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**US ARMY AVIATION CENTER**



**AVIATION SURVIVAL**

**PART IV: DIRECTION FINDING, SIGNALING,  
AND RECOVERY**

THIS SUBCOURSE HAS BEEN REVIEWED FOR  
OPERATIONS SECURITY CONSIDERATIONS.

**THE ARMY INSTITUTE FOR PROFESSIONAL DEVELOPMENT  
ARMY CORRESPONDENCE COURSE PROGRAM**

**A  
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**READINESS/  
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## AVIATION SURVIVAL

### PART IV: DIRECTION FINDING, SIGNALING, AND RECOVERY

Subcourse Number AV0664

#### **EDITION A**

United States Army Aviation Center  
Fort Rucker, Alabama 36362-5000

2 Credit Hours

Edition Date: September 1993

#### **SUBCOURSE OVERVIEW**

This correspondence course reflects a basic knowledge of survival procedures and techniques. This knowledge will increase your chances of surviving after a crash or forced landing or being captured by the enemy.

Prerequisites do exist for this course: This correspondence course is the fourth part of a four-part series. Part I, Survival Elements, Psychological Aspects, and Survival Medicine (AV0661), must be taken before attempting Parts II, Protection From the Environment (AV0662); III, Sustenance (AV0663); and IV, Direction Finding, Signaling, and Recovery (AV0664). Take Parts II through IV in any sequence.

This subcourse reflects the current doctrine when it was prepared. In your own work, always refer to the latest publications.

Unless otherwise stated, the masculine gender of singular pronouns refers to men and women.

#### TERMINAL LEARNING OBJECTIVE

**ACTION:** Adopt the Code of Conduct as a behavior guide for survival, traverse enemy or unfriendly territory, and maintain physical capability to evade.

AV0664

CONDITION: You will use the material in this correspondence course.

STANDARD: To prove competency of this task, you must achieve a minimum of 70 percent on the examination.

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## LESSON 1

### FIELD EXPEDIENT DIRECTION FINDING

Critical Tasks: 9103.01-0003  
9103.02-0001

### OVERVIEW

#### LESSON DESCRIPTION:

This lesson covers how to orient a map by several field expedient methods.

#### TERMINAL LEARNING OBJECTIVE:

**ACTION:** Adopt the Code of Conduct as a behavior guide for survival and traverse enemy or unfriendly territory.

**CONDITION:** You will use the lesson text to complete the action.

**REFERENCE:** The material in this lesson was derived from the following publications: AR 95-17, AR 350-30, and AR 525-90; AFM 64-5; FM 1-302, FM 20-150, and FM 21-76; and DOD Directive 1300.7.

**SAFETY CONSIDERATIONS:** none

**TRAINING RISK ASSESSMENT CODE:** L

**ENVIRONMENTAL CONSIDERATIONS:** none

### INTRODUCTION

In any survival situation following an aircraft emergency, it may become necessary to leave the crash site. In order to successfully travel, you will have to depend on available skills and equipment. When a compass is not available and there are no recognizable prominent landforms or other features, you may orient a map by any of the field expedient methods discussed in this lesson.

## 1. SHADOW-TIP METHOD

a. The chief method in determining direction and time is called the shadow-tip method. This simple method uses a stick and the sun and consists of only three basic steps (Figure 1-1). By using this method you determine an east-west line. A line drawn at right angles to the eastwest line at any point is the approximate north-south line. These two lines help orient you to any desired direction of travel.

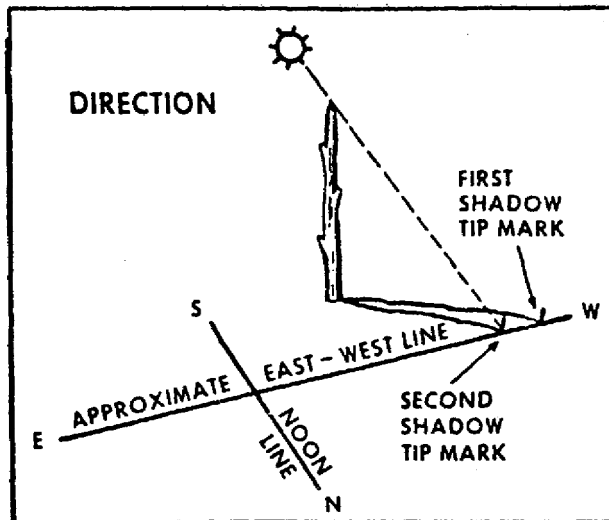
b. Inclining the stick to obtain a longer shadow does not impair the accuracy of the shadow-tip method. Therefore, a traveler on sloping ground or in highly vegetated terrain need not waste valuable time looking for a large level area. A flat spot, the size of the hand, is all that is necessary for shadow-tip markings, and the base of the stick can be either above, below, or to one side of it. Also, any stationary object (the end of a tree limb or the notch where branches are jointed) serves just as well as an implanted stick because only the shadow tip is marked.

c. You can also use the shadow-tip method to find the approximate time of day (Figure 1-2).

(1) To find the time of day, move the stick to the intersection of the east-west line and the north-south line; set the stick vertically in the ground. The west part of the east-west line indicates the time is 0600 and the east part is 1800 (anywhere on earth) because the basic rule always applies.

(2) The north-south line now becomes the noon line. The shadow of the stick is an hour hand in the shadow clock. With it the time is estimated using the noon line and the 6 o'clock line as the guides. Depending on the location and the season, the shadow may move either clockwise or counterclockwise, but this does not alter the manner of reading the shadow clock.

(3) The shadow clock is not a timepiece in the ordinary sense. It always reads 0600 at sunrise and 1800 at sunset. However, it does provide a satisfactory means of telling time in the absence of properly set watches. Being able to establish the time of day is important for such purposes as keeping a rendezvous, prearranged concerted action by separated persons or groups, and estimating the time of remaining daylight. Shadow clock time is closest to conventional clock time at midday, but the spacing of the other hours, compared to conventional time, varies with the locality and date.



- STEP 1:** Place a stick or branch into the ground at a fairly level spot where a distinct shadow will be cast.
- STEP 2:** Mark the shadow tip with a stone, twig, or other means.
- STEP 3:** Wait until the shadow tip moves a few inches. If a 4-foot stick is being used, about ten minutes should be sufficient.
- STEP 4:** Mark the new position of the shadow tip in the same way as the first.
- STEP 5:** Draw a straight line through the two marks to obtain an approximate east-west line. If uncertain which direction is east and which is west, observe this simple rule: The sun always rises in the east and sets in the west (but rarely due east and due west). The shadow tip moves in just the opposite direction. Therefore, the first shadowtip mark is always in the west direction and the second mark in the east direction.

