National Defence / Défense nationale

B-GL-371-008/FP-001

ARTILLERY IN BATTLE

FIELD ARTILLERY

GUN DRILL, 105 mm HOWITZER, C3

(ENGLISH)

(This publication supercedes B-GL-306-011/PT-001, 1974-01-15)

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Issued on Authority of the Chief of the Land Staff

Canada

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Canada

PREFACE

GENERAL

1. This manual is written primarily for detachment commanders and instructors. The duties of the Gun Position Officer (GPO) are given in B-GL-371-004/FP-001*, Duties at Regimental Headquarters and the Gun Position*, and are not described in this manual unless a description is necessary to understand the duties of the detachment.

2. Maintenance which is part of detachment drill is described in Chapter 7. For a general description of the howitzer and ammunition, together with full details of routine maintenance and the action of all working parts, reference should be made to B-GL-371-009/Fp-001, *Field Artillery, Handbook of Equipment and Ammunition, 105 mm Howitzer*.

3. Throughout this manual, the term gun and howitzer are synonymous.

4. ①, ②, etc. are used throughout this manual to refer to specific gun detachment members, i.e. Number 1, Number 2, etc., although in a few cases this usage also refers to the guns themselves, e.g. ④ is the Number 4 Gun. In the latter case, it will be clear from the context that the reference is to the gun rather than to detachment members.

5. This publication is available electronically at http://lfdts-6a.d-kgtn.dnd.ca/ael/publications.asp?tab=370 on the Defence Information Network (DIN) or at www.army.dnd.ca/ael on the World Wide Web.

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GENERAL DUTIES

GENERAL

1. The following summary of principal duties is not a comprehensive list, but is intended as a guide to detachment commanders and instructors.

DUTIES OF ①

2. ① commands the detachment and is responsible for the entire service of the howitzer. Normally ① acts directly on the orders of the GPO, but during anti-tank engagements is responsible for fire control after the GPO has ordered "ENGAGE".

3. When gun programs are in use, ① controls the fire of the gun in accordance with the written detail of the gun program, but acts immediately on any verbal orders from the GPO.

4. ① ensures that detachment equipment is, in all respects, serviceable. Detachment members are responsible to ① for the completeness and serviceability of parts and stores which they examine at preparation for action and examination of equipment. ① reports any defects in equipment or ammunition to the GPO or Troop Leader.

5. ① ensures that the gun is, at all times, laid at the correct bearing, gun correction and elevation, and checks that fuze and charge are correct before loading.

6. ① orders the gun loaded and fired.

7. ① supervises the preparation and supply of ammunition, and reports any unserviceable ammunition to the GPO.

8. ① is responsible that the maximum protection is provided for the detachment, consistent with the efficient service of the gun.

9. During pauses in firing, ① supervises equipment maintenance, and directs clearing up salvage.

10. During firing, ① watches the action of the recoil mechanism, and corrects any faults as authorized.

11. During firing, ① ensures that the spades dig in evenly and that they are evenly supported.

12. ① arranges reliefs, and may order any member to rest if the service of the gun can be maintained without them.

13. ① is responsible for the following miscellaneous details:

a. arranging camouflage as ordered by the GPO;

b. recording details of the ammunition fired in each series; and

c. destruction of unused propellant charges on the orders of the GPO.

DUTIES OF ②

14. ② operates the breech and firing mechanism.

15. ② operates the right brake and ensures it is off before travelling.

16. ② sets the elevation and gun correction scales, and lays for elevation.

17. During prolonged periods of firing, ② cleans and lightly oils the breech and firing lock as opportunity offers.

18. ② fires the gun on order from ①.

19. ② operates the right axle lock and trail locking pin, and ensures they are correctly positioned for travelling or firing.

20. ② is responsible for clamping the cradle strut before travelling.

DUTIES OF ③

21. ③ sets the panoramic telescope at the bearing ordered, directs ④ in planting aiming posts and setting up the collimator, and lays for bearing.

22. ③ operates the left brake and ensures it is off before travelling.

23. ③ operates the left axle lock and trail locking pin, and ensures they are correctly positioned for travelling or firing.

DUTIES OF ④

24. ④ assembles and sets up the collimator.

25. ④ assembles and plants the aiming posts, when ordered.

26. ④ affixes and orients the aiming post lights.

27. During a fire mission, ④ will load, alternating with ⑤ and ⑥.

DUTIES OF ⑤

28. ⑤, assisted by ④ and ⑥, prepares ammunition and loads the gun.

DUTIES OF ⑥

29. ⑥, assisted by ④ and ⑤, prepares ammunition and loads the gun.

30. ⑥ lays the loudspeaker cable.

DUTIES OF ⑦

31. ⑦ is the detachment Second in Command (2IC).

32. ⑦ operates the fuze setters.

33. ⑦ prepares the charge and sets the fuze, if applicable, for all fire missions, as soon as the ammunition has been ordered.

34. ⑦ ensures that the ammunition is kept clean, and is protected from dampness and extremes of temperature.

CHAPTER 2
GUN DRILL

INTRODUCTION

1. **General**. For the convenience of instructors and detachment commanders, explanatory notes are given at the beginning of certain sub-sections of this, and subsequent, chapters. During training, the contents of these notes should be explained indoors, informally around the gun, before instruction in drill is given. Before beginning instruction in gun drill, the instructor should ensure that detachment members are familiar with the names of the relevant parts of the equipment, and understand how they are to be operated.

2. **Reduced Detachments**. Drill with reduced detachments should be practiced as soon as the detachments are proficient in the normal drill. In the later stages of training, drill with reduced detachments should be regarded as normal rather than exceptional.

3. **Orientation Definitions**:

   a. When the gun is hooked into the vehicle or when the gun has been unhooked, but the trail is not yet lowered to the ground, the term "front" refers to the direction in which the vehicle is pointing.

   b. When the trail is on the ground, the term "front" refers to the direction in which the muzzle is pointing.

   c. The terms “right”, “left” and “rear” are always used in relation to "front" as described in paragraph 3a.

TO FORM DETACHMENT REAR (OR FRONT)

4. **Drill**:

a. On the order "DETACHMENT REAR (FRONT)", the detachment falls in, in two ranks: ①, ③, ⑤, and ⑦ from right to left in the front rank; ②, ④ and ⑥ in the rear rank covering ③, ⑤ and ⑦ respectively, with one space between ranks. They dress by the right and stand at ease.

b. With only six members, ⑥ takes the place normally occupied by ⑦.

c. At detachment rear, when the gun is hooked to the vehicle, the front rank is three paces in rear of, and facing, the muzzle, with ① covering the right gun wheel.

d. At detachment rear, when the trails are on the ground, the front rank is one pace in rear of the lunette, with ① covering the right gun wheel. They face the breech.

e. At detachment front, when the gun is hooked to the vehicle, the front rank falls in three paces in front of the vehicle, with ① covering the right vehicle wheel. They face the direction the vehicle is pointing.

f. At detachment front, when the trails are on the ground, the front rank falls in three paces in front of the muzzle, with ① covering the right gun wheel. They face the direction the muzzle is pointing.

g. When the gun is hooked to the vehicle, the driver will fall in on his side of the vehicle in line with the door.

TO TELL OFF

5. On the order “TELL OFF”, the detachment commander numbers "one" in a clear voice, the member on the right in the rear rank numbers "two", the front rank member "three", and so on.

TO CHANGE ROUND

6. **Drill**:

a. On the order “CHANGE ROUND”, ① takes one pace to the left rear and one pace to the left. The member on the left in the rear rank takes two short paces to the front.

b. At the same time, the remainder of the front rank take two short paces to the right, and the remainder of the rear rank two short paces to the left.

c. When the detachment consists of six members, the member on the left in the rear rank takes one pace to the left and one pace to the left front.

TO MOVE THE GUN

7. **Notes**:

a. The drill described in paragraph 2 is used for moving the gun on firm level ground, e.g. in gun sheds or on parade squares. On uneven ground, manhandling drill should be employed (see Chapter 6).

b. The order “FOR GUN DRILL, PREPARE TO ADVANCE (RETIRE)” will normally be given when the detachment is in its position at detachment rear.

c. If, after the gun has been moved to the front (or rear), it is desired to move it in the opposite

direction, the order "HALT" and "PREPARE TO RETIRE (ADVANCE)" is given.

d. The order to move the gun is "WALK—MARCH". This indicates that there is no attempt to keep in step. The gun is moved by ② and ③ pushing in front, or in rear, of the shield, with ④, ⑤, ⑥, and ⑦ on the lifting handles.

e. When the gun is to be moved without the vehicle, the order "RETIRE" means that the gun is to be moved trails first, i.e. in the direction in which the trail is pointing.

f. On the order "ADVANCE", the gun will be moved muzzle first, with the trails at waist height.

8. **Drill**:

a. On the order, "FOR GUN DRILL, PREPARE TO ADVANCE", the detachment doubles to its position, ①, ③, ⑤, and ⑦ to the left of the equipment, ②, ④ and ⑥ to the right, as follows:

(1) ② and ③ take up their positions in rear of the shield;

(2) ① is positioned to best supervise the movement of the gun;

(3) ④, ⑤, ⑥, and ⑦ take up their position at the trails, the highest numbers nearest the lunette; and

(4) the detachment stands at attention facing the front, even numbers on the right and odd numbers on the left.

b. On the order "WALK", ② and ③ release the brakes, ⑦ orders "LIFT", and ④, ⑤, ⑥, and ⑦ raise the trails off the ground.

c. On the order “MARCH”, the detachment moves the gun as directed by ①.

d. On the order “HALT”, ② and ③ cautiously apply the brakes, ⑦ orders “LOWER”, and ④, ⑤, ⑥, and ⑦ lower the trails gently to the ground.

e. On the order “FOR GUN DRILL, PREPARE TO RETIRE”, the detachment acts as detailed above, except that all numbers face the rear, with ② and ③ in front of the shield.

f. On the order “PREPARE TO RETIRE”, when the detachment is facing the front, or “PREPARE TO ADVANCE”, when the detachment is facing the rear, ①, ④, ⑤, ⑥, and ⑦ turn inward about, while ② and ③ move to the required positions at the shield.

TO MOUNT AND DISMOUNT

9. **Drill**:

a. On the order “MOUNT”, the detachment doubles to the vehicle, odd numbers proceeding along the right side of the gun, even numbers along the left. The detachment mounts and sits in the vehicle facing inwards, as follows:

(1) ③, ⑤ and ⑦ sit on the right, ②, ④ and ⑤ on the left, lowest numbers nearest the tailgate; and

(2) ① sits beside the driver.

b. On the order “DISMOUNT”, the detachment dismounts and takes up its position at detachment rear.

TO CLAMP AND UNCLAMP THE CRADLE

10. **Consideration**. In order to avoid damage to the elevating and traversing gears, the cradle must always be clamped before travelling.

11. **Drill**:

a. **To Clamp the Cradle**. ② unclamps the cradle locking strut from the firing position and clamps the cradle, assisted by ③ operating the elevating and traversing gears. ② must inform ③ in which direction to move the barrel, e.g. "TRAVERSE RIGHT (LEFT)", "ELEVATE (DEPRESS"), "STEADY", "CLAMPED".

b. **To Unclamp the Cradle**. ②, assisted by ③ easing the elevating and traversing gears, releases the retaining catch of the cradle locking strut, swings it clear, and secures it in the firing position.

TO OPEN AND CLOSE THE BREECH

12. **Considerations**:

a. The breech block is held in the closed position by the retaining latch on the breech block operating lever.

b. It is held in the open position by its own weight.

c. When a round is inserted, the rim of the cartridge engages the extractor and causes the breech block to pivot on its axis, thus partially closing the breech.

13. **Drill**:

a. **To Open the Breech**. With the left hand, ② grasps the spring loaded handle of the breech

block operating lever, pushes down on the handle to release the latch, and rotates the handle to the rear, releasing the lever when the breech block has reached its stops.

b. **To Close the Breech**. With the left hand, ② grasps the spring loaded handle of the breech block operating and rotates it in a forward direction until the retaining latch is engaged.

TO PREPARE FOR ACTION

14. **Considerations**:

a. **General**:

(1) The Command Post Officer (CPO) will normally order "PREPARE FOR ACTION" shortly before the guns move into action to ensure that the equipment is, in all respects, ready.

(2) If time permits, and if the move into action is expected to be short, the CPO will normally order the quick sight test to be carried out at this time.

b. **Cover Definitions**:

(1) The Overall Cover completely covers the barrel group, recoil system, cradle, sight quadrant mounts, and traversing and elevating mechanisms.

(2) The Breech Cover covers the breech mechanism, sight quadrant mounts, and cradle.

(3) The Sight Cover covers only the panoramic telescope and mount when the gun is in action, to be used at night or in

inclement weather. It is carried in the tool box.

(4) The Quadrant Cover covers only the range quadrant when the gun is in action, to be used at night or in inclement weather. It is carried in the tool box.

15. **Drill**:

a. **Preparation**:

(1) On the order "PREPARE FOR ACTION", the detachment dismounts.

(2) ② and ③ go to the rear of the shield, ② on the left, ③ on the right. They apply the hand brakes and unlock the axle, at the same time checking the brakes and axle locks for ease of working.

(3) ④, ⑤, ⑥, and ⑦ go to the trails, odd numbers on the right, even numbers on the left, ⑥ and ⑦ nearest the lunette.

(4) ⑥ removes the cotter pin from the towing hook.

(5) ⑦ releases the catch on the towing hook of the vehicle, and orders "LIFT". The trails are lifted clear of the hook. ⑦ then signals by raising his right arm or reporting "CLEAR".

(6) ① signals (or orders) "ADVANCE", and the vehicle is advanced 5 metres and halted.

(7) ⑥ rotates the drawbar to the firing position while the trails are supported by ④, ⑤ and ⑦.

(8) ⑦ then orders “LOWER”, and the trails are lowered gently to the ground.

(9) ⑤ unlocks the trails and fits the handspike into its socket.

(10) ⑤ and ⑥ take up their positions, ⑤ on the handspike, ⑥ on the drawbar.

(11) ① orders “SPREAD”, and the trails are spread by ⑤ and ⑥.

(12) ② and ③, working at the breech, and ④ and ⑤ working at the muzzle, remove the overall cover, if still fitted.

(13) ④ folds the overall cover and places it in the vehicle.

(14) ② locks the right trail in the firing position and, assisted by ③, removes the breech cover, placing it alongside the right gun wheel. ② unclamps the cradle lock strut.

(15) ② removes the muzzle cover and places it on the right axle, and removes the elbow telescope from its case and fits it.

(16) ② uncovers the bubbles of the quadrant mount, depresses the gun and opens the breech.

(17) ③ locks the left trail in the firing position, and assists ② in removing the breech cover and unclamping the cradle lock strut.

(18) ③ fits the panoramic telescope and uncovers the mount bubbles.

b. **Examination**:

(1) ① examines the bore and recoil system, and ensures that the detachment and equipment are, in all respects, ready for action.

(2) ② examines the range quadrant and sight scale, the elbow telescope, elevating gear, and the breech and firing gear.

(3) ② sets the elevation scale to zero and the sight scale to 300.

(4) ② closes the breech after ① examines the bore, elevates or depresses the barrel to the approximate travelling position, covers the bubbles of the quadrant mount, removes the elbow telescope, fits the telescope in its case, replaces the muzzle cover, and places the breech cover on the cradle.

(5) ②, assisted by ③, clamps the cradle lock strut in the travelling position, and replaces the breech cover. ② then removes the right trail locking pin from the firing position and inserts it in the travelling position.

(6) ③ examines the panoramic telescope and mount, sets the main scale micrometer and gunner's aid to zero, replaces the panoramic telescope, and leaves the telescope mount upright.

(7) ③ examines the traversing gear and traverses the gun to the approximate travelling position.

(8) ③ assists ② in clamping the cradle lock strut and replacing the breech cover. ③

then removes the left trail locking pin from the firing position and inserts it in the travelling position.

(9) ④ obtains the breech cover from ⑦ and place it by the right wheel, and examines the aiming posts, aiming post lights, the right wheel and tire, and the collimator.

NOTE

To avoid damage to aiming posts when replacing them on the gun, the posts must be positioned properly in the canvas cover, and placed in the brackets with the cover flap outward and towards the front.

(10) ⑤ examines the staff sections, and the left wheel and tire.

(11) ⑦, assisted by ⑥, examines the stores and sorts the ammunition.

c. **Assembly**:

(1) ⑤ is on the handspike, ⑥ the drawbar.

(2) ① orders "CLOSE", and the trails are closed.

(3) ⑤ locks the trails in the travelling position and replaces the handspike on the left trail.

(4) ② and ③ lock the axle locks in the travelling position.

d. **Hooking In**:

(1) On completion of their tasks, the detachment takes up position as follows:

① where he can see the detachment and direct the vehicle into the required position; ② and ③ kneeling beside the gun wheels, facing the rear, ② on the right, ③ on the left; and ④, ⑤, ⑥, and ⑦ kneeling at the rear of the trails and facing the rear, in line with the lunette (odd numbers on the left, even numbers on the right, highest numbers nearest the lunette).

(2) ① directs the vehicle into the required position, and orders "HOOK IN".

(3) ⑦ orders "LIFT". ④, ⑤, ⑥, and ⑦ lift the trails.

(4) ⑥ rotates the drawbar to the travelling position.

(5) ② and ③ release the brakes and push on the shield as necessary, and the gun is hooked in.

(6) ⑦ locks the catch on the towing hook of the vehicle.

(7) ⑥ fits the cotter pin.

(8) The detachment then takes up its position at detachment rear, ① calls for reports, then doubles to the CPO and reports any deficiencies and the ammunition state.

TO COME INTO ACTION

16. **Considerations**:

a. When the guns are brought into action, the order or signal "ACTION" will be given as the guns approach the selected position. Each gun platform

will normally be marked by a flag or marker, and ① brings the gun into action with the telescope mount directly over the marker. When positions are not marked, the responsibility for choosing the platform rests with ①.

b. If the position is to be occupied by the independent method, the guns will be halted under cover close to the gun position, and ① (and possibly ③) will be taken to the gun position. ① will be shown the platform and will reconnoitre the route to it. ① will then lead the gun into action as ordered by the Gun Position Officer (GPO).

c. Although equipment is designed to withstand hard use under service conditions, careful work by the driver and detachment can greatly reduce the risk of damage without loss of efficiency.

CAUTION

To reduce risk of an accident, no-one will walk backwards when moving the trails.

d. If the ground is difficult, the GPO/CPO will order "NUMBER ___. DOUBLE-MAN NUMBER". Any ① may, at any time, order his detachment to assist another detachment.

e. The signals shown in Figure 2-1 are used by the GPO/CPO and ① for controlling the movement of vehicles when coming into and out of action. Voice control is the simplest method at night.

Ser	Order	Signal
1	"ACTION"	The hands are clenched and the arms extended straight to the front of the body, facing the required bearing of fire.
2	"HALT"	Either arm is raised vertically above the head.
3	"ADVANCE"	① faces the driver, extends the right arm to the front of the body, and brings the hand upwards and towards the face, bending the arm at the elbow.
4	"REVERSE"	① places both arms in front of the body with elbows bent, with palms upright and towards the driver. ① moves the forearms backward and forward as long as the reverse movement is required.
4	CHANGE DIRECTION.	① extends one arm, with the fist clenched, in line with the shoulder, in the direction in which the vehicle is to move.

Figure 2-1: Signals for Controlling Vehicle Movement

17. **Drill**:

a. **The Approach**:

(1) Having received the order or signal "ACTION", ① dismounts on approaching the gun platform. ① stands where he can see when the gun is in the required position, and can signal the driver that the gun has been unhooked. ①'s position will normally be to the right front of the towing vehicle.

(2) When the gun is in the required position, ① signals or orders "HALT" to the driver and orders "ACTION ___".

(3) The detachment dismounts.

b. **Unhooking**:

(1) ② and ③ go to the rear of the shield, ② on the left and ③ on the right. They apply the handbrakes, unlock the axle, and lock the axle locks in the firing position.

(2) ④, ⑤, ⑥, and ⑦ go to the trails, odd numbers on the right, even numbers on the left, ⑥ and ⑦ nearest the lunette.

(3) ⑥ removes the cotter pin from the towing hook, ⑦ releases the towing hook and orders "LIFT". The trails are lifted clear of the hook. ⑦ then signals by raising his right arm, or reporting "CLEAR".

(4) ① signals "ADVANCE". The vehicle is advanced 5 metres and halted.

(5) ⑥ rotates the drawbar to the firing position while the trails are supported by ④, ⑤ and ⑥.

(6) At ACTION REAR, ⑦ orders "LOWER", and the trails are lowered gently to the ground.

(7) At ACTION RIGHT (LEFT, FRONT), ① orders "TRAILS RIGHT (LEFT)", ④ and ⑥ (or ⑤ and ⑦) move around the drawbar to avoid walking backwards, and the trails are moved in the direction ordered. ② and ③ operate the handbrakes as required. When the gun is pointing in the direction ordered, ① orders "HALT, LOWER", and the trails are lowered gently to the ground.

c. **Positioning**:

(1) ⑤ unlocks the trails and fits the handspike into its socket.

(2) ⑤ and ⑥ take up their positions, ⑤ on the handspike and ⑥ on the drawbar. ① orders “SPREAD”, and ⑤ and ⑥ spread the trails.

(3) ② locks the right trail in the firing position and, assisted by ③, removes and places the breech cover by the right gun wheel, and unclamps the cradle. ② removes the muzzle cover and places it on the right axle; opens the breech, ensures that the sight scale is set to 300 and the elevation scale to zero; and uncovers and levels the bubbles.

(4) ③ locks the left trail in the firing position, and assists ② in removing the breech cover and unclamping the cradle lock strut. ③ fits the panoramic telescope; ensures that the main scale, micrometer and gunner's aid are set to zero; and uncovers and levels the bubbles.

d. **Positioning Stores and Ammunition**:

(1) ④ and ⑤ remove the tool chest from the vehicle and place it 5 metres in rear of the left trail.

(2) ⑥ and ⑦ unload the stores and ammunition from the vehicle and place them in a convenient position in rear of the left trail.

(3) ① signals the vehicle to “DRIVE ON”, and the vehicle proceeds to the vehicle

area under the supervision of the Troop Sergeant Major (TSM).

(4) ⑥ lays the loudspeaker cable, and takes the gun marker to the command post (CP). ① connects the cable to the speaker.

(5) ① sets the respirator to achieve the correct buffer action during firing. Normal settings are: travelling and washing—0; low angle fire—0 or 1; and high angle fire—2 or 3.

(6) ④ prepares the collimator and aiming posts.

e. **Considerations**:

(1) On the completion of its tasks, the detachment takes up its position in action.

(2) When guns are to be fired at high angle, recoil pits, at least 30 cm (12 inches) deep, will be prepared. After the gun is in the firing position, it will be elevated to maximum elevation, and a recoil pit, which will ensure sufficient clearance throughout the limits of traverse, will be dug. The pit should be covered with planking or filled with sandbags when engaged in low angle fire to facilitate the loading of equipment.

POSITIONS IN ACTION

18. **Drill**:

a. ① kneels in a position to best supervise the work of the detachment, usually in rear of, and close to, the right trail.

b. ② stands to the right of the breech, close to and facing it, outside the trail.

c. ③ stands on the left of the gun, facing the front, and outside the trail.

d. ④, ⑤, ⑥, and ⑦ kneel 5 metres in rear of the left trail, and to the right of the tool box, ⑦ nearest the tool box.

e. The detachment stands as required to perform its duties.

