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FM 6-94

DEPARTMENT OF THE ARMY FIELD MANUAL

Ch 1,

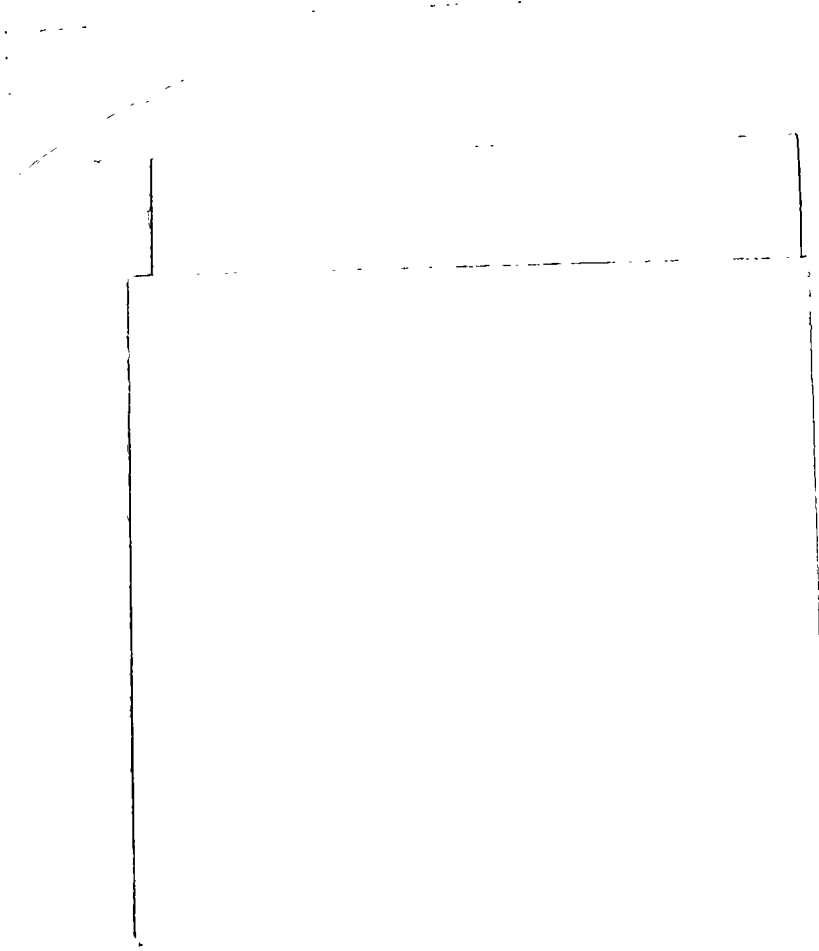
**175-MM GUN M107
SELF-PROPELLED
AND
8-INCH HOWITZER M110
SELF-PROPELLED**

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**HEADQUARTERS, DEPARTMENT OF THE ARMY
MAY 1968**

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CHANGE

No. 1

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, D.C., 24 December 1969

**175-mm GUN M107 SELF-PROPELLED
and
8-INCH HOWITZER M110 SELF-PROPELLED**

FM 6-94, 20 May 1968, is changed as follows:

Page 6, paragraph 5b(4). In line 1, "throg" is changed to read "through 8."

Page 6, paragraph 5c. In line 3, "(SNL,s)" is changed to read "(SNL's)."

Page 20, paragraph 39. In line 4, "type" is changed to read "tube". In line 10, "miles" is changed to read "mils."

Page 20, paragraph 40. In line 5, "No. 6 in aiming the aiming" is changed to read "No. 6 in aligning the aiming."

Page 20, paragraph 41. In line 7, "tthe" is changed to read "the." In line 9, "the tube using the power elevation counter dial and elevates (or depresses) the tube using the power elevating mechanism

until" is changed to read "the tube using the power elevating mechanism until."

Page 21, paragraph 52. In line 5, "chair" is changed to read "chain."

Page 30, paragraph 96. Table 4. In line 2 (caption), "M100" is changed to read "M110", and "He" is changed to read "HE."

Page 31, paragraph 96. Table 5. In line 9, "600
5 1.5" is changed to read "800

5 1.5."

Page 35, chapter 7. In the title, "SITUATIONS REQUIRE" is changed to read "SITUATIONS THAT REQUIRE"

Page 37. Figure 16 is superseded as follows:

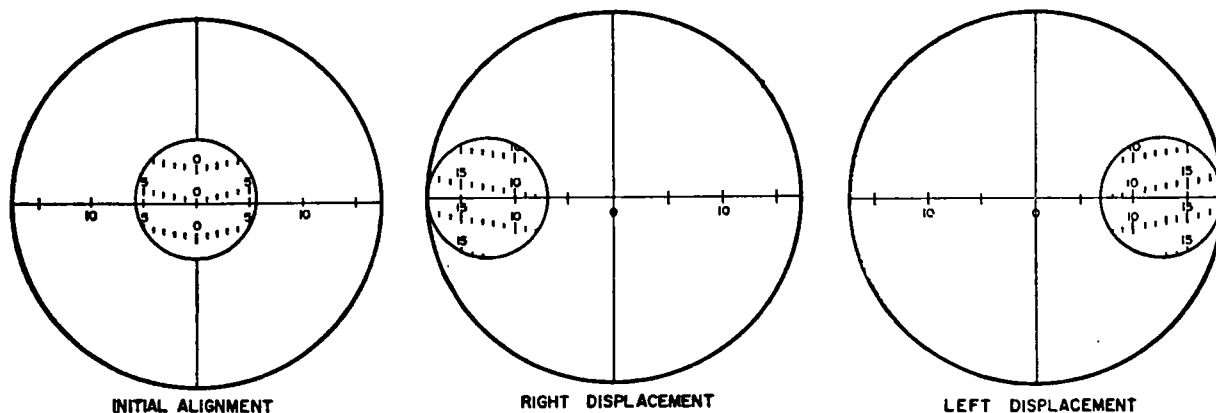


Figure 16. Gunner's sight picture of collimator when correcting for displacement.

Page 38, paragraph 112a. In line 11, "The realine" is changed to read "To realine."

Page 39, paragraph 117b. In lines 13 and 14, "Projectiles stacked in the open tarpaulins should be raised at least six inches" is changed to read "Projectiles stacked in the open should be raised at least six inches."

Page 43, paragraph 121. In line 1, "cnontrol" is changed to read "control."

Page 43, paragraph 121b. In line 1, "The line of sight" is changed to read "The lines of sight."

Page 43, paragraph 122a. In line 4, "reults" is changed to read "results." In line 5, "because of" is changed to read "because a."

Page 44. Paragraph 123b is superseded as follows:

b. Tube. To level the tube, apply the gunner's quadrant error determined in the end-for-end test as outlined in paragraph 135, to the level correction indicated on the breech of the weapon. Set the total correction on the gunner's quadrant, place the gunner's quadrant on the tube quadrant seats and center the bubble. The tube is now level.

Page 44, paragraph 125. In line 4, "tst-" is changed to read "test-." In line 9, "telesocpe" is changed to read "telescope."

Page 44, paragraph 127. In line 7, "trunnions if unnecessary" is changed to read "trunnion is unnecessary."

Page 48, paragraph 133e. In line 3, "31" is changed to read "131."

Page 48, paragraph 133g. In line 3, "pare din" is changed to read "pared in."

Page 49, paragraph 139. In lines 4 and 5, "actually correct vertical plane at all elevations," is changed to read "actually establish the tube (regardless of cant) in the correct vertical plane at all elevations."

Page 50, paragraph 142a. In line 1, "Go level" is changed to read "Level."

Page 51, paragraph 144. In line 3, "cross-level level bubble" is changed to read "cross-level-bubble."

Page 51, paragraph 146. In line 7, "tets" is changed to read "test."

Page 62, paragraph 187b(6). In line 2, "of" is changed to read "at."

Page 62, paragraph 187c. In line 20, "(No time considered for this operation.)" is changed to read "(No time considered for this operation.)"

Page 64, paragraph 189b(2). In line 6, "poss" is changed to read "posts."

Page 65, paragraph 191c. In line 8, "QUADRANTT 215" is changed to read "QUADRANT 215."

Page 66, paragraph 193c. In line 2, "Action of candidate Examiner commands" is changed to read "Examiner commands Action of candidate."

In line 5 "MASK" is changed to read "CREST."

In line 11, "Action of candidate Examiner commands" is changed to read "Examiner commands Action of candidate".

Page 68, reference 1. In line 2, "320-5" is changed to read "310-25." In line 3, "320-50" is changed to read "310-50." In line 7, "Polices" is changed to read "Policies."

Page 68, reference 4. In line 2, "pelled." is deleted.

Table 1. Sequence 2. Chief of Section. In line 2, "enplaces" is changed to read "emplaces."

By Order of the Secretary of the Army:

Official:

KENNETH G. WICKHAM,
Major General, United States Army,
The Adjutant General.

W. C. WESTMORELAND,
General, United States Army,
Chief of Staff.

Distribution:

To be distributed in accordance with DA Form 12-11 requirements for 175 mm Gun, M107, SP/8
"Howitzer, M110, SP."

FIELD MANUAL

No. 6-94

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, D.C., 20 May 1968

175-MM GUN M107, SELF-PROPELLED, AND 8-INCH HOWITZER M110, SELF-PROPELLED

	Paragraphs	Page
CHAPTER 1. GENERAL -----	1-4	3
2. ORGANIZATION -----	5, 6	6
3. SECTION DRILL -----		
Section I. General -----	7, 8	9
II. Preliminary commands and formations -----	9-14	9
CHAPTER 4. PREPARING THE PIECE FOR FIRING AND TRAVELING -----		
Section I. Preparations for firing -----	15, 16	14
II. Preparations for traveling -----	17, 18	14
CHAPTER 5. FIRING BY INDIRECT LAYING -----		
Section I. General -----	19, 20	15
II. Duties of chief of section -----	21-36	16
III. Duties of gunner -----	37-46	18
IV. Duties of assistant gunner, cannoneers, and driver --	47-89	21
CHAPTER 6. FIRING BY DIRECT LAYING -----		
Section I. Technique of fire -----	90-96	28
II. Duties of chief of section -----	97-104	31
III. Duties of gunner, assistant gunner, cannoneers, and driver -----	105-108	33
CHAPTER 7. TECHNIQUES AND SITUATIONS THAT REQUIRE SPECIAL ATTENTION -----	109-118	35
8. BORESIGHTING -----		
Section I. General -----	119-122	41
II. Testing target method -----	123-125	43
III. Distant aiming point method -----	126, 127	44
IV. Standard angle method -----	128-131	44
CHAPTER 9. BASIC PERIODIC TESTS -----		
Section I. General -----	132, 133	48
II. Test of gunner's quadrant -----	134, 138	48
III. Tests for telescope mount M137, panoramic telescope, and elevation quadrant M15 -----	139-145	49
IV. Test of fuze setters -----	146-147	51
CHAPTER 10. MAINTENANCE AND INSPECTIONS -----	148-157	52
11. DECONTAMINATION OF EQUIPMENT -----	158-161	53
12. DESTRUCTION OF EQUIPMENT -----	162-165	55
13. SAFETY PRECAUTIONS -----	166-171	56

This manual supersedes FM 6-94, 5 November 1962, including C 1, 17 September 1963.

	Paragraphs	Page
CHAPTER 14. TRAINING		
Section I. General -----	172-174	58
Section II. Minimum training schedule -----	175-177	58
CHAPTER 15. TESTS FOR QUALIFICATION OF GUNNERS		
Section I. General -----	178-185	60
Section II. Tests -----	186-195	61
APPENDIX A. REFERENCES -----		68
INDEX -----		70

CHAPTER 1

GENERAL

1. Purpose and Scope

a. This manual is a guide to assist commanders in developing the gun (howitzer) sections of 175-mm gun M107 and 8-inch howitzer M110 firing batteries into efficient smooth-working teams with a sense of discipline. This manual prescribes individual duties and section drills, tests and adjustments for sighting and fire control equipment, and instructions for the destruction and decontamination of equipment. The material contained herein is applicable, with modification, to both nuclear and nonnuclear warfare.

b. Users of this manual are encouraged to recommend changes or provide comments to improve it. Comments should be keyed to the specific page, paragraph, and line of text in which change is recommended. Reasons should be provided for each comment to insure understanding and complete evaluation. Comments should be forwarded direct to Commandant, U.S. Army Artillery and Missile School, ATTN: AKPSIAS-PL-FM, Fort Sill, Oklahoma 73503.

2. Definition of Terms

a. Section. As used in this manual, the term section is intended to designate only the personnel required to serve the weapon and its

equipment. Appropriate TOE's prescribe the personnel and equipment for each section.

b. Front. The front of a section is the direction in which the muzzle of the gun (howitzer) points.

c. Right (Left). The direction right (left) is the right (left) of one to the rear of the piece, facing the piece.

d. In Battery. A gun (howitzer) is said to be in battery when the recoiling parts are in the normal firing position.

3. Description of Equipment

The motor carriages of the 175-mm gun M107 (fig. 1) and the 8-inch howitzer M110 (fig. 2) are identical. The singular difference in the weapons are the tubes. To insure proper use of the motor carriage and to avoid accidents caused by exceeding its capabilities and limitations, all members of the section should be familiar with the performance characteristics shown in figure 3. For further details pertaining to fulltrack vehicle capabilities and combat driving, see TM 21-306.

4. References

Publications covering related matters which are not discussed in detail in this manual are listed in appendix A.

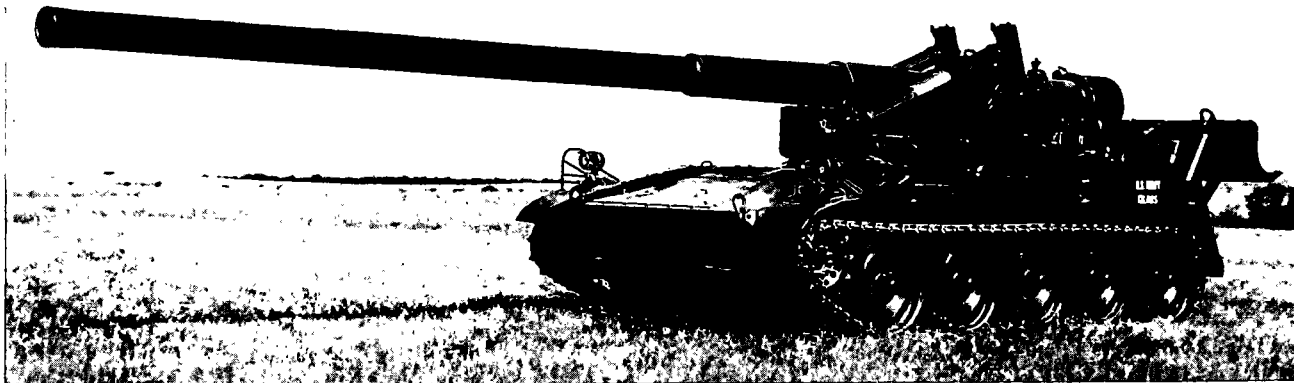


Figure 1. 175-mm gun M107, self-propelled.

3-9

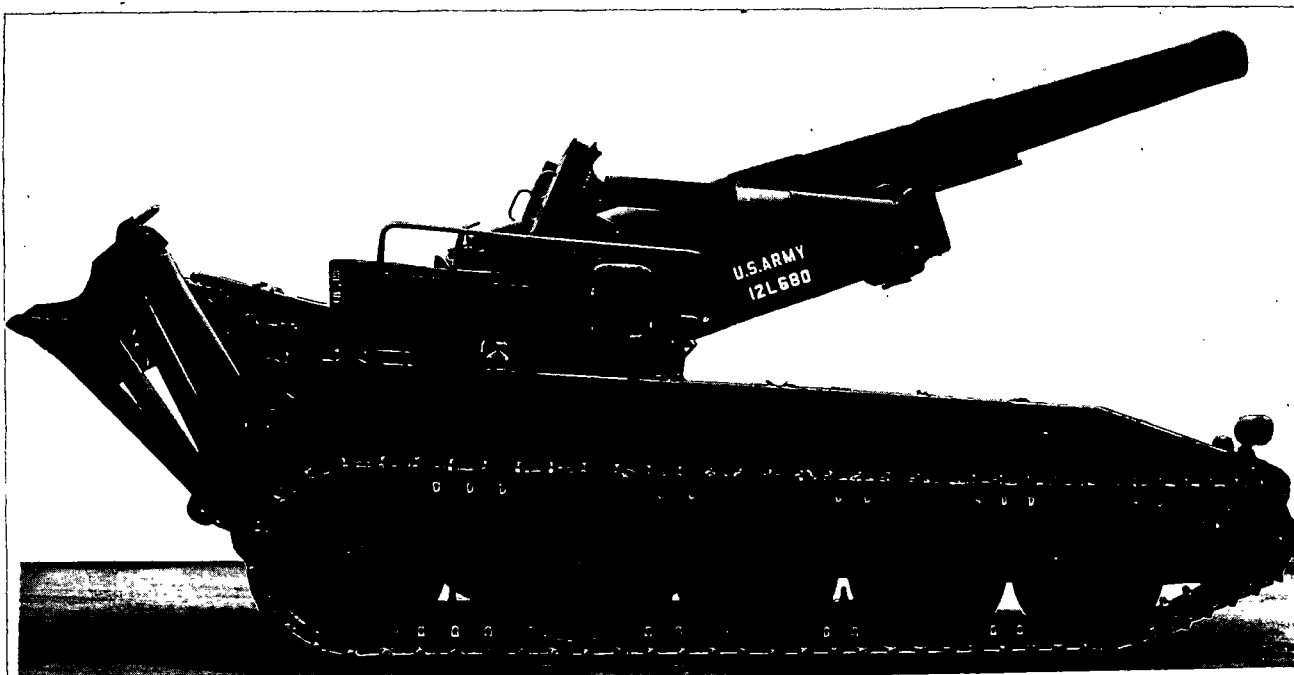


Figure 2. 8-inch howitzer M110, self-propelled.

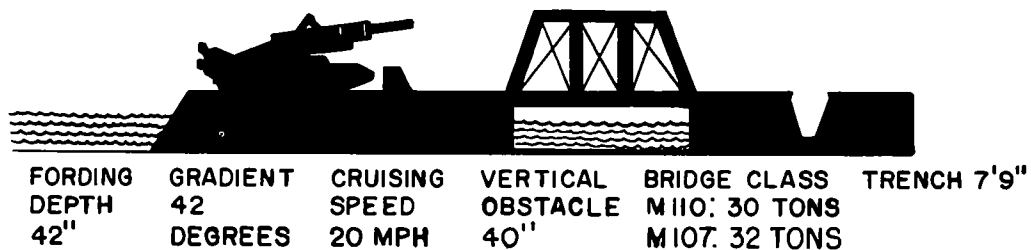
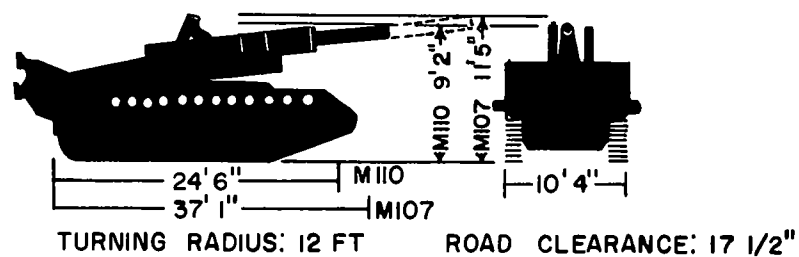


Figure 3. Performance characteristics of the motor carriage, 175-mm gun M107 and 8-inch howitzer M110.

CHAPTER 2

ORGANIZATION

5. Composition of the Gun (Howitzer) Section

a. The gun (howitzer) section consists of section personnel; a 175-mm gun M107, self-propelled, or an 8-inch howitzer M110, self-propelled; a section vehicle; and auxiliary equipment (fig. 4 and 5).

b. Personnel of the gun (howitzer) section consists of—

- (1) A chief of section (CS).
- (2) A gunner (G).
- (3) An assistant gunner (AG).
- (4) Eight cannoneers number 1 through.
- (5) A motor carriage driver (MD).
- (6) A section vehicle driver (SD).

c. Section equipment is listed in appropriate TOE's and standard nomenclature lists (SNL,s) (appendix A).

6. General Duties of Personnel

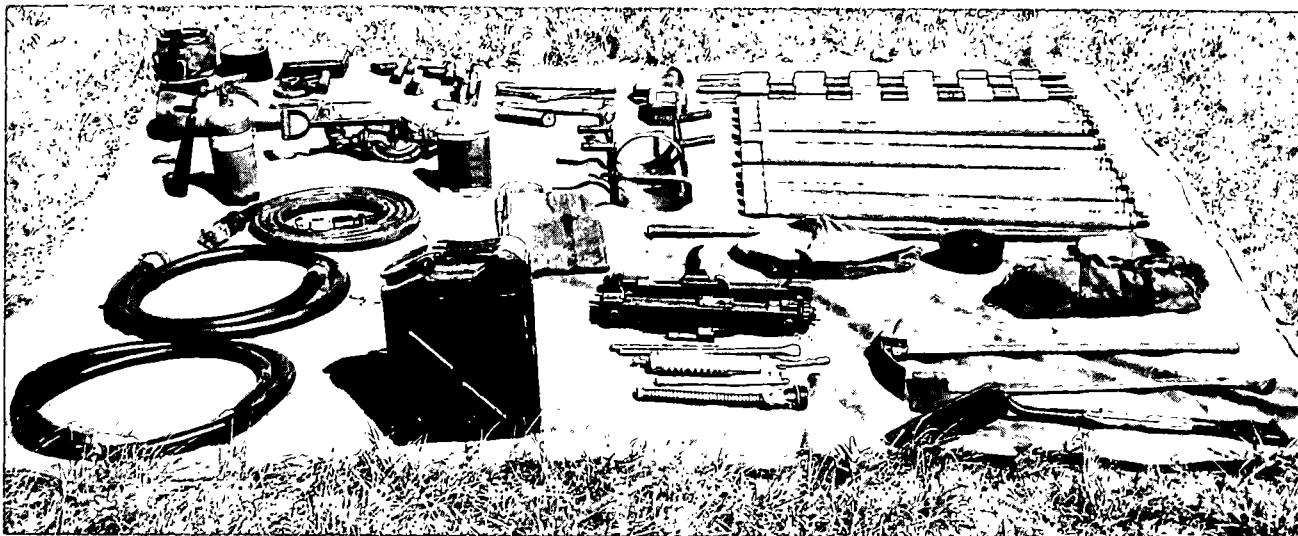
a. *Chief of Section.* The chief of section is the

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 in section drill, duties in firing, tests and adjustment of sighting and fire control equipment, and inspection and maintenance of all section equipment, including the performance of scheduled preventive maintenance service on the motor carriage and section vehicle.
- (3) Observance of safety precautions.
- (4) Preparation of field fortifications for protection of equipment, ammunition, and personnel.
- (5) Camouflage, light and noise discipline; local security; and chemical, biological, and radiological (CBR) warfare security discipline.
- (6) Maintenance of Equipment Log Book (TM 38-750).
- (7) Police of the section area.



Figure 4. 175-mm gun M107, self-propelled, and section personnel.



a. A method of displaying section equipment.

