* No. 3 receives the projectile from No. 5 (par. 27*b*(2)) and assisted by No. 4 (par. 26*b*(2)) seats the projectile in the cartridge case. No. 3 inspects each round to see that it is free from dirt and that the rotating band is not burred. He wipes off any foreign matter with a cloth and sets aside any projectiles with burred rotating bands until time permits removing burrs with a file.

(2) *To fuze or change fuzes of projectiles.* No. 3 removes the fuze or closing plug

from the projectile; removes (or replaces) the supplemental charge, if necessary; and screws in the designated fuze. In assembling fuzes to, or disassembling fuzes from shell, only the authorized fuze wrench should be used. VT fuzes should be screwed in by hand and tightened with fuze wrench M18, using only manual force. *Do not hammer on the wrench or use an extension handle.* If a time fuze is used, No. 3 removes the safety pull wire from the fuze and, if a booster is inserted, from the booster. Boosters without safety pins will not be used.

(3) *To set the fuze setter.*

(*a*) *Fuze setter M22.* The corrector scale is not used. No. 3 makes certain that the corrector scale is locked at corrector setting 30. He releases the time scale clamping screw marked T and, holding the fuze setter by the outer ring, turns the body until the index on the body is opposite the announced time on the time scale. He then locks the time scale clamping screw, being careful not to disturb the setting. For accuracy, No. 3 looks squarely at the scales and indexes in the same manner each time.

(*b*) *Fuze setter M28* (fig. 19). This fuze setter has no corrector scale. It has

two time scale rings; one for use on 45-second fuzes and one for 100-second fuzes. In addition the M28 has a night lighting device incorporated in the handle. Except for the corrector scale, operation of the M28 is similar to that of the M22.

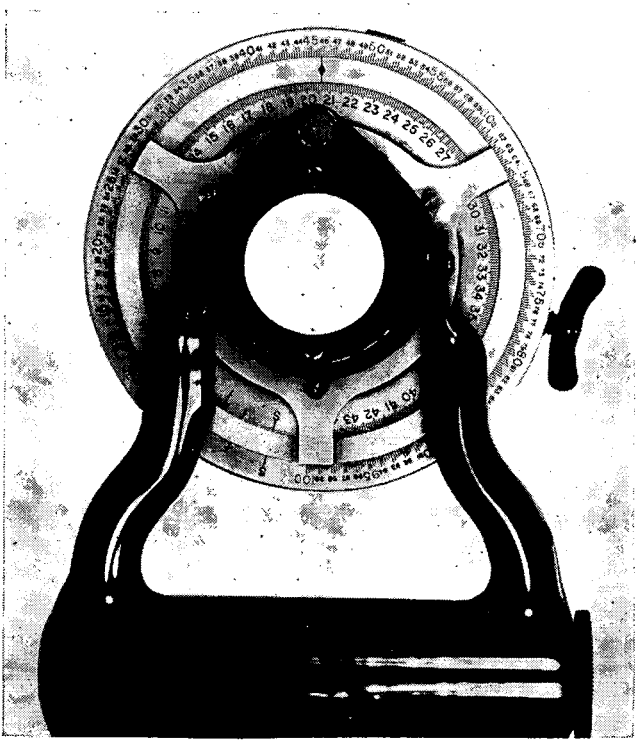


Figure 19. Fuze Setter M28.

(4) *To set fuzes.*

(*a*) *Selective superquick and delay fuzes.* When FUZE QUICK is commanded, No. 3 will verify the superquick setting. (The slot on the setting sleeve should be alined with the letters SQ.) When FUZE DELAY is commanded, he will turn the setting sleeve until the slot is alined with the word DELAY.

(*b*) *Combination time and superquick fuzes.* These fuzes may be set for time action. However, the percussion element will detonate the round upon impact if the time element fails. After fuzing the projectile, No. 3 removes the safety pull wire from the fuze. For percussion action the command is FUZE QUICK M500 (or other designation). No. 3 then verifies that the S on the setting ring is alined with the index on the fixed ring. If not, he sets it at S.

(*c*) *VT fuzes.* Current standard models of these fuzes require no setting by any personnel.

(*d*) *Setting time fuzes.*

1. *Using fuze setter M22 or M28.* After making the announced settings on the fuze setter, No. 3 carefully places it over the fuze and turns the setter until the notch on the time ring of the fuze engages the stop on

the setting ring of the fuze setter. He then pushes down on the fuze setter until the notch fully engages the stop, and turns it until the pawl in the adjusting ring assembly drops into the notch of the fixed fuze ring. This prevents further turning and indicates that the fuze is set. He then lifts the fuze setter from the fuze and makes a visual check of the fuze setting to insure that the fuze ring notch was actually engaged and that the fuze is set properly. If the desired time setting is passed, he replaces the fuze setter on the fuze and continues rotation in the original direction until the stop pawl of the fuze setter engages the fixed notch of the fuze and prevents further rotation. The setting is then rechecked visually.

2. *Using fuze setter M14 or M27.* These are wrench-type fuze setters in which the fuze time scale is used in setting the fuze. No. 3 engages the key of these wrench-type fuze setters in the notch on the setting ring of the fuze and rotates the setting ring or upper cap so as to increase the time setting until the announced setting of the fuze time scale is opposite the index mark on the fuze.

(5) *To apply special corrections to fuze settings.* When special corrections are announced for his gun, No. 3 will apply the fuze setting special correction; the command is for example, TIME 18.2, NO. 1 PLUS 0.7. The No. 3 cannoneer on No. 1 gun must add 0.7 of a second to 18.2. He continues to apply the correction to all subsequent commands received for fuze time in that mission or until a new special correction is received for his gun.

(6) *To replace unused ammunition in containers.* Under the personal supervision of the chief of section and assisted by No. 5, No. 3 replaces unused ammunition in containers. He is careful that the lot number on the ammunition corresponds to the lot number on the container.

26. No. 4

a. List of Duties.

(1) To prepare charges.
(2) To assist No. 3 in assembling rounds.
(3) To assist No. 3 in setting time fuzes.
(4) To place prepared rounds on the rear deck.
(5) To replace increments in the cartridge case before the rounds are replaced in their containers.

b. Detailed Description of Duties.

(1) *To prepare charges.* The fire command

will designate the charge. Upon receiving the cartridge case from No. 5 (par. 27*b*(2)), No. 4 verifies that there are seven powder increments and removes those numbered higher than the charge designated. He then replaces the remaining increments in the cartridge case in their original numerical order.

(2) *To assist No. 3 in assembling rounds.* After No. 4 has prepared the charge, he assists No. 3 to assemble the projectile to the cartridge case, taking care that the lip of the cartridge case is not damaged when No. 3 seats the projectile.

(3) *To assist No. 3 in setting time fuzes.* See paragraph 25*b*(4) (*d*) for details of setting time fuzes.

(4) *To place prepared rounds on the rear deck.* As soon as the round is prepared for firing, No. 4 places it base forward on the rear deck of the motor carriage ready for No. 2 to pick up and load into the breech. When No. 2 is ready to load the gun and rounds have not been previously prepared, No. 4 passes the prepared round directly to No. 2. This movement is made in such a manner that No. 2 is able to grasp the round with his left hand in front of the rotating band and his right hand on the base of the cartridge case, making sure that the pro-

jectile and cartridge case do not separate.

(5) *To replace increments in the cartridge case before rounds are replaced in their containers.* Under the personal supervision of the chief of section, No. 4 replaces increments in cartridge cases for all ammunition prepared for firing but not fired. He carefuly checks to see that all seven increments are present, in the proper condition, assembled in the proper numerical order, and that the lot number is the same as the lot number of the container.

27. No. 5

a. List of Duties.

(1) To set out aiming posts.

(2) To remove ammunition from containers.

(3) To assist No. 3 in replacing unused ammunition in containers.

b. Detailed Description of Duties.

(1) *To set out aiming posts.* When so directed by the chief of section, No. 5 sets out the aiming posts under the guidance of the gunner (par. 22*b*(3)).

(2) *To remove ammunition from containers.* No. 5 removes the taped end from the cartridge case portion of the ammunition container and tilts the container so that the cartridge case can be taken by No. 4. He then reverses ends of the container

and repeats the process so that the projectile is received by No. 3. During extended firing when ammunition is delivered to the section, No. 5 may be on the ground in rear of the vehicle. When he is working on the ground, he disassembles the ammunition and places the projectile and cartridge case on the rear deck of the motor carriage where Nos. 3 and 4 can reach them easily.

(3) *To assist No. 3 in replacing unused ammunition in containers.* See paragraph 25*b*(6) for details of replacing prepared rounds of ammunition in containers.

28. Driver

a. List of Duties.

(1) To move the cartridge if large shifts are necessary.

(2) To perform maintenance in stabilized situations.

(3) To assist No. 5 in handling ammunition.

(4) To repair wire.

b. Detailed Description of Duties.

(1) *To move the carriage if large shifts are necessary.* Until the direction of fire is definitely determined and at such other times as necessary, the driver will be at his post prepared to move the motor carriage. At the direction of the chief of section, the driver will shift the carriage to permit a large deflection shift

to fall within the on-carriage traverse limits.

(2) *To perform maintenance in stabilized situations.* When firing is stabilized and the engines are not running, the driver performs such maintenance as may be accomplished without interfering with the firing of the gun. Any disassemblies or maintenance operations that will render the vehicle immobile for any period of time must be ordered by the chief of section.

(3) *To assist No. 5 in handling ammunition.* When No. 5 is unable to keep up with the ammunition requirements dictated by a high rate of fire, the chief of section may direct the driver to assist in the handling of ammunition.

(4) *To repair wire.* The driver, when directed by the chief of section, will make repairs to the intra-battery communication system.

Section II. DIRECT LAYING, GENERAL

29. General

a. Firing by direct laying is a technique that demands special training. The section must operate as an independent unit. Training in direct laying is based on the technique employed in indirect laying. Targets taken under fire by the

section in direct laying usually those capable of returning fire on the section at point-blank range; therefore, the speed and accuracy required in indirect laying becomes even more important for direct laying missions.

b. There are two basic systems of direct laying for use with the 105-mm howitzer: The *two-man, two-sight system* (pars. 33 to 37 incl.) where the gunner, using the panoramic telescope, lays for direction, and No. 1, using the elbow telescope, lays for range; and the *one-man, one-sight system* (pars. 38 to 42) where the gunner lays for both direction and range using the panoramic telescope.

c. The chief of section will designate the system of laying to be used when firing by direct fire methods. Selection of the system is dependent upon the type which can more effectively engage the target. Training must include both systems of direct laying.

d. For additional information on direct laying, see FM 6–140.

30. Preparation of a Range Card

a. The chief of section is responsible for defense in his assigned sector, but he should be prepared to fire on targets in other sectors.

b. As soon as possible after occupation of position, the chief of section measures or estimates the ranges to critical points in likely avenues of

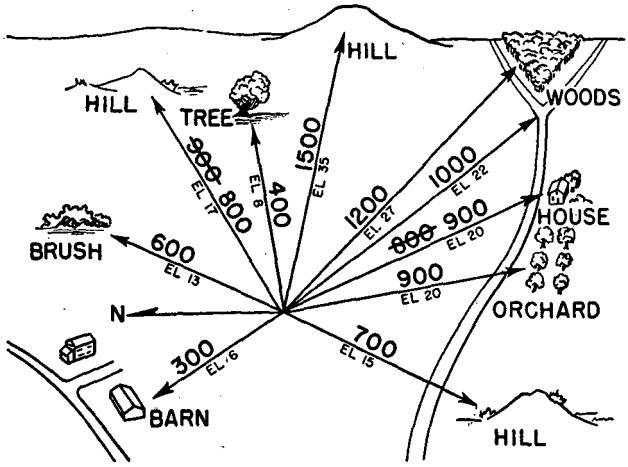


Figure 20. Range card for direct laying.

approach for enemy tanks and vehicles. For quick reference he prepares a range card (fig. 20) upon which he notes these ranges.

c. If there are no prominent terrain features, stakes may be driven into the ground at critical points for reference. As time permits, the range card will be improved by replacing estimated ranges with more accurate ranges obtained by firing, pacing, taping, vehicle speedometer reading, map measurements, or survey.

31. Field of Fire

The sector of fire for the gun should, if possible, be cleared of all obstructions that might endanger battery personnel when the gun is fired, or that

might hinder observation. Care should be taken not to give away the location of the position.

32. Conduct of Fire

a. Types and Selection of Targets for Direct Laying. Targets for direct laying usually consist of hostile vehicles, tanks, and personnel threatening the battery. Enemy personnel, whether alone or accompanying tanks, will seldom present themselves as a clearly defined target. Normally, attacking infantry, using all available cover, reveal themselves only fleetingly. Accordingly , fire is conducted on the area containing the attackers rather than upon the individuals. Tanks usually attack in groups and may be accompanied by infantry. Normally, first priority is given to attack of those targets within the assigned sector of the weapon and second to targets in other sectors. Priority within the assigned zone is given to—

(1) Tanks at short ranges, threatening to overrun the position.

(2) Hull down stationary tanks covering the advance of other tanks.

b. Ammunition and Fuzes.

(1) *General.* For close-in fires a variety of fuzes and shells are available. When using high explosive shell, charge 7 is used habitually for speed, ease in adjustment, imparting forward motion to fragments, and more effective fuze action.

The flat trajectory resulting from use of charge 7 coupled with dug-in guns may make extremely close-in fire impossible due to projectiles skipping without detonating on impact. At ranges of 200 to 400 yards fuzes may fail to function on hard, flat ground; however, preparation of sectors of fire will remedy this situation. The terrain may be prepared for direct fire by placing mounds of sandbags, dirt, or logs in the gun's sector of responsibility. When direct fire is placed on these or other previously selected points as they are approached by an attacking force, the necessity for adjusting fire is reduced.

(2) *Ammunition.* Ammunition may be HE, HEAT, or white phosphorus (WP). HEAT is designed for, and is highly effective in, antitank and antivehicle fires. Shell HE is ideally suited for antipersonnel fire and is effective against vehicles and tanks. WP may be used to set immobile tanks and vehicles on fire, to further restrict defiles, and to produce casualties. However, consideration must be given to the effect on the defense of the resulting smoke screen.

(3) *Fuzes.* HEAT projectiles contain base detonating fuzes. WP ammunition is fuzed with a superquick-delay fuze while

in direct fire HE may be used with fuzes quick, delay, or time.

(*a*) Fuze quick is the most desirable fuze to use with HE shell on close-in fires. It is highly effective and, since no fuze setting is required, is much faster to use.

(*b*) The time required to set the fuze and to adjust the point of impact for maximum ricochet effect makes fuze delay less desirable than fuze quick. When using fuze delay to gain ricochet effect, the point of impact is adjusted 10–30 yards in front of the target. If less than 50 percent of the bursts are ricochet, the fuze should be changed to quick.

(*c*) Fuze time is the least desirable fuze for close-in fires. At short fuze settings, variations in time of burning give wide range dispersion. Hence, this fuze should be used only for ranges of more than 1000 yards. The areas covered effectively by air and ricochet bursts are similar.

c. Trajectories. Trajectory characteristics change with the type of ammunition and the charge fired. The following trajectory characteristics govern the conduct of fire:

(1) *Ranges from 0 to 400 yards using HEAT or ranges from 0 to 600 yards using HE*

charge 7. Within these range limits, the trajectory will be flat enough to prevent an 8-foot tank from passing safely under it. Fields of fire and terrain allowing, the upper range limits for the ammunition and charge used are the ideal at which to open fire. Fire can then be conducted over the maximum time without misses if deflection is correct. Also there is less risk of obscuring the target with the smoke from a short burst.

(2) *Ranges from 400 to 700 yards using HEAT, or 600 to 1000 yards using HE charge 7*. These range limits include the zone in which the trajectory is sufficiently flat to permit direct estimation of range without actually bracketing the target. Assuming little dispersion, if a hit is obtained at the bottom of an 8-foot tank firing at the upper range limit, 700 yards for example, with HEAT, the adding of a 100-yard range change will result in a round that will just brush the top of the tank. During adjustment within this zone, range changes should seldom be more than 100 yards, and frequently range changes of 50 yards will be sufficient. The upper limits mentioned herein are the greatest ranges at which fire should be opened unless tactical conditions require otherwise. A trained

crew should obtain hits by the second shot.

(3) *Ranges from 700 to 1300 yards using HEAT or 1000 to 1800 yards using HE charge 7.* This zone includes the ranges at which hits are only reasonably possible. Bracket methods are normally used to obtain adjustment in this zone. There is more dispersion in this zone, and fire should not be opened at these ranges unless surprise is not important.

(4) *Ranges over 1300 yards using HEAT, or over 1800 yards using HE charge 7.* At ranges over 1300 yards using HEAT or over 1800 yards using HE charge 7, direct laying is not advisable against moving targets. Dispersion is the controlling factor. Ranges must be known accurately or determined by bracketing. At these ranges the slope of fall of the projectile becomes so great that a hit on a moving target is very difficult to obtain.

d. Vertical Displacement Table. Vertical displacement is the change in the point of burst (up or down) between two rounds fired at an upright target at different range settings. Table III shows the vertical displacement for a 100-yard range change at various ranges, firing shell HEAT and shell HE charge 7. The use of vertical displacement in direct firing is explained in FM 6–140.

Table III. Vertical Displacement (Feet) per 100-Yard Range Change.

Range (yards)	Displacement, feet, shell HEAT	Remarks	Displacement, feet, shell HE Charge 7	Range (yards)
100	1	Start firing using 400 yard range setting.	0.5	100
200	2		1.5	200
300	3		2	300
			2.5	400
			3.5	500
400	4	Start firing with estimated range. Increase or decrease by multiple of 50 or 100 yards. Bracketing not necessary.	4	600
500	5.5		5	700
600	6		5.5	800
700	8		6	900
			7	1000
800	9	Bracket target (get bursts over and short) to obtain hit.	8	1100
900	10.5		9	1200
1000	11.5		10	1300
1100	13		10.5	1400
1200	14.5		11.5	1500
1300	16		13	1600
			14	1700
			14.5	1800
Over 1300	----	At ranges over 1300 yards using HEAT or over 1800 yards using HE charge 7, direct firing is too inaccurate to be used against moving targets (*c*(4) above).	----	Over 1800

Note. Computed from data obtained from FT 105–H–4. Two-man, two-sight system.