PASSAGE OF ORDERS

19. **Considerations**:

a. The guns in action are numbered ①, ②, ③, etc. from right to left as viewed from the rear. In case of doubt, due to dispersed siting, the GPO will allot numbers. In all cases, these numbers stand throughout the action, regardless of the bearing in which the guns are laid.

b. Orders will normally be passed and acknowledged through the loudspeaker system. If this fails, orders will be passed by voice and acknowledged as follows:

(1) ①s that are visible from the CP shall raise one hand vertically above the head; and

(2) ①s that are not visible from the CP shall report "NUMBER" ____ in succession from the right.

c. When orders are being passed by voice, each ① will look towards the next ① on the side away from the CP, and will read back any orders which are not immediately acknowledged. If ① still fails

to acknowledge, the order will be read back by the GPO.

d. Repetition of an order will be requested, or attention will be called to omissions or obvious verbal errors, by use of "VERIFY _____," e.g. "VERIFY BEARING".

e. ① will read back orders affecting the detachment, in a voice no louder than is necessary, only when the order has not been heard by the members concerned or when specially detailed in this manual.

f. Reports from ① to the GPO will be acknowledged by the GPO raising one hand vertically above the head, or by ordering "DOWN (NUMBER OF GUN(S))".

g. Orders from the GPO always take precedence over reports from ①.

TO DIRECT THE MOVEMENT OF THE TRAILS

NOTE

Figure 2-2 shows the signals used for directing the movement of the trails.

Ser	Order	Signal	Action
1	"TRAILS RIGHT (LEFT)"	Arm extended towards the rear; palm of the hand turned in the direction required.	⑤ and ⑥ move trails in the direction indicated until the HALT signal is given.
2	"HALT"	Fist clenched.	⑤ and ⑥ stop the movement and remain at the trails.
3	"TAKE POST"	Sharp tap on the buttock with the palm of the hand.	⑤ and ⑥ steady the trails until the brakes have been applied, then take up positions in action.

Figure 2-2: Signals for Directing Movement of the Trails

TO MOVE THE TRAILS

20. **Considerations**:

a. When the gun is first laid in the centre of arc (C of A), the traversing gear should be approximately central. Thereafter it should not be necessary to move the trails unless the traverse becomes expended.

b. When ① considers that the movement of the trails is necessary, he will order "TAKE POST TO LAY". If the trails are embedded, ① must first order "RUN UP".

c. Due to uneven ground or the gun being on a slope, it may be necessary to brake one wheel, e.g. if the trails are to be moved right, ① may order "LEFT BRAKE ON: TRAILS RIGHT".

21. **Drill**:

a. On the order "TAKE POST TO LAY", ③ centres the traverse, if necessary.

b. ② and ③ release the handbrakes.

c. ⑤ and ⑥ take up their positions on the handspike and drawbar, respectively.

d. On the signal or order "TRAILS RIGHT (LEFT)", ⑤ and ⑥ move the trails in the required direction.

e. On the signal or order "TAKE POST", ② and ③ apply the handbrakes. The then takes up its position in action.

TO RUN UP

22. **Considerations**:

a. The following drill is used for clearing the spades, either at coming out of action, or when the limits of traverse have been exceeded and the equipment must be re-laid in a bearing beyond the limits of the traversing handwheel.

b. If the gun is loaded, ① must order "MAKE SAFE" before ordering "RUN UP".

c. If the ground is difficult, the GPO, section commander, or ① may order "DOUBLE MAN NUMBER ___".

23. **Drill**:

a. On the order "RUN UP", ③ brings the traverse to centre.

b. ② and ③ release the handbrakes.

c. ② and ③ take up positions beside the right and left wheels respectively, and push on the shield.

d. ④ and ⑥ on the drawbar, and ⑤ and ⑦ on the handspike, heave upwards and forwards.

e. ① coordinates their efforts by ordering "TOGETHER: HEAVE".

f. ① orders "TAKE POST TO LAY" or "CEASE FIRING", as applicable, when the spades are clear.

g. ② and ③ apply the brakes if "CEASE FIRING" has been ordered.

TO LAY IN THE CENTRE OF ARC

24. **Considerations**:

a. During training, before detailing the drill of this and subsequent sections, the instructor will ensure that members who are to perform the duties of ①, ② and ③ are familiar with the drill for sight setting and laying as detailed in Chapter 4.

b. The GPO ensures that the original bearing to all guns is in the direction ordered. This direction, from which all subsequent bearings are measured, is known as the C of A.

c. When the individual angle method is to be used, and if the passage of orders by voice is likely to be difficult, the GPO will either:

(1) order runners to be sent from each detachment to the director (the drill as described previously, except that all orders and reports will be written and ① will not call back angles to the GPO); or

(2) pass the angles to the guns through the loudspeaker system (the drill as described previously, ① calling the angles back to the GPO through the loudspeaker).

d. When the individual angle method is being used, and if time permits, the GPO will read back the measurement of the angle to each panoramic telescope once ① has reported "NUMBER FINISHED WITH DIRECTOR". This repetition will eliminate errors due to the movement of the panoramic telescope during laying. If the GPO finds that the original angle remains correct, he will order "NUMBER ___: RECORD AT ___". If a new angle is required, the GPO will order this angle, and the drill as described previously will be repeated.

25. **Drill**:

a. **Individual Angle Method**:

(1) On the order from the GPO "AIMING POINT DIRECTOR. NUMBER ___" (angle in mils), ① reads back to the GPO the angle ordered. If the repetition is incorrect, the GPO orders the correct angle again; if the repetition is correct, the GPO will acknowledge.

(2) ③ sets the angle ordered on the main scale of the panoramic telescope.

(3) ① checks the setting and orders "TAKE POST TO LAY".

(4) ③ directs the movement of the trails until the gun is roughly laid in its bearing.

(5) On the signal or order "TAKE POST", the drill is carried out; ③ lays on the director, reports "ON", and ① checks lay.

(6) When laid, ① reports to the GPO "NUMBER ___: FINISHED WITH DIRECTOR".

b. **During a Night Occupation** (when aiming posts are already planted):

(1) Having received the angle to the aiming posts from the GPO, ③ sets the angle ordered on the main scale of the panoramic telescope.

(2) ① checks the setting and orders “TAKE POST TO LAY”.

(3) ③ directs the movement of the trails until the gun is laid roughly in its bearing.

(4) On the signal or order “TAKE POST”, the drill is carried out.

(5) ③ lays on the aiming posts making due allowance for displacement.

(6) When the gun is laid, ① immediately records C of A.

c. **During a Night Occupation** (when aiming posts have not been planted):

(1) Having received the first angle to the director from the GPO, ③ sets it on the main scale of the panoramic telescope.

(2) ① checks the setting and orders “TAKE POST TO LAY”.

(3) ③ directs the movement of the trails until the gun is laid roughly in its bearing.

(4) On the signal or order “TAKE POST”, the drill is carried out.

(5) ③ lays on the director, reports “ON”, ① checks lay and, if necessary, illuminates

the panoramic telescope by means of a flashlight shining through the eyepiece.

(6) When the gun is laid, ① reports to the CP through the loudspeaker, "NUMBER ___: FINISHED WITH DIRECTOR".

d. **Aiming Point Method**:

(1) On the order from the GPO, "AIMING POINT", ① doubles to the GPO, ascertains the aiming point, and then doubles back to the gun.

(2) The GPO orders the angle to the aiming point and ③ sets it on the main scale of the panoramic telescope.

(3) ① checks the setting and orders "TAKE POST TO LAY". ① directs the movement of the trails until the gun is laid roughly in its bearing.

(4) On the signal or order "TAKE POST", the drill is carried out.

(5) ① lays on the aiming point.

e. **Passing Parallel Line**. Passing and receiving parallel line from one gun to another is used when a gun cannot see the director or vice versa. The drill involves passing an angle from a gun that has been laid in the C of A to a gun which could not observe or be observed from the director.

(1) The GPO will order "NUMBER____, PASS PARALLEL LINE TO NUMBER _____".

(2) ① orders ③ to turn the head of the panoramic telescope onto the telescope of the receiving gun.

(3) ① checks the lay, opens the index door, notes the reading on the main scale and orders ③ to read.

(4) ③ reads aloud the main scale reading and if they agree, ① adds or subtracts 3200 mils from the reading and passes the resulting angle to the receiving gun, e.g. "NUMBER FOUR LAY ON NUMBER ONE AT 3245".

(5) The ① of the receiving gun will read back the angle and lay the gun in the C of A.

TO RECORD CENTRE OF ARC

26. **Considerations**:

a. The GPO will order the original bearing to be recorded as C of A. Three independent records will be made as follows:

(1) a record of the main scale reading to Gun Aiming Point (GAP) 1;

(2) a record of the main scale reading to GAP 2; and

(3) a record of the bearing of the C of A ordered by the GPO.

b. ① will select GAPs in the following priority:

(1) by day: collimator, aiming posts, close GAP, and distant GAP; and

(2) by night: collimator, aiming posts with TRI-LUX lights, and night picket.

c. As soon as all three records have been completed, ① will report to the GPO “NUMBER _____ RECORDED”.

d. If fire orders are received before the C of A has been recorded, the GPO will normally order "DEFER SECOND RECORD". ① will then report “NUMBER ___ RECORDED”, as soon as the detail of sub-subparagraphs a(1) and a(3) have been completed and checked. When the record described in sub-subparagraph a(2) has been deferred in this way, ① will complete this record at the earliest opportunity without further orders from the GPO.

e. After the C of A has been recorded, ① will direct planting a marker in the C of A in front of the gun. This marker will be used as an aid in measuring bearings, and as a means of checking that the gun is at all times laid at the correct bearing. ① will point out GAPs 1 and 2 and the C of A marker to all detachment members.

f. The records of the C of A will stand until cancelled by a subsequent order from the GPO, e.g. “RECORD AT ___”.

g. The original bearing in which the guns are laid may be altered by the GPO by ordering a fresh bearing, e.g. “BEARING ___: RECORD AT ___”. On the latter order, ③ will lay on the GAP at the bearing ordered. The C of A marker will be moved to correctly reflect the bearing C of A in which all guns are recorded.

h. In both cases ① will order previous records erased, and the drill as described above will be carried out with the gun laid in the new C of A ordered.

i. During the laying of the gun in the C of A, and the recording of C of A, both the longitudinal and cross level bubbles of the telescope mount must be

central, and the gunner's aid must be at zero. The setting of the elevating knob of the panoramic telescope and the elevation of the gun does not affect the accuracy of this drill.

j. Under no circumstances will ① amend the C of A record without orders from the GPO. Should it be obvious to ① that the C of A record is wrong, ① will report the fact to the GPO, who will arrange for a check, and order a new record made.

27. **Drill for Recording C of A**:

a. On the order "RECORD AT ___", ① turns the panoramic telescope onto the selected GAP 1.

b. ③ records the ordered bearing on the record plate.

c. ① orders "LOOK: READ".

d. ③ identifies GAP 1 by looking through and over the telescope, reads the main scale, and records the reading on the record plate.

e. While ③ is recording this angle, ① ensures that the gunner's aid is set to 0, slips the slipping scale to the bearing ordered, and checks that the telescope is still laid on GAP 1. ① then reads the main scale, checks ③'s record, and turns the telescope onto the selected GAP 2.

f. ① orders "LOOK: READ".

g. ③ identifies GAP 2 by looking through and over the telescope, reads the main scale, and records the reading on the record plate.

h. ① reads the main scale, and checks ③'s record.

i. ① orders GAP 1.

j. ③ turns the panoramic telescope onto GAP 1. ③ reports the main scale reading, closes the index door, and reports the bearing on the slipping scale. ① ensures that these readings agree with the records on the record plate; if they do not ① takes the necessary steps to correct them, and then reports to the GPO "NUMBER _____ RECORDED".

TO RECORD CENTRE OF ARC AT NIGHT

NOTE

For laying by night see appropriate heading.

TO PLANT AIMING POSTS

28. **Considerations**:

a. To reduce the danger of aiming posts becoming obscured by the muzzle, they should be planted to the left front or right rear of the gun.

b. ① will order "AIMING POSTS FRONT (OR REAR)".

c. To reduce risk of confusion, aiming posts should be planted alternately to the left front and right rear of the guns.

d. When aiming posts are to be planted, ① should indicate to ④ where the near post will be planted. The distance from the gun to the near post should be approximately 50 metres; however, the distance from the gun to the near post should equal that from the near post to the far post, regardless of distance.

e. Radiation Safety. See Annex I regarding hazards from instruments such as TRI-LUX lights which have radioactive light sources.

29. **Signals**. Figure 2-3 shows the signals used by ③, their meanings, and the action to be taken by ④.

Ser	Order and Signal	Action by ④
1	"MOVE IN THE DIRECTION INDICATED". The right arm is extended upwards to the right, or the left arm extended upwards to the left, the palm of the hand in the direction required.	④ holds the post upright, clear of the body, and moves in the direction indicated, continuing until the "HALT".
2	"HALT". Arm dropped.	④ halts and allows the post to slip through the fingers until the point rests on the ground.
3	"PLANT". Both arms dropped from above the head.	④ presses the point firmly into the ground, ensures that the post is upright, and then steps clear.
4	"MOVE TOP OF POST IN DIRECTION INDICATED". Both arms extended above the head and moved laterally in the direction required.	④ moves the top of the post in the direction indicated, continuing until the "HALT" signal is given. ④ ensures that the post is firmly planted and then steps clear.
5	"PICK UP". Both arms extended to the front and raised upwards.	④ pulls the post out of the ground and awaits further signals.
6	"COME IN". Body turned in the direction required. Both arms extended above the head and lowered in the direction required.	When at the far post, ④ doubles to the near post; when at the near post, ④ doubles back to his position in action.

Figure 2-3: Signals Used by ③ for Planting Aiming Posts

30. **Drill**:

a. On the order "RECORD AT ___" ① will order "AIMING POSTS FRONT (REAR)". ④ obtains the aiming posts and doubles to a position about 50 metres in front (or rear) of the gun as indicated by ①, and, as closely as can be judged, in the line indicated. ④ plants the first aiming post, then doubles a further equal distance with the second post, and lines it up with the panoramic telescope and near aiming post.

b. ④ faces the gun and awaits further instructions from ③. As soon as ④ has planted the near aiming post, ③ turns the panoramic telescope accurately onto it. ③ then directs the planting of the far post exactly in line with the near one.

c. ③ signals ④ to come in to the near post, to straighten it if necessary, and then signals ④ to come in.

d. ① checks the alignment and ensures that the gunner's aid is set to zero.

e. ③ and ① then complete the drill for recording C of A, using the aiming posts.

TO PLANT AIMING POSTS DURING A NIGHT OCCUPATION

31. **Considerations**:

a. During a night occupation, the C of A is recorded by:

(1) collimator;

(2) two aiming posts with TRI-LUX lights; and

(3) night picket.

b. The GPO orders the C of A to be recorded by ordering "RECORD AT ___".

c. To reduce the possibility of confusion, guns should alternate the color arrangement of lights on their posts.

d. The light on the far post should be adjusted to appear above the light on the near post. To accomplish this, it may be necessary to remove the top section of the near post.

32. **Drill**. On the order "RECORD AT ___":

a. ④ obtains the aiming posts and proceeds to a point 50 metres to the front/rear of the gun as directed by ①. ④ plants the first aiming post, fits the appropriate light, and turns the light so that it is facing the gun.

b. ③ lays the graticule of the panoramic telescope on the light of the first post and, as a signal to ④, momentarily turns the panoramic telescope light OFF.

c. On this signal, ④ turns the light through 3200 mils and proceeds a further distance equal to the first interval. ④ lines up the second post with the light on the near post and the light in the panoramic telescope. ④ then fits the other light, ensures that it is facing the gun, and returns to the near post, rotating the light on the near post so that it is facing the gun.

d. ① checks the alignment and ensures that the gunner's aid is set to zero.

e. ① and ③ then complete the drill for recording C of A.

TO CHECK BEARING

33. **Considerations**:

a. The aim of the following drill is to ensure that the gun is parallel to the director.

b. The drill should be carried out:

(1) as soon as possible after the C of A has been recorded;

(2) as soon as possible after the spades are embedded by firing;

(3) before the beginning of a fire plan;

(4) at least once daily;

(5) at first light following a night occupation; and

(6) when an error in bearing has occurred which cannot otherwise be detected.

c. The drill is accomplished by checking the guns at the nearest 100 mils to the current bearing. It is carried out by the GPO using the director.

34. **Drill**:

a. On the order "CHECK BEARING. AIMING POINT DIRECTOR. CANCEL CONVERGE. BEARING ___" (to the nearest 100 mils), ③ sets the gunner's aids to zero, sets the bearing and lays on the GAP in use. ① checks and ③ turns the panoramic telescope onto the director.

b. ① checks the lay and notes the reading on the main scale and micrometer.

c. ① orders "READ". ③ reads the main scale and micrometer, and reports to ① as a check.

d. On the order "NUMBER _____", (gun) ① reports the reading "NUMBER ___, _____", (angle read) and the GPO reads back the angle.

e. If the repetition is correct, ① acknowledges. If the repetition is incorrect, ① reports the angle again.

f. When the angle reported by ① is correct the GPO orders "NUMBER _____ CORRECT".

g. ① will order ③ to lay on GAP 1.

h. When the angle reported by ① is incorrect:

(1) the GPO orders "NUMBER ___, (gun)", (new angle). This new angle will cause the guns to be laid correctly in the current bearing of fire;

(2) ① reads back the angle to the GPO, and if the repetition is correct the GPO orders "NUMBER (gun)__, RECORD AT _____" (current bearing);

(3) at the conclusion of the check, the GPO will give the necessary orders for relaying the guns on the last target or the Final Protective Fire (FPF) task as applicable; and

(4) the C of A marker will not be moved unless a new C of A has been ordered for all guns.

TO MEASURE THE ANGLE OF SIGHT TO A CREST

35. **Consideration**. Immediately after the guns are in action, the GPO may require reports on the vertical angle from each gun to any crest visible from the gun position.

36. **Drill**:

a. On the order "MEASURE ANGLE TO CREST", ① assisted by ② and ③ will lay on the crest indicated by sighting along the bottom of the bore.

b. ② then sets the sight scale to 300 mils, cross levels, and, by means of the elevation knob, brings the longitudinal bubble into the centre of its run.

c. ① reads the angle on the elevation scale and reports to the GPO "NUMBER (gun) ANGLE TO CREST ___".

TO LOAD

37. **Considerations**:

a. **General**:

(1) The gun will not be loaded without the order "LOAD" from ①, except when engaging tanks (see Chapter 3).

(2) When a cartridge only is to be loaded, ① will order "CARTRIDGE ONLY: LOAD".

b. **Rules**. ① will observe the following rules of fire discipline in deciding when to order "LOAD":

(1) Rules applicable when impact fuzes have been ordered:

(a) A gun is initially loaded as soon as a method of adjustment or method of fire for effect (FFE) has been ordered for that gun.

(b) In adjustment, only the guns ordered to ADJUST FIRE are loaded.

(c) Throughout adjustment, the adjusting gun(s) will be reloaded on receipt of an elevation or the order LOAD from the GPO.

(d) Guns will not be loaded sooner than is necessary to maintain the rate of fire ordered. After an order for FFE has been carried out, guns will not be reloaded until the GPO orders a new method of adjustment or FFE.

(2) Rules applicable when time or CVT fuzes have been ordered:

(a) No gun will be initially loaded until a method of adjustment or orders for FFE have been ordered for that gun, together with a fuze setting.

(b) Once having loaded, guns will be reloaded as follows: during adjustment the adjusting gun(s) will be reloaded immediately after the fuze setting and elevation for each succeeding round have been ordered.

(c) During FFE the guns will not be reloaded sooner than is

necessary to maintain the rate of fire ordered.

(3) Rules applicable when time fuzes have been ordered:

(a) When the order "FUZE, M__, IMPACT" is received, the rules for impact fuzes are followed, fuzes being set to safe.

(b) When the order "TIME" is given, the rules for time fuzes are followed, fuzes being set to burst in the air.

c. **Ammunition**:

(1) The preparation of ammunition is described in B-GL-371-009/FP-001, *Field Artillery, Handbook of Equipment and Ammunition, 105 mm Howitzer*.

(2) Throughout a fire mission, unless a specific number of rounds have been ordered, six ready rounds will be available.

(3) When time fuzes are ordered, fuzes will be set only on those rounds which are included in the method of adjustment or method of FFE, as follows:

(a) fuzes are set by ⑦;

(b) ① checks the setting of every round before it is loaded, and when ammunition has been prepared in advance, ① ensures that the round is taken from the correct stack.

(4) Except when engaging tanks the procedure is as follows:

(a) ① checks every cartridge before it is loaded by receiving the excluded charges from the loading number to ensure that the proper bags are enclosed;

(b) ① periodically checks the bore for residue and deposit on the chamber wall, and orders it cleaned when necessary.

(5) ① should ensure that the gun is not left loaded while the gun is hot. If orders are received which will result in this ① reports "NUMBER (gun) LOADED: GUN HOT". (A gun is considered hot when it is painful to touch the barrel.)

(6) As soon as the ammunition is ordered, ⑦ prepares the rounds for loading.

(7) Fuzes are not set until the method of adjustment or FFE for that gun has been ordered.

(8) ⑦ sets CVT, time and impact fuzes to the setting ordered.

(9) ⑦ adjusts the charge to the charge ordered.

(10) ④, ⑤ and ⑥ load the gun on the orders of ①.

(11) If difficulty is experienced in closing the breech after the cartridge has been loaded, the loading number obtains the extracting and ramming tool, and endeavours to

force the cartridge home. Should this fail, ① orders "UNLOAD".

(12) On no account will an attempt be made to drive the cartridge home.

(13) If a gun is loaded with other than the type of ammunition ordered, ① will so report, e.g. "NUMBER (gun) LOADED WP". The GPO orders "UNLOAD", or issues orders as to the disposal of the wrong ammunition.

38. **Drill**:

a. **Loading Drill with Impact Fuzes**:

(1) When the ammunition is ordered, ⑦ prepares rounds for the charge ordered.

(2) ④, alternating with ⑤ and ⑥, carries a prepared round and excluded charges to the gun to be loaded. The loading number takes up the loading position beside the left trail, halfway between the spade and breech, facing the breech, and clear of recoil.

(3) At the appropriate moment ① orders "LOAD".

(4) The loading number hands the excluded charges to ① and calls out "CHARGE ____." ① checks the fuze setting.

(5) ① orders "CORRECT" if the round is correct. ① holds the excluded charge bags for that round until the round is fired, and then throws the bags over the right trail.

(6) ① orders "WRONG: CHARGE __" if the charge is incorrect, and the next loading number brings a correct round forward. The incorrect round is returned to ⑦ for correction.

(7) The loading number, holding the round in the hollow of the left arm, inserts the nose of the projectile into the breech. With the right hand clenched and positioned at the base of the cartridge, the loading number pushes the round home.

(8) ② closes the breech with the left hand.

b. **Loading Drill with CVT or Time Fuzes**:

(1) ① checks the fuze setting of the projectile and reports "CORRECT" or "WRONG: FUZE ___". If the fuze setting is not correct, the next loading number brings a correct round forward, and the incorrect round is returned to ⑦ for correction.

(2) ① orders "LOAD" and the gun is loaded.

TO UNLOAD

39. **Considerations**:

a. When a change of charge, or END OF MISSION is ordered after the gun has been loaded, ① orders "CARTRIDGE ONLY, UNLOAD".

b. In the case of a change of charge, ① then orders "CARTRIDGE ONLY, LOAD", unless the complete round has been extracted, when ① orders "LOAD".

c. If, on extraction, the projectile remains in the bore and "END OF MISSION" has been ordered, ①

orders waste to be stuffed into the chamber and the breech closed.

d. When "MISFIRE" is reported, the drill for misfires must be followed. A projectile must not be left in the bore when the gun is hot.

40. **Drill**:

a. **For Unloading the Cartridge Only**:

(1) On the order from ① "CARTRIDGE ONLY, UNLOAD", ② opens the breech, taking care not to eject the cartridge violently.

