

FIELD ARTILLERY
VOLUME II
HANDLING OF UNITS IN THE FIELD
PAMPHLET No. 5
LOCATING UNITS

INTRODUCTION

Let us suppose that the delivery means available to us and the enemy match each other in their characteristics. In these circumstances the side which operates a more efficient target acquisition system **WILL WIN THE GUN BATTLE**. There in lies the imperative need for efficient locating units.

CHAPTER 1

**TACTICAL MISSIONS AND OUTLINE
ORGANIZATION OF LOCATING UNITS**

SECTION 1 – TACTICAL MISSIONA

a locating unit has the following tactical missions to accomplish:-

- a. Location of hostile weapons by radar and **sound ranging**.
- b. *Gunner*:
 - (1) Datum and time registration by radar.
 - (2) Registration and adjustment of friendly fire by radar , **sound ranging**.
 - (3) Calibration by radar.
 - (4) Airburst fixation by radar.

- c. Conduct and coordination by radar.
- d. Provision of ballistic meteorological data for friendly artillery and sound ranging troops by meteorological [troop](#).
- e. Collection and reporting of battle field intelligence by all personnel having access to such information.

SECTION 2 – ORGANIZATION

Outline Organization

1. **Locating Regiment [Artillery](#)** The outline organization of the locating regiment [artillery](#) is shown in figure 1. A suggested distribution of personnel and vehicles based on existing TO&E is given at Annex 'A'.

REGIMENTAL HEADQUARTERS

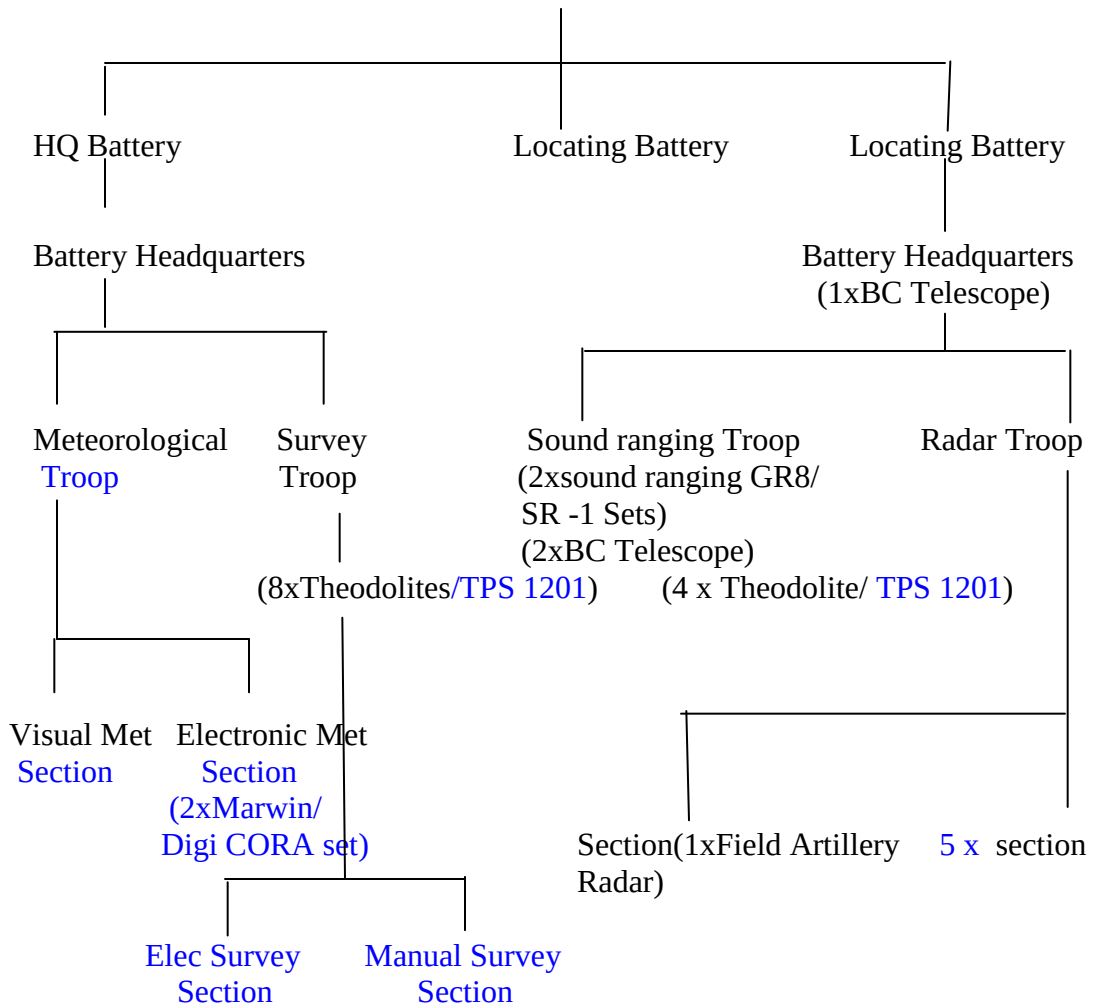


Figure 1. Outline organization of **Locating Regiment Artillery**

2. **Locating Battery Artillery** . The outline organization of the locating battery artillery is shown in figure 2. A suggested distribution of personnel and vehicles based on existing TO&E is given at Annex 'B'.

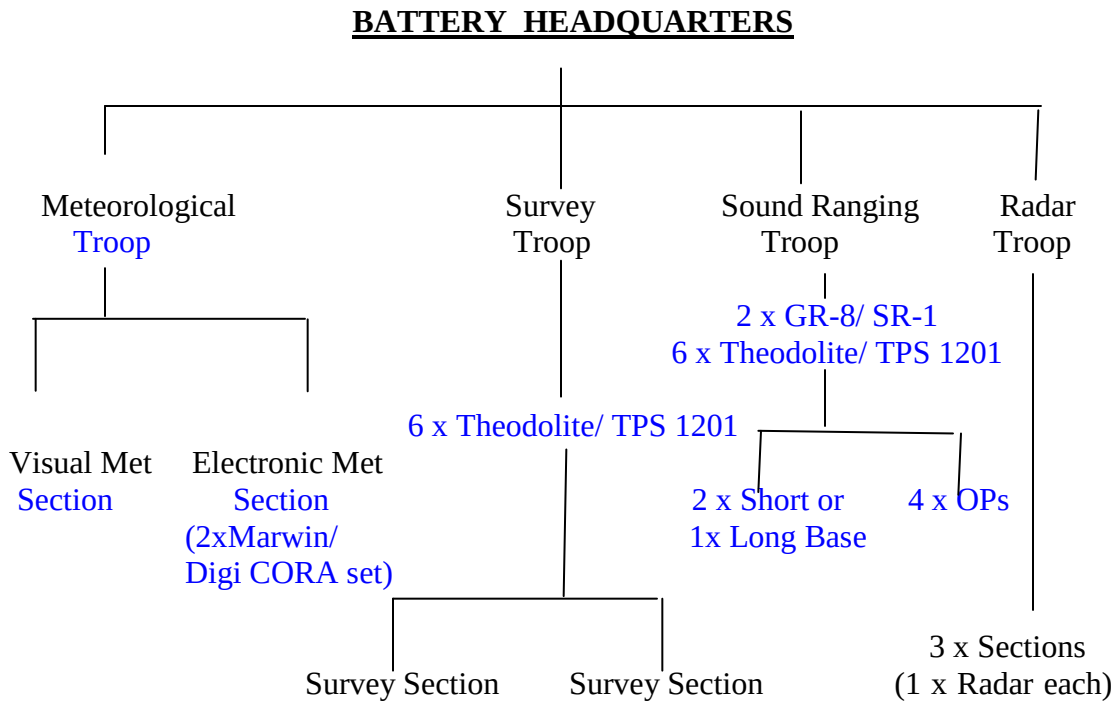


Figure 1. Outline organization of **Locating Battery Artillery**

3. **Meteorological and Survey Battery .** The outline organization of the Meteorological and Survey Battery is shown in figure 3. A suggested distribution of personnel and vehicles based on existing TO&E is given at Annex 'C'.

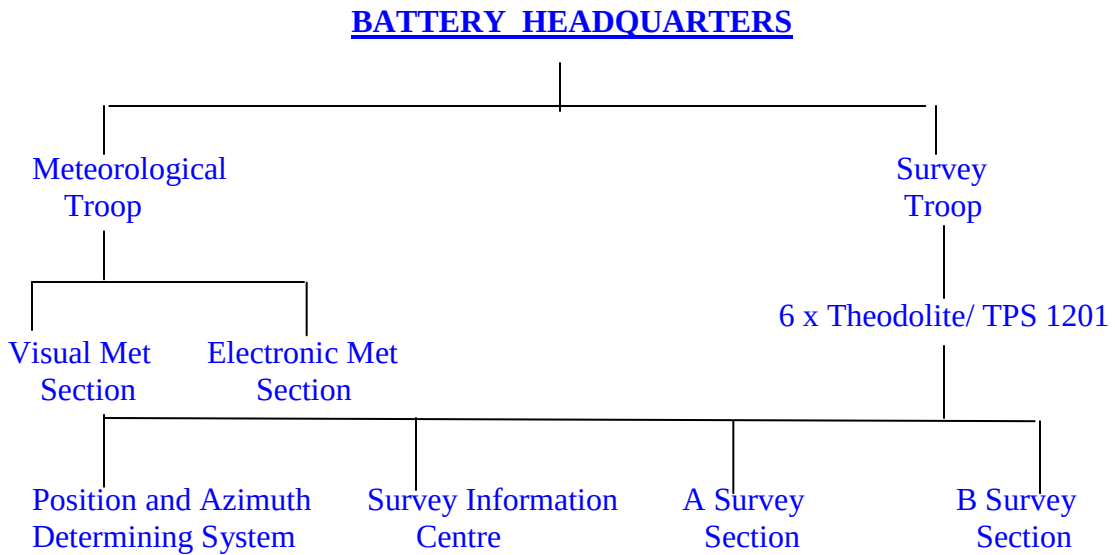


Figure 3. Outline organization of Meteorological and Survey Battery

4. **Survey 'troop headquarters artillery Armoured Division.** In the armoured division the locating elements consist of only a survey troop and meteorological section which are part of headquarters battery.

Mission

5. **General.** The lowest tactical unit is a troop. The missions of respective components of locating units are generally the same. The locating regiment artillery provides locating cover to corps divisional locating battery to an infantry division. **The divisions have meteorological survey battery.** The meteorological survey battery provide survey and meteorological data to divisional artilleries and artillery brigades without locating cover.

6. **Meteorological Troop.**

- a. Provision of meteorological data to artillery units of formation.
- b. Provision of weather data for sound ranging in case of **locating regiments artillery** and **locating batteries artillery**.

7. **Survey Troop.** **Survey troop of locating regiment artillery.**

- a. Survey
 - (1) Provision of survey data on Corps or higher grid.
 - (2) Fixation of targets.

8. **Survey Troop.** **Survey troop of locating battery artillery**

- a. Provision of survey data on divisional or higher grid to artillery units.

- b. Provision of survey data to sound ranging bases and radar sites in case of locating batteries.
- c. Fixation of targets.
- d. calibration of guns.

9. **Survey Troop.** Survey troop of Meteorological and Survey battery artillery.

- a. Provision of survey data on divisional or higher grid to artillery units.
- b. Fixation of targets.
- c. calibration of guns.

10. **Sound Ranging Troop.** The sound ranging troop of a locating battery is organized to deploy two short bases or one long base, whereas a sound ranging troop of locating regiment artillery normally deploys a long base or two short bases

- a. Location of short range hostile weapons.
- b. Adjustment of friendly fire.
- c. Collection of battlefield intelligence.

11. **Radar Troop**

- a. Location of hostile mortars, guns and rockets.
- b. Conduct of datum and time registration.
- c. Adjustment of friendly fire.
- d. Calibration of guns.
- e. Air burst fixation.

12. **Standard Lettering.** A standard system of lettering the troops, sections and Ops is given in Table 1. This lettering is used for identifications purposes in the reports sent to ICB staff.

TABLE 1 – A Standard System of the Troops, Sections and OPs

Serial	Unit/Sub-unit	Survey Troops	Sound Ranging Troop	Radar Troop
a	b	c	d	e

1 Locating Regiment

a. Headquarter Battery

Troops	A
Sections	AA Survey AB Sections

b. First Locating Battery

		B	C
Section	-	BA (Right) BB(Left)	CD CE CF
Outposts	-	A (Right) B(Left)	CG CH

c. Second Locating Battery

Troops	-	D	E
Sections	-	-	ED
Outpost	-	A (Right) B(Left) (In case of two short bases)	EE EF EG EH

2. Divisional Locating Battery

Troop	A	B	C
Sections	AA (Right) AB (Left)	BA(Right) BB(Left)	CA (Right) CB (Centre) CC(Left)
Outposts	-	A(Right) B(Left)	

13. Serial numbers allotted by sub-units ie troops or sections to hostile batteries located by them will be prefixed by the appropriate lettering.

SECTION 3 – **REGIMENTAL HEADQUARTERS**

1. The missions of RHQ in action are principally command and administration. Once deployed, the locating devices communicate all ICB information direct to ICB staff in their missions.

2. Principal duties of key personnel are described in the following paragraphs.

Duties of Key Personnel

The CO's primary duties are:-

- a. To provide locating support as ordered by higher artillery commander.
 - b. To act as an adviser to CC Artillery on locating, survey and meteorological matters.
 - c. To deploy the regiment on orders from higher artillery commander.
4. The main duties of the 2IC are:-
- a. To represent CO in his absence.
 - b. To deploy, command and administer RHQ.
 - c. To make frequent visits to batteries.
 - d. To keep himself informed of the latest tactical situation.
5. **The Adjutant.** He is the CO's staff officer and is responsible under the supervision of the 2IC for the organization and control of regimental command post. His important duties are:-

- a. To assist of CO in planning, preparation and issue of operation orders and instructions.
- b. To assist the CO in deploying the regiment.
- c. To keep the CO, BCs and ICB staff informed of the tactical situation.
- d. To organize communications of the regiment.
- e. To maintain tactical and technical maps.

6. **The Quartermaster (QM).** He is the supply officer to the regiment. His main duties include:-

- a. Maintenance of material and personnel ie replenishment repairs and replacement.
- b. Liaison with administrative staff of HQ Corps Artillery and other services.
- c. Makes frequent visits to RHQ and batteries to determined particular difficulties or requirement apart from those appearing on normal indents.

7. **The Quartermaster Technical and Mechanical Transport Officer (QM Tech & MTO)**

- a. Maintenance of equipment and vehicles including recovery and repairs.
- b. Liaison and coordination with repair organization.
- c. Makes frequent visits to RHQ and batteries to determine particular difficulties.

8. **The Subedar Major (SM).** He is the chief link between the CO and men. He makes frequent visits to sub-units, particularly to

isolated detachments from the point of view of morale. He is responsible for the organizing of local defence of RHQ.

9. **The Naib Subdar quartermaster.** He assists the QM in his administrative duties and commands the RHQ Wagon lines.

10. **The Regimental Havildar Major (RHM).** He assist the 2IC in establishment of RHQ and is responsible for marking it by day and by night.

11. **The Regimental Quartermaster Havildar (RQMH).** He assists the QM in his administrative duties.

Siting of RHQ

12. It is normally sited close to corps ICB command post. Occasions may, however, arise when it will have to be placed well forward in order to provide a wireless relay station for ICB information.

SECTION 4 - BATTERY HEADQUARTERS (BHQ)

General

1. The function of battery headquarters in action are principally command and administration. In addition the BHQ staff of a divisional locating battery will augment or assist the divisional ICB staff.

2. The duties of key personnel are given in the following paragraphs.

Duties of Key Personnel

3. **The Battery Commander (BC).** His main duties are:-

- a. To deploy his battery in accordance with the orders of higher commander so as to accomplish the assigned mission.
- b. To ascertain the adequacy and effectiveness of local defence of the battery installations.
- c. To maintain close liaison with the ICB staff and artillery units.
- d. Aim of ICB Staff

In addition, the BC of the divisional locating battery is responsible to advise the Commander Artillery of locating, survey and meteorological matters. **He also act as relief to GSO-2 (I&CB).**

4. **The Battery 2IC.** He is responsible in the battery for the maintenance of material and men ie replenishment, repairs and replacements. His other duties are: -

- a. To represent BC in his absence.
- b. To deploy, command and administer BHQ.
- c. To organize the local defence of BHQ.

In a withdrawal he may be required to represent BC in the reconnaissance of the rear position.

5. **The Battery Subedar.** He commands the BHQ wagon lines.

6. **The Battery Havildar Major (BHM).** He assists the battery 2IC in the establishment of BHQ and is responsible for marking it by day and by night.

7. **The Battery Quartermaster Havildar (BQMH).** He assists the battery 2IC in his administrative duties.

8. **The Battery Signal Havildar (BSH).** He is BC's signal adviser and supervises the communications within the battery.

Siting of BHQ

9. The selection of site for BHQ will be made as follows: -
 - a. In case of divisional locating battery, the BHQ should be sited close to the divisional ICB command post.
 - b. The BHQ of headquarters battery of a locating regiment should be placed in the vicinity of RHQ.
 - c. The locating battery of locating regiment should site its BHQ near one of the troops, preferably with sound ranging command post.

CHAPTER 2

TACTICAL EMPLOYMENT

SECTION 5 – GENERAL PRINCIPLES

General

1. The overall locating cover including survey and meteorological requirements, is planned and coordinated by the commanding officer in case of a locating regiment artillery and by the battery commander in case of a locating battery artillery. As the components of a locating unit are required to operate over a wide area, the detailed reconnaissance and deployment is carried out by the troop commanders and in some cases by the section commanders.

2. The manner in which the allotted missions will be accomplished should be left to the unit commander concerned, who should advise higher headquarters of the capabilities and limitations of their units under the existing conditions.