Section III. DIRECT LAYING, TWO-MAN, TWO-SIGHT SYSTEM

33. Chief of Section

a. List of Duties.

(1) To conduct the fire of his gun.

(2) To alert his section.

(3) To identify or select the target.

(4) To select the charge, fuze, and projectile.

(5) To give direction of the target.

(6) To determine the lead in mils.

(7) To give the command for range.

(8) To give subsequent commands based on observed effect.

b. Detailed Description of Duties.

(1) *To conduct the fire of his gun.* The chief of section conducts the fire of his gun when the executive commands TARGET (IDENTIFICATION), FIRE AT WILL, or simply FIRE AT WILL.

(2) *To alert his section.* The command to alert the section is 1. CANNONEERS, 2. POSTS. At the command, members of the section move to their posts to be ready for the initial fire command. If the target is outside the maximum traverse of the gun, the alert is followed by the necessary signals to the driver to get the motor carriage pointed in the approximate direction of the target.

(3) *To identify or select the target.* If the executive designates an object as the target, the chief of section must identify this target correctly. If the target is a group of tanks or other objects, the chief of section selects the target which, in his estimation, is the greatest threat to his own position or the position of the supported troops. He repeats the identification to his section, employing the minimum number of words, such as TANK, MOVING TANK, ENEMY INFANTRY, (OR OTHER TARGET).

(4) *To select the charge, fuze, and projectile.* The chief of section commands the appropriate items in sequence such as SHELL HE, CHARGE 7, FUZE, or SHELL HEAT. He selects the charge, fuze, and projectile in accordance with the consideration contained in paragraph 32.

(5) *To give the direction of the target.* The chief of section ascertains the direction of movement of the target and commands TRAVERSE RIGHT (LEFT), STEADY—ON. While giving these commands he looks along the tube or through the open sight of the panoramic telescope.

(6) *To determine the lead in mils.* The amount of lead in mils is determined by the speed of the target, the range, the

course, and the ammunition being fired. Figure 21 shows approximate initial leads that should be used for various speeds when firing HEAT and HE charge 7. The initial command for lead is LEAD (SO MUCH). During adjustment the lead is changed by the command RIGHT (LEFT) (SO MUCH).

SPEED	LEAD			
	TARGET TRAVELLING PERPENDICULAR TO LINE OF FIRE.		TARGET TRAVELLING 45° TO LINE OF FIRE.	
	HE–AT	CHARGE 7	HE–AT	CHARGE 7
SLOW (0–10 MPH)	5	5	5	5
MEDIUM (10–20 MPH)	20	15	15	10
FAST (OVER 20 MPH)	30	25	20	20

Figure 21. Approximate leads.

(7) *To give the command for range.* The command is RANGE (SO MUCH). The range commanded by the chief of section is that range to be set on the sight reticle. During adjustment of fire, range is corrected by the command ADD (DROP) (SO MUCH).

(8) *To give subsequent commands based on observed effect.* The chief of section observes each round and gives the necessary commands for changes in lead and range to adjust the burst to the target.

34. Gunner

a. List of Duties.

(1) To center the cross-level bubble on the panoramic telescope mount.

(2) To set the elevation indexes and the azimuth scales of the panoramic telescope at zero.

(3) To lay on the target with the announced lead.

(4) To track the target.

(5) To command FIRE.

(6) To follow subsequent commands.

b. Detailed Description of Certain Duties.

(1) *To lay on the target with the announced lead and track the target.*

(*a*) Prior to any direct fire mission the gunner verifies that the movable azimuth micrometer (gunner's aid) index is set at zero.

(*b*) If the slipping azimuth and slipping micrometer scales have not been slipped, the gunner zeros these two scales.

(*c*) If only the slipping azimuth scale has been slipped, the gunner disregards scale. He opens the door over the non-slipping azimuth scale and sets that scale at zero. The micrometer scale is brought to zero.

(*d*) If both the slipping micrometer scale and the slipping azimuth scale have

been slipped, the gunner opens the azimuth scale door and turns the non-slipping azimuth scale to zero. He then turns the azimuth micrometer knob until the left index of the micrometer matches the right index.

(*e*) The operations described in (*a*), (*b*), (*c*), and (*d*) above make the line of sight of the telescope parallel to the axis of the bore. The gunner then tracks target using the traversing handwheel to keep the appropriate vertical grid line in the reticle of the telescope on the center of the visible mass of the target. The announced lead

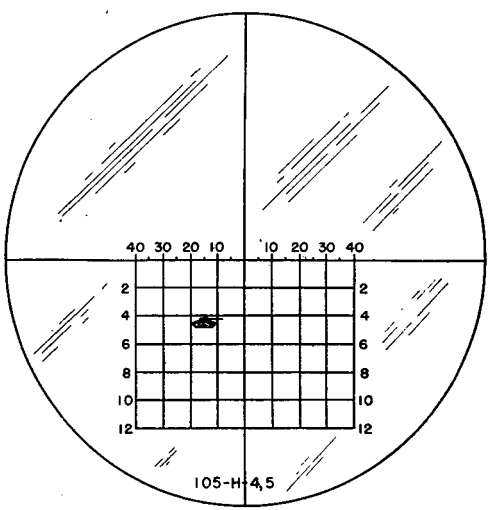


Figure 22. Gunner's sight picture, two-man, two-sight system (lead 15 mils).

is measured on the horizontal reticle scale (fig. 22). In the two-man, two-sight system the vertical location (range) of the target is controlled by No. 1. If time does not permit the chief of section to announce the lead, it is estimated by the gunner.

(2) *To command FIRE.* After No. 1 has called "Set" and when ready, the gunner commands FIRE.

35. No. 1

a. List of Duties.

(1) To lay for range, using the elbow telescope.

(2) To track the target.

(3) To call "Set" when the gun is loaded and the correct range line is on the center of the visible mass of the target.

(4) To follow subsequent commands.

b. Detailed Description of Certain Duties. In direct laying, using the elbow telescope, No. 1 sets off the range commanded by the chief of section by placing the appropriate range line in the reticle of the elbow telescope on the center of the visible mass of the target; he tracks the target with the elevating handwheel maintaining the proper range line on the center of the target (fig. 23).

36. No. 5

a. List of Duties.

(1) To open and close the breech.

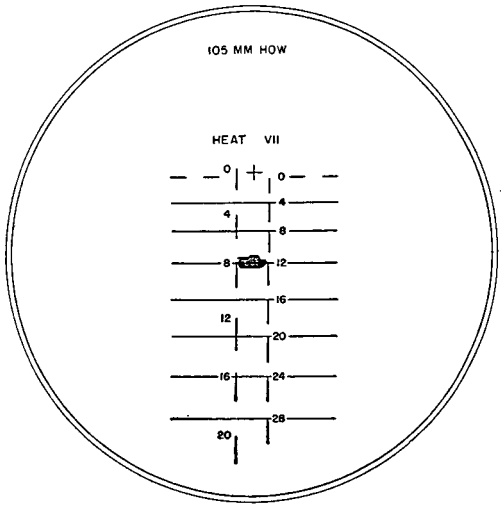


Figure 23. No. 1's sight picture, elbow telescope M16A1C, two-man, two-sight system, shell HEAT, range 800 yards.

(2) To indicate that the gun is loaded by tapping No. 1 on the shoulder.

(3) To fire the gun at the gunner's command.

b. Detailed Description of Certain Duties. No. 5 will take position in rear of No. 1 and will open and close the breech and fire the gun. He taps No. 1 with his right hand; when the gun is loaded, he pulls the lanyard with his left hand when the gunner commands FIRE.

37. Remainder of Section

The remaining cannoneers perform their duties as prescribed for indirect laying.

Section IV. DIRECT LAYING, ONE-MAN, ONE-SIGHT SYSTEM

38. Chief of Section

The duties of the chief of section are the same as in the two-man, two-sight system (par. 33). Since the panoramic telescope's reticle range lines are graduated for shell HE, charge 5, the chief of section must consider the ammunition being fired and announce the appropriate range setting. At short ranges (under 2400 yards) the elevations for charge 7 are almost exactly half those of charge 5. The reticle can be used for charge 7 by laying with half the true range. When firing shell HEAT the correct range setting is determined and announced by the chief of section.

39. Gunner

a. List of Duties.

(1) To match the elevation indexes of the panoramic telescope mount and set the azimuth scales of the sight at zero.

(2) To center the cross-level bubbles on the panoramic telescope mount.

(3) To lay on the target with the announced lead and range.

(4) To track the target.

(5) To command FIRE.

(6) To follow subsequent commands.

b. Detailed Description of Certain Duties. The gunner matches the sight mount elevation indexes on the actuating arm and rocker and those on the

elevation knob and shaft. He then sets the elevation indexes and azimuth scales of the panoramic telescope at zero. Action in regard to slipping scales is as described in paragraph 34. After laying approximately on the target, he centers the telescope mount cross-level bubble. He then lays on the target with the announced lead and range measured on the scales of the reticle (fig. 24). Other duties are performed as in the two-man, two-sight system (par. 34).

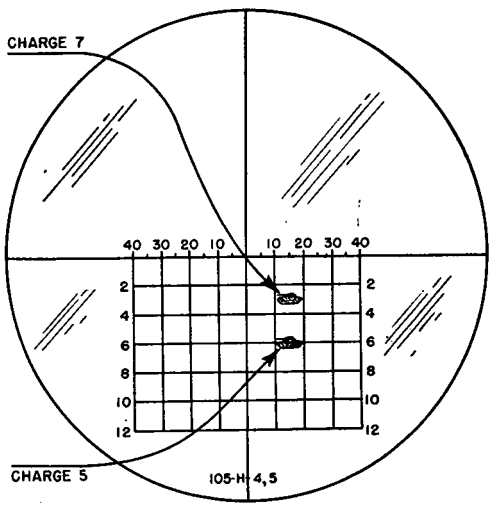


Figure 24. Gunner's sight picture, one-man, one-sight system (lead 15 mils, range 600 yards).

40. No. 1

The duties of No. 1 when using the one-man, one-sight system are to open and close the breech,

to call "Set" when the gun is loaded, and to fire the gun at the gunner's command FIRE.

41. Remainder of the Section

The remaining cannoneers perform their duties as prescribed for indirect laying.

CHAPTER 6

TECHNIQUES AND SITUATIONS THAT REQUIRE SPECIAL ATTENTION

42. Precision in Laying

a. Sighting and laying instruments, fuze setters, and elevating and traversing mechanisms must be properly operated to reduce the effects of lost motion. For uniformity and accuracy the last motion in setting instruments and in laying should be in the direction prescribed in this manual. To insure accurate laying, personnel who lay the gun must be required to verify the laying after the breech has been closed.

b. The line of sight when setting and reading a scale or centering a bubble should be at a right angle to the scale or level vial to prevent parallax errors. Bubbles should be centered exactly.

c. For uniformity and accuracy in laying on aiming posts, the vertical hair in the reticle of the panoramic telescope should be alined with the left edges of the aiming posts.

43. Aiming Points and Displacement Corrections

a. General. After the gun has been laid initially for direction it is referred to the aiming posts and usually to one or more distant aiming points. An aiming point must have a sharply defined

point or vertical line clearly visible from the gun so that the vertical hair of the panoramic telescope can be alined on exactly the same place each time the gun is relaid.

b. Distant Aiming Point. A distant aiming point is one at sufficient distance (at least 2000 yards) so that normal displacements of the gun in firing or traverse will not cause a horizontal angular change in direction (with the same settings on the azimuth scales) of more than ½ mil. The executive officer usually designates the distant aiming point or points to be used.

c. Aiming Posts.

(1) Two aiming posts are used for each gun. Each post is equipped with a light for use at night. The most desirable distance from the gun to the far aiming post is 100 yards, considering accuracy of laying, visibility, and ability to control the aiming post lights. First the far post is set up and alined. The near post is then set up and alined halfway between the far aiming post and the gun (par. 22*b* (3)). The vertical hair of the telescope must be on the left edge of the aiming posts for proper alinement. To insure equal spacing of aiming posts, the distance to both the near and the far post should be paced by the same man. Where ground conditions make pacing inaccurate, the distance from the gun to the posts may be measured using the pano-

ramic telescope and the aiming post as measuring devices ((4) below).

(2) For night use, the aiming post lights should be adjusted so that the far one will appear several feet above the near one. On flat terrain this may be accomplished by using only the lower half of the near post. The two lights placed in this way will establish a vertical line for laying the gun.

(3) Since the panoramic telescope is mounted at considerable distance from the center of rotation of the top carriage, large changes in deflection will cause misalinement of the aiming posts. Placing the aiming posts to the left front at a deflection of approximately 2600 when the gun is in the center of traverse will keep this misalinement to a minimum and still allow for maximum visibility.

(4) To measure the distance from gun to aiming posts the stadia method may be employed, using the panoramic telescope and the aiming post as measuring devices. No. 5 cannoneer, when setting out the aiming posts, holds the upper section of one of the aiming posts in a horizontal position, perpendicular to the line of sighting. The gunner measures the length of this section in mils on the reticle of the panoramic telescope. For example, the upper section of the aiming post is 4½ feet long so that it measures 15 mils

when it is 100 yards from the gun. The proper location for the near post, in this case, would be at the point at which the 4½-foot section measures 30 mils. In many cases, the ideal spacing of 50 and 100 yards cannot be obtained, but the posts will be properly spaced when the near post is set at a point where one section of the aiming post (4½-feet) held horizontally measures twice the number of mils it measured at the far post location. This measurement may be performed at night by attaching the night-lighting devices on the ends of one section of an aiming post and holding it horizontally.

d. Correction for Displacement of Aiming Posts. When the gunner notes that the vertical hair of the telescope's reticle is displaced from the line formed by the two aiming posts (or aiming post lights), he lays the gun so that the far aiming post (light) appears exactly midway between the near aiming post (light) and the vertical hair (fig. 25). If the displacement is due to traversing the gun, the gunner continues to lay as described above. If the displacement is due to progressive shifting of the carriage from shock of firing or other cause, the gunner will notify the chief of section, who, at the first lull in firing, will notify the executive and request permission to realine the aiming posts. To realine, the gun is laid with the far post midway between the near post and the vertical hair (fig. 25). The far aim-

ing post is moved into alinement with the vertical hair of the telescope and then the near aiming post is alined. If terrain conditions make it impracticable to move one of the two aiming posts, the gun is laid for direction and referred to the aiming post that cannot be moved. This deflection is reported to the executive. The other post is alined using the method described in paragraph 22*b*(3) and the azimuth micrometer scale is slipped to retain the same deflection that was used prior to realinement of the aiming posts.

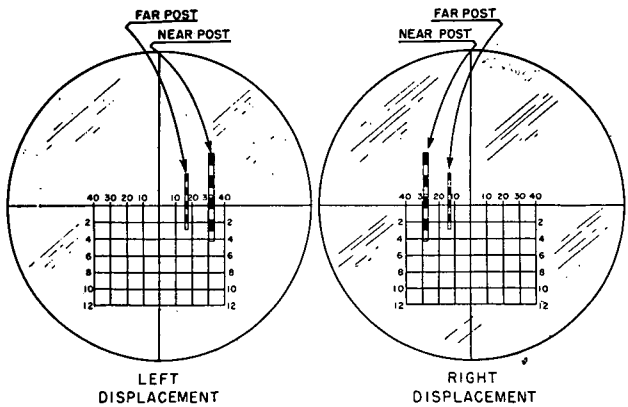


Figure 25. Gunner's sight picture of aiming posts in proper relationship when correcting for displacement.

44. Testing Target

If the regular target, TT 7159214, or a visible distant aiming point is not available, a testing target may be improvised either by drafting the aiming diagrams to the correct measurements or by the following technique:

a. Carefully bore sight the gun on a distant aiming point.

b. Place a flat piece of masonite, wallboard, or similar material covered with a sheet of weather resistant paper 50 yards in front of the gun so that its face is perpendicular to the line of sight through the tube. To render the testing target stable, it may be fastened to a stand similar to that shown in figure 26.

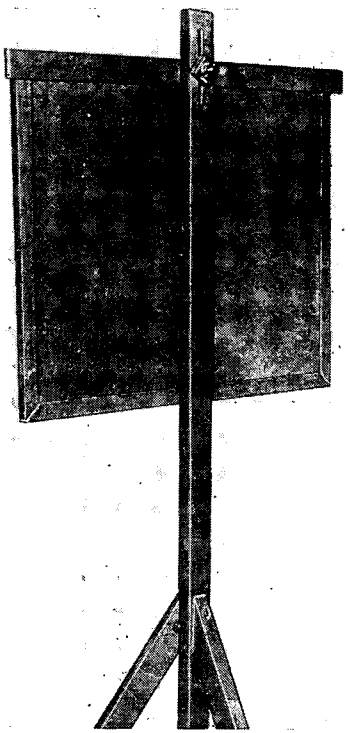


Figure 26. Rear view of a bore sighting target stand.

c. Without disturbing the relationship of the telescopes to the tube, mark on the paper the centers of the lines of sight through the telescopes and the tube.

d. From the centers marked, construct aiming diagrams such as are found on standard testing targets.

e. For use in either leveling or canting the test target a mil scale may be drawn at the bottom of the target. A small nail at the top marks the center from which the arc was drawn and provides a hook from which to suspend the plumb line (fig. 27).

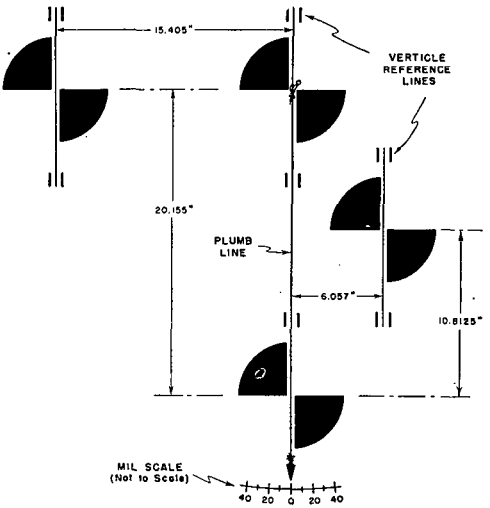


Figure 27. Vertical reference lines and mil scale drawn on testing target.

f. Vertical reference lines may be drawn through the centers of each of the diagrams (fig. 27). These lines may be used when the trunnions cannot be leveled, by setting the test target with the cant angle of the gun. The target is rotated until the line of sight through the tube tracks the reference line when the tube is elevated or depressed. Similarly, the panoramic telescope should be adjusted so that its reticle tracks the appropriate reference line when the tube is elevated or depressed.

g. To facilitate bore sighting in darkness, drill a $\frac{1}{16}$-inch hole through the mounted testing target at the center of each aiming diagram. A flashlight held against the target behind the appropriate hole provides an aiming point for use in blackout conditions. Fasten patches of felt padding on the back of the target covering the regions of each hole so that light from the flashlight will not escape. The flashlight must be lighted only after it is placed firmly in position. Care must be taken to prevent disturbing the position of the testing target.