(2) A loading number receives the round, or cartridge, and returns it to ⑦.

(3) If the cartridge only is ejected, ① checks that the complete cartridge has been removed and orders "CHARGE _____ CARTRIDGE ONLY, LOAD".

(4) In the case of "END OF MISSION", and the projectile remains in the bore, ① orders waste stuffed into the breech. ② closes the breech.

b. **For Unloading the Complete Round**:

(1) On the order from ① "UNLOAD", ② opens the breech taking care not to eject the cartridge violently. A loading number receives the round (or cartridge) and returns it to ⑦. If the projectile remains in the bore, ② depresses the gun to the horizontal.

(2) Waste is stuffed into the chamber and the breech is closed. ⑤ assembles the rammer and staff, ① inserts the assembly

into the barrel until the cup encloses the fuze or until it comes in contact with the projectile. ①, assisted by ⑤, pushes and, if necessary, taps the assembly lightly until the projectile is dislodged. A loading number receives the projectile and returns it to ⑦.

TO LAY

41. **Considerations**:

a. The detailed drill for sight setting is given in Chapter 4, which describes detachment duties for each of the different methods of laying.

b. Indirect laying with the range quadrant is the normal method and is used unless otherwise ordered.

c. The complete orders and action for laying the gun for the first round of a fire mission are given in Figure 2-5. For subsequent rounds, only a few of these orders will be necessary.

d. When the trails are embedded, they should not be moved if the target is within the scope of the top traverse.

e. ① ensures that the gun is always laid at the correct bearing and elevation. As a rough check ① therefore measures all bearings from the C of A marker by extending the arm to its full length and, using the hand, measuring angles (see Figure 2-4).

f. ② reports the actual setting of the sight and elevation scales, whenever the settings are changed, by reporting "GUN CORRECTION (OR ELEVATION) ___".

g. ① examines the setting of the panoramic telescope, elevation scale, and sight scale whenever he considers it necessary.

h. ① determines the exact settings, or alternatives to settings, to be applied to the sights in all cases when these settings are not ordered by the GPO, e.g.:

(1) **Elevations**. When laying with the range quadrant, ② applies the gun correction to the sight scale and the elevation to the range quadrant scale. When laying with the gunner's quadrant, ① applies the correction for index error to the elevation ordered and sets the resulting elevation on the gunner's quadrant.

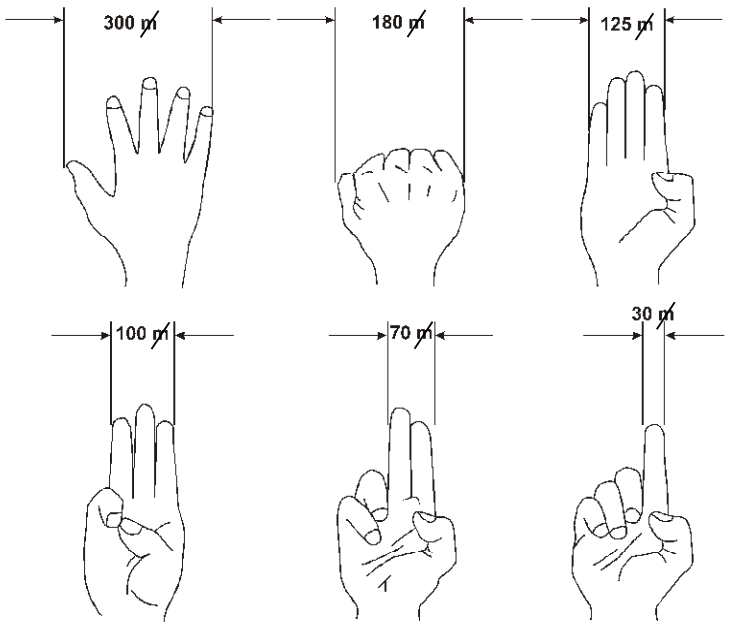


Figure 2-4: Approximate Angular Values for an Average Hand

(2) **Fuze Setting**. ① applies the fuze correction to all subsequent fuze settings, and orders the exact fuze setting to ⑦.

i. When the gun is not loaded until ② and ③ have completed the lay, they will relay.

42. **Drill**:

a. **Normal Indirect Laying**. For normal indirect laying sequence see Figure 2-5.

Ser	Order	Action
1	"CONVERGE"	③ moves the gunner's aid the number of mils ordered.
2	"BEARING"	③ sets the bearing ordered on the panoramic telescope and lays for bearing. ① checks the bearing by measuring from the C of A.
3	"GUN CORRECTION"	② sets the angle ordered on the sight scale and reads back the actual setting on the scale: "GUN CORRECTION _____".
4	"ELEVATION"	② sets the elevation ordered on the elevation scale and reads the setting: "GUN CORRECTION _____". ② lays for elevation. ③ lays for bearing when all apparent motion of the gun has ceased, and reports "ON". ② makes final adjustments and reports "READY".

Figure 2-5: Normal Indirect Laying Sequence

b. **Indirect Laying Using the Gunner's Quadrant**. For indirect laying sequence using the gunner's quadrant see Figure 2-6.

Ser	Order	Action
1	“CONVERGE _____”	③ moves the gunner's aid the number of mils ordered.
2	“BEARING _____”	③ sets the bearing on the panoramic telescope and lays for bearing. ① measures the bearing using the C of A marker.
3	“QUADRANT LAYING _____”	① obtains the gunner's quadrant. ② cleans the breech levelling plate.
4	“ELEVATION _____”	① applies the correction for index error to the elevation ordered and sets in on the gunner's quadrant. ① then hands the quadrant to ②. ② reads the setting to ① and hands it back. ① holds the quadrant on the breech levelling plates with the words "line of fire" at the bottom and the arrow pointing towards the muzzle. ② lays for elevation. ③ lays for bearing and when all apparent motion of the gun has ceased, reports “ON”. ② makes final adjustments and reports “READY”. ① removes the quadrant from the breech.

Figure 2-6: Indirect Laying Sequence Using the Gunner's Quadrant

c. **Open Action**. This type of laying may be carried out using either the normal two-man, two-sight method or the one-man lay method. The differences are described below:

(1) Two-Man, Two-Sight Method. ③ lays for bearing and ② lays for elevation in the normal indirect manner (see Figure 2-7).

(2) One-man Lay Method. ③ lays for both bearing and range (see Figure 2-8).

d. **Anti-tank Drill** (Two-man, Two-sight Method). ③ lays for bearing and ② lays for range, using the elbow telescope (see Chapter 3).

e. **To Change from Direct to Indirect Laying During a Fire Mission**:

(1) When engaging a target by direct fire (one-man lay method), the need may arise to change to indirect fire.

(2) Drill: On the order "INDIRECT", ① turns the panoramic telescope onto a GAP; ③ identifies the GAP by looking through and over the telescope; ① slips the slipping scale to zero; ② and ③ lay as for indirect laying.

Ser	Order	Action
1	"FIRE MISSION GUNS (number of guns): OPEN ACTION"	③ sets the main scale and the elevation index and micrometer of the rotating head to zero. ③ cross levels the mount. ① checks the settings and slips the slipping scale to zero. ② sets the sight scale to 300 and the elevation scale to zero.
2	"REFERENCE POINT: BEARING _____"	③ sets the bearing ordered (on the slipping scale) and lays on the reference point, using the reference point as a GAP. C of A is not recorded.
3	"GUN CORRECTION _____" "ELEVATION _____".	② sets the angle ordered on the sight scale. ② sets the elevation ordered on the elevation scale and reads back the setting: "ELEVATION ___" . ② then lays for elevation.
4	"BEARING _____ or BEARING RIGHT (LEFT) _____".	Corrections to bearing are applied by ③. Bearings right (or left) may be ordered if no confusion can arise.

Figure 2-7: Two-man, Two-sight Method—Sequence of Laying

Ser	Order	Action
1	"DIRECT LAYING. ONE MAN LAY"	③ sets the main scale and the elevation index and micrometer of the rotating head to zero. ③ matches the indices on the actuating arm and rocker, and on the end of the elevation worm of the telescope mount, by means of the elevation knob, and clamps them in position. ③ cross levels the mount and covers the longitudinal level vial. ① checks the settings and slips the slipping scale to zero.
2	"REFERENCE POINT _____". "RIGHT (LEFT) _____". "DESCRIPTION OF TARGET"	③ directs the gun at the target by ordering "TRAVERSE RIGHT (LEFT)" or by movement of the trails if necessary, ordering "ON" when the gun is directed at the target. ③ satisfies himself that he has recognized the target.
3	"RIGHT (LEFT) _____" (if necessary)	③ sets the correction to the target on the slipping scale of the panoramic telescope.
4	"RANGE _____"	③ reads back the range, lays the correct range line of the reticle on the target, lays, and reports "READY".

Figure 2-8: One-man Lay Method—Sequence of Laying

TO MEASURE THE QUADRANT ELEVATION

43. **Consideration**. During a fire mission, the need may arise to change to laying by gunner's quadrant. The GPO will order "QUADRANT LAYING: REPORT QE". The angle measured will

include the correction for index error. Therefore, ① must add/subtract the index error from the measured elevation before reporting it to the GPO.

44. **Drill**:

a. On the order "QUADRANT LAYING: REPORT QE", ② and ③ lay at the last bearing and elevation ordered.

b. ① places the gunner's quadrant on the levelling plates of the breech ring and centres the bubble by moving the arm and micrometer. ① then reads the setting and passes the quadrant to ②.

c. ② reads and calls out the setting as a check.

d. ① adds/subtracts the index error from the reading and reports the resulting angle as "NUMBER ____ QE _____".

TO FIRE

45. **Considerations**

a. The gun will not be fired without the order "NUMBER (gun) FIRE" from ①, except when engaging tanks (after the first anti-tank round has been fired on the order from ①), or when the sentry fires the gun on an FPF task.

b. Before ordering the gun fired, ① must be satisfied that his turn to fire has come, the gun is ready, the detachment is clear of recoil, and the trajectory will clear any crest or obstacle, such as a tree or camouflage, close to the front of the gun. If clearance is in doubt, ① will satisfy himself that the trajectory will clear such objects by looking along the top of the barrel for bearing and along the bottom of the bore for elevation.

c. The opening round of a fire mission will not be fired until the GPO has ordered the method of adjustment or the order "FIRE FOR EFFECT".

d. When "AT MY COMMAND" is in force, the order to fire must come from the GPO.

e. "AT MY COMMAND" remains in force until a new fire mission is ordered, or "CANCEL AT MY COMMAND" is given. When "AT MY COMMAND" is in force and the order "FIRE FOR EFFECT" includes more than one round, the order "FIRE" authorizes all rounds specified to be fired without further orders.

f. Whenever the executive order to fire must come from the GPO, ① orders "NUMBER (gun)___", and then reports the gun ready, by raising one arm if he is visible from the command post, or by reporting "NUMBER ___ READY" if he is not visible.

g. After the opening round of a fire mission, and when "AT MY COMMAND" is not in force, ① orders the gun fired as follows:

(1) **During Adjustment**. Each elevation is the order for ① of the adjusting gun to fire as soon as the gun is ready. When "___ GUNS (NUMBER OF GUNS) OR BATTERY RIGHT (LEFT) ADJUST FIRE" is ordered, guns fire one round in succession from the right (left) as ordered. If no interval is given the standard five seconds will be used. This order should be coupled with AT MY COMMAND to ensure that all guns are ready.

(2) **At FFE**. Each gun independently fires the number of rounds ordered, ①

ordering "FIRE" as soon as the gun is ready unless an interval is given.

h. **Interval**. The interval is ordered in seconds, e.g. "ELEVATION 350: THREE ROUNDS FIRE FOR EFFECT, 60 SECONDS" or "ELEVATION 350: _____ GUNS RIGHT ADJUST FIRE, 10 SECONDS".

(1) At FFE the interval is the time between the firing of individual rounds by any one gun.

(2) At battery right (left) adjust fire, the interval is the time between the firing of one gun and the next gun.

46. **Drill**:

a. ① orders "NUMBER (gun)___" shortly before his turn to fire.

b. ② stands facing inwards and grasps the handle of the firing lanyard with the right hand.

c. ③ stands facing the front.

d. The loading number kneels clear of recoil.

e. The remainder of the detachment kneel at their positions in action.

f. At the appropriate moment ① orders "FIRE".

g. ② pulls the firing lanyard with the right hand, and opens the breech with the left hand. (Care should be taken when firing at high angles with extreme left traverse.)

MISFIRES

47. **Considerations**:

a. This drill is designed to disclose the cause of failure to fire and to indicate the correct immediate remedy. When this remedy is of a temporary nature, ① at the first opportunity carries out a full examination and ensures that the defect is corrected. In the case of defective ammunition ① places the defective component at a safe distance from the gun and, at the earliest opportunity, notifies the GPO.

b. Throughout the misfire drill, the detachment must remain clear of the path of recoil. The detachment and any cartridges must also be clear of the line of possible flash when the breech is opened.

c. Failures to fire can be divided into two main classes depending on whether or not the firing lock has been tripped.

(1) **If the Firing Lock Has Not Been Tripped**. The probable causes, the immediate remedies and the subsequent action where necessary are as follows:

(a) The Gun is Set at Safe — ② opens the breech sufficiently to clear the firing shaft, allows it to move forward, and closes the breech.

(b) The Breech is Not Fully Closed—② closes the breech.

(c) The Gun Has Not Fully Counter-Recoiled—② sets the gun to safe. ① ensures that the arm on the firing shaft is behind the trigger shaft. If the gun cannot

be set to safe, ① orders "CARTRIDGE ONLY UNLOAD". ① sets the respirator to a larger opening. If this does not remedy the fault, the gun must be taken out of action.

(d) Defective Firing Gear—① fits the spare firing lock or orders "EMERGENCY FIRING".

(2) **If the Firing Lock Has Been Tripped**. The gun is said to have misfired when the firing lock has been tripped twice and the gun has failed to fire twice. Due to the danger of a hangfire, a pause of one minute (30 minutes for blank) is then made before the breech is opened to investigate the cause. The probable causes, the immediate remedies, and subsequent actions, when necessary, are as follows:

(a) Primer Not Fairly Struck—this fault is due to a broken or worn firing pin. ① fits the spare firing lock, and at the first opportunity examines the firing lock and fits a new firing pin.

(b) Primer Fairly Struck—① orders "LOAD" or "CARTRIDGE ONLY, LOAD", as applicable, and places the defective cartridge clear of all personnel. At the first opportunity, ① examines the cartridge to determine:

i If the Primer Has Not Fired—this may be due to a

defective primer or insufficient striking force. If the fault recurs, insufficient striking force is indicated and ① fits the spare firing lock. At the first opportunity, ② cleans the breech and firing mechanism and its recess, including the firing hole.

ii. If the Primer Has Fired—the failure of the primer to ignite the charge indicates either defective propellant or defective primer. ① places the defective component at a safe distance from the gun and at the earliest opportunity, notifies the GPO.

d. As soon as the gun is again ready, ① reports "READY" to the GPO, or fires without further orders as follows:

(1) If gun programs are in use, ① orders the correct bearing and elevation for the time at which he is ready, and continues the program. Rounds detailed for the time that the gun is out of action will not be fired.

(2) See Figure 2-9 for a summary of causes of misfires.

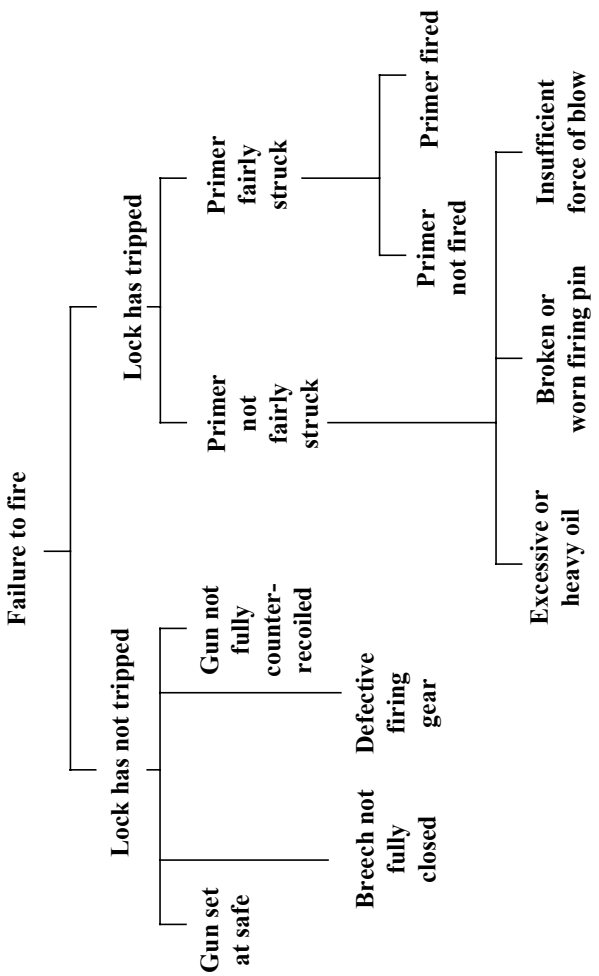


Figure 2-9: Summary of Causes of Misfires

48. **Drill**:

a. If the gun fails to fire, and the firing lock has not been tripped, ① ensures that the gun is not set to safe, the breech is fully closed, the firing gear is not defective, and the gun is in full counter-recoil

position. If any of the above is found to be incorrect, action is taken to correct it, and ② again pulls the lanyard.

b. If the gun fails to fire, and the firing lock has been tripped, ② immediately pulls the firing lanyard a second time. If the gun again fails to fire, ① reports to the GPO "NUMBER ___(gun): MISFIRE".

c. After reporting "MISFIRE", ① observes the regulation pause of one minute (30 minutes in the case of blank ammunition), and then orders "CARTRIDGE ONLY, UNLOAD".

d. ② opens the breech carefully and ① accepts the cartridge (or round) and inspects the primer.

(1) If the printer has been fairly struck ① orders "LOAD" or "CARTRIDGE ONLY, LOAD", as applicable and sets the offending cartridge aside for later examination.

(2) If the primer has not been fairly struck, ① returns the cartridge or round to a loading number and immediately orders the firing lock to be changed. ① then orders "LOAD" or "CARTRIDGE ONLY, LOAD", as applicable.

e. ① then reports "NUMBER ___(gun) READY" to the GPO, or orders "FIRE", as applicable.

TO RECORD A TARGET

49. **Considerations**:

a. A record may be required from each gun which has engaged the target, giving complete details of the final data. The GPO orders the target recorded

and includes the letters and number, e.g. "RECORD AS TARGET ZP 1234".

b. ① records the actual settings on the sights, the fuze and gunner's quadrant where applicable.

c. A record is prepared by ① on a Target Record Form (see Figure 2-10).

TARGET RECORD (① TO GPO)		
1	Target Letter and Number	ZP 1234
2	Number in Action	3
3	Shell	HE
4	Fuze	M557
5	Propellant	Dual Gran
6	Charge	5
7	Bearing (on sight)	3316
8	Convergence	R5
9	Gun Correction (angle on sight scale)	313
10	Fuze Setting	Delay
11	Elevation (on sight or gunner's quadrant)	442
12	Index Error Correction	---

Figure 2-10: ①'s Target Record

50. **Drill**:

a. On the order "RECORD AS TARGET ___", ① of each gun that has fired during the fire mission inspects the ammunition and sights, and completes a target record form.

b. ① then calls for reports of the relevant details from ②, ③ and ⑦ and compares these with his own record. Having corrected all discrepancies, ① sends the target record to the CP.

TO CHECK FIRING

51. On the order "CHECK FIRING", all work on the gun is continued, but the gun is not fired until the order "CANCEL CHECK FIRING" is received.

TO STAND FAST

52. "STAND FAST" is only used in connection with safety. All action on the gun position will cease immediately and detachment members will stand motionless. The order is cancelled by "CANCEL STAND FAST", which may only be given by the originator of the "STAND FAST" order.

TO CEASE LOADING

53. After the order "CEASE LOADING", no gun will be loaded until "CANCEL CEASE LOADING" or orders for a new fire mission are received. The detachment continues its duties and any guns previously loaded will be fired at the appropriate moment.

TO MAKE SAFE

54. **Considerations**:

a. The order "MAKE SAFE" is normally given by ①, but is also given by the GPO when guns are to be laid on their FPF task and left loaded.

b. If the gun is loaded, ① must order "MAKE SAFE" under the following circumstances:

(1) when the order "REST" is given;

(2) when personnel are required to work in front of the gun, or in the path of recoil;

(3) if it is necessary to move the trails; or

(4) when ordered to "MAKE SAFE" by the GPO.

c. "MAKE SAFE" is cancelled by orders for a new fire mission or "CANCEL MAKE SAFE".

55. **Drill**

a. On the order "MAKE SAFE" from ①, ② opens the breech sufficiently for the trigger shaft to clear the arm on the firing shaft, pulls the firing shaft to the rear by means of the firing lanyard, closes the breech, and releases the lanyard.

b. ① inspects to ensure that the firing shaft is behind the trigger shaft.

c. On the order "TAKE POST", ② opens the breech sufficiently to clear the firing shaft and closes it.

TO REST

56. **Considerations**:

a. When the order "REST" is given, detachments remain at their guns ready to fire at short notice. ① of a gun ordered to rest does not acknowledge subsequent orders nor does the detachment follow up fire orders. "REST" is cancelled by "CANCEL REST" or by orders for a new fire mission.

b. The guns must remain laid as last ordered.

57. **Drill**:

a. On the order "REST", ① orders "MAKE SAFE" if the gun is loaded.

b. ① orders any necessary work to be carried out around the gun, and when the work is completed

orders "NUMBER _____(gun): REST". The detachment rest at its position in action.

STAND EASY/END OF MISSION

58. **Considerations**:

a. When the order "STAND EASY" or "END OF MISSION" is given, the detachments concerned are withdrawn from their guns to a position previously ordered by the GPO. ① of the detachment(s) concerned does not acknowledge subsequent orders.

b. At "STAND EASY" ① will order any necessary work to be carried out. The gun must remain laid as last ordered.

c. When laid on an FPF task, it may be necessary for the guns to remain loaded. In this case, the GPO must order "LOAD: MAKE SAFE" before ordering "STAND EASY".

d. "END OF MISSION" is cancelled by orders for a new fire mission.

e. "STAND EASY" is cancelled by "TAKE POST" or by orders for a new fire mission.

59. **Drill**. On the order "END OF MISSION" or "STAND EASY", ① orders "CARTRIDGE ONLY, UNLOAD" if the gun is loaded. ① orders any necessary work to be carried out around the gun. When completed, ① orders "DETACHMENT REAR", marches the detachment to the stand easy position, and orders "FALL OUT".

TO "TAKE POST"

60. **Consideration**. "TAKE POST" may be used by the GPO or ① when the detachment is required to resume their positions in action. "TAKE POST" is cancelled by "STAND EASY".

TO "PREPARE TO ADVANCE (OR WITHDRAW)"

61. The order "PREPARE TO ADVANCE (WITHDRAW)" is given as a warning that a move is anticipated. ① will order ammunition and stores not required for the immediate service of the gun to be repacked. Preparations for coming out of action will be made as far as possible. The guns must remain in action until "CEASE FIRING" is ordered.

TO "EMPTY GUNS"

62. **Considerations**:

a. On the order "EMPTY GUNS", any guns already loaded will be laid at the last bearing and elevation ordered, and will be fired. The order "EMPTY GUNS" is in itself an order to fire, and no additional order is required if "AT MY COMMAND" is in force. Omission of this order need only be verified if the gun is loaded.

b. As soon as the gun is empty, ① reports "NUMBER ___ EMPTY".

c. Ammunition which has been removed from its container will be examined and if serviceable will be dealt with as follows:

(1) Time Fuzes. Set to safe and reinsert pins.