Figure 1-1. Determining direction by shadow

d. The shadow-tip system is ineffective for use beyond 66.5 degrees (°) latitude in either hemisphere due to the position of the sun above the horizon. Whether the sun is north or south

of you at midday depends on the latitude. North of  $23.4^{\circ}\text{N}$ , the sun is always due south at local noon and the shadow points north. South of  $23.4^{\circ}\text{S}$ , the sun is always due north at local noon and the shadow points south. In the tropics, the sun can be either north or south at noon, depending on the date and location, but the shadow progresses to the east regardless of the date.

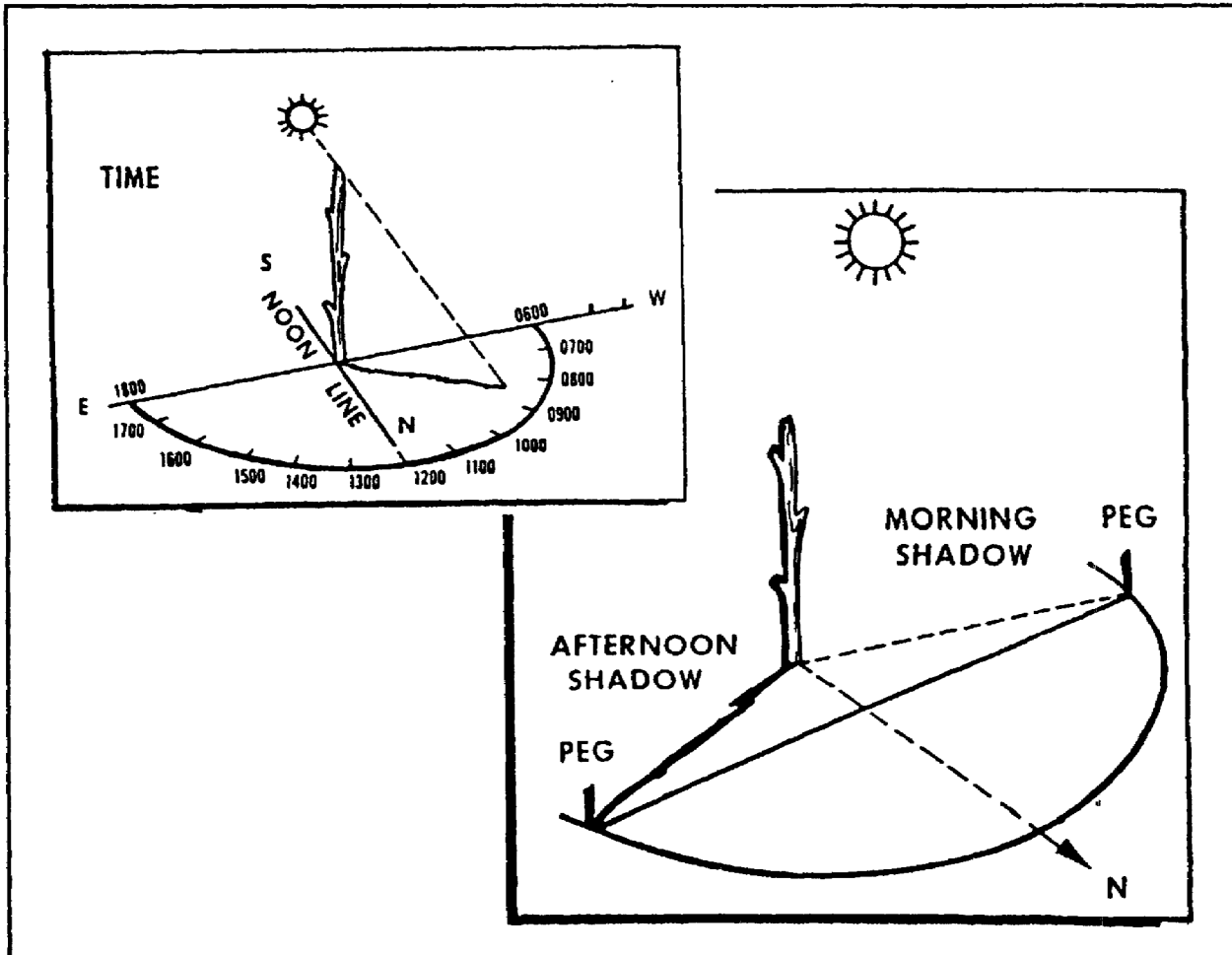
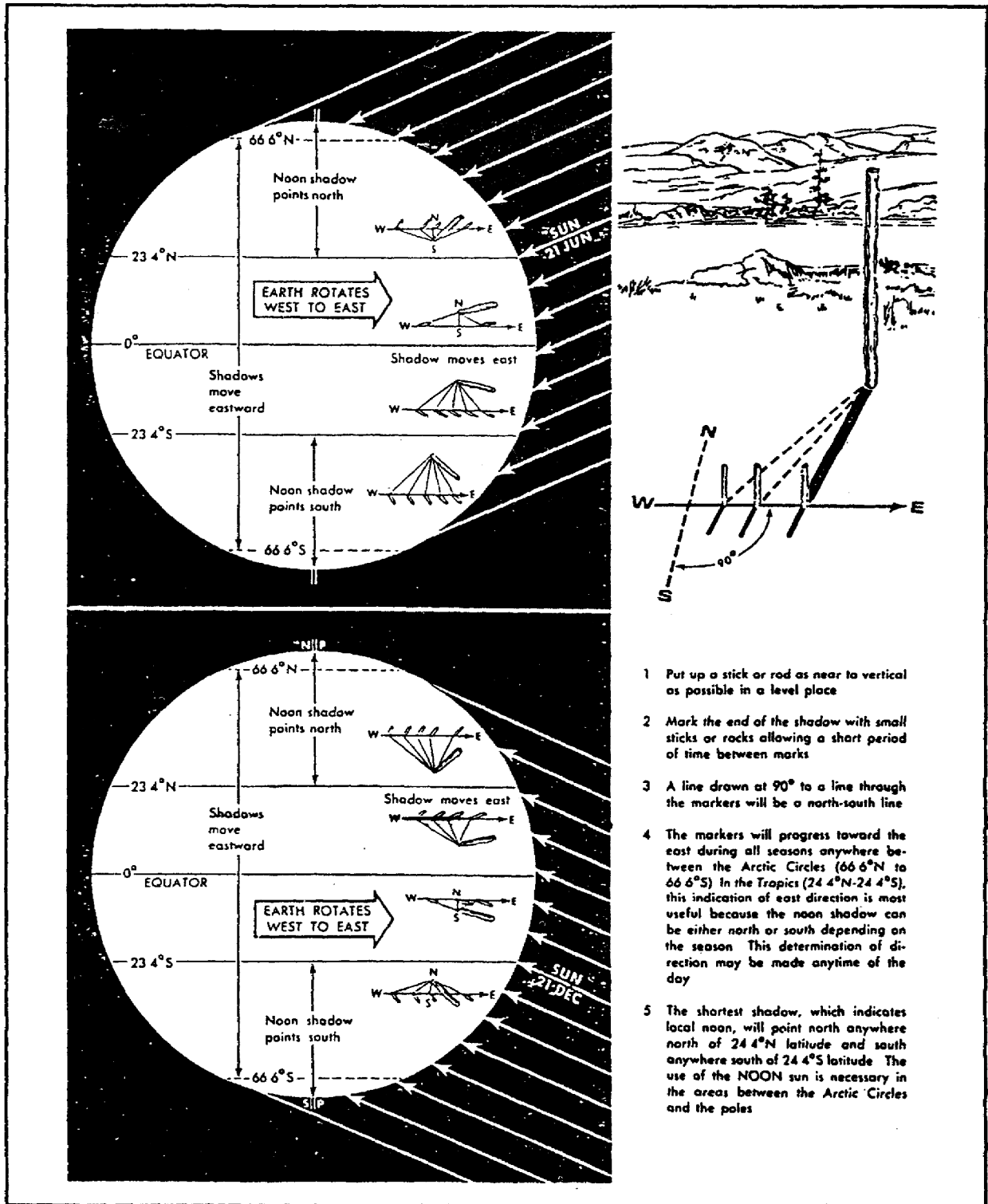