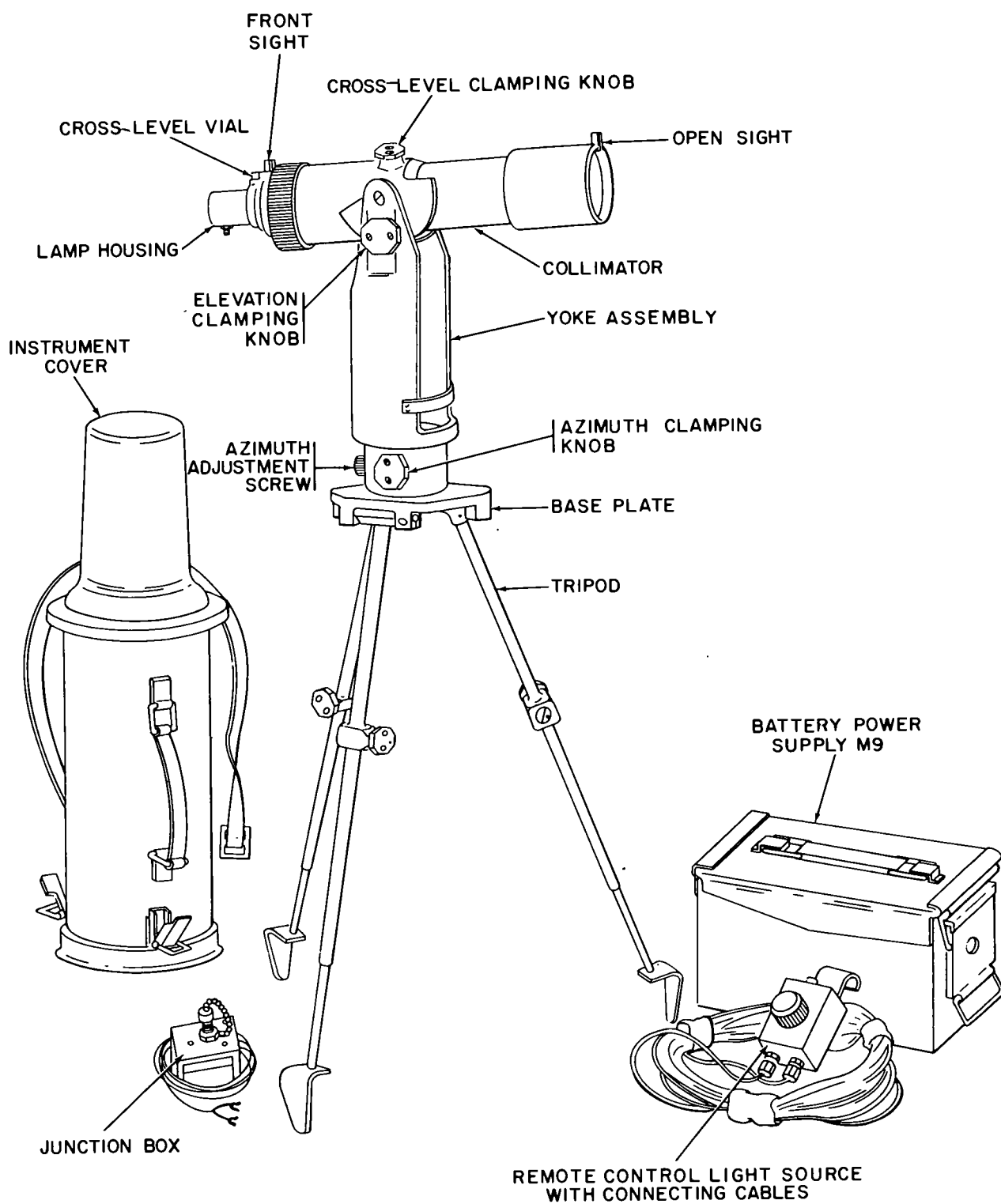
Figure 5. Equipment.

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

c. Assistant Gunner. The assistant gunner assists the gunner in performing his duties and, in an emergency, acts as the gunner. The assistant gunner's specific duties are prescribed in appropriate chapters of this manual.

d. Cannoneers. Cannoneers perform the duties listed in this manual and any other duties assigned by the chief of section.

e. Drivers. The drivers' primary duties are driving their respective vehicles and performing preventive maintenance. They also perform the duties prescribed by this manual and by the technical manuals pertaining to their vehicles, and other duties assigned by the chief of section. These duties can include substituting for any member of the section in firing.



b. Infinity aiming references collimator and auxiliary equipment.

Figure 5—Continued.

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. Adherence to drills prescribed in this manual is necessary to develop maximum efficiency and to prevent injury to personnel and damage to equipment. Section drill must be conducted in silence, except for commands and reports. The section must be drilled until reactions to commands are automatic, rapid, and efficient.

b. Errors are corrected immediately. Each member of the section must be impressed with the importance of reporting promptly to the

chief of section any errors discovered before or after the command to fire has been given. The chief of section will report errors immediately to the executive.

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

d. Duties should be rotated during training so that each member of the gun (howitzer) 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 (howitzer) 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. Higher numbered cannon-eers, if present, form in order between No. 8 and the motor carriage driver. The chief of section may indicate in his preparatory command the place and direction in which the section is to form. At the first formation for a drill or exercise, the caution "As gun (howitzer) section(s)" precedes the command. The commands are FALL IN, or 1. IN FRONT (REAR) OF YOUR PIECE(S), 2. FALL IN, or 1. ON THE ROAD FACING THE PARK, 2. FALL IN. Execu-

tion is as follows: The section moves at double time and forms at close interval, at attention, guiding on the gunner. The driver of the section vehicle is to the left of the motor carriage driver and is the last in line. To execute 1. IN REAR OF YOUR PIECE, 2. FALL IN, the section falls in as shown in figure 6.

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; for example, "Gunner," "Assistant Gunner," "1," "2," "3," "4," "5," "6," "7," "8," "Driver," "Driver." Each man, except the gunner, turns his head smartly to the front as he calls out his designation.

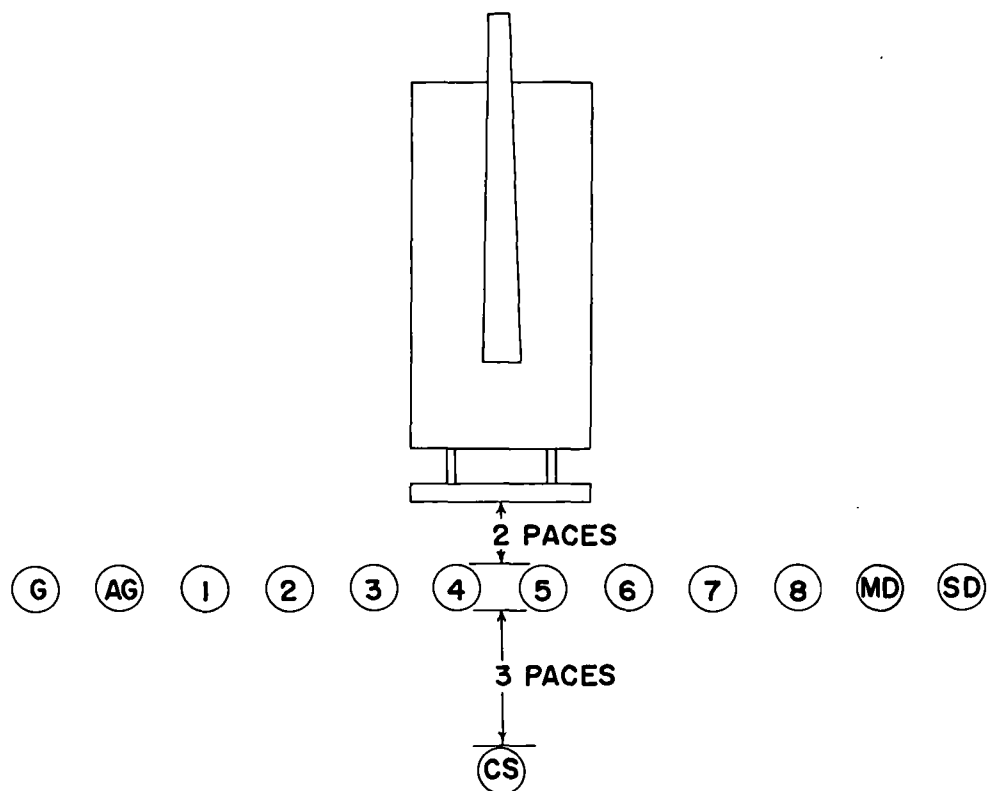


Figure 6. Formation of the section in rear of the piece.

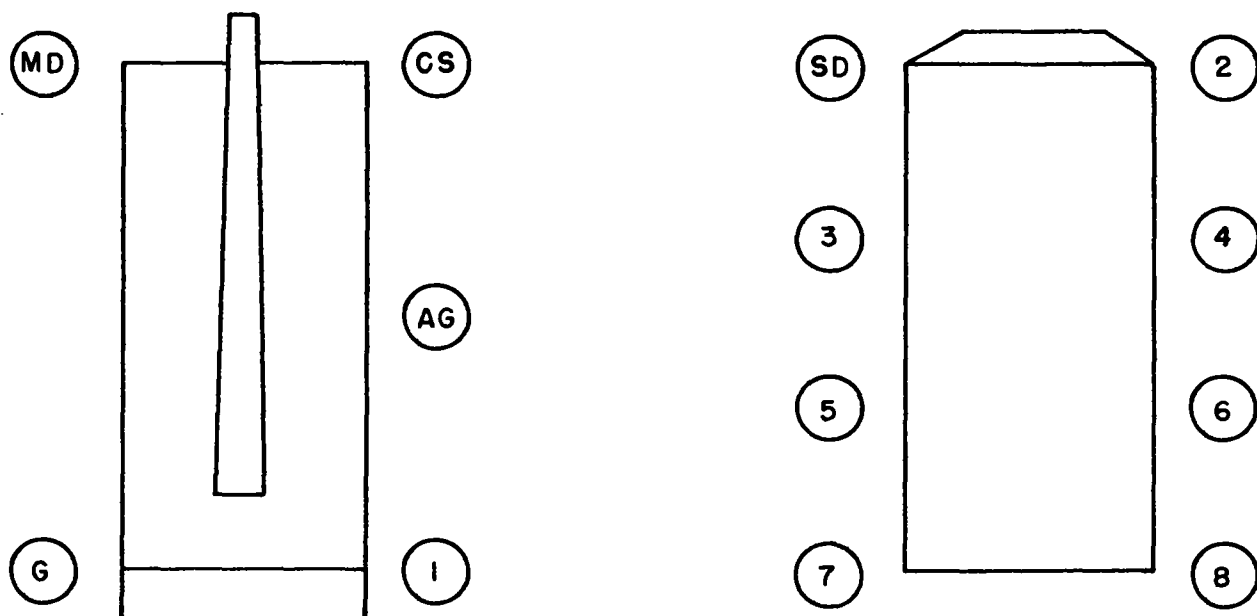


Figure 7. Posts of section dismounted.

10. To Post 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 7. All personnel are 2 feet outside the tracks and facing the front.

b. *Prepared for Action.* The piece having been prepared for action the section is posted as shown in figure 8. All personnel face to the front.

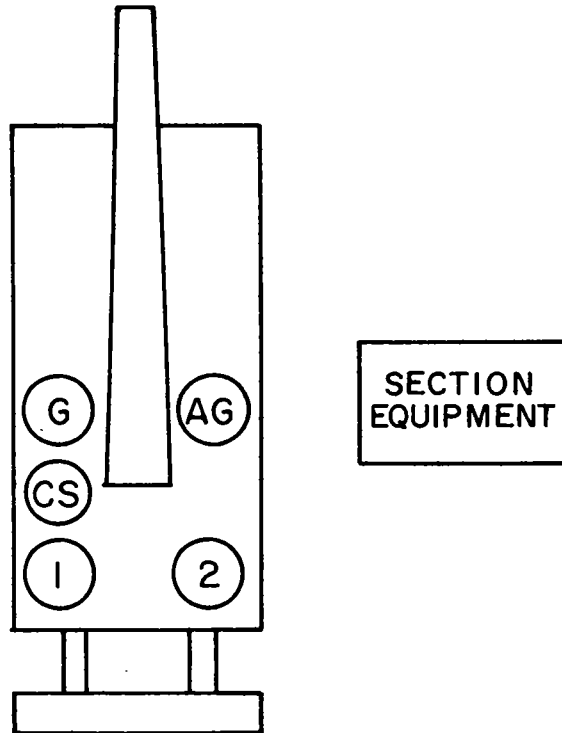


Figure 8. Posts of section prepared for action.

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* (fig. 6), the commands are 1. CHANGE POSTS, 2. MARCH, or 1. SECTION CHANGE POSTS, 2. MARCH.

a. At the command 1. CHANGE, POSTS, 2. MARCH, The assistant gunner and all numbered cannoneers except No. 8 take two left steps, taking the position of the next higher numbered cannoneer. At the same time No. 8 moves at double time in rear of the rank to the post of the assistant gunner. All other members of the section stand fast.

b. At the command 1. SECTION CHANGE POSTS, 2. MARCH, all members of the section except the individual at the extreme left take two left steps. The excepted man moves at double time in rear of the section and takes the post of the gunner.

12. To Mount

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

a. At the preparatory command, the section moves at double time to the positions shown in figure 7. At the command of execution, all per-

sonnel mount as indicated in figure 9. The chief of section, driver of the motor carriage, gunner, assistant gunner, and No. 1, mount on the motor carriage. Likewise, at the command of execution, the driver of the section vehicle, and No. 2, 3, 4, 5, 6, 7, and 8 mount into the section vehicle as shown in figure 9. If any members of the section are not to mount, 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, DRIVERS STAND FAST, 2. MOUNT.

b. If the command is MOUNT, the section mounts in the manner and order prescribed for the command 1. PREPARE TO MOUNT, 2. MOUNT. Dismounted posts are not taken.

13. To Dismount

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

a. At the preparatory command, the personnel mounted in the section vehicle unlatch and open the doors (tailgate) of the vehicle and all members of the section assume positions from which they can dismount promptly. At the command of execution, they dismount and take (at double time) the posts shown in figure 7.

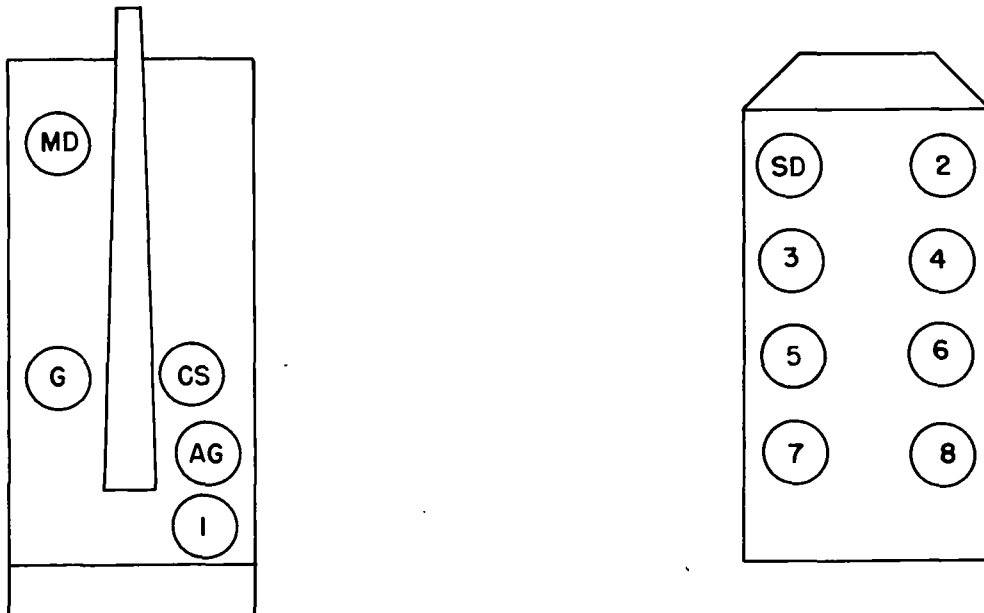


Figure 9. Section mounted.

b. If the command is simply DISMOUNT, the section executes all that is 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 to relieve them temporarily from *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 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 piece to insure that settings and laying remain undisturbed. During these periods, the chief of section may direct the men to improve the position, to replenish ammunition, or to do other necessary work.

CHAPTER 4

PREPARING THE PIECE FOR FIRING AND TRAVELING

Section I. PREPARATIONS FOR FIRING

15. General

The weapons of a battery will ordinarily be moved into position individually under the direction of the executive, chief of firing battery, 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 (easy to identify) should be placed in the direction of fire, 50 to 100 meters 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, and TM 21-306.

16. To Prepare for Action

a. The piece being in position or approaching it, the command is PREPARE FOR ACTION. Duties of individuals are given in table 1. Each

man takes his post (fig. 8) on completion of his duties.

Table 1. Duties in Preparing for Action
(Located in back of manual)

b. The piece 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 the piece is moving or halted, but only the operations that are practicable are performed while moving. Immediately after the piece is established in position, preparation for action is completed without further command.

c. If PREPARE FOR ACTION has not been ordered before the piece is established in position, the command is habitually given by the chief of section as soon as the vehicle is halted in position. When preparation for action is not desired, the command "DO NOT PREPARE FOR ACTION" must be given.

Section II. PREPARATIONS FOR TRAVELING

17. March Order

To prepare for movement, the command is MARCH ORDER. Duties of individuals are given in table 2. Each man takes his post (fig. 7) on completion of his duties.

Duties in March Order
(Located in back of manual)

18. To Resume Firing in Another Position

a. If the piece is to be moved a short distance

and if firing is to be resumed promptly, the command MARCH ORDER is not given. When such 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 weapon is prepared for travel as in *a* above, the operations pertaining to march order are completed.

CHAPTER 5

FIRING BY INDIRECT LAYING

Section I. GENERAL

19. Instructions

Caution: Use manual traverse and elevation **ONLY** when the hydraulic system fails.

The general instructions in paragraphs 7 and 8 while the weapon is prepared for travel as in *a* on the conduct of section drill apply equally to the duties required in firing by indirect laying. The sequence of duties performed in firing is shown in table 3. For duties of the battery executive, see FM 640 and FM 6-140.

Table 3. Duties in Firing

(Located in back of manual)

20. Duties of Individuals

In general, the duties of individuals in the section in indirect fire are given in *a* through *l* below. These duties apply to personnel of both the gun and howitzer sections.

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

b. The gunner sets the announced deflection, lays for direction, refers the panoramic telescope, alines the aiming posts, or the collimator, whichever is appropriate, assisted by No. 6, operates the power manual traversing mechanism, and announces "Ready" when the piece is ready to be fired. From the gunner's position, it is possible for him to set the announced elevation and lay for elevation using the power elevating mechanism. However, these duties are not normally performed by the gunner.

c. The assistant gunner sets the announced

elevation, lays for elevation, operates the power manual elevating mechanism, and calls "Set" when the piece is laid for elevation.

d. No. 1 operates the loader-rammer.

e. No. 2 loads the projectile assisted by No. 1, measures the depth of ram, announces the depth of ram to the chief of section, receives the powder charge from No. 7 and No. 8, loads the powder charge, closes the breech, inserts the primer, attaches the lanyard to the firing lock and fires the piece. After firing, he opens the breech, swabs the powder chamber, inspects the bore and calls "Bore clear."

Note. Depth of ram measured and announced for 175-mm gun only.

f. No. 3, assisted by No. 4, installs the projectile on the loading tray, straps the projectile to the tray, and attaches the loading tray to the loading arms. After the projectile and powder are loaded, No. 3 receives the loading tray from No. 1.

g. No. 4 assists in preparing ammunition and assists No. 3 in installing the projectile on the loading tray and attaching the loading tray to the loading arms.

h. No. 5 assists in preparing ammunition, fuzes the projectiles, and sets time assisted by No. 6.

i. No. 6 assists in preparing ammunition, assists No. 5 in fuzing projectile and setting time, and assists the gunner in alining the aiming posts, or collimator as appropriate.

j. No. 7, assisted by No. 8 and the prime mover driver, prepares powder charges and, assisted by No. 8, moves the powder charge to the rear of the piece and passes it to No. 2.

k. No. 8 assists in preparing powder charges and assists No. 7 in moving the powder charge to the piece.

l. The prime mover driver assists in preparing powder charges and shifts the carriage when directed to do so by the chief of section.

Section II. DUTIES OF CHIEF OF SECTION

21. List of Duties

- a. Indicates the aiming point to the gunner.
- b. Measures the angle of site to the mask.
- c. Follows fire commands.
- d. Indicates when the piece is ready to be fired.
- e. Gives the command to fire.
- f. Reports errors and other unusual incidents of fire to the executive.
- g. Records basic data.
- h. Lays the piece for elevation, assisted by the assistant gunner, when the gunner's quadrant is used.
- i. Measures the elevation.
- j. Conducts prearranged fires.
- k. Observes and checks frequently the functioning of the materiel.
- l. Assigns duties when firing with reduced personnel.
- m. Verifies the adjustment of the sighting and fire control equipment.
- n. Controls the movement of the motor carriage.
- o. Checks all ammunition (which has been prepared for firing) before it is loaded for travel.

22. Indicates the Aiming Point to the Gunner

When an aiming point has been designated by the battery executive officer (FM 6-140), the chief of section will assure himself of proper identification and point out the aiming point to the gunner. If there is any possibility of misunderstanding, the chief of section will turn the panoramic telescope until the horizontal and vertical crosshairs are on the aiming point designated.

23. Measures the Angle of Sight to the Mask

- a. The command is MEASURE THE ANGLE OF SITE TO THE MASK. The chief of section, sighting along the lowest element of the bore, directs the gunner to traverse and elevate the tube until the line of sight just clears the crest at its highest point in the probable field of fire. The gunner then turns the elevation counter knob in the appropriate direction until the elevation level bubble is centered. The chief of section reads the elevation from the elevation counter dial and reports to the executive, "Number (so and so), angle of site (so much)."
- b. When the executive announces the minimum quadrant elevation and charge or the minimum quadrant elevation for each charge, the chief of section records the data in a notebook.

24. Follows Fire Commands

The chief of section will follow fire commands. He will repeat the commands as required.

25. Indicates When the Piece Is Ready To Be Fired

When the executive can see arm signals made by the chief of section, the chief of section will raise his right arm vertically as a signal that the piece is ready to be fired. He gives the signal as soon as the gunner calls "Ready" and No. 2 has attached the lanyard. When arm signals cannot be seen, the chief of section reports orally to the executive, "Number (so and so) ready."

26. Gives the Command to Fire

When No. 2 can see the 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 number (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.

27. Reports Errors and Other Unusual Incidents of Fire to the Executive

a. If the piece cannot be fired, the chief of section will promptly report that fact to the executive and the reasons therefore; for example, "Number (so and so) out; misfire." When it is discovered that the piece has been fired with an error in laying, the chief of section will report that fact at once; for example, "Number (so and so) fired 40 mils right." When the gunner reports that the aiming posts are out of alinement, the chief of section will report that fact and, during the next lull in firing, ask permission to realine them by saying number (so and so) requests permission to realine aiming posts. Likewise, the chief of section promptly reports other unusual incidents that affect the service of the piece.

b. If the zero line on the collimator cannot be seen by the gunner due to displacement of the weapon, he will continue to lay his piece on the collimator, taking up the correct sight picture (fig. 16 and para 111).

28. Records Basic Data

The chief of section will record data of a semi-permanent nature in a notebook. These data include minimum elevations; aiming points used and their deflections; prearranged fires when section data sheets are not furnished; safety limits in elevation and deflection; date, hour, and number of rounds fired; and calibration and special corrections when appropriate.