(2) Impact Fuzes. Set to quick.

(3) VT Fuzes. Set to safe, and if applicable remove from projectiles and place in containers.

(4) Cartridges. Make up to charge 7.

d. Unserviceable ammunition will be set aside and its condition reported to the GPO.

e. The following ammunition is unserviceable, and will not be fired or replaced in the vehicle under any circumstances:

(1) fuzes which cannot be set to safe or quick; and

(2) projectiles from which VT fuzes cannot be removed.

f. At practice, defective ammunition will be set aside for examination by an ammunition technical officer.

g. During operations, defective ammunition will be dumped and clearly marked.

h. The preparation of ammunition for return to the vehicle is described in B-GL-306-015/MS-001, *Field Artillery, Volume 15, Handbook of Equipment and Ammunition, 105 mm Howitzer C1*.

TO "CEASE FIRING" AND "HOOK IN"

63. **Considerations**:

a. The guns must be empty before "CEASE FIRING" is ordered. ① will normally be left to choose the most convenient direction for hooking in. At drill, the instructor may order the direction of hooking in.

b. The signals which are used by ① to direct the movement of the vehicle are described in Figure 2-1.

c. When detailing the drill for "RIGHT (OR LEFT, OR FRONT) HOOK IN", the instructor will give the complete detail, modifying the drill for "REAR HOOK IN", as follows: As soon as the trails are closed, ① orders "TRAILS RIGHT (LEFT)", and the trails are manhandled through 1600 or 3200 mils in the direction required under the orders of ①.

d. Due to the trails jamming against the axle on uneven ground, it may be necessary to lift the lower trail leg slightly on closing the trails.

64. **Drill**

a. **Initial Action**:

(1) On the order "CEASE FIRING", ① sets the respirator to zero, orders "RUN UP", and when the spades have been cleared orders "CEASE FIRING". ① disconnects the loudspeaker.

(2) ② and ③ remove the trail locking pins from the firing position and insert them in the travelling position.

(3) ② closes the breech, elevates or depresses the gun to the approximate travelling position, covers the bubbles of the quadrant mount, places the breech cover on the breech.

(4) ③ covers the bubbles of the telescope mount and traverses the gun to the approximate travelling position. ③ replaces the panoramic telescope in its case, tilts the telescope mount fully to the front, and assists ② in clamping the cradle lock strut and replacing the breech cover.

(5) ④ collects the aiming posts, if necessary, and secures them on the right trail. ④ packs up the collimator.

(6) ⑥ reels in the loudspeaker cable.

b. **Preparing to Hook In**:

(1) ⑤ is on the handspike; ⑥ the drawbar.

(2) ① orders "CLOSE" and the trails are closed.

(3) ⑤ locks the trails in the travelling position and replaces the handspike on the left trail.

(4) ② and ③ lock the axle locks in the travelling position.

(5) ⑤ secures the staff sections to the left trail.

(6) ④, ⑤, ⑥, and ⑦ place stores and ammunition convenient for loading.

c. **Awaiting the Vehicle**. On completion of its tasks, the detachment takes up its position as follows:

(1) ① to see the detachment and direct the vehicle into the required position;

(2) ② and ③ kneeling beside the gun wheels, facing the rear, ② on the right, ③ on the left; and

(3) ④, ⑤, ⑥, and ⑦ kneeling beside the trails; odd numbers on the left and the even numbers on the right, highest numbers nearest the lunette, facing the rear.

d. **Hooking In**:

(1) ① directs the vehicle into a convenient position for loading stores and ammunition and then into the required position. ① orders "HOOK IN".

(2) ⑦ orders "LIFT". ④, ⑤, ⑥, and ⑦ lift the trails.

(3) ⑥ rotates the drawbar to the travelling position.

(4) ② and ③ release the brakes and push on the shield, as necessary, and the gun is hooked in.

(5) ⑦ locks the catch on the towing hook of the vehicle. ⑥ fits the cotter pin.

(6) The detachment mounts without further orders.

(7) ① satisfies himself that the equipment is ready to travel, mounts, and directs the driver to the assembly position.

(8) At drill, when no towing vehicle is available, the detachment forms detachment rear.

DRILL WITH REDUCED DETACHMENTS

65. **Drill**. In action, detachments may be reduced by reliefs, casualties or members employed on other details. With reduced detachments the drill is carried out as far as possible in the normal way, duties being combined as directed by ①. The following allotment of duties can be taken as a guide:

a. **With Six Members**. The duties of ⑥ and ⑦ are combined.

b. **With Five Members**. The duties of ⑤, ⑥ and ⑦ are combined.

c. **With Four Members**:

(1) ① performs the duties of ① and ②; and

(2) the duties of ④, ⑤, ⑥, and ⑦ are combined.

DRILL WITH DAMAGED EQUIPMENT

66. **Consideration**. Variations of drill are used in action when damaged equipment cannot be replaced or repaired as follows:

a. **Damaged Range Quadrant**. The gun is laid by gunner's quadrant.

b. **Damaged Panoramic Telescope**. The GPO or Section Commander directs the gun onto the required bearing by compass.

c. **Damaged Cross Level Bubble**. ② and ③ follow the normal sequence of laying, cross levelling and sights as near as they can judge by eye.

d. **Damaged Firing Gear**. ② attaches the firing lanyard to the trigger shaft.

PRECAUTIONS TO BE OBSERVED WHEN FIRING BLANK AMMUNITION

67. **Considerations**:

a. No officer, NCO, or gun number who has not qualified in gun drill may command a section, or form part of a gun detachment, firing blank ammunition at salutes or during training.

b. When firing blank cartridges, no gun will be reloaded within 15 seconds of firing. Even after this interval, no gun will be reloaded until ① has examined the chamber and bore and removed any debris.

c. In the event of a misfire, the normal misfire drill is carried out, except that a pause of not less than 30 minutes must be allowed to elapse before the breech is opened. No one will be in rear of the breech when it is opened.

CHAPTER 3
ANTI-TANK DRILL

PREPARATION FOR OPENING FIRE

1. **Considerations**:

   a. In choosing the gun position, the GPO considers its suitability for anti-tank defence, and sites individual guns to achieve the best defence consistent with the need for concealment, ease of control, and the ability to carry out normal field artillery tasks.

   b. In order to ensure an all-round watch for tanks, and to provide a rapid means of indicating targets, the GPO allots zones of observation to each gun.

   c. To provide a means of indicating difficult targets, the GPO normally chooses one or two reference objects in each zone and indicates these to ①, together with the name of each reference object and the range to it.

   d. The GPO normally orders the maximum range at which fire is to be opened.

   e. The GPO is responsible, when necessary, for ordering special states of preparedness and for general control of the troop's fire, including allotting targets to guns and giving the executive order to engage targets.

   f. As soon as possible after coming into action, ① ensures that the detachment knows the zone for which they are responsible, the ranges to reference objects, and the range for opening fire ordered by the GPO.

g. ① orders cartridge cases for HESH to be chambered, and then placed in a convenient position.

2. **States of Preparedness**:

a. **General**. When a threat of tank attack is reported, the GPO orders "PREPARE FOR TANKS", or "TANK ALERT". When the threat has passed, the normal state will be restored by ordering "CANCEL PREPARE FOR TANKS", or "CANCEL TANK ALERT".

b. **Prepare for Tanks**:

(1) The order "PREPARE FOR TANKS" means a tank attack is considered likely, but not necessarily imminent. The guns remain laid on their present task.

(2) Ten rounds of HESH per gun are prepared and placed in a convenient position.

(3) ① ensures that all preparations for the normal state have been completed, and that at least one detachment member is keeping a close watch on the zone allotted. Camouflage nets are removed if ordered.

(4) The elbow telescope is fitted.

(5) "PREPARE FOR TANKS" is cancelled by "CANCEL PREPARE FOR TANKS", or "TANK ALERT".

c. **Tank Alert**:

(1) The order "TANK ALERT" means a tank attack is considered imminent.

(2) Any other task on which the guns are engaged lapses. ① orders "RUN UP: TAKE POST TO LAY", and the gun is moved to face its zone.

(3) Guns are loaded.

(4) Longitudinal and cross level vials are covered.

(5) Scribe lines of the telescope mount rotating head, the elevation micrometer and the elbow telescope are matched; the main scale, micrometer and slipping scales are set to zero. The mount is clamped.

NOTE

If the gun has not been zeroed, the rotating head and elbow telescope will be set to zero and the sight testing mark, respectively.

(6) A close watch is kept on the zone allotted.

d. **Anti-tank Action**:

(1) When tanks are seen, the GPO indicates the direction to some or all guns by means of the pre-arranged zones and reference objects.

(2) Until the GPO orders "ENGAGE", ① does not order "FIRE", but issues all other necessary orders, and tracks the movement of the tanks with his gun.

(3) When the tanks are identified as hostile and are within effective range, the GPO passes control of fire to all or some of the ①s by ordering "ENGAGE: NUMBER

___ ENGAGE" or "NUMBER ___ AND NUMBER ___ ENGAGE".

(4) "ENGAGE" is cancelled by "CHECK FIRING".

(5) "TANK ALERT" is cancelled only by "CANCEL TANK ALERT".

APPLICATION OF FIRE

3. **General**. The effective application of fire depends on:

a. correct initial orders by ①, including a clear indication of the target;

b. correct choice of initial range and lead by ①;

c. accurate laying by ② and ③;

d. immediate response by ④ or ⑦ to the order "FIRE" from ③;

e. correct observation by ① and accurate corrections if required; and

f. good drill by the remainder of the detachment.

4. **Fire Control**:

a. **Initial Orders**. To quicken drill and to ensure that errors or omissions are more readily detected, orders are given by ① in a standard sequence, as follows:

(1) **Indication of Target**. This indicates the beginning of a mission, e.g. "TARGET: HULL-DOWN TANK". (The term "hull-down" is used if the bulk of the target is not visible).

(2) **Range**. This assists ② and ③ in locating the target, and tells them the sight graticule to be used.

(3) **Trails or Traverse Right or Left**. This order is used to direct the gun at the target, e.g. “TRAILS LEFT”, “TRAVERSE RIGHT”.

(4) **Description**. A description of the target may be necessary if ② or ③ do not recognize it.

(5) **“ON”**. This order tells ②, ③, ⑤, and ⑥ that the gun is pointed at the target.

(6) **Lead**. This tells ③ the graticule to be used.

(7) “**FIRE”**. This tells ③ to order “FIRE” as soon as the gun is laid.

b. **Initial Range**. ① orders the estimated range to the target. All ranges are ordered in metres, e.g. “FOUR HUNDRED” or “SIX FIVE ZERO”. ② will lay the range line ordered by ① on the centre of the visible mass.

c. **Description of Target**. No description need be given when the target is obvious. When a description is required it should be brief and the most obvious feature should be named first, e.g.:

(1) by direction of movement, e.g. “MOVING RIGHT”, or “HEAD ON”;

(2) by position or size of group, e.g. “CLOSE GROUP”,or “SMALL GROUP”; or

(3) by position of a tank within a group, e.g. “FRONT TANK”, “LAST TANK”, or “SECOND TANK FROM LEFT”.

d. **Indication by Sectors or Reference Objects**. When ① cannot return to the gun, direction to the target is indicated to ② and ③ by using sectors and, if necessary, angles right or left of the reference objects, e.g.:

(1) "FRESH TARGET: HULL-DOWN: 600. RIGHT SECTOR: REFERENCE HOUSE, RIGHT 10"; or

(2) "FRESH TARGET: 400: RIGHT SECTOR: LARGE GROUP: FRONT TANK".

e. **Initial Lead**. Figure 3-1 shows the initial leads for a crossing target.

Lateral Speed of Target (km/h)	Leads (mils)
15	10
30	20
50	30

Figure 3-1: Initial Leads for a Crossing Target

NOTES

1. For a target crossing diagonally, half the lead is ordered.

2. For stationary or head on targets, the lead is zero. A small lead may sometimes be required to allow for wind.

f. **The Form of Lead Orders**. All leads are ordered in units, e.g. "RIGHT 5" or "LEFT 10". Each lead cancels the previous lead. ③ lays with the panoramic telescope using the graticule corresponding to the lead ordered; and reads back each lead to ①.

5. **Observation and Corrections**:

a. **Observation of Fire**. Whenever possible, ① will observe the path of the projectile at the target and not the fall of shot. Wrong deductions may be made if the projectile is observed before or after passing the target.

b. **Corrections**:

(1) The object is to hit with the first round. If the first round misses, either range or lead must be altered at once with the object of hitting with the second round.

(2) Except for a short round, it will seldom be possible to judge the range of a round which is incorrect for line. ① should therefore ensure that the line is correct before altering the range.

(3) If a round misses widely, a bold correction must be ordered. In all other cases, the rules given in subparagraphs c and d below will apply.

c. **Corrections to Lead**:

(1) If a round misses to the right or left, ① orders a fresh lead. The alteration required depends on the range, and on the width presented at the target.

(2) The correct alterations in lead for targets between 400 and 600 metres are as follows:

(a) for direct or diagonal crossers—10 mils;

(b) head on targets—5 mils;

(c) and hull-down targets—5 mils.

(3) These alterations to lead should be doubled for targets at ranges under 400 metres, and halved for targets at ranges over 600 metres.

d. **Correction to Range**:

(1) Ranges from 0 to 300 metres using HESH, or ranges from 0 to 500 metres using HE Charge 7. Within these range limits, the trajectory will be flat enough to hit a completely visible (2.5 metre high) tank without correcting for range.

(2) Ranges from 300 to 600 metres using HESH or 500 to 900 metres using HE Charge 7. These range limits include the zone in which the trajectory is sufficiently flat to permit direct estimation of range without bracketing the target. If a hit is obtained at the bottom of a 2.5 metre tank firing at the upper range limit, e.g. 600 metres with HESH, adding a 100-metre range change will result in a round which will just brush the top of the tank. During adjustment within this zone, range changes should seldom be more than 100 metres and frequently range changes of 50 metres will be sufficient.

(3) Ranges from 600 to 1200 metres using HESH or 900 to 1600 metres using HE Charge 7. This zone includes the ranges at which hits are only reasonably possible. Bracket methods are normally used to obtain adjustment in this zone. Fire should not be opened at these ranges unless absolutely necessary.

e. **Vertical Displacement Table**. Vertical displacement is the change in the point of burst between two rounds fired at an upright target at different ranges. Figure 3-2 shows the vertical displacement for a 100-metre range change at various ranges, firing HESH and HE Charge 7.

HESH Shell		Remarks	HE Charge 7	
Range (m)	**Displacement (ft)**		**Displacement (ft)**	**Range (m)**
100 200 300	1 2 3	Start firing using 400-metre range setting.	0.5 1.5 2.0 2.5 3.5	100 200 300 400 500
400 500 600	4 5.5 8	Start firing using estimated range. Increase or decrease by multiples of 50 or 100 metres. Bracketing is not necessary.	4.0 5.5 6.0 7.0	600 700 800 900
700 800 900 1000 1100 1200	9 10.5 11.5 13.0 14.5 16.0	Bracket the target to obtain a hit.	8.0 9.0 10.0 10.5 11.5 13.0 14.5	1000 1100 1200 1300 1400 1500 1600
1300	Firing at moving targets at this distance is too inaccurate.			1700 1800

Figure 3-2: Vertical Displacement in Feet per 100 m Change in Range

ANTI-TANK LAYING

6. **Considerations**:

a. **Point of Aim**. The point of aim is the centre of the visible mass of the target.

b. **Ranges**. All ranges are set on the graticule of the elbow telescope. When the one-may lay method is used, they are set on the graticule of the panoramic telescope.

c. **Lead**. The lead ordered is laid on the point of aim.

d. **Movement of the Trail**. After ① has initially directed the gun onto the target, ③ will order "TRAILS RIGHT (LEFT)" when a movement of the trail is necessary, and "HALT" when the movement is sufficient.

e. **Sequence of Laying**:

(1) ② lays the graticule of the elbow telescope at the range ordered onto the centre of the visible mass.

(2) ③ lays the graticule of the panoramic telescope at the lead ordered onto the centre of the visible mass.

ANTI-TANK DUTIES

7. **Duties of ①**:

a. ① controls the fire of the gun as follows:

(1) Selects the most dangerous target in the direction indicated by the GPO.

(2) Indicates this target to ② and ③ by directing the gun onto it.

(3) Gives the initial orders for the engagement.

(4) Takes up a position to observe.

(5) Orders "FIRE" when: ready to observe; the target is within the range for opening fire; and the GPO has ordered "ENGAGE".

(6) Observes and, if necessary, corrects the fire of the gun. ① makes no correction on any round for which ② or ③ has reported "WRONG" (unless a correction is necessary due to target movement), but reads back "WRONG".

(7) Orders "CHECK FIRING" when satisfied that the target has been destroyed or has disappeared. ① then selects a fresh target if available and engages it. If it is in the same group as the last, and requires the same lead and range, ① orders "(DESCRIPTION): CANCEL CHECK FIRING". Otherwise ① gives a complete set of initial orders, and if it is not practicable to return to the gun to indicate the target to ② and ③, describes its position by means of sectors or reference objects.

8. **Duties of ②**:

a. Lays for range using the elbow telescope unless ① has ordered "ONE-MAN LAY". The two-man lay is normal for anti-tank shooting.

b. Applies the range by laying the appropriate range line of the elbow telescope on the centre of the visible mass.

c. Ensures that he has recognized the target indicated by ①. If uncertain, ② reports "TARGET LOST". ② reports "ON" when laid at the correct range.

d. Keeps the gun laid for range, as ordered, throughout the shoot, except on the order "STAND BY" from ③, at which time he removes his eye from the eyepiece until the gun has fired.

e. Reports "WRONG" whenever the gun has fired when laid at an incorrect range.

f. Reports "TARGET LOST" whenever he cannot see the target.

9. **Duties of ③**:

a. Orders "FIRE" whenever the gun is to be fired. ③ lays for line using the panoramic telescope.

b. Lays ahead of the target for line making due allowance for loading when necessary. As the target approaches the correct line ③ orders "STAND BY" and then "FIRE" at the appropriate moment.

c. Applies the lead by laying the appropriate vertical line of the panoramic telescope onto the centre of the visible mass, keeping the gun laid for line, as ordered, throughout the mission.

d. Ensures that he has recognized the target indicated by ①. If uncertain, ③ reports "TARGET LOST".

e. Reads back all leads ordered by ①.

f. When laid, ③ orders "STAND BY ___ FIRE" provided that:

(1) ① has initially ordered “FIRE”;

(2) ② has reported “ON”; and

(3) ④ or ⑦ has reported “READY”.

g. Reports “WRONG” whenever the gun has fired when laid incorrectly for line.

h. Reports “TARGET LOST” whenever he cannot see the target.

i. Orders “TRAILS RIGHT (LEFT)” when a movement of trails is necessary.

10. **Duties of ④**:

a. Alternately with ⑦, loads, operates the breech and fires the gun.

b. As soon as ④ has loaded, he grasps the firing lanyard and reports “READY”. ④ fires on the order “FIRE” from ③, and opens the breech. It is vital that there be no delay between ③'s order to fire and the firing of the gun.

11. **Duties of ⑤ and ⑥**. ⑤ and ⑥ man the trails on the order “TAKE POST TO LAY” and remain on the trails until ① orders “TAKE POST”. ① will not order “TAKE POST” before the GPO has ordered “CANCEL TANK ALERT”.

12. **Duties of ⑦**:

a. Alternately with ④, loads, operates the breech and fires the gun.

b. As soon as ⑦ has loaded, he grasps the firing lanyard and reports “READY”. ⑦ fires on the order “FIRE” from ③, and opens the breech. It is vital that there be no delay between ③'s order to fire and the firing of the gun.

ANTI-TANK GUN DRILL

13. **Drill**:

a. **Preparation**. On the order from the GPO “TANK ALERT”, the following drill is carried out:

(1) ① orders “TAKE POST TO LAY” and “RUN UP”, if necessary, and the gun is moved to face its zone.

(2) ⑤ and ⑥ remain at the trails (brakes are not applied unless the ground is frozen or very hard).

(3) ② depresses the gun to zero elevation and matches the scribe lines of the elbow telescope.

(4) If the gun has been zeroed, the rotating head and elevation worm of the panoramic and elbow telescope will be set at the scribe lines for shooting.

(5) ③ matches the scribe lines on the telescope mount and clamps them in position; sets the main scale, micrometer and slipping scales to zero; and sets the fine elevation index on the panoramic telescope to the scribe line "S" (for shooting).

(6) ① orders “HESH: LOAD”.

(7) ④ loads, takes up position at the breech ready to fire, and reports “READY”.

(8) ⑦ takes up the loading position with a ready round.

(9) Having loaded, the loading number will move around to the right of the cradle, close the breech with the left hand, grasp the firing lanyard in the right hand, and report "READY".

b. **Engagement**. On the order from the GPO "TANKS. ___ SECTOR" or "TANKS. REAR", the following drill is carried out:

(1) ① selects a target, estimates the range and orders "TARGET. ___ (RANGE)". ② reads back the range.

(2) ① directs the gun at the target by ordering "TRAILS RIGHT (LEFT)" or "TRAVERSE RIGHT (LEFT)", at the same time ordering target description, if necessary, and the lead.

(3) ③ reads back the lead.

(4) ① orders "ON" when the gun is directed at the target. ② and ③ identify the target, and the detachment take up their positions as detailed in this Chapter in a previous sub-section.

(5) ② lays the range line of the elbow telescope on the visible mass and, when correctly laid for range, reports "ON".

(6) ① takes up position to observe.

(7) ③ lays the panoramic telescope as ordered on the centre of the visible mass.

(8) On the order from the GPO, "___ENGAGE", or as soon after that order as the gun is ready, ① orders "FIRE".

(9) ③ orders “STAND BY ... FIRE”, and at the same time steps clear.

(10) ② steps clear on the order “STAND BY” from ③, and resumes laying immediately after the gun has fired.

(11) ④ or ⑦ fires on the order “FIRE” from ③.

(12) ① observes and orders any corrections necessary.

(13) ④ or ⑦ reload as soon as the gun is fired and report “READY”.

(14) The gun is always reloaded without further orders, and is fired on ③'s order “FIRE”.

(15) If no orders or corrections are given by ①, ③ continues to fire at the current settings.

THE ONE-MAN LAY METHOD

14. **Considerations**. The two-man lay method is normal for anti-tank drill, but the need may arise when the one-man lay will have to be used, e.g. a broken elbow telescope. The following changes to the drill for the two-man lay will be used:

a. ① orders “HE, CHARGE 7: LOAD: ONE-MAN LAY”;

b. ③ matches the scribe lines on the telescope mount and clamps them into position; and

c. ② assists ④ and ⑦ in loading and firing.

CHAPTER 4
LAYING

THE PANORAMIC TELESCOPE

1. **Description**:

   a. **The Scales**. The panoramic telescope has two horizontal scales graduated in opposite directions as follows:

      (1) **Main Scale**. This scale is graduated anti-clockwise in hundreds of mils. The corresponding unit scale is on the right micrometer. It measures the clockwise angle between the bearing at which the gun is laid and the line at which the telescope is laid. This scale is used to lay in the original bearing to record the angles to aiming points, and to check the bearing at which the gun is currently laid. To ensure that this scale measures true horizontal angles during these important operations, the cross-level and longitudinal bubbles of the telescope mount must each be in the centre of its run. With these conditions satisfied, the setting of the elevation scale is immaterial.

      (2) **Slipping Scale**. This scale is graduated clockwise in hundreds of mils. The corresponding scale in mils is on the left micrometer. This scale, when oriented on an aiming point, provides a means of laying the gun at any desired bearing. The scale may be "slipped" or "set".

b. **To Slip the Slipping Scale**:

(1) This is an operation which is performed only by ①. The object is to ensure that the slipping scale reads the bearing at which the gun is laid when the telescope is laid on the aiming point in use.