Figure 1-2. Equal-shadow method of determining time

## 2. EQUAL-SHADOW METHOD

A more accurate equal-shadow method of determining direction (Figures 1-2 and 1-3) is used at all latitudes less than 66 degrees at all times of the year. This variation includes the steps in Figure 1-4. Although this is the most accurate version of the shadow-tip method, it must be performed around noon. You must watch the shadow and complete STEP 3 at the exact time the shadow tip touches the arc.





- 1 Put up a stick or rod as near to vertical as possible in a level place
- 2 Mark the end of the shadow with small sticks or rocks allowing a short period of time between marks
- 3 A line drawn at 90° to a line through the markers will be a north-south line
- 4 The markers will progress toward the east during all seasons anywhere between the Arctic Circles (66.6°N to 66.6°S) In the Tropics (24.4°N-24.4°S), this indication of east direction is most useful because the noon shadow can be either north or south depending on the season This determination of direction may be made anytime of the day
- 5 The shortest shadow, which indicates local noon, will point north anywhere north of 24.4°N latitude and south anywhere south of 24.4°S latitude The use of the NOON sun is necessary in the areas between the Arctic Circles and the poles

Figure 1-3. Stick-and-shadow method of determining direction

- STEP 1:** Place a stick or branch into the ground vertically at a level spot where a shadow at least 12 inches long will be cast.
- STEP 2:** Mark the shadow tip with a stone, twig, or other means. This must be done 5 to 10 minutes before noon when the sun is at its highest point (zenith).
- STEP 3:** Trace an arc using the shadow as the radius and the base of the stick as the center. A piece of string, shoelace, or a second stick may be used to form the arc.
- STEP 3:** As noon is approached, the shadow becomes shorter. After noon, the shadow lengthens until it crosses the arc. Mark the spot as soon as the shadow tip touches the arc a second time.
- STEP 4:** Draw a straight line through the two marks to obtain an east-west line.

Figure 1-4. Determining direction by shadow around noon.

### 3. CELESTIAL CONSTELLATION (STAR) METHOD

At night, you may use the stars to determine the north line in the northern hemisphere or the south line in the southern hemisphere. Figure 1-5 shows how this is done.

### 4. SUN-AND-WATCH METHOD

You can use a watch to determine the approximate true north or south (Figure 1-6). The watch method can be in error, especially in the extreme latitudes, and may cause circling. To avoid this, make a shadow clock and set the watch to the time indicated. After traveling for an hour, take another shadow-clock reading.

a. In the northern hemisphere, the hour hand is pointed toward the sun. A south line can be found midway between the hour hand and 1200 standard time. During daylight savings time, the north-south line is midway between the hour hand and 1300. If there is any doubt as to which end of the line is north, remember the rule that the sun is in the east before noon and in the west in the afternoon.

