CHAPTER 3

STANDARD PATTERN MINEFIELDS

Standard pattern minefield laying is laborious and time-consuming, but allows better mine concealment than row laying. Standard pattern minefields are well-suited for protective and nuisance minefields. They can be used in terrain where the nature of the ground makes row laying methods impracticable.

To achieue their maximum effect, mines must be laid so they cannot be seen and so a vehicle's wheel or track, or a person's foot, exerts enough pressure to detonate them.

The method used to lay mines depends on the method of mine operation, the type of ground in which the mine is to be laid, and the type of ground cover available for camonflage.

MINEFIELD COMPONENTS

Mine Strips

The mine strip is the foundation of a standard pattern, hand-laid minefield. If a mine strip was laid in one straight line, the enemy would be able to easily locate mines; therefore, mine strips are laid in several segments as shown in Figure 3-1, page 3-2.

When siting, laying, and recording mine strips, all measurements are expressed in meters or paces. Directions are recorded as magnetic azimuths, in degrees.

Mine Clusters

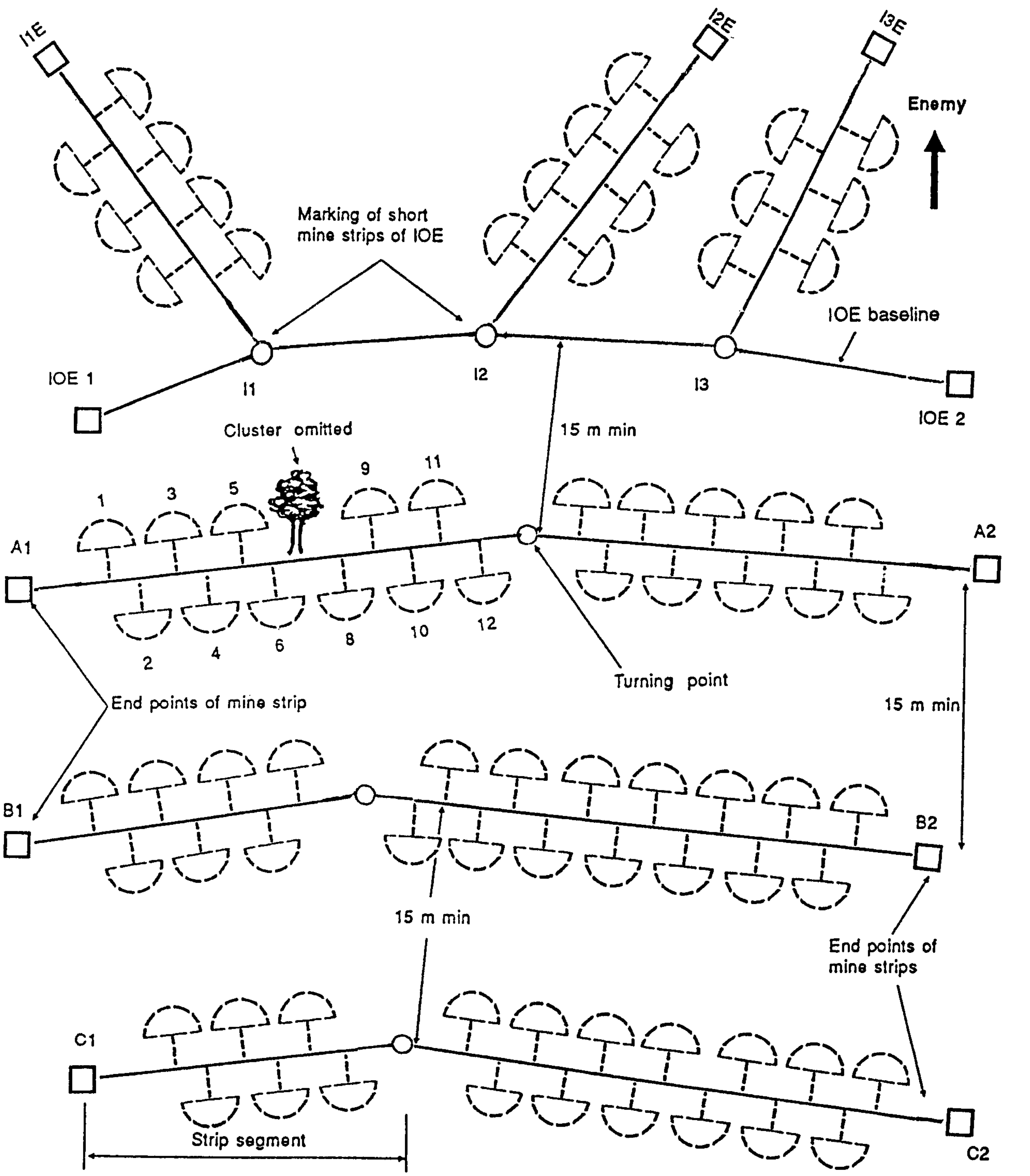
The cluster is the basic unit of a minefield. It may consist of one to five mines that are laid within a 2-meter-radius semicircle (Figure 3-2, page 3-3). When clusters are incorporated in a mine strip, they are numbered progressively and may consist of—

- One AT mine.
- One AT mine and one to four AP mines.
- Up to five AP mines.

Clusters are placed at 6-meter intervals, center to center, to form rows. Two parallel rows, 6 meters apart, form a mine strip. The arrangement of clusters in a mine strip is shown in Figure 3-3, page 3-3.

Rules for Positioning Clusters Within a Strip

The first cluster (Number (No.) 1) is placed on the enemy side of the strip centerline, 6 meters from the beginning-of-strip marker. Following clusters are numbered consecutively. Odd-numbered clusters are always on the enemy side of the strip centerline. The direction of laying follows the numbering; that is, from A1 to A2, B1 to B2, and so on.



NOTES:
1. The direction of laying is as per the number; that is, from A1 to A2, B1 to B2, and so on.
2. Odd-numbered clusters will always be on the enemy side of the strip.

□	End of row markers.
Δ	Landmarks.
○	Turnpoints. The next cluster cannot be any closer than 3 meters from that turnpoint.
◇	Turnpoint on the IOE baseline.

★ *Figure 3-1. Minefield layout*

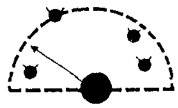
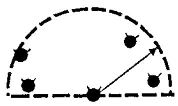
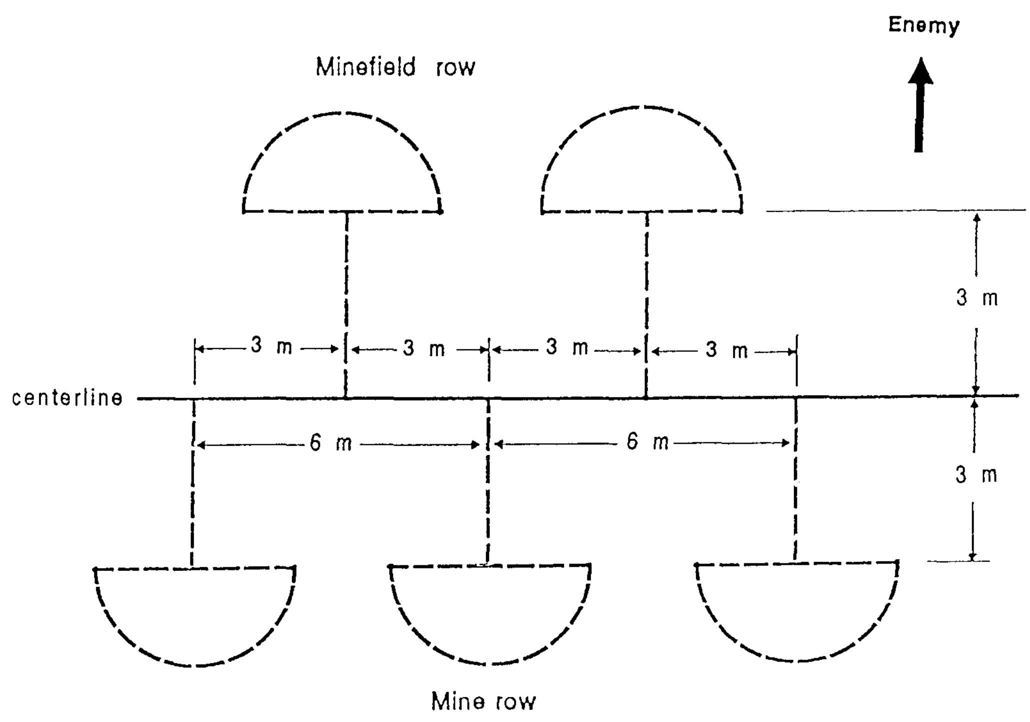
Individual laying of AT mine (to be at base of cluster).	
Cluster with one AT mine plus several AP mines within or on a 2 m semi-circle from the AT mine (AT mine must be base mine).	
Individual laying of AP mine (to be at base of cluster).	
Cluster with several AP mines within or on a 2 m semicircle of the central AP mine (most easily detected mine is to be base mine).	