(2) With the gun laid at the correct bearing and the telescope laid on the aiming point, ① loosens the clamp of the slipping scale, slips the scale to the bearing ordered, and re-clamps it.

(3) Holding the right micrometer knob to ensure that it does not move, ① loosens the clamp and the left micrometer scale, slips the scale to the required number of units, and re-clamps it.

c. **To Set the Slipping Scale**:

(1) This is the operation by which all bearings are set on the sights during a mission. When ③ relays on the aiming point, the gun is laid at the bearing at which the sight is set.

(2) ③ moves the main and slipping scales, clamped together as one unit, and sets the slipping scale and left micrometer scale at the bearing ordered.

d. **The Gunner's Aid**:

(1) This consists of an adjustable index for the left micrometer scale. It can be offset from 0 to 20 mils, left or right.

(2) By setting the gunner's aid at the convergence ordered, any subsequent

setting of the sights will cause this convergence to be applied.

(3) The gunner's aid will be set to zero unless CONVERGE is ordered.

e. For convenience during indirect laying, the rotating head is provided with an elevation knob for moving the image up or down until it appears in the centre of the field of view.

f. **The Reticle Pattern**. The reticle pattern of the panoramic telescope is gridded with horizontal range lines indicating ranges from 0 to 2200 yards, in increments of 200 yards. Vertical lines on the reticle indicate leads from 0 to 40 mils right or left of the centre line, in increments of 10 mils. The zero range line is sub-divided in increments of 5 mils. The reticle is graduated for ranges corresponding to charge 7, HE M1, and is so marked.

THE ELBOW TELESCOPE

2. The elbow telescope is used for laying for range in anti-tank laying, using the two-man, two-sight method. The reticle pattern of the elbow telescope is gridded with horizontal range lines indicating ranges from 0 to 2200 yards in increments of 200 yards. The reticle is graduated for ranges corresponding to HEAT M67, however, it also applies to HESH. For more detail on the sight see B-GL-371-009/FP-001 *Field Artillery, Handbook of Equipment and Ammunition 105 mm Howitzer*.

SIGHT SETTING

3. **Considerations**:

a. **Use of the Quick Release Mechanism**. The quick release mechanisms are used for moving scales through angles greater than 200 mils. No

attempt will be made to re-engage the gears at the exact setting ordered. The micrometer will be turned through at least one complete turn to ensure that the gears have re-engaged correctly.

b. **Scale Settings and Final Motions**. In order to avoid errors caused by backlash, the following restrictions must be strictly adhered to:

(1) **Bubbles**. The bubbles must be centred exactly.

(2) **Indices**. The indices must be aligned exactly with the proper graduation.

(3) **Traverse**. The last motion of the traversing handwheel must be such as to cause the vertical hairline of the panoramic telescope to approach the GAP *from left to right* .

(4) **Elevation**. When elevating or depressing the barrel, the last motion of the handwheel must be in the direction that offers the *greatest resistance*.

(5) **Bearing**. The right hand will always be used in setting an angle on the panoramic telescope, except on the gunner's aid, which will be set with the left hand.

4. **Drill**:

a. **To Set the Angle to an Aiming Point**:

(1) On the order "AIMING POINT ___" or "AIMING POINT DIRECTOR: NUMBER ___, ___", ③ uses the quick release mechanism, if required, and, having re-engaged the gears, turns the micrometer knob until the main scale is set to the even hundred mils *below* the

angle ordered, and the main scale micrometer reads 0, as illustrated in the following examples: Example 1. The angle ordered is "3257". The angle which ③ sets on the main scale is 32 (3200). Example 2. The angle ordered is "0698". The angle which ③ sets on the main scale is 6 (600).

(2) ③ then turns the micrometer knob away from him until the main scale micrometer reads the required number of mils. In example 1, 57 mils is set on the main scale micrometer. In example 2, 98 mils is set on the main scale micrometer.

b. **To Set a Bearing**. On the order "BEARING ____", ③ uses the quick release mechanism, if required, and, having re-engaged the gears, sets the slipping scale by turning the micrometer knob until the slipping scale is set to the even hundred mils *below* the bearing ordered, and the slipping scale micrometer reads 0. ③ then turns the micrometer knob towards him until the slipping scale micrometer reads the required number of mils.

c. **To Set an Alteration to the Current Bearing**. On the order "BEARING RIGHT (LEFT) ___", ③ turns the micrometer knob and counts the mils on the slipping scale micrometer, as follows:

(1) When "RIGHT" is ordered, ③ turns the micrometer knob towards him. When "LEFT" is ordered, ③ turns the micrometer knob away from him.

(2) In each case ③ turns the knob with his right hand.

d. **To Set a Convergence**:

(1) On the order "CONVERGE: NUMBER RIGHT (LEFT) _____", ③ moves the index of the gunner's aid the number of mils in the direction indicated, and repositions the slipping scale micrometer to the bearing ordered.

(2) If the convergence exceeds 20 mils, ① applies it to each bearing ordered and orders the result to ③.

(3) A "RIGHT" convergence is *added* to the ordered bearing. A "LEFT" convergence is *subtracted* from the ordered bearing.

e. **To Set a Gun Correction**. On the order "GUN CORRECTION ___", ② sets the sight scale to 300, and the micrometer to 0. ② then turns the sight micrometer knob in the appropriate direction until the micrometer reads the required number of mils.

f. **To Set an Alteration to the Gun Correction**. On the order "GUN CORRECTION RAISE (LOWER)", ② turns the sight scale micrometer knob in the appropriate direction and counts the required number of mils.

g. **To Set an Elevation on the Elevation Scale**:

(1) On the order "ELEVATION ___", ② turns the elevation knob until the elevation scale is set to the even hundred *below* the elevation ordered, and the elevation micrometer reads zero.

(2) ② then turns the elevation knob until the elevation micrometer reads the required number of mils.

h. **To Set an Alteration to the Elevation**. On the order "ELEVATION, ADD (DROP) ___", ② turns the elevation knob and counts the mils on the elevation micrometer in the appropriate direction.

i. **To Set an Elevation on the Gunner's Quadrant**. When "QUADRANT LAYING" is ordered, ① applies the correction for index error to all elevations ordered, and sets the quadrant by moving the index arm to the nearest 10 mils *below* the elevation ordered. ① then sets the index micrometer to the nearest whole mil or, if necessary, to the nearest 0.1 mil.

CHOICE OF GUN AIMING POINTS 1 AND 2

5. **Considerations**:

a. ① is responsible for choosing the GAPs.

b. If a distant object is used as a GAP:

(1) it must be conspicuous and unmistakable;

(2) it must have a definite edge on which to lay;

(3) it must be positioned such that it can be used for all targets within the gun's zone of fire; and

(4) it must not be obscured by the muzzle of the gun at high elevation, or by the movements of the detachment, or by other guns or their detachments.

c. GAP 1 must satisfy the requirements of a good GAP and, in addition, must be as far distant as possible. Approximately 1500 metres may be used as a guide. The most suitable position is to the left front or the right rear.

d. GAP 2 must satisfy the conditions of a good GAP and, in addition, must be near enough to ensure that it will not be obscured by changes in weather conditions, but not so near that inaccuracies in bearing will result as the gun is moved in traverse. Approximately 300 to 600 metres may be used as a guide. The most suitable position is to the left front or the right rear.

POINT OF AIM

6. **Considerations**. During indirect laying, ③ uses the traversing handwheel to lay the vertical crosshair of the telescope as follows:

a. **When Using an Aiming Point**. ③ lays on the left edge of the aiming point unless otherwise ordered.

b. **When Using the Collimator**. The vertical crosshair is laid as detailed in Annex G.

c. **When Using Aiming Posts**. ③ lays on the left edge of the aiming posts, provided they appear in line. If the posts are not in line, but displaced left or right, ③ lays in such a manner that the far aiming post appears exactly midway between the near aiming post and the vertical hairline. The horizontal hairline is laid at the ground level of the near aiming posts (see Figure 4-1).

d. **When Direct Laying**. The point of aim is the centre of the visible mass of the target.

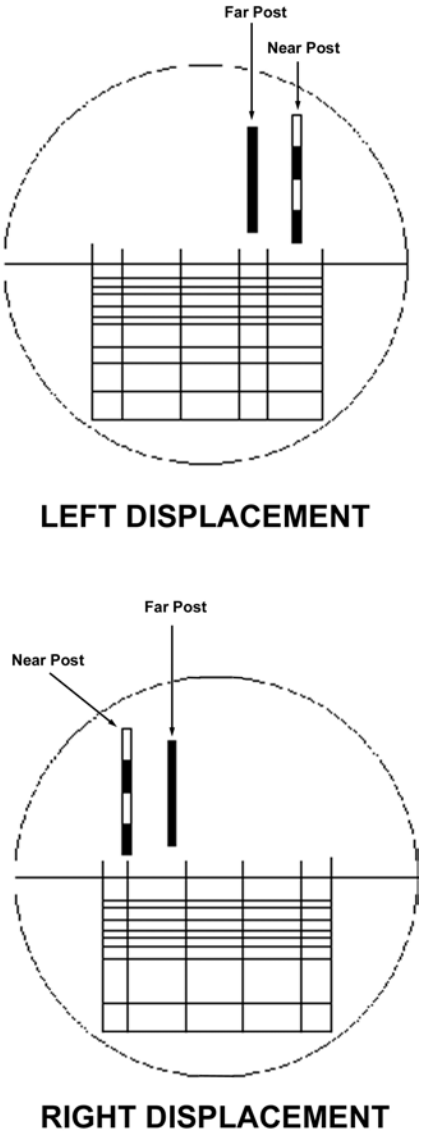


Figure 4-1: Displacement Laying

SEQUENCE OF LAYING

7. **Considerations**:

a. The sequence of laying drill must be rigidly followed. If an incorrect sequence is followed, one adjustment may upset a previous one and result in delay or an incorrect lay.

b. The gun is laid for elevation when the sight and elevation scales are correctly set and the cross and longitudinal level bubbles are centred.

c. The gun is laid for bearing when the slipping scale and gunner's aid are correctly set, the vertical crosshair of the panoramic telescope is laid on the correct point of aim, and the cross level and longitudinal level bubbles are centred.

d. Unless the trunnions are accurately levelled, a small adjustment to either bearing or elevation will alter the other. However, a small adjustment for elevation will have less effect on the bearing than a small adjustment for bearing will have on the elevation. Thus, in indirect laying, it is desirable that final adjustments for bearing and elevation be carried out simultaneously, with ③ reporting "ON" when laid and all apparent motion of the gun has ceased. ② may make a further fine adjustment before reporting “READY”.

e. The following describes the sequence of operations as they should be carried out. This sequence is designed for accurate and consistent laying with a minimum of delay.

(1) **To Lay for Elevation**. ② elevates or depresses rapidly until the longitudinal level is approximately centred. ② then centres both bubbles by operating the cross levelling knob and elevating handwheel.

(2) **To Lay for Bearing**. ③ traverses rapidly until the vertical crosshair of the panoramic telescope is laid on the aiming point. ③ then alternately levels the cross and longitudinal level bubbles and traverses back on the point of aim until the gun is laid for bearing. ③ should make every effort to keep the bubbles centred during any movement of the gun by ②. The cross-level and elevation knobs can be adjusted simultaneously.

8. **Drill for Indirect Laying**

a. **Normal Indirect Laying**. For normal indirect laying sequence see Figure 4-2.

Ser	Action by ③	Action by ②
1	Sets the convergence and bearing ordered. Lays for bearing.	
2		Sets the gun correction and elevation ordered.
3	Keeps the cross and longitudinal level bubbles level. Lays for bearing when all apparent movement of the gun has ceased and reports “ON”.	
4		Makes final adjustments and reports “READY”.

Figure 4-2: Normal Indirect Laying Sequence

b. **Drill for Quadrant Laying**. For quadrant laying sequence see Figure 4-3.

Ser	Action by ③	Action by ②
1	Sets the convergence and bearing ordered. Lays for bearing. Keeps cross and longitudinal level bubbles level.	Lays for elevation by means of the gunner's quadrant.
2	Lays for bearing when all apparent movement of the gun has ceased, and reports “ON”.	
3		Makes any final adjustment for elevation and reports “READY”.

Figure 4-3: Quadrant Laying Sequence

9. **Direct Laying**:

   a. Direct laying will be done by the one-man lay method where ③ lays for both direction and range using the panoramic telescope.

   b. Having clamped the sight mount ③ lays as follows:

      (1) lays on the point of aim for direction and range using the panoramic telescope;

      (2) cross levels the mount; and

      (3) lays for direction and range on the point of aim and reports “READY”.

10. **Anti-tank Laying**. For anti-tank laying see Chapter 3.

TO CHANGE FROM ONE AIMING POINT TO ANOTHER

11. **Considerations**:

a. It is sometimes necessary to change from one aiming point to another, e.g. from GAP 1 to GAP 2.

b. If, during a fire mission, the current aiming point becomes unusable, ③ will report this fact to ①, e.g. “GAP 1 OBSCURED”. ① will then order the change to an alternate aiming point.

12. **Drill**. On the report “GAP OBSCURED” by ③:

a. ① notes the reading on the slipping scale and the gunner's aid, and orders “REPORT”.

b. ③ reports the reading on the slipping scale and the gunner's aid.

c. ① orders ③ to set the panoramic telescope at the recorded angle to the aiming point, e.g. GAP 2.

d. ③ sets the gunner's aid to zero, and sets the main scale at the angle to the aiming point ordered.

e. ① checks the setting and slips the slipping scale to the bearing of the C of A.

f. ① orders the current convergence and bearing as noted in subparagraph a above.

g. ③ sets the gunner's aid and the slipping scale as ordered, and relays on the new aiming point.

TO REPOSITION THE SLIPPING SCALE

13. **Consideration**. If the slipping scales are correctly clamped by ① they should not slip, but if they do slip they can be repositioned using the drill detailed previously.

14. **Drill**:

a. ① orders ③ to set the panoramic telescope at the recorded angle to the current aiming point, e.g. aiming posts.

b. ③ sets the gunner's aid to zero and sets the main scale and micrometer at the angle for the aiming point ordered, as recorded on the record plate.

c. ① checks the setting and slips the slipping scale to the reading for the C of A.

d. ① obtains the correct bearing from the GPO or from the nearest gun.

e. ① then orders the gun to be laid at the current convergence and bearing.

f. ③ sets the gunner's aid and the slipping scales as ordered and re-lays on his aiming point.

TO COMPLETE A DEFERRED CENTRE OF ARC RECORD

15. **Considerations**:

a. If "DEFER SECOND RECORD" is ordered, or if fire orders are received during the recording of the C of A, ① will report "NUMBER _____ RECORDED" as soon as the record to the first aiming point has been completed.

b. The record of the main scale reading to GAP 2 must then be completed without further orders at the first opportunity.

c. Before beginning this operation, ① must note the bearing at which the gun is laid, in order that the gun can be re-laid as last ordered after the operation is complete.

16. **Drill**:

a. ① notes the current reading of the slipping scale and gunner's aid, and orders ③ to report the reading as a check.

b. Having corrected any discrepancy, ① orders "CENTRE OF ARC".

c. ③ sets the slipping scales to the C of A, the gunner's aid to zero, and lays on GAP 1.

d. ① checks that the main scale reading agrees with the reading to GAP 1 as recorded on the record plate.

e. The drill for recording GAP 2 is then carried out in the normal manner.

f. ① then orders the gun to be laid as last ordered.

g. ③ sets the scales and relays on GAP 1.

NIGHT LAYING

17. **Consideration**:

a. Illumination is required for the aiming posts, panoramic telescope, and telescope mount.

b. An instrument light is provided for the panoramic telescope. Aiming post lights are used for the

aiming posts and a lighting system is incorporated in the range quadrant.

c. The GPO is responsible for illumination of the troop GAPs. ① is responsible for illumination of the sights and aiming posts.

d. The M1A1 collimator has its own built-in light source (see Annex G).

CHAPTER 5
SIGHT TESTING

NOTES

1. **Object**. The object of sight testing is to ensure that sights maintain a direct and precise relationship to the bore of the gun.

2. **Checking**. After an adjustment has been made as the result of any test, the test will be repeated in order to ensure that the adjustment has been accurately made.

3. **Sequence**. Some tests are dependent on correct adjustments having already been made in some of the previous tests. The tests will, therefore, always be carried out in sequence.

4. **Training**. During training, the quick sight tests, bore sight and elevation tests will be carried out frequently in order that all ranks concerned are practised in both tests and adjustments.

5. **Droop**. Droop is disregarded in sight testing. The effect of droop, if any, is absorbed in the results of calibration.

TYPES OF TEST

6. **Periodic Tests**. The GPO is responsible for ordering these tests carried out, and ① is responsible for carrying out the tests. Adjustments will only be carried out by personnel qualified to make them. Basic accuracy tests are carried out:

   a. immediately on receipt of a new weapon;

   b. once every three months, if the gun is being fired;

   c. once a year if the weapon is being used for dry training only;

   d. as soon as possible after extensive use, accidents, or after crossing extremely rough terrain; and

e. when the weapon fires inaccurately for no apparent reason.

7. **Quick Sight Tests**. The object of these tests is to disclose any gross error in bearing and/or elevation. The GPO is responsible for ordering these tests conducted, and ① is responsible for doing the tests and ensuring that the appropriate adjustments are made. They are carried out:

a. daily when firing;

b. on the order "PREPARE FOR ACTION";

c. as soon as possible after the C of A has been recorded;

d. after each change of position;

e. immediately before a deliberate fire plan;

f. during any pause in prolonged firing; and

g. weekly, when not firing.

8. **Bore Sight and Elevation Test**. The GPO is responsible for ordering this test conducted, and ① is responsible for doing the test and ensuring that the appropriate adjustments are made. This test is used to check the scales against the bearing and elevation at which the gun is laid, and is carried out:

a. when the quick sight test indicates there is an error; and

b. immediately after a periodic test.

PREPARATION FOR TESTS

9. **Consideration**. Before carrying out periodic tests, or the bore sight and elevation test, the carriage will be placed on a firm platform which is as level as possible, the trunnions will be levelled,

and the correction for index error in the gunner's quadrant will be ascertained.

10. **To Level the Trunnions**. The trunnions may be levelled by one of the following three methods:

a. **The Plumb Bob Method**. This is the most accurate and must be used for the periodic tests before adjustments are made or the reference lines scribed on the mount. The procedure is as follows:

(1) Suspend a plumb line, at least 10 metres long, 2 to 3 metres in front of the muzzle. Insert the bore sighting disc in the chamber, or remove the firing lock and affix the crosshairs to the muzzle.

(2) Align the crosshairs with the plumb line by sighting through the bore, moving either the plumb line or by traversing, provided the gun remains approximately in the centre of traverse.

(3) Elevate and depress the gun, checking to see that the vertical crosshair tracks the plumb line throughout its length. If it tracks, the trunnions are level. The maximum allowable error is 1 mil.

(4) If the vertical hair does not track the plumb line within limits, it will be made to do so by blocking the lower trail and repeating the process.

b. **Matching Reference Lines**. This is a quick method of levelling the trunnions. They are scribed and checked during periodic tests, after the panoramic telescope has been found correct. The procedure is to match the four white reference lines on the telescope mount and, by blocking the lower trail, bring the cross level bubble to the centre of its run. The trunnions are then level.

c. **Gunner's Quadrant Method**. The gunner's quadrant is used to level the trunnions when the use of a plumb bob is not practical and reference lines have not been scribed on the telescope mount. The procedure is to clean the top of the breech ring, place a gunner's quadrant set to zero on the breech ring at right angles to the axis of the bore, and level the bubble of the gunner's quadrant by blocking one of the trails. The trunnions are then be level.

11. **To Find the Correction for Index Error**:

a. The object of finding the correction for index error of the gunner's quadrant is to ensure that it accurately indicates the angle at which the gun is laid.

b. Procedure:

(1) Set both the index arm and micrometer scale of the gunner's quadrant to zero.

(2) Place the quadrant on the levelling plates of the breech ring, the line of fire arrow pointing towards the muzzle. Centre the bubble by means of the elevating handwheel.

(3) Turn the quadrant end for end and replace it on the levelling plates. The bubble should again be central.

(4) If it is not, centre the bubble by means of the quadrant micrometer knob, setting the index arm to read -10 mils, if necessary, and read the setting.

(5) Half of this reading (subtracted from 10 if the index arm is set to -10 mils) is the correction for index error. It is plus if the

index arm is set to zero, and minus if set to -10 mils.

NOTE

Care should be taken in determining that the correction for index error is minus. With the index arm set to -10 mils, and the micrometer reading set to 6, the index error will be -4. The correction for index error will be -2. Set the index arm to -10 and the micrometer to 8. Set the correction on the gunner's quadrant and repeat subparagraphs 3b(2) and (3). If the bubble does not remain central, repeat the process from subparagraph 3b(1).

(6) The correction for index error will be recorded, and must be applied with its correct sign to all elevations when laying by gunner's quadrant.

(7) At the first opportunity, the quadrant will be forwarded to a fire control system technician for adjustment.

c. **Examples**. The following examples show the application of the correction found.

(1) Example 1 (elevation below 800 mils):

Correction for index error +0.2 mils

Elevation ordered 458.0 mils

Angle set on gunner's quadrant 458.2 mils

(2) Example 2 (elevation above 800 mils):

Correction for index error +0.3 mils

Elevation ordered 956.0 mils

Angle set on gunner's quadrant 955.7 mils

(3) For angles greater than 800 mils the quadrant is reversed and so a plus correction must be subtracted.

PERIODIC TESTS

12. **Considerations**:

a. The tests specified earlier will be performed using this manual, and need not be memorized.

b. If the maximum allowance error is exceeded during any of the tests, the equipment will be adjusted by a weapons technician (land).

c. The tests will be performed in the sequence shown.

13. **Preparation**:

a. Level the trunnions.

b. Bore sight the weapon in accordance with para 28 of this Chapter.

c. Do not disturb this setting, and check it frequently, since the accuracy of the following tests is dependent upon the trunnions being exactly level.

d. In addition to the preparations outlined in the previous sub-section, obtain a machined steel plate or piece of plate glass, preferably square in shape, at least 15 cm long.

14. **To Test the Telescope Mount**:

a. Lay the gun accurately at zero elevation by means of the gunner's quadrant.

b. Centre the cross and longitudinal level bubbles. Turn the cross-level knob throughout its limits of motion.

c. The longitudinal level bubble should remain central. Maximum allowable error is one-half a graduation of the bubble vial.

d. Centre the cross and longitudinal level bubbles.

e. Elevate the barrel to maximum elevation in steps of 100 mils. Level the longitudinal level bubble after each step. Maximum allowable error is one-half a graduation of the bubble vial.

15. **To Test the Cross and Longitudinal Level Bubbles on the Mount**:

a. Centre the cross and longitudinal level bubbles.

b. Place the machine plate (or plate glass) on top of the panoramic telescope mount.

c. Set the gunner's quadrant at zero (corrected for index error). Place the quadrant on the machined plate, parallel to the axis of the bore. The quadrant bubble should be central. If it is not, centre it by means of the quadrant micrometer knob. Maximum allowable error is 0.2 mils.

d. Set the quadrant back to zero and place it on the machined plate at right angles to the axis of the bore.

e. The quadrant bubble should be central. If it is not, centre it by means of the quadrant micrometer knob. Maximum allowable error is 0.2 mils.

16. **To Test the Elevation Indices on the Mount**:

a. Lay the gun accurately at zero elevation with the gunner's quadrant and centre the cross and longitudinal level bubbles.

b. The fine indices on the longitudinal levelling knob shaft and the coarse indices on the rocker and actuating arm should coincide. If not, they must be adjusted by a weapons technician (land).