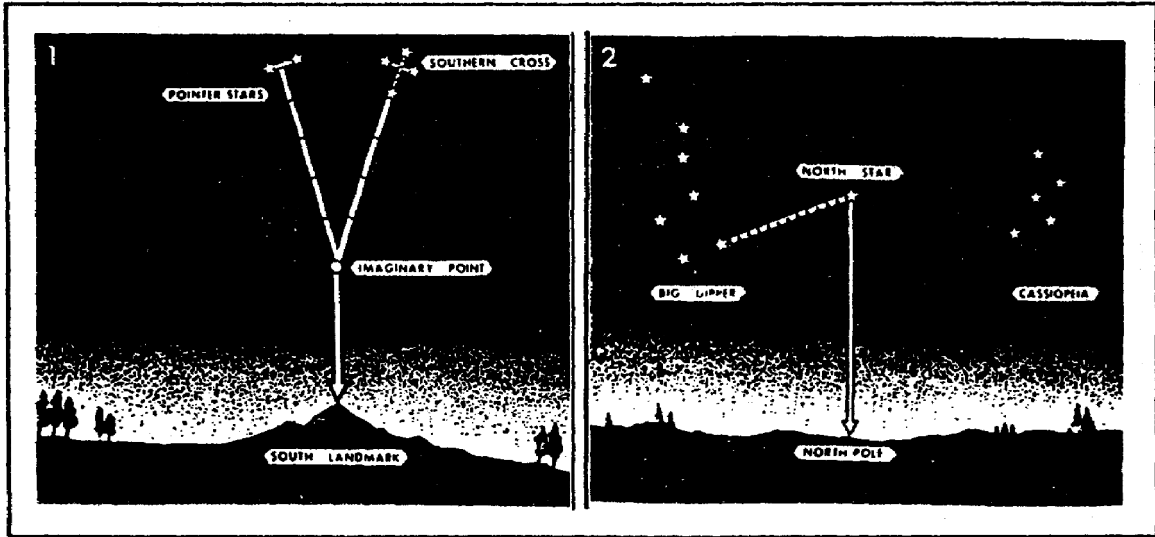


Figure 1-5. Determining direction by using stars

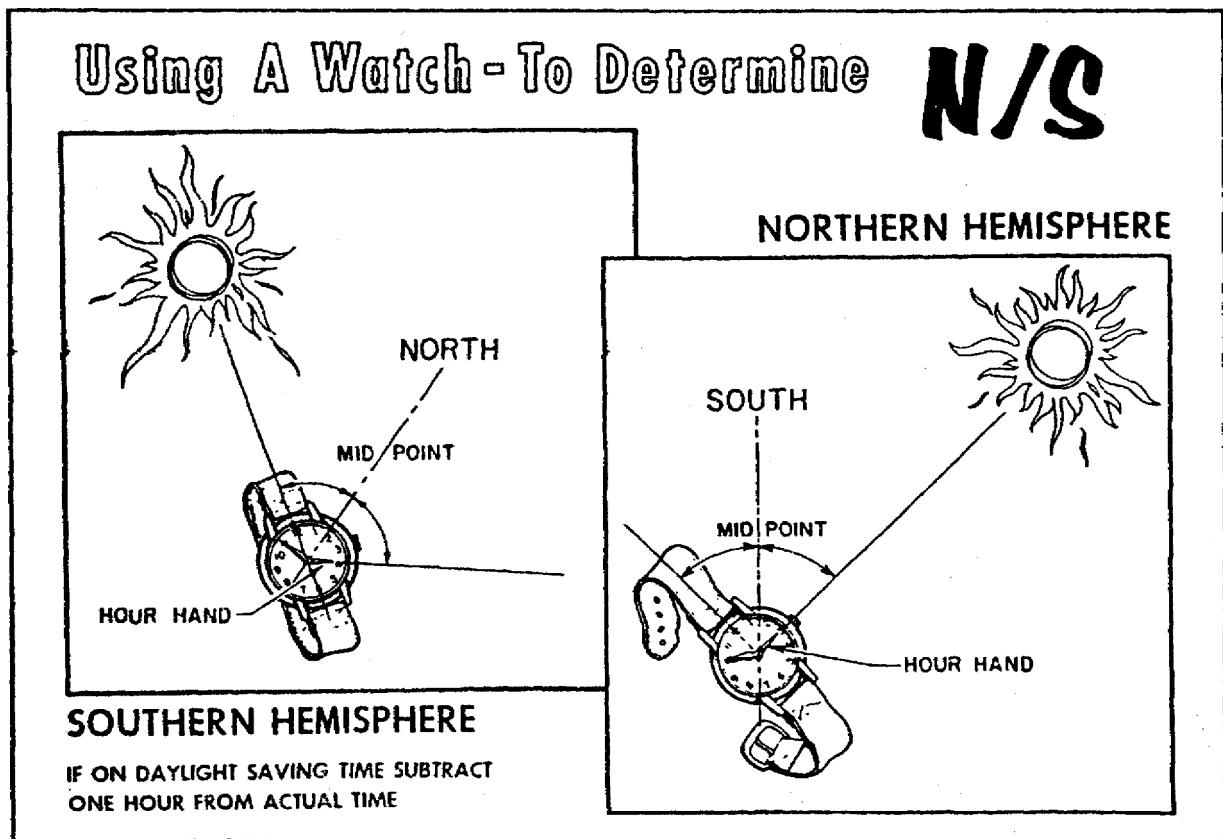


Figure 1-6. Directions using a watch

b. In the southern hemisphere, however, the method is different. The 1200-hour dial is pointed toward the sun, and halfway between 1200 and the hour hand will be a north line. During daylight savings time, the north line lies midway between the hour hand and 1300.

## **5. ORIENTING A MAP TO A SPECIFIC POSITION**

### **a. With a Compass**

When using a map and compass, orient the map toward north with the compass. Next, locate two or three known positions on the ground that are identified on the map. Using the compass, determine an azimuth to one of the known positions (Figure 1-7). Once the azimuth is determined, recheck the orientation of the map and plot the azimuth on the map. To plot the azimuth, place the front corner of the straightedge of the compass on the corresponding point on the map. Rotate the compass until the determined azimuth is directly beneath the stationary index line. Then draw a line along the straightedge of the compass and extend the line past the estimated position on the map. Repeat this procedure for the second point. If only two azimuths are used, the technique is referred to as biangulation. If a third azimuth is plotted to check the accuracy of the first two, the technique is called triangulation. When using three lines, a triangle of error may be formed. If the triangle is large, recheck the work. However, if a small triangle is formed, evaluate the terrain to determine the actual position. One azimuth may be used with a linear land feature (river, road, or railroad) to determine specific position.

### **b. Without a Compass**

A true north-south line determined by the stick and shadow, sun and watch, or star method may be used to orient the map without a compass. However, visible major land features are used to orient the map to the lay of the land. Once the map is oriented, identify two or three landmarks and mark them on the map. Lay a straightedge on the map with the center of the straightedge at a known position as a pivot point and rotate the straightedge until the known position of the map is aligned with the present position and draw a line. Repeat this for the second and third positions. Each time a position line is plotted, you must still align the map with true north and south. If three lines of position are plotted and form a small triangle, use terrain evaluation to determine your present position. If they form a large triangle, recheck your calculations for errors.