Figure 3-2. Cluster compositions



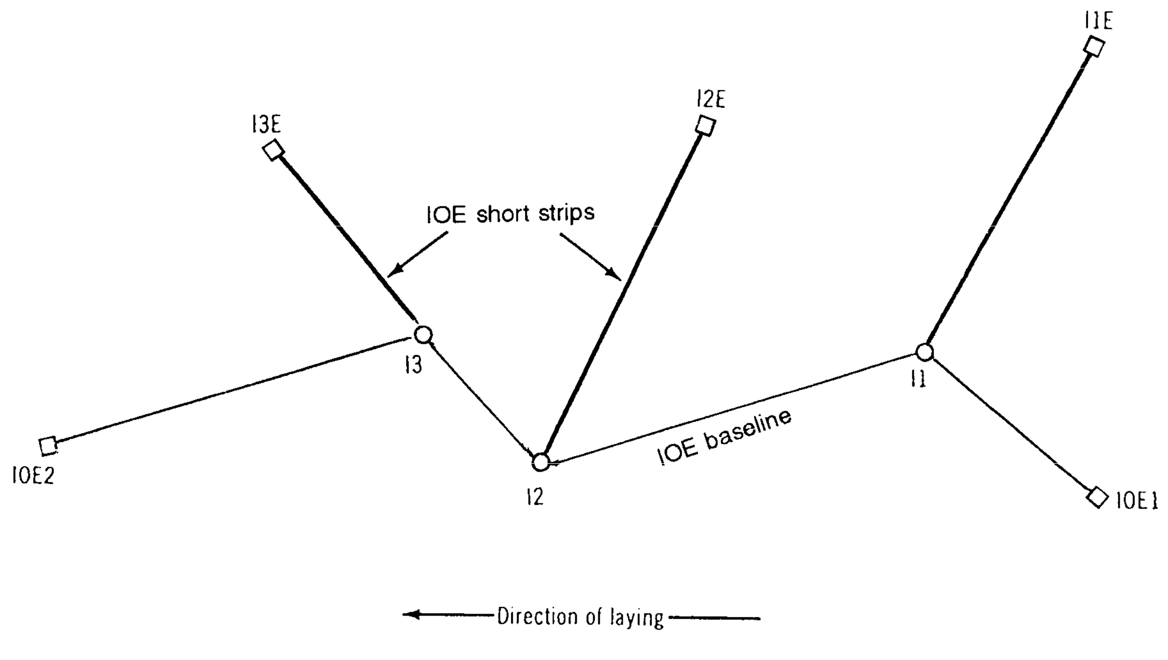
★ ***Figure 3-3. Arrangement of clusters in a strip***

The IOE is normally the first part of the minefield encountered by the enemy. It consists of a baseline from which short strips are extended (Figure 3-4). Short strips along the IOE deceive the enemy on the minefield's pattern, spacing, and size. IOE placement and composition are largely dictated by the time allowed for laying the minefield, terrain conditions at the laying site, and the tactical situation.

The IOE baseline extends from one end point (IOE 1) to another end point (IOE 2). The laying direction is indicated by end point markers. Laying always begins at IOE 1. Intermediate or turning points are marked in consecutive order beginning with 11. On the enemy side of the IOE baseline, short strips are extended from turning points at irregular angles. They are identified by turning point markers.

Turning points should be no more than 45° from the last azimuth. The length of short strips is not standard. At the end of each short strip, an end marking stake is driven into the ground. Stakes are marked in consecutive order beginning with I1E for recording purposes. No trip wires are used in the IOE, but AHDs may be employed.

AP mines actuated by trip wires are only placed on the enemy side of each regular strip. No more than one mine per cluster uses trip wires, and no more than two trip wires extend from the mine. Trip wires are angled toward the enemy and should be at least 2 meters from a cluster, minefield lane border, or minefield boundary. Trip wires are only used with AP fragmentation mines; they are not considered AHDs.

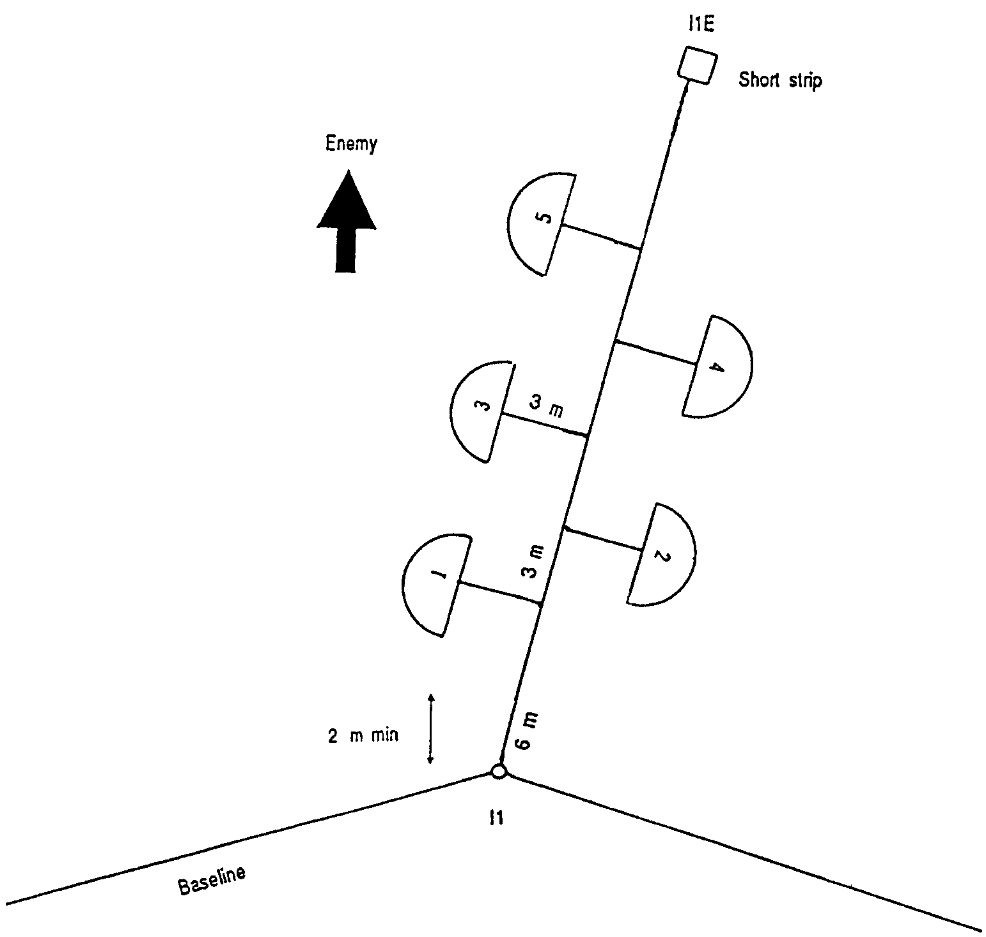


★ *Figure 3-4. IOE with short strips*

Standard Pattern Minefield Rules

- Clusters.
  - A cluster is a 2-meter-radius semicircle located 3 meters off the strip centerline.
  - There are two types of clusters: live and omitted. Live clusters contain mines.
  - A live cluster contains as many as five mines (only one can be an AT mine).
  - Omitted clusters do not contain mines, but they are numbered. They are reported on DA Form 1355 (Notes Section). (See Chapter 5.)
  - Clusters are omitted within lanes or gaps: in areas less than 2 meters from boundaries, lanes, or another cluster (including the IOE); and in areas where the terrain (trees and rocks) prohibits emplacement.
  - The base mine in a live cluster is the first mine laid. It is 3 meters from the strip centerline.
  - When a live cluster contains an AT mine, the mine is always used as the base mine. If an AT mine is not present, the largest, metallic AP mine is used as the base mine.
  - ★ The first cluster in a mine strip is located on the enemy side, 6 meters from the start of the regular strip marker.
  - The minimum distance between a cluster and a lane, gap, boundary, or another cluster is 2 meters (measured from the edge of the cluster).
  - Cluster composition is the number of mines, by type, in any cluster in a specific strip.
  - Cluster composition remains the same through the entire mine strip and is recorded on DA Form 1355 (Notes Section).
  - The types of AP mines may vary within a cluster.
  - The cluster boundary must be no closer than 15 meters to the minefield perimeter fence.
  - Clusters are numbered beginning with the first cluster on the enemy side. Therefore, odd-numbered clusters are always on the enemy side of the strip, and even-numbered clusters are on the friendly side.
- Mine strips.
  - There are two types of mine strips: regular and short. (Short strips are described under IOE rules below.)
  - A regular strip consists of a strip centerline and two rows of clusters (row 1, enemy side: row 2, friendly side).
  - Regular strips are marked and recorded. They are designated by letters (A, B, and so forth), with strip A being closest to the enemy.
  - Regular strips are sometimes referred to as lettered strips. A standard pattern minefield contains a minimum of three regular strips.
  - The minimum distance between strip centerlines is 15 meters; there is no maximum distance.
  - Safety tapes are used to ensure personnel installing trip wires do not move forward into armed clusters. A safety tape is used behind each regular strip. Safety tapes are 8 meters from the strip centerline (3 meters from the outer edge of a cluster).
  - Within a mine strip, the cluster composition must remain the same unless the cluster is omitted.
  - Marking of end points indicates the direction of laying (for example, Al to A2).