17. **To Test the Reference Lines on the Sight Mount**:

a. With the gun laid accurately at zero elevation, centre the cross and longitudinal level bubbles. The reference lines should coincide.

b. If they do not, and provided the trunnions have been levelled by plumb line, the old reference lines will be removed and new ones scribed.

18. **To Test the Range Quadrant**:

a. With the gun laid accurately at zero elevation, centre the cross and longitudinal level bubbles of the range quadrant.

b. Turn the cross level knob throughout its limits of motion. The longitudinal level bubble should remain central. Maximum allowable error is one-half a graduation of the vial.

c. Cross level the range quadrant and elevate the barrel to maximum elevation.

d. Centre the longitudinal level bubble. The cross level bubble should be central. Maximum allowable error is one-half a graduation of the vial.

19. **To Test the Telescopes for Parallax**:

a. Parallax is the apparent movement of the reticle with respect to the target as the eye is moved from side to side or up and down when viewing.

b. Install the panoramic and elbow telescopes in their mounts.

c. Lay each in turn on a reference object 300 to 500 metres distant, shifting the eye from side to side and up and down while observing the reference object.

d. If the reticle appears to move with respect to the target, the telescope is out of adjustment.

20. **To Test the Panoramic Telescope for Backlash**:

a. Zero the scales on the panoramic telescope.

b. Traverse and elevate as necessary to place the panoramic telescope reticle crosshairs on an aiming point. A plumb line may be used.

c. Rotate the telescope head through 6400 mils by means of the right micrometer. The telescope crosshairs should return to the aiming point within 1 mil.

d. Rotate the telescope through 6400 mils by means of the right micrometer in the opposite direction. The telescope crosshairs should again return to the aiming point within 1 mil.

21. **To Scribe Reference Lines**:

a. The object of scribing reference lines is to record the correct relationship of moving parts of the telescope mount in regards to non-moving parts, thus enabling ① to rapidly sight test the howitzer.

b. On completion of the above tests, and if the barrel and sighting equipment are in alignment within the tolerances laid down, lay the gun exactly at zero, and level the telescope mount in both directions. Scribe lines will now be placed on the telescope mount as follows:

(1) across the junction of the cross-levelling segment and the cross-levelling worm housing;

(2) across the junction of the cross-levelling worm knob shaft and cross-levelling worm housing;

(3) across the junction of the rocker and the actuating arm; and

(4) straight across the junction of the longitudinal levelling knob shaft and the bracket.

c. These references lines are cut into the paint only. They are then neatly filled in with white paint.

22. **To Determine the Standard Angle**:

a. The ideal time to determine the standard angle for later use is during periodic tests, when the panoramic telescope has been found to be in correct alignment. The procedure for determining the standard angle is as follows:

(1) A parallax shield is first constructed of stiff cardboard or brass shim stock. It should be the same size as the object lens housing, with a vertically and horizontally centred slot 0.5 mm wide by 1 cm long. The shield should be placed in front of the object glass with the slot in the vertical position.

(2) After checking the recoil system with the gun in the firing position, mark the normal position of parts that move in recoil with respect to parts that do not move in recoil. A reference mark can be scribed or painted across the junction of the cradle and sleigh.

(3) Carefully level the trunnions by means of a plumb bob.

(4) Bore sight the gun.

(5) Lay the gun at 300 mils elevation.

(6) Fasten the parallax shield over the object glass on the panoramic telescope.

(7) Simultaneously using the right micrometer knob and the elevation index, and approaching from the left, align the right edge of the vertical crosshair with the left edge of the muzzle, and the bottom edge of the horizontal zero range line with the top of the muzzle. This results in the muzzle appearing in the lower right quadrant of the reticle pattern (see Figure 5-1).

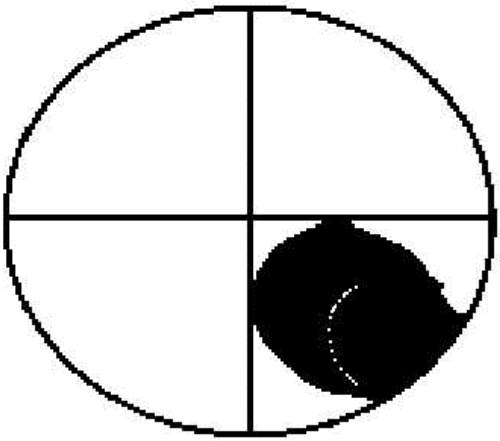


Figure 5-1: Sight Picture for Standard Angle Test

(8) Verify that the cross-level and longitudinal bubbles are level, and that the vertical hairline of the telescope is exactly on the junction of the pin with the muzzle.

(9) Read and record the angle on the main scale and micrometer to the nearest 1 mil. This is the standard horizontal angle for the gun tested.

(10) Scribe a line across the junction of the rocker and actuating arm, and the longitudinal level knob and bracket. Fill in the lines neatly with red paint.

THE QUICK SIGHT TESTS

23. **Consideration**. The quick sight tests consist of the alignment test using the recorded standard angle, and the elevation test using an elevation of 300 mils.

24. **Preparation**. On the order "QUICK SIGHT TEST" proceed as follows:

a. Match the white scribe lines of the cross-levelling segment and worm housing, and the cross-levelling worm knob shaft and worm housing.

b. Match the red scribe lines of the rocker and actuating arm, and the longitudinal levelling knob and bracket.

c. Fasten a parallax shield over the object glass of the panoramic telescope.

d. Verify that the parts that move in recoil are in the same position in respect to non-moving parts as they were when the standard angles were determined. If they are not in the same position, the amount of recoil oil in the recoil mechanism must be adjusted until the distance is the same.

e. Lay the gun at an elevation of 300 mils by means of the range quadrant.

25. **Alignment Test**:

a. Simultaneously using the right micrometer knob and the elevation index, and approaching from the left, align the right edge of the vertical crosshair with the left edge of the muzzle, and the bottom edge of the horizontal zero range line with the top of the muzzle. This results in the muzzle appearing in the lower right quadrant of the reticle pattern (see Figure 5-1).

b. The main scale and micrometer should now be set at the recorded standard angle. If not, the bore sight and elevation test must be carried out. When it is not possible to bore sight the howitzer at this time, the following adjustments are made as a temporary measure:

(1) Slacken the two screws in the right micrometer knob. Slip the micrometer to the standard angle and tighten the screws.

(2) Check that the telescope is still correctly laid on the muzzle.

26. **Elevation Test**:

a. Set the sight scale to 300 and the micrometer to zero.

b. Place the gunner's quadrant, tested for index error and set to 300, on the breech levelling plates, and bring the bubble to the centre of its run by means of the elevating handwheel.

c. Level the longitudinal and cross-levelling bubbles by means of the elevation micrometer and cross-levelling knob.

d. The elevation scales should read 300, and the micrometers should read zero. Maximum allowable error is ±1 mil.

e. If the elevation indices do not match they will be adjusted as follows:

(1) Slacken the screws on the index plate of the elevation scale and set it to 300. Tighten the screws.

(2) Slacken the screws on the elevating knob and slip the micrometer to zero.

(3) Verify the adjustment.

BORE SIGHT AND ELEVATION TESTS

27. **Consideration**:

a. These tests consist of:

(1) a bore sight (alignment) test; and

(2) an elevation test.

b. The bore sight and elevation tests can be carried out separately. Should there be an error in the alignment and/or elevation of a gun found as a result of the quick sight test, that gun will be withdrawn from action, the bore sight and/or elevation test performed, any adjustment made, and the gun returned to action.

c. Adjustments made as a result of alignment tests do not affect the angle passed from the director, nor the recorded angles to GAPs, etc.

28. **Bore Sight Test**:

a. **Object**. The object of this test is to ensure that the main scale of the panoramic telescope correctly records the clockwise horizontal angle between the bearing in which the gun is laid and the line of sight through the panoramic telescope. This is an accurate method of bore sighting.

b. **Preparation**:

(1) Level the trunnions.

(2) Set up the target testing sight about 50 metres in front of the gun and at right angles to the axis of the bore or, select as a laying mark a well-defined object at least 2000 metres distant (see Figure 5-2).

(3) Insert the bore sighting disc at the breech end, or remove the firing lock and affix crosshairs at the muzzle.

(4) Fix the panoramic telescope in its mount and check the telescope for slackness in the tangent screws.

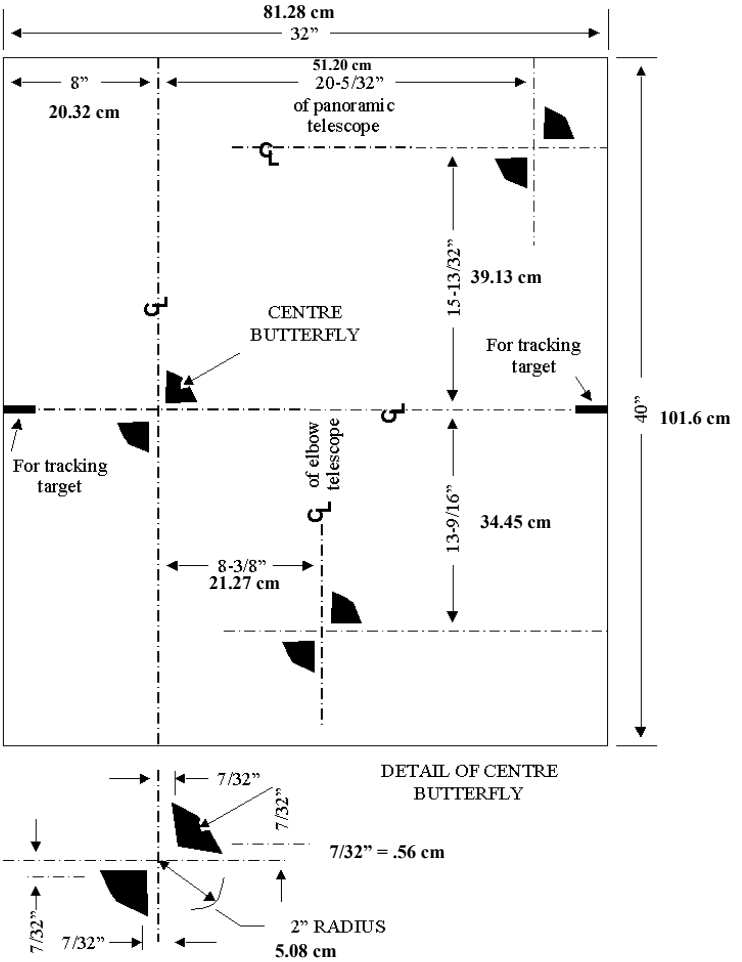


Figure 5-2: The Target Testing Sight

(5) Level the barrel using the gunner's quadrant, and centre the cross-level and longitudinal level bubbles of the telescope mount (unless another method has been used).

(6) Match the coarse and fine indices of the rotating head and the four reference lines on the telescope mount.

(7) Using the elevating and traversing hand wheels, lay the bore on the distant object, or on the centre butterfly of the target testing sight.

c. **Test and Adjustments**:

(1) To test the panoramic telescope for alignment, lay it on the distant laying mark, or on the left butterfly of the target testing sight, by means of the right micrometer and elevation knobs of the panoramic telescope.

(2) The main scale and right micrometer should read zero mils, and the coarse and fine elevation indices of the rotating head should coincide.

(3) If the test shows that the panoramic telescope is not in alignment for line and/or elevation, the sight is adjusted as follows:

(a) by means of an Allen wrench, slacken any two set screws of the index ring, and the set screws of the right micrometer head;

(b) shift the main scale index and the right micrometer skin to

zero, and reclamp them in position;

(c) slacken the three set screws on the elevation knob;

(d) shift the fine index to zero and reclamp; and

(e) check the alignment of the bore and the telescope.

(4) The adjustment of the coarse indices will be carried out by a weapons technician (land).

29. **Elevation Test**:

a. **Object**. The object of this test is to ensure that the elevation scale correctly indicates the elevation applied to the gun.

b. **Procedure**:

(1) Level the trunnions if they are not already levelled.

(2) Determine the correction for index error of the gunner's quadrant.

(3) Set the elevation scale and micrometer to zero.

(4) Set the sight scale to 300 and the micrometer to zero, and level the barrel by means of the gunner's quadrant.

(5) Level the longitudinal and cross-levelling bubbles by means of the elevation micrometer and cross-levelling knob.

(6) The elevation scale and micrometer should read zero.

c. **Adjustment of Indices**. If these tests show that the elevation indices do not match they will be adjusted as follows:

(1) Slacken the screws on the index plate and set the plate to zero. Tighten the screws.

(2) Slacken the screws on the elevating micrometer and slip the micrometer to zero. Tighten the screws.

(3) Recheck.

d. **Consistency Test**. The object of this test is to disclose inconsistency in the range quadrant. The procedure is as follows:

(1) Lay the gun accurately at 300 and 700 mils respectively by means of the gunner's quadrant.

(2) Centre the cross and longitudinal level bubbles after each operation; the elevation scale should read 300 and 700 mils respectively. Maximum allowable error is ±1 mil. If a discrepancy of more than 1 mil occurs, adjustment must be carried out by a weapons technician (land).

30. **The Elbow Telescope Test**:

a. **Object**. The object of this test is to ensure that the elbow telescope correctly indicates the range applied to the gun.

b. **Procedure**:

(1) Slacken the clamping bolt and match the T (for testing) scribe lines across the elevation worm and housing, if present (see Figure 5-3).

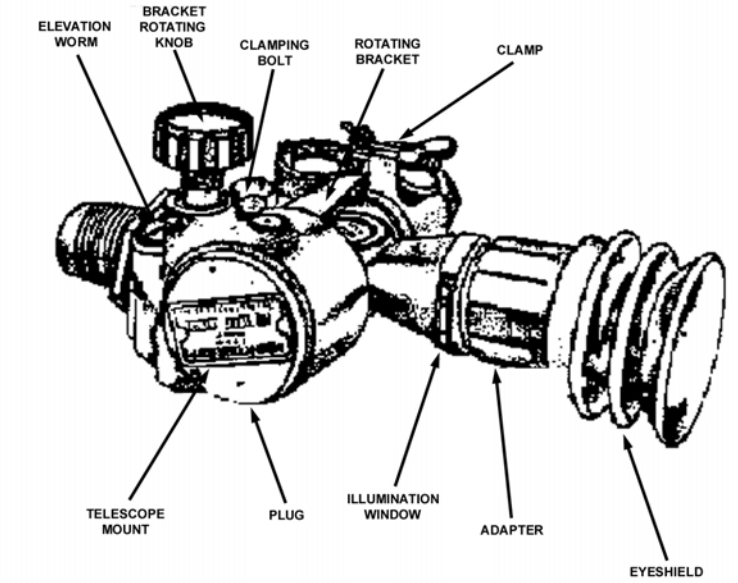


Figure 5-3: The Elbow Telescope

(2) Sight through the elbow telescope and bring the reticle pattern horizontal by means of the bracket rotating knob.

(3) The N range line should now be laid on the laying mark or right butterfly of the target testing sight. If correct, set the elevation worm back to S (for shooting), if present, and tighten the clamping bolt.

c. **Adjustments**:

(1) Slacken the clamping bolt and rotate the elevation worm until the N range line is correctly positioned on the laying mark or butterfly.

(2) Tighten the clamping bolt and, if the elevation worm has not been scribed, cut a reference line in the paint across the junction of the elevation worm and housing and mark it with a T (for testing). These scribe marks should be neatly filled in with white paint.

(3) No provision is made for adjustment for line.

(4) Whenever the reference lines marked T are changed, the S reference lines will also be affected and the gun must be zeroed again.

ZEROING

31. **Considerations**:

a. The object of zeroing is to ensure that the point of impact for elevation coincides with the point of aim, at the range at which zeroing is carried out.

b. Zeroing should be carried out at least every quarter life of the gun, or after any adjustment to the range quadrant due to a period test.

c. The ammunition to be used for zeroing will be HESH or Squash Head Practice.

32. **Preparation**:

a. Bring the gun into action on a level platform and carry out the bore sight and elevation tests.

b. At 400 metres from the gun and as nearly as possible at the same level, set up a zeroing target, i.e. a black canvas screen, 3 metres square, divided centrally by horizontal and vertical white bands.

Ensure that the bottom of the screen is clear of the ground.

33. **Test and Adjustments**:

a. The gun will be zeroed as follows:

(1) Match the reference lines.

(2) Set the rotating head of the panoramic telescope to zero.

(3) Lay the 400-yard reticle of the elbow telescope and the vertical reticle of the panoramic telescope on the intersection of the white bands.

(4) Fire the gun.

(5) If the round misses the target, alter the lead or range used, relay and fire. Continue to correct until a hit is obtained.

(6) Fire a total of three rounds at the range which gives hits, relaying accurately on the centre of the target for each round.

(7) Relay after the last round of the group.

(8) Without disturbing the alignment of the bore, lay the 400-yard reticle of the elbow telescope on the mean point of impact of the three-round group by means of the elevation worm.

(9) Record this by scribing a line across the worm and housing. The lines should be neatly filled in with red paint and labelled S for shooting. This mark will always be used when engaging targets using the elbow telescope.

(10) Revolve the elevation knob of the panoramic telescope until the 400-yard reticle of the telescope is laid on the mean point of impact of the three-round group.

(11) Record this by scribing lines on the elevation micrometer opposite the fine index, filling it in with red paint and labelling it S for shooting. These marks will always be used when engaging targets by direct laying.

(12) Relay on the target at the mean point of impact.

(13) Fire a check round.

b. The result of zeroing is accepted as correct if the check round strikes the target within the three-round group.

CHAPTER 6
MANHANDLING AND WINCHING

INTRODUCTION

1. It may be necessary to use chains, winches, planks, and improvised aids to assist in moving the gun over difficult country. Manhandling will be exceptional when the gun is hooked in.

2. Detailed instructions for driving and winching are given in the appropriate manuals. These notes are intended only as a guide.

3. Guns will often have to be manhandled into position. As far as possible, each detachment should be capable of moving the gun without outside assistance. The correct methods of lifting and pulling must be applied. Manhandling is not a drill, and detachment members should be detailed to tasks in accordance with their physique.

MANHANDLING

4. **Lifts and Pulls**:

   a. **Positions**. In lifting heavy objects the best position is with the feet parallel and approximately 30 cm apart, the knees bent, and the back as straight as possible. Full use is then made of the strong muscles of the buttocks and legs, thus conserving energy and reducing the chance of injury, especially to the back.

   b. **The Collier's Lift**. The back is turned towards the object to be lifted, which is then grasped with arms straight, knees bent, and back as straight as possible. The lift is then performed by straightening the legs, using the leg and buttock muscles. This lift can be applied from the muzzle side of the shield when the gun is to be taken trails first over an obstacle.

c. **The Rope Pull**:

(1) This is a pull as in a tug-of-war. The rope is held under the right armpit, and grasped with both hands close together, the left hand in front palm upward, and left arm straight. The feet should be at right angles to the rope, both pointing to the right and about 30 cm apart from front to rear. The left leg should be straight to provide leverage and the right leg bent to provide driving power.

(2) If members are placed on the right of the rope, their positions are as described above, but with "left" and "right" interchanged.

(3) In order to avoid waste of effort when two or more members are to pull on a rope, the rope must be straight, i.e. members must be aligned in the direction of the pull, and if the rope is attached low down, must be sized with the shortest in front.

(4) On the level, the pull is divided into two phases, "taking strain" and "heaving", while on a slope there is a third phase, "holding". The pull is controlled as follows:

(a) On the order “TAKE STRAIN”, each member allows the body to fall back to an angle of about 45 degrees, keeping the body straight from the sole of the leading foot to the crown of the head. The sides of the feet should be dug well into the ground and the rope made taut.

(b) On the order "HEAVE", the strain is maintained on the rope and each member lowers the angle of the body and heaves by a powerful stretch of the legs and body. As soon as possible, both feet are moved in the direction of the pull.

(c) On the order "HOLD" each member holds the rope taut until the brakes have been engaged or until chocks have been placed under the wheels. The order "REST" is then given.

d. **Towing on the Flat**. When the gun is on fairly level ground and can be kept on the move, ropes can be used for towing. The ropes are attached to the axles, each member faces the direction of the tow, and pulls on the rope with one or both hands beside the body, the leading member on each rope passing the rope round the body.

5. **Aids to Manhandling**. To avoid wasted energy, full use should be made of the following aids:

a. **Spades**. When going uphill it is generally best to manhandle the gun muzzle first. The spades can then be used to prevent the gun running back when "HOLD" is ordered.

b. **Brakes**. These should be applied at once on the order "HOLD", and released on the "TAKE STRAIN".

c. **Chocks**. These are stones, wooden blocks, and the like, which are placed close against a wheel to prevent the gun from running down hill, or placed against a vertical obstacle to form a small ramp or step.

d. **Ramps and Planks**. These may be used for crossing a ditch, or for making a sloping path over a vertical obstacle.

WINCHING

6. **General**:

a. An attempt to tow the gun after wheel spin has begun is almost certain to result in bogging the vehicle. The gun should be unhooked at once, and the vehicle driven forward to the extent of the winch cable. The vehicle is then turned about, halted, the brakes applied, and the winch cable pulled out and attached to the lunette by means of a shackle. The gun is then winched to the vehicle.

b. If the vehicle is now on moderately firm ground but further bad patches are anticipated, the gun may be left attached to the winch cable, the winch brake applied, and the vehicle driven backwards until wheel spin begins again. The winch brake can then be released and the vehicle driven slowly backwards, paying out the winch cable. Before the end of the cable is reached, the vehicle is halted and braked, and the gun again winched forward.

7. **Considerations**. The following considerations are important:

a. The vehicle should be pointed as closely as possible along the line of pull, so that the pull is direct.

b. The shackle must be used for attaching the cable to the lunette.

c. The cable must be under tension during paying out and winding in.

d. The cable must be kept clean and must not be allowed to drag on the ground.

e. The cable must not be completely unwound from the winch drum. There should be three or four turns of the cable around the drum before winching begins.

f. Care should be taken that the spades are kept clear of the ground during winching.

g. Care should be taken to ensure that all personnel stand clear of the cable, as a potentially dangerous whipping action will occur if the cable breaks.

CHAPTER 7
INSPECTION AND PREVENTIVE MAINTENANCE

GENERAL

1. A thorough systematic inspection of the howitzer is absolutely necessary to guard against unexpected breakdown at a moment when maximum performance is required. Never let equipment run down. Keep it in first class fighting condition by careful inspection and prompt repair.

AIMS OF INSPECTION

2. The immediate aims of inspection are to:

   a. determine the condition of the howitzer;

   b. detect faulty or careless maintenance, especially inadequate lubrication;

   c. determine whether adjustments, repairs or parts replacement are necessary; and

   d. ensure that all authorized modifications have been made.

3. Inspection should always be accompanied by corrective measures to remedy any deficiencies or defects found.

INSPECTION PROCEDURE

4. **Carriage in General**:

   a. Examine the condition of all welds and rivets. Ensure there are no loose, broken or missing plates, bolts, nuts, screws, or cotter pins. Check that all exposed parts are clean, free from rust and properly lubricated. See that all parts are adjusted and tightened.

b. Check the condition of paint, bare spots and rust. Clean and repaint as required. Ensure that all bearing surfaces are free from paint and rust.

c. Lubrication fittings should be clean and should function properly. They should be identified by a 2 cm RED coloured circle painted about their bases.

5. **Lunette and Drawbar**:

a. Inspect the lunette for condition, excessive wear (ovality) of the loop, and tightness of the drawbar.

b. Check rotational movement of the drawbar assembly, ensuring that all movement is unobstructed.