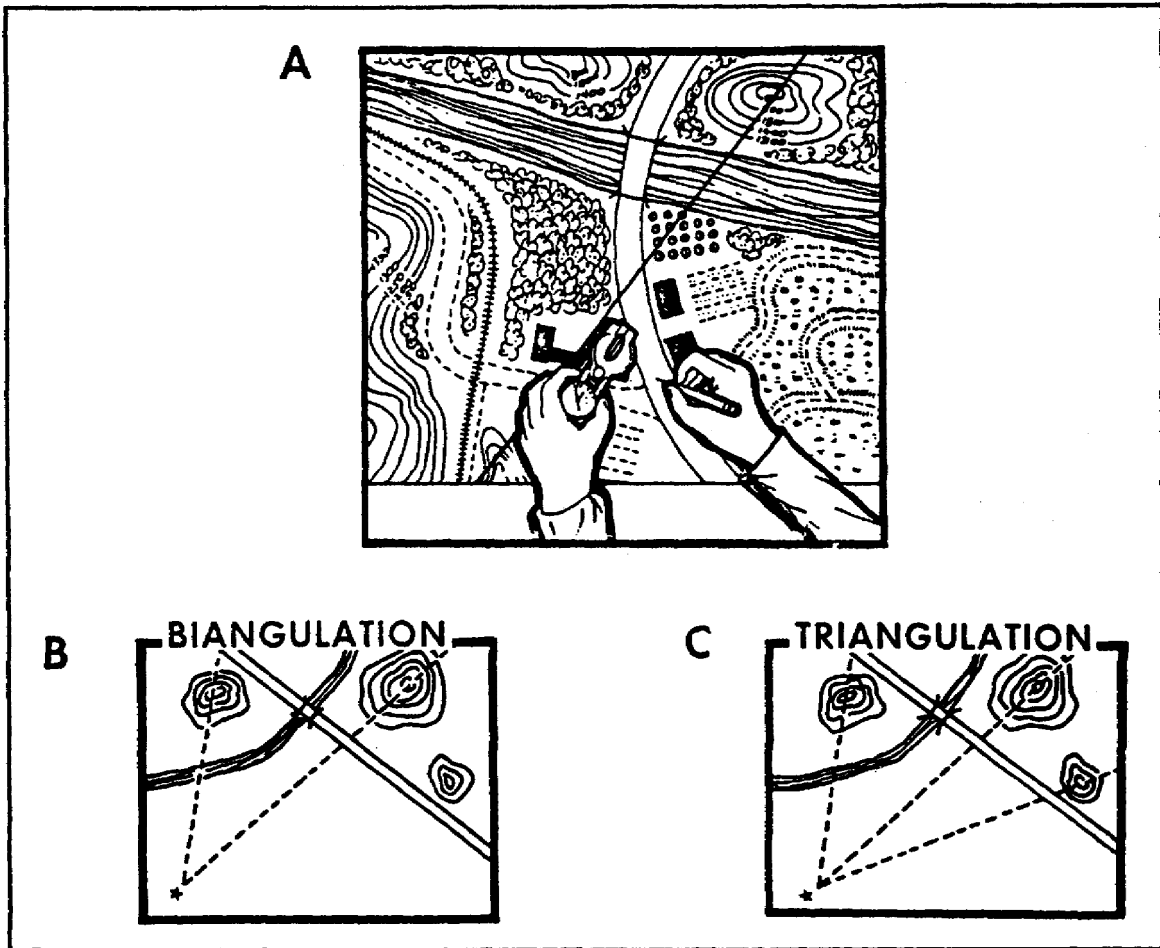


Figure 1-7. Azimuth, biangulation, and triangulation

## 6. DEAD RECKONING

Dead reckoning is the process of locating your position by plotting the course and distance from the last known location. In areas where maps exist, even poor ones, travel is guided by them. It is a matter of knowing your position at all times by associating the map features with the ground features. A great portion of the globe is unmapped or only small scale maps are available. You may be required to travel in these areas without a usable map. Although these areas could be anywhere, they are more likely to be found in frozen wastelands and deserts.

a. For many centuries, mariners used dead reckoning to navigate their ships when they were out of sight of land or during bad weather. It is just as applicable to navigation on land. Movement on land must be carefully planned. In military

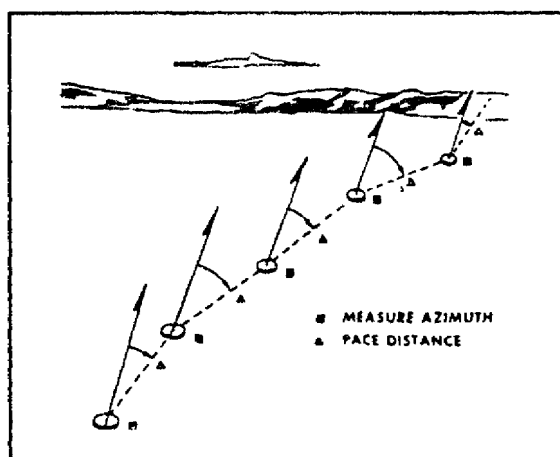
movement, the starting location and destination are known. If a map is available, they are carefully plotted along features along the route. These intermediate features, if clearly recognizable on the ground, serve as checkpoints. If a map is not available, plot on a blank sheet of paper. Select a scale so that the entire route fits on one sheet. Clearly establish a north direction, then plot the starting point and destination in relationship to each other. If the terrain and enemy situations permit, the ideal course is a straight line from starting point to destination. Seldom is this possible or practicable. The travel route usually consists of several courses with an azimuth established at the starting point for the first course to be followed. Distance measurement begins with the departure and continues through the first course until a change in direction is made. A new azimuth is established for the second course, and the distance is measured until a second direction change is made, and so on. Keep records of all data and plot all positions.

b. To measure distance, count the number of paces in a given course and convert them to the map unit. For our purpose, a pace (surveyor's pace) is equal to the distance covered every time the same foot touches the ground. Usually paces are counted in hundreds, and hundreds can be kept track of in many ways. Such ways include making notes in a record book, counting individual fingers, placing small objects (pebbles) into an empty pocket, tying knots in a string, or using a mechanical hand counter. Distances measured this way are only approximate, but with practice they can become very accurate. Each person who uses dead reckoning navigation needs to establish the length of an average pace by pacing a measured course many times and computing the mean (Figure 1-8). In the field, an average pace must be adjusted often because of certain conditions. Slopes cause the pace to lengthen on a downgrade and shorten on an upgrade. A headwind shortens the pace while a tailwind increases it. Surfaces (sand, gravel, mud, and similar surface materials) tend to shorten the pace, and elements (snow, rain, or ice) reduce the length of the pace. Excess clothing weight shortens the pace while the type of shoes worn affects traction and, therefore, the pace length.

c. Record in a log (Figure 1-9) all of the distances and azimuths used for dead reckoning navigation while traveling. Often, relatively short stretches of travel cannot be traversed in a straight course because of some natural features (a river or a steep, rugged slope). Show this break in normal navigation on the log to ensure proper plotting.

d. Plot the course of travel directly on the face of the map or on a separate piece of paper using the same scale as the map. If you choose the latter method, transfer the complete plot to the map sheet if at least one point of the plot is also shown on the map.