- IOE rules.
  - The IOE consists of a baseline from which short strips are extended at turning points.
  - The IOE is located on the enemy side of the minefield.
  - Short strips originate only from turning points along the IOE baseline.
  - The number and length of short strips depend on the tactical situation and resources available to the emplacing commander.
  - The number of clusters in the IOE is about one-third the number used in a regular strip.
  - The first cluster along a short strip is placed on the enemy-side and can be no closer than 6 meters from the IOE baseline, and the cluster boundary can be no closer than 2 meters from the baseline (Figure 3-5). If the short strip is exactly parallel to the enemy direction of travel, the noncommissioned officer in charge (NCOIC) designates the enemy side of the strip.
  - The IOE baseline is labeled at the beginning (IOE 1) and end (IOE 2) according to the direction mines are emplaced.
  - Short strips are labeled at turning points (11) and at the end (I1E).



★ *Figure 3-5. Clusters on short strips*

- The IOE contains a safety tape, located 2 meters behind and following the IOE baseline.
- The IOE baseline is no closer than 15 meters to any point (strip centerline) on a regular strip; there is no maximum distance.
- An IOE short strip is no closer than 15 meters to another IOE short strip; there is no maximum distance.
- AHDs may be employed.

• Trip wire rules.

- Trip wires are not used in the IOE.
- Trip wires may be used in regular strips, but only one mine per cluster may be actuated by a trip wire.
- Trip wires are employed no closer than every third cluster.
- No more than two trip wires can be used on a mine.
- Trip wires are used only on the enemy side of the row/strip.
- Trip wires are not considered AHDs.
- Trip wires are located no closer than 2 meters to the border of a minefield lane, safety tape, cluster, another trip wire, IOE baseline, or minefield perimeter fence.
- Trip wires can only be used with AP fragmentation mines.

• Turning points.

- The last cluster before the turning point will have a distance of at least 3 meters.
- The first cluster after the turning point is laid on the opposite side of the strip centerline from the last cluster, and 3 meters from the last turning point.
- The angle of any given turning point cannot exceed 45° from the last azimuth. (This ensures a minimum distance of 2 meters between clusters in the same row.)

• General rules.

- The farthest extremities of a regular strip determine the minefield front. Minefield depth is measured from the friendly strip/row to the enemy strip/row and includes the IOE, if used.
- Strips can be laid left to right or right to left.
- Depth is determined by using the IOE.
- Back azimuths are not used to record the minefield.
- The minefield will have two landmarks located to the rear of the minefield (never to the extreme side or front).
- If landmarks are more than 200 meters away from the last regular strip or out of the direct line of sight, intermediate markers are used. Intermediate markers are placed no closer than 75 meters to the last end of the strip/row marker.
- Measurements may be in meters or paces (1 pace = ¾ meter). If paces are used, convert them to meters before recording on DA Form 1355.

• Minefield lanes. Minefield lanes are left for the use of dismounted patrols and vehicles (Figure 3-6, page 3-8).

- Lanes are sited before laying begins.
- Lane locations should not be obvious.
- Clusters are not laid within 2 meters of lane edges.
- Lanes are not straight, but are zig-zagged.
- Lanes cross the mine strip centerline at approximately right angles.
- Direction changes will not exceed 45°. (This ensures long vehicles will be able to negotiate turns, if necessary.)

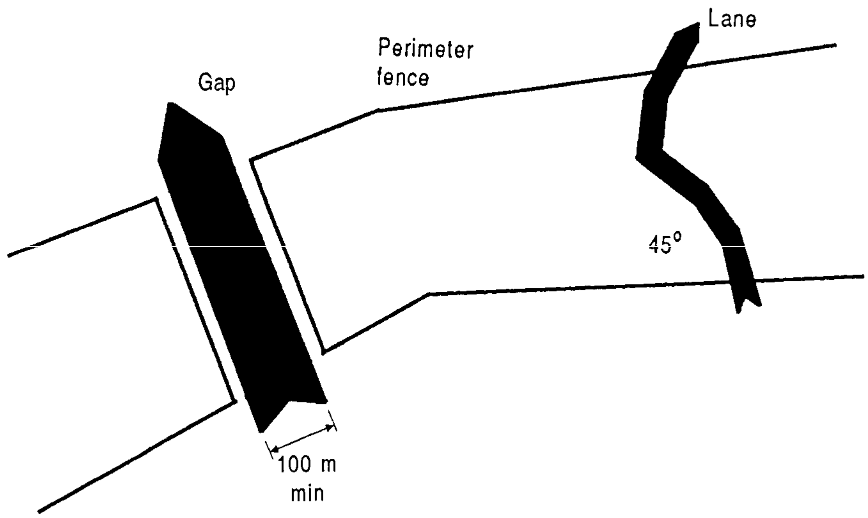


Figure 3-6. Lanes and gaps

- The number of lanes must be sufficient to ensure that no one lane is overused and turned into an obvious track.
- Sufficient mines are stockpiled so the responsible unit can seal lanes suspected of being located by the enemy.
- Recommended minefield lane widths are: footpath, 1 meter; one-way vehicle lane, 8 meters; and two-way vehicle lane, 16 meters.

• Minefield gaps. Minefield gaps are left so friendly forces can pass through in tactical formation. Their normal width is 100 meters or more. (See Figure 3-6.) The gap should closely resemble the rest of the minefield so it will not be discovered by the enemy. The ground within the gap should be disturbed with tracks to represent the passage of mine-carrying vehicles. Signs of mine laying (digging, scattered spoil, crates, and other evidence of activity) should be visible. The following points should be observed:

- Gaps are sited before laying begins.
- Gaps are located along recognizable features (fences, tracks, or creeks).
- Gaps should run straight through minefield; gaps will not contain bends.
- Sufficient mines must be stockpiled so the responsible unit can seal gaps when necessary.

STANDARD PATTERN MINEFIELD LOGISTICAL CALCULATIONS

In addition to allowing accurate recording, conventional minefield emplacement allows the unit to accurately calculate the number of mines required for a minefield based on its size and density.

To simplify the calculation process, the Minefield Requirements Computation Form has been developed (Figure 3-7, pages 3-10 through 3-12). This work sheet is provided to the platoon leader or sergeant as a step-by-step guide to the mathematics involved in the logistical computation process. Properly completed, the Minefield Requirements Computation Work Sheet provides the number of mines to order (by type), number of regular strips to be emplaced, strip cluster composition, estimated man -hours required to install the minefield, amount of fencing and marking material to order, number of truckloads required to carry the mines, and number of rolls of engineer tape to order.

Step-by-step procedures for completing the work sheet are shown in Figure 3-8, pages 3-13 through 3-18. Each step is explained in the example to facilitate the reader's understanding of the logic behind the calculations. For more information on standard pattern minefield rules and procedures, see page 3-5.

Strip Cluster Calculation

Accuracy is the main requirement of a standard pattern minefield. The following cross-check system has been designed to enable the minefield officer in charge (OIC) to accurately record the number of mines laid.

- Compare the strip feeder report with the amount of pins and clips returned by the laying party.
- Compare the strip feeder report with the mine tally sheet.
- Check the strip feeder report with the following strip cluster computation.

Step 1. Add the total length of the strip as determined by the recording party.

EXAMPLE: 30 + 42 + 21 = 93 meters.

Step 2. The first and the last cluster in the strip are located 6 meters in from the end of strip markers. Subtract 12 from Step 1.

EXAMPLE: 93 - 12 = 81 meters.

Step 3. Clusters are not located on turning points. Multiply the number of turning points by 3 and subtract it from Step 2.

EXAMPLE: 81 - 3(2) = 75 meters.

Step 4. Divide Step 3 by the cluster spacing (that is, 3).

EXAMPLE: $\frac{75}{3}$ =25 clusters.

Step 5. Add one cluster, because when a line is divided, there is one more interval than spacing.

EXAMPLE: 25 + 1 = 26 clusters.

From these computations, the minefield OIC is able to cross-check the information on the strip feeder report. In this example, strip A should have a total of 26 clusters, less any omitted.

Platoon Emplacement Procedures

The platoon is the basic unit used to install a standard pattern minefield. Orders to the laying unit OIC specify the proposed location, the length, and the mine type and density. The platoon organization and equipment is shown in Table 3-1, page 3-18.

The OIC makes a map study and conducts a ground reconnaissance of the site if the situation permits. He determines locations for each mine strip, landmarks, fences, mine dumps, and approaches. Using the Minefield Requirements Computation Work Sheet (Figure 3-7, pages 3-10 through 3- 12), the OIC determines the required number of mines and other materials; arranges for mines to be drawn; and organizes the platoon into siting, laying, recording, and marking parties.

The siting party places boundary stakes or pickets as strip markers at the beginning and end of each mine strip and at points where strips change direction. The siting party lays tape on the centerlines of each strip, lane, and traffic path. After completing siting, it augments other parties.