45. Cease Firing

The command CEASE FIRING is normally given to the gun section by the chief of section, but in emergencies anyone present may give the command. At this command, regardless of its source, firing will cease immediately. If the gun is loaded, the chief of section will report that fact to the executive. The executive acknowledges this announcement by saying "No. (so-and-so)

loaded." If CEASE FIRING came from the fire direction center, firing is resumed at the announcement of the elevation. If CEASE FIRING came from within the firing battery, the executive will investigate the condition that caused the command to be given. When corrected, firing is resumed at the executive's announcement of the elevation.

46. Changes in Data During Firing

a. Before Gun Is Loaded. Corrected data is announced. The new data is then set off and firing resumed at the announcement of the elevation.

b. After Gun Is Loaded. The command CEASE FIRING is given. If no change in fuze setting is required, or if the gun is loaded with percussion-fuzed shell, the new data is set off and firing is resumed at the announcement of the elevation. If the gun is loaded with time-fuzed shell, and the data requires a change in fuze setting, the chief of section will suspend firing and that fact will be reported to the executive; for example, "No. 2 loaded, time (so much)." The gun will not be unloaded unless directed by the executive. In continuous fire, changes in data are so applied as not to stop the fire or break its continuity.

47. To Unload the Gun

a. A complete round, once loaded, should always be fired in preference to being unloaded, but military necessity may dictate otherwise.

b. When the command UNLOAD is given, No. 1 opens the breech slowly; No. 2 standing at the

breech, receives the ejected round or cartridge case.

c. Should the extractor fail to extract the complete round, the staff and unloading rammer (head) is used. This will be done only under the immediate supervision of an officer. He inspects the recess in the head of the rammer to assure that it is free from obstructions. No. 1 then inserts the rammer in the bore until the head incloses the fuze and comes into contact with the projectile. He pushes and, if necessary, taps the rammer staff slightly, or operates the spring-operated rammer, until the round is dislodged. He then pushes it out of the breech and No. 2 receives it.

d. If the cartridge case is extracted but not the projectile, No. 1 fills the chamber with waste and closes the breechblock. He dislodges the projectile as in *c* above. No. 2 then opens the breech, removes the waste, and receives the projectile as No. 1 pushes it to the rear.

e. For further information on unloading, see FM 6–140 and TM 9–325.

f. In case of a misfire, the instruction contained in paragraph 85 will be followed.

48. Care of Ammunition

a. To insure uniform results in firing, to prolong the life of the tube, and to avoid accidents, care must be exercised in the storage and handling of ammunition at the battery. Provisions of TM 9–1900 applicable to field service should be followed carefully. In the field, conditions existing in

each position will determine the amount of time, labor, and materials required to store and preserve the ammunition adequately. If the position is to be occupied for only a few hours, a tarpaulin spread on the ground may be sufficient; for longer periods of time more elaborate facilities should be provided.

b. Ammunition must be protected from damage. When ammunition is received, it should be sorted into lots and placed in the best available storage. Powder temperature should be kept as uniform as possible. Ammunition data cards should be kept until after all ammunition for that lot is expended. Ammunition should be left in containers until its early use is expected. Protection should be provided against moisture, dirt, direct rays of sun, and, as far as practicable, hostile artillery fire and bombing. Protection from weather, dirt, and sun may be obtained by the use of tarpaulins below and above ammunition and dunnage between the layers. Projectiles piled in the open should be raised off the ground by at least 6 inches. If drainage is not good, ditches should be dug around piles. A liberal use of dunnage should be made between layers and covering tarpaulins should be raised from the stack at least 6 inches to insure adequate ventilation. Each stack should contain not more than 75 rounds and should be not more than 4 layers high. Stacks should be at least 10 yards apart.

c. For further information on care of ammunition, see FM 6–140, TM 9–325, TM 9–1900, and TM 9–1901.

49. Ammunition Assembly Trough

To speed up the assembly of semifixed ammunition after the power charge has been prepared and to guard against accidental pinching of the assembler's hand, assembly troughs may be improvised. Specifications for a type trough are shown in figure 28.

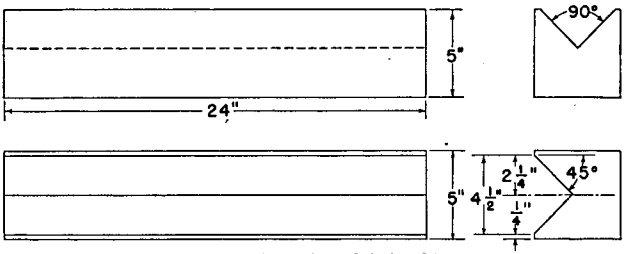


Figure 28. Ammunition assembly trough.

50. Section Data Board

When positions are occupied for more than a few hours, data boards may be used by each section for recording such items as deflections to aiming points, calibration corrections when appropriate, minimum elevations, data for barrages and counterpreparations, and other data which may be needed quickly. If such information assumes a standard pattern, the section may paint a form on the inside of the hull and chalk in the various items of information in the appropriate spaces.

51. Hand Signals

Standard hand signals are used to indicate to the driver the proper movement of the motor carriage. Dismounted signals are given facing the driver and are as illustrated in FM 21–60 and FM 25–10.

52. Touch Signals

The following are touch signals used by the chief of section or the gunner when mounted to indicate to the driver the proper movement of the motor carriage.

a. Move Forward. Tap slowly between shoulder blades.

b. Increase Speed. Tap rapidly between shoulder blades.

c. Halt. Steady pressure on top of the head.

d. Decreases Speed. Tap lightly on top of the head.

e. Move Backward. Tug on back of collar.

f. Change Direction. Pull on right or left shoulder until turn is completed.

g. Sound Siren. Run thumb rapidly upward between shoulder blades.

CHAPTER 7

BORE SIGHTING AND BASIC PERIODIC TESTS

Section I. GENERAL

53. Purpose and Scope

The purpose of this chapter is to outline the procedures for bore sighting and for making basic periodic tests of on-carriage fire control equipment. The procedures covered will include only those that may be accomplished at battery level.

54. Equipment

The following equipment is needed for performing bore sighting and periodic tests:

a. Bore Sights. Front and rear bore sights or improvised substitutes are necessary for both bore sighting and testing. If bore sights are not available, cross hairs may be fastened on the muzzle and the firing pin hole in the breechblock bushing may be used as a rear sighting guide by removing the firing lock from the closed breechblock.

b. Testing Target. A testing target (par. 44) or suitable substitute is needed for both bore sighting and testing. If the testing target is not available, a clearly defined aiming point 2000 yards or more from the gun may be used for bore sighting.

c. Tools. The section equipment includes all the necessary tools for bore sighting and testing. Care must be taken in using the screw drivers and wrenches to insure that damage to fastenings does not result through carelessness or the use of inappropriate tools.

d. Plumb Line. Although not essential for bore sighting, it is necessary that a plumb line be used in the basic periodic test in order to obtain maximum accuracy. The farther from the gun that the plumb line is placed, the longer the line must be. For example, to be effective at 6 feet in front of the tube, the line must be at least 30

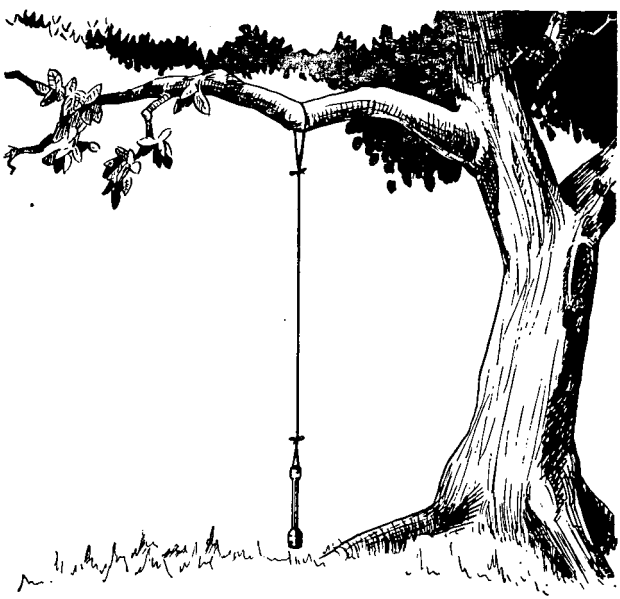


Figure 29. Plumb line suspended from tree.

feet long. To keep such a long plumb line taut it may be necessary to add weight to it. Wrenches or rocks may be used. The tendency of the weight to swing may be decreased by placing a bucket containing water or other liquid under the plumb line so that the plumb bob is partially immersed in the liquid. A plumb line strung from a building or tree as in figure 29 is more desirable and should be used if possible. Units in garrison may find it convenient to rig a plumb line on a building. The line may then be nailed in place so that it can be used permanently.

Section II. BORE SIGHTING

55. General

a. Description. Bore sighting is the process of verifying that the alinement of the on-carriage fire control equipment is parallel both for deflection and, except for the aiming circle method, for elevation with the axis of the tube of the weapon. Any misalinement discovered is corrected as described in paragraph 57. Bore sighting is conducted by section personnel before firing and during lulls in firing.

b. Methods. Four methods of bore sighting the 105-mm howitzer are—

(1) Testing target method.
(2) Distant aiming point method.
(3) Aiming circle method.
(4) Standard angle method.

c. Leveling. Prior to starting the tests the gun should be placed in its center of traverse. Al-

though it is not absolutely necessary to level the trunnions for bore sighting, it is advisable to do so whenever possible. Accurate results can be obtained more readily if the trunnions are level, since a corresponding tilt does not have to be introduced in the panoramic telescope mount and in the testing target. The trunnions should be leveled by moving the carriage to level ground or by blocking up one side of the motor carriage.

(1) *Plumb line.* The best method to check leveling is by means of the plumb line. The line is suspended directly in front of the axis of the bore. When the trunnions are level, the line of sight should track the plumb line as the tube is depressed and elevated throughout the limits of elevation. If the trunnions cannot be leveled without shifting the carriage, and the cant is only slight, the following technique may be used. Traverse the tube from center and shift the carriage to bring the line of sight back on the plumb line. Elevate the tube to determine whether it more nearly tracks the plumb line. Repeat this experiment until the line of sight tracks the plumb line exactly.

(2) *Gunner's quadrant.* If the plumb line cannot be used, a check of approximate leveling may be accomplished by use of the gunner's quadrant placed on the breech ring parallel to the trunnions. In leveling operations using the gun-

ner's quadrant, a quadrant that has been tested (par. 62) and found to be accurate is required.

(3) *Scribed lines.* When it is impossible to level the trunnions the cross-level bubble cannot be used. If the tube cannot be leveled the longitudinal-level bubble cannot be used. To permit bore sighting when either of these conditions exist, lines should be scribed on the sight mount after a basic periodic test (pars. 61–64) when the mount is in correct adjustment. These scribed lines can be matched later, when leveling is impossible, to retain the same relationship between the axis of the bore and moving parts of the on-carriage sighting equipment. After a basic periodic test with the tube and sighting equipment in perfect alinement, use a knife blade or other sharp metal point to scribe lines as shown in figure 30. Care should be taken that the lines are scribed in the paint only and are not cut into the metal. Fill the scribed lines with white paint and wipe off the excess. If conditions prevent bore sighting with the tube level, longitudinal compensation for an unlevel (elevated or depressed) tube may be made by matching the scribed lines ① and ② of figure 30. If the trunnions cannot be leveled, cross-level compensa-

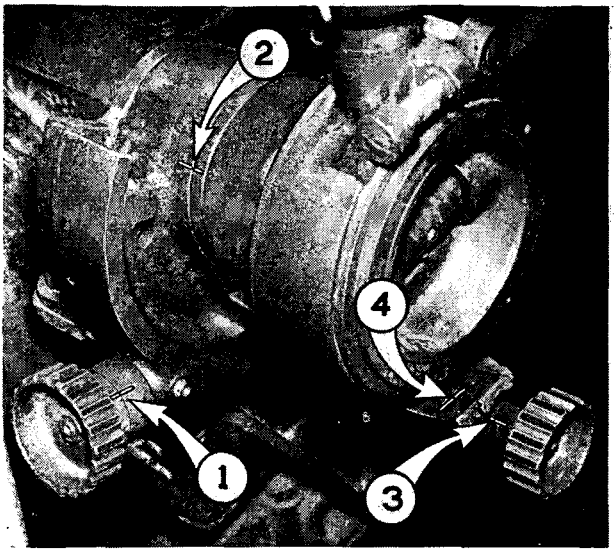


Figure 30. Scribed lines.

tion may be made by matching scribed lines ③ and ④ of figure 30.

56. Conditioning

The on-carriage sighting equipment of the weapon is in correct adjustment when the following conditions exist:

a. Mounts and instruments are securely attached and there is no binding or excessive backlash between gears.

b. The line of sight of the panoramic telescope is parallel to the axis of the bore.

c. When the trunnions are level the line of sight of the panoramic telescope remains in a plane

parallel to the vertical plane passing through the axis of the bore as the tube is elevated throughout its limits of elevation or depression.

d. All bubbles are level when the weapon is leveled both laterally and longitudinally and all scales and indexes read zero except the angle of sight scale which reads 300.

57. Testing Target Method

This method consists of making the line of sight of on-carriage fire control equipment parallel to the axis of the tube using the aiming diagrams of the testing target as aiming points.

Caution: For weapons modified per MWO ORD C21–W19, i.e., a bracket added to raise the sight 8 inches, test target 1–T–283–42 is not correct and must have an additional diagram improvised above the sight diagram.

The steps to be followed are—

a. Trunnions. Level the trunnions as exactly as possible (par. 55).

b. Tube. Using the gunner's quadrant, level the tube.

c. Bore Sights. Place the breech and muzzle bore sights in their proper positions.

d. Test Target Alinement. Without moving the gun (except for elevating and depressing slightly when using testing target reference lines) aline the center testing diagram with the line of sight through the tube (fig. 31). The target normally should be located at least 50 yards in front of the muzzle.

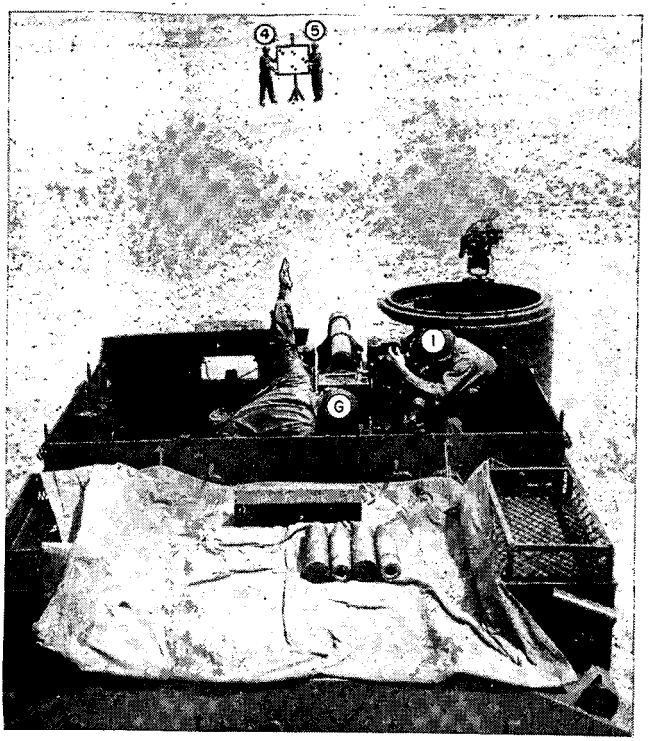


Figure 31. Alining the testing target.

e. Cant Compensation. If the trunnions are level, level the target by means of a plumb line (fig. 29). If the trunnions are not level, cant the target to correspond to the cant of the trunnions. In either case the face of the target is perpendicular to the axis of the bore.

f. Panoramic Telescope Lateral Alinement. It is assumed that all lost motion has been eliminated (par. 42) and that the cross-level bubble is in

adjustment (par. 63*c*). Level and zero the sight as in paragraph 22*b*. As both the azimuth scale and the slipping azimuth scales are set at zero, the door may be either open or closed. If the vertical hair of the reticle is not in alinement with its aiming diagram, loosen the tangent locking screws (fig. 32) and adjust the tangent screws (fig. 33) until the vertical hair is properly alined,

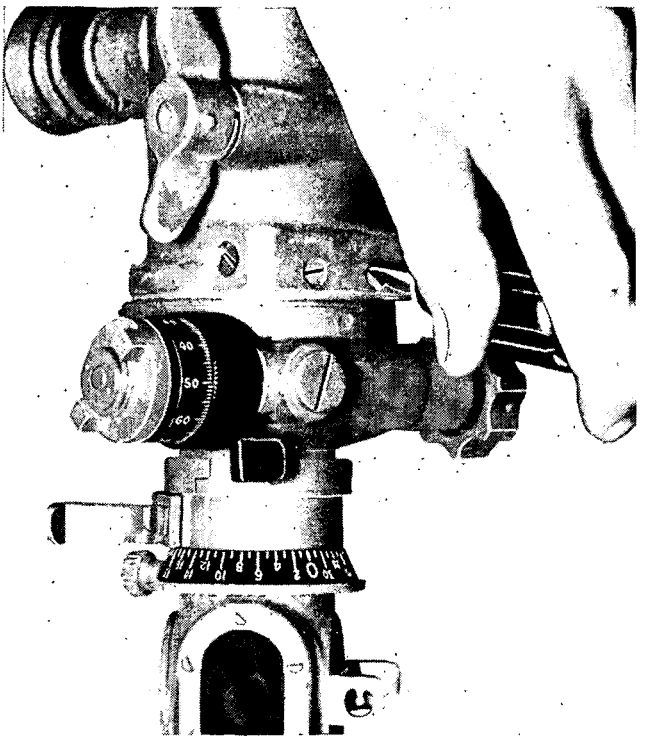


Figure 32. Loosening a tangent locking screw.

making sure that the panoramic telescope fits snugly against the tangent screws without binding. Tighten the locking screws and verify the adjustment.

g. Panoramic Telescope Horizontal Alinement. If the horizontal hair of the reticle is out of alinement, turn the elevation knob of the telescope until it is alined properly. Loosen the clamping screws (fig. 34) and shift the scale into coincidence with the fixed index (fig. 35). Tighten the locking screws and verify the adjustment.

h. Elevation Index. Loosen the elevation index locking screws. Slip the movable index until it

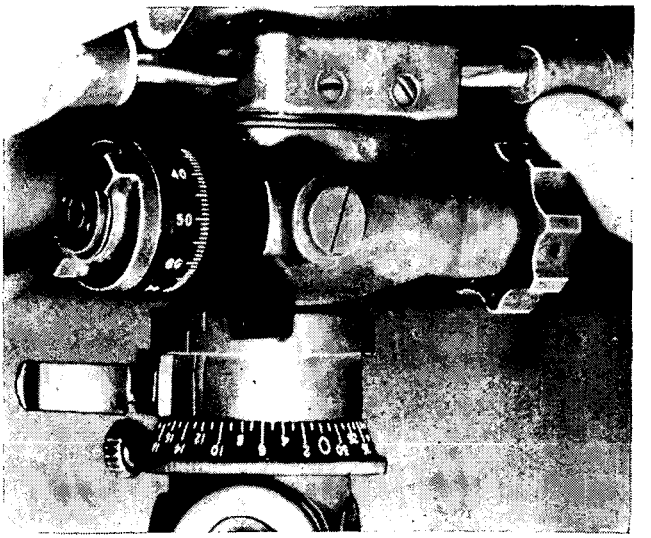


Figure 33. Adjusting the vertical reticle with the tangent screws.