6. **Spades and Trails**:

a. Examine spades for cracks and distortions, the condition of welding and reinforcements, and loose rivets.

b. Examine trails for straightness and seams for welding. Examine the trail handle, handspike bracket, cleaning staff supports, and aiming post supports. Inspect the trail travelling lock loop, and the pin and cotter pins, for wear or damage. Examine the trail travelling lock handle and the hook and latch, ensuring the latch is free but not loose.

c. Ensure that handles and levers of the cleaning staff supports engage without effort. Check the quick opening devices for holding the handspike in the travelling position.

d. Check the travelling lock brackets for proper adjustment and correct alignment with the travelling lock shaft.

e. Open and close the trails and check for excessive play or binding at the trail hinge pins. See that hinge pins are properly lubricated and not scored or badly worn.

7. **Axle, Equalizing Support, Wheels and Tires**:

a. Inspect the axle and equalizing support for alignment. A bent axle or equalizing support must be replaced.

b. Inspect all machined surfaces, checking for burrs and rust spots.

c. Rotate the axle lock lever assemblies to the open and close positions. Assemblies should operate freely. Check for burrs, rust spots or excessive looseness. Ensure the lock shaft guide screw and nut are properly adjusted and not loose.

d. Check the hand brakes by jacking the wheels. Using one hand, spin the wheel vigorously; at the same time apply the brake slowly, noting when the brake takes hold. The brake, when properly adjusted, should begin to take hold when the lever assembly has moved 3 cm from the OFF position, and the wheel should stop completely after approximately 3 cm more of travel.

e. Check the tires for uneven wear (an indication that wheels are out of alignment or tires are not inflated to 275 kPa (40 PSI)). Check the wheel nuts for tightness. Ensure that valves are serviceable and that valve caps are present.

f. Inspect tires for cracks in the side walls. Tires should be correctly inflated to 275 kPa (40 PSI).

8. **Traversing Mechanism**:

   a. Traverse the howitzer through its complete range. The traversing mechanism should work freely and smoothly.

   b. Check the traversing handwheel for backlash. If backlash is present, it should not exceed one-quarter turn of the handwheel.

   c. Check bolts and screws for tightness and brackets for cracks or other damage.

9. **Elevating Mechanism**:

   a. Elevate and depress the howitzer through its complete range, ensuring the mechanism works freely and does not bind.

   b. Check the right and left handwheel for tightness on the shaft, and for backlash. Allowable free play is one-quarter turn of the handwheel.

   c. Inspect gear cases and gear case screws for cracks and tightness.

   d. Check the worm shaft and gears for worm bushings and bearings.

   e. Check the elevating arcs for damaged teeth, burrs or wear.

10. **Equilibrator**:

   a. Check the action of the equilibrator by depressing and elevating the howitzer through its complete range. It should elevate and depress easily.

   b. Inspect the inner and outer springs and spring seats for cracks and proper placement. Inspect the fulcrum for cracks and other defects. Inspect nuts on the equilibrator guide rods for proper fit.

11. **Firing Mechanism**:

    a. Check the operation by pulling the lanyard. Note the operation of the firing shaft pawl, and inspect the firing shaft and lanyard for wear or damage.

    b. Examine the firing shaft guide bracket for wear and correct alignment with the firing shaft.

12. **Shields**:

    a. Inspect the main shields for loose nuts in the panoramic telescope case. Brackets must be kept tight.

    b. Examine the surface of the shield for cracks.

13. **Cradle Lock Strut**:

    a. Inspect the brace for cracks and excessive wear. Inspect turnbuckles for cracks. Examine all nuts for burrs and thread fit.

    b. Examine the cradle lock piece for burred threads and excessive wear on the strut hinge pin. Ensure the strut support latch assembly operates properly.

14. **Bore and Muzzle Brake**:

    a. **General**. The bore should be free from dirt, grit, rust, and propellant fouling (not to be confused with coppering of the bore). A clean bore is not necessarily a shiny bore; it might frequently have a dull grey appearance. A shiny bore usually indicates that abrasives have been used in the cleaning operation.

    b. **Damage to the Forcing Cone**. Scratches, nicks, pitting, and scoring of the bore may permit leakage of gas past the rotating band of the projectile, causing erosion of the bore, subsequent loss of muzzle velocity, and loss of range.

c. **Rifling**. Check the lands for stripping and shearing. If this is present, the howitzer must be inspected by a weapons technician (land) before it is fired.

15. **Breech and Firing Lock**:

a. The breech block should open and close without binding. In the closed position it should be positively locked. All sliding surfaces and threads should be clean, smooth, and free from burrs or scratches. The levelling plates should be free from dirt, burrs, scratches, roughness, or paint. The breech operating lever catch should be tight and free from wear or damage.

b. All parts should be clean and properly lubricated. Examine the breech block bushing for a worn firing pin hole and tightness in the breech. The surface of the breech block bushing should be flush with the surface of the breech block. All screws should be flush or below the surface.

c. Inspect the following parts for satisfactory operation, scores, deformation, cracks, breakage, wear, or other damage:

(1) breech block operating assembly;

(2) operating lever pivot;

(3) extractor;

(4) trigger shaft;

(5) trigger shaft detent and trigger shaft detent spring; and

(6) firing lock and firing spring.

d. Examine the condition of the firing pin and check for correct protrusion. The firing pin must not be

broken or deformed, and must have sufficient force to fire the primer.

16. **Recoil Mechanism**. Check that the recoil slides are clean, free from rust, not burred or scratched, and properly lubricated. Check that the sleigh rails fit the cradle guides snugly.

17. **Sighting and Fire Control Equipment**:

a. Check to ensure all sighting and fire control equipment is complete. Any missing, broken or bent parts should be noted and action initiated for immediate replacement. Ensure all instruments are secure on the carriage and that clamp and wing nuts are serviceable.

b. Ensure all bearing surfaces are clean and lightly oiled. Check all graduations and indices for legibility. Ensure that watertight seals are not broken. Check to see that level vials are serviceable, unbroken, tightly mounted, and covered when not in use.

c. Check handwheels and knobs for ease of operation. Operate the cross-levelling and longitudinal-levelling mechanisms through their entire range. Mechanisms should work freely without excessive lost motion, and be free from binding.

d. Look through the instruments, noting any evidence of chipping, fungus, separation, dirt, grease, finger prints, moisture, or scratches on the lenses or prisms. Note the condition of the horizontal and vertical cross lines and scales on the reticle. Ensure the field of view is clear.

e. Check the eyepiece assembly for looseness, and note the condition of the eye shield, covering caps, and filters.

f. Check for parallax by focusing the instrument on a sharp, well-defined aiming point. Move the eye from side to side and up and down, observing the target and the reticle simultaneously. If there is any apparent movement of the reticle in relation to the target, parallax exists and must be reported to a weapons technician (land).

PREVENTIVE MAINTENANCE

18. **General**. Preventive maintenance is the care exercised and the work performed to keep the equipment in good operating condition. It includes:

a. cleaning and lubrication;

b. adjustments; and

c. detection and correction of possible causes of malfunctions.

19. Preventive maintenance, like an inspection, must be systematic, therefore the following procedure is recommended.

a. **Before Firing**:

(1) **Bore, Chamber and Muzzle Brake**. Wipe dry.

(2) **Breech and Firing Mechanism**. Ensure proper function.

(3) **Recoil Mechanism**. Check for excessive oil leakage. Drain and re-establish oil reserve. Adjust respirator.

(4) **Recoil Slides**. Clean and oil exposed surfaces.

b. **During Firing**:

(1) **Recoil Mechanism**. Observe behaviour and check for: smooth operation; complete run-out without shock; excessive oil leakage; and length of recoil.

(2) **Recoil Slides**. Keep exposed surfaces lubricated.

(3) **Breech and Firing Mechanism**. Clean and lightly oil during pauses in firing.

(4) **Bore,Chamber and Muzzle Brake**. Inspect periodically for excessive fouling.

c. **After Firing**:

(1) **Bore, Chamber and Muzzle Brake**. When the tube has cooled and can be touched with the bare hand, and for three consecutive days after firing (or longer if sweating occurs), its bore is cleaned with an authorized cleaning solvent. Apply the cleaning solvent to the bore brush. Insert the brush into the bore from the chamber end and thoroughly scrub all surfaces with a push-pull action. When clean, the bore will have a uniform, grey appearance. After each cleaning, the bore is wiped dry of cleaning solvent and thoroughly oiled with low temperature general purpose lubrication oil (type 3GP 335A).

(2) **Breech Mechanism**. Strip, clean and oil daily for three consecutive days or until sweating stops.

(3) **Elevating Arcs and Pinions**. Clean and lightly oil.

(4) **Recoil Mechanism**. Inspect for leakage. Turn respirator to closed position.

(5) **Recoil Slides**. Clean and oil exposed surfaces.

(6) **Traversing Mechanism**. Clean and lightly oil.

(7) **Howitzer, General**. Overall inspection and correction of deficiencies.

d. **Weekly Service**:

(1) **Bore, Chamber and Muzzle Brake**. Examine for evidence of propellant fouling or corrosion. Clean and oil.

(2) **Breech Mechanism and Firing Lock**. Examine for evidence of corrosion or other damage. Check for clean, smooth operation. Clean and oil.

(3) **Carriage or Mount**. Observe general condition. Check for cleanliness, proper lubrication and condition of paint.

(4) **Covers**. Check for proper installation and condition of canvas.

(5) **Elevating Mechanism**. Check for smoothness of operation throughout its entire range. Check handwheel backlash.

(6) **Oil Points**. Wipe clean and oil.

(7) **Recoil Mechanism**. Check for excessive oil leakage. Keep respirator in closed position.

(8) **Recoil Slides**. Check for rust or damage. Wipe clean and oil exposed bearing surfaces.

(9) **Sighting and Fire Control Instruments**. Wipe clean and oil exposed bearing surfaces.

(10) **Tires and Wheels**. Inspect general condition and tire pressure.

(11) **Traversing Mechanism**. Check for smoothness of operation throughout its entire range. Check handwheel backlash.

e. **Monthly Service**:

(1) **Grease Fittings**. Wipe clean and lubricate.

(2) **Range Quadrant and Telescope Mounts**. Clean and oil.

f. **Before Travelling**:

(1) **Howitzer, General**. Prepare for travelling. Check for loose bolts or parts.

(2) **Lighting System**. Check installation and operation.

(3) **Covers**. Check installation.

(4) **Drawbar and Pintle**. Check engagement and safety pin.

(5) **Handbrakes**. Check adjustment.

(6) **On-Carriage Equipment and Tool Chests**. Check installation, loading and security.

(7) **Travelling Locks and Latches**. Check for proper alignment and engagement.

(8) **Tires and Wheels**. Inspect general condition and tire pressure.

ANNEX A
DENIAL OF MILITARY EQUIPMENT AND SUPPLIES TO THE ENEMY

1. **Reference**. STANAG 2113 (Edition 4), *Denial of Military Equipment and Supplies to an Enemy*.

DEFINITIONS

2. **Denial**. Removal from a threatened area, rendering unusable by the removal of parts, contamination (other than by NBC means), immobilization or partial or total destruction of military equipment or supplies.

3. **Military Equipment and Supplies**. This includes civilian equipment and supplies used by allied forces.

GENERAL

4. The enemy must be denied the use of military equipment and supplies, other than medical equipment and supplies.

5. Denial to the enemy should, if possible, not preclude their later use by Canadian or allied forces.

6. Destruction of military equipment and supplies will only be ordered when their falling into enemy hands cannot be prevented by other forms of denial.

7. Denial of military equipment and supplies to prevent their use by an enemy is the responsibility of the user.

8. Provision of instructions and means for, and training in, the denial of military equipment and supplies is a national responsibility.

9. **Priorities**. The priorities and extent of the denial of military equipment and supplies must be decided by the commander ordering it, taking into account their potential value to the enemy. Some examples could be:

a. **As a High Priority**:

(1) classified equipment, material and documents;

(2) petroleum, oils and lubricants;

(3) sophisticated weapons systems or electronic equipment;

(4) heavy weapons and associated ammunition;

(5) communications equipment;

(6) ferrying and bridging equipment; and

(7) air, sea and land transport.

b. **As a Second Priority**. Any other stores, equipment or facilities which may be of use to the enemy.

c. **Extent of Denial**. This will depend on the time available and the probability of recapture. In denial of equipment, all detachments must follow the same procedure, so that, for example, if numerous guns are captured they will all be deficient in the same essential part.

TEMPORARY DISABLEMENT

10. To disable the 105 mm Howitzer so that it can be brought into action immediately after recapture, remove the panoramic telescope, elbow telescope, gunner's quadrant and firing lock.

11. To disable the gun so that it can be brought into action after repair, remove the items in paragraph 9. In addition, remove the oil filling valve and drain the oil reserve.

DESTRUCTION

12. The authority for ordering the destruction of equipment and supplies is vested in divisional and higher commanders, who may delegate it to subordinate commanders.

REPORTING

13. Reporting the destruction of equipment and supplies will be through command channels.

PROCEDURE

14. **Ammunition**. If time permits, fire all ammunition at Charge 7, saving two rounds of HE. If time does not permit, lay out the charge bags in a straight line and ignite them from an upwind position. Ensure that all personnel are safe from flames.

15. **The Gun**. To destroy the gun, place an HE projectile in the muzzle and load with HE. Fire the gun from behind cover by means of a length of rope or wire attached to the trigger shaft. If time permits, drain the oil reserve prior to firing. This will increase the damage done to the gun when fired.

ANNEX B
CONSTRUCTION OF GUN PITS

1. **Reference**. This annex should be read in conjunction with the applicable Engineer manual on demolitions.

BASIC DIMENSIONS

2. The basic dimensions of a gun pit giving arcs of fire for the top traverse are shown at Figure B-1.

3. To increase the arc of fire by a further 200 mils on either side, the rear wall of the pit should be prolonged a further 1.2 m on either side.

4. For 6400 mil traverse, the gun pit has a 3.6 m radius.

METHOD OF CONSTRUCTION

5. The procedure may have to be varied and certain items omitted, depending on the nature of the ground and time available, but the recommended sequence is as follows:

a. **Marking**. Mark the perimeter of the pit on the ground. For night digging it should be marked with white tape.

b. **Removing the Sod**. Remove the sod from the area inside the perimeter, leaving a strip around the edge of the pit approximately .6 m wide. This strip acts as a guide during excavation and in the construction of the sandbag wall. Stack the sods, grass to grass and earth to earth, outside the perimeter. Remove topsoil and pile it against the sods.

c. **Preparations for Revetment**. Insert short pickets approximately 1.2 m outside the perimeter, and attach eight strands of revetment wire to each picket. Lay the wire on the ground and allow a

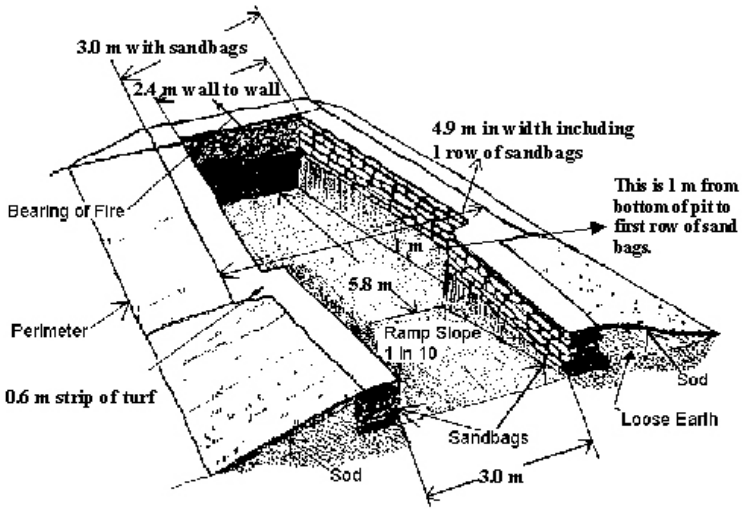
0.3 m overlap at the pit wall. One short picket and wire are required for each 0.6 m of revetment. This distance may be increased to 0.9 m if firm revetment material, such as corrugated iron sheeting or planks, is to be used.

d. **Digging and Sandbagging**:

(1) Digging and sandbagging should proceed concurrently. During digging, keep all soil within the perimeter. Lay the first, third, fifth, etc., courses of sandbags as leaders, with the neck away from the centre of the pit. Lay the second, fourth, sixth, etc., courses of sandbags as stretchers, i.e. lengthways along the wall, with the side seam away from the centre of the pit.

(2) Sandbags should be filled three-quarters full, the corners should be tucked in when laid, and the sandbag beaten flat with a shovel or pick handle. Do not break the bond when laying stretchers. On completion of digging and sandbagging, spread the soil evenly against the sandbags, as shown in Figure B-1.

e. **Sodding**. Spread the soil over the banks and the tops of the sandbag walls, and cover with sods.



1. **Sandbags—1 row wide from floor up, then CGI and 2m pickets.**
2. **The walls have to be built up to accommodate the C3.**

Figure B-1: Gun Pit Construction

f. **Revetment**. Before starting revetment check the measurements of the pit, then proceed as follows:

(1) **Preliminary Revetment**. Start revetment which cannot be done once the pit is occupied.

(2) **Final Revetment**. Providing the ground is not unduly soft, final revetment may be carried out after occupation of the pit.

(3) **Windlassing**. Attach the revetment wires to the retaining pickets. Windlass the wires at the perimeter by inserting and twisting a stick or .15 m nail between the wires. Drive the short pickets below ground and bury the revetment wires.

g. **Drainage**. Drainage must be considered during the reconnaissance and construction of a gun pit, and should be completed as early as possible.

h. **Shelters**. Shelters for ammunition and for the detachment should be dug close to the gun pit, and be connected to the pit by communication trenches.

ANNEX C
THE GUN POSITION OFFICER'S INITIAL SEQUENCE OF ORDERS

1. Figure C-1 describes a GPO's initial sequence of orders. The orders underlined must always be included. ① will call attention to any omission by using the word “VERIFY”, coupled with the order concerned, e.g. “VERIFY BEARING”.

Ser	GPO's Orders
1	WARNING ORDER
2	TYPE OF ENGAGEMENT
3	TRAJECTORY
4	AMMUNITION
5	LOAD
6	CONVERGE
7	BEARING
8	QUADRANT LAYING
9	GUN CORRECTION
10	FUZE CORRECTION
11	FUZE SETTING
12	AT MY COMMAND
13	ELEVATION
14	METHOD OF ADJUSTMENT or ORDER FOR FIRE FOR EFFECT
15	DESCRIPTION OF TARGET

Figure C-1: The GPO's Initial Sequence of Orders

ANNEX D
FIRE PLANS

GENERAL

1. This annex contains information about fire plans for the guidance of ①.

2. A fire plan is one or more fire missions conducted on a timed program.

PREPARATION OF AMMUNITION

3. All ammunition to be used should, if possible, be prepared before the fire plan starts, as there will be little time for preparing charges or setting fuzes during firing.

4. Ammunition should be stacked in groups by serials, and charges should be prepared, checked and marked. Mixed lots should be fired whenever possible.

SIGHT TESTING

5. Sight tests are carried out as follows:

   a. bore sight and elevation tests if possible, otherwise the quick sight test, before the fire plan begins; and

   b. quick sight test during rest periods, when firing a long fire plan.

TIMINGS

6. **General**. The first round of any serial is fired at the time given for the beginning of the serial, and the last round is fired not later than the time given for the end of the serial. Any rounds which

have not been fired by the time ordered for the end of the serial must lapse.

7. **Control of Timings**

a. The order "FIRE" will normally be given by the GPO for the opening round.

b. Timings are best controlled by the GPO, rather than by ①. This is done by voice, the GPO ordering "LAY ON SERIAL ____" and "SERIAL ___: FIRE" at the appropriate time.

c. If it is necessary to remain on a serial for longer than the time shown, the GPO will order "SERIAL ___ DWELL: FIRE FOR EFFECT _____ ROUNDS ___ SECONDS". The guns continue to engage the serial named until further orders or the method of fire ordered has been completed.

d. Timings may be controlled by ①, taking this timing from the initial order "FIRE" by the GPO.

e. GPOs will always brief ①s on the method of fire control.

DUTIES OF ①

8. After the last round fired in any serial, ① orders the bearing (if altered), fuze setting (if necessary) and elevation for the next serial.

9. ① orders the detachment to rest and to resume at the times ordered.

10. ① ensures that the gun is laid at the current bearing and elevation while resting, except when carrying out the quick sight test.

11. ① ensures that maintenance is carried out as necessary.

GUN PROGRAM

12. An example of ①'s gun program is shown at Figure D-1. Bearing and gun corrections may be incorporated in the bearing and elevation as shown in the example. Total ammunition required for any one fire plan may be shown in a convenient space on the form.

GUN PROGRAM

Originator **19** Name of Fire Plan **HOT STEEL** H-Hour **1600 HRS**

a	b	C	d	e	f	g	h	i	j	k	l	m	n	o
Serial	Time		Type of Engagement	Ammo	Charge	Bearing Corrections	Bearing	Site	Gun Corrections	At My Command	Fuze	Elevation	Method of Fire	Remarks
	From	To												
1	**1559:30**	**1607:30**		**TIME**	**5**	1 2 3 4	**2684**		1 2 3 4		**22.2**	**378**	**8 RDS FFE 60 SECS**	
2	**1609:30**	**1613:30**		**HE Q**	**5**	1 2 3 4	**2521**		1 2 3 4			**394**	**4 RDS FFE 60 SECS**	
3	**1614:30**	**1617:30**		**HE Q**	**5**	1 2 3 4	**2535**		1 2 3 4			**412**	**3 RDS FFE** 60 **SECS**	
4	**ON**	**CALL**		**HE Q**	**7**	1 2 3 4	**2617**		1 2 3 4			**317**	**4 RDS FFE**	
5	**1637:30**	**1644:30**		**HE Q**	**7**	1 2 3 4	**2728**		1 2 3 4			**369**	**14 RDS FFE 30 SECS**	
						1 2 3 4			1 2 3 4					
						1 2 3 4			1 2 3 4					

Figure D-1: Example of Gun Program

ANNEX E
ARTILLERY SALUTES

GENERAL

1. Authorization for firing artillery salutes is detailed in orders issued by NDHQ or delegated subordinate headquarters. This annex deals only with the preparation and conduct of the mission.

PRECAUTIONS

2. When firing blank ammunition, the following precautions must be observed:

a. No officer, NCO or gun number who has not been trained in gun drill may command a section or form part of a gun detachment.

b. No gun will be reloaded within 15 seconds after firing.

c. ① will examine the chamber and ensure that any debris is removed before ordering load. A wet rag should be available at each gun for this purpose.

PREPARATIONS

3. When firing an artillery salute has been ordered, the GPO should ensure that the following preparations are completed 30 minutes before saluting time:

a. the guns are ready on the on the gun position;

b. the ammunition, including spare rounds, has been examined and issued to the guns;

c. all ammunition has been chambered, and oversize rounds withdrawn from the guns; and

d. all members of the detachment are familiar with the drill for a misfire when firing blank ammunition.

4. The GPO should appoint the following assistants and ensure that each is familiar with his duties:

a. A deputy to supervise any action required at a gun owing to a misfire or a jammed cartridge. This deputy will note the time of a misfire, and indicate to the GPO and ① when the breech may be opened. The deputy will also order the redistribution of ammunition when required.

b. A timer to time the interval between rounds, and to indicate to the GPO each time a round should be fired.

c. A counter to check off each round as it is fired, and to inform the GPO when the last round of the salute has been fired.

MISFIRES

5. When a misfire occurs with blank ammunition, the breech shall not be opened until 30 minutes have elapsed, therefore the gun will be out of action for the remainder of the salute. The remaining ammunition must be redistributed to the other guns on the orders of the GPO or deputy.

6. The timer will make no attempt to make up for lost time, but will start the interval from the time the next gun actually fires.