Capabilities and Limitations

3. The capabilities and limitations of locating elements are: -

a. *Meteorological Troop*. The electronic method makes use of the actually measured data prevalent in the various zones of the atmosphere, hence it is more accurate as compared with visual method. In bad visibility, observation with visual method cannot be made. Normally it takes 30 minutes with visual method and 60 minutes with electronic method to up station and begin observations. Another 30 minutes are taken to complete observation and formulate the message.

b. *Survey*. Two methods are used.

(1) Triangulation.

(2) Traverse

Triangulation is by far the quicker process in any terrain affording deployment of observation station. Where intervisibility of observation stations is restricted by terrain and weather it may be quicker to use traverse. Under favourable conditions, a survey party can traverse, 1,000 yards/Metre in one hour and in triangulation 30 minutes will be required for observation at each station. While making an estimate of time, allowance should be made for reconnaissance, travel time between stations and computations.

c. *Sound Ranging*. This method affords locations of hostile weapons with an accuracy of 100 yards / metres. The ranges at which this accuracy is attainable, are dependent on the base length. A long base will give this accuracy at ranges 1-1/2 times the base length and a short base at ranges 2-1/2 times the base length. It has the ability to locate weapons hidden from visual observation and is

particularly effective in fog. The sound ranging set normally provides location at ranges from 3,500-20,000 yards, 3000 / 18000 metres. The maximum range is limited by the intensity of the sound. Mountainous terrain may or may not materially affect its operations, depending on the relative location of the base, the source of sound and ground contours in the area under considerations. Battlefield noises and simultaneous firing from a large number of weapons tend to confuse film reading. High winds impair accuracy and make the operation of the base ineffective. A long base takes approximately 6-8 hours and a short base 2-4 hours to deploy excluding traveling time to the deployment area.

- d. *Radar Ranging.* This equipment locates guns / mortars with an accuracy of 100 yards / metres or 1% of the range, which ever is more. The Radar is much quicker to deploy than Sound Ranging devices. For this reason it is most useful in operations like pursuit or rapid exploitation where neither a broad front nor time permits the employment of sound ranging to the desired degree. The radar is less affected by adverse weather than sound ranging . Heavy rain and snow have negligible affect on range of Radar. It takes twenty minutes for the radar section to come into action and be ready for weapon location after reaching the radar sites.

Principles

4. The following points must be borne in mind for the employment of locating devices:-

- a. As the limitations of sound ranging do not apply to radar ranging and vice versa, these devices must be assigned the same zone of observation in order to complete each other.

- b. The locating devices must not be placed so far forward as to subject them to frequent interruptions from the enemy.
 - c. The sound ranging OPs, and radars must be sited within a locality occupied by some unit for reasons of security and administration.
 - d. In case of redeployments, the planning must ensure a continuous locating cover.
5. A locating battery artillery will be employed as a unit under the centralized control of the battery commander. Whenever artillery in the corps is engaged in an operation the locating resources in the entire will be deployed on locating plan.

Grouping

6. Under extreme circumstances, to facilitate control and administration in action, the sound ranging and radar troops of a locating battery artillery may be reorganized according to their anticipated layout on the ground. In such a case, one troop might consist of a sound ranging section and one radar section and the other troop of a sound ranging section and two radar sections.

SECTION PN 6– ORDERS FROM ARTILLERY COMMANDER

1. An artillery commander is provided with an ICB appreciation by this ICB staff. Based on this, he makes the following decisions: -
- a. Area over which he requires locating cover.
 - b. Priority of any one part of parts of the area, in the event of locating devices being unable to cover the whole area of owing to primary importance as a likely hostile battery area.

- c. Time factor and likely development of operation:-
 - (1) The suitable employment of all or part only of the locating devices.
 - (2) The priority for movement of these devices and their reconnaissance group.
 - (3) The reconnaissance of alternative sites in order to cover future moves or likely enemy penetrations.
 - d. Grouping:
2. A locating unit commander must know: -
- a. Missions.
 - b. The limitations imposed on siting the devices; these will usually be the dispositions of our own troops.
 - c. The time factor.
 - d. The location of survey information centre.
 - e. Any special grouping required.
3. After a map reconnaissance, to decide how he may best carry out the artillery commander's intention, It will be necessary for the unit commander to consult the artillery commander in order to obtain his assent or further order on the priorities for coverage of the front and any further grouping of the unit considered necessary.

SECTION 7 – ORDERS FROM UNIT COMMANDER

General

1. After receiving his order a locating unit commander carries out map appreciation. The size of area of responsibility, of locating units precludes detailed ground reconnaissance by respective battery or

regiment commander. Plans are made from map appreciations. At times however limited ground reconnaissance may be essential.

Orders

2. Orders are received by all available officers and key personnel.
3. The BC of a locating battery artillery will include the following details in the execution para of his orders: -
 - a. *Survey Troop*
 - (1) Missions in order of priority including radar and sound ranging requirements.
 - (2) Grid to be used.
 - (3) Information regarding trig points in the area.
 - (4) Location of survey information centre and time for its opening.
 - (5) Time by which to accomplish the task.
 - b. *Meteorological Section*
 - (1) Location of meteorological station.
 - (2) Timings and frequency of messages including types and the method of observation.
 - (3) Means of broadcast etc.
 - c. Grouping of locating devices.
 - d. *Task For Locating Troops.*
 - (1) Map plan for sound bases and radar sites.
 - (2) Zones of observations.

- (3) Timings of observations.
 - e. Restriction on the composition and move of reconnaissance parties and main bodies.
4. The CO of a locating regiment artillery will include the following details in the execution para of his orders.
- a. Grouping.
 - b. *Mission*
 - (1) Headquarters battery (survey and met).
 - (2) A locating battery.
 - (3) B locating battery
 - c. *Move Instructions*
 - (1) Compositions.
 - (2) Routes.
 - (3) Timings.
 - (4) RVs.
 - d. Survey information
 - e. Any special instructions.
5. The BC of a headquarters battery or a locating battery will use those headings in paragraph 4 which pertain to his sub-unit.
6. A list of headings which may be required in deployment orders is given at Annex 'C'.

SECTION 8 – DEPLOYMENT PROCEDURE

General

1. A locating unit may received orders to deploy when it is either:-

- a. At rest in a concentration area.
- b. On the move.
- c. In action.

2. The case considered here is that of a unit deploying from rest in a concentration area and occupying the positions immediately after reconnaissance has been completed. The drill is basically the same in all other cases.

3. Within the concentration area, the unit should be so arranged that its sub-units can have the area in any particular order required by the unit commander.

Outline Procedure

4. A Corps Locating Regiment; After CO has issued his orders, the deployment of the regiment proceeds as under: -

- a. *RHQ.* 2IC reconnaissance and deploys.
- b. *HQ Battery.* BC after his map reconnaissance issues orders to battery 2IC, meteorological officer and survey troop commander. Battery 2IC deploys BHQ. Meteorological officer selects site and establishes the meteorological station. Survey troop commander after detailed reconnaissance issues orders to his troop. He may sub allot the survey task to section commanders or may employ the whole troop together.
- c. *Locating Batteries.* Each battery moves to the deployment area under the battery 2IC. BC with reconnaissance parties moves ahead and liaises with the BC of the divisional locating battery. After arrival of the battery he issues orders to battery 2IC, sound ranging and radar troop commanders. If **flash ranging** section has been grouped

with the battery, the section commander will also attend the orders. Battery 2IC deploys the BHQ. Sound ranging troop commander deploys the sound ranging base. Radar troop commander deploys one radar himself and orders the section commander to deploy the second one. At the first available opportunity, the troop commander should check on the suitability of radar site selected by the section commander. **Flash ranging** sections will be deployed by its section commander.

5. **A divisional Locating Batter MAS Bty.** The divisional locating battery deploys in a similar fashion as the headquarters battery (para 4a) with the following variations: -

- a. Battery commander's orders are also received by sound ranging and radar troop commanders and their section commanders.
- b. One sound ranging short base is deployed by the troop commander and second one by the section commander.
- c. Radar troop commander deploys one radar himself and orders the section commander to deploy the other two. At the first available opportunity, the troop commander should check on the suitability of radar sites selected by the section commanders.

Reconnaissance Parties

6. The size of the reconnaissance parties will depend on the tactical situation, the degree of congestion on the roads and orders from the higher commander. The normal composition of reconnaissance parties is given in Table 2.

Table II. **Normal Composition of Reconnaissance Parties**

Serial	Unit/Sub-Unit	Troops/Sections	Name of Vehicle	Type of Vehicle	Personnel
a	b	c	d	e	f
1.	RHQ	-	Z-2	Truck ¼ Ton	2IC Subedar Major Regimental Havildar Major Driver Operator Communication (Unit)
2	Headquarter Battery	BHQ	X	Truck ¼ Ton	Battery Commander Operator Communication (Unit) Driver
			X-1		Driver
			K		Battery 2IC Battery Havildar Major Operator Communication (Unit) Driver
		Met Section	Met	Truck ¼ Ton	Met officer Driver
		Survey / Flash Ranging	RA	Truck ¼ Ton	Troop Commander Operator Communication (Unit) Driver

a	b	c	d	e	f
			Svy 4	Truck ¼ Ton	Troop Havildar Survey Party Driver
			FA	"	Section Commander Operator Communication (Unit) Driver
3.	Locating Battery	BHQ	X	"	Battery Commander Operator Communication (Unit) Driver
			X-1	"	Driver
			K	"	Battery 2IC Battery Havildar Major Driver
		Sound Ranging	RB (RD)	"	Troop Commander Troop Havildar Operator Communication (Unit) Driver
			GB (GD)	"	Section Commander Operator Communication (Unit) Driver

a	b	c	d	e	f
			OB (OD)	Truck ¼ Ton	Signal Havildar Driver
			SBI (SDI)	"	Survey Havildar Survey Pair Driver
		Radar	RC (RE)	"	Troop Commander Troop Havildar Driver
4	Divisional Locating Battery/ MAS Bty	BHQ	X	"	Battery Commander Operator Communication (Unit) Driver
			K	"	Battery 2IC Battery Havildar Major Operator Communication (Unit) Driver
		Met Section	Met	"	Met officer Driver
		Survey	RA	"	Troop Commander Survey pair Operator Communication (Unit) Driver
		Survey	Svy-4	"	Troop Havildar Survey Pair Driver

a	b	c	d	e	f
		Sound Ranging	RB	Truck ¼ Ton	Troop Commander Troop Havildar Operator Communication (Unit) Driver
			GB	"	Section Commander Operator Communication (Unit) Driver
		Radar	RC	"	Troop Commander Troop Havildar Driver

CHAPTER 3

THE METEOROLOGICAL SECTION

SECTION 9 – TACTICAL MISSION AND ORGANIZATION

Mission

1. The missions of a meteorological section are :-
 - a. *Primary Missions*
 - (1) Provision of ballistic meteorological message to artillery firing units.
 - (2) Provision of meteorological information to sound ranging and radar troops or sections.
 - b. *Secondary Missions:* Liaison with other meteorological services for exchange of meteorological information.

Organization

2. Tactical grouping for manoeuvre of the meteorological sections in a corps locating regiment and a divisional locating battery are given in Annex 'A' and 'B' respectively.

Duties of Meteorological Officer (Met Officer)

3. He commands the meteorological section and his main duties are:-
 - a. To deploy and administer the section.

- b. To advise his battery commander, commanding officer or artillery commander on meteorological matters and to recommend the frequency of meteorological messages.
- c. To maintain close liaison with other meteorological agencies including other artillery meteorological section in the vicinity.

SECTION 10 – **PRODUCTION OF METEOROLOGICAL MESSAGES**

General

1. Two methods are used to produce a ballistic meteorological message:-
 - a. Visual method.
 - b. Electronic method.

Visual Method

2. *Equipment:* The following equipment is used:-
 - a. Theodolite.
 - b. Timer.
 - c. Psychrometer.
 - d. Aneroid barometer.
 - e. Pilot balloons.
 - f. Inflation equipment.
 - g. Plotting set.
 - h. Meteorological table for artillery.

3. **Observation.** Figure 4 illustrates the complete process of production of a visual meteorological message. The outline procedure is as under:-

- a. *Ballistic Densities:* These are obtained by converting the surface observation of temperature, pressure and relative humidity with the use of meteorological tables.
- b. *Ballistic Winds:* The bearings and elevations of the released pilot balloon obtained by tracking it with a theodolite, are plotted and weighted to get the wind speeds and directions.

4. **Visual Team:** A visual team normally consists of four men, which may at times be reduced to two men but in that case time required to produce a message will be more. Duties are given below:-

Four men team

a

No.1. Theodolite operator

No.2. Time recorder

No.3. Zone wind plotter and
Surface observer

No.4. Ballistic wind plotter

Two men team

b

No.1. Theodolite operator and
ballistic wind plotter.

No.2. Time recorder, zone
wind plotter and surface
observer.

Figure 4. Production of visual meteorological message.

5. A visual team should normally take 30 minutes to set up the station and begin observation. Another 30 minutes will be required to complete observation and produce the meteorological message.

Electronic Method

6. **Equipment.** The following equipment is used:-
 - a. Radio sonde.
 - b. Rawin set.
 - c. Radio sonde recorder.

- d. Base-line check set.
- e. Power unit.
- f. Meteorological station set complete.

7. **Observation.** Figure 5 illustrates the complete process of production of an electronic meteorological message. The procedure is as under:-

- a. *Ballistic Densities and Temperatures* Radio sonde transmits the measured quantities of temperature, humidity and pressure which are recorded by the radio sonde recorder. Through a process of evaluation and plotting, the ballistic densities and temperatures are determined.
- b. *Ballistic Winds:* The bearings and elevations to the radio sonde are recorded by the control recorder at pre-set intervals. These bearings and elevations are plotted and weighted to get the wind speeds and directions.

8. **Electronic Team.** An electronic team consists of **six men four man** with duties as given below:-

Temperature and density team	Wind Team
a	b
No.1. Radio sonde recorder operator (RO)-Team leader	No.4. Zone wind computer Team leader (ZWC)
No.2. Temperature-density plotter (T.D.P)	No.5. Zone wind plotter (ZWP)
No.3. Temperature-density computer (TDC)	No.6. Ballistic wind plotter (BWP)

9. A well trained team will require about 90 minutes in which to set up the station and begin observation. Another 30 minutes will be required to complete observation and produce the meteorological message.

Figure 5. Production of Electronic Meteorological Message

Comparison of Two Methods

10. The advantages and disadvantages of visual over electronic and vice versa are listed in Table III.

Table III – Comparison of Visual and Electronic Methods

Visual	Electronic
a	b
Advantages	Disadvantages
1. It provides adequate accuracy for ranges normally fired by divisional artillery	1. All data are very accurate to any height required by present weapons. Gives accuracy necessary for the deduction of VEs.
2. Procedure and computations are simple	2. Observation is not limited by weather conditions.
3. It is economical in men and material	3. Densities and temperatures aloft are actually measured.
4. Maintenance of equipment is simple	
5. It is more mobile	
6. It is quicker	
Disadvantages	Disadvantages
1. Observations to determine ballistic winds are impossible under conditions of poor visibility.	1. Procedure and computations are complicated; training is difficult.
2. Rate of balloon rise is assumed. There is no positive way of measuring the height of the balloon	2. More personnel are required

a	b
3. Prevailing densities and temperature are estimated and not actually measured	3. Maintenance of equipment is difficult
4. Accuracy is unacceptable for the deduction of VEs.	4. Equipment is expensive.
	5. It is less mobile
	6. Takes more time

11. If due to poor visibility a visual team cannot take observation of the wind aloft, a radar section may be approached to obtain wind data.

12. The electronic method is more accurate but being expensive is should be resorted to under the following conditions: -

- a. For deduction of VEs.
- b. For weapons with ranges beyond 15,000 yard 1400 metres.
- c. When ordered by artillery commander.
- d. When visibility is bad and radar observation for wind data is not available.

SECTUON 11 – FORMS OF METEOROLOGICAL INFORMATION

General

1. Meteorological information is given out in the following forms:-
 - a. Meteorological messages for use by the firing units.
 - b. Weather data for sound ranging.

Type

2. The types of meteorological messages and artillery weapons which use each of these are tabulated in table 4.

Table IV. **TYPES OF METEOROLOGICAL MESSAGES**

Type	User Artillery
(a)	(b)
Type 2	Anti-aircraft guns firing at aerial targets (surface to air)
Type 3	All guns firing at ground targets (surface to surface)

3. The rate of change of meteorological conditions varies with terrain and time of day year. For example in the plains of Punjab meteorological conditions remain fairly stable between 1000 hours and 1500 hours during the month's of March, April and October. On the other hand meteorological conditions in Baluchistan change considerably during the two hours succeeding dawn and preceding dusk throughout the year. The frequency with which meteorological messages are required is directly related to the rate of change of meteorological conditions. Meteorological messages to be of any value must be valid at the time when targets are engaged.

Validity and Frequency

4. Modern electronic equipment is capable of producing very accurate measurements of the atmosphere through which the radio sonde travels however, the exact atmosphere which effects the flight of the projectile cannot actually be measured as explained in Figure 6. This is due to the fact that the atmosphere conditions vary in time and space. The variation with time is particularly problematic in the case of the wind.

Figure 6. A View of Trajectory and Path of Radio Sonde Flight.

5. No fixed rule can be made as to the frequency of meteorological messages since the rate of variation of the atmosphere conditions is never absolutely predictable. The meteorological officer is responsible for recommending the frequency of messages, based upon the weather at any particular time. Normally weather data for sound ranging should be transmitted every hour and the ballistic meteorological messages every two hours.

Dissemination of Meteorological Information

6. Rapid distribution of all types of meteorological messages is essential because the changing atmospheric conditions will render the message invalid. The quickest possible means should be used. The artillery commander must lay down a standard procedure for the distribution of messages to artillery units including sound ranging troops within the formation. In his deployment orders he gives the timings and frequencies of meteorological messages. Two methods for dissemination of their messages are suggested below: -

- a. The meteorological section passes the meteorological messages on line or wireless to HQ artillery who in turn broadcast these to units on line or wireless.

- b. A "meteorological broadcast net" is established and the meteorological section broadcast the messages directly to the units. Frequency and time for opening of this net are ordered by HQ artillery.