29. Lays the Piece for Elevation When Gunner's Quadrant Is Used

a. Although the normal method of laying for elevation is by use of the elevation counter, the gunner's quadrant may be used to lay for elevation when a refinement greater than 1 mil is desired. The gunner's quadrant is also used to check the accuracy of the elevation counters. The command is **USE GUNNER'S QUADRANT**.

b. An elevation of quadrant 361.8, for example, is set on the gunner's quadrant as follows:

The upper edge of the plunger plate is set opposite the 360 mark on the scale on the quadrant frame, and the micrometer on the arm is set to read 1.8. Care must be taken to use the same side of the quadrant in setting both the plunger plate and the micrometer.

c. When the announced elevation has been set on the gunner's quadrant, the piece has been loaded, and the breechblock has been closed, the gunner's quadrant is set on the quadrant seats of the elevation quadrant M15 or on the quadrant seats of the panoramic telescope mount M137. The words *line of fire* must be at the bottom of the quadrant with 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 seats 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 settings, so that in each case he will view the quadrant bubble from the same angle.*

d. The chief of section then directs the assistant gunner to elevate or depress the tube until the bubble is centered. The chief of section cautions the assistant gunner when the bubble approaches the center, so that the final centering may be performed accurately.

e. Normally, special and calibration corrections are added algebraically at the battery fire direction center, and the quadrant then would be announced as Number (so and so), quadrant (so much).

30. Measures the Elevation

At the command **MEASURE THE ELEVATION**—the piece having been laid—the chief of section directs the assistant gunner to check the leveling of the elevation quadrant mount. The chief of section then sets the micrometer of the gunner's quadrant at zero and places it on the quadrant seats of the elevating mechanism.

a. Moves the plunger arm of the gunner's quadrant until the bubble passes to the end of the vial away from the plunger arm hinge.

b. Slowly lowers the plunger arm until the bubble just passes to the end of the vial toward the hinge.

c. Turns the micrometer until the bubble is accurately centered.

d. Removes the quadrant and reports the elevation setting to the nearest 0.1 mil as "Number (so and so), elevation (so much)."

31. Conducts Prearranged Fires

When the execution of prearranged fires is ordered, the chief of section conducts the fire of his section in conformity with the prescribed data.

32. Observes and Checks Functioning of the Materiel

The chief of section closely observes the functioning of all parts of the materiel during firing. Before the piece is fired, he insures that the recoil and counterrecoil systems contain the proper amount of oil; thereafter he carefully observes the functioning of these systems. He promptly reports to the executive any evidence of malfunctioning (TM 9-2300-216-0).

33. Assigns Duties When Firing With Reduced Personnel

When the number of personnel serving the piece is temporarily reduced below that indicated in this manual, the chief of section will assign duties to best facilitate the service of the piece. Loss of cadremen, various details, and casualties will necessitate the section's operating with a reduced number of personnel to the extent that it is almost normal for section members 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.

34. Verifies the Adjustment of the Sighting and Fire Control Equipment

See TM 9-2300-216-10 for detailed instructions on testing and adjusting sighting and fire control equipment.

35. Controls the Movement of the Motor Carriage

When it is necessary to move the motor carriage, the chief of section instructs the driver to start the engine. He then controls the displacement of the motor carriage by hand signals or by oral instructions. To shift the carriage when a new direction of fire is designated, the motor carriage should be moved so that when the tube is pointed in the new direction and the spade is seated the panoramic telescope will be over its original position and the aiming posts, or the collimator, will still be in alinement.

36. Checks All Ammunition Which Has Been Prepared for Firing Before It Is Loaded for Travel

The chief of section personally checks all ammunition not fired that has been prepared for firing before it is replaced in containers. He sees that powder increments prepared for firing are present in proper condition, are of the same lot number as the container, and are assembled in proper numerical order. He checks all time and/or VT fuzes that have been set to see that they are reset to SAFE and that the eyebolt lifting plugs are reinstalled in all projectiles. The chief of section also insures that the supplemental charge has been replaced and that grommets are replaced on the rotating bands of projectiles.

Section III. DUTIES OF GUNNER

37. List of Duties

a. Centers the cross-level bubbles on the panoramic telescope mount.

b. Lays the piece for direction.

c. Alines the aiming posts, assisted by No. 6.

d. Lays the piece for elevation when directed to do so by the chief of section.

e. Sets a common deflection to a common aiming point after the piece has been laid.

f. Sets or changes deflection.

g. Signals and/or calls "Ready."

h. Refers the panoramic telescope.

i. Makes corrections for aiming post displacement.

38. Centers the Cross-Level Bubble on the Panoramic Telescope Mount

The gunner centers the cross-level bubble on the telescope mount, as part of all operations that involve the use of the panoramic telescope. This bubble is centered prior to using the telescope and the level of the mount is verified before the gunner calls "Ready." The panoramic telescope M115 and telescope mount M137 are shown in figure 10.

39. Lays the Piece for Direction

The piece being in position, tube in the center of traverse—and not laid for direction, the executive officer commands BATTERY ADJUST AIMING POINT THIS INSTRUMENT. The gunner replies "Number (so-and-so) aiming point identified," the executive officer commands NUMBER (SO-AND-SO) DEFLECTION (SO MUCH). The gunner repeats the command, opens the door of the azimuth count and sets the command deflection on the azimuth counter dial. He then directs the driver to move the motor carriage until the vertical crosshair of the sight reticle is approximately on the executive's aiming circle. The gunner then tra-

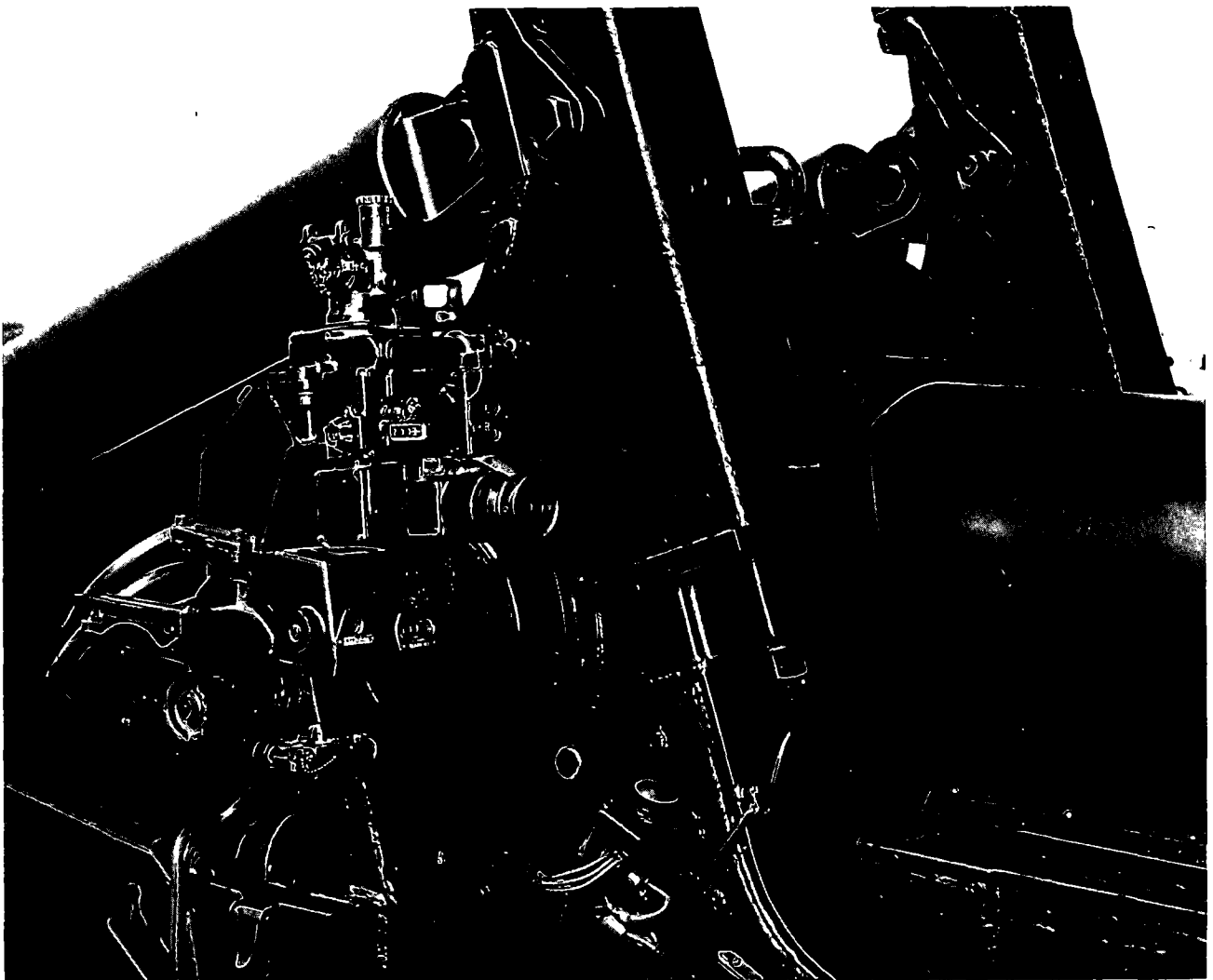


Figure 10. Panoramic telescope M115 and telescope mount M137.

verses the tube until the vertical crosshair of the telescope is exactly centered on the executive's aiming circle. The recoil spade is then dug in and the type placed in battery. He checks to insure that the bubbles are centered and announces "Number (so-and-so) ready for recheck." As additional deflections are commanded by the executive officer, the gunner repeats the commands and announces the number of miles difference between the new and previously announced deflection. The gunner then traverses the tube until the vertical crosshair is centered on the executive's aiming circle and announces, "Number (so-and-so) ready for recheck," unless the executive announces "Number (so-and-so) is laid." When the executive announces "number (so-and-so) is laid," the tube has been oriented and should not be traversed except on order of the executive. The gunner records the deflection that has been set on the azimuth counter dial.

40. Aligns the Aiming Posts, Assisted by Number 6

The piece having been laid as in paragraph 39, the gunner rotates the head of the panoramic telescope to deflection 2600 or the prescribed deflection (terrain permitting), and, using hand signals, directs No. 6 in aiming the aiming posts, or the collimator, with the vertical crosshair of the telescope. If, because of the nature of the terrain, the aiming posts, or the collimator cannot be set to the left front of the piece at deflection 2600, they may be set to the left rear. After the aiming posts or collimator have been aligned, the gunner records the azimuth to the aiming posts, closes the door and turns the reset knob, setting 3200 on the azimuth reset counter dial. All subsequent deflections are read from the azimuth reset counter dial.

41. Lays the Piece for Elevation When Directed To Do So By the Chief of Section

The piece is normally laid for elevation by the assistant gunner. However, when circumstances make it desirable for the gunner to lay for elevation, he may do so by using the elevation counter which is a part of the telescope mount and operating the power elevating mechanism. To lay for elevation, the gunner sets the an-

nounced quadrant on the elevation counter dial and elevates (or depresses) the tube using the power elevation counter dial and elevates (or depresses) the tube using the power elevating mechanism until the elevation level bubble is centered. He must also insure that the cross-level bubble is centered.

42. Sets a Common Deflection to a Common Aiming Point After the Piece Has Been Laid

The piece having been laid, the executive may command AIMING POINT, CHURCH STEEPLE (or other point), REFER. At this command without moving the tube, the gunner turns the telescope to the aiming point and reports the deflection indicated on the azimuth reset counter dial. The executive then commands COMMON DEFLECTION 3200. At this command, the gunner depresses the azimuth counter reset knob and sets 3200 on the azimuth reset counter dial. He then makes a final check to verify that the line of sight is still on the aiming point.

43. Sets or Changes the Deflection

The command is DEFLECTION (SO MUCH). If, for example, the command is DEFLECTION 3283, the gunner repeats deflection 3283 and then rotates the azimuth knob in the appropriate direction until 3283 is set on the azimuth reset counter dial. The gunner then traverses the piece until the vertical crosshair of the reticle is on the left edge of the aiming posts or the center line of the collimator, or on a designated aiming point. Final motion for traversing is accomplished using the hydraulic traversing system and is always from left to right.

44. Signals and/or Calls "Ready"

After the piece has been loaded, primed, and laid in both direction and elevation and is ready to be fired, the gunner calls and/or signals, "Ready," by shouting or raising his left arm to signify that the piece is ready to be fired.

45. Refers the Panoramic Telescope

The command is AIMING POINT THIS IN-

STRUMENT (OR OTHER POINT), REFER. Without disturbing the laying of the piece, the gunner turns the panoramic telescope until, with the elevation and cross-level bubbles centered, the vertical crosshair of the reticle is on the point designated. He then opens the door of the azimuth counter dial, reads the deflection on the azimuth counter and reports to the ex-

ecutive, "Number (so-and-so) deflection (so much)."

46. Makes Corrections for Aiming Post or Collimator Displacement

For details of correcting for aiming post or collimator displacement see paragraphs 111 and 112.

Section IV. DUTIES OF ASSISTANT GUNNER CANNONEERS, AND DRIVER

47. Assistant Gunner's Duties

- a. Sets announced elevation.
- b. Lays for elevation.
- c. Calls "Set" when the piece has been laid for elevation.
- d. Returns the tube to loading elevation after firing.

48. Sets Announced Elevation

The assistant gunner sets the elevation announced by the executive on the elevation quadrant dial (fig. 11), using the elevation knob.

49. Lays for Elevation

Having set the announced elevation on the elevation quadrant dial, the assistant gunner elevates or depresses the tube, using the power elevating mechanism, until the elevation level bubble is centered, and insures that the cross-level bubble is also centered.

50. Calls "Set" When the Piece Has Been Laid for Elevation

When the tube has been laid at the announced quadrant and the bubbles in the elevation level and cross-level vials have been centered, the assistant gunner calls "Set."

51. Returns the Tube to Loading Elevation After Firing

After the piece has been fired, the assistant gunner returns the tube to the loading position which is marked by an index on either trunnion bearing.

52. List of Number 1 Cannoneer's Duties

- a. Loads and rams the projectile.
- b. Stows the loader-rammer and removes the loading tray.

Caution: Inspect power rammer to insure rammer chair is set for proper timing (TM 9-2300-216-10).

53. Loads and Rams the Projectile

The loader-rammer being in the stowed position, No. 1 operates the swing control (fig. 12) to move the loader-rammer to the rear of the piece. He then operates the loader control to lower the loader arms to receive the loading tray and projectile. Assisted by No. 2, No. 1 then moves the loading trough forward to the breech ring. When the loading tray has been attached to the loading arms by No. 3 and No. 4, No. 1 again operates the loader control to raise the loading tray and projectile to the loading trough. He then operates the ram control to ram the projectile.

54. Assists Loading the Power Charge

When the projectile is rammed, No. 2 turns and receives the powder charge from No. 7 and No. 8 and lays it on the loading tray assisted by No. 1. Number 2 then moves the powder charge forward into the chamber.

55. Stows the Loader-Rammer

After the projectile and powder charge have been loaded, No. 1 operates the swing control to move the loader rammer to the stowed position, and removes the loading tray which he hands to No. 3.

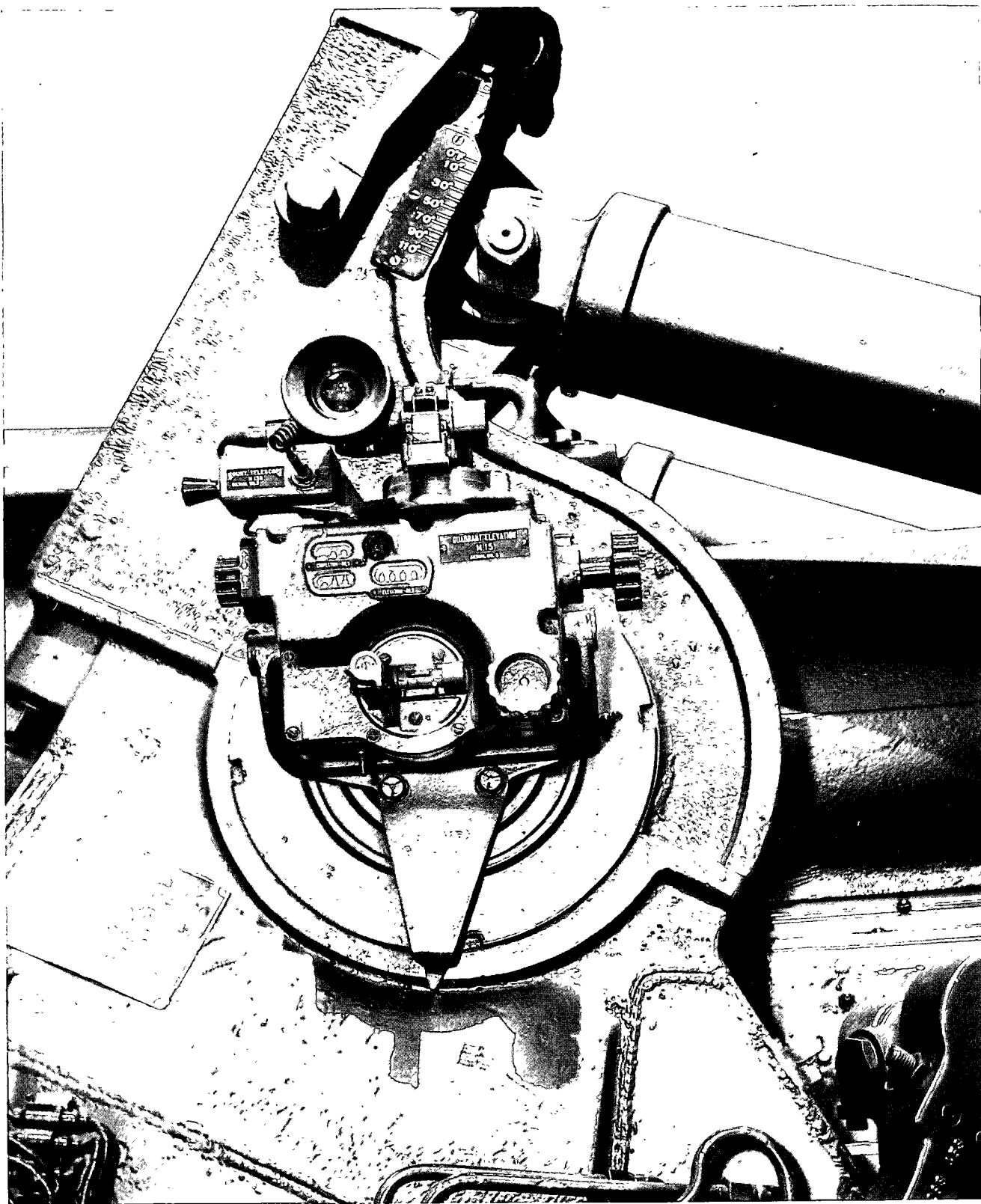


Figure 11. Elevation quadrant M15.

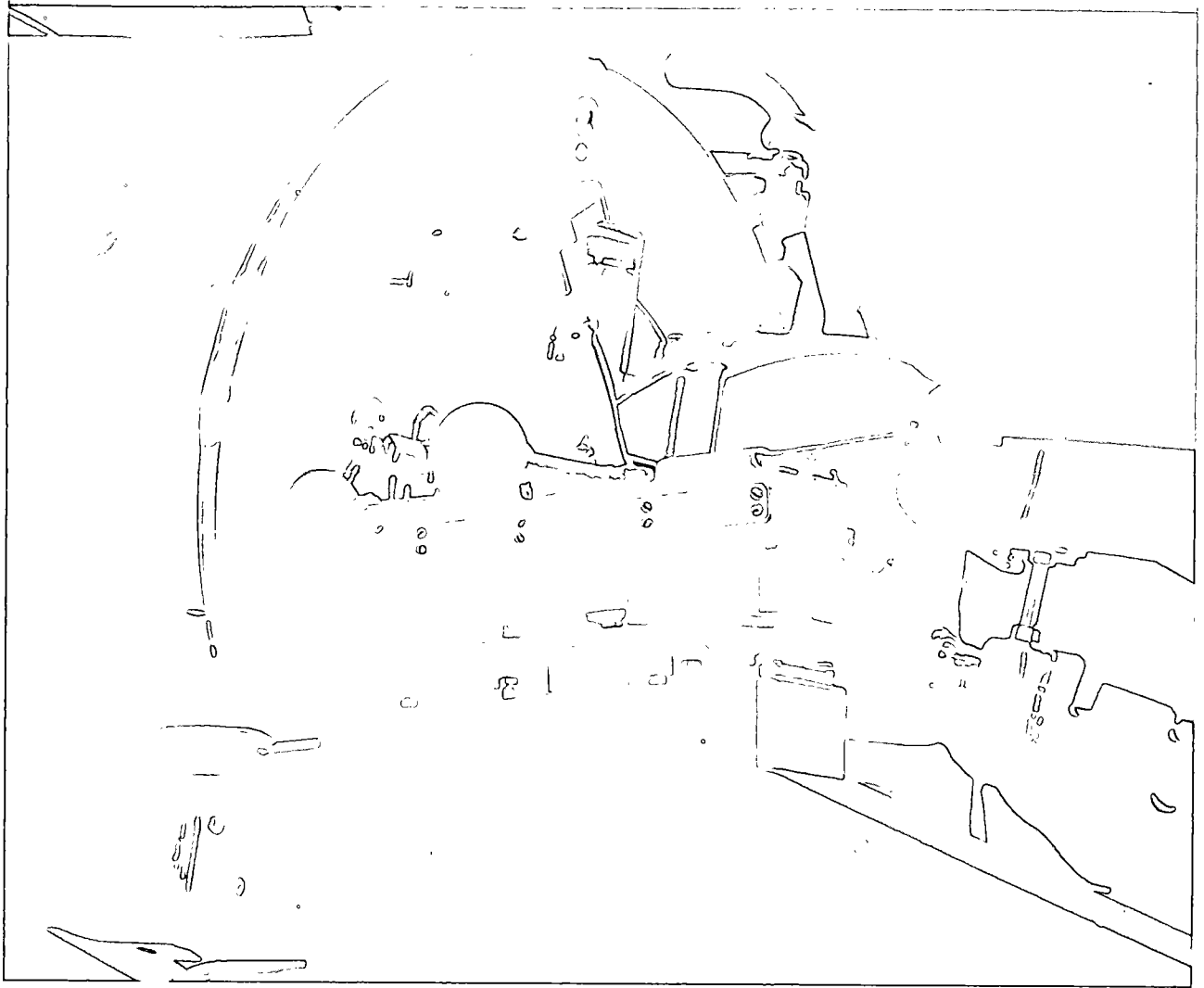


Figure 12. Loader and rammer controls.

56. List of Number 2 Cannoneer's Duties

- a. Assists No. 1 in loading the projectile, loads the powder charge.
- b. Opens and closes the breech.
- c. Inserts the primer and closes the firing lock.
- d. Attaches the firing lanyard and fires the piece.
- e. Checks to insure that the spent primer has been ejected, swabs the powder chamber, and inspects and announces condition of the bore. Checks to insure that no foreign matter has built up on the forcing cone.
- f. Clean the primer vent and ream the primer seat.

57. Assists Number 1 in Loading the Projectile, and Loads the Powder Charge and Removes the Loading Tray

After No. 1 has placed the projectile on the loading trough, No. 2 grasps the handle of the loading trough and assists in moving the loading trough forward to the breech ring. No. 2

then receives the powder charge from No. 7 and No. 8 and assisted by No. 1 places the powder charge on the loading trough. After the powder charge has been loaded, No. 2 assists No. 1 in moving the loading trough to the rear.