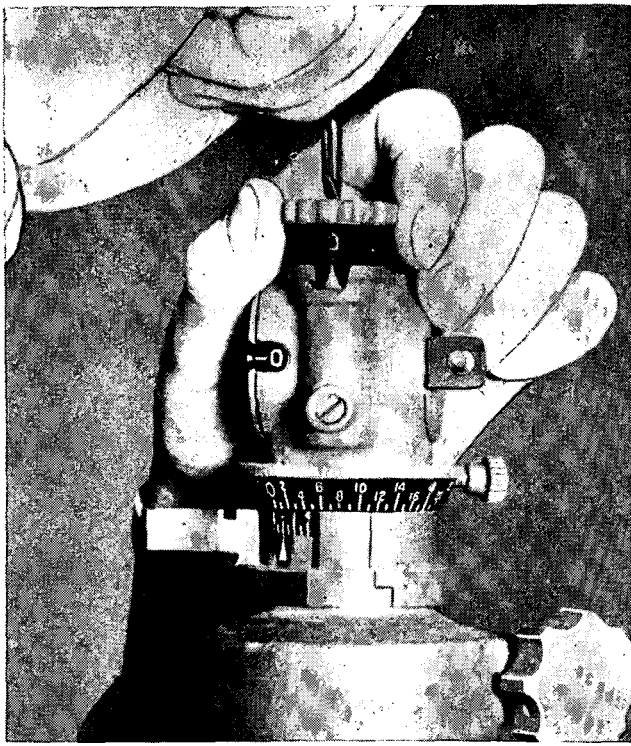


Figure 34. Loosening the clamping screws.

coincides with the fixed index (fig. 36). Tighten the screws and verify the adjustment.

i. Elevation (Range) Quadrant. Verify that the locking screws of the elevation micrometer are tight. With the line of sight through the tube still on the appropriate aiming diagram and with the elevation scale near or on zero, set the elevation micrometer scale at zero. Level the longi-

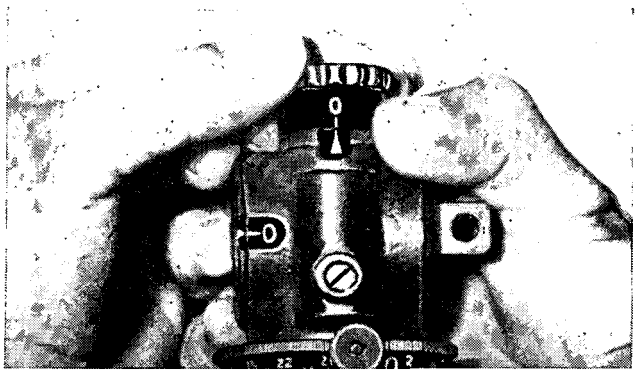


Figure 35. Shifting zero of the elevation knob to its index.

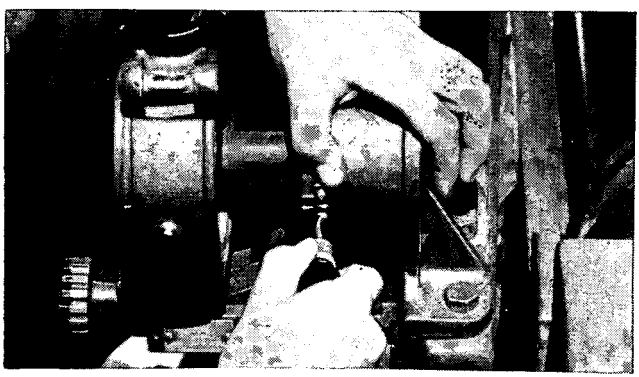


Figure 36. Shifting elevation index into coincidence.

tudinal- and cross-level bubbles of the range quadrant with the angle of site micrometer and the cross-leveling worm knob.

j. Elevation Scale Index. If the elevation scale index does not coincide exactly with zero, loosen the screws holding the index plate and slide

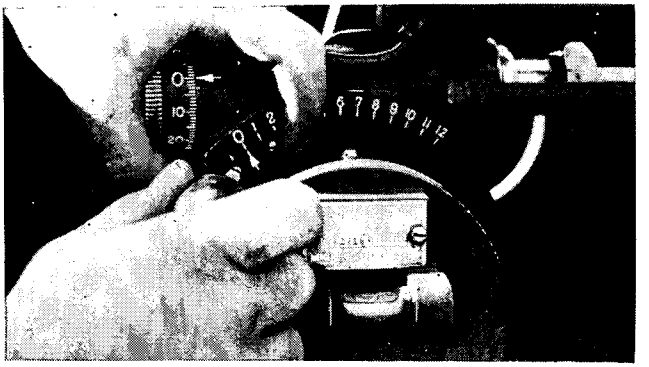


Figure 37. Shifting elevation scale index to zero.

the plate to zero (fig. 37). Tighten the screws and verify the adjustment.

k. Angle of Site Scale. If the angle of site scale does not read 3(300), loosen the two locking screws of the scale and slip the scale until the numeral 3 is in coincidence with the index (fig. 38). Tighten the screws and verify the adjustment.

l. Angle of Site Micrometer. If the angle of site micrometer does not read zero, loosen the clamping screw in the micrometer knob and slip the scale to zero (fig. 39). Be sure that the knob does not turn, thus throwing the bubble off center. Tighten the locking screw and verify the adjustment.

m. Elbow Telescope.

(1) *M23 mount.* No deflection adjustment can be made. If the zero range line of the elbow telescope does not match the

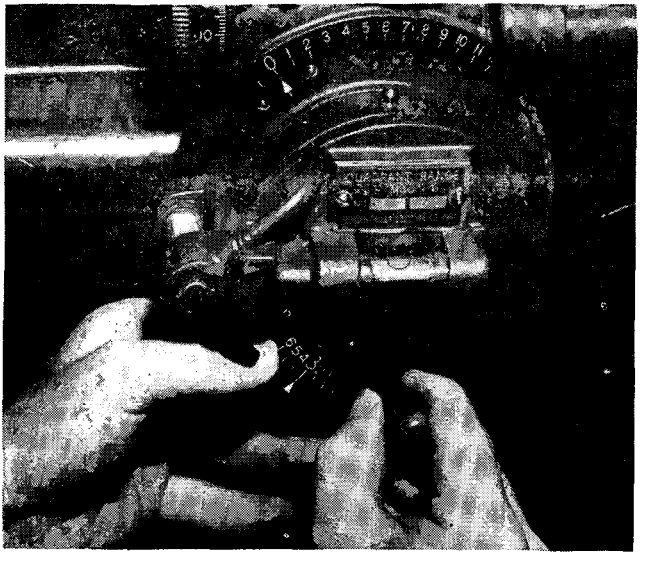


Figure 38. Shifting angle of site scale to 3 (300).

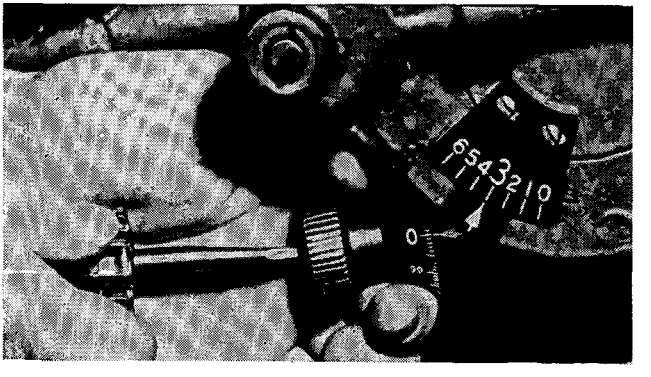


Figure 39. Adjusting angle of site micrometer scale to zero.

horizontal line of its aiming diagram, loosen the worm clamping bolt. With a screwdriver bring the zero line into alinement with the horizontal line on the aiming diagram. Tighten the worm clamping bolt and verify the adjustment. If the horizontal reticle is not parallel to the horizontal line of its diagram, bring it into alinement by turning the bracket rotating knob.

(2) *M42 mount.* There is no provision for leveling the reticle lines. If the vertical reticle is not in alinement, loosen the jam nut on the lateral adjusting screw and, with a screwdriver, turn the lateral adjusting screw to aline the reticle. Tighten the jam nut and verify the adjustment. If the horizontal reticle is not in alinement, loosen the jam nut on the elevation adjusting screw and, with a screwdriver turn the elevation adjusting screw to aline the reticle. Tighten the jam nut and verify the adjustment.

58. Distant Aiming Point Method

This method consists of alining the on-carriage fire control equipment and the line of sight through the tube on a common point at least 2000 yards from the gun. A distant aiming point may be used instead of the testing target if the testing target is not available or if the tactical situation makes its use impracticable. The steps prescribed for the testing target method (pars.

57*c* through 57*m*) apply except that the bore sights and optical sights are alined on the same point instead of on the diagrams of the testing target. Accurate cross leveling of the trunnions is unnecessary when bore sighting on a distant aiming point because the lines of sight converge on a single point. Normally the tube will not be level, so the scribed lines (par. 55*c*(3)) will be used.

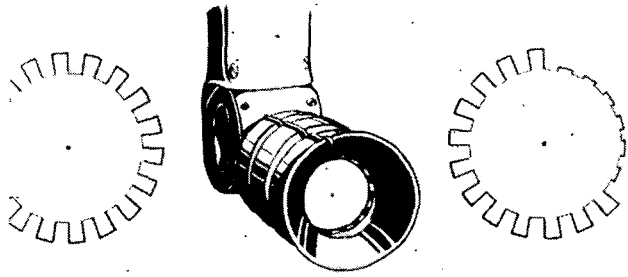
59. Aiming Circle Method

a. General. The aiming circle method may be used when weather or terrain conditions prohibit the use of the testing target method or the distant aiming point method. The aiming circle method corrects only for deflection errors. It does not include a test for determining elevation errors. When this method is used, any adjustment made should be verified at the earliest opportunity by bore sighting with the testing target or distant aiming point. Before bore sighting with the aiming circle certain preparatory steps (*b* below) must be performed, preferably after a basic periodic test (pars. 61–64), when the panoramic telescope mount is in correct adjustment.

b. Preliminary Operation.

(1) *To insure accuracy.* The greatest care must be exercised in all phases of these operations. All final movements of the instruments must be made so that the reticles approach the final position from left to right to eliminate the effects of lost motion in the gears.

(2) *Parallax.* Parallax in the aiming circle and the panoramic telescope must be eliminated. This is done with the aiming circle, after focusing, by placing in front of the eyepiece lens a dark colored cardboard or metal parallax shield of the same diameter as the eyepiece-lens focusing sleeve. The shield should have a vertically and horizontally leveled slot one-sixteenth inch wide and one-fourth inch long. It may be held in place with a piece of adhesive tape around the edge of the focusing sleeve. To eliminate parallax in the panoramic telescope, a shield of the same diameter as the eyepiece-lens housing and having an exactly centered hole one-sixteenth inch in diameter is mounted in front of the eyepiece lens (fig. 40). A more permanent parallax shield may be constructed of brass or bronze shim stock. When constructed of metal a series of fingers approximately three-sixteenths inch wide and one-fourth inch long separated by one-fourth inch spaces should extend beyond the perimeter of the shield. These fingers should be bent along the circumference of the circle until they form an angle of 90° with the surface of the shield. They serve as a means of clipping the shield in place quickly and permit easy removal. Where the eyepiece has a rubber eyeguard, the fingers



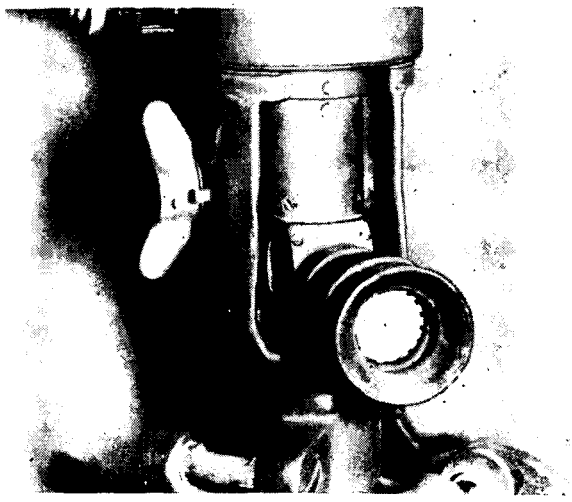


Figure 40. Parallax shield.

permit alinement within the guard without its removal.

c. *Procedure.* Steps to be followed are—

(1) Insert the bore sights or improvise substitutes.

(2) Level the trunnions as exactly as possible.

(3) Sight through the bore sights and aline the aiming circle in front of the gun at a distance of 30 to 40 yards.
(4) Set up the aiming circle, and with the scales set at zero, sight through the axis of the bore.
(5) Sight through the axis of the bore, and with the elevating and traversing mechanism, aline exactly the line of sight through the bore on the objective lens of the aiming circle.
(6) Recheck to insure that at zero setting the line of sight through the aiming circle is directly through the axis of the bore.
(7) Level panoramic telescope mount bubbles and point objective lens toward the aiming circle.
(8) With the upper motion of the aiming circle turn to the center of the objective lens of the panoramic telescope and read the angle.
(9) Set the angle from the aiming circle ((8) above) on the azimuth micrometer scale of the panoramic telescope.
(10) Adjust the tangent screws until the vertical hair of the telescope is exactly on the center of the objective lens of the aiming circle. Recheck the angle settings and the alinement of the vertical hairs.

60. Standard Angle Method

a. General. Conditions may exist when the bore sighting methods previously described are imprac-

ticable. Under such circumstances the alinement of the optical axis of the panoramic telescope parallel to the axis of the bore may be tested and adjusted by referring to a selected point on the muzzle. The deflection and elevation angles necessary to refer the line of sight of the telescope to the selected point on the muzzle are referred to as the standard angles. Once the standard horizontal and vertical angles have been determined, they may be used for a quick test of the alinement of the panoramic telescope when more precise methods cannot be used. Misalinement discovered and corrected as a result of this test should be verified by a more accurate method at the earliest opportunity. When using the standard angle method of bore sighting, be sure that the position of the recoiling parts with respect to the nonrecoiling parts is the same as when the standard angles were determined. Because of this, the recoil system must be checked to see that it contains the proper amount of recoil oil before determining the standard angles.

b. Preliminary Operations. The procedure for determining standard angles is as follows:

(1) With the tube in battery, scribe lines in the paint to mark the position of parts which move in recoil with respect to parts which do not move in recoil (fig. 41).
(2) Carefully level the trunnions.
(3) Bore sight the gun using a testing target.
(4) With adhesive tape fasten a bright common pin in the left horizontal witness

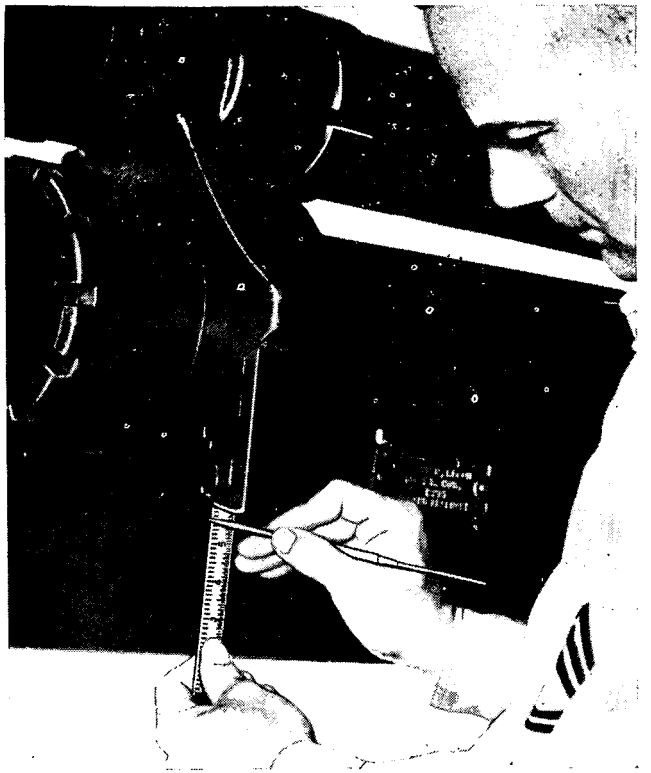


Figure 41. Scribing line to mark normal position of recoiling parts.

mark. Allow the pin to project to the left of the muzzle (fig. 42).