Exchange of Data

7. The meteorological section can obtain valuable data by maintaining contact with other meteorological agencies like PAF, civil meteorological departments, radars and other artillery meteorological sections. Since the section is not capable of forecasting weather, the PAF and civil meteorological departments can provide information about the prevalent weather and the major changes that are expected. This will enable the meteorological officer to plan or vary the flight schedules. Forecast of maximum temperature will help the section in base-line checks. Meteorological section should transmit data to these agencies to help them buildup synoptic maps. These agencies may provide meteorological data for artillery when so requested.

8. Other meteorological sections can provide meteorological messages in case the areas of interest overlap or the frequency of meteorological messages requires assistance by other section. Liaison with these sections is also necessary for the allocation of radio sonde frequencies when schedules are similar, locations are close and units have not made arrangements for taking alternate soundings.

SECTION 12 – DEPLOYMENT

General

1. The deployment and operations of a meteorological section must be planned and executed so as to provided meteorological data to the user units on a prearranged schedule. If necessary, an advance detachment consisting of a visual team may be employed to prepare meteorological messages for units requiring it urgently.

Procedure

2. The meteorological officer after having received orders proceeds as under: -

- a. Selects the location of the meteorological station and forward RV for his section off the map. The RV should be as near the deployment area as possible.
- b. Orders his section the location of RV and time to be there.
- c. Reconnoiters and selects the site for meteorological station.
- d. Calls his section forward and deploys.

Selection of Meteorological Station

3. The site selected for a meteorological station should meet the following requirements: -

- a. It should be centrally located with respect to firing units.
- b. The height of the station should be as close to the main height of firing units as possible and should not differ by more than 600 feet / 200 metres from the height
- c. It should have level and clear area of 200 yards / metres and there should be no restr around with an angle of sight greater than 3 degrees / 50 mils for electronic method and 6 degrees / 100 mils for visual method.
- d. It should be close to a headquarter where communication

4. The section will normally be sited close to BHQ but may be moved away to a separate position if necessary. In such cases the administrative and security arrangements will have to be tied up.

CHAPTER 4
THE SURVEY TROOP
SECTION 13 – **TACTICAL MISSIONS AND ORGANIZATION**

Mission

1. The missions of a survey troop are: -
 - a. *Primary*
 - (1) Survey of gun areas on a common grid.
 - (2) Survey of locating devices on the same grid as guns.
 - b. *Secondary*
 - (1) Provision of survey data in the OP area.
 - (2) Fixation of targets.
 - (3) Survey work required for calibration of own guns.
 - (4) Fixation of points for ground control of vertical air photographs.
 - (5) Study and interpretation of air photographs.
 - (6) Fixation of control points in enemy territory and when operating in an unmapped country behind our own lines.
 - (7) Assist engineer's survey when detailed to do so.
2. The normal means of providing survey data is by the establishment of BPs. Survey information is conveyed through BP cards (PAFB-6040). At least one BP is provided for each regimental area. This may be supplemented with additional BPs in case of widely dispersed batteries.

3. Flash and sound ranging bases may require one or more BPs according to terrain and length of base. In case of radar a BP must be provided as close to the radar site as possible.

4. The survey troop of corps locating regiment initiates corps grid and provides a minimum of two BPs in each divisional area.

Organization

5. Tactical grouping for manoeuvres of survey troop in a corps locating regiment and a divisional locating battery are given in Annexes 'A' and 'B' respectively.

Duties of Key Personnel

6. **The Troop Commander.** His main duties are:-

- a. To plan and conduct the survey of the allotted area.
- b. To supervise and coordinate the work of his section commander.
- c. To ensure that the information issued by the survey information centre is timely and accurate.
- d. To maintain close liaison with RSOs and higher survey agencies.

7. **The Section Commander.** He is responsible for: -

- a. Detailed reconnaissance and conduct of survey in the area allotted by the troop commander.
- b. Checking the BP cards before issue from the survey information centre.

8. **The Troop Havildar Major.** He is troop commander's assistant. His duties are: -

- a. To accompany the troop commander during his reconnaissance and assist him in siting of stations.
- b. To assist the troop commander in organization of field work and execution of his orders.

9. **The Section Havildar.** He is section commander's assistant. His duties are: -

- a. To site stations as ordered by the section commander.
- b. To visit and assist observing pairs in identification of stations.
- c. To collect field work and send it to computing centre in case of communication failure.

10. **The NCO Incharge Survey Information Centre.** He is responsible to organize the survey information centre. His main duties are: -

- a. To keep an up-to-date diagram of the survey scheme showing progress of field work.
- b. To maintain a diary showing the location and movement of officers, JCOs and observing pairs.
- c. To prepare and issue BP cards after these have been checked and signed by a section commander.

Survey Information Centre (SIC)

11. A survey troop, when deployed, establishes a SIC which acts as a collecting and distributing agency for artillery survey information. Its location is decided by the artillery commander and given out in the deployment orders. As a general rule it should be so located by easily accessible to gun units.

12. The SIC should have communications with troop commander, section commanders and the observing pairs and should have up-to-date information regarding the progress of field work at any time.

SECTION 14 – SURVEY METHODS

General

1. There are four survey methods: -
 - a. Traverse.
 - b. Triangulation.
 - c. Intersection.
 - d. Resection.
2. Traverse and triangulation are used to extend survey. Resection is used to initiate a grid, and intersection is used for fixation of targets.

Traverse

3. This is a process of extending orientation and fixation by means of a connected series of straight lines, known as legs. The length of legs, bearings and vertical angles are determined by linear and angular measurements. Figure 7 shows extension of survey from station 1 to station 5 by means of traverse. The data of station 1 is known. In order that the survey is completed within acceptable accuracy the traverse is closed on a point of known survey data.

Figure 7. A Traverse Scheme.

Triangulation

4. This is a process of extending orientation and fixation by observing the interior of a series of triangles. The sides of triangles connect mutually intervisible points spread over the area to be surveyed. A triangulation framework is shown in Figure 8.

Figure 7. A Triangulation Framework..

Comparison of Two Methods

5. The advantages and disadvantages of traverse over triangulation and vice versa are listed in Table V.

Table V. **Comparison Between Traverse and Triangulation**

Traverse	Triangulation
a	b
Advantages	Advantages
1. Reconnaissance is simple	1. The only linear measurement is that of base. Thereafter observations consist entirely of angular measurements.
2. Observation can start as soon as the first three or four stations have been sited.	2. It is convenient and rapid in open and undulating area.
3. It is less affected by poor visibility	3. Solution of triangles provides internet checks on observation and computation. The accuracy of triangulation is therefore more reliable than traverse.
4. Orientation and fixation can be taken to the exact point where required	4. It is convenient for measuring inaccessible distances such as across a river or a lake.
5. Stations can be more often sited inconspicuously on low ground	

a	b
6.	Computation can be started early and can proceed in step with the traverse

Disadvantages

1. The internet errors in linear measurement may accumulate unduly, owing to the need to measure. Each leg
2. The rate of progress may be slow for the same reason.
3. There are no internal checks on observation until the computation for the entire traverse is completed.
4. There are no checks, on systematic errors except for a circuit traverse, which opens and closes at points surveyed on a common grid.

Disadvantages

1. It requires more skill and time for reconnaissance and siting stations with relation to one another due to the requirement all-round visibility.
2. Stations are normally required to be sited conspicuously.

6. Triangulation being more accurate and quicker for survey over large area is preferred. Traverse should only be used in open terrain for comparatively short distances.

SECTION 15 – SURVEY PLANNING

General

1. The survey troop commander must know the following information from his BC, CO or artillery commander: -

- a. Survey tasks in order of priority including gun areas; and radar, flash and sound ranging requirements.
- b. Grid to be established.
- c. Availability of trig or higher survey data.
- d. Time available.
- e. Location of SIC.

2. Whenever the deployment of artillery units is foreseen, it will accelerate survey if the survey troop commander is given this information early along with the likely deployment area. He will then be able to establish stations on commanding features of the area and thereby lay the basis of his plan.

3. After receiving his orders, the troop commander proceeds as follows: -

- a. Carries out map-reconnaissance and makes tentative plan.
- b. Gives forward RV to his troop.
- c. Carries out ground reconnaissance.
- d. Decides on the survey plan.
- e. Gives deployment orders.
- f. Coordinates field work of the sections.

Map Reconnaissance

4. The troop commander marks on his map the following information likely to affect the survey plan: -

- a. Enemy dispositions.
- b. Gun areas.
- c. Likely deployment areas of locating devices.
- d. Any road blocks or minefields.
- e. All available survey data ie trig points or other points of known data.

5. He studies the map to determine location of observation points. These will be intervisible points on high features. With these points the troop commander makes his tentative plan. The plan will include:-

- a. The probable survey method to be used. Final decision should be taken after ground reconnaissance.
- b. Where and how to initiate the grid.
- c. What points should be visited during ground reconnaissance.
- d. What work can begin before ground reconnaissance.
- e. Where and at what time to RV with his troop.
- f. Whether the survey tasks can be accomplished in the allotted time with the survey resources available. If it cannot be accomplished, then he should recommend that either the time allotted be increased, some units be given low priority or additional survey personnel be made available.

6. Before proceeding on ground reconnaissance, the troop commander gives out the following orders to his troop: -

- a. RV for the troop.
- b. Time to be at RV.
- c. Route.
- d. Who should accompany him for ground reconnaissance.

Ground Reconnaissance

7. Normally the troop havildar major with one observing pair should accompany the troop commander on his ground reconnaissance. This observing pair can be employed to initiate the grid.

8. The following factors will influence the ground reconnaissance:-

- a. *Tactical Situation.* On this will depend the freedom of movement and limits of reconnaissance.
- b. *Terrain.* The nature of terrain will dictate the time required for reconnaissance and the method of survey, to be adopted.
- c. *Time Available.* Time available to complete the task will dictate the time which can be allowed for reconnaissance.
- d. *Survey Data Available.* Trig points or other points of known survey data should be visited and confirmed.
- e. *Limitations on Visibility.* In case of bad weather or the approach be left to the section commander reconnaissance should be left to the section commanders so that the field work can start early.

9. In order to save time and start the field work early the troop commander should confine himself to general reconnaissance to

confirm the feasibility of his tentative plan. Detailed ground reconnaissance can be undertaken by him and his section commanders after the preliminary work has started.

10. During ground reconnaissance, the following considerations must be borne in mind: -

- a. Keep to high ground as far as the tactical situation permits.
- b. Visit the likely stations to ensure intervisibility at instrument height and mark the selected ones.
- c. Once a station has been sited, take compass bearings to other visible features where other stations are to be sited. Back-bearings can be used to assist in identification. Prominent local details at a station if memorized can be used later as an aid in identification.
- d. Verify at BP stations that suitable ROs are available.
- e. Mark with a pencil all observable rays on the map by joining the respective stations.

Survey Plan

11. The factors which affect a survey plan are interrelated and should be considered as such: -

- a. *Tactical Situation.* On this will depend whether or not the stations can be sited at conspicuous and high features and thus will affect the choice of survey method.
- b. *Terrain.* The type of terrain over which the survey is to be carried is a primary factor in determining the survey method to be used. Whereas in an open, undulating or mountainous terrain, triangulation is quick and convenient;

in flat or densely wooded area some form of traverse provides the best practical answer.

- c. *Task Allotted and Priorities.* The consideration of this factor will help in making the estimate of time required where to initiate the grid and how to organize the field work will be dictated by this factor.
- d. *Time Available.* In order to be of value, survey results must be ready at the required time. The troop commander must adopt that survey method which provides the desired accuracy within the allotted time. For example if time is very limited and sufficient trig points or good maps are available, it may be necessary to determine fixation by resection and orientation by simultaneous astronomic observation for each regiment.
- e. *Availability of Trig Data.* If the trig points are available and are known to be accurate, theatre grid should be established from the outset. If time is limited and trig points are widely separated, it may be necessary to establish a lower grid which should later be linked up with the available trig points at the earliest opportunity so that a change to theatre grid is affected.
- f. *Weather.* Weather conditions, in so far as they affect visibility; influence the survey plan. For example, in poor visibility traverse will be quicker than triangulation because of difficulties in observing long rays. The troop commander should always be prepared with an alternative plan to be put into immediate operation should visibility deteriorate.

12. After having considered the above factors, the troop commander arrives at a survey plan which should fulfill the following requirements:

-

- a. *Flexibility and Simplicity.* Unnecessary changes of a plan should be avoided, but a plan should be flexible to allow changes to be made when deteriorating visibility or an extension of commitments renders it unsuitable or inadequate.
- b. *System of Checks.* It must contain an adequate system of checks. For example in triangulation check bases are introduced whereby a surveyed side is taped and compared. Similarly astronomic observations can be made to check on the accuracy of orientation.
- c. *Accuracy of Grid.* As far as possible, the grid initiated should be as close to the theatre grid as possible so that subsequent changes of grid can be avoided. The inclusion of astronomic observation will provide a close approximation to the theatre grid orientation
- d. *Distribution of Work.* The allotment of specific tasks to sections is desirable for ease of control and flexibility. This arrangement enables modifications to be more easily made, since section commanders will then be exercising close control of these observing pairs.

13. The survey plan is given out by the troop commander in his orders which are discussed in Section 16.

SECTION 16 – DEPLOYMENT

General

1. **The normal unit for survey is a troop.** The troop commander may sub-allot the task to the sections and coordinate their work but it should be very rare that a survey section is detached to carry out survey task independently. The larger the survey unit working, the easier it is to make the survey plan and to complete the work quickly. Small groups of surveyors can only carry out small tasks and are difficult to collect when once dispersed over the country.

The Troop Commander's Orders

2. Having formed his plan the troop commander issues his orders which should be received by the section commanders, the troop havildar major, the incharge SIC, and the section havildar.

3. The orders should follow the normal sequence of operation orders:-

Execution

- a. The outline plan i.e. whether traverse or triangulation is to be used.
- b. Allotment of tasks to sections, including responsibility for the establishment of BPs.
- c. Reconnaissance tasks of section commanders.
- d. The method of initiating orientation and fixation.
- e. In case of triangulation, the location of the base and instructions for its measurement.
- f. The names and approximate locations i.e grid reference of stations already established and the others which are to be

established along with the responsibility for their selection and siting.

- g. Particulars of available trig data.
- h. The organization for computation i.e whether on troop or section basis.
- j. Arrangements for further meetings with section commanders and a forecast of troop commander's own movement.

Command and Signals

- a. Location of SIC, time of its opening and any future move.
- b. Location of computing centre.
- c. Location of BHQ.

The Section Commander Orders

4. Having received orders from the troop commander, the section commander meets his section at a prearranged RV and gives orders to his observing pairs. These orders must contain the situation paragraph received from the troop commander.

5. Each observing pair must have a map and must be given copy of an oriented sketch of the survey plan. On the map should be plotted the grid references of all stations, that are definite and the location of the computing centre. The pairs must not only be given exact details of their own task, but must know enough of the general plan to be able to take appropriate action in the event of unforeseen difficulties. Thus all pairs must hear the complete orders and one member of each pair should check back the orders relating to their particular tasks.

6. The section commander's orders to an observing pair should contain some or all of the following details.

- a. Name and location of the station from which the pair is to observe and, if necessary, the route to get there.
- b. Instructions regarding the marking of the station.
- c. The names, grid references and description of all stations to which observations are to be taken. If available magnetic bearings thereto should also be given. Alternatively the pair may be required to deduce bearings from the plotted details on their maps.
- d. Tasks in order of priority, eg: -
 - (1) Stations to be observed.
 - (2) Astronomical observations.
 - (3) Details relating to linear measurement.
- e. Any special stores required.
- f. Arrangements for collection of results.
- g. Action to be taken on completion of task, ie, whether to remain at the station or return to the computing centre or to proceed to a RV.
- g. Synchronization of watches.

7. If traversing is to be carried out, orders are conveniently given at the opening station, and should include the following in amplification to the details in paragraph 5 above: -

- a. The type of traverse.
- b. Method of initiating orientation.

- c. Method of linear measurement (normally taping).
 - d. Any divergence from standard procedure.
8. Written orders left at subsequent stations or sent to observing pairs must indicate, preferably in diagrammatic form as shown in Figure 9.
- a. The number of the station.
 - b. Detail of task as discussed above.
 - c. Method of linear measurement to the next station if it is other than taping.
 - d. The magnetic bearing to the forward station.

Figure 9. Diagrammatic form of orders during Traverse.

- Notes:
1. Station 2 to be occupied.
 2. Angles are to be observed from station 2 to station 4 and 17 Field BP.
 3. Bearings from station 3 to station 4 and 17 Field BP are 340^0 / 6050 m and 50^0 / 900 m respectively.
 4. Distances from station 3 to station 4 and 17 Field BP are to be taped.

9. It may not always be possible to give complete details of task, as in paragraph 5 to 7 above, until the section commander has carried out some reconnaissance, but sufficient details can usually be given to ensure that stations are established without delay, and that observing pairs are kept fully occupied until further orders reach them.

Organization of Field Work

10. **Action by the Troop Commander.** After giving orders, the troop commander proceeds with further reconnaissance and the siting of any key stations essential to the execution of his plan. He pays particular attention to coordinating the work of his sections, ensuring that all rays linking those stations which are established by different sections are correctly observed and that there are no difficulties of identification. He completes the plan for tyine in necessary for that purpose. In addition he must: -

- a. Meet his section commanders from time to time according to a prearranged programme, to receive their reports and to give them further orders as required.
- b. Visit the computing centre to acquaint himself with the progress of work and to satisfy that all checks are rigorously applied.

- c. Keep the computing centre informed of any alterations or extension of the original plan.
- d. Exercise general supervision of the field work.

11. **Action by the Section Commander.** After giving orders, the section Commander: -

- a. Carries out reconnaissance and sites stations as ordered by the troop commander.
- b. Arranges the work of his pairs so that they are fully occupied and the computing centre is supplied with a steady flow of observation in the correct sequence.
- c. Visits stations to ensure that observing pairs understand their orders and have correctly identified the stations to be observed. In case of difficulty, he may indicate the station by laying the theodolite on the station marker.
- d. Keeps the computing centre and survey information centre informed of the progress of scheme and of his own whereabouts.
- e. Keeps a record of the map spot of all stations and compass bearings between them.
- f. Checks the BP cards before issue.