58. Opens and Closes the Breech

After the projectile and powder have been loaded and the loader-rammer has been moved to the stowed position, No. 2 closes the breech.

59. Inserts the Primer and Closes the Block Assembly

After the breech has been closed, No. 2 inserts the primer into the primer chamber and slides the block assembly until it is fully closed. After the piece has been fired, No. 2 opens the breech.

60. Attaches the Firing Lanyard and Fires the Piece

After the primer has been inserted into the firing mechanism, No. 2 attaches the lanyard to the firing lock and at the signal or command of the chief of section, he pulls the lanyard with his right hand in a quick steady movement to the left rear. Immediately after firing, No. 2 detaches the lanyard. In case of a misfire, the instructions contained in paragraph 168 will be followed.

61. Checks to Insure that the Spent Primer Has been Ejected, Swabs the Powder Chamber, and Inspects the Bore

After the piece is fired, No. 2 opens the breech and the spent primer is ejected automatically. Number 2 checks as he opens the breech to insure that the primer has been ejected. He then swabs the powder chamber, inspects the bore for obstructions and, if clear, he announces "Bore clear."

62. List of Number 3 and Number 4 Cannoneers' Duties

- a. Place the projectile on the loading tray.
- b. Carry the projectile to the loader rammer and attach the loading tray to the loading arms.
- c. Receive the loading tray from No. 1 after loading.
- d. Assist in preparing ammunition.

63. Install the Projectile on the Loading Tray

After the projectile has been fuze and prepared for firing, No. 3 and No. 4 place it on the loading tray and strap it to the tray.

64. Carry the Projectile to the Loader-Rammer and Attach the Loading Tray to the Loading Arms

After the projectile has been loaded on the loading tray, No. 3 grasps the loading tray on the left side and No. 4 grasps the tray on the right side. Together they carry the loading tray to the rear of the piece and attach it to the loading arms of the loader-rammer.

65. Receive the Loading Tray From Number 1 After Loading

After the projectile and the powder charge have been loaded, No. 1 removes the loading tray from the loading trough and passes it to No. 3, who returns it to the ammunition point.

66. Assist in Preparing Ammunition

No. 3 and No. 4 assist in preparing ammunition and perform other duties as directed by the chief of section.

67. List of Number 5 Cannoneer's Duties

- a. Fuzes or changes fuzes of projectiles.
- b. Sets the appropriate fuze setter.
- c. Sets fuzes.
- d. Removes fuzes from projectiles.
- e. Assists in preparing ammunition.

68. Fuzes or Changes Fuzes of Projectiles

No. 5 unscrews the eyebolt lifting plug from the fuze cavity of the projectile; inspects the cavity for rust and dirt; removes (or replaces) the supplementary charge, if necessary; and screws in the designated fuze. In tightening or loosening the fuze of the projectile, only the authorized fuze wrench should be used. Variable time (VT) fuzes should be screwed in by hand and tightened with fuze wrench M18 by using manual force only. *Do not hammer on the wrench or use an extension handle.* If a time fuze is used, No. 5 removes the safety pull

wire from the fuze and, if a booster is present, removes the safety pin from the booster.

69. Sets the Appropriate Fuze Setter

No. 5 releases the time scale clamping screw marked "T" and, grasping the handle, 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, he looks squarely at the scales and indexes in the same manner each time.

70. Sets Fuzes

Sets fuzes in accordance with TM 9-1300-203 and TM 9-2300-216-10 and appropriate TB's.

71. Removes Fuzes From Projectiles

If a fuzed projectile is not to be fired, the fuze is removed. The operation of inserting a fuze is reversed. If supplementary charges were issued with the projectile, they are replaced. Combination superquick and delay fuzes are reset to SQ (superquick). Time fuzes are reset to S (safe) and the safety pull wire is replaced, M514-series VT fuzes are reset to initial setting as shipped; i.e., to S or O (depending on the model number). All fuzes are returned to their containers. The eyebolt lifting plugs are replaced in the fuze cavities of the projectiles.

72. Assists in Preparing Ammunition

In addition to fuzing ammunition No. 5 assists in uncrating and preparing ammunition for firing and performs other duties as directed by the chief of section.

73. List of Number 6 Cannoneer's Duties

- a. Sets out aiming posts and/or collimator.
- b. Assists No. 5.
- c. Assists in preparing ammunition.

74. Sets out Aiming Posts and/or Collimator

No. 6 sets out aiming posts or collimator as described in paragraphs 111 and 112.

75. Assists Number 5

No. 6 assists No. 5 in performing the duties prescribed in paragraphs 68 through 72 above.

76. Assists in Preparing Ammunition

No. 6 assists in preparing and uncrating ammunition and performs other duties as directed by the chief of section.

77. List of Number 7 Cannoneer's Duties

- a. Inspects and prepares powder charges.
- b. Carries the powder charge to the piece assisted by No. 8.
- c. Passes the powder charge to No. 2 and calls out the number of the charge.

78. Prepares Powder Charges

Inspects and prepares powder charges in accordance with TM 9-2300-216-10 and TM 9-1300-203.

79. Carries the Powder Charge to the Piece Assisted by Number 8

No. 7, assisted by No. 8, carries the powder charge to the right rear of the piece. No. 7 is on the left side of the powder charge and No. 8 is on the right, with the igniter pad to the front of the piece.

80. Passes the Powder Charge to Number 2 and Calls Out the Number of the Charge

After the projectile has been rammed by No. 1, No. 7 calls out the number of the charge that he has prepared; for example, "Charge 3." This informs the chief of section that the proper charge has been prepared.

81. List of Number 8 Cannoneer's Duties

- a. Assists No. 7 in preparing powder charges.
- b. Assists No. 7 in carrying the powder charge to the piece.
- c. Performs other duties prescribed by the chief of section.

82. Assists No. 7 in Preparing Powder Charges

No. 8 assists No. 7 in his duties in preparing powder charges as prescribed in paragraph 78.

83. Assists Number 7 in Carrying the Powder Charge to the Piece

No. 8 assists No. 7 in carrying the powder charge to the piece as prescribed in paragraph 79.

84. Performs Other Duties Prescribed by the Chief of Section

No. 8 will assist in unloading powder charges and ammunition and perform such other duties as prescribed by the chief of section.

85. List of Motor Carriage Driver's Duties

- a. Assists in preparing powder charges.
- b. Shifts the motor carriage.
- c. Performs maintenance.

86. Assists in Preparing Powder Charges

The motor carriage driver assists in unloading powder charges and ammunition, assists No. 7 and No. 8 in preparing powder charges as pre-

scribed in paragraph 78, and performs such other duties as are prescribed by the chief of section.

87. Shifts the Motor Carriage

When directed to do so by the chief of section, the motor carriage driver shifts the motor carriage under the direction of the gunner as prescribed in paragraph 39.

88. Performs Maintenance

The driver performs such preventive maintenance as may be accomplished without interfering with the firing of the piece. Any disassembly or maintenance operation that will render the vehicle immobile for any period of time must be ordered by the chief of section.

89. Section Vehicle Driver's Duties

The section vehicle driver drives and maintains the section vehicle and is assisted by Numbers 6, 7, and 8 when not firing.

CHAPTER 6

FIRING BY DIRECT LAYING

Section I. TECHNIQUE OF FIRE

90. General

a. Firing by direct laying is a special technique that requires a high standard of training. The section must operate as an independent unit. Training in direct laying is based on the technique involved in indirect laying. Targets taken under fire in direct laying are usually those capable of returning fire at pointblank range; therefore, the speed and accuracy required in indirect laying become even more important for direct laying missions.

b. The *two-man, two-sight* system is normally used in laying for the attack of a mobile target. However, if the elbow telescope is inoperable, the two-man, two-sight system must be modified by using the elevation quadrant to lay for elevation. This system is referred to as the *two-man, one-sight system*. In either case, the gunner continues to lay for direction by viewing the target through the panoramic telescope. When the *one-man, one-sight* system is used, the gunner lays for lead and elevation with the panoramic telescope and the elevation counter of the telescope mount.

c. Stationary point targets, such as openings in permanent fortifications or cave openings, may be attacked by using either the indirect or direct laying methods. The indirect method is preferable. When the direct laying method is employed in attacking targets of this type, the service of the howitzer is as prescribed in *b* above.

d. For additional information on direct laying, see FM 60-40 and 6-140.

91. Preparation of a Range Card

a. The chief of section is responsible for de-

fense 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 approach for enemy tanks and vehicles and prepares a range card (fig. 13) on which he notes the ranges and elevations for quick reference.

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 is improved by replacing estimated ranges with more accurate ranges obtained by firing, pacing, taping, vehicle speedometer reading, map measurement, or survey.

92. Field of Fire

The sector of fire for the section should be cleared of all obstructions that might endanger battery personnel when the piece is fired or that might hinder observation. Care should be taken not to reveal the location of the position.

93. Targets

Targets for direct laying usually consist of 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 troops, using all available cover, reveal themselves only fleetingly. Accordingly, fire is conducted on the area containing the attackers rather than on the individuals. Tanks usually attack in groups and may be accompanied by infantry. Normally, first priority is given to

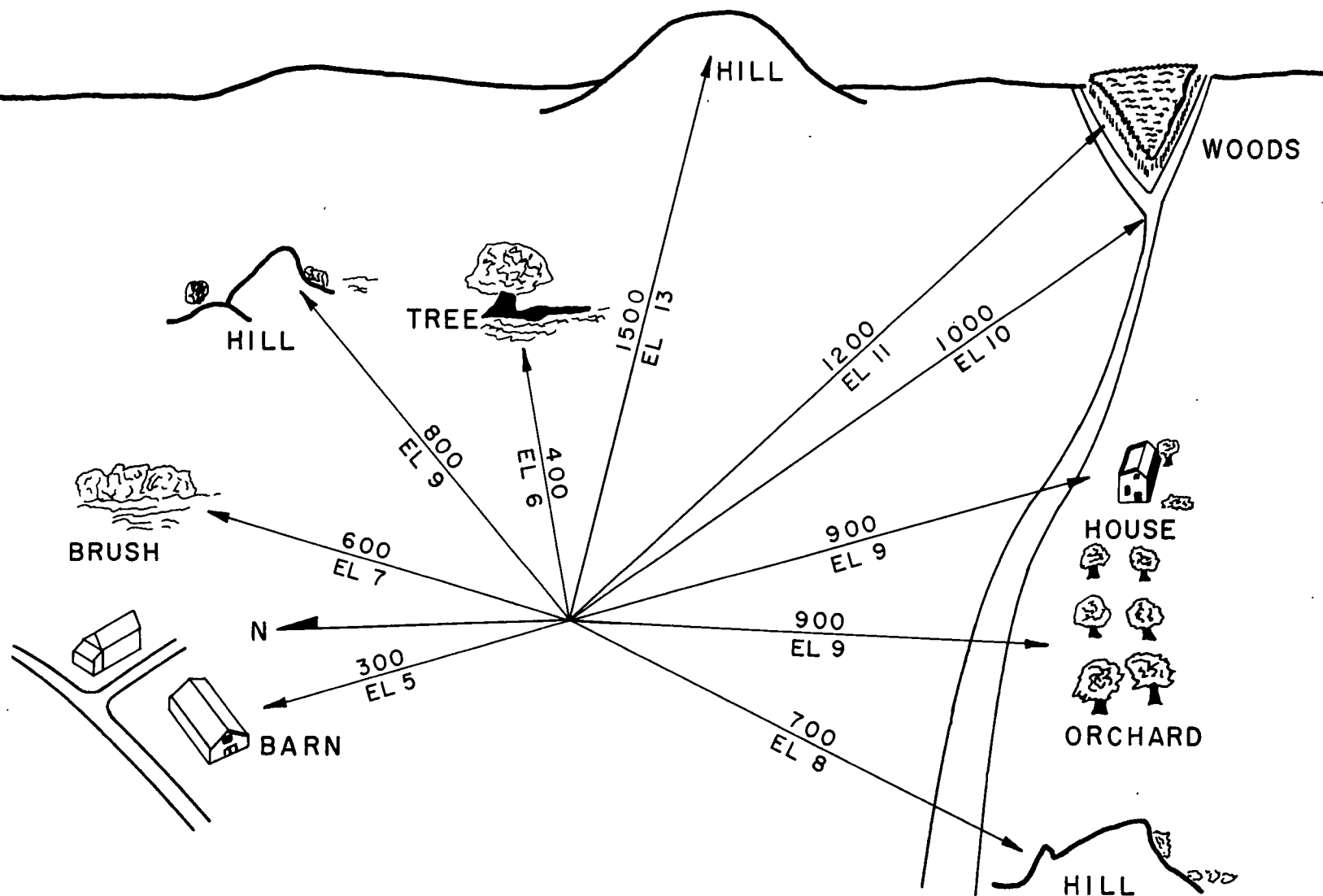


Figure 13. Range Card For Direct Laying.

attack of those targets within the assigned sector of the weapon and second priority to targets in other sectors. Priority within the assigned zone is given to—

a. Tanks at short ranges, threatening to overrun the position.

b. Hull-down, stationary tanks covering the advance of other tanks.

c. The commander's tank, if identified.

d. The tank nearest cover, which may disappear and reappear at unexpected places.

e. The rear tank of a column moving across the front of the position, to minimize the possibility of attracting attention of the tank column to the battery position.

94. Ammunition and Fuzes

a. *General.* For close-in fires, a variety of fuzes are available, (TM 9-2300-216-10 and TM 9-1300-203). For high-explosive shell, the highest charge is used habitually for speed, ease in adjustment, imparting forward motion to fragments, and more effective fuze action. The flat trajectory resulting from the use of the highest charge coupled with dug-in guns may make extremely close-in firing impossible, since the projectiles may not detonate on impact. The terrain may be prepared for direct fire by placing mounds of sandbanks, dirt, or logs in the sector of responsibility. When direct fire is placed on these points or other previously selected points, as they are approached by an attacking force, the necessity for adjusting fire is reduced.

b. *Ammunition.* Only high-explosive (HE) ammunition is used against type targets as mentioned in paragraph 90a. Shell, HE, is ideally suited for antipersonnel fire and is effective against vehicles and tanks.

c. *Fuzes.* High explosive shells may be fuzed with fuzes quick, delay, time, or concrete piercing. Fuze quick is the most desirable fuze to use with HE shell for close-in fires. It is highly effective and, since no fuze setting is required, is much faster to use. 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. If fuze delay is used

for ricochet effect, the point of impact is adjusted 10 to 30 meters short of the target; if less than 50 percent of the bursts ricochet, fuze quick should be used. Fuze time is the least desirable type of fuze for close-in fires. Because of the wide range dispersion resulting from variations in time of burning with short fuze settings, fuze time should be used only for ranges greater than 1,000 meters. The area covered effectively by air and ricochet bursts are similar. Concrete piercing fuze with shell HE should be used against concrete pillboxes or fortifications.

95. Trajectories

a. *General.* Trajectory characteristics change with the type of ammunition and the charge fired. The following trajectory characteristics govern conduct of fire for the 175-mm gun and 8-inch howitzer when the highest charge is used.

b. *175-mm Gun, M107.*

(1) *Ranges of 0 to 1,000 meters.* Within these range limits the trajectory is flat enough to prevent an 8-foot tank from passing 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, providing deflection is correct. There is also less risk of obscuring the target with smoke from a short burst. A 200-meter range change will usually raise or lower the relatively flat trajectory enough to bring the round on target.

(2) *Ranges 1,000 to 2,400 meters.* When firing within these ranges, bracket adjustment to the target is required. Range changes in 400-meter increments should be made until a bracket is obtained. This is necessary because the trajectory, and not the burst, is being adjusted. A near-miss, skimming the top of the target, will land well behind the target on the gun-target line. Spotting for the proper range shift in meters necessary for a target hit is difficult. Establishment of a bracket enables a more rapid adjustment on target.

(3) *Ranges over 2,400 meters.* At these ranges direct laying against moving targets is not advisable. The size of the target in the scope, the difficulty in estimating ranges and

the increasing angle of fall of the projectile combine to make the hitting of a moving target difficult and unlikely.

c. 8-inch Howitzer, M110.

(1) *Range 0 to 600 meters.* With these ranges the trajectory is flat enough to prevent an 8-foot tank from passing beneath it. Fields of fire and terrain allowing, the upper range limits are ideal at which to open fire. This allows maximum time for conduct of fire and lessens the risk of obscuring the target with a short burst. Range changes of 100 meters will normally be sufficient to shift the round onto the target.

(2) *Ranges 600 to 1,400 meters.* When firing within these ranges, bracket adjustment to the target is required. Range changes in 200-meter increments should be made until a bracket is obtained. Without a bracket, estimation of the correct range change in meters necessary to place the round on the target is difficult, due to the flatness of the trajectory. The use of the bracket provided for a more rapid adjustment on target.

(3) *Ranges 1,400 to 2,300 meters.* This zone includes the ranges at which hits are only reasonably possible. Again, bracket adjustment to the target is required. Range changes in 400-meter increments should be made until a bracket is obtained. Due to the increased difficulty in obtaining a target hit, fire should not be opened at these ranges unless surprise is not important.

(4) *Ranges beyond 2,300 meters.* At these ranges direct laying against a moving target is not advisable. The difficulty of seeing the target in the scope, the problems in range estimation and the increasing angle of fall of the projectile combine to make the hitting of a moving target difficult and unlikely.

96. Vertical Displacement Tables

Vertical displacement is the change in the point of burst (up or down) between two rounds fired with different ranges at an upright target. The vertical displacements at various ranges are shown in tables 4 and 5 for the 175-mm gun and the 8-inch howitzer.

**Table 4. Vertical Displacement Per 100-Meter Range Change,
8-Inch Howitzer M100 Projectile, He, M106, Charge 7*

Range meters	Elevations mils	Vertical displacement feet	Trajectory characteristics	Firing data
100	1	.0	Within these ranges the trajectory is flat enough to prevent an 8-foot tank from passing under it. 100 meter range shifts can be made to bring the round on target.	1. Start firing at estimated range or 400 meters, whichever is greater. 2. Make 100 meter range shifts until a target hit is obtained.
200	3	1.0		
300	4	1.5		
400	6	2.0		
500	7	2.5		
600	9	3.0	Within these ranges bracket adjustment of the target is required. 200 meter range changes should be made until a bracket is obtained.	1. Start firing with the estimated range at the closest 100 meter range line. 2. Adjustment on target by bracketing (over and shorts) is required. 3. Make 200 meter range changes until a bracket is obtained.
700	10	3.5		
800	12	4.0		
900	13	4.0		
1000	15	4.5		
1100	16	5.0		
1200	18	5.5		
1300	20	6.0	At ranges greater than 1400 meters bracket adjustment is also required. 400 meter range changes should be made until a bracket is obtained.	1. Start firing with the estimated range at the closest 100 meter range line. 2. Adjustment on target by bracketing (overs and shorts) is required. 3. Make 400 meter range changes until a bracket is obtained.
1400	21	6.5		
1500	23	7.0		
1600	25	7.5		
1700	26	8.0		
1800	28	8.5		
1900	30	9.0		
2000	31	9.5		
2100	33	10.0		
2200	35	10.5		
2300	37	11.5		

*Due to normal minimum elevation being only +35 mils, the Chief of Section must prepare his firing position so that direct fire can be employed at elevations shown in this table.

* Table 5. Vertical Displacement Per 200-Meter Range Change, 175-mm Gun M107

Projectile, HE, M-437, Charge 3

Range meters	Elevations mils	Vertical displacement feet	Trajectory characteristics	Firing data
200	1	.0	Within these ranges the trajectory is flat enough to prevent an 8-foot tank from passing under it. Range shifts of 200 meters should be made to bring the rounds on target.	1. Open fire at estimated range or 600 meters, whichever is greater. 2. Make 200 meter range changes until a target hit is obtained.
400	2	.5		
600	3	1.0		
600	5	1.5		
1000	6	2.0		
1200	7	2.0	At ranges greater than 1000 meters, bracket adjustment is required. Range changes of 400 meters should be made until a bracket is obtained.	1. Start firing at estimated range. 2. Adjustments on target by bracketing (overs and shorts) is required.
1400	8	2.5		
1600	10	3.0		
1800	11	3.5		
2000	12	4.0		
2200	14	4.5		
2400	15	5.0		

*Due to normal minimum elevation being only +35 mils, the Chief of Section must prepare his firing position so that direct fire can be employed at elevations shown in this table.

Section II. DUTIES OF CHIEF OF SECTION

97. List of Duties

- Conducts the fire of his piece.
- Identifies or selects the target.
- Estimates the range to the target.
- Converts range to quadrant when appropriate.
- Determines the lead in mils.
- Gives initial commands.
- Gives subsequent commands based on observed effect.

98. Conducts the Fire of His Piece

The chief of section conducts the fire of his piece when the executive commands TARGET (so-and-so), FIRE AT WILL, or simply FIRE AT WILL.

99. Identifies or Selects the Target

If the executive designates an object or one of a group of objects as the target, the chief of section must correctly identify the target. If the target is a group of tanks or other objects,

the chief of section selects the one that, 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, using the minimum number of words, such as LEAD TANK or MOVING TANK.

100. Estimates the Range to the Target

Range cards (fig. 13) with accurately measured ranges to key points provide the best means for determining the initial range. If a range card has not been prepared, the range is estimated.

101. Conversion of Range to Quadrant

The chief of section will prepare and have available, a table for use in converting range to quadrant. Maximum charge is used preparing the table. An example of such a table is table 6. When any method of fire other than the *two-man, two-sight* system is used, the chief of section converts the estimated range to mils and announces this value in his fire command as QUADRANT (so much).

Table 6. * Direct Fire Table, 8-Inch Howitzer, M110

8-inch howitzer, M110, charge 7 range (meters)	elevation (mils)	Trajectory characteristics	Firing data
100	1	Within these ranges, the trajectory is flat enough to prevent a tank (8' height) from passing under it. A range of 400 meters is ideal for opening fire on the target.	Start firing with the estimated range at the closest 100-meter range.
200	3		
300	4		
400	6		
500	7		
600	9	Within these ranges, bracket adjustment of the target is required. 200-meter range changes should be made until a bracket is obtained.	1. Start firing with the estimated range at the closest 100-meter range line. 2. Adjustment on the target by bracketing (overs and shorts) is required 3. Make 200-meter range changes until a bracket is obtained.
700	10		
800	12		
900	13		
1,000	15		
1,100	16		
1,200	18		
1,300	20		
1,400	21	At ranges over 1,400 meters, bracket adjustment of the target is also required. 400-meter range changes should be made until a bracket is obtained.	1. Start firing with the estimated range at the closest 100-meter range line 2. Adjustment on the target by bracketing (overs and shorts) is required. 3. Make 400-meter range changes until a bracket is obtained.
1,500	23		
1,600	25		
1,700	26		
1,800	28		
1,900	30		
2,000	31		
2,100	33		
2,200	35		
2,300	37		

* Due to normal minimum elevation being only +35 mils, the Chief of Section must prepare his firing position so that direct fire can be employed at elevations shown in these tables.