(5) Fasten the telescope parallax shield in place over the eyepiece (fig. 40).

(6) Verify that the elevation index and micrometer on the telescope are at zero.

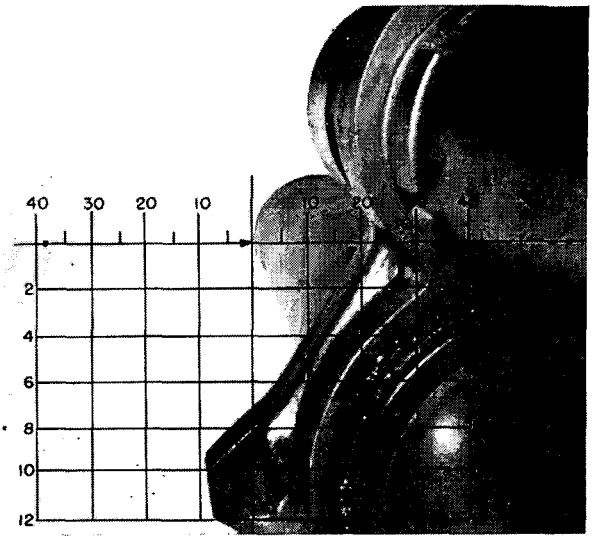


Figure 42. Sight picture of projecting pin.

(7) Elevate the tube until it is approximately level with the top of the panoramic telescope.

(8) Level the bubbles of the telescope mount and refer the telescope to the junction of the pin with the muzzle. Adjust the tube elevation and turn the azimuth micrometer knob until, with the bubbles level, the horizontal and vertical hairs of the telescope are exactly on the junction of the pin with the muzzle (fig. 42).

(9) Read the angle from the panoramic telescope to the nearest one-fourth mil. Since the graduations are to the nearest mil it

is necessary to interpolate to the nearest one-fourth mil. This is the standard azimuth (horizontal) angle for the gun tested.

(10) With either the range quadrant or gunner's quadrant measure the elevation of the tube to the nearest one-fourth mil. This is the standard elevation (vertical) angle for the gun tested.

(11) With a knife blade or other sharp metal point scribe lines in the paint on the following parts:

(*a*) Straight across the junction of the cross-leveling segment and the cross-leveling worm housing.

(*b*) Straight across the junction of the cross-leveling worm housing and the cross-leveling worm knob shaft.

(*c*) Straight across the junction of the rocker and the actuating arm.

(*d*) Straight across the junction of the elevation knob shaft and the bracket.

(12) Fill the scribed lines with red paint and wipe off the excess.

c. Procedure. Once the standard angles have been determined, steps in performing the standard-angle method of bore sighting are as follows:

(1) Verify that the parts that move in recoil are in the same position with respect to the nonrecoiling parts as they were when the standard angles were determined.

(2) Verify that the trunnions are canted not more than 10 mils; if convenient, level the trunnions.

(3) With adhesive tape fasten a pin in the left horizontal witness mark so that the pin projects out to the left of the muzzle.

(4) Using the range quadrant or gunner's quadrant elevate the tube to the standard elevation angle.

(5) Place the parallax shield on the eyepiece of the telescope.

(6) Set the standard azimuth angle on the panoramic telescope. Make sure that the red scribe lines are in coincidence.

(7) If the vertical reticle is not exactly on the junction of the pin and the muzzle, adjust the tangent screws until the vertical reticle is properly alined.

(8) If the horizontal reticle is not exactly on the junction of the pin and the muzzle, turn the elevating knob of the panoramic telescope until it is properly alined. Adjust the zero of the elevation knob scale so that it is in alinement with the index.

Section III. BASIC PERIODIC TEST

61. General

Basic periodic tests are performed by the section under the supervision of the battery executive and the artillery mechanic. These tests are performed at the discretion of the unit commander.

Suggested times for performance are—once each year if the gun is used only for nonfiring training; once every 3 months if the gun is fired; as soon as possible after intensive use, accidents, or traversing extremely rough terrain; and whenever the gun fires inaccurately for no readily apparent reason. The test reveals whether or not the on-carriage sighting equipment, the gunner's quadrant, and the fuze setter are in correct adjustment. Preparations for the test include—

a. Bore sight the gun (par. 57).

b. Place the motor carriage on a site that is as near level as possible.

c. Accurately level the trunnions, using jacks if necessary. Check the leveling by tracking a plumb line with the bore sights of the tube. The plumb line (par. 55*c*(1)) should be suspended approximately 5 feet in front of the muzzle and should be long enough to permit, if possible, maximum elevation of the tube while tracking the plumb line. The trunnions are level when the tube tracks the entire length of the plumb line without deviating more than the thickness of the muzzle bore sight cord. *Check this setting frequently as the following tests are dependent on the trunnions being accurately leveled at all times.*

62. Test of Gunner's Quadrant

a. General. The gunner's quadrant must be in proper adjustment before conducting tests and adjustments of other sighting and fire control equipment. Inspect the shoes of the gunner's quad-

rant for dirt, nicks, or burrs. Similarly, inspect the leveling plates on the upper surface of the breech ring. Dirt, nicks, or burrs on these surfaces will cause the instrument to give inaccurate readings.

b. End-for-End Test.

(1) Set both the index arm and micrometer scale of the gunner's quadrant at zero, making sure the auxiliary indexes match.

(2) Place the quadrant on the leveling plates of the breech, the line of fire arrow pointing toward the muzzle, and center the quadrant bubble by turning the elevating handwheel.

(3) Reverse the quadrant on the leveling plates (turn it end-for-end). If the bubble recenters, the quadrant is in adjustment and the test is completed.

(4) If the bubble does not recenter, try to center it by turning the micrometer knob.

(*a*) If the bubble centers, read the black figures and divide by two. This is the correction.

(*b*) Place the correction on the micrometer and level the tube using the elevation handwheel.

(*c*) Check by again reversing the quadrant. The bubble should center.

(5) If the bubble does not center as in (4) above, move the arc down one graduation (10 mils).

(*a*) Turn the micrometer until bubble centers.

(*b*) Take the reading on micrometer, add 10 to it, and divide the sum by 2. This is the correction.

(*c*) Place this reading on the micrometer leaving the arm at minus 10; level the tube with the elevation handwheel.

(*d*) Check by reversing the quadrant on the plates. The bubble should center.

(*e*) The quadrant should be sent to an ordnance unit if the correction of error amounts to more than plus or minus 0.4 mil.

c. Micrometer Test.

(1) Set the index arm to read 10 mils on the graduated arc and set the micrometer scale at zero.

(2) Place the quadrant on the leveling plates on the breech ring, the line-of-fire arrow pointing toward the muzzle, and center the quadrant bubble by elevating the tube.

(3) Set the index arm at zero on the graduated arc and turn the micrometer one revolution to read 10 mils.

(4) Reseat the quadrant on the leveling plates. The bubble should center.

Caution: Do not disturb the laying of the tube.

(5) If the bubble does not center, the micrometer is in error and must be adjusted by ordnance personnel.

d. Comparison Test. Compare readings taken at low, medium, and high elevations with all of the gunner's quadrants of a battery on a *single* gun whose quadrant seats have been accurately cross leveled. Any quadrant differing from the average by more than 0.4 mil at any elevation should be sent to ordnance for adjustment.

e. Correction. When a gunner's quadrant requires a correction as determined by the end-for-end test, this correction is not carried during firing but is applied only when making sight tests and adjustments.

63. Test of Telescope Mount

a. General. The purpose of this test is to determine whether the azimuth compensating mechanism of the telescope mount actually transmits the motion of the tube to the sight mount so that any deviation in deflection due to elevating the tube is corrected throughout all elevations. It checks the adjustment and mounting of the telescope mount, the setting of the cross-level and longitudinal-level vials, and the alinement of the telescope socket. Test *b* (below) may be performed with the trunnions either level or canted. It reflects total errors of the entire mechanism. Because compensating errors of various parts of the mount may result in the weapon testing out properly with test *b*, the other tests specified in *c* through *e* should be performed regardless of the result of test *b*. Total errors found in test *b* may then be narrowed down to errors in specific parts.

b. General Test.

(1) Bore sight the weapon.

(2) Make trunnions as level as possible.

(3) With bore as near zero elevation as possible sight through the bore on plumb line.

(4) Level mount bubbles and refer to a clearly defined distant aiming point near the front or rear.

(5) Elevate the tube to limits of plumb line, or maximum elevation, in 100-mil steps. At each step—

(*a*) Traverse if necessary to bring the line of sight through the bore to the plumb line.

(*b*) Level mount bubbles.

(*c*) Note deviation of optical axis of sight from the aiming point.

(6) Deflection deviation is measured on the azimuth micrometer scale—allowable deviation, 1 mil.

(7) Horizontal deviation is measured with the longitudinal-level bubble—allowable deviation, 1-vial graduation.

c. Basic Test for the Range Quadrant.

(1) *Cross-level test.*

(*a*) Center the cross-level bubble.

(*b*) Turn the elevation knob throughout its limits of motion.

(*c*) The cross-level bubble should remain centered within one-half vial graduation.

(2) *Pivot azimuth alinement test.*

(*a*) Center the previously tested cross-level bubble.

(*b*) Elevate and depress the tube, checking to see that the vertical muzzle hair tracks the plumb line, and watch the cross-level bubble.

(*c*) The cross-level bubble should remain centered within one-half vial graduation.

(3) *Pivot vertical alinement test.*

(*a*) Relevel the tube using the tested gunner's quadrant.

(*b*) Center the longitudinal-level bubble by turning the angle of site micrometer knob.

(*c*) Operate the cross-level knob throughout its limits of motion.

(*d*) The longitudinal-level bubble should remain centered within one-half vial graduation.

(4) *Angle of site test.*

(*a*) Recheck level of the tube with the tested gunner's quadrant.

(*b*) Cross level the range quadrant and set the elevation scale and elevation micrometer at zero.

(*c*) Center the longitudinal-level bubble by turning the angle of site micrometer knob.

(*d*) Set angle of site scale to read 3(300) and the angle of site micrometer to read zero.

(5) *Comparison test.*

(*a*) Compare the readings indicated by the tested gunner's quadrant with those of the range quadrant at low, medium, and high elevation of the tube.

(*b*) The two instruments should agree at all elevations checked.

d. Basic Test for the Panoramic Telescope Mount, and Panoramic Telescope.

(1) *Cross-level test.*

(*a*) Center the cross-level bubble.

(*b*) Turn the elevation knob throughout its limits of motion.

(*c*) The cross-level bubble should remain centered within one-half vial graduation.

(2) *Pivot alinement test.*

(*a*) Center the cross-level bubble and place the line of sight of the panoramic telescope on a sharply defined aiming point. (Plumb line may be used.)

(*b*) Elevate the tube to maximum elevation while keeping the telescope mount level longitudinally.

Note. Do not readjust the cross-level bubble after initial setting.

(*c*) Check at low, medium, and high elevations of the tube. The line of site of the panoramic telescope should not deviate more than 1 mil and the cross-level bubble should remain centered within one-half vial graduation.

(3) *Vertical alinement test of telescope mount.*

(*a*) Relevel the tube using the gunner's quadrant.

(*b*) Center the longitudinal-level bubble.

(*c*) Operate the cross-leveling knob throughout its limits of motion. The longitudinal-level bubble should remain centered within one-half vial graduation.

(4) *Basic test for the panoramic telescope.*

(*a*) Zero the scales on the panoramic telescope.

(*b*) Traverse and elevate the tube as necessary to place the panoramic telescope reticle cross hairs on an aiming point.

(*c*) Rotate the telescope head through a complete circle (6400 mils). The telescope cross hairs should return to the aiming point within 1 mil.

(*d*) Rotate the telescope head through a complete circle in the opposite direction. The telescope cross hairs should again return to the aiming point to within 1 mil.

(5) *Telescope mount socket alinement test.*

(*a*) Center the cross-level bubble.

(*b*) With the panoramic telescope scales set at zero, traverse the tube until the vertical hair of the telescope reticle is on the plumb line with both the cross-level and longitudinal-level bubbles centered.

(*c*) Sight through the telescope and rotate the elevation micrometer knob throughout its limits of motion. The vertical hair should remain on the plumb line within 1 mil.

(*d*) Set the panoramic telescope scales at 1600 mils, and shift the trails until the vertical hair is on the plumb line with both the cross-level and longitudinal-level bubbles centered.

(*e*) Rotate the telescope elevation micrometer knob throughout its limits of motion. The vertical hair should remain on the plumb line within 1 mil.

(6) *Allowable errors.* If the range quadrant, telescope mount, or panoramic telescope exceeds the tolerance authorized on any of the tests outlined, the howitzer and/or panoramic telescope should be sent to ordnance for adjustment.

64. Fuze Setters

a. General. Examine the stop which fits into the slot in the movable time ring and the adjusting pawl which engages the notch in the fixed fuze ring to see that their edges are not burred or bent. Depress the adjustable pawl against its spring to see that the movement of the pawl is free. In the following tests be sure to test the fuze setter with the fuze for which it is designed; the time scale on the fuze setter must have the same graduations as the time ring on the fuze.

b. Time Scale Test. Set the corrector to 30, if an M22 or M23, and set any convenient time on the time scale. Test the time scale of the fuze setter by setting several fuzes.

Caution: Before setting a fuze, make sure that the T and C screws (if applicable) of the fuze setter are tight to prevent any slipping of the scale indexes when the handle of the fuze setter is rotated.

The time set on the fuze should agree with the time setting on the fuze setter within one-fourth of the smallest graduation on the fuze time ring. The tolerance amounts to 0.05 second for fuzes having 0.2-second graduations, and 0.125 second for fuzes having 0.5-second graduations. If the fuzes set do not agree with the time set on the fuze setter, repeat the test as a check with a different setting. If the fuzes set still do not agree with the fuze setter, refer the instrument to an ordnance unit for adjustment.

Caution: Do not set any one live fuze more than twice. The fuze from a dud must never be used. Reset all fuzes to SAFE and replace the safety wire or cotter pin.

65. Ordnance Check

It is not contemplated that using units will have the necessary facilities, tools, or skilled mechanics to perform the more precise tests and adjustments of sighting and fire control equipment. When deficiencies recur or when defects cannot be corrected in the field, ordnance checks should be scheduled.

CHAPTER 8

MAINTENANCE AND INSPECTIONS

66. General

Maintenance and inspection is essential to insure that the section is prepared to carry out its mission immediately. Systematic maintenance and inspection drills provide the best insurance against unexpected breakdown at the critical moment when maximum performance is essential.

67. Disassembly, Adjustment, and Assembly

Disassemblies and adjustments of the weapon authorized to be performed by battery personnel are prescribed in TM 9–325 and TM 9–749, supplemented by instructions contained in Department of the Army Supply Manuals. No deviation from these procedures is permitted unless authorized by the responsible ordnance officer.

68. Records

a. The principal forms pertaining to the materiel are the Artillery Gun Book (OO Form 5825), the Field Report of Accidents (SR 385–310–1), and the Unsatisfactory Equipment Report (DA Form 468) (SR 700–45–5). Information on the purpose and use of these forms may be found in the forms themselves.

b. The chiefs of sections, battery executive, and battery commander also should keep semipermanent records for information and guidance.

69. Maintenance

For detailed instructions concerning maintenance of the 105-mm howitzer M2A1 and M2A2 and motor carriage M7B1, (M7B2) see TM 9–325, TM 9–749, and LO 9–749.

70. Inspections

Regular inspections are required to insure that materiel is maintained in serviceable condition.

a. The chief of section is responsible for the equipment within his section. He should inspect it thoroughly each day. If he sees the need for repair or adjustment, he notifies the battery executive immediately so that the necessary action may be taken.

b. The executive, accompanied by the artillery mechanic, should make a daily spot check inspection. He inspects different parts of the materiel each day to insure complete coverage every few days. At least once a month, the executive makes a thorough mechanical inspection of howitzer, motor carriage, auxiliary equipment, tools, and spare parts.

c. Battery, battalion, and higher commanders should make frequent command inspections to assure themselves that the equipment in their commands is being maintained at prescribed standards of appearance, condition, and completeness.

d. For details on inspecting the 105-mm howitzer M2A1 and M2A2, see TM 9–325. For details on inspecting the motor carriage M7B1 and M7B2, see TM 9–749. Deficiencies found during inspections should be remedied promptly.

e. Duties of individuals in performing the necessary inspections and maintenance of the howitzer and carriage are outlined in the following paragraphs. Work will be made routine, thorough, and rapid by following the drill outlined in these paragraphs. When the section is reduced in strength, the chief of section must reassign duties to insure that all maintenance steps are completed.

71. Duties in Inspection Before Operation (March)

The inspection performed before operation is a final check on materiel prior to leaving the motor park for training in the field, the bivouac area for combat, or before displacement. After inspection, and when all deficiencies have been corrected, the motor carriage, howitzer, and auxiliary armament are ready to go into action. Individual duties are as follows:

a. Chief of Section. The chief of section commands INSPECT EQUIPMENT.

(1) Supervises inspections by members of the section.

(2) Directs gunner to service recoil system. Inspects cylinders for leaks.

(3) Verifies presence of technical manuals and lubrication orders for carriage and

howitzer, trip ticket, drivers accident report form, and gun book.

(4) Inspects ammunition for lot number, condition, and stowage.

(5) Inspects loading of section equipment for completeness and stowage.

(6) Verifies proper supply of gasoline, oil, water, and emergency rations.

(7) Inspects and stows individual weapon and personal equipment.

(8) Receives reports of personnel of his section upon completion of their duties in inspection.

(9) Reports to battery executive when section personnel have completed their duties, "Sir, No. (so-and-so) in order," or reports any defects that the section cannot remedy without delay or assistance.

b. Gunner.

(1) Assisted by No. 1, unfastens and folds back breech end of howitzer cover; inspects for tears, wear, and broken or missing fastenings.

(2) Removes panoramic and elbow telescopes from case; passes elbow telescope to No. 1; insures cleanliness of panoramic sight; seats in mount.

(3) Tests operation of elevating and traversing mechanisms.