12. Once the observations have begun, it is not desirable to change the position of a station as the observations to it may have already been taken by some stations which might lead to mistakes. When the original siting of a station proves unsuitable for a particular ray or rays, it is safer to establish a second station.

SECTION 17 – SURVEY SCHEMES AND ORDERS

Introduction

1. The following examples show how various combinations of the recognized survey processes may be used in the survey plan. Regimental areas are indicated by cross-shading.
2. Figure 10 shows a plan which may be used during mobile operations in an area interspersed by woods. There are no trig points in the vicinity and only 1/25,000 maps are available. Map detail is liable to be inaccurate. Visibility is poor. Orders have been received that the divisional artillery is to be placed on a common grid. It is unlikely that the locating devices will deploy for some time. The survey troop of a divisional locating battery has been detailed to complete the survey task within three hours.

Figure 10. Traverse Scheme

EXAMPLE 1 – THE TROOP COMMANDER’S ORDERS

1. **Situation**

- a. Enemy.
- b. Own Troop.
 - (1) XXXXX
 - (2) XXXXX
 - (3) Gun area
 - 107 Mortar Battery 1866
 - 40 Field Regiment 2067
 - 41 Field Regiment 2165
 - 42 Field Regiment 2368
 - 43 Medium Regiment 2466

2. **Mission.** Divisional artillery will be placed on divisional grid by 1300 hours.

3. **Execution**

- a. A divisional grid initiated by map spotting and compass bearing will be established by traversing.
- b. *ALFA Section Commander.* You will initiate divisional grid at station 1 which will be BP for 41 Field Regiment. Thereafter run a circuit traverse to include BPs for 40 Field Regiment and 107 Mortar Battery. Use numerals 2 10 for numbering the stations.
- c. *BRAVO Section Commander.* You will run a parallel traverse to include BPs for 42 Field Regiment and 43 Medium Regiment. Use numerals 11 to 15 for numbering the stations.

- d. Each section is responsible for its computation.

4. **Command Signals**

- a. The SIC will be established in the grove at 222651 by 1100 hours.
- b. I shall visit ALFA Section at 1100 hours and BRAVO Section at 1200 hours.

Synchronize watches.

Any question?

EXAMPLE 2 – ALFA SECTION COMMANDER’S ORDERS

(issue at station 1 after siting of station 2)

- 1. Situation } As given by the Troop Commander
- 2. Mission }
- 3. **Execution**
 - a. ALFA section will establish BPs for 107 Mortar Battery, 40 Field Regiment and 41 Field Regiment by running a circuit traverse.
 - b. BPs for 42 Field Regiment and 43 Field Regiment will be established by BRAVO section.
 - c. Station 1 will be BP for 41 Field Regiment. Station 2 has been sited at 203656 at a bearing of 249⁰ / 4300 mils from station 1.
 - d. I will site other stations after orders.
 - e. *Pair 1*

- (1) Institute orientation at station 1 by compass.
 - (2) Take observation to station 2.
 - (3) Select ROs for BP 1 and take observation.
 - (4) Thereafter take observations at each station as per diagrammatic orders.
- f. *Pairs 2 and 3.* You will be taping pairs.
- g. *Computers*
- (1) Initiate fixation at station 1 by map-spotting.
 - (2) Carry out computation at each station and travel along the traverse route in a dodge.
- h. *All Pairs.* On completion of tasks, assemble at station 1.

4. **Command and signals**

SIC is being established in groves at 222651.

Synchronize Watches.

Any questions?

Triangulation

5. Figure 11 shows a triangulation plan for a divisional area. Orders have been given that the divisional artillery is to be placed on a divisional grid, preferably on the theatre grid and the survey plan must be capable of any extension necessary to meet radar sound ranging requirements later. A captured trig list, of unproved accuracy, is available, good 1/25,000 maps have been issued. Time is limited. Since the divisional fireplan includes a times programme of predicted shooting. The troop commander has had no opportunity for reconnaissance before receiving orders for deployment.

6. The troop commander carries out a map reconnaissance and chooses a suitable point at which to meet the section commander. The point commands a good view of the deployment area, and the survey troop is ordered to a RV nearby. A route to the RV is so selected that it includes one or two other good view points of the deployment area from where the troop commander may supplement his map reconnaissance by an inspection of the ground enroute.

7. The troop commander's plan is to produce a triangulation framework, if possible on the theatre grid, but on a divisional grid should bad visibility intervene to prevent linking up with available trig point or should the trig data prove unreliable.

8. He plans to initiate orientation by sun observation and the base of triangulation is taped. Initial fixation is determined by map resection and since good maps are available, no large displacement correction need be expected, if, therefore, trig data could not be used immediately, the divisional grid would have a close relation to the theatre grid, and any subsequent changes from the divisional grid to the theatre grid would be quick and fairly simple.

Figure 11. Triangulation Scheme.

9. Figure 11 shows the scheme diagram as completed after the troop and section commanders have carried out ground reconnaissance. The troop commander issued his orders at 0900 hours near the troop TV. Section commanders, troop havildar major, section havildars and incharge SIC attended.

EXAMPLE 1 – THE TROOP COMMANDER’S ORDERS

1. Situation

a. Enemy. X x x

b. Own Troops

(1) XXXXX

(2) XXXXX

(3) Gun areas

101 Mortar Battery - 7525

110 Field Regiment - 7827

111 Field Regiment - 7724

112 Field Regiment - 7822

113 Medium Regiment - 8025

2. **Mission.** Divisional artillery will be placed on theatre grid by 1530 hours, or on divisional grid should visibility deteriorate .

3. Execution

a. Theatre grid coordinates are available from the trig but all trig points are inaccessible. A divisional grid initiated by resection, astronomic bearing and tape distance will be established by triangulation.

b. *ALFA Section Commander*

- (1) Site station MOUND here and this will be BP for 11 Field Regiment.
- (2) Site BPs for 112 Field Regiment and 113 Medium Regiment calling these HILL and HUT respectively.
- (3) You are responsible for detailed planning of the initiation of the divisional grid.

c. *BRAVO Section Commander*

- (1) Site BPs for 101 Mortar Battery and 110 Field Regiment calling them TILLA and TEKRI respectively.
- (2) Reconnoiter stations to link up with ALFA section.
- (3) Arrange sub observation as a check.

d. Whenever possible, site stations to provide observation to trig points. As soon as possible report all observations to trig point to SIC.

e. I shall site stations for linking up with trig points. Troop havildar major with one pair from computing centre will accompany me.

f. *Trig Data*

- (1) TOWER
- (2) MARBLE ROCK
- (3) Point 1061

- g. All the three points will be fixed on divisional grid bearing and a such correction factors will be worked out for each pair of trig points and then values used to change to theatre grid.

4. **Command and Signala**

- a. SIC will established in area MOUND with the troop computing centre nearby.
- b. I shall vist BRAVO section area first.
- c. I shall meet ALFA section commander at 1200 hours.

Synchronize Watches.

Any questions?

EXAMPLE 2 – **ALFA SECTION COMMANDER’S ORDERS**

(issue at MOUND)

- 1. Situation }
 - 2. Mission } As given by the Troop Commander
- 3. **Execution**
 - a. *ALFA section is responsible to site: -*
 - (1) Station MOUND here - BP for 111 Field Regiment
 - (2) Station HILL - BP for 112 Field Regiment
 - (3) Station HUT - BP for 113 Medium Regiment

- b. BRAVCO section will site stations TILLA and TEKRI as BPs for 101 Mortar Battery and 110 Field Regiment respectively.
- c. The section havildar will reconnaissance station HILL in the locality 799228.
- d. After orders I will site station HUT at 802258.
- e. *Pair 1*
 - (1) Remain here at MOUND.
 - (2) Initiate fixation by resection.
 - (3) Take observations as indicated on the diagram.
 - (4) Take observations to ROs for BP.
- f. *Pair 2*
 - (1) Go with section havildar to HILL.
 - (2) Take observations as indicated on diagram.
 - (3) Take observation to ROs for BP.
- g. *Pair 3*
 - (1) Go with me to HUT.
 - (2) Take sub observation.
 - (3) Take observations as indicated on diagram followed by observations to ROs for BP.
- h. *Pair 4*
 - (1) Go with me to HUT.

- (2) Tape the base HUT to MOUND.
- (3) After that remain at HUT.
- j. *All pairs.* On completion of tasks, wait at your station for further orders.

4. **Command and Signals**

The SIC and computing centre will be in the vicinity of MOUND

Synchronize Watches.

Any questions?

CHAPTER 5 **FLASH RANGING**

General

1. The primary mission of survey and **flash ranging** troop of a corps locating regiment is to conduct on corps or higher grid. After completion of the survey task, the troop may be deployed for **flash ranging**. In such cases, the **flash ranging** section will be allotted additional administrative staff and transport; some additional surveyors from survey sections may also be necessary.
2. Cases may arise when the **flash ranging** section is required to deploy before the completion of survey task assigned to the survey and **flash ranging** troop. In such cases, the survey task will take more time. For detailed handling of **flash ranging** troop refer to FA 6/4.
3. The **flash ranging** section is designed to deploy either one long base or two short bases.

SECTION 18 – **TACTICAL MISSIONS AND ORGANIZATION**

Missions

1. The missions of **flash ranging** are: -
 - a. *Primary*
 - (1) To locate hostile weapons by cross observation of flash and smoke.
 - (2) To collect battlefield intelligence.
 - b. *Secondary*
 - (1) To adjust the fire of own artillery.
 - (2) To fix targets and datum points.
 - (3) To provide cross observation for the calibration of own guns, deduction of VEs and datum registration.
2. The **flash ranging** section may be supplemented from the personnel of survey sections after the latter have completed the survey task. The **flash ranging** section, unless called upon to deploy a **flash ranging** base, will participate in the survey operations of the survey / **flash ranging** troop.

Organization

3. Tactical grouping for manoeuvre of the **flash ranging** is given in Annex 'A'.

Duties of Key Personnel

4. **The Section Commander:** His main duties are: -
 - a. To command, administer and deploy **flash ranging** section.
 - b. To maintain liaison with the adjacent units to tie up local defence.
 - c. To act as relief in the **flash ranging** command post.
5. **The Field Section Commander.** The JCO incharge field section is responsible: -
 - a. To survey the **flash ranging** OPs on the available grid.
 - b. To act as relief in the **flash ranging** command post.
6. **The Command Post Officer (CPO).** The command post officer who is a JCO, is responsible for: -
 - a. The establishment of the command posts.
 - b. The technical processes of **flash ranging**.
 - c. The track plan, local defence and concealment of the command post and of the wagon lines if nearby.
7. **The OP No.1.** The main duties of each OP No.1 are: -
 - a. To ensure smooth occupation and functioning of his OP.
 - b. To organize relief at the OP and ensure continuous observation of the zone of responsibility.
 - c. The establish line communications from the OP to the command post.

SECTION 19 – PRINCIPLES OF FLASH RANGING

General

1. There are two types of flash ranging bases: -
 - a. Long base.
 - b. Short base.

Long Base

2. A long base normally consists of four OPs, each in communication with the command post byline or wireless. The total length of the base from 6,000 to 9,000 yards / 5500 to 8000 metres. The distance between two adjacent OPs must be such that the apex angle at the target end is not less than 500 mils and the total length of the base should be at least half of the maximum distance required for observation.
3. The OPs are surveyed on a common grid. The OP instruments are oriented on grid North when a target is observed, bearings are passed from each OP to the command post, where these are plotted on a gridded board. If the observations are correct, a quadrisection will be obtained at the location of the target, the coordinates of which can be scaled off (see Figure 12).
4. A base of three OPs may be used to provide cross observation for calibration, deduction of VE and datum registration.

Figure 12. Quadrisection from OPs.

The Short Base

5. **Outline Method.** The **flash ranging** short base consists of two OPs and a CO. OPs are numbered as A and B from right to left, facing the enemy (Figure 13). CP is normally located near A OP. The distance between the OPs varies from 200-700 yards / metres. Two short bases can be established by the section. Since the distance between the two OPs is relatively short, graphical intersection as a means of target location is not satisfactory. In short ranging base, the technique of computed intersection is used, and targets are polar plotted on a firing chart.

Figure 13. **Flash Ranging** Short Base.

6. **Computed Intersection.** With the help of bearings measured by A and B OPs to the target (T), and the base length (A to B) the triangle T A B can be solved by computation using the law of sine, Distance A to T can be computed using the equation:-

$$\text{Distance A to T} = \frac{\text{Base Length} \times \sin B}{\sin T}$$

Or log distance A to T = Log base length + log sin B - log sin T.

7. **Polar Plotting.** Targets are polar plotted from A OP. The elements needed to establish a polar plot are a point of origin (A OP), a direction (bearing A OP to target) and a distance (A OP to T). All this plotted on a firing chart to obtain the location of the HB.

Uses

8. **The Long Base.** Being more accurate this is the normal method of employment. It takes approximately 4-6 hours to deploy. This is the only method of obtaining locations on indirect flashes or sky reflections at night.

9. **The Short Base.** This method may give a reasonable accuracy for location of muzzle flashes, but is unsuited for location of hostile weapons from indirect reflections. In case, one of the OPs cannot observe a target, then the location of that target cannot be determined. It takes from 1/2 to 1 hour to deploy. The short base method of deployment should be used only in the following circumstances: -

- a. *Observing from a Salient.* If observation is needed from a salient it will often be impossible to deploy a long base owing to lack of room.

- b. *Observing Up Narrow Valleys.* The short base is particularly suited for observation through a narrow valley, where it is not possible to deploy a long base.
- c. *Flank Observation.* A short base may be deployed to observe a flank which is not adequately covered by other locating devices.

Capabilities and Limitations

10. Any HB which can be visually observed from three or more OPs can be accurately located by a **flash ranging** long base. When the muzzle flash is observed, the HB can be located with an accuracy, of 50 yards / metres when indirect reflections are observed, the accuracy may fall to 200 yards / metres. The long base can range in depth upto the limit of visibility and in width from 6,000-10,000 yards / 5500 to 9000 metres. **Flash ranging** is subject to the same limitations as any ground observer. These include: -

- a. Fog, heavy rain, or haze.
- b. Smoke, either friendly or enemy, in the target area or on the OP.
- c. Flat ground which does not afford high ground for observation.
- d. Hilly terrain, wooded areas or jungle which afford flash cover to the enemy artillery and concealment to his troops.
- e. Simultaneous and intense firing by the enemy artillery which makes it difficult for all observers to observe the same target.
- f. Use of flash reducing propellants by the enemy artillery .

- g. Use of flash simulators by the enemy, especially when synchronized with firing.

SECTION 20 – DEPLOYMENT OF A LONG BASE

General

1. A diagrammatic lay-out of a **flash ranging** long base is shown in Figure 14. The Ops are lettered A,B,C and D from right to left facing the target area.

Figure 14. Diagrammatic Layout of a Long Base.

2. The section may occupy position as follows:
 - a. After the position has been fully prepared with survey and cable laying completed; ,or.
 - b. After a portion of this work has been completed; or.
 - c. As soon as reconnaissance has been completed.
3. The case considered in this section is that of a section deploying from rest or a hide and occupying the positions immediately after reconnaissance has been completed. The procedure is basically the same in all cases of a long base deployment.

Procedure

4. The following are the main steps in deployment: -
 - a. The section commander receives his orders.
 - b. The section commander carries out map reconnaissance and formulates a tentative plan. He also decides the sequence of his ground reconnaissance.
 - c. The section commander gives out preliminary orders to his section including forward RV for the section, which should be in the general area provisionally selected for the command post.
 - d. The section commander along with field section Commander and four OP Nos. 1 carries out ground reconnaissance in order to select sites for OPs, command post and wagon lines. The command post officer will lead the section to the RV.
 - e. After ground reconnaissance, the section commander gives out orders.
 - f. The section commander supervise the occupation of OPs and the field section commander conducts the survey of the base. The command post officer organizes the command post.
 - g. Each OP party after occupation of OP lays cable to the command post and carries out the normal duties.
 - h. The section commander visits the survey information centre as soon as possible after occupation is started in order to obtain latest survey formation and to give details of any survey assistance that he may need.

5. If speed is essential, the following modifications may be made to the above procedure: -

- a. After map reconnaissance, the section commander orders one or more forward RVs to OP parties. Immediately on selection each OP is occupied.
- b. The survey of the base is started straightaway.
- c. The selection of command post and wagon line area is left to the command post officer.

Orders From Higher Commander

6. The **flash ranging** section commander must know the following from his battery commander or commanding officer

- a. Situation including forward infantry brigade headquarters and future plans.
- b. Zone to be covered by observation and suspect hostile battery area, if known.
- c. Survey information.
- d. Location of survey information centre, ICB headquarters and battery headquarters.
- e. Time to be ready.

Map Reconnaissance

7. While receiving his orders, the section commander plots the dispositions of own and enemy troops and allotted zone of observation on the map. He studies the map in order to select the location for the best keeping in mind the following considerations:-

- a. The Ops must be spaced as evenly as possible and roughly in a straight line.
 - b. The base should be square to the hostile battery area i.e. the right bisector of the base should pass through the centre of the hostile battery area.
 - c. The length of the base should be at least half of the distance to the farthest limit of the allotted zone. A longer base will give more accurate locations, but communication difficulties will outweigh this advantages.
 - d. The Ops must have common and the best possible view over the allotted zone.
 - e. The maintenance of communications between OPs and command post should be simple.
8. Inspection of the map will bring out the possible OPs in the area, narrow down the area of ground reconnaissance and enable the section commander to decide:-
- a. Suitable features for OPs.
 - b. An area for command post bearing in mind its relation to the OPs cover, accessibility, cable routes wagon lines etc.
 - c. Routes to OPs.
 - d. Relation of OPs to any trig point in the area or BP which may be established by the survey troop.
 - e. Areas to which the section can be moved if too far back.
 - f. Plan of ground reconnaissance.