MINEFIELD REQUIREMENTS COMPUTATION WORK SHEET

GIVEN

1. Desired density	AT _____	APF _____	APB _____
2. IOE representative cluster	AT _____	APF _____	APB _____
3. Front	_____ meters		
4. Depth	_____ meters		
5. Percentage of AHDs	_____		
6. Types of mines	AT _____	APF _____	APB _____
7. Type of truck/trailer	__________		
8. Lanes/gaps/traffic tapes	_____	_____	_____
9. Trip wire safety tapes	_____		

PART 1. NUMBER OF MINES

A. Front ÷ 9 = IOE live clusters _____ ÷ 9 = _____ (round up)

	AT	APF	APB
B. IOE representative cluster X number of IOE clusters = number of mines in IOE	_______ X _____ _______	_______ X _____ _______	_______ X _____ _______
C. Desired density X minefield front = mines in regular lettered strips	_______ X _____ _______	_______ X _____ _______	_______ X _____ _______
D. Subtotal of mines (lines B + C)	_______	_______	_______
E. 10% excess factor =	X 1.10	X 1.10	X 1.10
Total number of mines to order	_______	_______ (round up for each)	_______

PART 2. NUMBER OF REGULAR LETTERED STRIPS

A. Add desired density AT _____ + APF _____ + APB _____ = _____

B. 0.6 X line A above 0.6 X _____ = _____ (round up)

C. 3 X AT desired density 3 X _____ = _____

D. Number of regular letter strips required = highest number of lines B or C _____

PART 3. NUMBER OF AHDs

%AHDs X total number of AT mines _____

PART 4. STRIP CLUSTER COMPOSITION

A. Desired density

AT: 3 X _____ = _____ APF: 3 X _____ = _____ APB: 3 X _____ = _____

★ ***Figure 3-7. Blank Minefield Requirements Computation Work Sheet***

B. Cluster composition table

STRIP	AT	APF	APB	STRIP TOTAL (cannot exceed 5)
A	_____	_____	_____	_____
B	_____	_____	_____	_____
C	_____	_____	_____	_____
D	_____	_____	_____	_____
E	_____	_____	_____	_____
F	_____	_____	_____	_____
G	_____	_____	_____	_____
H	_____	_____	_____	_____
I	_____	_____	_____	_____
COLUMN TOTAL (cannot exceed desired density X 3 as computed in A above)	_____	_____	_____	_____

PART 5. NUMBER OF MAN-HOURS TO INSTALL MINEFIELD

Number of mines ÷ emplacement rate (mines per man-hour)

Number of AT mines: _____ ÷ 4 = _____ (round up)

Number of APF mines: _____ ÷ 8 = _____ (round up)

Number of APB mines: _____ ÷ 16 = _____ (round up)

_____ + _____ + _____ X 1.2 = _____ man-hours (round up)

PART 6. AMOUNT OF FENCING AND MARKING MATERIAL

A. Concertina wire

[(front X 2) + (depth X 2) + 160] X 1.4 = meters of concertina required

[(_____ X 2) + (_____ X 2) + 160] X 1.4 = _____ (round up)

Number of pickets = amount of concertina ÷ 15

_____ ÷ 15 = _____ (round up)

- OR -

B. Barbwire

[(front X 2) + (depth X 2) + 320] X 1.4 = meters of concertina required

[(_____ X 2) + (_____ X 2) + 320] X 1.4 = _____ (round up)

Number of pickets = amount of concertina ÷ 30

_____ ÷ 30 = _____ (round up)

★ *Figure 3-7. Blank Minefield Requirements Computation Work Sheet (continued)*

C. Number of signs = number of pickets = _____

PART 7. NUMBER OF TRUCKLOADS

AT mines

_____ cases/truck X _____ mines/case = _____ mines/truck

_____ mines required ÷ _____ mines/truck = _____ truckloads of AT mines

APF mines

_____ cases/truck X _____ mines/case = _____ mines/truck

_____ mines required ÷ _____ mines/truck = _____ truckloads of APF mines

APB mines

_____ cases/truck X _____ mines/case = _____ mines/truck

_____ mines required ÷ _____ mines/truck = _____ truckloads of APB mines

Total truckloads

_____ AT truckloads _____ APF truckloads + _____ APB truckloads =

_____ total truckloads required (round up)

PART 8. AMOUNT OF ENGINEER TAPE

A. Minefield boundaries depth X 2 = _____ X 2 = _____

B. Regular lettered strips front X number of regular strips = _____ X _____ = _____

C. IOE front X (number of IOE clusters X 3) = _____ + (_____ X 3) = _____

D. Lanes and gaps depth X 2 X number of lanes and gaps = _____ X 2 X _____ = _____

E. Traffic tapes depth X number of traffic tapes _____ X _____ = _____

F. Trip wire safety tape front X number of regular strips with trip wire _____ X _____ = _______

G. Subtotal (add lines A + B + C + D + E + F) _____ + _____ + _____ + _____ + _____ + _____ = _____ meters (round up)

H. Number of rolls to order line G X 1.2 _____ X 1.2 = ______ meters

_____ meters ÷ 170 meters/rolls = _____ rolls of tape (round up)

PART 9. DETERMINE SANDBAG REQUIREMENTS

A. Number of clusters in IOE (from 1A) = _____

B. Number of clusters in main field = number of clusters in IOE X 3 X number of regular strips (from 2D) = _____

C. Total number of clusters (add lines A and B) = _____

D. Number of sandbags = number of clusters X 3 sandbags/clusters (line C X 3) = _____

★ ***Figure 3-7. Blank Minefield Requirements Computation Work Sheet (continued)***

This information is normally determined by the engineer company commander or the staff engineer. It will be provided to the OIC or NCOIC of the emplacing unit during the mission briefing. In this example, the following guidance is given to the emplacing unit:

• Desired density	AT 1	APF 4	APB 8
• IOE representative cluster	AT 1	APF 2	APB 2
• Front	200 meters		
• Depth	300 meters		
• AHDs	10%		
• Type of mines	AT M15	APF M16A2	APB M14
• Truck/trailer type	5-ton dump		
• Lanes/gaps/traffic tapes	1 lane, 1 traffic tape (foot troops)		
• Trip wire safety tapes	3		

With this given information, the remainder of the form can be completed.

The regular strip has a cluster density of one cluster every 3 meters. The IOE has a cluster density of one-third that of a regular strip, or one cluster every 9 meters. Therefore, to obtain the number of clusters in the IOE, the length of the strip is divided by 9. Decimals are rounded up to the next higher whole number.

PART 1. NUMBER OF MINES

Step 1.

Front ÷ 9 = IOE live clusters (200 ÷ 9 = 23 (round up))

The representative cluster composition for the IOE clusters is established by the commander based on METT-T and is part of the given information. The number of clusters in the IOE is multiplied by the cluster composition to determine the number of mines, by type, in the entire IOE.

Step 2.

	AT	APF	APB
IOE representative cluster X	1	2	2
Number of IOE clusters =	23	23	23
Number of mines in IOE	23	46	46

The minefield front multiplied by the desired density determines the number of mines in the minefield.

NOTE: The desired density pertains only to the regular strips and does not take into account the number of mines in the IOE which were calculated in Step 2.

Step 3.

Desired density X	1	4	8
Minefield front =	200	200	200
Mines in regular lettered strips	200	800	1,600

The number of mines required for the IOE (Step 2) is added to the number of mines in the regular lettered strips (Step 3).

★ *Figure 3-8. Step-by-step procedures for completing the Minefield Requirements Computation Work Sheet*

Step 4. Subtotal of mines

(Steps 2 + 3) 223 + 846 = 1646

Ten percent is added to the total number of mines required to allow for damaged items and irregularities in terrain and strip length. This is accomplished by multiplying the total number of mines (Step 4) by 1.10. Decimals are rounded up to the next highest whole number.

Step 5.

10% excess factor =	1.10	1.10	1.10
Total number of mines to order	246	931	1811

These figures represent the total number of mines, by type, required for the entire minefield. When ordering by the case rather than by individual mines, the totals above should be divided by the number of mines per case and rounded up to the next whole case.

PART 2. NUMBER OF REGULAR LETTERED STRIPS

Step 1.

Add desired density AT 1 + APF 4 + APB 8 = 13

Each regular mine strip has a cluster every 3 meters and therefore has a density of one-third cluster per meter of front. A total density of 13 mines per meter of front in the previous example would equal 3 X 13 or 39 mines per 3 meters of front. Clusters may contain a maximum of five mines (only one of which may be an AT mine), so the resulting figure must be divided by 5. In short, to determine the minimum number of regular strips required, the total density must be multiplied by three-fifths (3 meters between clusters and five mines per cluster). For ease of calculation, three-fifths is converted to the decimal 0.6. Decimals are rounded up to the next highest whole number.

Step 2.

0.6 X Step 1 above 0.6 X 13 = 8 (round up)

The calculations to determine the minimum number of regular strips previously described are not suitable when the ratio of AT to AP mines is greater than 1:4. For example, if the desired density is 1-1-1, the total density is 3. The minimum number of strips then would be 3 X 3/5 = 1.8, rounded up to 2 strips. However, because of the restriction on the number of AT mines per cluster, it is not possible to obtain a density of 1 AT mine per meter of front with only 2 strips. A minimum of 3 regular strips will be required. The alternative means of determining the number of regular strips is found by multiplying the AT desired density by 3.

Step 3.

3 X AT desired density 3 X 1 = 3

The number of regular strips calculated by the first method and the alternative method are compared, and the higher figure is used as the minimum number of regular strips. The 8 determined by the *3/5 rule* is larger than the 3 determined by the alternative method. Therefore, the minimum number of regular strips in this example is 8.

Step 4.