The actual plotting can be done by protractor and scale. The degree of accuracy obtained depends on the quality of draftmanship, the environmental conditions, and the care taken in obtaining data while en route. Figure 1-10 (page 1-13) illustrates a paper plot of the data obtained for the log sample in Figure 1-9. Notice that four of the courses from A to H in Figure 1-10 are short and have been plotted as a single course equal to the sum of the four distances, using a mean azimuth of the four in Figure 1-9. This is recommended because it saves time without losing accuracy. If possible, tie a plot into at least one known intermediate point along the route. This is done by directing the route to pass near or over a point. If the plotted position of the intermediate point differs from its known location, discard the previous plot and start a new plot from the true location. Inspect the previous plot to see if there is a detectable constant error applicable to future plots; otherwise, it is of no further use.



**Figure 1-8. Compass navigation on foot**

e. An offset is a planned magnetic deviation to the right or left of an azimuth to an objective. It is used when approaching a linear feature from the side and a point along the linear feature (a road junction) is the objective. Because of errors in the compass or in map reading you may reach the linear feature and not know whether the objective lies to the right or left. A deliberate offset by a known number of degrees in a known direction compensates for possible errors. This offset ensures that, on reaching the linear feature, the user knows whether to go right or left to reach the objective. Figure 1-11 (page 1-15) is an example of the use of offset to approach an objective. Remember that the distance from "X" to the objective varies directly with the distance to be traveled and the number of degrees

offset. Each degree offset moves the course about 20 feet to the right or left for each 1,000 feet traveled.

**EXAMPLE:** In Figure 1-11, the number of degrees offset is 10 to the right. If the distance traveled to "X" is 1,000 feet, then "X" is located about 200 feet to the right of the objective.

1	2	3	4	5	6	7
ODOMETER READING AT START OF EACH COURSE	DISTANCE IN MILES	FORWARD AZIMUTH (MAGNETIC)	DECLINATION CORRECTION	DEVIATION CORRECTION	TRUE AZIMUTH	NOTES
A 4750						
	6	17°	13°	+3°	33°	
B 4756						
	9	358°	"	+2°	13°	
C 4765						
	8	341°	"	+1°	355°	
D 4773						
	1	314°	"	0°	327°	
E 4774						
	15	341°	"	+1°	355°	
F 4775	15	322°	"	0°	335°	
G 4777	1					
H 4778						
	12	300°	12°	-1°	311°	
I 4790						
	6	341°	"	+1°	354°	
J 4796						
	6	302°	"	-1°	313°	
K 4802						
	20	319°	"	0°	331°	
4810						Wahoo River
						Crossing
4814						Cut 2 miles
L 4824			Base Camp (data)			

Figure 1-9. Sample log



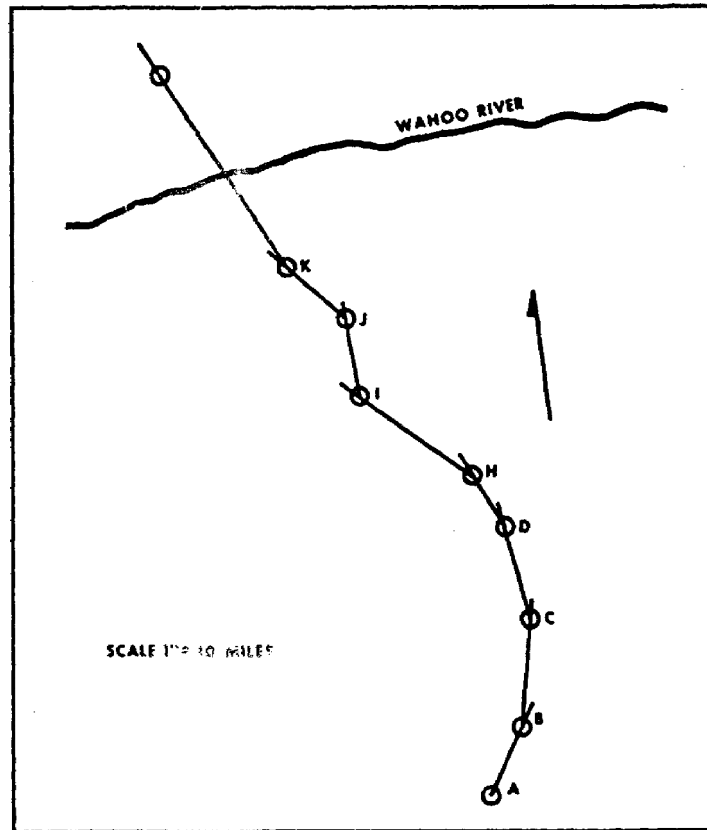


Figure 1-10. Separate paper plot

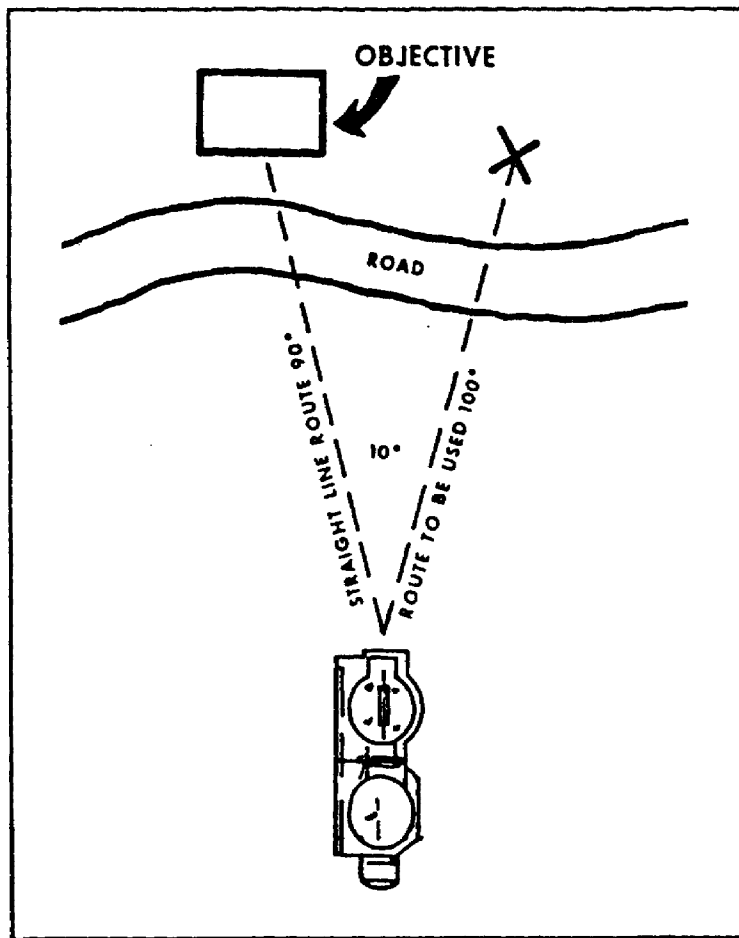
f. Figure 1-12 shows an example of how to bypass enemy positions or obstacles by detouring around them and maintaining orientation by moving at right angles for specified distances. Bypassing an unexpected obstacle at night is done in the same way.