(4) Bore sights the howitzer. (Bore sighting should be checked after displacement

and prior to firing whenever time permits.)

(5) When driver is ready to check transmission and final-drive oil level, traverses weapon to right limit to facilitate inspection.

(6) Tests night-lighting devices.

(7) Tests motions of panoramic telescope mount and inspects leveling devices.

(8) Replaces panoramic and elbow telescopes in case.

(9) Services recoil system when so directed by the chief of section.

(10) Moves tube, assisting Nos. 2 and 3 in locking traveling lock.

(11) Assisted by No. 2, verifies presence of the section tools and spare parts.

(12) Assisted by No. 1, replaces and secures breech end of howitzer cover. Inspects and stows individual weapon and personal equipment.

(13) Reports, "Gunner ready."

c. No. 1.

(1) Assists gunner unfasten and fold back breech end of howitzer cover.

(2) Hands vehicle tools to No. 4.

(3) Receives elbow telescope from gunner; secures in mount; assists gunner in bore sighting when target is alined; removes and passes to gunner.

(4) Tests operation of breechblock and firing mechanism.

(5) Inspects breechblock, chamber, and bore for cleanliness, freedom from foreign matter, and lubrication.

(6) Tests night lighting devices.

(7) Uncovers machine gun; inspects gun and mount; adjusts head space.

(8) Inspects machine gun ammunition.

(9) Inspects machine gun tools and spare parts.

(10) Inspects and stows individual weapon and personal equipment.

(11) Reports, "No. 1 ready."

d. No. 2.

(1) Assisted by No. 3, removes traveling-lock bracket.

(2) Verifies presence and serviceability of—

(*a*) Flag set.

(*b*) Hand grenades.

(*c*) Water and rations.

(*d*) First aid kit.

(*e*) Recoil and spare engine oil.

(*f*) Hand fire extinguisher.

(*g*) Decontaminating equipment.

(*h*) Rammer staff.

(*i*) Ample supply of cleaning and preserving material.

(3) Helps gunner inspect the section tools and spare parts

(4) Replaces traveling-lock bracket, assisted by No. 3, and engages lock.

(5) Inspects and stows individual weapon and personal equipment.

(6) Reports, "No. 2 ready."

e. No. 3.

(1) Assists No. 2 remove traveling-lock bracket.

(2) Inspects fuze setter.

(3) Inspects on-carriage ammunition for proper stowage; assisted by Nos. 4 and 5, stows any replenishment ammunition.

(4) Inspects howitzer and mount for loose parts and for broken or cracked welds.

(5) Takes breech cover from edge of carriage; assists No. 2 replace cover.

(6) Inspects and stows individual weapon and personal equipment.

(7) Reports, "No. 3 ready."

f. No. 4.

(1) Removes the muzzle cover and installs muzzle bore sight.

(2) Tests telephone and intrabattery communication equipment.

(3) Assists driver by—

(*a*) Inspecting under carriage for leaks.

(*b*) Opening engine compartment.

(*c*) Inspecting running engine for leaks.

(*d*) Inspecting lights for proper functioning.

(*e*) Checking fuel and coolant levels.

(*f*) Inspecting air cleaners and battery.

(4) Inspects track and suspension system for—

(*a*) Loose sprockets and support rollers.

(*b*) Loose track-pin wedge screws.

(*c*) Missing wedges.

(*d*) Worn track-pin bushings.

(*e*) Missing cushion stop rings.

(*f*) Improper track tension.

(*g*) Damaged or badly gouged bogie wheels.

(5) Closes engine compartment.

(6) Assisted by No. 5, sets up testing target when directed by gunner.

(7) Removes muzzle bore sight and replaces muzzle cover.

(8) Returns tools to No. 1.

(9) Assists No. 3 in stowing ammunition.

(10) Inspects and stows individual weapon and personal equipment.

(11) Reports, "No. 4 ready."

g. No. 5.

(1) Verifies presence and serviceability of aiming posts.

(2) Inspects fixed fire extinguisher and controls.

(3) Assists No. 4 in setting up and alining test target.

(4) Brings in and stows test target.

(5) Assists No. 3 in stowing ammunition.

(6) Inspects and stows individual weapon and personal equipment.

(7) Reports, "No. 5 ready."

h. Driver.

(1) Inspects ground beneath motor carriage for evidence of fuel leaks, oil leaks, or coolant leaks.

(2) Inspects engine and compartment for presence of fumes and evidence of fuel or oil leaks.

(3) Turns fuel filter handle one complete turn in either direction. (On M4A3 chassis checks coolant level.)

(4) Checks transmission and final drive oil level.

(5) Mounts and makes visual check of clutch release bearing. (Not required on M4A3 chassis.)

(6) Turns on main battery switch.

(7) Checks fuel supply and gages.

(8) Opens inside fuel shutoff valves.

(9) Checks engine oil level.

(10) Checks clutch pedal free travel.

(11) Sees that gear shift lever latch is operating and that the lever can be put into each position.

(12) Tests action of parking brakes.

(13) Tests operation of steering levers.

(14) Tests siren switch and fuel cutoff switch.

(15) Primes engine.

(16) Starts and warms up engine.

(17) Notes operation of all instruments on panel.

(18) Performs RPM drop check.

(19) Checks operation of all lights, assisted by No. 4.

(20) Inspects windshield and protectoscope.

(21) Moves motor carriage so entire track can be inspected by No. 4.

(22) Inspects and stows individual weapon and personal equipment.

(23) Reports, "Driver ready."

72. Duties in Inspection During Operation (March)

The inspections performed during operation are constant checks on the functioning of the motor carriage and the security of all stowed equipment. The responsibilities and duties of section personnel are as follows:

a. The chief of section supervises march discipline and assists the driver in detecting obstacles that would cause injury to personnel or damage to the carriage.

b. The gunner inspects the security of the traveling lock, fire control equipment, and gun covers.

c. No. 1 mans the .50 caliber machine gun as directed by the chief of section.

d. Other numbered cannoneers inspect security of stowed equipment, ammunition, and trailer and

act as air sentinels as directed by the chief of section.

e. The driver operates the motor carriage and inspects all instruments and controls (TM 9–749).

73. Duties in Inspection During Halt

The inspection at the halt is made to insure that the motor carriage and armament are in satisfactory operational condition. The halt provides the section an opportunity to inspect for malfunctions that could not be detected during operation. The duties of the members are as follows:

a. Chief of Section. The chief of section commands PERFORM HALT INSPECTION.

(1) Inspects general condition of motor carriage and armament.
(2) Supervises inspection by members of the section.
(3) Makes general check of tracks, sprockets, and suspension system; checks beneath vehicle for leaks.
(4) Receives report of section members.
(5) Reports to the battery executive when inspection is completed, "Sir, No. (so-and-so) in order," or reports any defects that the section cannot remedy without delay.

b. Gunner.

(1) Removes muzzle cover. If dirt has accumulated in tube, instructs No. 3 to swab bore.
(2) Bore sights howitzer if time permits; replaces muzzle cover.
(3) Reports, "Gunner ready."

c. No. 1.

(1) Checks .50 caliber machine gun and ammunition.

(2) Bore sights elbow telescope if time permits.

(3) Acts as air sentinel as directed by chief of section.

(4) Reports, "No. 1 ready."

d. No. 2.

(1) Removes and replaces firing lock, or installs and removes rear bore sight, if required.

(2) Checks transfer unit, differential, and final drives for evidence of overheating.

(3) Reports, "No. 2 ready."

e. No. 3.

(1) Inspects 105-mm ammunition in carriage for security and ready accessibility.

(2) Checks coolant level, replenishing if necessary.

(3) Reports, "No. 3 ready."

f. No. 4.

(1) Opens engine compartment and inspects for cleanliness and leaks.

(2) Inspects air cleaners for security and cleanliness.

(3) Closes engine compartment.

(4) Reports, "No. 4 ready."

g. No. 5.

(1) Inspects suspension system for loose parts and evidence of overheating.

(2) Removes rocks and mud from tracks and suspension system.

(3) Reports, "No. 5 ready."

h. Driver (TM 9–749).

(1) Idles engines at 800 rpm 3 to 4 minutes, noting operation of instruments on panel.

(2) Notes operation of engine controls.

(3) Inspects protectoscope.

(4) Stops engines.

(5) Checks fuel and oil levels, replenishing if necessary.

(6) Reports, "Driver ready."

74. Duties in Inspection and Maintenance after Operation

Immediately after operation the motor carriage and howitzer are given whatever servicing and maintenance needed to prepare them for further sustained action or to determine the need for maintenance by higher echelons. These operations may be performed in the motor park, bivouac area, or combat position. Individual duties of howitzer section personnel are as follows:

a. Chief of Section. The chief of section commands INSPECT EQUIPMENT.

(1) Makes general inspection of carriage, trailer, and armament.

(2) Inspects recoil system; services if necessary.

(3) Cleans and tests gunner's quadrant.

(4) Posts gun book; verifies presence of other forms and manuals.

(5) Supervises detailed inspection and maintenance by cannoneers and driver.

(6) Notifies executive of any requirements for personnel, oil and lubricants, ammunition, water and rations, and replacement of expendable equipment.

(7) Receives reports of section members.

(8) Reports to executive, "Sir, No. (so-and-so) in order," or reports any defects that the section cannot remedy without delay or assistance.

b. Gunner.

(1) Tests operation of elevating and traversing mechanisms.

(2) Cleans elevating and traversing mechanisms.

(3) Cleans and inspects coaxial telescope and mount.

(4) Cleans and inspects panoramic telescope and mount.

(5) Bore sights panoramic telescope and coaxial telescope.

(6) Cleans and tests night-lighting devices.

(7) Replaces panoramic telescope in case.

(8) Assisted by No. 1, inspects howitzer cover for torn or worn places and for broken or missing fastenings.

(9) Reports, "Gunner ready," or reports malfunctions.

c. No. 1.

(1) Cleans breachblock, assisted by No. 2.

(2) Assists in cleaning elevating mechanism.
(3) Unloads, dismounts, and cleans machine gun, assisted by No. 2.
(4) Reassembles and mounts machine gun, assisted by No. 2.
(5) Checks status of .50 caliber ammunition.
(6) Inspects machine gun tools and spare parts.
(7) Replaces machine gun cover (if in garrison).
(8) Tests elevation quadrant with gunner's quadrant.
(9) Cleans and tests night lighting devices.
(10) Cleans and tests firing mechanism.
(11) Assists gunner in inspecting howitzer cover.
(12) Reports, "No. 1 ready," or reports any malfunctions found.

d. No. 2.

(1) Assisted by No. 3, removes traveling lock.
(2) Assembles rammer.
(3) Assists No. 1 in cleaning breechblock.
(4) Assists No. 1 in cleaning machine gun.
(5) Removes firing lock for bore sighting or places rear bore sight in tube.
(6) Inspects the following: flag set, hand grenades, water and rations, first aid kit, recoil and spare engine oil, hand fire extinguisher, decontaminating equip-

ment, rammer staff, and supply of cleaning and preserving material.

(7) Replaces firing lock or removes rear bore sight.

(8) Assisted by No. 3, replaces traveling lock.

(9) Reports, "No. 2 ready," or reports malfunctions found.

e. No. 3.

(1) Assists No.2 in removing traveling lock.

(2) Cleans bore of howitzer assisted by Nos. 4 and 5.

(3) Refills ammunition racks assisted by Nos. 4 and 5.

(4) Polices and cleans inside of motor carriage.

(5) Assists No. 2 in replacing traveling lock.

(6) Reports, "No. 3 ready."

f. No. 4.

(1) Removes muzzle cover and installs muzzle bore sight.

(2) Assisted by No. 5, sets out test target if directed.

(3) Tests telephone and communication equipment.

(4) Assists No. 3 clean bore.

(5) Assists No. 3 refill ammunition racks.

(6) Opens engine compartment.

(7) Inspects running engine for loose parts, excessive vibration, and leaks.

(8) Inspects under carriage for evidence of leaks.

(9) Assists driver in checking lights, cleaning suspension system and outside of carriage, and replenishing fuel, oil, and coolant.

(10) Services air cleaners.

(11) Inspects fixed fire extinguisher and controls.

(12) Closes engine compartment.

(13) Removes muzzle bore sight and replaces muzzle cover.

(14) Reports, "No. 4 ready," or reports malfunctions found.

g. No. 5.

(1) Inspects and lubricates track and suspension systems.

(2) Assists No. 4 set out test target.

(3) Assists No. 3 clean bore of howitzer.

(4) Assists No. 3 refill ammunition racks.

(5) Brings in test target.

(6) Assists driver clean suspension system and outside of carriage.

(7) Reports, "No. 5 ready," or reports irregularities found.

h. Driver (TM 9–749).

(1) Idles engines 3 to 4 minutes before stopping.

(2) Notes engine operation and inspects instruments.

(3) Stops engines and closes fuel shutoff valves.

(4) Inspects the following: steering levers, selector and shift levers, siren, lights, periscope and heads, hatch hood, interphone equipment, and for evidence of leaks in the driver's compartment.
(5) Verifies presence of lubrication order and other required forms.
(6) Inspects oil levels in—differential, final drive, transfer unit, engine, and transmission; replenishes if necessary.
(7) Inspects coolant level; replenishes if necessary.
(8) Cleans suspension system and outside of carriage, assisted by Nos. 4 and 5.
(9) Reports requirements for fuel, lubricants, and maintenance.
(10) Reports, "Driver ready," or reports malfunctions found.

75. Duties in Weekly Inspection and Maintenance

In garrison these services are performed weekly whether the material is used or not. On maneuvers or in combat they are performed after each field operation. Individual duties are as follows:

a. Chief of Section. The chief of section commands PERFORM PERIODIC INSPECTION.

(1) Inspects general condition of carriage. Observes ground under vehicle for leaks.
(2) Supervises inspection; coordinates work of crew.
(3) Directs weekly lubrication, referring to lubrication orders.

(4) Receives reports of section members.

(5) Reports to executive, "Sir, No. (so-and-so) in order," or reports any defects that the section cannot remedy without delay or assistance.

b. Gunner.

(1) Inspects and cleans sighting equipment, sight mounts, and instruments.

(2) Assisted by No. 1, checks and cleans elevating and traversing mechanisms.

(3) Performs lubrication, with particular emphasis on howitzer and mount.

(4) Reports, "Gunner ready."

c. No. 1.

(1) Inspects and cleans firing mechanism.

(2) Inspects and cleans .50 caliber machine gun and mount.

(3) Assists gunner in checking and cleaning elevating and traversing mechanisms.

(4) Cleans right forward section of carriage.

(5) Passes vehicular tools to No. 4.

(6) Assists as directed in performing weekly lubrication.

(7) Reports, "No. 1 ready."

d. No. 2.

(1) Tightens loose bolts, nuts, and connections in hull interior.

(2) Cleans right rear section of carriage.

(3) Performs maintenance on batteries.

(4) Assists as directed in performing weekly lubrication.

(5) Reports, "No. 2 ready."

e. No. 3.

(1) Cleans left forward section of carriage.

(2) Inspects ammunition clamps for condidition and security.

(3) Inspects left track and suspension system.

(4) Tightens loose bolts and connections outside carriage on left side.

(5) Assists as directed in performing weekly lubrication.

(6) Reports," No. 3 ready."

f. No. 4.

(1) Cleans left rear of carriage.

(2) Receives vehicular tools from No. 1; inspects and cleans tools prior to returning them to No. 1.

(3) Inspects right track and suspension system.

(4) Tightens loose bolts and connections outside carriage on right side.

(5) Assists as directed in performing weekly lubrication.

(6) Reports, "No. 3 ready."

g. No. 5.

(1) Cleans outside of carriage.

(2) Touches up rust spots on carriage and howitzer.

(3) Assists as directed in performing weekly lubrication.

(4) Reports, "No. 5 ready."

h. Driver.

(1) Cleans and inspects driver's compartment; tightens nuts, bolts, and connections.

(2) Inspects instruments, electrical wiring, and connections.

(3) Cleans engines, engine compartment; cleans carburetor fuel screens.

(4) Performs lubrication, with particular emphasis on motor carriage.

(5) Reports, "Driver ready."

CHAPTER 9

DECONTAMINATION OF EQUIPMENT

76. General

Equipment which has been contaminated by chemical, biological, or radiological agents constitutes a danger to personnel. *Contamination* means the spreading of an injurious agent in any form and by any means. Persons, objects, or terrain may be contaminated. *Decontamination* is the process of making any contaminated place or thing safe for unprotected personnel. This can be done by covering, removing, destroying, or changing into harmless substances the contaminating agent or agents. Generally, only equipment contaminated by persistent agents need be decontaminated.

77. Decontamination for Chemical Agents

a. Ammunition. With rags, wipe off visible contamination from projectiles. Apply DANC (decontamination agent, noncorrosive, M4), wipe with gasoline-soaked rag, then dry. If DANC is not available, scrub with soap and cool water. Slurry (equal weights of water and chloride of lime) can be used on contaminated ammunition containers, but it must not be allowed to penetrate to the ammunition itself.

b. Instruments. If exposed to corrosive gases, clean instruments as soon as possible with alcohol (or gasoline, if no alcohol is available), and apply a thin coat of light machine oil. A rag dampened with DANC may be used, followed by drying with a clean rag and then applying a coat of machine oil. DANC injures plastic or hard rubber surfaces. surfaces.

c. Weapons. Remove dirt, dust, grease, and oil. Do not apply wet mix but allow surfaces to air after soil and dirt have been removed. DANC can be used on all metal surfaces except the bore. Also effective on metal are hot water, cleaning solvent, or repeated application of gasoline on swabs. If the emergency use of gasoline-soaked swabs is made (FM 21–40), extreme care must be taken to insure that the gasoline does not spread the contamination and that no gasoline in liquid or vapor form remains. This excess would be ignited when the gun is fired. After decontamination, weapons are dried and oiled.

d. Automotive Equipment. Exposure to the air can neutralize light contamination from spray. For heavier contamination use DANC on interior or exterior surfaces which personnel are likely to touch. For larger area decontamination, wash vehicle with water and scrub painted surfaces with soap and water.