102. Determines the Lead in Mils

The appropriate lead in mils for targets moving at various speeds for firing with the maximum charge is as follows:

Lateral speed	Lead (mils)	
	175-mm gun	8-inch howitzer
Under 10 MPH -----	5	5
10 MPH or over -----	5	10

103. Gives Initial Commands

The chief of section gives fire commands containing the following elements in sequence:

a. Designation of Target. The command is TARGET (so-and-so). Identification must be clear and unmistakable and should be expressed in the minimum number of words.

b. Projectile, Charge, and Fuze. The chief of section selects the appropriate projectile,

charge, and fuze and commands SHELL (such-and-such), CHARGE (such-and-such), if applicable, and FUZE (such-and-such).

c. Lead. The command is LEAD (so much). See paragraph 102 for the method of determining lead.

d. Method of Fire. Fire is continuous unless otherwise commanded. In continuous fire, the piece is loaded and laid as rapidly as possible and fired at the command of the gunner.

e. Range or Quadrant. The command is RANGE (so much) or QUADRANT (so much). The range commanded by the chief of section is that range to be set on the sight reticle of the direct fire telescope. For determining range, see paragraph 100. If the *two-man, one-sight* system or the *one-man, one-sight* system is to be used, the chief of section announces the range element of the command as quadrant. The announced quadrant is applied as indicated in paragraphs 105 and 106.

104. Gives Subsequent Commands Based on Observed Effect

a. The chief of section gives the following commands based on observed effect:

(1) *Change in lead.* During adjustment the lead in mils is changed to a new lead command incorporating total lead.

(2) *Change in range.* During adjustment, the range is increased by the command ADD

(so much) and is decreased by the command DROP (so much). When the *two-man, one-sight* system or *one-man, one-sight* system is used, the commands are UP (so much) or DOWN (so much).

b. When the breechblock is closed, the chief of section gives further changes in firing data based on movement of the target during the time required for loading.

Section III. DUTIES OF THE GUNNER ASSISTANT GUNNER, CANNONEERS, AND DRIVER

105. Two-Man, Two-Sight System

a. *Duties of the Gunner, Central Laying.*

(1) The gunner centers the cross-level bubble on the panoramic telescope mount, zero's the Gunner's Aid Counter, and sets 3,200 on the azimuth 6,400 mil counter.

(2) Places the announced lead on the azimuth 6,400 mil counter.

(3) Tracks the target with the power traversing mechanism and places the vertical line of the reticle directly on the target.

(4) He continues to track the target by traversing the tube.

(5) When the assistant gunner calls "SET," indicating that the tube has been laid for range, and when, at the same time, the vertical line is directly on the target, the gunner commands "FIRE."

b. *Duties of the Gunner, Reticle Laying.* Having received the fire command, the gunner performs the following duties:

(1) The gunner insures that the cross-level bubble is centered, the azimuth 6,400 mil counter is set at 3200, and the gunner's aid index is at zero.

(2) The gunner establishes the lead announced by the chief of section by sighting through the panoramic telescope and traversing the tube until the target appears in the proper relationship to the vertical crosshair of the sight reticle (fig. 14). When the announced lead has been established the gunner continues to track the target by traversing the tube.

(3) When the assistant gunner calls "SET" indicating that the tube has been laid for range and when, at the same time, the proper

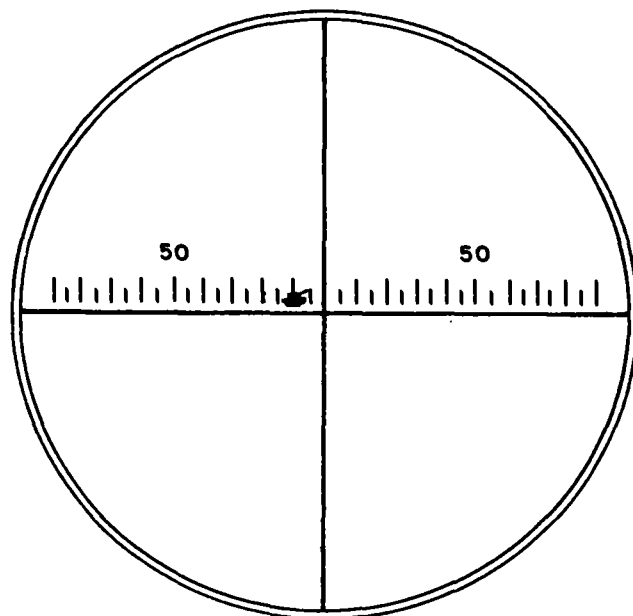


Figure 14. Gunner's sight picture, reticle laying, lead 10 mils.

lead has been established, the gunner commands FIRE.

(4) After firing, the gunner continues to track and fire on the target until it is destroyed or until a subsequent fire command is issued by the chief of section.

c. *Duties of Assistant Gunner—Central and Reticle Laying.* Having received the fire command, the assistant gunner performs the following duties:

(1) Insure the cross-level bubble is centered, the elevation counter dial is set at zero, and the appropriate setting is on the correction indicator dial.

(2) Lays the piece for range (elevation) by sighting through the direct fire telescope and by elevating or depressing the tube until the target appears in the proper relationship to the range lines of the telescope reticle (fig. 15).

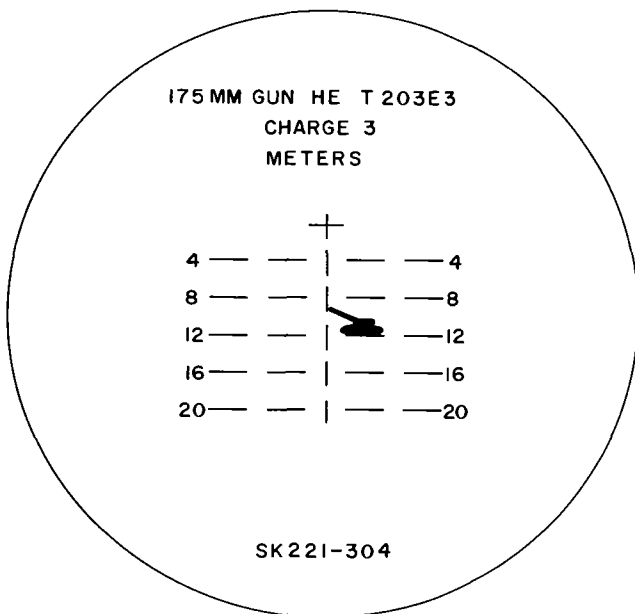


Figure 15. Assistant gunner's sight picture, direct fire telescope, range 1,200 meters, lead 5 mils.

(3) When the piece has been laid for range, the assistant gunner calls "Set." He continues to call "Set" as long as he is laid on the target.

106. Two-Man, One-Sight System

a. *Duties of the Gunner.* The duties of the gunner in the two-man, one-sight system are the same as those listed in paragraph 105a for the two-man, two-sight system.

b. *Duties of the Assistant Gunner.* In the two-man, one-sight system, the chief of section announces quadrant rather than range in his fire

command. The assistant gunner sets the announced quadrant on the elevation counter dial and insures that the appropriate setting is on the correction indicator dial. He then elevates or depresses the tube until the elevation level bubble is centered and centers the cross-level bubble. When the tube has been laid at the announced quadrant, the assistant gunner calls "Sets."

107. One-Man, One-Sight System

a. In the one-man, one-sight system, the piece is laid for both deflection and elevation by the gunner. The chief of section announces quadrant in his fire command rather than range.

b. The gunner sets the announced quadrant on the elevation counter dial and insures that the appropriate setting is on the elevation correction indicator dial. He then elevates or depresses the tube until the elevation level bubble is centered and centers the cross-level level bubble. With 3200 set on the azimuth counter dial and the gunners aid index at zero, he then traverses the tube until the vertical crosshair of the telescope reticle is on the target or the proper lead is established. When the tube has been laid, the gunner commands FIRE. After firing, he continues to lay on the target until it is destroyed or a subsequent fire command is given by the chief of section.

108. Duties of Cannoneers and Driver

a. Cannoneers perform the same duties in firing by direct laying as, those prescribed for firing by indirect laying. No. 2 receives the command to fire from the gunner.

b. The driver of the motor carriage takes his post in the driver's compartment, starts the engine, and prepares to shift the vehicle as directed.

CHAPTER 7

TECHNIQUES AND SITUATIONS REQUIRE SPECIAL ATTENTION

109. 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 the instruments must be from lower to higher numbers; final motion of the elevating handcrank must be in the direction of more difficult movement, and final motion in traversing must be from left to right when using the manual system. Personnel who lay the piece must be required to verify the laying after the breech has been closed.

b. When a bubble is centered, the line of sight must be at a right angle to the scale or level vial to prevent parallax errors. Bubbles must be centered exactly.

c. For uniformity and accuracy in laying on aiming posts or the collimator, the vertical crosshair in the reticle of the panoramic telescope must be alined with the left edges of the aiming posts, or the center line of the collimator.

110. Aiming Points

a. *General.* After the piece has been laid initially for direction, it is referred to the aiming posts or collimator and usually to one or more distant aiming points as described in paragraph 21. An aiming point must have a sharply defined point or vertical line which is clearly visible from the piece, so that the crosshairs of the panoramic telescope can be alined on exactly the same place each time the piece is relaid.

b. *Distant Aiming Point.* A distant aiming point is one at sufficient distance so that normal displacements of the piece in firing or traverse will not cause a horizontal angular

change in direction (with the same setting on the azimuth counters) of more than one-half mil. This distance should be at least 1,500 meters. The executive officers usually designate the distant aiming point or points to be used.

111. Use of Aiming Posts or the Infinity Aiming Reference Collimator M1

a. *Aiming Posts.*

(1) Two aiming posts are used for each piece. Each aiming post is equipped with a reflector for use at night. The most desirable distance from the piece to the far aiming post is 100 meters, considering accuracy of laying, visibility, and ability to control the aiming post reflectors. First, the far aiming post is set up and alined. The near aiming post is then set up at the midpoint between the far aiming post and the panoramic telescope and is alined by the gunner so that the vertical crosshair of the telescope and the left edge of the two aiming posts are in alinement. To insure equal spacing of aiming posts, the distances to both the near and far aiming posts should be paced by the same man. If ground conditions make spacing inaccurate, the distances from the piece to the aiming posts may be measured by using the panoramic telescope, with the aiming posts as measuring devices (4 below).

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

(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 misalignment of the aiming posts. Placing the aiming posts to the left front when the piece is in the center of traverse will keep this misalignment to a minimum and still allow maximum visibility.

(4) To measure the distance from the piece to the aiming posts, the stadia method may be employed by using the panoramic telescope and the aiming posts as measuring devices. Number 6 cannoneer, in 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 using the reticle of the panoramic telescope. For example the upper section of the aiming post is $4\frac{1}{2}$ feet long and measures 14 mils when it is 100 meters from the piece. The proper location for the near aiming post, in this case, would be the point at which the $4\frac{1}{2}$ foot section measures 28 mils. In many cases, the ideal spacing of 50 and 100 meters cannot be obtained, but the aiming posts will be properly spaced when the near aiming post is set at a point where the $4\frac{1}{2}$ foot section measures twice the number of mils it measured at the far aiming post location. This measurement may be performed at night by attaching the night lighting devices at the $4\frac{1}{2}$ foot marks on the aiming posts.

b. Infinity Aiming Reference Collimator M1. The collimator is an optical instrument intended to be used for indirect laying of artillery weapons by establishing an optical reference from which weapon deflection angles can be measured.

(1) The mounting base (b, fig. 5) is a mechanical assembly consisting of a tripod and yoke subassembly which houses the azimuth and elevation controls. The tripod supports the collimator at a normal height of 3 feet above the ground and is leveled by extending or retracting the hinged tripod legs. The azimuth clamping knob directly below the yoke is used to clamp the azimuth mechanism. The elevation yoke allows the collimator to be adjusted plus or minus 48° in the vertical plane. The elevation clamping knob located near the top of the yoke is used to operate the elevation clamping mechanism.

(2) The collimator assembly (b, fig. 5) consists of an optical system, a mechanical

housing, and a light source. The reticle pattern is essentially an azimuth reference scale repeated at vertical intervals to form a grid throughout the collimator field of view. The reticle pattern may be cross-leveled by rotating the entire collimator assembly about the optical axis. A cylindrical cross-level vial attached to the collimator serves as a reference in cross-leveling. A cross-level clamping knob near the center of the collimator permits rotation of the collimator for cross-leveling and locks the collimator in place after it has been cross-leveled. Open sights on the collimator assembly permit rapid alignment of the optical system with the panoramic telescope sight of the weapon.

(3) When the collimator is used with self-propelled weapons, DC power is provided by the electrical system of the vehicle. A wire-wound series resistor within the junction box reduces the voltage so that the 12-volt lamp of the collimator may be safely operated from the 24/28-volt electrical system of the vehicle. The remote control unit contains a PUSH-TO-USE switch for turning the reticle illumination ON or OFF and a rheostat for regulating the intensity of the light.

(4) The collimator optics are protected when not in use by a cover made from fiberglass-reinforced plastic. The cover is equipped with a carrying handle and is attached to the collimator by three snap-latches. A strap restrains the tripod legs when they are folded.

c. Operation. The infinity aiming reference collimator M1 is basically an optical instrument used in indirect fire by artillery weapons. It is intended to replace the M1-series aiming posts as a reference from which deflection angles may be measured. After the weapon has been laid for direction, the collimator may be positioned 4 to 17 meters to the left front of the panoramic telescope sight at a deflection established by unit SOP. Best results are obtained from 5 to 12 meters, depending on the weapon.

(1) *Preparation for use.*

(a) *Setting up the collimator.*

1. Loosen the strap on the instrument cover assembly and open the latches between the cover end and the collimator base. Depress the tripod legs, then open the latches and remove the cover.

2. Set the tripod legs into the ground as level and firmly as possible consistent with the situation and the time available. Precise leveling is not necessary since the reticle can be cross-leveled separately.

3. Loosen the azimuth and elevation clamping knobs. Move the collimator, while sighting through the front and rear sights, until the optical system is sighted on the panoramic sight of the weapon.

4. Release the collimator clamping knob. Refer to the cylindrical cross-level vial located on the collimator, rotate the collimator until the bubble is centered. The reticle pattern is then cross-leveled.

(b) *Laying and referring.* After the collimator has been set up and aligned with the panoramic telescope of the weapon, the gunner's sight picture should appear as shown in (1), figure 16, provided there is no displacement. For accurate laying and referring, the gunner should be able to see at least a 7-mil diameter area or two significant numbers on the reticle pattern. He is normally able to see an area of this size when the collimator is between 5 and 12 meters from the weapon. The numbers shown in the reticle pattern indicate angles of 5-mil increments. Individual mils are marked by short vertical lines in the V format of the pattern. The V format of the pattern indicates left and right displacement of the weapon even when a small portion of the reticle pattern is visible. To correct for piece displacement, the gunner sights on the collimator and matches

the reticle of the panoramic telescope with the collimator reticle pattern. For example, if the gunner sees 10 and 15 in the collimator and the reticle slopes upward from right to left, which indicates right displacement, he matches the left portion of the panoramic telescope reticle with the collimator reticle pattern as shown in (2) and (3), figure 16.

d. Care and Handling.

(1) Stops on the instrument limit the travel of the collimator in elevation or depression. The operator should not attempt to force the collimator beyond the stop limits.

(2) The collimator should be covered and protected from dust and moisture when it is not in use.

(3) The collimator assembly should not be pointed directly at the sun unless a filter is used; the heat from the focused rays may damage the optical elements.

(4) All exposed surfaces must be kept clean and dry to prevent corrosion and/or etching of the optical elements.

(5) Instrument knobs should not be forced beyond their limit of motion.

112. Correction for Displacement of Aiming Posts or the Collimator

a. *Correction for Displacement of Aiming Posts.* When the gunner notes that the vertical line of the telescope is displaced from the line formed by the two aiming posts (or aiming post lights), he lays the piece so that the far

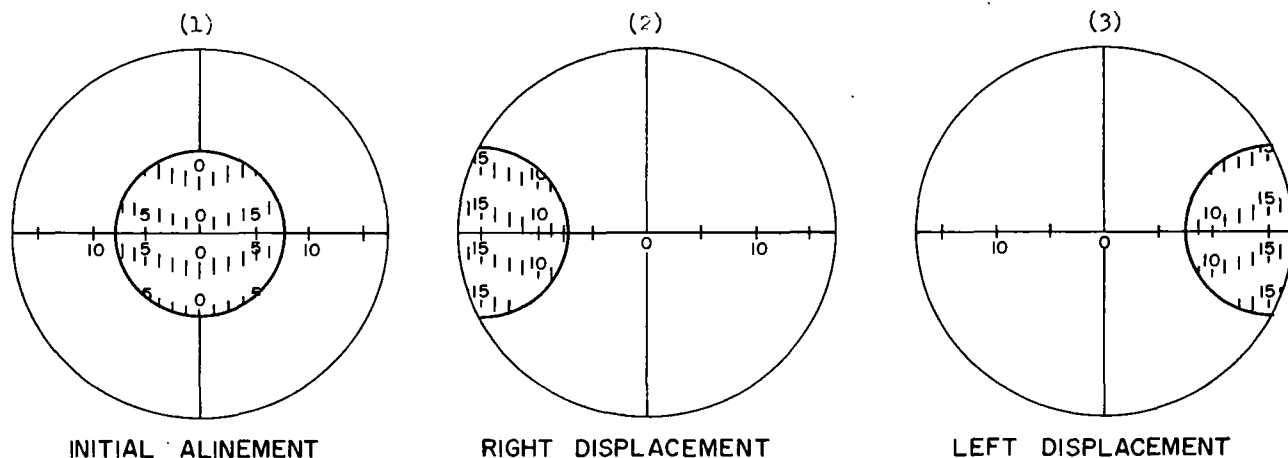


Figure 16. Gunner's sight picture of collimator when correcting for displacement.

aiming post (light) appears exactly midway between the near aiming post (light) and the vertical crosshair (fig. 17). If the displacement is due to traversing the piece, the gunner continues to lay as described above. If the displacement is due to progressive shifting of the carriage caused by the 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. The realine the aiming posts, the piece is laid with the far aiming post midway between the near aiming post and the vertical crosshair (fig. 17). The far aiming post is moved into alignment with the vertical crosshair 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 piece is laid for direction and referred to the aiming post that cannot be moved. The other post is alined by using the method described in paragraph 40, and the azimuth reset counter is turned to 3200.

b. Correction for Displacement of Weapon When Using the Collimator. In case of weapon displacement during firing, the gunner simply traverses the howitzer until reticle match is again obtained, and the howitzer is alined parallel to its original orientation (para 111c and fig. 16).

113. Depth of Ram

The depth of ram must be verified as outlined in TM 9-2300-216-10.

114. Check Firing

The command CHECK FIRING is normally given to the section by the chief of section, but in emergencies anyone present may give the command. At this command, regardless of its source, firing ceases immediately. If the piece is loaded, the chief of section reports that fact to the executive. The executive acknowledges this announcement by saying "number (so-and-so) loaded." If CHECK FIRING is commanded by the fire direction center, firing is resumed at the announcement of CANCEL CHECK FIRING and the quadrant. If CHECK FIRING is commanded from within the firing battery, the executive investigates the condition that caused the command to be given.

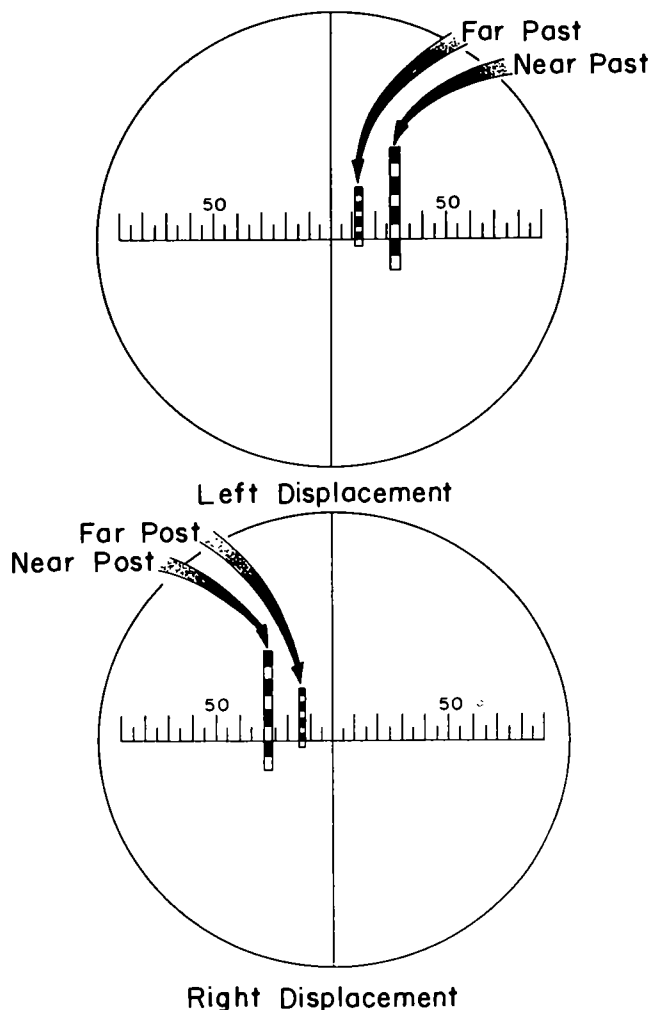


Figure 17. Gunner's sight picture of aiming posts in proper relationship when correcting for displacement.

When the condition is corrected, firing is resumed at the executive's command of CANCEL CHECK FIRING.

115. Changes in Data During Firing

If it is necessary to correct any element of firing data, all firing previously ordered but not yet executed is topped by the command CHECK FIRING. Corrected data is then announced. If the piece is not loaded, the new data is set off and firing is resumed at the command CANCEL CHECK FIRING QUADRANT (so much). If the piece is loaded and no change in the fuze setting is required or if the piece is loaded with a percussion-fuzed projectile, the new data is set off and firing is resumed at the command CANCEL CHECK FIRING QUAD-

RANT (so much). If the piece is loaded with time-fuzed projectile and a change is required in the fuze setting, the chief of section suspends firing and reports that fact to the executive; for example, "No. 2 loaded, time (so much)." The piece 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.

116. To Unload the Piece

A complete round, once loaded, should always be fired in preference to being unloaded unless military necessity dictates otherwise. The piece will be unloaded only on the specific order and under the direct supervision of an officer. To unload the 175-mm gun or the 8-inch howitzer (TM 9-2300-216-10), the command is UNLOAD, and the operation is performed as follows:

a. The chief of section has the primer removed, the breech opened, the powder charge withdrawn, the chamber filled with waste, the breech closed, and the tube depressed to zero elevation.

b. Numbers 3 and 4 insert the unloading rammer into the muzzle end of the tube and push carefully until the rammer head encircles the fuze and is seated against the projectile. Steadily increasing pressure is applied by tapping the end of the rammer staff with a wooden block, if necessary, to loosen the projectile.

c. When the projectile is loosened, No. 3 and No. 4 suspend operation of the rammer while the chief of section has the breech opened and the waste removed. Number 1 then places the loading trough and loading tray in position in the breech to receive the projectile. As the tube is elevated to the load position (approximately 180 mils), the chief of section, standing at the breech end of the bore, holds a section of rammer staff, if available, or a similar item, firmly against the base of the projectile. He steadies its backward movement as the assistant gunner and No. 2 push the projectile onto the loading trough.

d. After it is unloaded, the projectile is disposed of as directed by the chief of section.

e. For further information on unloading, see FM 6-140 and TM 9-2300-216-10.