DRILL FOR MISFIRES

7. If the gun fails to fire on the first attempt, the firing number will immediately fire again.

8. If the gun fails to fire on the second attempt, ① will report "NUMBER _____ MISFIRE".

9. The GPO will immediately order that gun to check firing and the next gun to fire, e.g. "② CHECK FIRING. ③ FIRE".

10. The detachment of the gun concerned will remain at their positions in action until the salute has been completed (except to redistribute ammunition as ordered by the GPO or deputy).

11. After 30 minutes have elapsed, and on order from the GPO or deputy, ① of the gun concerned will order "UNLOAD", and accept the round from the breech.

12. The round will be examined by the GPO or deputy and, if the primer has been struck, the round will be placed in a container, clearly labelled "misfire", for return to the issuing unit. No attempt will be made to destroy the contents of the cartridge case.

13. If the primer has not been struck, the round will be returned to the issuing unit along with the spare ammunition.

DRILL FOR JAMMED CARTRIDGES

14. When a cartridge becomes jammed during loading, the following drill will be carried out:

a. ① will immediately report "NUMBER ___ OUT OF ACTION".

b. The GPO will then order that gun to check firing and the next, in turn, to fire.

c. ① will make every effort to remove the jammed cartridge, remedy the cause of jamming, and load.

d. When the gun is loaded, ① will report "NUMBER ___ READY" to the GPO or deputy.

e. On the report of READY, the GPO may either order that gun to cancel check firing and include it in the orders to fire, or have the remaining ammunition redistributed among the other guns.

FIRE DISCIPLINE

15. Due to the nature of the fire mission, and the number of rounds to be fired, a slight departure from recognized fire discipline is required. A sequence of orders for an artillery salute is shown in Figure E-1.

16. The interval between rounds is normally 10 to 15 seconds but should be the same throughout the mission.

17. Two guns must be ready to fire as each round is ordered, thus ① of each gun must ensure that his gun is loaded and ready when the gun preceding his is ordered to fire.

Ser	Orders	Remarks
(1)	(2)	(3)
1	"FIRE MISSION FOUR GUNS"	---
2	"ROYAL SALUTE"	---
3	"21 ROUNDS BLANK"	---
4	"BEARING _____"	
5	"GUN CORRECTION"	
6	"ELEVATION _____"	
7	"LOAD"	---
8	"REST"	---
9	"CANCEL REST"	Given just before dignitaries are due to arrive, if applicable.
10	"AT MY COMMAND"	---
11	"① FIRE" "② FIRE" "③ FIRE" "④ FIRE", etc.	Given at the appropriate time. The GPO retains control until the salute is complete.
12	"UNLOAD"	Given after the last round has been fired.
13	"END OF MISSION"	---

Figure E-1: The GPO's Sequence of Orders for a Royal Salute

ANNEX F
OPEN ACTIONS AND SNIPING GUNS

OPEN ACTION

1. Open actions are used to engage targets which are visible from the gun position or targets that the battery may encounter while on the move. The GPO may order direct or indirect fire, and selects the highest possible charge to be used.

2. Since speed is essential, the guns are not laid in their C of A by the normal method. Instead the GPO will:

a. select an unmistakable reference point from which to measure the angle to the target using the hand or, if time permits, a compass or director;

b. estimate the bearing and range to the target; and

c. give the initial sequence of orders (see Figure F-1).

Ser	GPO's Orders	Action
1	"FIRE MISSION FOUR GUNS (OR NUMBER)". "OPEN ACTION". "HE M557 QUICK, CHARGE 7".	Guns are brought into action as indicated.
2	"REFERENCE POINT, CHURCH TOWER" "BEARING 0150"	On the order "REFERENCE POINT" ① will ensure that the main and slipping scales are set to zero. The bearing ordered is then set on the slipping scale and the guns are laid using the reference point as a GAP. C of A is not recorded.
3	"ELEVATION _____". "NUMBER _____ ADJUST FIRE".	Guns are laid in the normal manner.
4	"BEARING _____ OR BEARING (RIGHT OR LEFT _____)". "ELEVATION _____".	Alterations to bearing may be ordered as right or left provided no confusion can arise.

Figure F-1: The GPO's Initial Sequence of Orders for an Open Action

3. **Considerations**:

   a. If ① has any difficulty identifying the reference point, ① will double to the GPO who will indicate the reference point and order the bearing to the reference point.

b. ⑤ and ⑥ will take up their normal positions in action once the trails have been embedded.

c. Alterations to bearings may be ordered as "RIGHT" or "LEFT", provided no confusion can arise.

4. **Drill**:

a. On the order "FIRE MISSION ___ GUNS (number of guns to engage) OPEN ACTION", guns are brought into action in the normal manner.

b. On the order "REFERENCE POINT", e.g. "CHURCH TOWER BEARING 0150", ① will ensure the main scale and slipping scale are set to zero.

c. ③ sets the bearing ordered on the slipping scale of the panoramic telescope.

d. ① checks the setting and orders "TAKE POST TO LAY", if necessary.

e. ③ directs the movement of the trails until the gun is roughly laid on the reference point, then signals "TAKE POST".

f. ② and ③ will lay the gun accurately, ③ using the reference point as a GAP.

g. On the order "LOAD", ⑤ and ⑥ will take up their positions on the hand spike and drawbar respectively and bear down. This will assist the bedding in of the spades when the gun fires.

h. Subsequent bearings may be ordered as "BEARING RIGHT (LEFT)" or as a new bearing.

SNIPING GUN

5. **Introduction**. A special procedure using a single gun is sometimes used to destroy small targets by direct or close indirect fire, e.g. against pillboxes, roadblocks, fortified observation posts (OPs), or fortified anti-tank guns.

6. Great accuracy is required. This implies that:

a. a large calibre gun firing at a high charge is preferable;

b. the gun, preferably SP, should be deployed as close to the target as possible since vertical Probable Error (PE) increases rapidly with an increase in range, thereby decreasing accuracy; and

c. very accurate laying is required, which may be achieved by using a gunner's quadrant, permitting corrections of one tenth of a mil for elevation.

7. Deliberate preparations are required for occupying the position, engaging the target, and withdrawing the gun.

8. The fire mission is conducted by normal indirect fire methods due to the danger of the target becoming obscured. The detachment may be accompanied by an officer or NCO for observation of fire or an OP party may be tasked for this role. ① must be prepared to carry out the observation of fire task in the event that an observer is not available.

9. **Procedure**:

a. **Preparations for the Task**. When ordered by the artillery commander authorized to order the movement of guns, the GPO, observer and detachment commander shall ensure that they:

(1) know the task, route and rendezvous (RV);

(2) know the originator of the task;

(3) know with whom to liaise on arrival;

(4) have the necessary stores for the completion of the task, i.e. binoculars, prismatic compass, Graphic Firing Tables (GFT) or tabular firing tables, the correct type and amount of ammunition, radios or telephones, map, protractor, etc.;

(5) have instructions on where to report or whom to contact on completion of the task;

(6) brief the detachment on all aspects of the operation;

(7) deploy and orient the gun;

(8) order the initial sequence of orders to the gun, excluding "ADJUST FIRE"; and

(9) finally, occupy an OP if required.

b. **During the Mission**:

(1) Corrections to bearing and elevation will be ordered by the observer in mils, following the normal rules for adjustment of fire, i.e. correct for line, then bracket for range (see B-GL-371-002/FP-001, *Field Artillery, Duties of the Battery Commander and the Observer,* Chapter 2, "Adjusting Fire".)

(2) Adjustment is carried out until a target round is attained.

(3) Fire for effect is ordered with any necessary corrections.

(4) Confirmation is obtained from the originator of the task that the mission has been completed satisfactorily, and the mission is then ended.

c. **On Completion of the Task**. ① shall:

(1) withdraw by the selected route;

(2) return to the selected RV; or

(3) carry out further orders received.

10. **Detailed Duties of ①**. On arrival at the RV, ① will:

a. Order ⑦ to "PREPARE FOR ACTION" (③ will set the main and slipping scales to 0 mils).

b. Report to the originator of the task to determine:

(1) the target location and description;

(2) the gun area; and

(3) restrictions, if any.

c. Conduct a detailed reconnaissance of the area allotted and select:

(1) a suitable gun platform and mark it;

(2) the route in and out;

(3) a suitable aiming point/GAP (care must be taken to ensure that the aiming point/GAP will not become obscured by the gun or by smoke during firing),

(4) the method of orienting the gun (see Considerations on next page);

(5) the bearing and range to the target; and

(6) a position from which to observe the target (the position should be forward and upwind of the gun).

d. On completion of the reconnaissance, return to the RV and brief the detachment on the operation.

e. Accompanied by the driver and ③, return to the gun platform and show the driver the in route, out route and the gun platform.

f. Show ③ the target and aiming point/GAP, and brief the method of orientation (① will leave ③ at the gun platform to observe the target and return with the driver to the RV).

g. Deploy and orient the gun.

h. Order the initial sequence of orders to the detachment, excluding the order "ADJUST FIRE" (see Figure F-1 - The GPO's Initial Sequence of Orders for an Open Action). Charge 7 is the normal charge used in the sniping role (for ease of reference, Figure F-2 provides range/elevation values for Charge 7).

i. If no observer is available, occupy the OP and when ready to observe, order "ADJUST FIRE".

j. Complete the task.

11. **Considerations**:

a. One method of orienting a sniping gun is the aiming point method, which is described hereafter. Once the gun platform has been marked, ① takes up a position at or near the gun marker and uses a compass to determine the angle between the target and the aiming point. If the reference point is to the *left* of the target, the angle found is the bearing ordered to the gun.

Example: Bearing to the Target 5850 mils

Bearing to the Aiming Point 3640 mils

Angle found/Bearing ordered to the gun 2210 mils

b. If the aiming point is to the *right* of the target, the angle found is subtracted from 6400 and the result ordered to the gun as a bearing.

Example: The angle found between the target and the aiming point was 1800 mils. Then, 6400 - 1800 = 4600 mils. The bearing ordered to the gun would be 4600 mils.

c. If the bearing to the target is determined from the map, then the compass bearing to the aiming point must be converted to a *grid* bearing before proceeding to find the angle between the target and the aiming point.

d. The range to the target will be determined from the map and verified by estimation.

e. ① is not restricted to the aiming point method of orientation.

Ranges (metres)	Elevation (mils)
200	4
400	8
600	12
800	17
1000	21
1200	26
1400	31
1600	36
1800	41
2000	47
2200	52
2400	58
2600	65
2800	71
3000	78
3200	85
3400	92
3600	100

Figure F-2: Range/Elevation Table for Charge 7

ANNEX G
INFINITY AIMING REFERENCE

COLLIMATOR M1A1

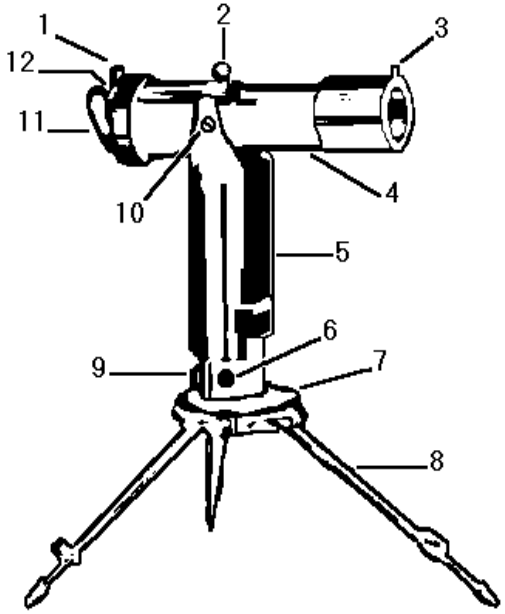
1. The collimator is an optical instrument used for indirect laying of artillery equipment by establishing an optical reference from which bearings can be measured. It consists of a tripod with telescoping hinged legs, a mount base, and a yoke sub-assembly which houses the bearing and elevation controls. The bearing clamping knob is below the yoke and the elevation clamping knob is at the top of the yoke. The elevation yoke allows the collimator to be adjusted plus or minus 853 mils in the vertical plane (see Figure G-1).

2. The collimator assembly consists of an optical system, a mechanical housing and a built-in self-luminous tritium light source. When using instruments with radioactive light sources, detachment members should be particularly alert for radiation and poisoning hazards (see annex I).

3. The reticle pattern is a bearing reference scale repeated at vertical intervals, thus forming a grid in the field of view. The reticle pattern is cross-levelled using the cross-level bubble, and the collimator is locked in the level position by means of the clamping knob. Open sights on the collimator permit alignment between the collimator and the panoramic telescope.

4. When not in use, the optical system is protected by a fibreglass reinforced plastic cover. The cover is attached to the collimator by three snap locks. A strap restrains the tripod legs when folded.

5. When the gun has been laid in the C of A, the collimator is placed from 10 to 15 metres to the left front of the panoramic telescope at an approximate bearing of 5900 mils.



1. Front Sight
2. Cross-Level Clamping Knob
3. Open Sight
4. Collimator
5. Yoke Assembly
6. Bearing Clamping Knob
7. Base Plate
8. Tripod
9. Bearing Adjustment Screw
10. Elevating Clamping Knob
11. Rear Cover
12. Cross-Level Bubble

Figure G-1: Collimator M1A1

SETTING UP THE COLLIMATOR

6. **Drill**:

a. Unfasten the strap on the instrument cover. Fold down the legs, extend as required and plant them firmly in the ground. Unfasten the latches between the cover and collimator base and remove the cover.

b. The collimator should be as level as possible, approximately 1 metre high.

c. Loosen the elevation and bearing clamps. Sight through the front and rear sights until the optical system is sighted on the panoramic telescope.

d. Release the collimator clamping knob and level the cross-level bubble; tighten the clamping knob. The reticle pattern is now cross-levelled.

e. The M1A1 collimator is fitted with a rear cover which must be opened for daylight operation. The cover can be rotated to reflect maximum light through the rear of the lamp assembly. For night operation, the cover is left in the closed position.

RECORD CENTRE OF ARC

7. The collimator is recorded and used as GAP 1 and the aiming posts as GAP 2.

8. The C of A is recorded in the normal way.

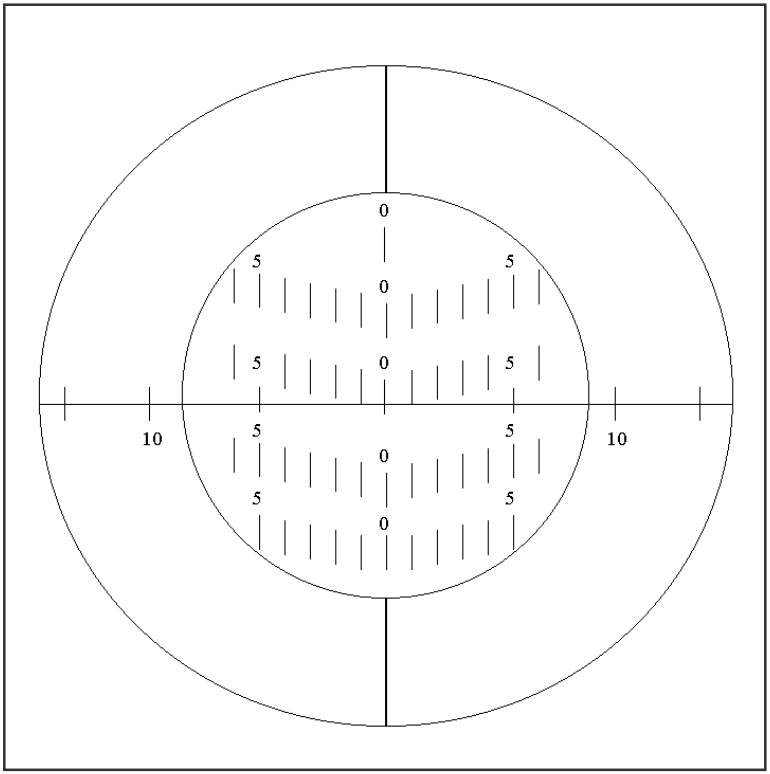


Figure G-2: Initial Alignment

DRILL

9. On the order "RECORD AT _____", ① orders "COLLIMATOR". ④ sets up the collimator 10 to 15 metres to the left front of the gun at an approximate bearing of 5900 mils.

10. ④ roughly levels the collimator and by means of the front and rear sight, aligns it on the panoramic telescope.

11. ③, with the hand extended, signals ④ to move the collimator left or right as indicated by the direction of his palm.

12. ④, using the bearing adjustment screw, slowly moves the collimator in the direction indicated. When the zero line of the V

format appears in the centre of the panoramic telescope (see Figure G-2), ③ signals clamp by making a fist.

13. ④ clamps the collimator and returns to the gun.

LAYING

14. The numbers shown in the reticle pattern are in increments of 5 mils. Individual mils are marked by short vertical lines in the V format of the pattern. This V format indicates left or right displacement of the weapon. To correct for displacement, ③ sights on the collimator and matches the reticle of the panoramic telescope with the reticle of the collimator. For example, if ③ sees 10 to 15 mils in the collimator and the reticle slopes upwards from right to left, indicating a right displacement, ③ matches the left portion of the panoramic telescope reticle with the collimator reticle pattern as shown in Figure G-3.

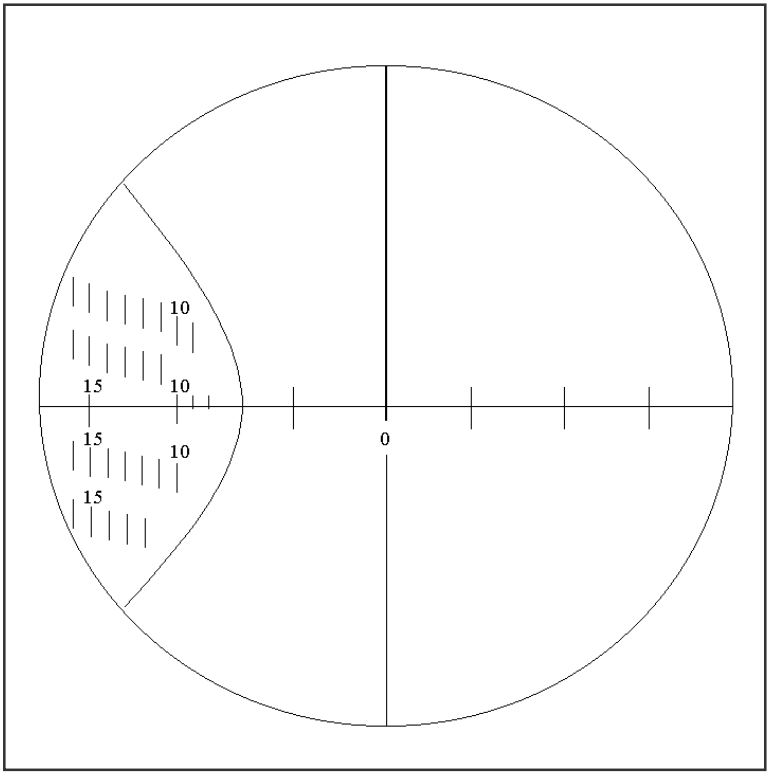


Figure G-3: Right Displacement

ANNEX H
FIRST AID TREATMENT FOR WHITE PHOSPHORUS BURNS

GENERAL

1. White phosphorus coming in contact with skin will cause severe and painful burns. Every person handling or storing white phosphorus ammunition shall be familiar with the emergency first aid treatment for white phosphorus burns.

2. Wherever there is a possibility of white phosphorus burns the unit shall be equipped with the following first aid equipment:

a. buckets/jerry cans of water;

b. suitable eye wash bottles or fountains;

c. asbestos gloves (Mittens, Cloth, Asbestos NSN 8415-21-104-2107); and

d. gauze pads, etc., as necessary.

FIRST AID TREATMENT

3. The first aid treatment for white phosphorus burns is as follows:

a. Move patient from immediate area and remove contaminated clothing and footwear.

CAUTION

Do not use oils, grease dressings, tannic acid, or other preparations. White phosphorus is soluble in oils, and thus could be absorbed more readily and cause serious systemic phosphorous poisoning.

b. White phosphorus burning on the skin should be extinguished by immediate submergence of the affected part in water and by covering the involved area with a dressing kept completely and continuously wet.

c. If white phosphorus is splashed into the eyes, wash the eyes with copious quantities of water for at least 15 minutes and apply a wet pad. This pad must be kept wet or burning will resume.

d. After neutralization and/or removal of all loose particles of white phosphorus, the treatment is the same as for a thermal burn. General principles of patient management apply, especially for any extensive burns.

4. Embedded visible pieces of phosphorus should be removed surgically and it is important that any person burnt by white phosphorus be taken to the nearest medical facility immediately upon completion of this first aid.

NOTE

As long as unoxidized phosphorus remains embedded in the skin, the contaminated area should be kept submerged in water.

ANNEX I
RADIATION AND POISONING HAZARDS OF INSTRUMENTS USING RADIOACTIVE LIGHT SOURCES

GENERAL

1. Certain types of instrument lights contain a radioactive gas. The gas is sealed in the zinc-coated glass container which, if broken, presents two potential hazards:

a. radiation from the released gas; and

b. poisoning from the coated glass splinters.

2. Gun detachments and mortar crews should be particularly alert to these hazards.

3. Instruments using radioactive light sources include:

NATO Stock Number	Nomenclature
1290-99-960-8743	LIGHT, AIMING POST, TRI-LUX ORANGE, L2A1
1290-99-960-84-8742	LIGHT, AIMING POST, TRI-LUX GREEN, L1A1
1290-21-851-8522	Set of one each of the above
1290-21-857-1743	AIMING CIRCLE C2
1240-00-332-1870	M1A1 COLLIMATOR

SAFETY PRECAUTIONS

4. The radiation hazard from one broken glass container is negligible unless the released gas, which disperses quickly, is inhaled. If a container is broken in a confined space, such as a

vehicle, the space should immediately be evacuated by all personnel and thoroughly aired.

5. Glass fragments from the broken container should be disposed of in the following manner:

a. the contaminated area should be wiped with a damp cloth to collect the glass fragments. Gloves must be worn to protect the hands;

b. the cloth and fragments should be placed in a suitable container, such as a metal can or plastic bag, and disposed of as normal waste; and

c. hands should then be thoroughly washed with soap and water.

6. Any cuts or abrasions caused by the glass fragments must be washed with soap under running water to wash out any foreign matter. The casualty should then be referred immediately to the nearest medical officer even though the injury might normally be regarded as trivial.

ANNEX J
REFERENCES AND STANDARDIZATION AGREEMENTS

1. The following publications are related to and should be used in conjunction with this manual:

a. B-GL-371-002/FP-001 *Field Artillery, Duties of the Battery Commander and the Observer*;

b. B-GL-371-004/FP-001 *Field Artillery, Duties at Regimental Headquarters and the Gun Position*;

c. B-GL-371-005/FP-001 *Field Artillery, Instruments*; and

d. B-GL-371-009/FP-001 *Field Artillery, Handbook of Equipment and Ammunition, 105 mm Howitzer*.

2. The following NATO Standardization Agreement has been incorporated into this volume: STANAG 2113 (Edition 4) *Denial of Military Equipment and Supplies to an Enemy*.

LIST OF ABBREVIATIONS

BD	Base Detonating
C of A	Centre of Arc
CFP	Canadian Forces Publication
Chap	Chapter
CP	Command Post
CPO	Command Post Officer
CVT	Controlled Variable Time
FFE	Fire for Effect
FPF	Final Protective Fire
GPO	Gun Position Officer
GAP	Gun Aiming Point
HEAT	High Explosive Anti-tank
HEAT-T	High Explosive Anti-tank (Tracer)
HE	High Explosive
HESH	High Explosive Squash Head
mph	Miles per hour
Para	Paragraph
QE	Quadrant Elevation
TSM	Troop Sergeant-Major
VT	Variable Time
WP	White Phosphorus
2IC	Second in Command