78. Decontamination for Biological and Radiological Agents

a. General. After a contaminating attack, recovery of equipment may be achieved either by

waiting, to permit the decay of contamination, or by active decontamination to reduce danger to a level where it is no longer a significant hazard to operating personnel. Decontamination may be either rough or detailed, depending on the urgency of the military situation. The procedure adopted will be a command decision.

b. Rough Decontamination. Rough decontamination is performed when urgency is the main factor. Its purpose is to reduce contamination sufficiently to permit personnel to work with, or clsoe to, equipment for limited periods. Rough decontamination may be achieved by means of water or steam if available. Soap or other detergent used in conjunction with water or steam aids in decontamination.

c. Detailed Decontamination. Detailed decontamination, in which the emphasis is on thoroughness, will be carried out in rear areas and repair bases and includes procedures of surface decontamination, aging and sealing, and disposal.

79. References

For further information on decontamination, see FM 21–40, TM 3–220, and TF 3–1407.

CHAPTER 10

DESTRUCTION OF EQUIPMENT

80. General

a. Tactical situations may arise in which it is necessary to abandon equipment in the combat zone. In such a situation all abandoned equipment must be destroyed to prevent its use by the enemy.

b. The destruction of equipment subject to capture or abandonment in the combat zone will be undertaken only upon authority delegated by a division or higher commander.

c. All batteries will prepare plans for destroying their equipment in order to reduce the time required should destruction become necessary. The principles to be followed are—

(1) Plans for destruction of equipment must be adequate, uniform, and easily carried out in the field.

(2) Destruction must be as complete as the available time, equipment, and personnel will permit. Since complete destruction requires considerable time, *priorities* must be established so that the more essential parts are destroyed first.

(3) The same essential parts must be destroyed on all like units to prevent the

enemy from constructing a complete unit from damaged ones.

(4) Spare parts and accessories must be given the same priorities as the parts installed on the equipment.

81. Methods

To destroy equipment adequately and uniformly all personnel of the unit must know the plan and priority of destruction and be trained in the methods of destruction.

82. References

For detailed information on destruction of the 105-mm howitzer, fire control equipment, and motor carriage, see TM 9–325 and TM 9–731E; for destruction of ammunition, see TM 9–1901.

CHAPTER 11
SAFETY PRECAUTIONS

83. General

Safety precautions to be observed in training are prescribed in SR 385–310–1. Additional information is found in FM 6–140, TM 9–325, TM 9–749, TM 9–1900, and TM 9–1901. The more important safety precautions are summarized in the following paragraphs.

84. Ammunition

a. All ammunition on the ground at the firing position must be so placed that it is protected against explosion in case of accident at the position. Flames and explosive materials such as gasoline must be kept away from ammunition. Ammunition should be protected from direct rays of the sun by use of a tarpaulin or other suitable covering.

b. Battery personnel must not attempt to disassemble fuzes.

c. If for any reason a round is not fired after the time fuze has been set, the fuze must be reset to SAFE before it is restowed.

d. All rounds not fired which have been prepared for firing must be checked by the chief of section to insure that all seven powder increments

are present in proper order and condition, and that they are of the proper lot number. He also verifies that the lot number on the ammunition corresponds to the lot number on the container. For ammunition that is to be returned to Ordnance, a battery officer must certify that it has been properly reassembled (FM 6–140).

85. Misfires

a. In the event of a misfire, two more attempts are made to fire the gun.

Caution: The gun should remain as laid and all personnel must stay clear of the muzzle and path of recoil.

All personnel not required for the operation should be cleared from the vicinity.

b. Upon the command to unload (par. 47), the procedure is as follows:

(1) Open the breech to extract the cartridge case. Should the complete round be extracted, the projectile is separated from the cartridge case.

(2) Inspect the primer in the base of the cartridge case immediately to determine whether the indent is normal.

(3) Throw the cartridge case clear of all personnel to prevent injury in case of a hang-fire.

(4) The projectile is reloaded with another cartridge case and firing is resumed.

c. See TM 9–325 for action to be taken in case the indent on the primer is light or if there is no

indent, indicating that the firing lock is not functioning properly.

d. See SR 385–310–1 for safety regulations pertaining to misfires.

86. Drill and Firing

a. The gun is kept unloaded except when firing is imminent.

b. Members of the section on the ground pass in rear of the carriage when going from one side to another.

c. Personnel should stay a safe distance from the breech to prevent injury when the gun recoils.

d. During firing, personnel should use waste in their ears to protect eardrums against injury.

e. In training, there must always be a safety officer for each artillery unit firing. For duties of the safety officer, see FM 6–40.

CHAPTER 12

TRAINING

Section I. GENERAL

87. Purpose and Scope

The purpose of this chapter is to present the absolute minimum requirements for training the personnel of a gun section in the performance of their duties in service of the gun. It includes general information on the conduct of training, and tests to be given for the qualification of gunners.

88. Objectives

The objectives are speed in training cannoneers in their individual duties; and, through drill, to weld them into an effective, coordinated team able to function efficiently in combat. During training, supervisors may well keep in mind the proficiency sought by Army Training Tests (ATT) 6–1, 6–2, and 6–5. Maximum efficiency is attained through continuous drills.

89. Conduct of Training

a. Training will be conducted in accordance with the principles set forth in FM 21–5. Its goal should be the standards set forth in FM 6–125, TM 6–605, SR 615–25–15, and SR 615–25–20.

b. In general, individual training is conducted by noncommissioned officers as far as practicable. Officers are responsible for training plans, for conducting unit training, and for supervising and testing individual training.

c. Throughout training, the application of prior instruction to current training must be emphasized.

d. A record of the training received by each individual should be kept. This may be done by each chief of section keeping a progress card for each man in his section. This card should show each period of instruction attended, tests taken, and remarks pertaining to progress. Progress cards should be inspected frequently by the battery executive to make sure that they are being kept properly and to determine the state of training. *Requiring the chief of section to keep these records emphasizes his responsibility toward his section.*

e. The necessity for developing leadership and initiative in noncommissioned officers must be emphasized constantly throughout training.

90. Standards to be Attained

A satisfactorily trained section must be capable of performing the following functions in the times indicated (TM 6–605):

a. Firing 10 rounds (drill ammunition) at different deflections, elevations, and time fuze settings, using the same charge, in 3 minutes by day and 4 minutes by night. Changes in data should

be typical for an area time mission; data is announced from prepared cards.

b. Performing after-firing care and maintenance of armament. The gun being in position, clean and lubricate, disassemble and assemble the breech and firing mechanism, and inspect the weapon, in 30 minutes by day and 40 minutes by night. All tools and materials required should be available at the position.

c. Performing 6-months inspection and maintenance of armament. The gun prepared for action in the gun park, clean and lubricate, as authorized, all parts and assemblies, and prepare for ordnance inspection in 2 hours. All tools and materials required should be available in the gun park.

d. Each member of the section should know the duties of all other members of the section and be able to perform efficiently in all positions. See paragraphs 91–104 for tests to be given for the qualification of gunners.

Section II. TESTS FOR QUALIFICATION OF GUNNERS

91. Purpose and Scope

This section prescribes the tests to be given in the qualification of gunners. The purposes of the tests are twofold:

a. To provide a means of determining the relative proficiency of the individual artillery soldier in the performance of the duties of the gunner, 105-mm howitzer M2 and modifications. *The tests*

will not be a basis for determining the relative proficiency of batteries or higher units.

b. To serve as an adjunct to training.

92. General Instructions

a. Standards of Precision. The candidate will be required to perform the tests in accordance with the standards listed below:

(1) Scale settings must be exact and matching indexes must be brought into coincidence.

(2) Level bubbles must be exactly centered.

(3) The vertical hair in the reticle of the panoramic telescope must be alined on the left edge of the aiming post or on exactly the same part of the aiming point or target each time the gun is laid.

(4) Final motions of azimuth and elevation setting knobs, as well as traversing and elevating handwheels, must be made in the appropriate direction. For elevating, the final motion of the handwheel should be in the direction of the more difficult movement. Final motion for traversing is from left to right. Final movement of the vertical hair of the telescope is from left to right.

b. Assistance. The candidate will receive no unauthorized assistance. Each candidate may select authorized assistants as indicated in the tests. In the event a candidate fails any test because of

the fault of the examiner or any assistant, the test will be disregarded, and the candidate will be given another test of the same nature.

c. Time. The time for any test will be the time from the last word of the command to the last word of the candidate's report. The candidate may begin any test after the first word of the first command.

d. Scoring. Scoring will be conducted in accordance with the two subparagraphs *Penalties* and *Credit* under each subject. If a test is performed correctly, credit will be given in accordance with the subparagraph *Credit* under each subject. No credit will be allowed if conditions exist as specified in the subparagraphs headed *Penalties.*

e. Preparation for Tests. The gun will be prepared for action and the candidate posted at the proper position corresponding to the test being conducted or as indicated in the subparagraphs entitled "Special instructions." The examiner will insure that the candidate understands the requirements of each test and will require the candidate to report "I am ready," before each test.

f. Qualification Scores. Minimum scores required for qualification in the courses are as follows:

Individual classification	*Points*
Expert gunner	90
First-class gunner	80
Second-class gunner	70

93. Outline of Tests

Paragraph number	Subject	Number of tests	Points each	Maximum credit
97	Direct laying, panoramic telescope	4	2	8
98	Direct laying, elbow telescope	4	2	8
99	Indirect laying, deflection only	18	2	36
100	Laying for elevation with elevation (range) quadrant	3	2	6
101	Laying for elevation with gunner's quadrant	3	2	6
102	Displacement correction	2	------	4
	Part I	(1)	3	(3)
	Part II	(1)	1	(1)
103	Measuring site to the mask	1	4	4
104	Measuring elevation	1	4	4
105	Measuring deflection	1	4	4
106	Tests and adjustment of sighting and fire control equipment	6	------	10
	Tests 1, 3, 4, and 5	(4)	2	(8)
	Tests 2 and 6	(2)	1	(2)
107	Materiel	3	------	10
	Tests 1 and 2	(2)	3	(6)
	Test 3	(1)	4	(4)
	Total credit			100

94. Direct Laying, Panoramic Telescope

a. Scope of Tests.

(1) Four tests (two groups of two tests each) will be conducted in which the candidate will be required to execute commands similar to those given in *c* below.

(2) Tests 1 and 2 (and tests 3 and 4) will be executed as one series of commands.

(3) The candidate will be tested in the duties of the gunner, using the one-man, one-sight system.

b. Special Instructions.

(1) A stationary target will be placed approximately 600 yards from the gun.

(2) The fixed azimuth scale and micrometer scale will be set at zero, and indexes on telescope mount will be matched.

(3) The candidate will be posted as the gunner.

(4) The gun will be pointed so that—

(*a*) A shift of approximately 100 miles will be required for tests 1 and 3.

(*b*) It will not be necessary to shift the motor carriage for any of the four tests.

(5) Laying at the termination of tests 1 and 3 will not be disturbed prior to beginning tests 2 and 4.

(6) The examiner will announce the assumed direction of the movement of the target at the beginning of tests 1 and 3. The assumed direction of the movement of

the target in test 3 will be opposite to that in test 1.

c. Outline of Tests.

Test number	Examiner commands (for example)	Action of candidate
1 and 3	TARGET, THAT TANK; LEAD 5, RANGE 600.	Traverses tube until proper lead has been set. Places proper range line of reticle on the center of the visible mass of the target. Centers cross-level bubble. Gives the command, FIRE, when ready and steps clear.
2 and 4	RIGHT (LEFT) 10, ADD (DROP) 200.	Same as test 1 above.

d. Penalties. No credit will be allowed if, after each test—

(1) The azimuth scale has been moved from zero.

(2) The indexes on the azimuth micrometer have been moved from zero.

(3) The indexes on the telescope mount are not in coincidence.

(4) The lead in mils is not set properly.

(5) The proper range line of the reticle is not on the center of the visible mass of the target.

e. Credit.

Time in seconds, exactly or less than	4	4⅘	5
Credit	2.0	1.5	1.0

95. Direct Laying, Elbow Telescope

a. Scope of Tests.

(1) Four tests (two groups of two tests each) will be conducted in which the candidate will be required to execute commands similar to those given in *c* below.

(2) Tests 1 and 2 (and tests 3 and 4) will be executed as one series of commands.

(3) The candidate will be tested in the duties of No. 1 cannoneer, using the two-man, two-sight system.

b. Special Instructions.

(1) A stationary target will be placed approximately 600 yards from the gun.

(2) For tests 1 and 3 the field of view of the telescope will be placed on the target, with the correct range line more than 100 yards off the target.

(3) The laying of the gun will not be disturbed after tests 1 and 3.

c. Outline of Tests.

Test number	Examiner commands (for example)	Action of candidate
1 and 3	TARGET, THAT TANK; RANGE 500.	Places proper reticle line for announced range on the center of the visible mass of the target. Calls, "Set" and steps clear.
2 and 4	ADD (DROP) 400.	Same as test 1 above.

d. Penalties. No credit will be allowed if, after each test—

(1) The correct range line is not on the center of the visible mass of the target.

(2) The range lines of the reticle are not approximately horizontal.

Time in seconds, exactly or less than	1⅝	1⅘	2
Credit	2.0	1.5	1.0

96. Indirect Laying, Deflection Only

a. Scope of Tests. Eighteen tests will be conducted in which the candidate will be required to execute commands similar to those given below. Tests 1 through 4 (and tests 5 through 9, 10 through 13, and 14 through 18) will be executed as one series of commands.

b. Special Instructions.

(1) Commands will not necessitate shifting carriage.

(2) The examiner will select a suitable aiming point and identify it to the candidate.

(3) Commands for special corrections will be given *only* in the tests indicated in the examples below.

(4) The command for new deflections for each test will be within the following prescribed limits:

Test number	Maximum change (mils)	Minimum change (mils)
2 and 11	180	140
3 and 12	90	70
4 and 13	40	20
7 and 16	100	60
8 and 17	50	30
9 and 18	20	10

(5) The gun will be laid with correct settings at the conclusion of each test before proceeding with the next test.

(6) Aiming posts will be set out in prescribed deflection and distances for these tests.

(7) The examiner will designate the section number of the gun to be used. The examiner will announce special corrections in deflection to be applied by the candidate.

c. Outline of Tests.

Test number	Examiner commands (for example)	Action of candidate
1 and 10	SPECIAL CORRECTIONS, DEFLECTION 2890, NO. 1 LEFT 7	Sets deflection and applies special correction. Centers cross- and longitudinal - level bubbles. Traverses tube until vertical hair is on left edge of aiming posts. Checks centering of bubbles.

Test number	Examiner commands (for example)	Action of candidate
		Re-lays if necessary. Calls "Ready" and steps clear.
2 and 11	DEFLECTION 2760 ____	Sets deflection change. Leaves correction on gunner's aid. Lays on aiming posts. Checks centering of bubbles. Re-lays if necessary. Calls "Ready" and steps clear.
3 and 12	DEFLECTION 2835 ____	Same as test 2 above.
4 and 13	NO. 1, RIGHT 4_____	Same as test 2 above, but changes gunner's aid to right 4 and resets deflection 2835 opposite index.
	At conclusion of test 4 (13) give CEASE FIRE, END OF MISSION. (No time considered for this operation.)	Gunner moves gunner's aid to zero.
5 and 14	AIMING POINT, CHURCH STEEPLE, REFER.	Refers telescope to church steeple. Reads deflection and calls "No. 1, Deflection (so much)."
6 and 15	DEFLECTION 2800, REFER.	Slips the slipping azimuth micrometer scale to zero. Slips the slipping azimuth scale to 2800.

Test number	Examiner commands (for example)	Action of candidate
		Verifies that vertical reticle is on church steeple. Calls "No. 1, Deflection 2800." Steps clear.
7 and 16	SPECIAL CORRECTIONS DEFLECTION 2920 NO. 1, LEFT 7	Same as test 1 above.
8 and 17	DEFLECTION 3040	Same as test 2 above.
9 and 18	DEFLECTION 3080	Same as test 2 above.

d. Penalties.

(1) No credit will be allowed if, after each test—

(*a*) The deflection is set incorrectly.

(*b*) The cross-level or longitudinal-level bubble is not centered.

(*c*) The vertical hair of the telescope is not on the aiming point or left edge of aiming posts, as the case may be.

(2) No credit will be allowed if the last motion of the traverse was not made to the right.

e. Credit.

Time in seconds, exactly or less than—			
Tests 1, 10, 6, and 15 each	12	13	14
Other tests, each	8	9	10
Credit	2.0	1.5	1.0

97. Laying for Elevation with Elevation (Range) Quadrant

a. Scope of Tests. Three tests will be conducted in which the candidate will be required to execute commands similar to those given below.

b. Special Instructions.

(1) Each test will require a change of settings and the accompanying laying of the tube in elevation within the following limits: Site, 15 to 25 mils; elevation, 20 to 40 mils.

(2) Commands for elevation for tests 2 and 3 will not be made in multiples of 5 mils.

(3) Special corrections for site will be applied by the candidate.

(4) The candidate will be posted as No. 1 cannoneer.

c. Outline of Tests.

Test number	Examiner commands (for example)	Action of candidate
1	SITE 295, ELEVATION 280.	Sets anounced site and elevation. Centers cross-level and longitudinal-level bubbles. Calls "Set" and steps clear.
2	SITE 320, ELEVATION 316.	Same as test 1 above.
3	SPECIAL CORRECTIONS, SITE 310, NO. 1 UP 2, ELEVATION 323.	Same as test 1 above.

d. Penalties.

(1) No credit will be allowed if, after each test—

(*a*) The site or elevation is not set accurately.

(*b*) The cross-level or longitudinal-level bubble is not centered.

(2) No credit will be allowed if the last movement of the tube was not in the direction in which it is most difficult to turn the elevating handwheel.

e. Credit.

Time in seconds, exactly or less than	6%	7%	8%
Credit	2.0	1.5	1.0

98. Laying for Elevation with Gunner's Quadrant

a. Scope of Tests. Three tests will be conducted in which the candidate will be required to execute commands similar to those given below.

b. Special Instructions.

(1) The gunner's quadrant will be set at zero for the first test.

(2) Each succeeding test will require a change of quadrant elevation setting within the limits of 30 to 60 mils.

(3) The candidate will be posted to the left of and facing the breech, with the gunner's quadrant in his hand.

(4) An assistant, selected by the candidate, will be posted to the right of the breech to operate the elevating handwheel.

c. Outline of Tests.