Preliminary Orders

9. On completion of the reconnaissance it will be possible to give preliminary orders to include the following details: -

- a. Situation.
- b. Task and zone allotted.
- c. Probable method of deployment.
- d. Composition and tasks of reconnaissance parties.
- e. Survey information.
- f. RVs for the reconnaissance parties and the remainder of the section.
- g. Time to be ready.

10. The following will attend the section commander's order: -

- a. Field section commander.
- b. Four OP Nos 1.
- c. Command post officer.
- d. Signal NCO.

Ground Reconnaissance

11. **Reconnaissance Party.** The normal composition of reconnaissance party is:-

a.	Truck ¼ Ton	Section Commander	1
		Driver	1
		OP Nos	2
b.	Truck ¼ Ton	Field Section Commander	1
		Driver	1
		OP Nos	2

12. **Siting the base.** The requirements of an ideal base are given in paragraph 7a above. Depending on the retrain it may not be possible to meet all these requirements. The possible layouts are given below: -

- a. An ideal base in a favourable terrain (figure 15).

Figure 15. Ideay Layout

- b. A suitable depending on the availability of the commanding features (figure 16). Observation over the centre is obtained from all four OPs and over either flank of the front from three OPs. Only two centre OPs have view of the entire allotted zone.

Figure 16. A Layout, When all OPs cannot have common view of the allotted zone

13. The final siting of the base and selection of area for OPs is done by the section commander as a result of his ground reconnaissance. The detail of an OP is normally made the responsibility of the No.1. The siting may be supervised by the section commander.

14. In siting the base section commander need not be influenced by the formation boundaries. In order to cover the allotted zone, the OPs may be deployed within the adjacent formation area, provided permission to do so is obtained.

15. Siting of OPs. The following major considerations will affect the siting of an OP.

- a. *View.* The primary task of **flash ranging** is location of hostile weapons., therefore, it is important that each OP should have the maximum command of the allotted zone. It may often be better to site an OP some distance behind the FDLs to gain height as shown in Figure 17. Position A is better than position B.

Figure 17. Siting of an OP.

- b. *Concealment.* The site selected for a **flash ranging** OP should be simple to camouflage and conceal like any other OP.
- c. *Protection.* To like other artillery OPs, the **flash ranging** OPs also normally depend on the local infantry for protection. It is therefore important to discuss the matter with local infantry commander preferably before the OP is occupied, to ensure that the protection will be provided to the OP. Whenever possible the OP and rest centre should

have field of fires which the OP party can cover with their personal weapons. Protection against shell fire and weather is also essential since the OP may be manned for long periods.

- d. *Covered Approach.* For routine reliefs and OP that has covered entrance is the best. This consideration should not, however, be made a reason for giving up a good OP.
- e. *Accessibility.* To facilitate occupation administration and visits, there should preferably be a satisfactory vehicle route to a point within reasonable walking distance of the OP.
- f. *Communication.* In addition to a vehicle route which facilitates cable laying and maintenance, the OP should be suitable for maintenance of wireless communication.
- g. *Survey.* It should preferably so sited with a view that survey data can be extended to it easily.
- h. *Rest Centre.* Each OP should have rest centre within reasonable distance to allow freedom of movement to personnel off duty, and it should be able to accommodate the OP vehicles. If possible the OP line communication should be laid via the rest centre. In any case there must be communication between OP and rest centre.

16. **Siting of Command Post.** A building is most suitable for a command post provided it is not a obvious target for enemy artillery and provided it satisfies other requirements. An ideal command post is the one which is located in the centre of this base about 1500 to 2000 yards / metres in rear of the OPs and fulfils the following requirements:

-

- a. Accessibility to vehicles.
- b. Cover from air ground observation.
- c. Protection against enemy patrols.
- d. Protection against splinters.
- e. Ability to work both by day and night without interference.
- f. Good cable routes to OPs.
- g. Suitable car park within walking distance of command post.

17. **Wagon Line.** It is normally possible to site wagon lines in the vicinity of command post so that the car park and wagon lines are combined. This arrangement has many administrative advantages but on occasions it may be tactically unsound. The following point should be considered for the selection of a wagon line area: -

- a. Concealment from air observation.
- b. Adequate room for dispersion of vehicles.
- c. Good approaches and exists; and firm standing.
- d. Within short distance of a two-way traffic route leading to the front.

18. **Survey Planning.** The field commander, while accompanying the section commander on ground station, studies the terrain in order to plan the survey of the base. During reconnaissance he should decide on the survey method and the location of observation station.

Detailed Orders

19. After carrying out ground reconnaissance, the section commander meets his section at the RV and gives out orders. The execution paragraph of his orders will include: -

Execution

- a. Type of base and number of OPs.
- b. Priority of tasks.
- c. OP areas.
- d. Zones of observation.
- e. Survey.
- f. Command post.
- g. Protection and local defence.
- h. Time to be ready.

Occupation of OPs

20. Each OP No 1:

- a. Leads his OP part to a place in rear of the OP where the vehicle can be parked in safety.
- b. Reconnaissance suitable covered approach to the OP and takes up two observers and the wireless operator.
- c. Points out FDLs and zones of observation to the observer and gives orders for preliminary fixation and orientation for the OP.
- d. Gives orders to the wireless operator regarding the positioning of wireless set and its remote control. Normally wireless set is kept in the rest centre and the remote control at the OP.
- e. Gives orders to the remaining party for cable laying.
- f. Selects and organizes the rest centre.
- g. Selects alternative position for the OP, which should be prepared for occupation as soon as possible.

- h. Signal party.
- j. Organize of OP maintenance.

Survey

21. After section commander's orders, the field section commander will issue orders to the survey party. The survey of the base will be carried out to an accuracy of 1:3000 using any of the survey methods.

22. Initially the command post with its survey staff will act as computing centre. The OP parties may also be asked to assist in survey. Each OP party must be provided with fixation and orientation.

23. After completion of the base survey, the survey party with supplement the command post team.

Organization of Command Post Area

24. The command post officer, after receiving orders, leads his vehicle to the area allotted. On arrival in the area, he will organize the layout as follows: -

- a. Selects and allots area for the command post and wagon line including car park.
- b. Formulates the track plan.
- c. Selects cable routes in the vicinity of the command post.
- d. Carries out necessary sign posting.
- e. Organize local defence.

Duties and Reliefs

25. For good observation it is essential that observers are properly rested. Although it is possible to work at high pressure without rest for long periods during battle, the actual standard of observing will fall off very rapidly after two hour's continuous observations. The relief of all personnel engaged in observing duties should, therefore, be arranged so that each observing period does not exceed two hours and that a fresh observer comes on duty every hour. The OCsU should also be trained in observing duties.

26. The relief of all other personnel should also be so arranged that the maximum amount of rest is allowed consistent with the efficient manning of communications and other command post and OP equipment. Work on these relief bases in command post and OP will be a satisfactory solution. The responsibility for making out duty rosters for the OPs and command post rests with OP Nos 1 and the command post officer respectively.

SECTION 21 – DEPLOYMENT OF A SHORT BASE

General

1. The two OPs and a command post under the charge of a JCO will deploy a short base. The procedure of deployment is similar to that adopted for deployment of a long base.

Orders

2. When ordered to deploy, the JCO incharge short base must know the following: -

- a. Tactical situation.
- b. Zone and depth of observation.
- c. Area in which short base is to deploy.
- d. Priority of task.

- e. Time to be ready.

Reconnaissance and Deployment

3. The JCO incharge short base leads his complete party to a point nearby the area of deployment. He takes his OP Nos 1 with him and reconnoiters the sites for OPs and command post.

4. **Selection of OPs.** While selecting the sites for OP, the following points must be considered:-

- a. Both OPs should have common and the best view of the zone allotted.
- b. The base should be square to the allotted zone of observation, i.e. right bisector of the base should pass through the centre of the area to be observed.
- c. The length of the base should not be less than $\frac{1}{7}$ th the distance to the farthest limit of the allotted zone, so that the apex angle at the target is not less than 150 mils.
- d. As far as possible, the two OPs should be intervisible.

5. Selection of Command post. It should be as near as possible to one of the OPs in order to shorten the communications. As far as possible, the other considerations for the selection of command post, as discussed in Section 20, paragraph 17, must be met.

6. On completion of the reconnaissance, the JCO incharge short base gives orders for the deployment and establishment of the short base.

Survey

7. The internal survey of the base is carried out by the short base party. This presents no difficulty when the instruments at A and B posts are intervisible. Parallelism can be achieved simply by each observer laying on the instrument of the other at the correct reading, while the base length can be found by taping. If the instruments are not intervisible, it is normally possible to set up a third station which can see A and B posts, and by means of a simple survey process, the accurate readings to get A and B posts instruments on parallel lines can be found, together with the base length.

8. The internal survey consists of the orientation and fixation of the A post, which can be initiated. When the higher grid data is provided by the survey troop, the change of grid can be affected.

CHAPTER 6

SECTION 22 – TACTICAL MISSIONS AND ORGANIZATION

Mission

1. The missions of a sound ranging troop are: -
 - a. *Primary*
 - (1) Location of hostile weapons.
 - (2) Adjustment of friendly artillery onto active hostile weapons, ie, sound on sound adjustment.
 - b. *Secondary*
 - (1) Collection of battlefield information.
 - (2) Registration and adjustment of friendly artillery on targets other than hostile weapons.

- (3) Provision of survey data to other units in the area, eg, a radar.

2. The sound ranging troop when not employment in its primary role may be called upon to assist the survey troop or conduct survey operation independently to the meet the survey requirements of the formation.

Organization

3. Tactical grouping for manoeuvres of sound ranging troops in a corps locating regiment and a divisional locating battery are given in Annex 'A' and 'B' respectively. The sound ranging troop of a divisional locating battery is organized to deploy two short bases when a sound ranging troop of corps locating regiment normally deploys a long base.

Duties of Key Personnel

4. **The Troop Commander.** His main duties are: -
 - a. To deploy the sound ranging base.
 - b. To liaise and coordinate the local defence if OPs and command post with the neighboring units.
 - c. To liaise with cooperating gun units and arrange communication for sound adjustment shoots.
 - d. To visit OPs at frequent intervals to ensure that they are working efficiency, that the necessary reliefs have been detailed and that administrative and local defence arrangements are satisfactory.
 - e. To act as relief in the command post.

5. When the sound ranging troop is required to deploy two short bases which will normally be the case with the sound ranging troop of divisional locating battery, the troop commander will deploy one base and the other base will be deployed by the section commander.
6. The Field Section Commander. He is responsible: -
 - a. To survey the microphone positions.
 - b. To act as relief in the command post.
7. **The Command Post Officer.** He is responsible for: -
 - a. The establishment of the command post.
 - b. The technical processes of sound ranging.
 - c. The track plan, local defence and concealment of the command post and of the command post and of the wagon lines if nearby.
8. **The Command Post No 1.** He assist in the establishment and technical work of the command post, and is responsible for collecting of all information and for maintaining the command post diary.
9. **The Troop Havildar Major.** He commands the troop wagon lines and is responsible for all detailed administration within the troop.
10. **The OIP Nos 1.** Each OP No. 1 is responsible for: -
 - a. Establishing the OP to cover the allotted zone.
 - b. Detailing reliefs so that OP is continually manned.
 - c. Establishing communications from the OP to the command post.
11. **The Signal Havildar.** He is responsible for:-

- a. Establishing communication from the command post to the microphone.
- b. Servicing microphone and OP communication.
- c. Providing and servicing the wireless communications required.
- d. Battery charging.

SECTION 23 – PRINCIPLES OF SOUND RANGING

Basic Theory

1. The discharge of a gun or burst of a shell causes a sound disturbance or pressure vibration of the air which lasts for only a fraction of a second. The impulse so produced, a sound wave, travels outwards through the air at ranging are dependent on atmospheric conditions. Sound ranging techniques locate the source of the sound wave (the gun or the shell) by measuring the relative times of arrival of the sound wave at several accurately located microphones.

2. In figure 18, A and B are two microphones. OP is the right bisector of AB. As the gun at G fires, the sound waves are produced. As soon as these sound waves pass over A and B, their arrival times are recorded. The time interval (ie, the difference between the arrival times at A and B) multiplied by the velocity of sound is one side of the right angled triangle ABC. The angle θ in right angle ABC and OGH are equal. The value of angle θ is computed by use of the trigonometric formula; $\text{Sine } \theta = t/V$, where 't' equals time interval multiplied by the velocity of sound and 'V' equals the length of line AB. The value of angle θ is laid off from the midpoint of a pair of microphones on that side of the right bisector over which the sound wave first passed. The line making the angle θ with the right bisector will pass through or very near the sound source. If several such lines are produced from several pairs of microphones, the intersection of these lines will be location of the sound source.

Figure 18. Theory of Sound Ranging

Classification of Bases

3. The sound ranging bases are classified as under: -
 - a. *Short Base.* It is deployed for short range location. It usually consists of four microphones, an OP and a command post. The normal sub-base length is two sound seconds-675.2 metres. The layout of the base with accuracy zones is shown in Figure 19.

Figure 19. Short Base with Accuracy Zones.

- b. *Long Base.* A long base consists of six microphones, two OPs and a command post. The subbase, length can be 1,000 to 2,000 metres. The base is deployed for long range locations. The layout of the base with accuracy zones is shown in Figure 20.

Figure 209. Long Base with Accuracy Zones.

4. A rough rule which may be applied to determine the accuracy zones is given below:-

a. *A Long Base*

(1)	100 yards / metres accuracy	45 Degrees / 800 mils each side of the right bisector of the base to a distance of 1-1/2 times the base length
(2)	200 yards / metres accuracy	- As above but upto 2-1/2 time the base length

b. *A Short Base*

(1)	100 yards / metres accuracy	45 Degrees / 800 mils each side of the right bisector of the base to a distance of 2-1/2 times the base length
(2)	200 yards / metres accuracy	- As above but upto 3-1/2 time the base length

Types of Bases

5. The types of bases will depend on terrain and likely hostile area. The types of bases (Figure 21) which may be deployed are as follows: -

- a. *Straight Regular.* All microphones lie on a straight line and are equally spaced.

- b. *Nearly Straight Regular.* The individual microphones may be approximately 100 yards / metres off the proposed straight lines of the base and similarly sub base lengths may vary by 100 to 200 yards / metres from each other. The microphones in this case are not placed by actual survey. These are deployed by map planning / spotting.
- c. *Curved Regular.* All microphones lie on the arc of a circle and are equally spaced.
- d. *Straight Irregular.* All microphones lie on a straight line but the sub-base lengths are unequal.
- e. *Curved Irregular.* All microphones lie on the arc of a circle but the sub-base length are unequal.
- f. *Irregular.* Any base other than those given above.

Figure 21. Types of Sound Ranging Bases.

6. All types of bases provide equally accurate locations. A straight regular base facilitates film interpretation, because of a set pattern of

breaks on the film, as such it is the ideal base. An irregular base can fit in any type of terrain and is simple to deploy.

7. A curved base is mainly used when it is desired to obtain very accurate locations in a particular small hostile battery area. The radius of the arc on which a curved regular base is established is related to the length of the sub-base that is to be used and the distance from the mid point of the base to centre of the hostile battery area. The ratio of sub-base length to the radius of the arc varies from 1: 6 to 1:9 Figure 22 shows the relationship between the radius of the arc, the sub-base length and the distance to the centre of hostile battery.

Figure 22. Radius of Curved Regular Base.

8. A sub-base and radius of the arc will be selected which will fit the base to the available terrain with the centre of the arc near the centre of the hostile battery area. Survey and computation data for curved regular bases is given in Table 6.

TABLE 6. Computation Tables for Curved Regular Bases

Ratio of S to R	Offset Angle		Double Offset Angle		L Factor	Log L Factor
	Degrees	Mils	Degrees	Mils		
1:6.0	9° 31'	16" 169 m	19° 03' 16"	338.8 m/	4.8628	0.6868865
1:6.5	8° 47'	50" 156.4 m	17° 35' 40"	312.8 m/	4.8828	0.6886696
1:7.0	8° 10'	16" 145.3 m	16° 20' 33"	290.5 m/	4.8989	0.6900975
1:7.5	7° 37'	41" 135.6 m	15° 15' 23"	271.2 m/	4.9118	0.6912441
1:8.0	7° 09 1'	10" 127.2 m	14° 18' 19"	254.3 m/	4.9224	0.6921773
1:8.5	6° 43'	50" 119.7 m	13° 27' 57"	239.4 m/	4.9312	0.6929528
1:9.0	6° 21'	35" 113.1 m	12° 43' 10"	226.18 m/	4.9386	0.6936054

Explanation

- Ratio of S to R is the ratio of sub-bae length to radius of base.
- In curved regular base, bearing M1 to M6 equals bearings M3 to M4. Bearings between adjacent microphones are worked out as follows:

-

Bearing M1 to M2 = Bearing M1 to M6 – double offset angle.

Bearing M2 to M3 = Bearing M1 to M6 – offset angle.

Bearing M4 to M5 = Bearing M1 to M6 + offset angle.

Bearing M5 to M6 = Bearing M1 to M6 + double offset angle.

3. L factor multiplied by sub-base length equals of the long chord ie distance M1 to M6.

4. Log L factor plus log sub-base length equals log of long chord.

Capabilities and Limitations

9. Sound ranging can locate hostile weapons over a wide area with reasonable accuracy for an indefinite period. The sound ranging system being passive cannot itself be located. Poor audibility hills, eg, high winds, lapse of temperature, intervening hills etc will adversely affect the sound ranging. During intense bombardment a continuous response appears on the film and locations are difficult to obtain.

SECTION 24 – SELECTION AND SITING OF SOUND RANGING BASE

Principles of Siting

1. It will seldom be possible to select the perfect base; the following principles must be borne in mind in order to attain the most effective compromise: -

- a. *The base should be straight and regular.* A straight base gives a wide effective zone and a regular base an evenly covered effective zone. Equal sub-base lengths also simplify film reading, although deviations upto 50 yards / metres in the siting of microphones should have no adverse effect.