Number of regular lettered strips required = highest number of Steps 2 or 3 = 8

PART 3. NUMBER OF AHDs

0.10 X 223 = 22.3 = 23 (round up)

★ *Figure 3-8. Step-by-step procedures for completing the Minefield Requirements Computation Work Sheet (continued)*

PART 4. STRIP CLUSTER COMPOSITION

The cluster composition table is prepared by the OIC of the laying unit to control the allocation of mines to a regular lettered strip. The cluster composition remains constant within a particular letter strip, but it may vary among different strips. As the mines are allocated by strip, no more than 1 AT mine can be placed in each representative cluster, and each cluster can have a maximum of 5 mines.

A tabular format is prepared to facilitate the distribution of mines by emplacement personnel. Note that at the top of the form, each component of the desired density is multiplied by 3. The number 3 is always used regardless of the minimum number of regular lettered strips because it is the number of mine strips required to give a minefield density of one mine per meter of front when a cluster contains only one mine of each type. Each mine strip has a cluster every 3 meters and therefore has a density of one-third mine per meter when a cluster contains one of each type of mine.

Step 1. Desired density

AT: 3 X 1 = 3   APF: 3 X 4 = 12   APB: 3 X 8 = 24

The resulting numbers are the maximum amount of mines that the sum of each column in the table cannot exceed. With an APF desired density of 4, for example, 3 X 4 = 12, and therefore the sum of the APF mines in the representative cluster composition for each of the regular strips cannot exceed 12.

Note that the total number of mines includes mines in the regular lettered strips as well as those in the IOE short strips. The laying rates for mines per man-hour are—

AT mines: 4 mines per man-hour

APF mines: 8 mines per man-hour

APB mines: 16 mines per man-hour

PART 5. NUMBER OF MAN-HOURS TO INSTALL MINEFIELD

The number of hours for each mine type is rounded up, summed, and a 20-percent excess factor is included by multiplying the total by 1.2. The resulting figure is the total number of man-hours required for emplacement and represents straight work time only. It does not take into account time for transportation to and from the emplacement site, meals, breaks, and limited visibility or NBC conditions. The commander's judgment and experience should be exercised in determining the time required for transportation, meals, and breaks. When working under limited visibility or NBC conditions, the total man-hours (after the excess factor has been included) should be multiplied by 1.5.

In this example, a total of 357 man-hours is required as determined below. Note each decimal is rounded up to the next highest whole number.

Number of mines ÷ emplacement rate (mines per man-hour)

Number of AT mines: 246 ÷ 4 = 62 (round up)

Number of APF mines: 961 ÷ 8 = 121 (round up)

Number of APB mines: 1811 ÷ 16 = 114 (round up)

PART 6. AMOUNT OF FENCING AND MARKING MATERIAL

Standard pattern minefields must be marked and fenced. The amount of fencing required depends on whether barbwire (two strands) or concertina is used. The amount of wire for a two-strand barbwire fence is calculated with the following formula:

[(front X 4) + (depth X 4) + 320] X 1.4

The formula for calculating single concertina is—

[(front X 2) + (depth X 2) + 160] X 1.4

★ *Figure 3-8. Step-by-step procedures for completing the Minefield Requirements Computation Work Sheet (continued)*

Step 1.

Concertina wire

[(front X 2) + (depth X 2 + 160] X 1.4 = meters of concertina required

[(200 X 2) + (300 X 2) + 160] X 1.4 = 1624 (round up)

Number of pickets = amount of concertina ÷ 15

1624 ÷ 15 = 109 (round up)

The number of pickets required is equal to the total amount of fence divided by 30 if barbwire is used, or 15 if concertina is used.

The number of minefield marking signs is equal to the number of pickets.

In this example, one-strand barbwire is used.

NOTE: These calculations determine the marking and fencing materials required for the minefield perimeter only. Additional materials may be required for lanes and gaps.

Step 2.

Barbwire

[(front X 2) + (depth X 2) + 320] X 1.4 = meters of barbwire required

[(200 X 2) (300 X 2) + 320] X 1.4 = 1848 (round up)

Number of pickets = amount of barbwire ÷ 30

Step 3.

Number of signs = number of pickets = 62

PART 7. NUMBER OF VEHICLES

The number of vehicles required depends on the type and amount of mines as well as the type of vehicles available. The total mines by type required is divided by the number of mines per vehicle to determine the number of vehicle loads required to transport the mines.

In this example, M15 AT mines, M16A2 APF mines, and M14 APB mines are hauled in 5-ton dump trucks (crated). (See Table 2-2, page 2-36.)

AT mines:

246 mines required ÷ 204 mines/truck = 1.20 truckloads of AT mines

APF mines:

931 mines required ÷ 888 mines/truck = 1.04 truckloads of APF mines

APB mines:

1811 mines required ÷ 13,770 mines/truck = 0.13 truckloads of APB mines

Total truckloads:

1.2 AT truckloads + 1.04 APF truckloads + 0.13 APB truckloads = 2.37 truckloads (round up) = 3 truckloads required

★ *Figure 3-8. Step-by-step procedures for completing the Minefield Requirements Computation Work Sheet (continued)*

PART 8. AMOUNT OF ENGINEER TAPE

An extensive amount of engineer tape is used to mark the initial layout of a standard pattern minefield. Engineer tape comes in 170-meter rolls and is used to mark the following portions of the minefield.

NOTE: In this example, only one lane and one roll of traffic tape are required.

Step 1.

Minefield boundaries depth X 2 = 300 X 2 = 600

Step 2.

Regular lettered strips front X number of regular strips = 200 X 8 = 1,600

Step 3.

IOE front + (number of IOE clusters X 3) = 200 + (23 X 3) = 269

Step 4.

Lanes and gaps depth X 2 X number of lanes and gaps = 300 X 2 X 1 = 600

Step 5.

Traffic tape depth X number of traffic tapes 300 X 1 = 300

Step 6.

Trip wire safety tape front X number of regular strips with trip wire 200 X 3 = 600

Step 7.

Total amount of tape for each portion of minefield = (Add Steps 1 through 6) = 600 + 1600 + 269 + 600 + 300 + 600) = 3969 meters

Step 8.

Add 20% excess total amount of engineer tape of MF X 1.2 3,969 X 1.2 = 4,762.8 = 4,783 (round up)

Step 9.

Total number of rolls total amount of engineer tape, in meters, from Step 8 ÷ 170 meters/rolls 4,763 meters ÷ 170 = 28.01 = 29 rolls

PART 9. NUMBER OF SANDBAGS

To determine the number of sandbags for the removal of spoil.

Step 1.

Number of clusters in IOE (Step 1, *Number of Mines*) = 23

Step 2.

Number of clusters in minefield = number of clusters in IOE X 3 X number of regular strips (Step 4, *Number of Regular Lettered Strips*)

23 X 3 X 8 = 552 (round up)

★ Figure 3-8. Step-by-step procedures for completing the Minefield Requirements Computation Work Sheet (continued)

Step 3.

Total number of clusters (add Steps 3 and 4) = 474

Step 4.

Number of sandbags = number of clusters X 3 sandbags/cluster

(Step 3 X 3) + 575 X 3 = 1725

Figure 3-8. Step-by-step procedures for completing the Minefield Requirements Computation Work Sheet (continued)

Table 3-1. Platoon organization and equipment

Personnel	**Officer**	**NCO**	**EM**	**Equipment**
Supervisory personnel	1	1		Officer: Map, lensatic compass, notebook, and minefield record forms NCO: Map, notebook, and lensatic compass
Siting party		1	3	Stakes or pickets, sledgehammers, engineer tape on reels, and nails to peg tape
Marking party		1	2	Barbwire on reels, marking signs, lane signs, wire cutters, gloves, sledges, pickets, and a picket pounder
Recording party		1	2	Sketching equipment, lensatic compass, minefield record forms, map, and metric tape
First laying party		1	6-8	Notebook for squad leader, picks, shovels, and sandbags
Second laying party		1	6-8	Same as first laying party
Third laying party		1	6-8	Same as first laying party
Totals	1	7	25-31	

One laying party is responsible for installing, arming, and camouflaging all mines on a strip or portion of a strip. Each laying party is then assigned additional strips.

The recording party obtains necessary reference data, prepares DA Form 1355 (see Chapter 5), and installs intermediate markers when needed. All distances are recorded in meters.

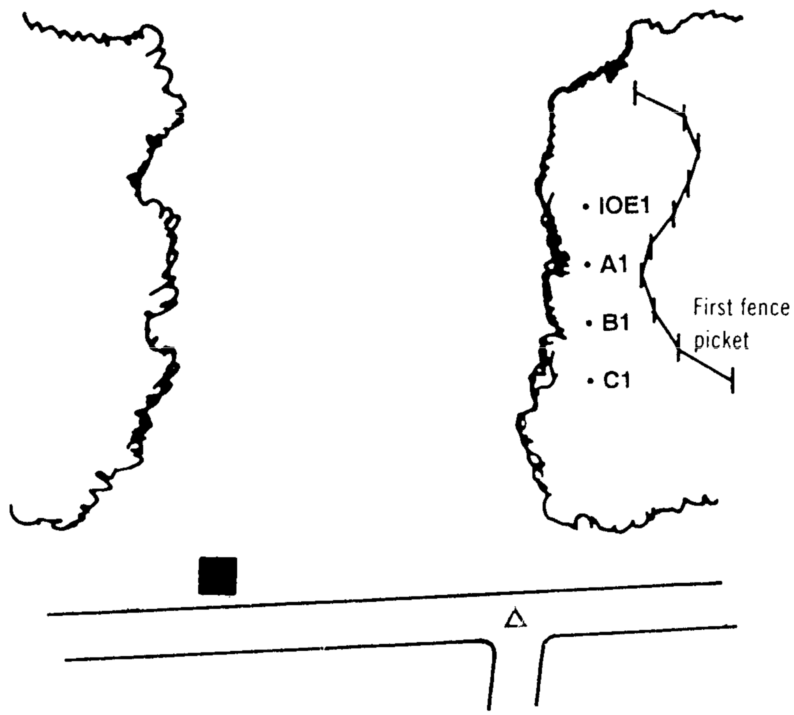
The marking party erects fences and signs to mark minefield boundaries and lanes. After completing marking, it augments other parties.