Test number	Examiner commands (for example)	Action of candidate
1	QUADRANT 180_____	Sets quadrant elevation on gunner's quadrant. Seats quadrant. Has assistant elevate or depress the tube until the quadrant bubble is centered. Calls "Ready" and waits for examiner to verify laying.
2	QUADRANT 240_____	Same as test 1 above.
3	QUADRANT 205_____	Same as test 1 above.

d. Penalties.

(1) No credit will be allowed if, after each test—

(*a*) The quadrant elevation is set incorrectly.

(*b*) The quadrant is not properly seated.

(*c*) The quadrant bubble is not properly centered.

(2) No credit will be allowed if the last movement of the tube was not in the direction in which it is most difficult to turn the elevating handwheel.

e. Credit.

Time in seconds, exactly or less than___	6	6⅔	7
Credit _____	2.0	1.5	1.0

99. Displacement Correction

a. Scope of Test. One test, consisting of two parts, will be conducted in which the candidate will be required to execute the commands given below.

b. Special Instructions.

(1) Aiming posts will be set out at the prescribed distances.

(2) An assistant, selected by the candidate, will be stationed close to the far aiming post.

(3) The examiner will require the candidate to lay the gun on an announced deflection and report "I am ready."

(4) The far post or the motor carriage will then be moved so that a displacement of 5 to 10 mils occurs.

(5) The laying of the gun at the termination of part I will not be disturbed for part II.

c. Outline of Test.

(1) *Part I.*

Examiner commands	Action of candidate
CORRECT FOR DISPLACEMENT.	Lays the gun so that the far post appears midway between the near post and the vertical cross hair of the telescope. Checks centering of bubbles. Re-lays if necessary. Calls "Ready" and steps clear.

(2) *Part II.*

Examiner commands	Action of candidate
ALINE AIMING POSTS____	Records deflection on shield and announces "Deflection (so much) recorded." Directs assistant in alining aiming posts. Calls "Ready" and steps clear.

d. Penalties. No credit will be allowed if—

(1) *Part I.*

(*a*) The far aiming post does not appear midway between the near post and the vertical cross hair of the telescope.

(*b*) The cross-level or longitudinal-level bubble is not centered.

(*c*) The last motion of traverse was not made to the right.

(2) *Part II.*

(*a*) The deflection is other than the announced deflection.

(*b*) The aiming posts are not properly alined.

(*c*) The vertical hair of the telescope is not on the aiming posts.

e. Credit.

Part I, time in seconds, exactly or less than ____3	3⅓	3⅔	4
Credit ____3.0	2.0	1.5	1.0
Part II, no time limit____			
Credit ____1.0	--	--	--

100. Measuring Sight to Mask

a. Scope of Test. One test will be conducted in which the candidate will be required to execute the command given below.

b. Special Instructions.

(1) The gun, prepared for action, will be placed 200 to 400 yards from a mask of reasonable height.

(2) The tube will be pointed so that it is 100 to 150 mils above the crest and 100 to 150 mils right or left of the highest point of the crest.

(3) The candidate will take post at the right rear of the breech.

c. Outline of Test.

Examiner commands	Action of candidate
MEASURE SITE TO MASK.	**Sights along lowest element of bore and operates elevating and traversing mechanism until line of sight just clears crest.** **Sets angle of site scale at 300, centers longitudinal-level bubble by turning elevating knob, and centers cross-level bubble.** **Reads elevation from elevation scale and micrometer.** **Reports "No. (so-and-so), Site to mask (so much)."**

d. Penalties. No credit will be allowed if—

(1) The line of sight along the lowest element of the bore does not just clear crest.

(2) The cross-level or longitudinal-level bubble is not properly centered.

(3) The angle of site scale does not read 300.

(4) The site is announced incorrectly.

e. Credit.

Time in seconds, exactly or less than	11	12	13	14
Credit	4.0	3.0	2.0	1.5

101. Measuring Elevation

a. Scope of Test. One test will be conducted in which the candidate will be required to measure the elevation by means of the gunner's quadrant.

b. Special Instructions. Prior to the test the examiner will lay the tube at a selected elevation, measure the elevation, and then set the gunner's quadrant at zero.

c. Outline of Test.

Examiner commands	Action of candidate
MEASURE THE ELEVATION.	Places gunner's quadrant on quadrant seats of the breech ring. Levels bubble by raising or lowering the index arm and turning the micrometer knob. Announces "No. (so-and-so), Elevation (so much)," and hands quadrant to examiner.

d. Penalties. No credit will be allowed if—

(1) The quadrant bubble is not centered when the quadrant is seated properly.

(2) The elevation is announced incorrectly.

e. Credit.

Time in seconds, exactly or less than	8	9⅘	10⅘
Credit	4.0	3.0	2.0

102. Measuring Deflection

a. Scope of Test. One test will be conducted in which the candidate will be required to measure and report a deflection in accordance with the command given below.

b. Special Instructions.

(1) The gun will be laid on aiming posts to the left front.

(2) An aiming point within 200 mils to the left or right of the aiming posts will be designated by the examiner and identified by the candidate.

c. Outline of Test.

Examiner commands	Action of candidate
NUMBER (SO-AND-SO), AIMING POINT, THAT (SO-AND-SO), REFER.	**Centers cross-level and longitudinal-level bubble.** **Refers to aiming point.** **Checks centering of bubbles and re-lays telescope if necessary.** **Reads deflection and reports, "No. (so-and-so) deflection (so much)" and steps clear.**

d. Penalties. No credit will be allowed if—

(1) The cross-level or longitudinal-level bubble is not centered properly.

(2) The vertical hair of the telescope is not on the aiming point.

(3) The deflection is announced incorrectly.

(4) The traversing handwheel is turned.

e. Credit.

Time in seconds, exactly or less than	5	5⅝	6	6⅝
Credit	4.0	3.0	2.0	1.5

103. Tests and Adjustment of Sighting and Fire Control Equipment

a. Scope of Tests. Six tests will be conducted in which the candidate will be required to demonstrate the methods employed in making the prescribed tests and authorized adjustments, or describe the action taken (i.e., send to the ordnance maintenance company) if adjustment is not authorized to be made by using personnel.

b. Special Instructions.

(1) The gun will be prepared for the tests as indicated in paragraphs 54 and 55.

(2) The equipment needed for the tests is listed in paragraph 54.

(3) The candidate will select an assistant who will operate the elevating handwheel at the direction of the candidate during tests 1 and 2 and adjust and aline the testing target at the direction of the candidate prior to test 5.

(4) The tests will be conducted in the chronological sequence indicated in *c* below. After completion of test 2, the gunner's quadrant used in tests 1 and 2 will be used for test 3, with the proper correction, as determined in test 1, carried on the quadrant, provided the correction does not exceed 0.4 mil.

(5) Adjustments which the candidate may be required to accomplish will fall within the following limits:

(*a*) Elevation and angle of site scales, not to exceed one 100-mil graduation.

(*b*) Elevation and angle of site micrometer scales, not to exceed ten 1-mil graduations.

(*c*) Rotating head and telescope mount elevation indexes, none.

(*d*) Rotating head and telescope mount elevation micrometer indexes, not to exceed one-fourth turn.

(*e*) Panoramic telescope azimuth scale, not to exceed one 100-mil graduation.

(*f*) Panoramic telescope slipping azimuth micrometer scale, not to exceed ten 1-mil graduations.

(6) The tube will be leveled at the conclusion of test 2 and will not be disturbed thereafter.

c. Outline of Tests.

Test number	Examiner commands	Action of candidate
1	PERFORM END-FOR-END TEST ON GUNNER'S QUADRANT.	Performs test as prescribed in paragraph 62*a* and *b*. Calls "Error (so many) mils, quadrant serviceable (unserviceable)" and hands quadrant to examiner for verification.
2	PERFORM MICROMETER TEST ON GUNNER'S QUADRANT.	Performs test as prescribed in paragraph 62*c*. Calls "Quadrant micrometer is (is not) in error."
3	TEST TELESCOPE MOUNT.	Performs tests and makes adjustments, if necessary, as prescribed in paragraph 63*b*. Calls "Cross- (longitudinal-) level bubble(s) within (without) allowable limit." ***Caution:*** Do not turn cross-leveling or elevation knobs of the telescope mount after this test.
4	TEST RANGE QUADRANT.	Performs tests and makes adjustments, if necessary, as prescribed in paragraph 63*c*.

Test number	Examiner commands	Action of candidate
		Calls "Ready" and steps clear. *Note.* Prior to test 5, the cross- and longitudinal-leveling of the tube and the panoramic telescope mount will be verified by the examiner, and the testing target will be alined by the candidate with help of his selected assistant as described in paragraph 63.
5	TEST ADJUSTMENT OF PANORAMIC TELESCOPE.	Performs tests and makes adjustments, as prescribed in paragraph 63*d*. Calls "Ready" and steps clear.
6	TEST ADJUSTMENT OF ELBOW TELESCOPE.	Inspects elbow telescope for adjustment and makes adjustments, if required, as described in paragraph 57*m*. Calls "Ready" and steps clear.

d. Penalties.

(1) *General.* The tests are not essentially speed tests. The purpose of the prescribed time limits is to insure that the candidate can perform the operation without wasted effort.

(2) *Test 1.* No credit will be allowed if—

(*a*) The bubble of the gunner's quadrant does not center when verified by the examiner.

(*b*) The error (one-half the amount of the angle which was indicated when the quadrant was first reversed and the bubble centered by moving the index arm and micrometer) is announced incorrectly by the candidate.

(*c*) The candidate fails to declare the quadrant unserviceable if the error (necessary correction) is 0.4 mil or more.

(*d*) The time to complete the test exceeds 2 minutes.

(3) *Test 2.* No credit will be allowed if—

(*a*) The procedure is not followed correctly.

(*b*) The time to complete the test exceeds 1 minute.

(4) *Test 3.* No credit will be allowed if—

(*a*) The bubble of the gunner's quadrant is not centered in either direction.

(*b*) The candidate does not announce correctly in regard to the status of either the cross-level or the longitudinal-level bubble.

(*c*) The matching indexes on the rocker and actuating arm or those on the elevation knob and shaft are not in coin-

cidence when the adjustments are complete.

(*d*) The time to complete the test and adjustments exceeds 4 minutes.

(5) *Test 4.* No credit will be allowed if—

(*a*) The elevation micrometer does not read zero when the elevation scale reads zero.

(*b*) The angle of site does not read 300 when the cross-level and longitudinal-level bubbles are centered.

(*c*) The cross-level or longitudinal-level bubble is not properly centered.

(*d*) The time to complete the tests and adjustments exceeds 2 minutes.

(6) *Test 5.* No credit will be allowed if—

(*a*) The candidate fails to make any adjustment when such adjustment is indicated.

(*b*) The rotating head elevation micrometer indexes are not in coincidence.

(*c*) The zero line of either the azimuth scale or azimuth scale micrometer is not in coincidence with its respective index.

(*d*) The center line of the bore, as viewed through the bore sights, or the line of sight of the telescope do not fall on their respective sighting points on the testing target when all scales are set at zero.

(*e*) The time to complete the tests and adjustments exceeds 4 minutes and 30 seconds.

(7) *Test 6.* No credit will be allowed if—

(*a*) The reticle is not horizontal.

(*b*) The N range line is not in coincidence with the proper sighting line of the testing target.

(*c*) The time to complete the test and adjustment exceeds 1 minute.

e. Credit.

(1) The candidate will be scored on the general merit of his work in addition to the specific requirements above.

(2) If the tests and adjustments are performed correctly within the prescribed time limit, maximum credit will be given as follows:

Test 1	2
Test 2	1
Test 3	2
Test 4	2
Test 5	2
Test 6	1
Total	10

104. Materiel

a. Scope of Tests. The candidate will be required to perform three tests as outlined below.

b. Special Instructions.

(1) *Tests 1 and 2.* For tests 1 and 2, a paulin will be spread for the convenience of the candidate in laying out the disassembled parts. The candidate will be allowed to select the tools and accessories necessary for the performance of the tests prior to the start of the tests.

(2) *Test 3.*

(*a*) A complete set of lubrication equipment authorized for use of battery personnel will be made conveniently available on a paulin.

(*b*) Every type of lubricant, in plainly labeled containers, used on the gun will be placed conveniently on the paulin.

c. Outline of Tests.

Test number	Examiner commands	Action of candidate
1	DISASSEMBLE BREECH MECHANISM AND FIRING LOCK.	Performs the operation as described in TM 9-325, laying the parts on the paulin. After disassembly, identifies all parts to examiner.
2	ASSEMBLE BREECH MECHANISM AND FIRING LOCK.	Performs the operation as described in TM 9-325.

Test number	Examiner commands	Action of candidate
3	DAILY, WEEKLY, AND MONTHLY LUBRICATION TEST.	Selects proper lubricating equipment and lubricant and shows *how* and with *which lubricant* each lubrication point is serviced. (Actual lubrication is not performed.)

d. Penalties.

(1) The tests are not essentially speed tests. The purpose of the maximum time limits is to insure that the candidate can perform the operations without wasted effort.

(2) No credit will be given if the following time limits are exceeded:

Test 1	1½ minutes
Test 2	3 minutes
Test 3	2 minutes

(3) A penalty of one-half point will be assessed for each component part not correctly identified or omitted in test 1. There is no time limit imposed on the identification of component parts. However, the examiner may reduce the grade if it becomes obvious that the candidate is not familiar with the nomenclature.

e. Credit.

(1) The candidate will be scored on the general merit of his work in addition to the specific requirements above.

(2) If each test is performed correctly within the prescribed time limit, maximum credit will be given as follows:

Test 1	3
Test 2	3
Test 3	4
Total	10

APPENDIX

REFERENCES

AR 600–70_____Badges.
ATP 6–300_____Field Artillery Unit Training Program.
ATT 6–1_____Training Tests for Field Artillery Howitzer or Gun Battery.
ATT 6–2_____Training Tests for Field Artillery Battalion Firing.
ATT 6–5_____Training Tests for Light and Medium Field Artillery Battalions, Involving Displacement and Continuous Fire Support.
SR 110–1–1_____Index of Army Motion Pictures, Kinescope Recordings, and Film Strips.
SR 310–20-series__List of Military Publications.
SR 320–5–1_____Dictionary of United States Army Terms.
SR 385–310–1_____Regulations for Firing Ammunition for Training, Target Practice, and Combat.
SR 615–25–15_____Military Occupational Specialties.
SR 615–25–20_____Career Fields.
SR 700–45–5_____Unsatisfactory Equipment Report.
T/O&E 6–317_____Field Artillery Battery, 105-mm Howitzer, Self-Propelled, Armored or Howitzer Company, Armored Cavalry Reconnaissance Battalion.
TF 3–1407_____Decontamination Procedures—Part I: Basic Techniques.
FM 5–15_____Field Fortifications.
FM 5–20_____Camouflage, Basic Principles.
FM 5–20B_____Camouflage of Vehicles.
FM 5–20D_____Camouflage for Field Artillery.

FM 5–25 ..... Explosives and Demolitions.
FM 6–40 ..... Field Artillery Gunnery.
FM 6–101 ..... The Field Artillery Battalion.
FM 6–125 ..... Qualification Tests for Specialists, Field Artillery.
FM 6–140 ..... The Field Artillery Battery.
FM 17–50 ..... Logistics, Armored Division.
FM 21–5 ..... Military Training.
FM 21–8 ..... Military Training Aids.
FM 21–40 ..... Defense Against Chemical Attack.
FM 21–60 ..... Visual Signals.
FM 23–65 ..... Browning Machine Gun, Caliber .50 HB, M2.
FM 25–10 ..... Motor Transport.
LO 9–749 ..... Carriage Motor, 105-mm Howitzer, M7B1.
TM 3–220 ..... Decontamination.
TM 6–605 ..... Field Artillery Individual and Unit Training Standards.
TM 9–324 ..... 105-mm Howitzer M4 (Mounted in Combat Vehicles).
TM 9–325 ..... 105-mm Howitzer M2A1, Carriages M2A1 and M2A2, and Combat Vehicle Mounts M4 and M4A1.
TM 9–575 ..... Auxiliary Sighting and Fire Control Equipment.
TM 9–717 ..... 105-mm Howitzer Motor Carriage M37.
TM 9–731E ..... Carriage Motor, 105-mm Howitzer, M7.
TM 9–735 ..... Medium Tanks M26 and M45.
TM 9–749 ..... Carriage, Motor, 105-mm Howitzer M7B1.
TM 9–850 ..... Abrasive, Cleaning, Preserving, Sealing, Adhesive, and Related Materials Issued for Ordnance Materiel.
TM 9–3007 ..... 105-mm Howitzers M2A1, 105-mm Howitzer Recoil Mechanisms M2A1, M2A2, and M2A3, 105-mm Howitzer Carriages M2A1 and M2A2, and 105-mm Howitzer Mounts M4 and M4A1.

TM 9–1527_____Gunner's Quadrant M1 and M1918 and Machine Gun Clinometer M1917.
TM 9–1545_____Telescope Mounts and Range and Elevation Quadrants for Motor Carriages, Field Artillery and Antiaircraft Artillery.
TM 9–6111_____Panoramic Telescopes M1, M12, M12A2, M12A5, and M12A6.
TM 9–1590_____Fuze Setters M14, M22, M23, M25, and M27.
TM 9–1900_____Ammunition, General.
TM 9–1901_____Artillery Ammunition.
TM 9–2300_____Artillery Materiel and Associated Equipment.
TM 9–2810_____Tactical Motor Vehicle Inspection and Preventive Maintenance Services.
TM 9–2853_____Preparation of Ordnance Materiel for Deep Water Fording.
TM 21–301_____Driver Selection, Training and Supervision, Half-Track and Full-Track Vehicles.
TM 21–305_____Driver's Manual.
TM 21–306_____Manual for the Full-Track Vehicle Driver.
DA ORD Supply Manuals:
SNL G–199___Carriage, Motor, 105-mm Howitzer, M7B1.
SNL K–1_____Cleaning and Preserving Materials.
SNL R–1_____Ammunition for Light Artillery.
SNL R–3_____Fuzes and Primers.
SNL R–7_____Demolition Materiel, Land Mines, and Fuzes.
DA Form 468_____Unsatisfactory Equipment Report.
OO Form 5825____Artillery Gun Book.

INDEX

[AG 472.2 (23 Dec 53)]

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