- b. *The base should face the centre of the hostile battery area.* The right bisector of the base should pass through the centre of the hostile battery so that: -
 - (1) The maximum use is the made of the frontage of the base.
 - (2) Greater accuracy is obtained because the majority of locations will fall in the centre of the effective zone of the base.
- c. *The base should be as far forward as possible.* In order to locate more distant hostile weapons and have majority of the locations in the centre of effective zone, the base should be sited as far forward as possible. The advancement of the base will be limited by the positions of OPs which must always be able to operate the base in time. For this reason it will seldom be possible to site a long base nearer than 2,000 yards / mettes and a short base nearer than 1,000 yards / mettes to the FDLs.
- d. *The microphones should be naturally screened.* When siting microphones, advantage should be taken of any natural or improvised wind screening available. A microphone placed in a wood or thick undergrowth is well screened and there is no appreciable loss in audibility. The shelter sides of hedges, hollows in the ground and buildings are other suitable places and the microphone should be sited at a distance equal to the height of the screening.
- e. *The microphones should be sited at the same height.* To avoid inaccuracies due to large variations in the heights of microphone positions, as far as possible, these should be sited approximately at the same height. The difference in

height between adjacent microphone should not exceed 200 feet / 60 metres.

- f. *The microphones should be intervisible.* The survey of the base is considerably simplified if the microphones are intervisible. This principle, however, should not be given priority if it conflicts with other more important considerations.
- g. *The microphones should be so sited as to facilitate cable laying and maintenance.* In order to facilitate cable lying from command post to microphones; and its maintenance the microphones should be, if possible, placed near the vehicular routes.

Factor affecting the Siting of the Base

2. The following factors will influence the selection and siting of the base.

- a. *The Tactical Situation.* The expected or planned operations will dictate how far forward a base should be sited. In case of planned attack by friendly troops the base should be placed well forward to cover the advance as long as possible. In defence the base may be sited further back so that it can function even at critical periods. It is to remain in action for at least 48 hours.
- b. *The Shape of FDLs.* The shape of FDLs will influence the siting of OPs, the type of the base and its location.
- c. *The Location and Extent of Probable Hostile Battery Area.* The location and extent of probable hostile battery area will dictate the type and length of the base. A limited area can be most effectively covered by a curved base. Where the area is so extensive that it can not be covered by one

base, the use of crossed bases may have to be made. Figure 23 shows the layout of crossed bases. The use of switchboard SB-223 allows this operation to be carried out by the use of one sound ranging recorder.

Figure 23. Crossed Sound Base.

- c. *The Time Available.* If time available to deploy a long base is limited, a short base may be deployed and when time becomes available this short base can be expanded to a long base. Use of radio sound data transmission system may be used with microphones when cable lying is expected to delay the operation of the base.
- d. *Type of Terrain.* In rough terrain, an irregular base is simple to deploy. While operating in mountainous country, it is advisable to place the microphones on forward slopes near the crests in order to obtain better audibility.

- e. *Meteorological Conditions.* Prevailing winds striking prominent topographical features may produce eddies. If possible such eddies between the microphones and the hostile battery area should be avoided. A prevailing wind which always blows from one flank may require that the base be shifted downwind to compensate for the wind effect on the sound travel path as shown in Figure 24.

Selection and Siting of out post (OP)

3. A position selected for an OP should meet the following requirements: -

- a. An OP should be so located that the observer can hear a sound from any part of the zone for that OP at least 2 seconds before it arrives at any microphone. The time lapse will compensate for the delay in the observer's reaction time and the delay in the start of recording long base, one of the two OPs should be located in front of the microphone 2 and the second OP in front of microphone 5 – each at a distance of 1500-2,000 yards / metres ahead of the base; and the OP for a short base should be placed 1,000 – 1,500 yards / metres in front of the centre of the base.

Figure 24. Side Slipping a Base.

- b. An OP should if possible be placed at a vantage point for visual observation into enemy territory to aid in the estimation of direction of sound of hostile battery firings.
- c. The site selected for an OP should be, as far as possible, free from any interfering noises, such as small arms fire, friendly artillery fire, enemy shelling and vehicular traffic, which would conceal the sound of hostile battery firing. Exposed windy places should be avoided.
- d. Natural cover and concealment should be available.
- e. An OP should have a covered approach.
- f. For protection an OP should be sited within a defended locality.

Selection and Siting of the Command Post

4. A command post may be set up in a building, vehicle or dugout. The site selected for a sound ranging command post should: -

- a. Be located as near the centre of the microphone base as is consistent with security in order to reduce the communication requirements as much as possible.
- b. Provide cover and concealment.
- c. Be accessible to vehicles.
- d. Provide good cable routes to microphones and OPs.
- e. Provide protection against enemy patrols.
- f. Facilitate work both by day and night without interference.

- g. Have wagon line area within reasonable distance if possible.

SECTION 25 – DEPLOYMENT OF A LONG BASE

General

1. A sound ranging troop may receive orders to deploy when it is either:-
 - a. At rest or in a 'hide' or
 - b. On the move or
 - c. In action.
2. The case considered here is that of a troop deploying from rest or 'hide' and occupying positions immediately after reconnaissance has been completed.

Procedure

3. The following are the main steps in deployment: -
 - a. The troop commander receives orders.
 - b. The troop commander carries out map reconnaissance and prepares map plan of the base.
 - c. The troop commander gives out preliminary orders including forward RV for the troop. The forward RV should normally be the place provisionally selected for command post.
 - d. The Troop commander accompanied by field section commander and signal havildar carries out ground reconnaissance. The command post officer leads the troop to the RV.

- e. After completion of the ground reconnaissance, the troop commander gives out orders.
- f. After orders: -
 - (1) The troop commander deploys OPs.
 - (2) The field section commander conducts the survey of base.
 - (3) The microphones parties under the general supervision of signal havildar lay cable and establish the microphone positions.
 - (4) The command post officer deploys the command post.
- g. Each OP after occupation lays cable to the command posts and carries out the normal duties.
- h. The troop commander visits SIC to collect survey information.

Orders

- 4. The troop commander receives deployment orders to include the following details from his battery commander: -
 - a. Tactical situation.
 - b. Tasks.
 - c. Zone of observation which may be given in the form of likely hostile battery areas.
 - d. Survey information.

- e. Time to be ready.
- f. Location of SIC.

Map Reconnaissance

5. If suitable maps are available, a detailed map reconnaissance will greatly facilitate the selection of sound ranging base. While receiving his orders, the troop commander marks the FDLs and the likely hostile battery area on the map. A transparent template showing the relative locations of microphones for the type of base to be used and the OIP, is then superimposed on the map to determine the suitable positions to be occupied. The template should be of the same scale as the map. A typical template showing base coverage and the right bisector of the base as well as the microphone and OP positions is shown in Figure 25.

Figure 25. A Typical Sound Ranging Base Template.

6. When the template is used, it is superimposed on the map with the right passing through the centre of the likely hostile battery area. Keeping in view the FDLs the template is then shifted about until the OPs are located on suitable terrain and the microphones are in acoustically suitable positions. The positions of OPs and microphones are thus plotted on the map and the command post area is selected. The positions selected are not considered final until ground reconnaissance has been completed.

Preliminary Orders

7. After formulating the map plan of the base, the troop commander gives out the preliminary orders which will include the following details in the execution para: -

- a. Outline plan, ie, the type and size of the base
- b. Map locations of microphones, OPs and command post.
- c. Forward RV for the troop and timings for move.
- d. Composition and instructions for the reconnaissance group.
- d. Time to be ready.
- e. Available survey information.

Ground Reconnaissance

8. **Reconnaissance Party.** The composition of a reconnaissance part for a sound ranging troop of a corps locating regiment is given in Annex 'A'. When tactical situation does not allow the maximum reconnaissance party, minimum of two vehicles should be utilized as follows: -

- | | | | |
|----|----------------|---|-----------------|
| a. | Truck 1/4 tons | - | Troop commander |
| | | - | Signal havildar |
| | | - | Driver |

- b. Truck 1/4 tons
 - Field section commander
 - Survey pair
 - Driver

9. **Conduct of Reconnaissance.** The ground reconnaissance is necessary to the map reconnaissance. Since the maps in use may be out of date or the positions selected may have been occupied by other units. The degree of ground reconnaissance will depend on the type of base to be deployed: -

- a. *Straight or Curved Regular Base.* A general reconnaissance to determine the feasibility of the deployment of these types of bases will suffice.
- b. *Other Bases.* Detailed reconnaissance is carried out and the site for each microphone is selected and marked.

10. If time is available, the troop commander also selects the command post and wagon line areas, otherwise this task can be assigned to the command post officer.

Deployment Orders

11. After completion of the ground reconnaissance, the troop commander returns to the RV to meet the main body and gives out deployment orders. The execution paragraph of these orders will include the following details: -

- a. Outline plan.
- b. Location of microphone positions and command post; and the bearing of the base in case of regular base.

- c. Orders for microphone parties:-
 - (1) Task.
 - (2) Routes.
 - (3) Labels – the letters to be used for labeling.
 - (4) Amount of cable required.
- d. Survey plan for the base.
- e. Orders for Ops.
- f. Time to be ready.

Deployment

12. **Microphone Parties.** The composition of a microphone party together with duties and responsibilities for main items of stores is shown in Table 7.

TABLE 7 – **COMPOSITION LOF THE MICROPHONE PARTY**

Detachment No	Duties	Stores
No 1 (Surveyor)	<i>During Cable Laying</i>	
No 1 (Surveyor)	a. Keeping the party informed of the tactical situation and giving orders for cable laying	Maps, map board, scale, protector compass
	b. Supervising the laying and testing of cable and assisting when necessary	

Detachment No	Duties	Stores
	c. Controlling the speed and route of the vehicle d. Controlling the speed of the cable layer and paying out cable as necessary. e. Ordering the types of crossing to be made.	
	<i>At the Microphone Position</i>	
	f. Marking the microphone position in relation to the survey station (ie 3 yards / metres north of it). g. Supervising the testing of cable and microphone. h. Digging in and screening the microphone j. Map-spotting or map resetting the survey station.	

Detachment No	Duties	Stores
------------------	--------	--------

No 2
(Signaller)

During Cable Laying

- | | |
|--|---|
| <p>a. Laying the cable clear of the road by means of a crook stick.</p> <p>b. Tying back the cable and making temporary crossings.</p> <p>c. Carrying out the drill for testing the cable at the end of each drum.</p> | <p>Cable, cable laying equipment possible crossing, microphone, wind screen, telephone, radio transmission data unit.</p> |
|--|---|

At the Microphone Position

- d. Carrying out the drill for testing the cable and microphone.
- e. Installation of radio transmission data unit

Detachment No	Duties	Stores
------------------	--------	--------

No 3
(Signaller)

During Cable Laying

- a. Walking along the cable behind the party, making it safe, improving crossing and labeling

Mutlocks, pliers
labels.

At the Microphone Position

- b. If a above is complete, assisting No 1. in marking the microphone position and digging in and screening the microphone

No 4 (Driver) a. Driving and servicing the Truck 1 Ton vehicle

- b. Assisting the party as required by No 1.

13. The vital importance of a good microphone cable cannot be too strongly stressed. The cable may be several miles long and any fault which occurs may not only put the microphone out of action but may also take considerable time to and remedy. The essentials of cable laying given in Section 30, paragraph 11 should be strictly followed.

14. **Out Posrs (OPs).** The troop commander takes one OP with him for deployment and gives RV to the second OP. After deploying the first OP, the troop commander deploys the second OP. After selection of the OP site, the troop commander issues the following orders to each OP party and indicates on ground: -

- a. Enemy and friendly troops.
- b. Zone of observation.
- c. Op position.
- d. Rest centre.
- e. Alternative OP position.
- f. Any special instruction.

15. The composition of an OP party with duties and responsibilities for main items of stores is shown in Table 8. The allotment of duties is a suggested one only and must be adopted to meet unusual conditions.

TABLE 8 – COMPOSITION LOF THE OP PARTY

Detachment No	Duties	Stores
	<i>During Deployment</i>	
No 1 (Havildar Surveyor)	a. Keeping party informed of the tactical situation and giving orders for occupation of the OP.	Maps, map board, scale, protector compass
	b. Supervising the establishment of temporary OP.	
	c. Preparing the main and alternative OP.	
	d. Reconnoitering a position for servicing and sleeping.	
Detachment	Duties	Stores

No	
No 2 (Surveyor)	e. Liaison with local infantry f. In line laying acting as No.1 of the party and selecting the line route. <i>In Action</i> g. Ensuring efficient manning of OP.. h. Administering OP. j. Acting as relief to No.2 <i>During Deployment</i> a. Establishing a temporary OP with wireless communication to compass, the CP. Map, map board, scale, protractor, binoculars OP control unit, stop watch <i>In Action</i> b. Listening and identifying hostile weapons and reporting them to No.3 c. Starting and stopping the recorder at the correct time.

Detachment No	Duties	Stores
No 3 (Signaller)	<i>During Deployment</i>	
	a. Assisting No.2 with the Wireless set establishment of the remote control temporary OP and setting up unit, watch. the wireless set.	
	<i>In Action</i>	
No 4 (Driver)	b. Recording the reports called by No.2 and passing them to the CP.	
	c. Starting and stopping the recorder at the correct time.	
	<i>During Deployment</i>	
No 5 (Surveyor)	a. Driving and servicing the vehicle and assisting the party as ordered by No.1	
	<i>In Action</i>	
	b. Acting as relief to No.3	
No 5 (Surveyor)	<i>During Deployment</i>	
	a. Acting as No.2 of line laying party during line laying	Cable, cable laying equipment telephone

Detachment No	Duties	Stores
------------------	--------	--------

In Action

c. Acting as relief to No.2

No 6
(Signallerr)

During Deployment

- a. Acting as No.3 of line laying party during line laying Muttock, pliers, cables
- b. Assisting No.1 in the preparation of the main, and alternative positions

In Action

c. Acting as relief to No.3.

16. It is usually necessary to occupy a temporary position while the main position is being prepared. As soon as the OP is established, the No.1 sends the grid reference of the position to the command post and reports 'the OP in action'

17. **Command Post.** On arrival at the command post position the command post officer first makes quick reconnaissance to decide on the layout, the method of occupation and the track plan and then issues orders to the detachment for occupation. The first task in the establishment of command post is to set up the line. Test Set TS-26, so that microphone parties can connect their cables and start laying without delay.

18. The base may be reported in action when the following conditions have been fulfilled: -

- a. Communication has been established to at least one OP.
- b. At least four microphone are in action.
- c. The recorder and associated equipment are functioning correctly.
- d. Plotting board is ready for the microphones in action.

Survey of the Base

19. The field section commander is responsible to conduct the internal survey of the base, link it with higher grid survey and carry out the change of the grid. The internal survey includes the relative fixation of microphone positions only. The planning and conduct of internal survey will depend on the type of base.

20. **Straight or Curved Regular Bases.** For these types of bases, the requirement of survey is to locate on the ground the complete positions of the microphones. Two traverse parties are used. These parties start working in opposite direction from a central starting point which may be the position of microphone 3 or 4. For taping, calibrated wires of .25 sound seconds (84.4 metres) length are used.

21. **Other Bases.** In case of irregular bases, the microphone positions are selected and marked on the ground. The location of these triangulation or traverse, or a combination of both.

SECTION 26 – DEPLOYMENT OF A SHORT BASE

General

1. A sound ranging troop of a divisional locating battery deploys two short bases to provide ICB staff with information on short range hostile weapons. Short range weapons are defined as those weapons, except small arms, which are deployed within the zone of the short base. They consist primarily, of mortar and infantry guns, but the heavier artillery

weapons, where within the range of the base can also be located. A short base can also effectively engage targets located by it using sound adjustment method.

2. A short base may also be deployed as a basis for extension into a long base when time is short.

Deployment

3. **Orders.** The battery commander normally allots zones to be covered by the section and may order the midpoints and axes of reception of the bases with a given amount of tolerance. The troop commander deploys one section and the section commander deploys the second section.

4. **Procedure.** The drill for deployment of a short base is similar to the deployment of a long base with the following exceptions: -

- a. Normally a straight and regular base is deployed.
- b. The troop commander and section commander select the base sites and OP positions for their respective sections; and the JCO in each section conducts the survey of the base and supervises, the cable laying and establishment of a command post.
- c. While siting a short base, the characteristics of short range weapons should also be considered.

5. **Siting of the Base.** The principles of siting a short base and factors affecting these principles are the same as given in Section 24. In addition the following characteristics of short range weapons should also be borne in mind when selecting and siting the base: -

- a. *Range.* Short range weapons are seldom sited more than 4,000 yards / metres behind the FDLs owing to their limited range.
 - c. *Audibility.* Short range weapons, particularly mortars, have a comparatively faint sound of discharge. This sound is audible to a sound ranging microphone to a distance of about 6,000 yards / metres.
 - d. *Flexibility.* These weapons, particularly mortars, are highly mobile and take little time setting into and out of action. Consequently, short range HB arms may change rapidly.
 - e. *Rate of Fire.* Most short range weapons are capable of a sustained high rate of fire.
6. **Siting of OPs.** Only one OP is deployed with the short base. It should be sited at least two subbase lengths in advance of the centre of the base. Other considerations for selection of the OP position are given in Section 24.

CHAPTER 7

THE RADAR TROOP

SECTION 27 – TACTICAL MISSIONS AND ORGANIZATION OF RADAR TROOP

Missions

1. The missions of a radar troop are: -
 - a. *Primary.* Location of hostile weapons.
 - b. *Secondary*
 - (1) Adjustment of own artillery fire.
 - (2) Conduct of datum or datum and time registration.

- (3) Comparative calibration.
- (4) Air burst fixation.

Organization

2. Organizations for manoeuvre of the radar troops of corps locating regiment and divisional locating battery are given at Annex 'A' and 'B' respectively.

Duties of Key Personnel

3. **The Troop Commander.** His main duties are: -
 - a. To command, administer and train his troop.
 - b. To liaise with the units in whose locality his radars are deployed for coordinating their local defence.
 - c. To maintain liaison with ICB staff and other locating devices.
4. **The Section Commander.** His main duties are: -
 - a. To select the radar site and deploy it.
 - b. To conduct the survey of radar position.
 - c. To act as command post officer.
 - d. To organize local defence and ensure proper camouflage and concealment of the position.