117. 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 projectiles are received, they should be sorted into lots and placed in the best available storage. Ammunition data cards should be kept until all ammunition for that lot is expended. The eyebolt lifting plug should not be removed from unfuzed projectiles until the fuze is to be inserted. Protection should be provided against moisture, dirt, direct rays of the sun and, as far as practicable, artillery fire and bombing. Protection against weather, dirt, and the sun may be obtained by the use of tarpaulin and dunnage. Projectiles stacked in the open tarpaulins should be raised at least 6 inches. If drainage is not good, ditches should be dug around the stacks. A liberal use of dunnage should be made between layers, and covering tarpaulins should be raised at least 6 inches from the stack to insure adequate ventilation. Ammunition for the 175-mm gun and 8-inch howitzer should be stacked in a single layer and each stack should contain not more than 25 rounds. Stacks should be at least 10 meters apart.

c. Powder charges should be sorted into lots and protected from sources of high temperatures, including direct rays of the sun. More uniform firing is obtained if the charges are of the same temperature. Powder charges should not be removed from containers until just before firing.

d. Explosive elements in primers and fuzes are particularly sensitive to shock and high temperature; therefore, strict attention should be given to their care and handling. Protection

and safety devices should not be removed from fuzes until just before use. No attempt should ever be made to disassemble a fuze into its components.

e. For further information on care of ammunition, see FM 6-40, FM 6-140, TM 9-1900 and TM 9-1300-203.

118. Section Data Board

When a position is occupied for more than a

few hours, data boards may be used by each section to record such items as deflections to aiming points, calibration corrections when appropriate, minimum elevations, data for the final protective fires and counter-preparations, and other data which may be needed quickly. If such information assumes a standard pattern, the section may paint a form on a convenient part of the weapon and chalk in the various items of information in the appropriate spaces.

CHAPTER 8

BORESIGHTING

Section I. GENERAL

119. Description

a. Boresighting is the process of verifying that the optical axis of the on-carriage fire control equipment is parallel with the axis of the tube of the weapon, both for deflection and for elevation. Any misalignment discovered through bore sighting is corrected as described in paragraphs 123 through 126. The tube should be placed near its center of traverse prior to bore sighting. All instruments and mounts must be positioned securely; there must be no free play. Bore sighting is conducted before firing and, when necessary, during lulls in firing.

b. There are three methods of bore sighting these weapons.

(1) Testing target method (para 123-125).

(2) Distant aiming point method (para 126-127).

(3) Standard angle method (para 128-131).

120. Equipment

The following equipment is needed for bore sighting:

a. *Boresights*. Front and rear boresights or improvised substitutes are necessary for all but the standard angle method for boresighting. If boresights are not available, crosshairs may be fastened on the muzzle, and the obturator spindle vent may be used as a rear sighting guide.

b. *Testing Target* (fig. 18). A testing target or suitable substitute is needed for preparatory steps in testing and for certain methods of boresighting. If a testing target is not avail-

able, a clearly defined aiming point 1,500 or more meters from the piece may be used to accomplish approximately the same purpose as the testing target.

(1) The target should be mounted on a flat piece of masonite, wallboard, or similar material.

(2) To insure stability of the testing target throughout boresighting, it should be fastened securely to a stand.

(3) For use in either leveling or canting the testing target, a mil scale may be inscribed at the bottom of the target. A small nail at the top marks the center from which an arc was drawn and provides a hook from which to suspend the plumb line (fig. 18).

(4) A vertical reference line (fig. 18) may be drawn through the center of each diagram. These lines may be used when the trunnions cannot be leveled by setting the testing target with the cant angle of the piece. The target is tilted until the line of sight through the tube tracks between the tube reference line when the tube is elevated or depressed. Then the panoramic telescope is adjusted so that its vertical crosshair tracks between the appropriate reference lines when the tube is elevated or depressed.

(5) To facilitate boresighting in darkness, a 1/16-inch hole may be bored 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. Patches of felt padding should be fastened 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 lit only after

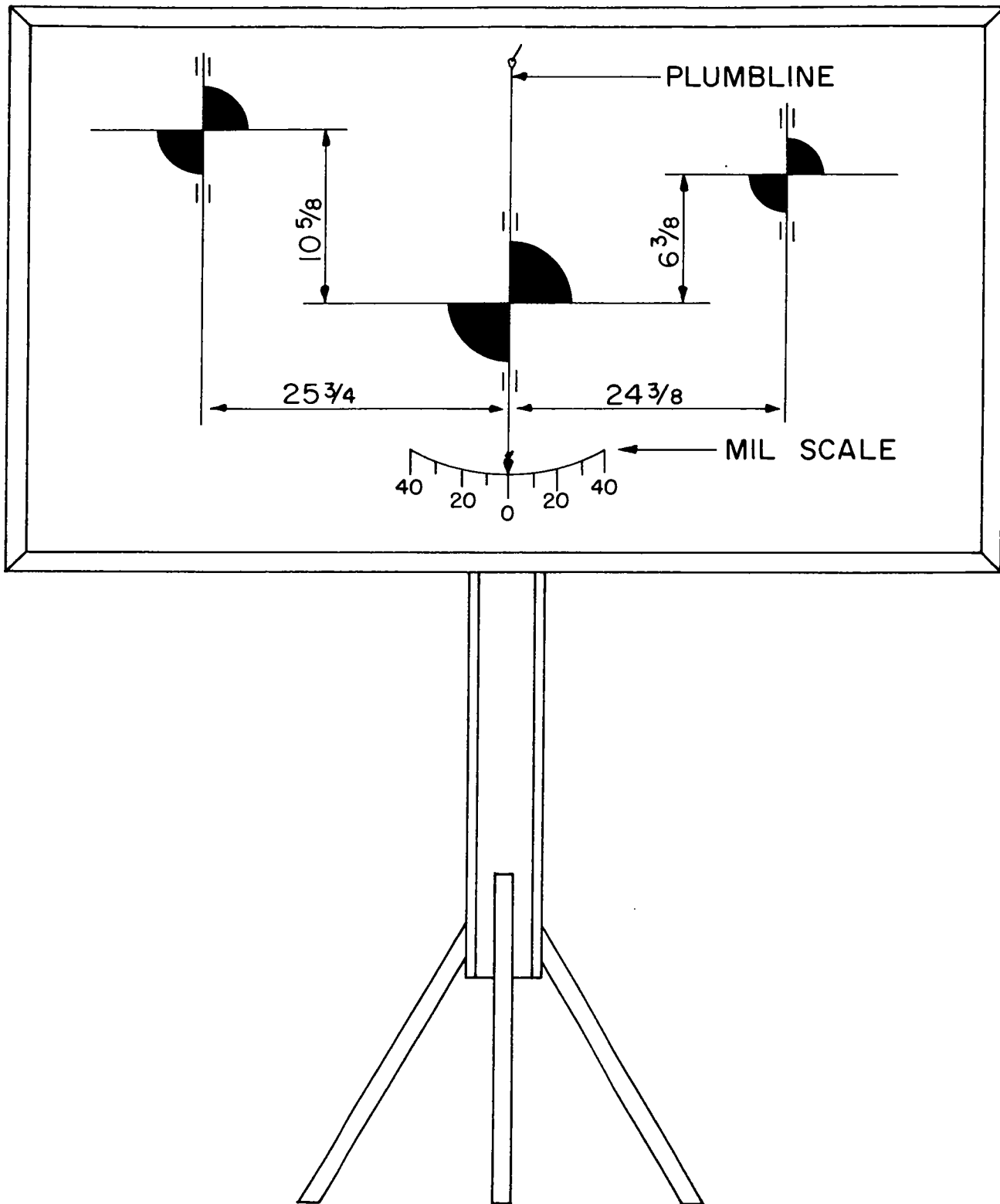


Figure 18. Testing target with mil scale and vertical reference lines.

it is placed firmly in position. Care must be taken to prevent disturbing the position of the testing target.

(6) If the proper testing target is not available, a substitute with aiming diagrams for the bore and panoramic telescope may be constructed in accordance with the dimensions shown in figure 18.

c. Tools. The section equipment includes all the necessary tools for boresighting and testing. If any item of sighting and fire control equipment fails to meet the prescribed tests, support maintenance personnel must be notified.

121. Conditions

The on-carriage fire control equipment is in correct alignment when the conditions in *a* through *d* below exist.

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

b. The line of sight of on-carriage sighting equipment are parallel to the axis of the bore throughout the limits of elevation.

c. Elevation counter dials read zero.

d. The azimuth counter dial reads 3200.

e. All level bubbles are centered.

122. Leveling

a. Trunnions. Although it is not absolutely necessary to level the trunnions for boresighting, it is advisable to do so whenever possible. Accurate results can be obtained more readily if the trunnions are level, because of tilt corresponding to the cant does not have to be introduced in the telescope mount and the testing target when it is used. The trunnions can be leveled by moving the carriage to level ground or by building up the standing for one of the motor carriage tracks. In no case should there be more than 20 mils of cant.

b. 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 at a distance of approximately 15 feet. The line of sight should track the plumb line as the tube is depressed and elevated between minimum elevation and the limits described by a plumb line which is as long as practicable. The plumb line must be shielded from wind currents, and the plumb bob or weight should be suspended in a container of liquid in order to keep the plumb line steady (fig. 19).

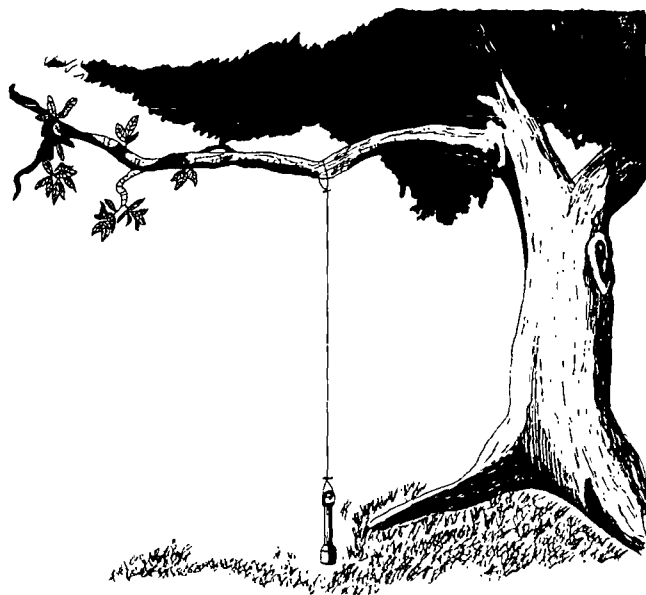


Figure 19. Plumb line suspended from tree.

c. Gunner's Quadrant. In leveling operations in which the gunner's quadrant is used, a quadrant that has been tested (para 134-138) and found to be accurate is required. The gunner's quadrant is placed on the flat surface of the recoil housing, beneath the breechblock. Since there are no quadrant seats at this location, only approximate leveling may be accomplished by this method.

Section II. TESTING TARGET METHOD

123. General

The testing target method of boresighting consists of using the aiming diagrams of the test-

ing target as aiming point. The preliminary steps in boresighting are as follows:

a. Trunnions. Level the trunnions as described in paragraph 122a.

b. *Tube.* Level the tube by performing the end for end test on the gunner's quadrant as outlined in paragraph 135. Make certain that the shoes on the gunner's quadrant are positioned between the engraved lines on the quadrant seats of the breech ring. When boresighting the 175-mm gun, the amount of tube droop indicated on the breech ring should be placed on the gunner's quadrant and the tube elevated until the bubble is centered. The tube is now level.

c. *Panoramic Telescope Mount M137 and Elevation Quadrant M15.* The panoramic telescope mount M137 and the elevation quadrant M15 are checked by insuring that the bubbles in the elevation level and cross-level vials are accurately centered and all numerical counters read zero. Place a tested gunner's quadrant on the quadrant seats of the elevating quadrant M15 and panoramic telescope mount M137 to insure that the error between the tube and the two mounts is within specified tolerance.

d. *Boresights.* Open the breech and insert the breech boresight in the chamber. Attach the muzzle boresight, stretching linen cords across the witness mark and over the cords on the muzzle and securing the ends by placing a strap around the end of the muzzle. If the breech boresight is not available, the obturator spindle vent may be used.

e. *Testing Target Alinement.* The testing target normally should be located at least 50 to 100 meters in front of the muzzle. If the trun-

nions are not level, cant the target to correspond to the cant of the trunnions. The face of the target must be perpendicular to the axis of the bore, both laterally and longitudinally. Without moving the piece, aline the tube testing target diagram with the line of sight through the tube.

124. Panoramic Telescope Alinement

Rotate the elevation and azimuth knobs until the horizontal and vertical lines of the reticle pattern are alined with the horizontal and vertical lines on the panoramic telescope diagram on the testing target (insure that the gunner's aid index is at zero). The azimuth counter dial should now read 3200 mils. If it does not, turn the azimuth knob until the vertical hairline is centered on the aiming diagram. Fully depress the boresight adjustment shaft until 3200 appears in the azimuth counter dial.

125. Direct Fire Telescope Alinement

After procedures prescribed in paragraph 124 are performed, check the direct fire telescope to determine whether the reticle of the telescope coincides with the reticle pattern of the testing target. If it does not, adjust the boresight adjustments of the telescope mount until the reticle of the telescope coincides with the reticle pattern of the testing target. If the reticle of the telescope cannot be brought into coincidence with the reticle pattern of the testing target, the mount must be adjusted by ordnance personnel.

Section III. DISTANT AIMING POINT METHOD

126. General

The distant aiming point method consists of alining the optical axis of the on-carriage fire control equipment and the line of sight through the tube on a common point at least 1,500 meters from the piece and as near zero elevation as possible.

127. Procedure

The steps prescribed for the testing target

method apply to the distant aiming point method, except that the boresights and optical sights are converged on the same point instead of parallel as on the diagrams on the testing target. Accurate crossleveling of the trunnions is unnecessary when boresighting on a distant aiming point, because of the convergence.

Section IV. STANDARD ANGLE METHOD

128. General

When existing conditions make other methods

of boresighting impracticable, the standard angle method may be used. In this method, the

alinement of the optical axis of the panoramic telescope parallel to the axis of the bore is 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. After the standard 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. Correction of misalinement, as a result of this test, should be verified by a more accurate method at the earliest opportunity. When the standard angle method of boresighting is being used, the recoiling parts must be in the same position with respect to the nonrecoiling parts as they were when the standard angles were determined. Therefore, the recoil mechanism must be checked to see that it contains the proper amount of recoil oil before determining the standard angles. Standard angles are usable only as long as the same tube-carriage combination is intact. If either the tube or carriage is changed, new standard angles must be established.

129. Parallax

Parallax in the panoramic telescope must be

eliminated. This is done by placing in front of the eyepiece lens a dark colored cardboard or metal parallax shield of the same diameter as the eyepiece lens housing (fig. 20). The shield should have an exactly centered hole one-sixteenth inch in diameter. A more permanent parallax shield may be constructed of brass or bronze shim stock. When the shield is constructed of metal, a series of fingers approximately three-sixteenths inch wide and one-fourth inch long separated by $\frac{1}{4}$ -inch spaces should extend beyond the perimeter of the shield. These fingers should be bent along the circumference of the circle to form an angle of 90° with the surface of the shield. The fingers serve as a means of clipping the shield in place quickly and permit easy removal. If the eyepiece has a rubber eyeguard, the metal shield may be attached within the eyeguard.

130. Preliminary Operations

The ideal time to determine the standard angles for later use is after performing basic periodic tests when the trunnions are level and the panoramic telescope mount is known to be in correct alinement. Procedure for determining standard angles is as follows:

a. With the tube in battery, scribe lines in

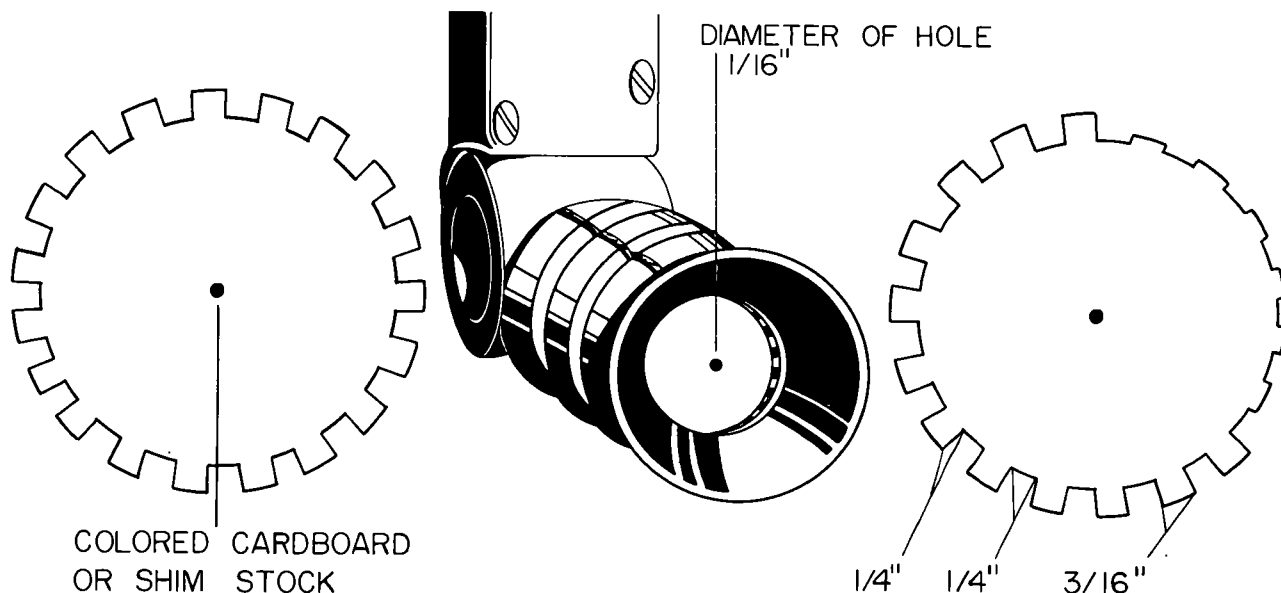


Figure 20. Parallax shield on eyepiece of telescope.

the paint to mark the normal positions of the parts which move in recoil with respect to parts which do not move in recoil.

b. Bore sight the piece by using a testing target or distant aiming point.

c. With friction tape, fasten a bright, straight pin in the left horizontal witness mark. Allow the pin to project to the left of the muzzle (fig. 21).

d. Fasten the parallax shield over the eyepiece of the panoramic telescope.

e. Verify that the elevation counter dial reads 0 mils and that the telescope mount is level.

f. Turn the azimuth knob and elevate or depress the tube as necessary and place the crosshairs of the sight on the pin in the left horizontal witness mark of the tube.

g. Verify that the telescope mount is level

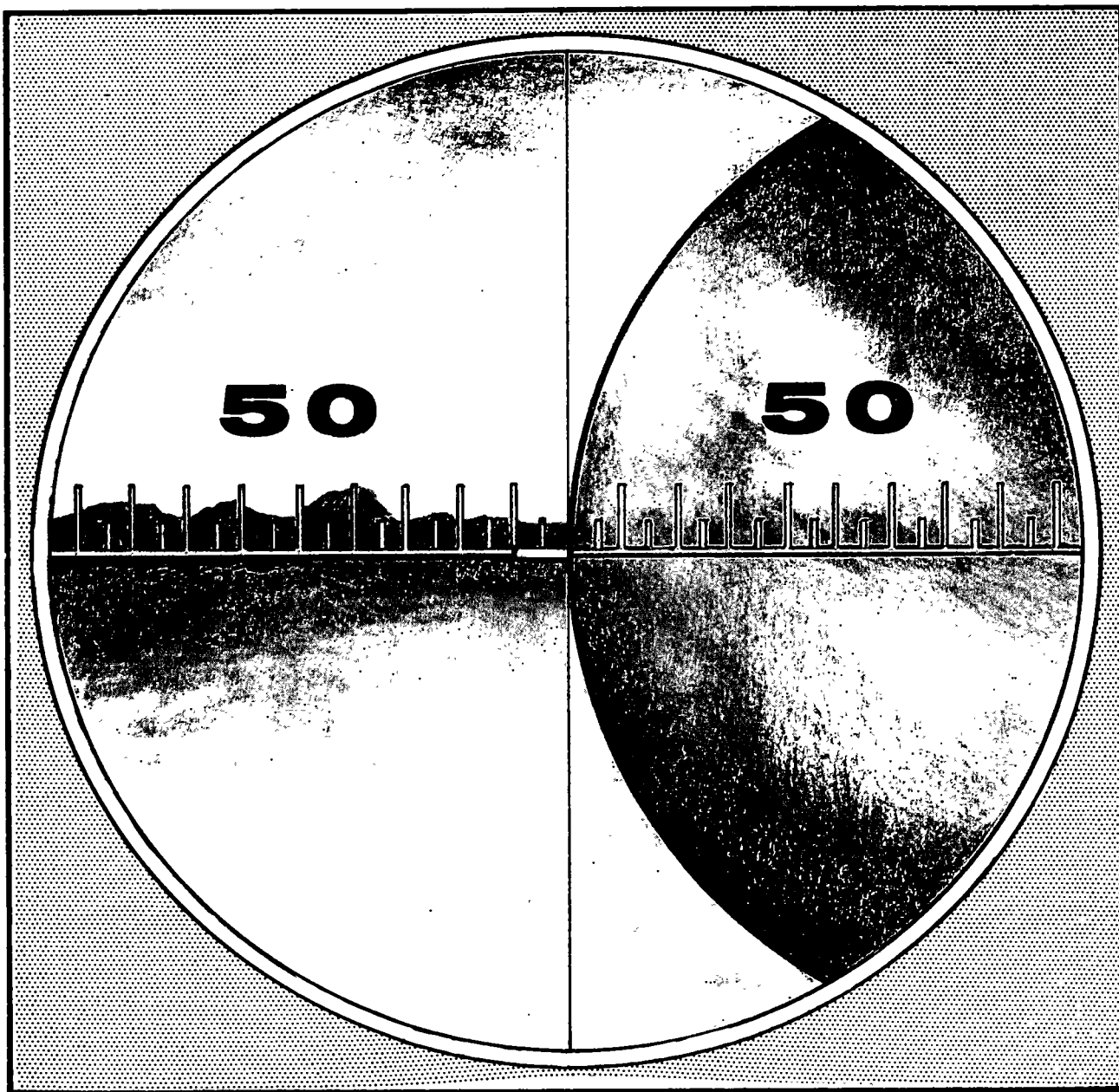


Figure 21. Sight picture of projecting pin.

and that the horizontal and vertical lines of the telescope are exactly on the junction of the pin with the muzzle.

h. Read and record the deflection from the azimuth counter dial of the panoramic telescope to the nearest one-fourth mil. This is the standard azimuth angle for the piece tested.

i. With the gunner's quadrant seated on the quadrant seats, of either the elevation quadrant M15 or the panoramic telescope mount M137, measure and record the elevation of the tube to the nearest one-fourth mil. This is the standard elevation angle for the piece tested.

131. Procedure

After the standard angles have been determined and recorded, the steps in performing the standard angle method of boresighting are as follows:

a. Inspect the scribe lines to 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.

b. With friction tape, fasten a bright straight pin in the left horizontal witness mark so that the pin projects out to the left of the muzzle.

c. Place the parallax shield on the eyepiece of the telescope.

d. Set off the standard elevation angle (para 130*i*).

e. Set off the standard azimuth angle on the azimuth counter dial of the panoramic telescope (para 130*h*).

f. If the intersection of the crosshairs of the panoramic telescope is not exactly on the junction of the pin and the muzzle, the sight is out of adjustment. If the azimuth angle is in error, it may be corrected by section personnel by adjusting the boresight adjustment shaft.