**EXAMPLE:** Moving on an azimuth of 360 degrees and wishing to bypass an obstacle or position, you would first change direction to 90 degrees and travel for 100 yards. Next, you would change direction back to 360 degrees and travel for 100 yards. Then you would change direction to 270 degrees and travel for 100 yards. Again you would change direction to 360 degrees and get back on the original azimuth.

## 7. POLAR COORDINATES

a. You can determine a point on the map or plot from a known point by giving a direction and a distance along the direction

line. This method of point location uses polar coordinates (Figure 1-13). Polar coordinates are especially useful in the field because magnetic azimuth is determined from the compass, and distance can be estimated. The reference direction is normally expressed as an azimuth; the distance is determined by any convenient unit of measurement (meters or yards).



**Figure 1-11. Deliberate offset**

(1) To find direction and position at night in the Northern Hemisphere, one star, Polaris (the Pole Star), is never more than approximately 1 degree from the North Celestial Pole. In other words, the line from any observer in the Northern Hemisphere to the Pole Star is never more than 1 degree away from true north. Find the Pole Star by locating the Big Dipper or Cassiopeia, the two groups of stars very close to the North Celestial Pole. The two stars on the outer edge of the Big Dipper are called pointers because they point almost directly to Polaris. If the pointers are obscured by clouds, Polaris can be

identified by its relationship to the constellation Cassiopeia. Figure 1-14 indicates the relation between the Big Dipper, Polaris, and Cassiopeia.

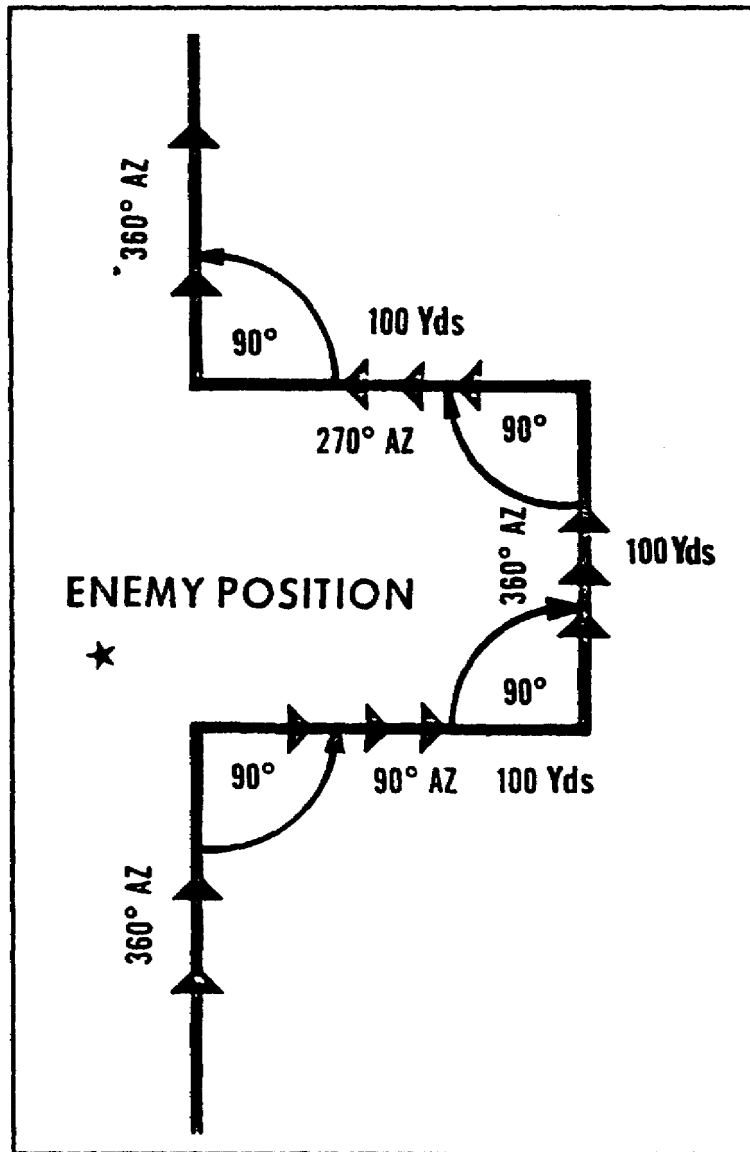
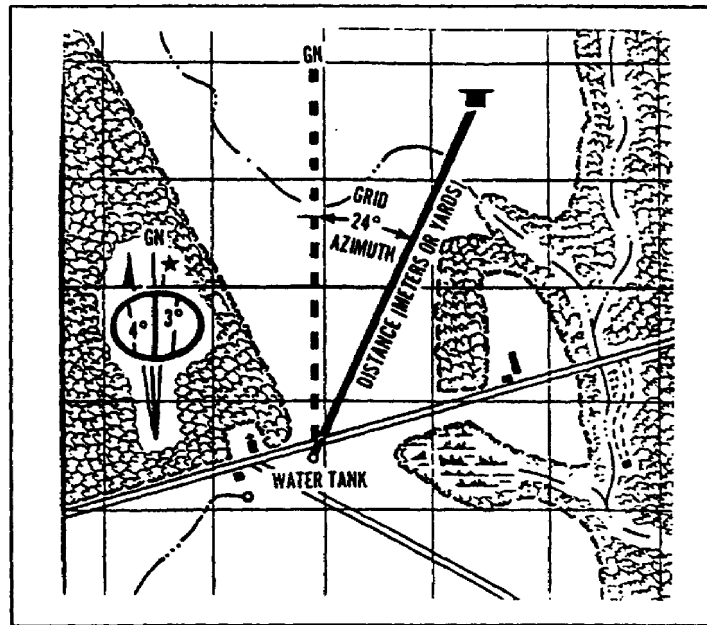


Figure 1-12. Detour around enemy position

(2) In the Southern Hemisphere, Polaris is not visible. There the Southern Cross is the most distinctive constellation. When flying south, the Southern Cross appears shortly before Polaris drops from sight astern. An imaginary line through the long axis of the Southern Cross, or True Cross, points toward the South Pole. The True Cross should not be confused with a larger

cross nearby known as the False Cross. The False Cross is less bright and more widely spaced. Two of the four stars in the True Cross are among the brightest stars in the heavens; they are the stars on the southern and eastern arms. Those of the northern and western arms are not as conspicuous but are bright.