SECTION 28 – PRINCIPLES CAPABILITIES AND LIMITATIONS OF RADAR RANGING

Principle of Radar Ranging

1. Field artillery radar works on the principle of radio wave reflection. These waves when transmitted by the radar travel at the speed of light ie 186,000 miles per second/3 hundred million

metres/second, in the direction of transmission as beam. These waves on striking an object are reflected back to the radar. During return journey knowing the speed of the reflected waves and their travel time, the direction and elevation can be determined in relation to the position of the antenna.

Figure 26. Radio Wave Reflection

2. The AN/TPQ-36 radar set is highly mobile radar system designated for automatic first round location of weapons firing projectile type rounds. The projectile trajectories can be tracked in two different modes. In hostile mode, it tracks the ascending trajectory and thus gives the location of weapon, in friendly mode it tracks descending trajectories and gives location of projectile impact/ burst. The later can be used for adjustment of friendly fire. The radar is computer controlled and once it is set up and initialized, a single operator can process target return. The significant capabilities are:-

- a. Range and Accuracy: It can locate weapons upto maximum of 24 kilometres with an accuracy of 100 metres or 1% of the range whichever is more. The field artillery and mortars can be effectively located upto 12 Kilometres.
- b. Simultaneous Location: It can locate simultaneously guns firing from multiple positions. A maximum of 10 positions can be located simultaneously.

- c. **Mobility:** It is highly mobile radar system, and can be deployed and redeployed rapidly provided suitable deployment sites are available. The occupation of position and preparation to locate weapons should normally take 20 minutes excluding the reconnaissance time travelling.
- d. **Operation:** The location time is almost instantaneous ie, 5-15 seconds and upto 99 locations can be permanently stored in radar memory. The radar can function continuously for an indefinite period and is unaffected by darkness and fog.

3. **Special Features**

- a. **Location Averaging:** The location averaging feature is used to correlate newly acquired location with old location in permanent storage. If a correlation occurs, the new location is averaged with the location in permanent storage.
- b. **Auto Censoring:** This feature is used to reduce target processing. In this each new track is examined for close proximity to existing weapon location. If correlation is found and number of averaged locations is above an assigned threshold the track is dropped.
- c. **Impact Prediction:** The impact prediction function computes the gun location from the tracking data and it also predicts where the projectile will land. It helps in according the priority for CB.
- d. **Pulse Interfering Rejection :** This feature improves radar performance by rejecting interfering pulses which are not synchronized with radar pulses.

- e. Jam Strobe: This feature indicates to radar operator, when the system is being jammed. The information includes the direction of jammer and the frequency being jammed.
- f. Video Integration: Video integration helps increasing the probability of direction of mortar and artillery projectiles.
- g. Search Sector: Once antenna is facing one direction, it can search in a sector from 225 mils to 1600 mils, the extended azimuth, enables search in azimuth sectors greater than 1600 mils. The sectors are automatically divided into sub sectors of maximum 1600 mils.
- h. Censor and Priority Zones: This provides a means of ignoring to provide locations quickly in other zones defined as priority zones.

Limitations

4. Following are the limitations of this equipment:-

- a. Availability of Suitable Sites: At times the technical and tactical requirements impose certain restriction on selection of site keeping in view the sufficient track coverage and equipment survivability.
- b. *Enemy Countermeasures*.Frequencies coupled with Jam Strobe function enable the operator to take effective and quick countermeasures.
- c. *Maintenance*:Efficient maintenance system is necessary for trouble free service and survivability of the equipment.

SECTION 29 – EMPLOYMENT

General

1. The troop commander having received deployment orders from the battery commander proceeds as follows: -

- a. Carries out map reconnaissance and selects areas for radars and routes leading to them.
- b. Gives out orders to the section commanders who on receipt of orders carry out detailed reconnaissance and deployment of their sections.
- c. Visits each section in turn to satisfy himself with the deployment and to tie up their local defence.

Orders

2. The troop commander's orders follow normal sequence of operation orders and will normally include: -

- a. Grid references of likely radar positions.
- b. Zones or zones to be covered by the section with priorities.
- c. Timings including time to be ready.
- d. Survey information.
- e. Location of troop commander.

Action by Section Commander

3. Having received troop commander's orders each section commander proceeds as under: -

- a. Gives out forward RV to the section.
- b. Reconnoiters the area allotted and selects radar site.

- c. Marks positions of tracker mount, command post and generator.
- d. Selects a preliminary position and meets his section there.
- e. Leads and deploys the section.
- f. Liaises with local units for typing up local defence.

Selection of Radar Site

4. There are two main requirements of a radar site:-

- a. Tactical.
- b. Technical.

5. **Tactical Considerations.** The tactical considerations for selection of radar site are similar to those in choosing a position for a firing battery. Normally, following aspects are given special consideration.

- a. *Communication:* The radar has provision of installing two AN/VRC-46 wireless sets and two field telephones. The radar operates on unit command net and divisional artillery locating net, both duplicated by line. The other communication needed is restricted to wireless set for radar section/troop commander and a field telephone for administrative use.
- b. *Cover and Concealment:* The radar should be emplaced in defilade to the enemy to provide protection to personnel and equipment. The radar site must take advantage of natural cover such as broken ground, trees and shrubs.

- c. *Routes:* The site should have more than one route of approach. The deterioration to cross country mobility due to bad weather conditions must be considered.
- d. *Security:* If possible the radar site should be within defensive parameter of another unit/headquarters. This will ease the local defence requirements for the radar system. Failing which radar troop will need additional manpower and weapons to organize its local defence.
- e. *Survey:* The required survey data and site information are provided by survey team. Radar crew may have to conduct quick survey if survey data is not available immediately. The radar survey requirements are:-
 - (1) Site location.
 - (2) Site altitude.
 - (3) Distance from radar site (near stake) to boresight reference point (far stake).
 - (4) Grid bearing, nearest to 0.1 mil from near stake to far stake.
 - (5) Angle of sight, nearest to 0.1 mil, from near stake to far stake.

6. **Technical Consideration**

- a. There are no restriction on the location of shelter, except that it must be within 50 metres of the trailer owing to the length of the cables. The shelter can be entrenched, sandbagged or located amongst trees. The shelter should be located in protected area and not in the line of radiation of the antenna.

- b. *Generator.* The generator can be located in any convenient within 40 metres from the trailer. The generator can be emplaced in broken ground, under trees or any other place which can provide adequate ventilation and cover.
- c. *Trailer.* Following considerations should be kept in view while selecting trailer site:-
 - (1) *Slope of the Ground:* Slope of the ground should provide sufficient drainage and afford leveled ground for trailer. As a rule the site should have ground slope less than 7 degrees.
 - (2) *Area in Front of antenna:* Solid objects and heavy foliage should not extend above the bottom of the antenna within 200 metres. The radar signals may be attenuated by more than 1 decibel per metre of heavy foliage, therefore few metres dimension of heavy foliage can severely reduce radar effectiveness.
 - (3) *Mask Angle:* Mask angle is the angle to the top of the nearest obstruction from the antenna above which the radar provides coverage. High mask angle is useful as a defence against ground based jammers and direction finders. A mask angle from 15 to 30 mils will provide, the specified performance when the radar and weapons are located at the same height, the crest should be preferably within own FDLs.
 - (4) *Other Radar Operating in Area:* If other radar sets are also operating in same area, then the antennas should not face each other to avoid common illumination.

Survey of Radar

7. That radar is oriented and fixed by the section surveyors on the available grid. Efforts however should be made to provide a BP close to near stake to provide following information:-

- a. Fixation of the site including altitude.
- b. Distance from radar site (near stake) to bore sight reference point (far stake).
- c. Grid bearing and angle of sight from near stake to far stake.

Maintenance

8. Efficiency of radar is dependent upon regular and efficient servicing by the operator and the EME personnel. It requires the presence of EME personnel during operation with sufficient running spares.

CHAPTER 8

MISCELLANEOUS

SECTION 30 – COMMUNICATIONS

General

1. Reliable and efficient communications are vital for locating unit in the accomplishment of its primary mission ie, quick passage of hostile weapon locations to the ICB staff. Good communication are also essential for command and administration within the unit. Adequate means of communications must be provided within the unit, with the ICB staff and the higher artillery headquarters. An alternate means of communication must be provided for each existing means to ensure

continuous operation of the communication system; no one means can be considered infallible.

2. If an element of locating unit is placed in support of a formation or a unit, it will be the responsibility of the latter to establish communication link with the locating unit.

Wireless Communication

3. The primary means of communication in a locating unit is wireless. There are main types of wireless sets employed in a locating unit: -

- a. Medium range AM sets for communication with the ICB staff and met broadcast.
- b. Medium range FM sets for communication within the unit.
- c. Short range portable sets for survey pairs, **flash ranging** OPs and the out posts.

Nets

4. The locating units use some or all of the following nets as required: -

- a. Regimental net within the corps locating regiment.
- b. Battery net within the divisional locating battery and batteries of the corps locating regiment.
- c. Troop nets.
- d. Any special nets eg composite net for campsite group of sound ranging and radar sections.

5. The unit commander decides which nets are to be used and their composition.
6. In addition to the above all locating elements within the unit act as sub station to the locating net of the ICB staff.

Layout

7. A suggested wireless layout of a corps locating regiment and divisional locating battery is given at Annex 'D' and 'E' respectively. Basic allotment of individual wireless sets in a corps locating regiment and divisional locating battery is tabulated in Annex 'A' and 'B' respectively.

Call Signs

8. The standard call signs which are used on all nets within the corps locating regiment and divisional locating battery are tabulated at Annex 'F' and 'G' respectively. New stations joining the nets are allotted call signs from the spare numbers available with the units.

Line Communications

9. Duplicating wireless communication with line is essential for ensuring an uninterrupted flow of information and relieving the air from administrative traffic. Laying of comprehensive lines though, desirable is virtually impossible with the existing number of signalers in a locating unit. Unit commanders, depending upon the availability of time, should decide on the most essential line to be laid for a specific portion of his unit. Following order of priority in line laying is suggested: -

- a. Complete wiring of the sound ranging base including the out posts.
- b. From OPs to the command post of a **flash ranging** base.

- c. From radar sections to sound ranging command posts or BHQ whichever is nearer.
- d. From SR and FR command posts to BHQ.
- e. BHQs to RHQ in a corps locating regiment.

Responsibility of Line Laying

10. The provision of line is governed by the following principles: -
- a. Line will be laid from higher to lower HQ.
 - b. Laterally units will be connected from LEFT to RIGHT.
 - c. Supporting unit will provide line to the supported units.
 - d. The maintenance of line is the responsibility of the laying units.

Essential of Line Laying

11. The importance of secure line laying cannot be over emphasized. The line may be several miles long and any fault which occurs may not only put the line communication out of action but may also take several hours to locate and remedy. Following points must be observed in line laying: -

- a. Line should be reasonably slack and kept off the roads and tracks.
- b. Should be tied back at intervals particularly bends.
- c. Joints must be securely made and insulated.
- d. Cable laid across a road or track must be buried or carried overhead if burying is not possible.
- e. Sufficient slack should be left on both sides of crossings.

- f. Lines must be labeled at crossing and when they cross other lines.

Line Layout

12. A suggested line layout for a corps locating regiment and a divisional locating battery is given at Annex 'H' and 'J' respectively.

Rear Links

13. A rear link will normally be operated by a corps locating regiment and a divisional locating battery on their respective command nets. Likewise a line link is connected with the exchange of the artillery HQ. Rear links are provided and maintained by the personnel of the Signal Corps.

SECTION 31 – LIAISON

1. a locating units consists, in action, of a large number of small isolated components. To ensure local defence and swift dissemination of information liaison is essential. Liaison is discussed under the following headings: -

- a. Liaison for local defence.
- b. Liaison with gun units for engagement of hostile weapons.
- c. Liaison for the exchange of technical data.

Liaison for Local Defence

2. The unit commander will making a map plan will endeavour to site components within the depended localities or the positions where the local defence is a practical proposition.

3. The troop commander while carrying out ground reconnaissance will, in each case, visit the battalion in whose area any of detachments are to be sited. He will contact the affiliated battery commander at the battalion headquarters and through him, arrange the local defence with the battalion commander. They also decide upon the responsibility for moving various posts in the event of any emergency.

4. In default of troop commander's visit section commander will carry out liaison with the battalion as given in paragraph 3. in addition he will visit the company commander in whose area his section is deployed for integration the local defence of his section with the company defensive plan. The section commander should also make special arrangements for any special communications with the affiliated battery commander.

Liaison with Gun Units

5. When a locating device is ordered to pass locations of hostile weapons in the form of bombard orders direct to the guns or to adjust the fire of own artillery, it will come up on the battery net of the gun battery as call sign 8. The command post officer will conduct the shoot as if it were an additional observer.

6. Locating devices will receive orders from the appropriate ICB staff when they are to be employed in this way.

Liaison for the Exchange of Technical Data

7. The locating troop commanders are responsible to inform the SIC of the exact location of their bases and radars at the earliest. Extensive liaison is carried out by meteorological section and survey troops as given below: -

- a. *Meteorological Section.* It carries out liaison with: -

- (1) PAF and other civil meteorological departments for obtaining weather forecast. This helps the section in base line checks and making flight schedules. Meteorological sections provide data to these agencies to help them building up synoptic maps.
- (2) Other meteorological sections especially if their area of interest overlaps can provide metro message in case of equipment failure or when the frequency of metro messages require assistance by other meteorological sections. Liaison for the allocation of radio sonde frequencies is also essential when the locations are close and flight schedules are similar.

b. *Survey Troop.* It carries out liaison with: -

- (1) Engineer's survey for: -
 - Obtaining large scale maps.
 - Obtaining trig data.
 - Obtaining conversion factors.
 - Checking own survey.
 - Seeking assistance in establishing survey controls when not available
- (2) Other survey troops for the exchange of survey information.
- (3) With gun units and locating devices for obtaining the following information: -
 - The location of BP for their area.
 - Time for the establishment of BP.
 - Time at which the BP card will be ready.

Location of SIC.

Any other useful data eg location of BP in OP areas etc.

SECTION 32 – **LOCAL DEFENCE**

1. Liaison for local defence will ensure the integration of local defence of the isolated components into the local defence of the other arms. The unit commander while allocation automatic machine guns and rocket launchers must cater for the following: -

- a. Out posts.
- b. Command posts eg radar, flash ranging etc.
- c. Meteorological station.
- d. Wagon lines.
- e. Battery headquarters.
- f. Regimental headquarters.

2. If the tactical situation permits, it is advisable to group some of the above components and plan their local defence mutually.

3. The overall responsibility of protecting locating devices and elements in action rests with the formation commander being supported.

SECTION 33 – **WAGON LINES**

1. The siting of wagon lines will depend upon the unit commander's plan for the administration of the unit. Her will normally give orders regarding the location an protection of wagon lines. As far as possible the wagon lines should be pooled at battery level.

2. A suggested grouping of wagon lines is given below: -
 - a. *The Corps Locating Regiment:* -
 - (1) Battery headquarters of locating batteries with ` sound ranging troop headquarters.

 - (2) *Headquarters.* Battery headquarters meteorological section, survey troop and regimental headquarters.

 - b. *The Divisional Locating Battery:* -
 - (1) Battery headquarters, meteorological section and survey troop.

 - (2) Each sound ranging section should have its own wagon lines.

3. Radar sections will normally keep their wagon lines in the vicinity of their respective radars.

THE ORGANIZATION OF CORPS LOCATING REGIMENT FOR MANOEUVRE

Notes: 1. This is not intended to be a loading table. It does not account for every man and item of equipment.