The platoon mine emplacement procedure is shown in Figure 3-9. In the illustration, the minefield is laid from right to left.

Platoon Mine Emplacement Procedures

The OIC arrives at the site with the siting and marking parties. He goes to the right or left (depending on direction of lay) rear boundary of the field. This part of the minefield is farthest from the enemy. The OIC indicates the starting point of the rear strip (this is strip C in a three-strip minefield), and the siting party drives a boundary stake to mark the location.

The OIC designates a starting point for the marking party at least 15 meters to the right of the boundary stake. He indicates where the minefield marking fence should be placed. The marking party immediately begins to install fence pickets, working in a counterclockwise direction.



★ *Figure 3-9. Platoon mine emplacement procedures*

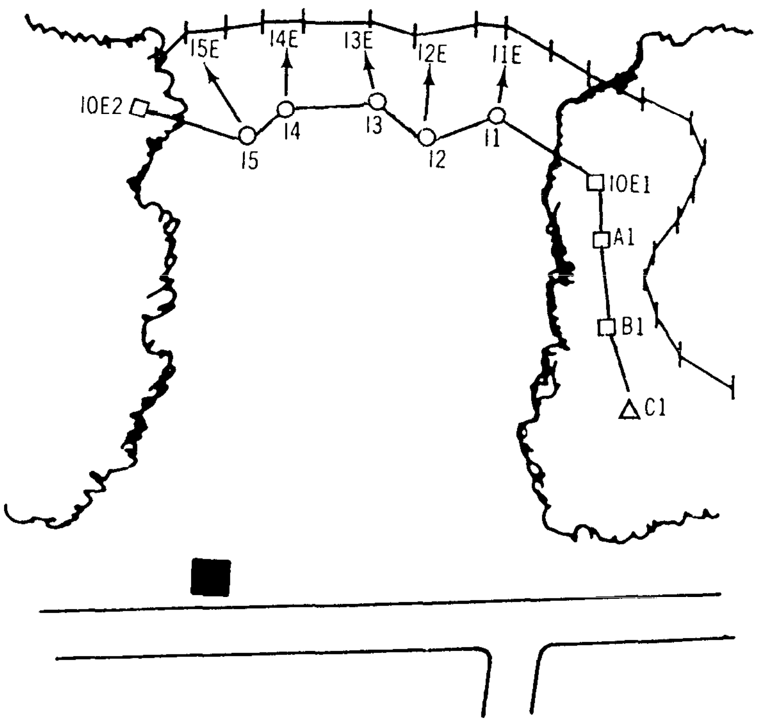
When all pickets are installed, the marking party encircles the field with a single strand of barbwire (at waist height) and fixes mine signs. The second strand is then emplaced if required.

From the boundary stake of strip C, the OIC moves in the direction of the enemy and establishes the starting point of strip B. Strip centerlines should not be parallel nor less than 15 meters apart. Two members of the siting party drive a strip stake at the starting point of strip B, and the remaining two members begin to lay tape between the two stakes. They fasten tape to the ground at frequent intervals to prevent its movement. This procedure is followed until the boundary stakes of the three regular strips (C, B, and A) and the IOE on the right-hand side of the minefield have been installed.

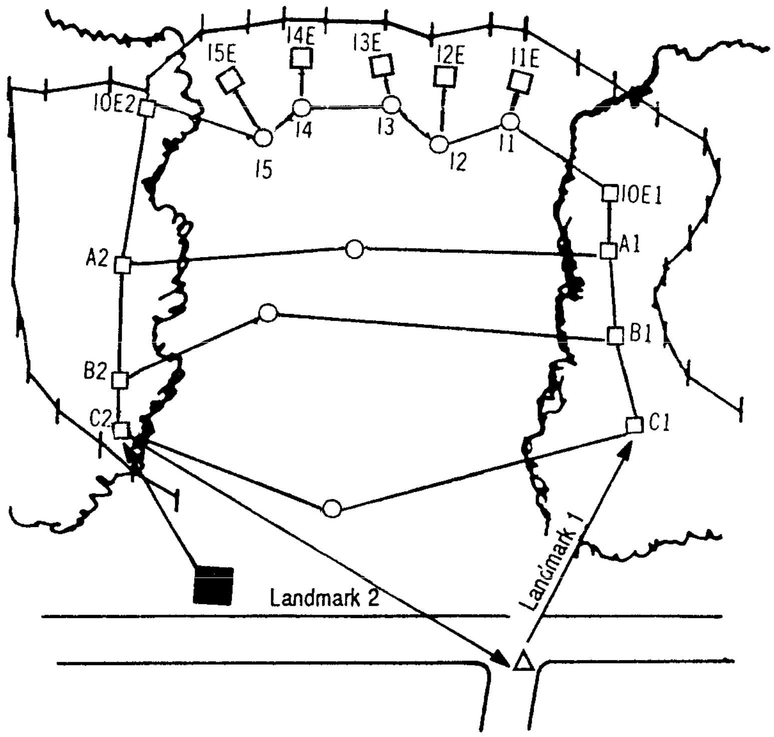
At the IOE boundary stake, the OIC gives the siting party a sketch of the minefield and instructions on siting the IOE baseline and the regular mine strip centerlines. The NCO and one other member of the siting party immediately begin setting stakes to indicate the IOE baseline. The centerline laying team lays the tape on the IOE baseline, leaving tape reels where tapes run out. At the same time, short strips extending from the IOE baseline are established. Each short strip ends with a stake that is designated as I1E, I2E, and so forth. Turning points are not used in short strips. (See Figure 3-10.)

Upon reaching the other IOE boundary, the NCO moves away from the enemy side, establishes the left boundary stake of strip A, stakes out strip A, and repeats until all strip centerlines are taped. All stakes are driven flush with the ground. (See Figure 3- 11.)

★ While the IOE is being taped, the recording party begins obtaining reference data for the Minefield Record. He starts from landmark 1 designated by the OIC and proceeds to C1 working behind the siting party. Once C2 has been sited, he proceeds from landmark 2 to C2 to establish distance and azimuth. Finally, he ties both C1 and C2 to both landmarks in the event one of the landmarks is removed/destroyed. The amount of detail obtained by the recording party depends on the tactical



★ *Figure 3-10. Short strips*



★ *Figure 3-11. Stakes driven flush into the ground*

classification of the minefield and any special orders. Aerial photographs taken of the minefield before the tracing tape is removed become valuable supplements to the Minefield Record.

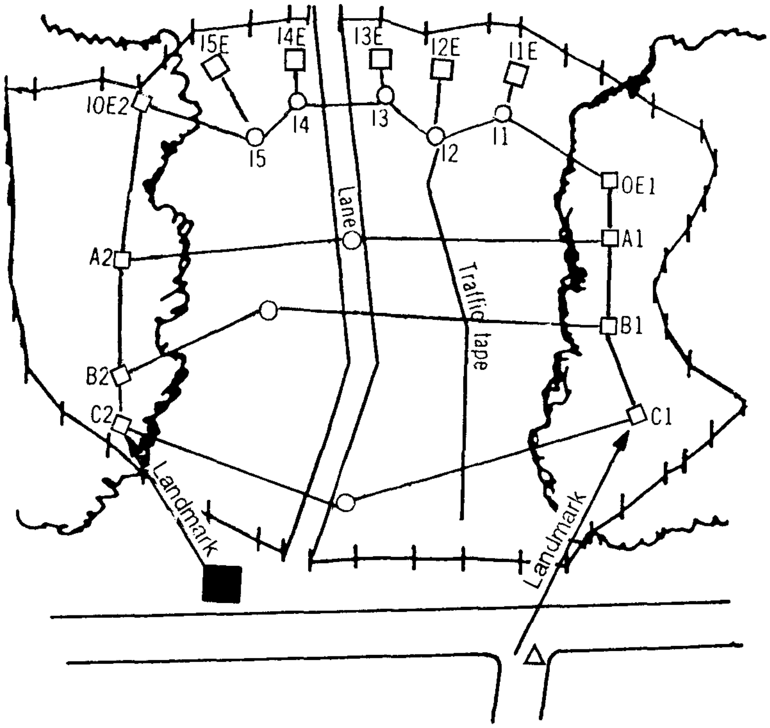
As soon as laying parties arrive at the site with mines, they establish mine dumps behind the field. AT mines are uncrated and stacked. Other types of mines are left in their crates with the crate lids removed. Fuzes and detonators are placed in separate boxes; fuze types are not mixed. Mine dumps are spaced a minimum of 150 meters apart.