Note. An azimuth angle error should be verified by boresighting, using the test target or distant aiming point method.

CHAPTER 9

BASIC PERIODIC TESTS

Section I. GENERAL

132. Purpose and Scope

a. The purpose of this chapter is to describe the procedures for performing basic periodic tests of on-carriage fire control equipment. The procedures covered include only those that may be accomplished at battery level. It is not contemplated that using units will have the necessary facilities, tools, or skilled personnel to perform the more precise tests and adjustments of sighting and fire control equipment. If the elevation counter, telescope mount, or panoramic telescope exceeds the tolerance authorized on any of the tests outlined, the piece and/or panoramic telescope must be sent to support for adjustment.

b. Basic periodic tests are performed by the section under the supervision of the battery executive, chief of firing battery, 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 piece is used for nonfiring training; once every 3 months if the piece is fired; as soon as possible after intensive use, following accidents, or after traversing extremely rough terrain; and whenever the piece fires inaccurately for no readily apparent reason. The tests will reveal whether the on-carriage sighting equipment, the gunner's quadrant, and the fuze setter are in correct adjustment.

133. Preliminary Conditions

For the on-carriage equipment to be in correct adjustment, the following conditions must exist:

a. 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.

b. Elevation counters read zero.

c. The azimuth counter dial reads 3200.

d. If the elevation level and cross-level level bubbles are centered, the telescope mount automatically compensates for error in azimuth caused by elevating the tube.

e. The sighting equipment is accurately bore sighted as described in paragraphs 119 through 31.

f. Prior to all tests of on-carriage fire control equipment, it is essential that the trunnion be leveled accurately. Leveling the trunnions is most easily accomplished as prescribed in paragraph 122. The best method for checking the level of the trunnions is by tracking a plumb line as described in paragraph 122b. If a plumb line cannot be used, approximate leveling may be accomplished by placing the gunner's quadrant on the flat surface of the recoil housing, beneath the breechblock.

g. Parallax shields for the panoramic telescope and the direct fire telescope must be prepared in order to eliminate parallax in viewing a plumb line or a testing target (para 129).

Section II. TEST OF GUNNER'S QUADRANT

134. General

The gunner's quadrant must be in proper adjustment before conducting tests and adjust-

ment of other sighting and fire control equipment. Inspect the shoes of the gunner's quadrant for dirt, nicks, or burrs. Similarly, inspect

the quadrant seats on the upper surface of the breech ring and the quadrant seats on the telescope mount and elevation quadrant. Dirt, nicks, or burrs on these surfaces will cause the inaccurate readings.

135. End-for-End Test

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

b. Place the quadrant on the quadrant seats of the breech ring with the line-of-fire arrow pointing toward the muzzle, and center the quadrant bubble by turning the elevating handcrank.

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

d. If the bubble does not recentre, try to center it by turning the micrometer knob. If the bubble centers, read the black figures and divide by 2. The quotient is the correction. Place the correction on the micrometer and level the tube by using the elevation handcrank. Check again by reversing the quadrant. The bubble should center.

e. If the bubble does not center as in d above, move the radial arm down one graduation (10 mils) and perform the following operations: Turn the micrometer until the bubble centers; add 10 to the reading on the micrometer, and divide the sum by 2. Place the value of the quotient reading on the micrometer, leaving the arm at minus 10; center the level bubble with the elevation handcrank; and check by reversing the quadrant on the seats. The bubble should recentre. Subtract the reading on the microm-

eter from 10 to obtain the error. If the correction of error is more than plus or minus 0.4 mil, the quadrant must be adjusted by support maintenance personnel.

136. Micrometer Test

a. Set the radial arm to read 10 mils on the elevation scale, and set the micrometer at 0.

b. Place the quadrant on the quadrant seats on the breech ring with the line-of-fire arrow pointing toward the muzzle, and center the quadrant bubble by elevating the tube.

c. Set the radial arm at 0 on the elevation scale, and set the micrometer at 10 mils.

d. Reseat the quadrant on the quadrant seats. The bubble should center.

Caution: Do not disturb the laying of the tube.

e. If the bubble does not center, the micrometer is in error and must be adjusted by support maintenance personnel.

137. Comparison Test

Compare readings taken at low, medium, and high elevations with each of the gunner's quadrants of a battery on the quadrant seats of a single piece. The trunnions of this piece should be level. Any quadrant differing from the average by more than 0.4 mil at any elevation should be sent to a support maintenance unit for adjustment.

138. 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 it is recorded and applied only when test are being made.

Section III. TESTS FOR TELESCOPE MOUNT M137, PANORAMIC TELESCOPE, AND ELEVATION QUADRANT M15

139. Purpose

The purpose of the tests for the telescope mount M137, the panoramic telescope, and the elevation quadrant M15 is to determine whether the azimuth counter and level vials actually correct vertical plane at all elevations. These

tests are performed to check the adjustment and mounting of the panoramic telescope mount, the accuracy of the level vials, and the alignment of the telescope socket. The test of the telescope mount described in paragraph 140 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's testing out properly, the other tests specified in paragraphs 141 through 145 must be performed regardless of the result of the test in paragraph 140. The total error found in this test may then be reduced to errors in specific components.

140. Test of Telescope Mount M137 Using a Plumb Line

a. With the boresights in place and the tube at a low elevation, traverse the tube so that the line of sight through the tube is on the plumb line; level the telescope mount by centering both the elevation level and cross-level bubbles.

b. Place the intersection of the crosshairs of the panoramic telescope reticle on any sharply defined aiming point and note the deflection.

c. Elevate the tube from minimum to maximum elevation (or limit of the plumb line) in 100-mil steps. At each step, traverse the tube (if necessary) to bring the line of sight back on the plumb line. Relevel the telescope mount in both directions and check for deviation of the line of sight from the aiming point. If the vertical crosshair is off the aiming point, it is alined on the aiming point with the azimuth knob. If the horizontal crosshair is off the aiming point, it is alined on the aiming point with the elevation knob, and the bubble displacement is noted.

d. If the vertical crosshair deviates from the aiming point by more than the authorized tolerance from the original deflection at any elevation tested or the correction for the deviation of the horizontal crosshair causes either level bubble to move in excess of one-half vial graduation, the telescope mount is out of adjustment or improperly mounted. The weapon must be referred to support maintenance personnel for adjustment or correction.

141. Test of Cross-Level Setting, Telescope Mount M137

a. Level the telescope mount M137 in both directions by centering the level bubbles.

b. Set the line of sight of the panoramic

telescope at 3200 with the parallax shield in place.

c. Suspend a plumb line to coincide with the vertical crosshair of the telescope reticle.

d. Turn the elevation knob of the panoramic telescope through the entire range of movement. If the line of sight deviates from the plumb line by more than the authorized tolerance, the level vials are out of adjustment and must be adjusted by support maintenance personnel.

142. Test of Longitudinal-Level Setting, Telescope Mount M137

a. Go level the telescope mount M137 in both directions by centering the level bubbles.

b. With the parallax shield in place, by turning the azimuth knob of the panoramic telescope, set the line of sight to 1,600 mils.

c. Suspend a plumb line to coincide with the vertical crosshair of the panoramic telescope.

d. Turn the crosslevel correction knob on the telescope mount through the entire range of movement. If the line of sight deviates from the plumb line by more than authorized tolerance, adjustment of the level vials is necessary. This adjustment must be performed by support maintenance personnel only.

143. Test for Panoramic Telescope

a. Set the azimuth counter dial at 3200.

b. Traverse and elevate the tube as necessary to place the panoramic telescope reticle crosshairs on an aiming point.

c. Rotate the telescope head through a complete circle (6,400 mils). The telescope crosshairs should return to within authorized tolerances of the aiming point.

144. Test of Elevation Counter, Telescope Mount M137

Using a gunner's quadrant that has been checked for accuracy, measure the elevation of the tube at 0, 225, 625, 1,025, and 1,155 mils by placing the gunner's quadrant on the quadrant seats of the M137 mount and centering the bubble of the gunner's quadrant. Turn

the elevation knob until the elevation level bubble is centered at each elevation and insure that the cross-level level bubble is centered. Check the readings of the elevation counter against the readings of the gunner's quadrant. If the two readings do not agree and the disagreement is constant at all elevations the appropriate correction is applied to the elevation correction indicator dial. If the magnitude of

the disagreement between the two readings varies with elevation of the tube, the elevation counter is out of adjustment and must be referred to support maintenance personnel.

145. Test of Elevation Quadrant M15

The elevation quadrant M15 is tested in the same manner as the elevation counter of the telescope mount M137 (para 144).

Section IV. TEST OF FUZE SETTERS

146. 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.

147. Time Scale Test

Set any convenient time on the scale. Test the time scale of the fuze setter by setting several fuzes. The time set on the fuze should agree with the time setting on the fuze setter. If the fuzes set do not agree and are not within the prescribed tolerances, repeat the test as a check with a different fuze setting. If the fuzes set still do not agree, refer the instrument to support maintenance for adjustment.

CHAPTER 10

MAINTENANCE AND INSPECTIONS

148. General

Maintenance and inspection are 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. Carriage maintenance for a self-propelled weapon takes on added importance in that ability to fire is dependent on carriage operation.

149. Disassembly, Adjustment, and Assembly

Disassemblies and adjustments authorized to be performed on the weapon by battery personnel are prescribed in TM 9-2300-216-10 and TM 9-2300-216-20 supplemented by instructions in Department of the Army technical manuals. No deviation from these procedures is permitted unless authorized by the responsible ordnance officer.

150. Records

a. The principal records pertaining to the weapon are the Equipment Log Book, DA Form 2404 (Equipment Inspection and Maintenance Worksheet) and DA Form 2407 (Maintenance Request). For detailed information on the use of these forms, see TM 38-750.

151. Maintenance

For detailed instructions concerning maintenance of the 175-mm gun M107 and the 8-inch howitzer M110, see TM 9-2300-216-10.

152. 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 battery executive, accompanied by the chief of firing battery and the artillery mechanic, should make a daily spot check inspection. He inspects different parts of the weapons and motor carriages each day to insure complete coverage every few days. At least once a month, the battery executive makes a thorough mechanical inspection of weapons, motor carriages, 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 175-mm gun M107 and inspecting the 8-inch howitzer M110 see TM 9-2300-216-10.

e. Duties of individuals in performing the necessary inspections and maintenance of the section vehicle, weapon, and carriage are given in table 7. Work will be made routine, thorough, and rapid by following the drills outlined in table 7. When the section is reduced in strength, the chief of section must reassign duties to insure that all maintenance is performed.

Table 7. Duties in Inspection and Maintenance

(Located in back of manual)

153. 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 or the bivouac area for combat or before displacement. Boresighting is accomplished at this inspection, if time permits. After inspection and after all deficiencies have been corrected, the weapon and carriage are ready for operation. For duties of section personnel, see table 7.

154. Duties in Inspection During Operation (March)

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

a. The chief of section and senior cannoneer riding in the section vehicle supervise march discipline of the motor carriage and section vehicle, respectively, and assist the drivers in detecting obstacles that would cause injury to personnel or damage to the vehicles.

b. The gunner, assistant gunner, and cannoneers inspect security of stowed equipment and act as air sentinels as directed by the chief of section.

c. The drivers operate their respective vehicles and inspect all instruments and controls.

155. Duties in Inspection During Halt

The inspection at the halt is made to insure that the motor carriage, weapon, and section vehicle are in satisfactory operational condition. The halt provides the section with an opportunity to inspect for malfunctions that cannot be detected during operation. Each mem-

ber of the section checks those items listed in table 7.

156. Duties in Inspection and Maintenance after Operation

Immediately after operation, the motor carriage, weapon, and section vehicle are serviced and maintained as necessary to prepare them for further sustained action or to determine the need for maintenance by higher categories. Boresighting is accomplished, if time permits. These operations may be performed in the motor park, bivouac area, or combat position. Individual duties of gun (howitzer) section personnel are listed in table 7.

157. Duties in Weekly Inspection and Maintenance

In garrison, inspection and maintenance duties are performed weekly; on maneuver or in combat, they are performed after each field operation.

a. *Chief of Section.* The chief of section supervises the section during inspection and maintenance of the gun (howitzer) motor carriage, section vehicle, tools, accessories, and equipment in accordance with TM 9-2300-216-10 and LO 9 2300-216-12. He obtains the assistance of the artillery mechanic and battery mechanic for operations requiring skill and tools beyond the capabilities of the section.

b. *Gunner, Assistant Gunner, and Cannoneers.* The gunner, assistant gunner, and cannoneers perform normal maintenance as directed by the chief of section.

c. *Drivers.* The drivers perform normal preventive maintenance services in accordance with appropriate technical manuals.

CHAPTER 11

DECONTAMINATION OF EQUIPMENT

158. 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.

159. Decontamination for Chemical Agents

a. Ammunition. With rags, wipe off visible contaminant from projectiles. Apply DANC (decontamination agent, noncorrosive, M4), wipe with solvent-soaked rag, and 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 into the ammunition itself.

b. Instruments. If exposed to corrosive gases, clean instruments as soon as possible with solvent, allow them to aerate, 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 clear plastic or hard rubber surfaces.

c. Weapons. Remove dirt, dust, grease, and oil from weapons. Do not apply wet mix but allow surfaces to air after oil and dirt have been removed. DANC can be used on all metal surfaces except the bore. Also effective on metal are hot water and soap or cleaning solvent.

After decontamination, weapons are dried and oiled.

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

160. Decontamination for Biological and Radiological Agents

a. General. After contaminating attack, recovery of equipment may be achieved either by waiting, to permit the decay of contamination, or by active decontamination, to reduce the 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 close 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, sealing, and disposal.

161. References

For further information on decontamination, see FM 21-40, TM 3-220, and TF 3-2871.

CHAPTER 12

DESTRUCTION OF EQUIPMENT

162. 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.*

163. Plans

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—

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

b. Destruction must be as complete as the available time, equipment, and personnel will permit. Since complete destruction requires con-

siderable time, *priorities* must be established so that the more essential parts are destroyed first.

c. The same essential parts must be destroyed on all like units to prevent the enemy from constructing a complete unit from undamaged parts.

d. Spare parts and accessories must be given the same priorities as the part installed on the equipment.

164. 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.

165. References

For detailed information on destruction of the 175-mm gun M107, 8-inch howitzer M110, fire control equipment, and the motor carriage, see TM 9-2300-216-10; for destruction of ammunition, see TM 9-1300-203.

CHAPTER 13

SAFETY PRECAUTIONS

166. General

Safety precautions to be observed in training are prescribed in AR 385-63. Additional information is found in FM 6-40, FM 6-140, TM 9-1300-203, and TM 9-2300-216-10. The more important safety precautions are summarized in paragraphs 167 through 170.

167. Ammunition

a. All ammunition on the ground at the firing position must be so placed that it is protected against explosion in case of an accident at the piece. Fire and explosive or flammable materials 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. M514-series VT fuzes must be reset to initial setting as shipped.

d. All rounds not fired which have been prepared for firing must be checked by the chief of section to insure that all powder increments are present in proper order and condition and that they are of the proper lot number. For further details, see FM 6-40, FM 6-140 and TM 9-2300-216-20.

168. Misfires

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

Caution. The piece 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. Wait 2 minutes after the last attempt to fire the weapon, before trying to remove the primer; and then only if you can stand clear of the path of recoil. Remove the primer and inspect it to see if it is dented.

c. If the primer is faulty, replace the primer and fire the weapon. If the primer is not at fault, i.e., the primer is not dented, then the fault is with the firing lock or breechblock; inspect. Repair or replace as needed, load, prime and fire.

d. If the primer fired, wait an additional 8 minutes more (which makes a total of 10 minutes from the last attempt to fire) then open the breech and remove the faulty charges.

e. Replace the charge and primer and fire the weapon.

Caution. If the person who is to remove the primer cannot stand clear of the path of recoil, wait 10 minutes before attempting to remove primer. Faulty charges and primers should be handled carefully and disposed of quickly.

f. For detailed procedures refer to TM 9-2300-316-10.

169. Explosive Projectiles in Hot Tubes

Explosive projectiles in hot tubes present an extremely hazardous situation. High rates of fire for extended periods with high charges necessitates the following precautions be observed:

a. A round that has been chambered in a weapon should be fired or removed from the weapon within 5 minutes.

b. If the round in a hot tube cannot be fired or removed within the 5 minute period, the following actions should be taken:

(1) Where a misfire is not involved and in the event the round cannot be fired or re-

moved within 5 minutes, the primer and propelling charge should be removed immediately and the cannon tube elevated to approximately 30 degrees (533 mils). All personnel should be evacuated to a safe distance. Allow the projectile and weapon to cool for 2 hours.

(2) After the 2 hour waiting period, one or more of the methods indicated in (a), (b), and (c) below should be attempted to clear the projectile from the tube. The weapon may be carefully moved or relocated to a remote position if necessary. If relocating is necessary, the cannon tube should be lowered and locked in the traveling position. Waste will be placed in the chamber to cushion the projectile and to protect the face of the breechblock while the weapon is being moved.

(a) Reload the weapon with the lowest propelling charge possible (Charge 1) and fire the weapon remotely.

Warning. It must be anticipated that the projectile may detonate in the cannon tube or along its trajectory upon firing. Therefore, all personnel must be evacuated to a safe distance or placed under adequate protective cover.

(b) Request Direct Support Maintenance personnel, with the technical advice of EOD personnel regarding the recognition of possible exuded explosive, to carefully remove the cannon tube (with stuck projectile) at a remote location away from buildings and unoccupied areas. The cannon tube containing the stuck projectile should then be released to EOD personnel.

(c) Request assistance from EOD personnel.

(3) If a misfire is involved, the following steps should be taken:

(a) Wait for 2 minutes from the last attempt to fire before removing the primer. If the primer has fired, personnel should be evacuated to a safe distance for a 2-hour waiting period without removing the propelling charge and the guidance outlined in paragraph b(2) above should be followed.

(b) If the primer has not fired after the 2-minute waiting period, a new primer will be tried or the faulty firing mechanism corrected. Should the new primer not fire, or it is not possible to fire the weapon within a total elapsed time of 5 minutes, the propelling charge will be removed and personnel evacuated to a safe distance for a 2-hour waiting period. The guidance outlined in paragraph b(2) above should be followed.

170. Drill and Firing

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

b. Personnel on the ground will pass in rear of the carriage when they go from side to side.

c. Personnel must stay a safe distance from the breech to prevent injury when the piece recoils.

d. During firing, personnel should protect their eardrums against injury by using ear-plugs or other suitable material.

171. Safety Officer

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 14

TRAINING

Section I. GENERAL

172. Purpose and Scope

The purpose of this chapter is to present the requirements for training section personnel in the performance of their duties in service of the piece. It includes general information on the conduct of training and tests for the qualification of gunner.

173. Objectives

The objectives of training are to speed the attainment of proficiency by cannoneers in their individual duties and, through drill, to weld them into an effective, coordinated team that is able to function efficiently in combat. During training, the supervisor should keep in mind the proficiency sought by the appropriate Army Training Tests (ATT). Maximum efficiency is attained through regular drills.

174. Conduct of Training

a. Training will be conducted in accordance with the principles set forth in FM 21-5. The goal of training should be the standards set forth in FM 6-125 and AR 611-201.

b. In general, individual training is conducted by noncommissioned officers as far as practicable. Officers are responsible for preparing

training plan, 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 in the section should be maintained on a progress card by the chief of 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 chief of firing battery and the battery executive to make sure 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. Section Drill. Each member of the section should know the duties of all other members and be able to perform efficiently in each duty position. See paragraphs 186 through 195 for tests to be given for the qualification of gunners.

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

Section II. MINIMUM TRAINING SCHEDULE

175. General

The training schedule outlined in paragraph 177 is a guide to meet the minimum training requirements for personnel of a gun (howitzer) section in subjects covered in this manual.

176. Individual Periods

a. Individual periods of training in service of the piece should be arranged, along with other battery training, into a balanced training program, taking into consideration the basic principles of training.

b. In general, except for service practice, periods on any subject should not be longer than 1 hour. Section drill periods should not exceed one-half hour and should be conducted in a vigorous manner.

c. Periods of drill should be preceded and followed by periods on subjects that are logically related to the drill. For example, a period of drill should be preceded by a period of testing and adjustment of sighting and fire control equipment and followed by a period of inspection and maintenance drills. A period on aiming post and/or collimator displacement correc-

tion may come between two periods of howitzer drill.

d. TM 9-2300-216-10 provides information on which to base periods of instruction on description, characteristics, and functioning of the piece; familiarization with the piece, including breech and firing mechanisms, barrel assembly and slides, recoil mechanism, equilibrator, elevating mechanism, and sighting and fire control equipment; and field assembly and malfunction. These periods should be included in the battery training schedule and closely allied with the training in service of the piece.

177. Training Schedule (78 Hr.)

*Method	Hours	Subject	Text references	Training aids and equipment
C, D, PW	1	Organization and composition of howitzer section, general duties of individuals, and formation of howitzer section.	Para 2-8.	Howitzer and motor carriage.
C, D, PW	1	Posts and posting, changing posts, and mounting and dismounting.	Para 9-14.	Do.
C, D, PW	2 (1-hour periods)	Prepare for action and march order.	Para 15-18.	Do.
C, D, PW	24 (½-hour periods)	Howitzer drill, duties in firing by indirect laying.	Para 19-98 110, 115, 119.	TOE equipment.
C, D, PW	9 (½-hour periods)	Howitzer drill, duties in firing by direct laying.	Para 90-108.	Do.
C, D, PW	6 (1-hour and ½-hour periods)	Test and adjustment of sighting and fire control equipment.	Para 119-147.	TOE equipment.
C, D, PW	2 (½-hour periods)	Aiming post and or collimator displacement correction.	Para 112.	TOE equipment and blackboard and chalk.
C, D, PW	4 (1-hour periods)	Inspections and maintenance drills.	Para 148-157.	TOE equipment.
C, D, PW	1	Decontamination of material.	Para 158-161.	Decontamination and TOE equipment.
C, D, PW	1	Destruction of material to prevent use by the enemy.	Para 162-169.	Demolition and TOE equipment.
C, D	1	Safety precautions.	Para 166-171.	TOE equipment.
PW	16 (4-hour periods)	Service practice, firing by indirect laying.	Para 19-89, 119-131.	Do.
PW	4	Service practice, firing by direct laying.	Para 90-108.	Do.
C, PW	6 (1-hour periods)	Review and tests of subjects previously covered.	All previous references.	Do.

*C—Conference; D—demonstration; PW—practical work.

CHAPTER 15

TESTS FOR QUALIFICATION OF GUNNERS

Section I. GENERAL

178. Purpose and Scope

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

a. To provide a means of determining the relative proficiency of the individual artillery soldier in the performance of the duties of the gunner. *The tests will not be a basis for determining the relative proficiency of batteries or higher units.*

b. To serve as an addition to training.

179. Standards of Precision

The candidate will be required to perform the tests in accordance with the standards listed in a through d below.

a. Settings must be exact.

b. Level bubbles must be centered exactly.

c. The vertical crosshair in the reticle of the panoramic telescope must be aligned on the left edge of the aiming post or the zero line of the collimator, or on exactly the same part of the aiming point each time the piece is laid.

d. Final motions of the azimuth and elevation setting knobs must be made in the appropriate direction (para 109). Bubbles must be centered using the hydraulic (power) elevating and traversing controls.

e. The appropriate elevation correction must be set on the correction indicator dial.