2. The organization is base on existing TO&Es

1. RHQ

Sub-Unit	Party	Name of vehicle	Type of vehicle	Personnel	Wireless net	Remarks
	CO's Party	Z	Truck utility ¼ Ton 4x4	CO OCU Driver	Artillery command and regimental net	
		Z1	-do-	Driver		
	2IC's party	Z2	Truck utility ¼ Ton 4x4	2IC RHM OCU Driver	Regimental net	
	RHQ Troop	A1	Truck shop van 2 ½ ton 6x6	Adjutant OCU Driver	Regimental and Artillery command net Loc devices net	Regiment command post.
		A2	Truck cargo ½ ton	Subedar 2 Major Clerks 5 Driver		Regiment office

Sub-Unit	Party	Name of vehicle	Type of vehicle	Personnel	Wireless net	Remarks
		A3	Motor cycle	DR		
	A&B Echelon	Q1	Truck utility 1/4 ton 4x4	QM OCU Driver	Regiment net	
		Q2	Truck cargo 2 1/2 ton 6x6	N/Dub QM EBR, Tailor Carpenter Driver		
		Q3	Truck cargo 2 1/2 Ton 6x6	RQMH Storeman Sweeper Driver		
		Q4	-do-	Cooks-3 Driver		Cook house and ration
		Q5	-do-	Mes Havildar Cooks Mess-2 Waiter-3 Masalchi Driver		Officer mess

2. **Headquarters Battery**

Sub-Unit	Party	Name of vehicle	Type of vehicle	Personnel	Wireless net	Remarks
Battery Headquarters	BC's party	X	Truck utility ¼ ton	BC OCU Driver	Regiment and battery net	
		X!	-do-	Driver		
Met section	Recce party	Met	-do-	Met Officer Driver		
Survey troop		RA	-do-	Troop Commander OCU Havildar OCU Driver	Battery and troop net	
		Svy 4	Truck utility ¼ ton	Troop Havildar Survey pair Driver		
Flash ranging section		FA	-do-	Section commander (flash ranging) OCU Driver	Battery and section net	

Sub-Unit	Party	Name of vehicle	Type of vehicle	Personnel	Wireless net	Remarks
Battery headquarters		K	Truck utility ¼ ton	Battery 2IC BHM OCU Driver		
	Main body	M	Truck cargo 1 ton 4x4	OCU 3 Driver		
		A	Truck cargo 2 ½ ton 6x6	Clerks 3 Driver		Battery office
		Q 1	Truck cargo 1 ton	Battery Subedar Radar mechanic Clerk OCU Driver	Battery net	
		Q 2	Truck cargo 2 2/1 ton 6x6	Cooks 3 Driver (MT Havildar)		Ration and cook house
		Q 3	-do-	BQMH Driver		Q Store

Sub-Unit	Party	Name of vehicle	Type of vehicle	Personnel	Wireless net	Remarks
		Q4	Truck cargo 2 ½ ton 6x6	Sweepers 3 Driver		Q store
Met section		Met 1	Truck cargo 2 ½ ton 6x6 with trailer water	Survey Havildar Surveyors 4 Driver		
		Met 2	Truck shop van 2 ½ ton 6x6 with trailer water 1 ½ ton	Survey Havildar Surveyors 6 Driver	Artillery command and battery net	Met command post
		Survey troop	GA	Truck utility ¼ ton 4x4	Section commander Driver	
		Svy 1	-do-	JCO Survey pair Driver		
		Svcy 2	-do-	Survey pair Driver		

Sub-Unit	Party	Name of vehicle	Type of vehicle	Personnel	Wireless net	Remarks
		Svy 3	Truck utility ¼ ton 4x4	Survey pair Driver		
		Svy 5	-do-	-do-		
		Svy 6	Truck utility ¼ ton 4x4	Survey pair Driver		
		Svy 7	Truck cargo 1 ton 4x4	Survey Havildar Surveyors 4 Driver		
		Svy 8	Truck cargo 1 ton 4x4	Survey Havildar Surveyors 4 Driver		
		SIC	Truck cargo 2 ½ ton 6x6	JCO Surveyors 2 Driver		

Sub-Unit	Party	Name of vehicle	Type of vehicle	Personnel	Wireless net	Remarks
Survey troop		QA1	Truck cargo 2 ½ ton 6x6	Driver		Survey and adm stores, POL rations etc.
Flash ranging section survey party		SA1	Truck utility ¼ ton 4x4	JCO Driver		
		SA2	Truck utility ¼ ton 4x4	Survey pair Driver		
		SA3	-do-	-do-		
		SA4	-do-	-do-		
Flash ranging section command post	Main body	FA 1	Truck cargo 2 ½ ton 6x6	JCO Surveyors 3 OCU Driver	Locating and section net	Flash ranging command post
Flash ranging OP party		OA q	Truck cargo 1 ton 4x46	Survey Havildar Surveyors 2 OCU Driver	section net	

Sub-Unit	Party	Name of vehicle	Type of vehicle	Personnel	Wireless net	Remarks
		QA2	-do-	-do-	-do-	
		OA3	Truyck cargo 1 ton 4x4	Survey Havildar Surveyors 2 OCU 3 Driver	Section net	
		OA 4	-do-		-do-	

3. Locating Battery

Battery Headquarters	BC's party	X	Truck utility ¼ ton 4x4	BC OCU Driver	Regiment and battery net	
		X!	-do-	Driver		
Sound ranging troop	Recce party RB (RD)		-do-	Troop commander Troop Havildar OCU Driver	Regiment and battery net	
		GB (GD)	Truck utility ¼ ton 4x4	Section commander Driver OCU		Field section commander

Sub-Unit	Party	Name of vehicle	Type of vehicle	Personnel	Wireless net	Remarks
		OB (OD)	Truck utility ¼ ton 4x4	OCU Havildar Driver		
		SBI (SDI)	-do-	Survey Havildar Survey pair Driver		
Radar troop		RC (RE)	-do-	Troop Commander Troop Havildar OCU Driver	Regiment and battery net	One OCU may be given from HQ
Battery headquarters		K	Truck utility 1 ton 4x4	Battery 2IC BHM OCU Driver	Battery net	
	Main body	M	Truck cargo 1 ton 4x4	OCU Havildar OCU 3 Driver		
		A	Truck cargo 2 ½ ton 6x6	Clerks 3 Driver		Battwery office

Sub-Unit	Party	Name of vehicle	Type of vehicle	Personnel	Wireless net	Remarks
Sound ranging troop field section (survey	Main body	SB 2 ((SD 2)	Truck utility ¼ ton 4x4	Survey pair Driver		
		SB 3 ((SD 3)	-do-	-do-		
		SB 4 ((SD 4)	-do-	-do-		
		SB 5 (SD 5)	Truck cargo 1 ton 4x4	Survey Havildar Surveyors 4 Driver		
Sound ranging troop OP		O 1	Truck cargo 1 ton 4x4	Survey Havildar Surveyor 2 OCU Driver		
		O 2	-do-	-do-		
		M 5	-do-	OCU 2 Driver		

Sub-Unit	Party	Name of vehicle	Type of vehicle	Personnel	Wireless net	Remarks
		M 6	Truck cargo 1 ton 4x4	OCU 2 Driver		
Sound ranging mike party		M 1	-do-	Surveyor OCU Driver		
		M 2	-do-	-do-		
		M 3	-do-	-do-		
		M 4	-do-	Surveyor OCU 2 Driver		
Sound ranging command post	Main body	Gb 1 (GD 1)	Truck cargo 2 ½ ton 6x6	JCO Survey Havildar Surveyors 4 OCU Driver	Locating and battery net	Sound ranging command post
Radar troop		GC 1 (GE 1)	Truck utility ¼ ton 4x4	Section Commander OCU Driver		
		GC 2 (GE 2)	Truck utility ¼ ton 4x4	Section Commander OCU Driver		

Sub-Unit	Party	Name of vehicle	Type of vehicle	Personnel	Wireless net	Remarks
		SC 1 (SE 1)	Truck utility ¼ ton 4x4	Survey pair Driver		
		SC 2 (SE 2)	-do-	-do-		
		CD 1 (ED 1)	Truck cargo 2 ½ ton 6x6	Operator radar 2 Surveyors 2 Driver		
		CE 1 (EE 1)	-do-	-do-		
		CD 2 (ED 2)	Truck shop van 2 ½ ton 6x6	Operator radar Havildar Operator radar 2 OCU 3 Radar mechanic Driver	Locating and battery net	Radar section command post
		CE 2 (EE 2)	-do-	-do-	-do-	

Sub-Unit	Party	Name of vehicle	Type of vehicle	Personnel	Wireless net	Remarks
Battwery headquarters	A Echelon	Q 1	Truck cargo 1 ton 4x4	Battery Subedar Radio mechanic Clerk Driver		
		Q 2	Truck cargo 2 ½ ton 6x6	Cooks 3 Driver (MT Havildar)		Ration and cook house
		Q 3	-do-	BQMH Havildar fitter vehicle Driver Sweeper 3		Q store
Sound ranging troop		QB 1 (QD 1)	Truck cargo 2 ½ ton 6x6	Driver		Adm stores, POL, ,rations etc

THE ORGANIZATION OF DIVISIONAL LOCATING BATTERY FOR MANOEUVRE

- Notes: 1. This is not intended to be a loading table. It does not account for every man and item of equipment.
2. The organization is base on existing TO&Es

Sub-Unit	Party	Name of vehicle	Type of vehicle	Personnel	Wireless net	Remarks
Battwery headquarters	BC's party	X	Truck utility ¼ ton 4x4	BC OCU Driver	Battery and arty command net	AN/GRC-9 AV/VRC-9
	Recce party	K	-do-	Battery 2IC BHM OCU Driver	Battery net	AN/VRC-9
Met section	"	Met	-do-	Met officer Driver		AN/GRC-9 AN/VRC-9
Survey troop	"	RA	-do-	Troop commander BHM OCU Driver	-do-	AN/VRC-9
		Svy 3	-do-	Troop Havildar Survey pair Driver	Troop net	AN/PRC-9

Sub-Unit	Party	Name of vehicle	Type of vehicle	Personnel	Wireless net	Remarks
Sound ranging	Recce party	RB	Truck utility ¼ ton 4x4	Troop Commander Troop Havildar OCU Driver	Battery net	AN/PRC-9
		GB	-do-	Section commander OCU Driver	Battery net	AN/VRC-9
Radar troop	Recce party	RC	-do-	Troop commander Troop Havildar OCU Driver	Battery net	AN/VRC-9
Battery headquarters	Main body	M	Truck cargo 1 ton 4x4	OCU Havildar OCU 4 Driver		
		A	-do-	Clerks 4 Driver (MT Havildar)		Battery office
		A1	Motor cycle	DR		

Sub-Unit	Party	Name of vehicle	Type of vehicle	Personnel	Wireless net	Remarks
Met section	Main body	Met 1	Truck cargo 2 ½ ton with trailer 1 ½ ton with generator	Survey havildar Surveyors 2 Driver		
		Met 2	Truck cargo 2 ½ ton with trailer water	Surveyors 2 Driver		
		Met 3	Truck shop van 2 ½ ton 6x6 with rawin set in 1 ½ ton trailer with trailer water	Survey Havildar Surveyors 4 Driver		
Survey troop	"	GA	Truyck utility ¼ ton 4x4	Right section commander Survey pair Driver	Battery net and troop net	AN/VRC-9 AN/PRC-6

Sub-Unit	Party	Name of vehicle	Type of vehicle	Personnel	Wireless net	Remarks
		Svy 1		Left section commander Survey pair Driver		AN/VRC-9 AN/PRC-6
		Svy 2	Truck utility ¼ ton 4x4	Survey Havildar Survey pair Driver	Troop net	AN/PRC-6
		Svy 4	-do-	-do-	-do-	-do-
		Svy 5	Truck cargo 1 ton 4x4	Survey Havildar Surveyors 6 OCU Driver		
		Svy 6	-do-	-do-	Troop and battery net	AN/PRC-6 AN/VRC-9
		SIC	Truck cargo 2 ½ ton with trailer 1 ½ ton	JCO Surveyors 6 Driver	Troop net	AN/VRC-6

Sub-Unit	Party	Name of vehicle	Type of vehicle	Personnel	Wireless net	Remarks
Sound ranging troop	Sound ranging survey party	SB	Truck utility ¼ ton 4x4	JCO Survey pair Driver		
		SB 2	-do-	-do-		
		SB 3	Truck cargo 1 ton 4x4	Surveyors 6 Driver		
		SB 4	-do-	-do-		
	OP party	O 1	Truck cargo 1 ton 4x4	Survey Havildar Surveyors 2 OCU 3 Driver	Section net	AN/PRC-9
		O 1	-do-	-do-	-do-	-do-
	Mike party	M 1	-do-	OCU 3 Driver		
		M 2	-do-	-do-		

Sub-Unit	Party	Name of vehicle	Type of vehicle	Personnel	Wireless net	Remarks
	Command post vehicle	GB 1	Truck cargo 2 ½ ton with trailer 1 ½ ton	Survey Havildar Surveyors 2 OCU Driver	Locating, Battery and section net	2xAN/GRC-9 2xAN/VRC-9 2xAN/PRC-9
Radar troop		GC 1	Truck ¼ ton 4x4	Section commander Driver	Battery net	AN/VRC-9
		GC 2	-do-	-do-	-do-	-do-
		GC 3	Truck utility ¼ ton 4x4	Section commander Driver	-do-	-do-
		CA 1	Truck cargo 2 ½ ton with trailer 1 ½ ton	Operator radar 2 Surveyors 2 Driver		
		CB 1	Truck cargo 2 ½ ton	Operator radar 2 Surveyors 2 Driver		

Sub-Unit	Party	Name of vehicle	Type of vehicle	Personnel	Wireless net	Remarks
		CA 2	Truck shop van 2 ½ ton 6x6	Operator radar Havildar Radar mechanic Operator radar 3 OCU 2 Driver	Locating net	AN/GRC-9
		CB 2	-do-	-do-	-do-	-do-
		CC 2	-do-	-do-	-do-	-do-
Battery headquarters		Q 1	Truck cargo 2 ½ ton with trailer 1 ½ ton	Battery Subedar Cooks 3 Waiters mess 2 Cooks mess 2 Driver		Ration and cook house
		Q 2	Truck cargo 2 ½ ton with trailer 1 ½ ton	Fitter vehicle Att personnel from EME and sig driver		Q stores

Sub-Unit	Party	Name of vehicle	Type of vehicle	Personnel	Wireless net	Remarks
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Q 3	Truck cargo 1 ton 4x4	BQMH Sweepers 5 Trademen Driver
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DEPLOYMENTS ORDERS

The following is suggested list of headings for deployment orders to a locating unit. It is unlikely that any one radar will contain all these headings. The Commanding Officer of a Corps Locating Regiment may leave the details of sound ranging and radar troops to the battery commanders and only give out their missions.

1. **Situation**

- a. Enemy Forces
- b. *Friendly Forces.* (including outline plan of troops supported and location of headquarters of other arms).
- c. Attachments and Detachments.

2. **Mission.** (Role of the regiment or battery)

3. **Execution**

- (a) *General Outline.* (Allotment of locating batteries to divisions etec).
- b. *Grouping.* (Reorganization to produce composite troops, allotment of **flash ranging** section to a locating battery etec).
- c. Tasks
 - (1) *Met Section*
 - (a) Location of station.
 - (b) Types of frequencies of messages.
 - (c) Method of observation.

(d) Means of broadcast.

(2) *Survey*

(a) Grid to be used.

(b) Survey information regarding trig data.

(c) Survey tasks in order of priority including radar and sound ranging requirement.

(d) Timings for the provision of survey data.

(e) Location of SIC and time for its opening.

(3) *Sound Ranging*

(a) Map plans for bases.

(b) Zones of observation

(c) Likely BP areas and timings for establishment.

(d) Allotment of guns, ammunition and communications in case of sound adjustment shoots.

(e) Time to be ready.

(4) *Radar*

(a) Proposed area for each radar site.

(b) Routes.

(c) Zones of search.

(d) Timings when survey data will be provided and time to be ready.

(e) Instructions regarding cooperation with guns if applicable.

(5) *Flash Ranging*

- (a) Deployment area.
- (b) Zones of observation.
- (c) Likely BP areas and timings for establishment.
- (d) Time to be ready.

d. *Reconnaissance Parties*

- (1) Composition.
- (2) Routes.
- (3) Timings.

e. *Move Orders*

- (1) SP.
- (2) Routes.
- (3) Timings.
- (4) Order of march.
- (5) Density.

f. *Alternative Sites.* Selection and preparation etc.

g. *Local Defence*

- (1) Priorities for digging and concealment.
- (2) Liaison with local troops.

4. **Administration and Logistics**

- a. Wagon Lines.
- b. POL and Supplies.
- c. Medical.
- d. EME
- e. Water points
- f. Traffic Control

5. **Command and Signals**

- a. *Locations*
 - (1) ICB command post.
 - (2) RHQ.
 - (3) BHQ.
 - (4) SIC.
- b. *Signal Layout*
 - (1) Wireless.
 - (2) Line.
 - (3) Code words and nicknames.
- c. Liaison
- d. Synchronization

Any Questions?

A CORPS LOCATING REGIMENT WIRELESS LAYOUT

**A DIVISIONAL LOCATING BATTERY WIRELESS
LAYOUT**

STANDARD CALL SIGNS CORPS LOCATING REGIMENT

Corps Locating Regiment	RHQ	I	CB		Co-Operation with firing units
CO	-1	GSO-1 I	CB	-1	Sound ranging -8A troop for sound on sound adjustment
2IC	-2	LO		-18	
ADJT	-3	GSO-3 I	CB (Air)	-Daily changing	Radar section -8B for adjustment of own fire
LO	-18	GSO-2 I	CB	-21,31, 41, etc daily changing	
SIG OFFR	-7	Units on ICB	call for	-23,33, 43 etc daily changing	
QM	-9	Corps Locating Regt	-Daily changing		

Corps Locating Regiment	RHQ	I	CB	Co-Operation with firing units	
HQ Battery		Locating Battery		Locating Battery	
BC	-20	BC	-40	BC	-60
Battery Capt	-22	Battery Capt	-42	Battery Capt	-62
Rear link	-24	Rear link	-44	Rear link	-64
Survey and Flash Ranging Troops		Sound Ranging Troop	Radar Troop	Sound Ranging Troop	Radar Troop
Troop -11 Commander		Troop -21 Commander	Troop -41 Commander	Troop -31 Commander	Troop -51 Commander
Troop HQ-13		Troop HQ-33	Troop HQ-43	Troop HQ-33	Troop HQ-53
SIC -88		Section -26,27 Commander	Section -46,47 Commander	Section -36,37 Commander	Section -56,57 Commander
Survey Section Commander -16,17		Outposts -25A, 25B	Outposts -35A, 35B		
OPs (Flash/Survey pairs-15A, 15B, 15C, 15D					

- Notes:-
1. An ICB officer or locating device uses the call signs of 8 when on Artillery formation or regiment net.
 2. Suffuxes of A,B,C etc may be used when two or more such stations are on the same net

3. Units on call for ICB will be allotted call signs by corps ICB staff.
4. Wireless sets on locating net will be allotted daily changing call signs by the corps ICB staff.

A DIVISIONAL LOCATING BATTERY WIRELESS

Divisional Locating Battery			I&CB	
Net		Call Sign	Net	Call Sign
BC		1	GSO 2 I&CB	1
Battery 2IC		2	Unit on call for CB	23,33,43 daily changing
Rear Link		Daily changing	Divisional Locating Battery	Daily changing call sign
Cooperation with Firing Unit			Sound ranging section for sound on sound adjustment	8A
			Radar section for adjustment of own fire	8B
Survey Troop		Sound Ranging Troop		Radar Troop
Troop Commander	11	51		91
Troop HQ	13	53		93
Section Commanders	16	56		96 (Right section)
	17	57		97 (Centre section)
		Out posts 55a,55B		98 (Left section)
SIC	88			
Survey pair	15A, 15B			
	15C, 15D			

- Notes:-
1. Suffixes of A,B,C etc may be used when two or more such stations are On the same net.
 2. An ICB officer or locating device used the call sign of 8 when on artillery formation or regiment net
 3. Wireless sets on the locating net will be allotted changing call signs by the divisional ICB staff.

LINE LAYOUT CORPS LOCATING REGIMENT

LINE LAYOUT DIVISIONAL LOCATING BATTERY