When the siting party completes the centerline staking, it installs lane tapes and traffic tapes, respectively. Traffic tapes are used by mine-laying personnel to assist in camouflage and to reduce the amount of traffic on strip centerlines. Traffic tapes are laid approximately perpendicular to the minefield trace at about 100-meter intervals. Tapes to mark lanes for tactical vehicles and patrols are also laid out. (See Figure 3-12, page 3-22.)

Emplacement Along a Standard Minefield Strip

The laying party must know the cluster composition of the strip, the location of any omitted clusters (due to terrain features), and future lane locations. When the centerline tape for a regular strip has been installed, the NCOIC designates all party members (except two) as layers to emplace the mines in the ground. The remaining two soldiers (usually the most experienced) are designated as fuzers and are responsible for arming mines. Layers pick up the maximum load of mines to be used as base mines in the clusters. Fuzers carry all fuzes and detonators.

The NCO then moves to the right or left boundary stake of the strip (depending on which direction the minefield will be installed) and organizes the layers into one column to the rear of himself and directly on the strip centerline. He measures 6 meters along the centerline for the first cluster and, pointing perpendicular from the centerline and in the direction of the



★ *Figure 3-12. Lay out tapes to mark lanes for tactical vehicles and patrols*

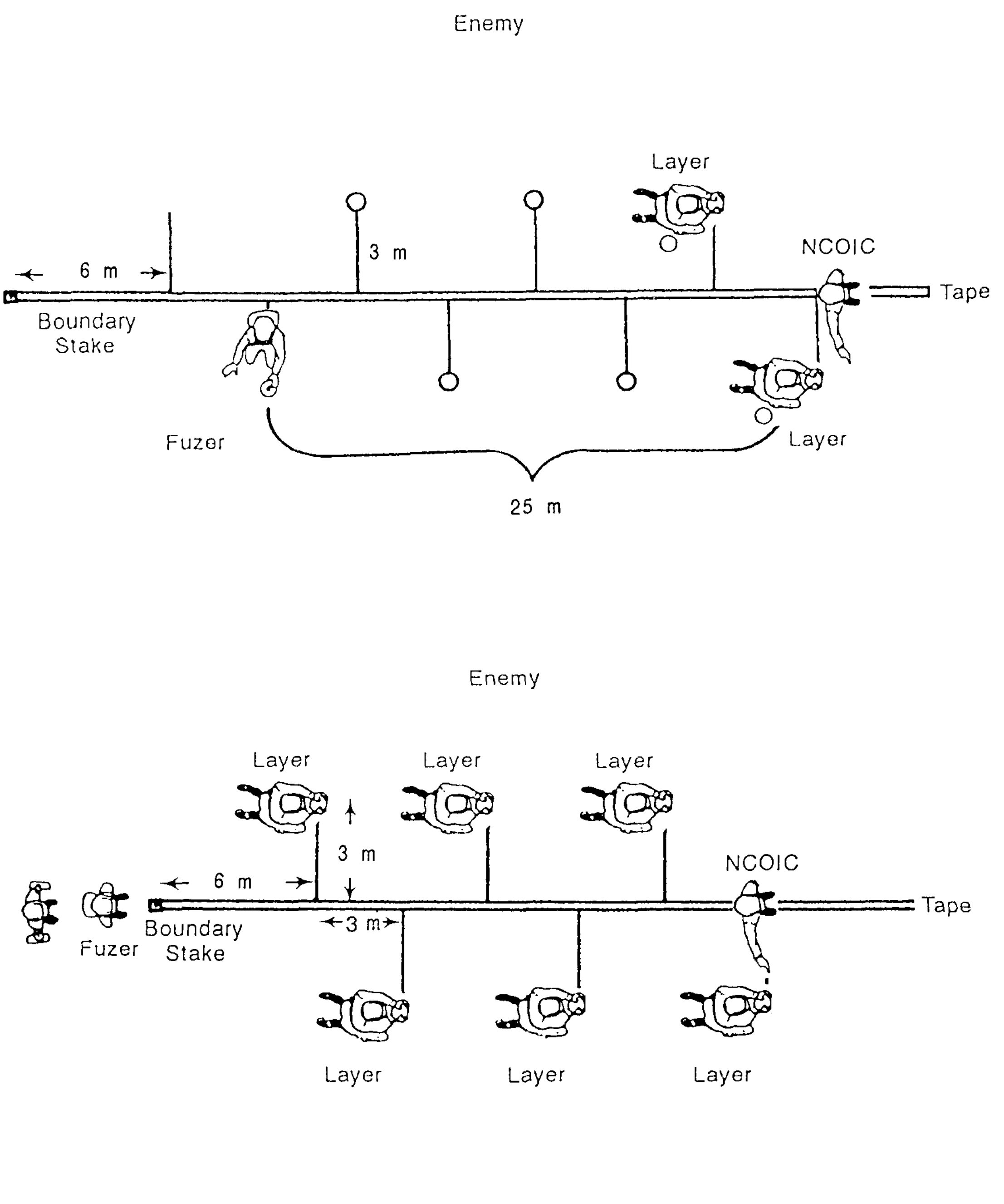
enemy, indicates the placement of the base mine. The first layer on the enemy side places a mine on the ground 3 meters from the centerline.

The NCO measures 3 more meters and indicates the placement of the second base mine on the opposite (friendly) side of the strip. The first layer on that side places a base mine on the ground. As the initial load of mines is laid, each layer returns to the nearest mine dump for another load. Fuzers follow behind the layers and insert the mine fuzes but do not arm the mines. This procedure is followed until the boundary stake on the far side of the minefield is reached.

The NCO tells layers the number and types of mines to be placed next to the base mine in each cluster. As AP mines are being placed, the NCO proceeds along the strip and ensures the proper number of AP mines are placed in each cluster. The NCO places a spool of trip wire next to mines that are to be activated by it.

When all mines are positioned in clusters, layers draw shovels and return to the starting boundary markers. One layer is assigned to dig holes for all mines in each cluster. The spoil from the holes is placed in sandbags and left beside the base mine at each cluster. Each layer checks the positioning of mines in the holes but leaves the mines beside the holes, not in them. The layers also anchor any trip wires with nails or stakes and wrap loose ends around fuzes. When digging has progressed at least 25 meters from the starting point, the arming operation begins. Fuzers arm all mines in a cluster, beginning with the mine farthest from the centerline and working back. They place all mines in holes, attach trip wires, and arm and camouflage mines. They place filled sandbags on the centerline of the strip opposite the base mine. Fuzers keep their back toward the centerline. Other personnel maintain a minimum distance of 25 meters from the fuzers. (See Figure 3- 13.)

Mines located in lanes are not initially buried but are placed to the side to prevent confusion in counting clusters. Mines may be buried later when the lane is closed. Upon completing the arming operation, fuzers give safety clips to the NCO, who verifies that all mines have been armed and camouflaged. Upon verification, the NCO checks the strip and ensures sandbags, tape, and debris are picked up. Safety clips



★ *Figure 3-13. Maintaining a minimum distance of 25 meters from the fuze* are then turned over to the platoon sergeant, who buries them 30 centimeters to the rear of the start of strip marker.

All mines and other explosive items are recorded against the party to which they are issued. They are summarized on a Mines Tally Sheet. (See Table 3-2.) If more than one mine dump is established, a Mines Tally Sheet is kept at each dump and the information is later transferred to a Master Tally Sheet.

The platoon sergeant is responsible for ensuring that the number of mines used per tally sheets is entered on the minefield record.

When a lane is no longer required through a minefield, it is sealed by a sealing party that consists of one NCO and two other soldiers. Before sealing starts, the party NCOIC checks the minefield record to ascertain the—

- Width of the lane to be sealed.
- Cluster composition of each strip and total number of mines required.
- Number of strips that intersect the lane.
- Azimuth of each strip and distance between strips along the lane centerline.
- Location of the mine dump.

The procedure for sealing is as follows:

- Party moves along the safe lane centerline until it arrives at the strip/safe lane marking picket. (See Figure 3- 14.)
- NCO lays out a strip centerline tape and a side tape on both sides of the safe lane to mark its boundaries. (See Figure 3- 15.)

Table 3-2. Example of a Mines Tally Sheet

		Types of Mines				
Strip	**Movement of Mines**	**M15**	**M16**	**M14**	**Trip Wire**	**AHD Type**
(a)	(b)	(c)	(d)	(e)	(f)	(g)
IOE Strip	No. forecast	23	46	46	--	--
	No. issued	23	46	46	--	--
	No. returned	--	--	--	--	--
	No. used	23	46	46	--	--
Strip A	No. forecast	81	154	154	35	--
	No. issued	81	154	154	35	--
	No. returned	7	6	6	9	--
	No. used	74	148	148	26	--
Strips B, C, D, and so forth	No. forecast					
	No. issued					
	No. returned					
	No. used					
Total	No. forecast					
	No. issued					
	No. returned					
	No. used					

Date _______ Rank _______ Name ______________________ Signature ______________________

- Clusters are laid.
- Side tapes and the safe lane centerline are recovered.
- Above steps are repeated at successive strips.
- NCO amends the minefield record.