180. Assistance

The candidate will receive no unauthorized assistance. Each candidate may select authorized

assistants as indicated in the tests. If 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.

181. 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 and should not be charged for any time used by the examiner.

182. Scoring

Scoring will be conducted in accordance with the two subparagraphs entitled *Penalties* and *Credits* under each subject. If a test is performed correctly, credit will be given in accordance with the subparagraph entitled *Credit* under each subject. No credit will be allowed if conditions exist as specified in the subparagraph entitled *Penalties*. No penalty will be assessed in excess of the maximum credit for each test.

183. Preparation for Tests

The piece will be prepared for action and the candidate posted at the proper position corresponding to the test being conducted or as indicated in the *Special Instructions* subparagraphs under each subject. 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.

184. Qualification Scores

Minimum scores required for qualification in the courses are as follows:

<i>Individual classification</i>		<i>Points</i>
Expert gunner -----		90
First-class gunner -----		80
Second-class gunner -----		70

185. Outline of Tests

Para	Subject	No. of tests	Points each	Maximum credit
186	Direct laying, direct fire telescope -----	4	2	8
187	Indirect laying, deflection only -----	18	2	36
188	Displacement correction	1	4	4
	Part I -----	--	(3)	(3)
	Part II -----	--	(1)	(1)

Para	Subject	No. of tests	Points each	Maximum credit
189	Measuring deflection ---	2	4	8
190	Laying for elevation, elevation counter ---	3	2	6
191	Laying for elevation, gunner's quadrant ---	3	2	6
192	Measuring elevation ---	1	5	5
193	Measuring angle of site to mask -----	1	4	4
194	Sighting and fire control equipment -----	2	4	8
195	Material -----	3	5	15
Total credit -----				100

Section II. TESTS

186. Direct Laying, Direct Fire Telescope

a. *Scope of Test.* 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. Each group of tests will be executed as one series of command.

b. *Special Instructions.*

(1) The *one-man, one-sight* system will be used.

(2) A stationary target will be placed approximately 600 meters from the piece.

(3) The azimuth counter dial will be set at 3200 and the gunner's aid index will be set at zero and the elevation bubbles will be centered.

c. *Outline of Tests.*

Test No.	Examiner commands (or example)	Action of candidate
1 and 3	TARGET, THAT TANK, FROM LEFT TO RIGHT LEAD 5, QUADRANT 25	Sets the announced quadrant on the elevation counter dial. Insures that the appropriate setting is on the elevation correction indicator dial. Elevates or depresses the tube until the elevation level bubble is centered. Centers cross-level level bubble. Traverses tube until proper lead has been established. Commands FIRE and steps clear.
2 and 4	RIGHT (LEFT) 6, UP (DOWN) 5.	Same as test 1 above.

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

(1) The azimuth counter setting has been moved from 3200.

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

(5) The piece will be pointed so that a shift of approximately 100 mils will be required for tests 1 and 3, and it will not be necessary to shift the motor carriage for any of the four tests.

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

(7) The examiner will announce the assumed direction of the movement of the target before tests 1 and 3. The assumed direction of the movement of the target in test 3 will be opposite that in test 1.

(2) The gunner's aid index has been moved from zero.

(3) The elevation level and cross-level bubbles are not centered.

(4) The proper setting is not on the elevation counter dial.

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

(6) The appropriate setting is not on the elevation correction indicator dial.

e. *Credit.* Time in seconds, exactly or less than Credit -----

8	8.5	9
2.0	1.5	1.0

187. 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 in c below. Each group of tests (test 1-4, 5-9, and 14-18) will be executed as one series of commands.

b. Special Instructions.

(1) Command will not necessitate movement of motor carriage.

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

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

c. Outline of Tests.

Test No.	Examiner commands (for example)	Action of candidate
1 and 10	SPECIAL CORRECTIONS, DEFLECTION 3290, NUMBER 1, LEFT 7	Sets deflection and applies special correction. Centers leveling bubbles. Traverses piece until vertical cross hair is on left edge of aiming posts, or zero line of the collimator Checks centering of level bubbles. Relays if necessary. Calls "Ready" and steps clear
2 and 11	DEFLECTION 3149	Sets deflection. Lays on aiming posts or zero line of collimator. Checks centering of level bubbles. Relays if necessary. Calls "Ready" and steps clear.
3 and 12	DEFLECTION 3236	Same as test 2 above.
4 and 13	NUMBER 1, RIGHT 4. At conclusion of test 4 (13) give END OF MISSION. (No time considered for this operation.)	Same as test 2 above.
5 and 14	AIMING POINT, CHURCH STEEPLE, (or such-and-such), REFER.	Refers telescope to church steeple. Reads deflection on azimuth counter dial and calls "NUMBER 1, deflection (so much)."

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

Test No.	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 piece will be laid with the correct settings at the conclusion of each test before proceeding with the next test.

(6) For these tests, aiming posts or collimator will be set out of prescribed deflection and distances.

(7) The examiner will designate the section number of the piece to be used and will announce, when applicable, special corrections in deflection to be applied by the candidate.

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

Test No.	Examiner commands (for example)	Action of candidate
6 and 15	DEFLECTION 3000, REFER	Sets deflection on azimuth counter. Verifies that vertical crosshair of the reticle is on appropriate part of aiming point. Calls "Number 1, deflection 3000." Steps clear.
7 and 16	SPECIAL CORRECTIONS, DEFLECTION 3080. NUMBER 1, LEFT 7.	Same as test 1 above.
8 and 17	DEFLECTION 3120	Same as test 2 above.
9 and 18	DEFLECTION 3135.	Same as test 2 above.

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

- (1) The deflection is not set correctly.
- (2) The level bubbles are not centered.
- (3) The vertical crosshair of the telescope is not on the aiming point or left edge of aiming posts, or zero line of collimator, as the case may be.

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

e. Credit. Time in seconds, exactly or less than—

Tests 1, 7, 10, and				
16, each -----	12	13	14	
Other tests, each ---	8	9	10	
Credit -----	2.0	1.5	1.0	

188. 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 in *c* below.

b. Special Instructions.

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

(2) An assistant, selected by the candidate, will be stationed near the far aiming post, or the collimator.

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

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

(5) The laying of the piece 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 piece so that the far aiming post appears midway between the near aiming post and the vertical crosshair of the telescope, or lays the piece so that the vertical crosshair of the telescope is in its proper position to the zero line when using the collimator. Checks centering of level bubbles. Re-lays if necessary. Calls "Ready" and steps clear.

(2) *Part II.*

Examiner commands	Action of candidate
ALINE AIMING POSTS	Sets 3200 on the azimuth reset counter dial and directs assistant in aligning aiming posts, or collimator. Calls "Ready" and steps clear.

d. Penalties. No credit will be allowed for either part if—

(1) *Part I.*

(a) The far aiming post does not appear midway between the near aiming post and the vertical crosshair of the telescope, or incorrect sight picture has been used with the collimator.

(b) The bubbles are not centered.

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

(2) *Part II.*

(a) The deflection on the azimuth reset counter dial is not 3200.

(b) The aiming posts are not properly alined.

(c) The vertical crosshair of the telescope reticle is not on the left edge of the aiming posts, or on the zero line of the collimator.

e. Credit. Part I, time in seconds, exactly
or less than ----- 3 $3\frac{1}{3}$ $3\frac{2}{3}$ 4
Credit ----- 3.0 2.0 1.5 1.0
Part II, no time limit --
Credit ----- 1.0 --- --- ---

189. Measuring Deflection

a. Scope of Test. Two tests will be conducted

c. Outline of Tests.

Test No.	Examiner commands	Action of candidate
1	NUMBER 1, AIMING POINT, CHURCH STEEPLE TO LEFT FRONT, REFER.	Centers the level bubbles. Refers to aiming point. Checks centering of bubbles. Reads deflection from the azimuth counter dial and reports, "NUMBER (so and so) deflection (so much)" and steps clear.
2	NUMBER 1, AIMING POINT, WATER TOWER, RIGHT FRONT, REFER.	Same as test 1 above.

d. Penalties. No credit will be allowed if—

(1) The level bubbles are not centered properly.

(2) The vertical crosshair of the telescope reticle is not on the aiming point properly.

(3) The deflection is not announced correctly.

(4) The weapon is traversed.

e. Credit. Part I, time in seconds, exactly
or less than ----- 5 $5\frac{3}{5}$ 6 $6\frac{3}{5}$
Credit ----- 4.0 3.0 2.0 1.5

c. Outline of Tests.

Test No.	Examiner commands	Action of candidate
1	QUADRANT 290.	Sets announced elevation. Elevates or depresses the tube. Checks level bubbles. Calls "Ready."
2	QUADRANT 326.	Same as test 1 above.
3	QUADRANT 323.	Same as test 1 above.

in which the candidate will be required to measure and report a deflection in accordance with the commands given in *c* below.

b. Special Instructions.

(1) The piece will be laid on aiming posts of the aiming posts or the collimator.

(2) The examiner will select two aiming points: the aiming point for test 1 will be within 200 mils to the left or right of the aiming posts, or the collimator, and the aiming point for test 2 will be within 200 mils on the opposite side of the aiming posts or the collimator.

(3) The appropriate aiming point will be designated by the examiner and identified by the candidate prior to the start of each test.

190. Laying for Quadrant, Elevation Counter

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

b. Special Instructions.

(1) Each test will require a change of settings and the accompanying laying of the piece in elevation. (All commands will be within the limits of 200 to 400 mils on the elevation counter.)

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

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

(1) The elevation counter is not set accurately.

(2) The level bubbles are not centered accurately.

(3) The appropriate correction is not set on the elevation correction indicator dial.

e. *Credit.* Time in seconds, exactly or less than _____ $6\frac{3}{5}$ $7\frac{3}{5}$ $8\frac{3}{5}$

Credit _____ 2.0 1.5 1.0

191. Laying for Quadrant, Gunner's Quadrant

a. *Scope of Tests.* Three tests will be con-

c. *Outline of Tests.*

Test No.	Examiner commands	Action of candidate
1	QUADRANT 190.	Sets elevation on gunner's quadrant and seats quadrant. Has assistant elevate or depress the tube until quadrant bubble is centered.
2	QUADRANT 245.	Calls "Ready," and waits for examiner to verify laying. Same as test 1 above.
3	QUADRANT 215.	Same as test 1 above.

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

(1) The quadrant elevation is not set correctly.

(2) The quadrant is not properly seated.

(3) The quadrant bubble is not properly centered.

e. *Credit.* Time in seconds, exactly or less

than _____ 6 $6\frac{3}{5}$ 7

Credit _____ 2.0 1.5 1.0

192. 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 Instruction.* Prior to the test the examiner will lay the tube at a selected elevation, measure the elevation; and set the gunner's quadrant at zero.

c. *Outline of Test.*

ducted in which the candidate will be required to execute commands similar to those in c 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 setting within the limits of 30 to 60 mils.

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

(4) An assistant, selected by the candidate, will be posted to elevate the tube.

Examiner commands	Action of candidate
MEASURE THE ELEVATION.	Places gunner's quadrant on the quadrant seats of the panoramic telescope-mount M137. Levels bubble by raising or lowering the index arm and turning the micrometer knob. Announces "Number (so-and-so) elevation (so much)," and hands quadrant to the 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 not announced correctly.

e. *Credit.* Time in seconds, exactly or less

than _____ 8 $9\frac{2}{5}$ $10\frac{3}{5}$

Credit _____ 5.0 3.5 2.0

193. Measuring Angles of Site to Mask

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

b. Special Instructions.

(1) The piece, prepared for action, will be placed 200 to 400 meters 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 be posted at the rear of the breach.

(4) An assistant, selected by the candidate, will be posted as gunner to elevate or depress and traverse the tube as directed by the candidate.

c. Outline of Test.

Action of candidate	Examiner commands
MEASURE ANGLE OF SITE TO MASK.	Sights along lowest element of the bore, and has the tube moved until the line of sight just clears the highest point of the crest. Rotates the elevation knob until the level bubbles are centered. Reads elevation

c. Outline of Tests.

Test No.	Examiner commands	Action of candidate
1	PERFORM END-FOR-END TEST ON GUNNER'S QUADRANT.	Performs test as prescribed in paragraph 135. 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 136. Calls "Quadrant micrometer is (is not) in error." States what action, if any, should be taken.

d. Penalties.

(1) *General.* The tests are not essentially speed tests. The purpose of the prescribed time limit 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 of the amount of

Action of candidate	Examiner commands
	from elevation counter. Reports, number (so-and-so), angle of site to the 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 M15 elevation quadrant bubble is not centered.

(3) The angle of site is not announced correctly.

e. Credit. Time in seconds, exactly or less than

15	16	17	18
Credit	4.0	3.0	2.0 1.5

194. Sighting and Fire Control Equipment

a. Scope of Tests. Two 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 to describe the action taken (i.e., send to the support maintenance if adjustment is not authorized to be made by using personnel).

b. Special Instructions. The piece will be prepared for action with the trunnions level and the tube in center of traverse.

the angle which was indicated when the quadrant first was reversed and the bubble centered by moving the index arm and micrometer) is not announced correctly by the candidate.

(c) The candidate does not declare the quadrant unserviceable if the error (necessary correction) exceeds 0.4 mil or does not declare the quadrant serviceable if the error (necessary correction) is 0.4 mil or less.

(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.

(c) The candidate fails to report necessary action to be taken.

e. Credit. If the tests and adjustments are performed correctly within the prescribed time limits, maximum credit will be given as follows:

Test 1	-----	4
Test 2	-----	4
Total	-----	8

195. Materiel Test

a. Scope of Tests. The candidate will be re-

c. Outline of Tests.

Test No.	Examines commands	Action of candidate
1	DISASSEMBLE BREECH AND FIRING MECHANISM.	Performs the operation as described in TM 2300-216-10, laying the disassembled parts on the paulin. After disassembly, identifies all parts to examiner.
2	ASSEMBLE BREECH AND FIRING MECHANISM.	Performs the operation as described in TM 9-2300-216-10.
3	PERFORM DAILY, WEEKLY, AND MONTHLY LUBRICATION TEST.	Using the lubrication order as a guide, selects proper lubrication equipment and lubricant and shows <i>how</i> , <i>when</i> , and with <i>which</i> lubricant each lubrication point on the piece 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	-----	12 minutes
Test 2	-----	16 minutes
Test 3	-----	5 minutes

(3) A penalty of one-half point will be assessed for each component part that is not correctly identified or is 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 correct nomenclature.

quired to perform three tests as prescribed in *c* below.

b. Special Instructions.

(1) *Tests 1 and 2.* For tests 1 and 2, a paulin will be placed on the firing platform 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. The candidate may have an assistant to aid him in lowering and lifting the breechblock.

(2) *Test 3.* A complete set of lubrication equipment authorized for use of battery personnel, including lubrication order, will be made available on a nearby paulin. Every type of lubricant used on the piece will be available in plainly labeled containers and placed on the paulin.

(4) A penalty of one-half point will be assessed for each lubrication point missed or lubricated improperly and for each time the improper lubricating device or lubricant is used.

e. Credit.

(1) The candidate will be scored on the general merit of his work in addition to the specific requirements in *c* above.

(2) If each test is performed correctly within the prescribed time limit, maximum credit will be given as follows:

Test 1	-----	5 points
Test 2	-----	5 points
Test 3	-----	5 points
Total	-----	15 points

APPENDIX A

REFERENCES

1. Army Regulation (AR)

- 320-5 Dictionary of United States Army Terms.
- 320-50 Authorized Abbreviations and Brevity Codes.
- 385-63 Regulations for Firing Ammunition for Training, Target Practice, and Combat.
- 611-201 Enlisted Military Occupational Specialties.
- 750-5 Organization, Policies, and Responsibilities for Maintenance Operations.

2. Army Training Programs (ATP)

- 6-100 Field Artillery Cannon Units.

3. Army Training Tests (ATT)

- 6-415 Field Artillery Battalion, Gun or Howitzer, Heavy.
- 6-358 Field Artillery Gun or Howitzer Battery, Heavy, Towed or Self-Propelled.

4. Department of the Army Pamphlet (DA Pam)

- 108-1 Index of Army Films, Transparencies, GTA Charts, and Recordings.
- 310-Series Military Publications Indexes.

5. Field Manuals (FM)

- 5-15 Field Fortifications.
- 5-20 Camouflage.
- 5-25 Explosives and Demolitions.
- 6-40 Field Artillery Cannon Gunnery.
- 6-125 Qualification Tests for Specialists, Field Artillery.
- 6-140 Field Artillery Cannon Battalions and Batteries.
- 21-5 Military Training Management.
- 21-30 Military Symbols.
- 21-40 Chemical, Biological and Nuclear Defense.
- 22-5 Drill and Ceremonies.
- 23-65 Browning Machine Gun, Caliber .50, HB, M2.

6. Technical Manuals (TM)

- 3-220 Chemical, Biological and Radiological (CBR) Decontamination.
- 9-1527 Gunner's Quadrants M1 and M1918 and Machine Gun Clinometer M1917.
- 9-1300-203 Artillery Ammunition.

9-1900	Ammunition, General.
9-2300-216-10	Gun, Field Artillery Self-Propelled, 175-mm, M107, and Howitzer, Heavy Self-Propelled, 8-inch, M110.
21-301	Driver Selection, Training, and Supervision; Tracked Vehicles.
21-306	Manual for the Tracked Combat Vehicle Driver.

7. Tables of Organization and Equipment (TOE)

6-437	Field Artillery Gun Battery, 175-mm, Self-Propelled.
6-447	Field Artillery Howitzer Battery, 8-inch, Self-Propelled.

INDEX

	Paragraph	Page		Paragraph	Page
Accuracy in laying	109	35	Chief of section—Continued		
Adjustment and disassembly	34, 149	18, 52	Duties—Continued		
Agents, decontamination for:			General	6	6
Chemical	159	54	Indirect laying	20	15
Biological and radiological	160	54	Maintenance	152	42
Aiming points	110	35	Collimator	40	20
Aiming posts	111	35	Commands	9, 24, 103	9, 16, 32
Alining aiming posts	40, 111	20, 35	Common deflection	42	20
Ammunition:			Conduct of drill	7, 19	9, 15
Care of	117	39	Data board, section	118	40
For direct fire	94	29	Decontamination	159	54
Restoring	36	18	Definitions	2	3
Safety precautions	167-169	56	Destruction of equipment	162	55
Assistant gunner:			Direct fire table	101	31
Duties:			Direct fire telescope	125	44
Direct laying	105	33	Direct laying	90	28
General	6	6	General:		
Indirect laying	21, 47	16, 21	Two-man, two-sight system ..	105	33
Basic periodic tests:			Two-man, one-sight system ..	106	34
General	132	48	One-man, one-sight system ..	107	34
Preliminary conditions	133	48	Dismount	13	12
Bore clear, to call	61	24	Displacement of aiming posts	47, 112	21, 37
Breech, opening and closing	58	24	Distant aiming point	110	35
Boresighting:			Drivers:		
Distant aiming point method	126	44	Duties:		
During darkness	113	38	Direct laying	108	34
General	119	41	General	6	6
Standard angle method	128	44	Indirect laying	16, 23,	
Call off, the command	9	9	85-89 14, 16, 26		
Cannoneers:			Maintenance	88, 152	26, 52
Duties:			Duties of personnel:		
Direct laying	90, 108	28, 34	Direct laying	90	28
General	6	6	General	6	6
Indirect laying:			Indirect laying	27-89	17-26
No. 1	21, 52	16, 21	Maintenance	152	52
No. 2	21, 56	16, 23	March order	23	16
No. 3	21, 62	16, 24	Prepare for action	16	14
No. 4	21, 62	16, 24	Elevation counter:		
No. 5	21, 67	16, 24	Elevation quadrant M15	145	51
No. 6	21, 73	16, 25	Telescope Mount M137	144	50
No. 7	21, 77	16, 25	Elevation, laying for	36, 44, 50	18, 20, 21
No. 8	21, 81	16, 25	Elevation quadrant M15:		
Care of ammunition	117	39	Test of	145	51
Check firing, the command	114	38	Equipment, description of	3	3
Change posts, the command	11	12	Errors in section drill	8	9
Changes in data	43, 115	20, 38	Fall out, the command	14	13
Chief of section:			Field of fire	92	28
Duties:			Firing lanyard	60	24
Direct laying	97	31	Firing with reduced personnel	9	9

	Paragraph	Page
Formations	9	9
Functioning of materiel	3	3
Fuzes	68, 94	24, 29
Fuze setter:		
General	70	21
Test of	146	51
Gunner:		
Duties:		
Direct laying	105	33
General	6	6
Indirect laying		
Maintenance	152	52
Gunner's quadrant:		
Comparison test	137	49
Correction of	138	49
End-for-end test	135	49
General	134	48
Micrometer test	136	49
Identifying the target	99	31
Indicating the aiming point	17	14
Indirect laying	26	16
Inspection and maintenance	152	52
Laying for direction, indirect fire	18	14
Laying for elevation	31, 44	18, 20
Lead, direct fire	102	32
Leveling trunnions	122	43
Light, aiming post	111	35
Loader-rammer	54, 55	21
Loading tray	63	24
Maintenance:		
After operation	156	53
Before operation	158	54
During halt	165	55
During operation	154	53
General	148, 174	52, 58
Weekly	157	53
March order	23	16
Measuring elevation	35	18
Methods of boresighting	122	43
Misfires	168	56
Mount, the command	12	12
Movement of motor carriage	40	20
Panoranic telescope:		
Alinement	124	44
Test of	143	50
Parallax	129	45
Positioning weapons	15	14
Posting the section	10	11
Posts of the section:		
Dismounted	10	11
Mounted	12	12
Prepared for action	10	11
Powder charges	57, 77, 177	23, 25, 39
Prearranged fires	36	18
Precision in laying	109	35
Prepare for action	16	14
Preparing ammunition	66	24
Plumb line	122	43
Primers	61, 117	24, 39

	Paragraph	Page
Range card	91	28
Range to target, direct laying	100	31
Ready, to call	45	20
Recording data	29	17
Records:		
Maintenance	150	52
Training	176	58
References	4	3
References lines, testing target	113	38
Referring the panoranic telescope	46	21
Reporting errors	34	18
Rotation of duties	8	9
Safety, general	166, 169	56
Safety officer	170	57
Section, composition of	5	6
Section drill:		
General instructions	8	9
Objectives	7	9
Section equipment	5	6
Set, to call	51	21
Setting fuzes	69	25
Short displacements	25	16
Site to mask	22	16
Stand fast, the command	12	12
Stadia method, aiming posts	111	35
Supervision of drill	8	9
Targets, direct fire	93	28
Telescope mount M137	139	49
Terms	2	3
Tests for qualification of gunners		
Direct laying	186	61
Displacement correction	188	63
General	178	60
Indirect laying	187	62
Laying for elevation, elevation counter	190	64
Laying for elevation, gunner's quadrant	191	65
Materiel	195	67
Measuring deflection	189	64
Measuring elevation	192	65
Measuring site to mask	22, 193	16, 66
Outline of	185	61
Preparation for	183	60
Scores	184	60
Sighting and fire control equipment	194	66
Testing target	113, 119	38, 41
Testing target method of boresighting	123	43
Tools for boresighting	120	41
Training:		
General	171	57
Records	175	58
Schedule	174, 176	58
Trajectories	95	29
Time fuze	70	25
Unloading the piece	116	39
Vertical displacement	96	30
VT fuze	70	25

By Order of the Secretary of the Army:

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