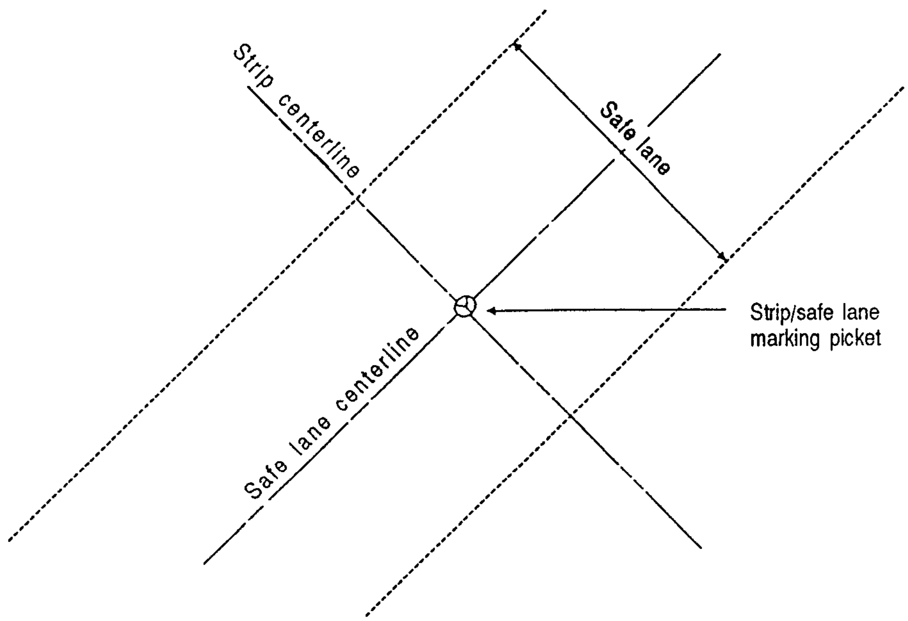


Figure 3-14. Sealing a lane - strip/safe lane marking picket

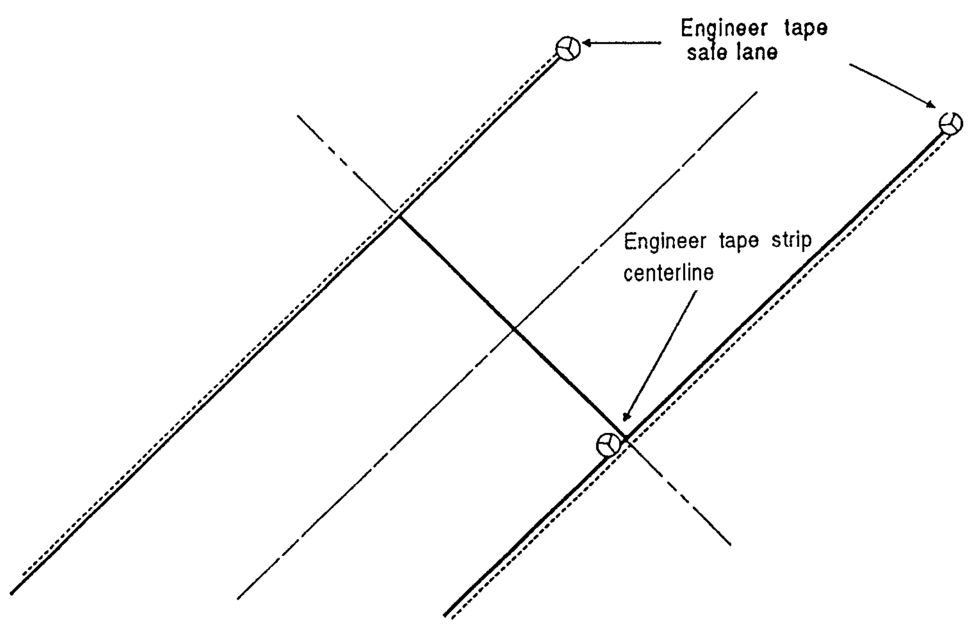


Figure 3-15. Sealing a lane - laying out the tapes

When gaps have to be sealed, fences are temporarily erected along the side boundaries. They are removed later to avoid indicating a passage through the field.

Party NCOICs do not act as working members; they ensure that—

- No one moves back into a mined area.
- Any irregularity (such as an omitted cluster) is recorded.
- All safety devices are recovered and checked against the minefield record.

Safety tapes are used to facilitate laying trip wires and to ensure a safe exit from the minefield. They create a network of safe routes to an area outside the minefield. When trip wires are used, safety tapes are laid between strips where the trip wire will be positioned (including Strip A and IOE baseline). If trip wires are not used, safety tapes are recommended but are not mandatory. Safety tapes may be removed progressively but are normally left in place until the minefield is complete.

NUISANCE MINEFIELDS

Factors Affecting Siting

Take the following factors into consideration:

- Effort needed by the enemy to bypass a mined area, either locally or by using alternative routes.
- Importance of an area or a route to the enemy.
- Goal achievement (maximum casualties/morale effect; minimum effort).
- The more ingenious the methods of concealment are, the longer it will take to lay mines.

Observation and covering fire are not essential and will seldom be feasible for nuisance minefields. Their value depends on effective siting and concealment to cause surprise.

Siting

The minefield OIC is responsible for detailed siting and design of a nuisance minefield. He must consider the minefield from the enemy's point of view and assess the courses open to the enemy when he encounters it. Such considerations may expose weakness in the initial plan and bring about a change to the proposed minefield layout or may lead to a decision to site the minefield elsewhere.

Location

In wooded or hilly country, the enemy's logistics transport will usually be confined to existing axial routes. Nuisance mines at selected sites along roads can impose considerable delay on the enemy and have a cumulative effect on his resources and morale. In open country, axial mining will not be very effective. The best sites for axial mining are—

- Natural defiles or constructed areas which are difficult to bypass (cuts, embankments, causeways, fords, forest tracks, and built-up areas.
- In the. vicinity of road craters, AT ditches, or any obstacles that have to be cleared.
- Around culverts.
- Demolished bridges, including likely adjacent crossing places and alternative building sites—particularly on the home bank.
- Likely assembly areas.
- Covered approaches or dead space.
- In the vicinity of fuel, supplies, or engineering material stocks that the enemy needs and that cannot be destroyed or removed.

- Railroads. The best places for mining are in or near culverts, bridges, sharp turns, tunnels, and steep grades. Lay mines where enemy trains cannot bypass the mined area on branches or spurs.

Laying

There is no absolute requirement for recording the precise location of individual nuisance mines. The practice of merely locating them in a defined boundary is used only when authorized. Recording mine positions that are laid to a pattern is easy and quick. Pattern laying should be used whenever it can be done without prejudicing concealment. When the number of mines to be laid on the site makes it impracticable or undesirable to lay mines in a pattern, they may be scatter-laid (provided their exact location is recorded) unless otherwise directed. Scatter laying by hand is useful in road blocks, bridge abutments, and craters when it would be difficult and wasteful to lay mines in a pattern. Again, scatter laying along routes to be denied to the enemy will add considerably to the delay imposed. All available types of AT and AP mines are used to make minefields complex and difficult to remove. Mine type combinations should be varied constantly so that each minefield presents a clearance problem. Deeply buried mines can be included; however, they take much longer to lay. These mines may be worthwhile around craters where the enemy is likely to need earthmoving equipment.

Laying Rules

If a nuisance minefield is laid to the standard pattern, standard procedures are followed. If mines are selectively positioned, procedures must be tailored to suit the situation. In all occasions, however, the following rules should be observed:

- The intended position for each mine is clearly marked on the ground before laying begins. If mines are used to indicate positions, they are clearly marked with a mine marker or tape.
- Laying parties work in pairs. Each pair is detailed to lay specific mines.
- The laying OIC briefs the pairs and clearly indicates the route they are to follow and the order in which mines are to be laid.
- If laying is done at night or if there is a chance pairs may stray from the indicated route, safety tapes are laid.
- Work is organized so the distance between each pair of men is a least 25 meters.
- If booby traps, AHDs, or trip wires are used, one member of the pair withdraws and the remaining member arms the mine. Mines are not armed until the order to do so is given by the OIC.

INSPECTION, MAINTENANCE, AND HAND OVER OF MINEFIELDS

Technical Inspection and Maintenance

Mines left in the ground for a long time may deteriorate and malfunction for one or more of the following reasons:

- Moisture may have entered the igniter or body of the mine and either neutralized the explosive or corroded the metal parts. Such action may be aggravated by local factors (soil acidity or wide temperature swings).
- Frost or heat may have subjected the mine to mechanical strain and caused distortion.
- Insects or vegetation may have caused obstructions.
- Animals may have turned mines over or detonated them.

Technical inspections should only be made by experienced engineers or EOD personnel. When a minefield deteriorates below the operating level, additional mine strips/rows are added to restore its effectiveness. They are sited to the front or rear of the existing minefield to increase its depth. The new mine strips are treated as a separate, additional minefield.

Technical inspections of minefields are nor-really done at three-month intervals. They are done more frequently during extreme weather conditions.

Minefield Hand Over

Minefield hand over is an extremely important task. Listed below are several items that need to be addressed between emplacing and over-matching units.

- Discuss minefield composition.
- Discuss minefield extent and walk/ride the minefield trace.
- Discuss friendly minefield marking.
- Discuss lane closure, if applicable.
- Train unit on how to close lane, if applicable.
- Discuss obstacle protection against enemy dismounted patrols.
- Sign over written report.
- Discuss indirect fires.
- Report completion of hand over to higher engineer headquarters.
- Forward written minefield report.