**Figure 1-13. Polar coordinates used to designate position on map**

(3) There is no conspicuous star above the South Pole to correspond to Polaris above the North Pole. In fact, the point where such a star would be, if one existed, lies in a region void of stars. This point is so dark in comparison with the rest of the sky that it is known as the Coalsack. Figure 1-15 shows the True Cross and--to the west of it--the False Cross.

b. Because of the altitude of Polaris above the horizon, it may sometimes be difficult to use this star as a bearing. Using a point directly on the horizon may be more convenient.

(1) The celestial equator is a projection of the earth's equator onto the imaginary celestial sphere. It always intersects the horizon line at the due east and west points of the compass. Therefore, any star on the celestial equator rises due east and sets due west (disallowing a small error because of atmospheric refraction). This holds true for all latitudes except those of the North and South Poles where the celestial equator

know if you are at the North or South Pole, so this technique is assumed to be of universal use.

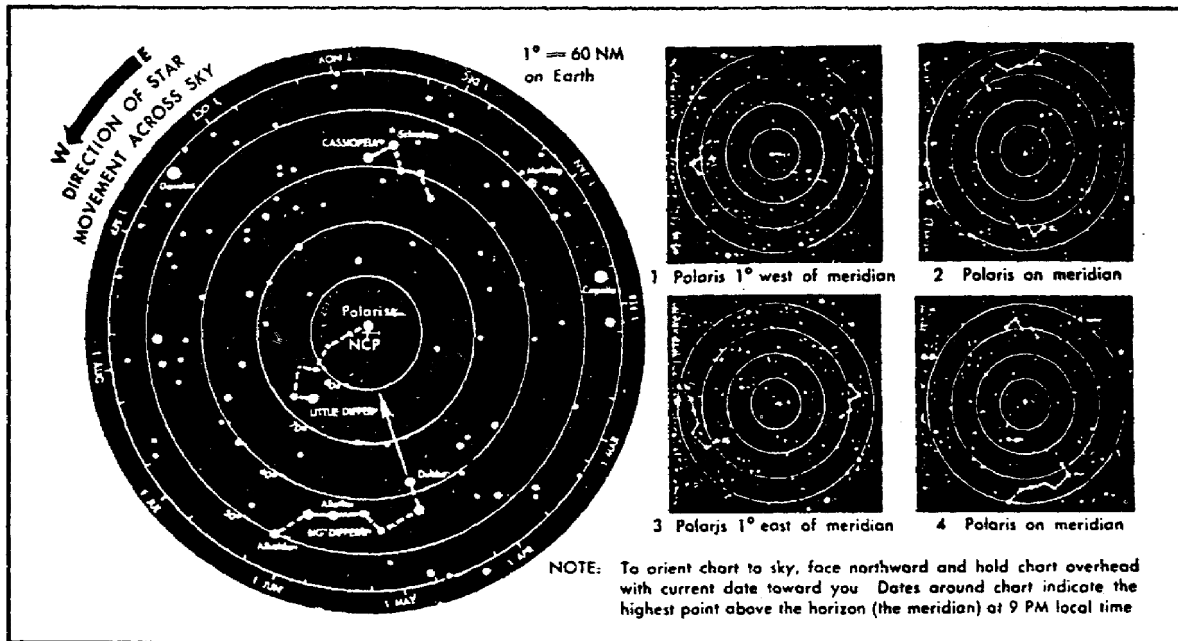


Figure 1-14. Finding direction from Polaris

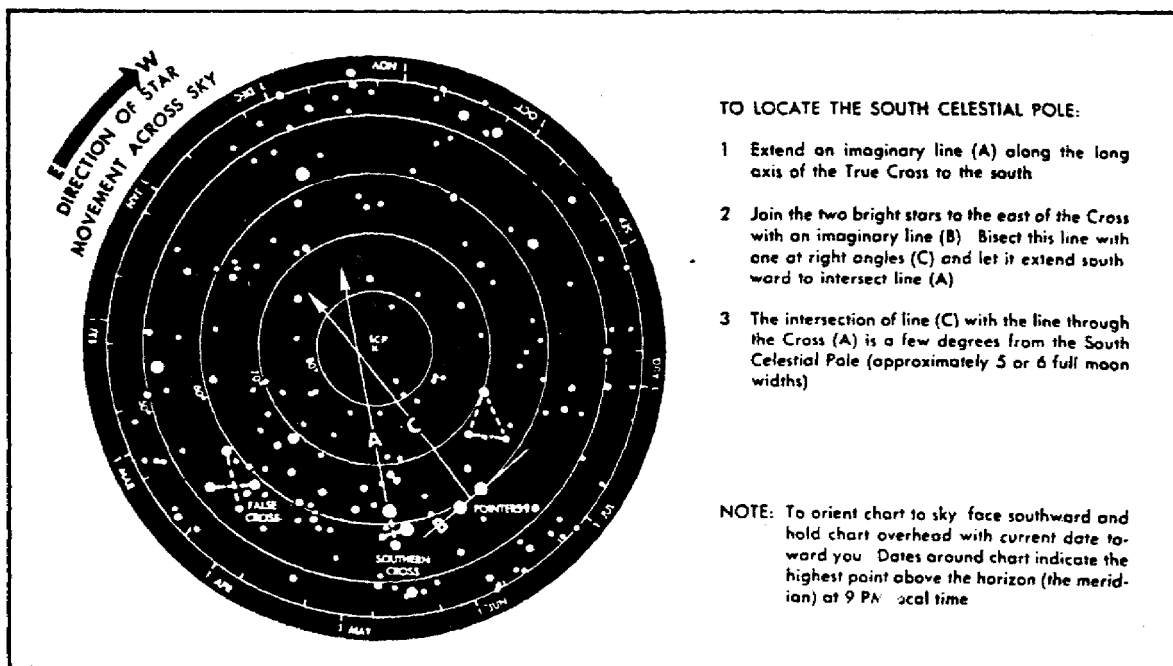


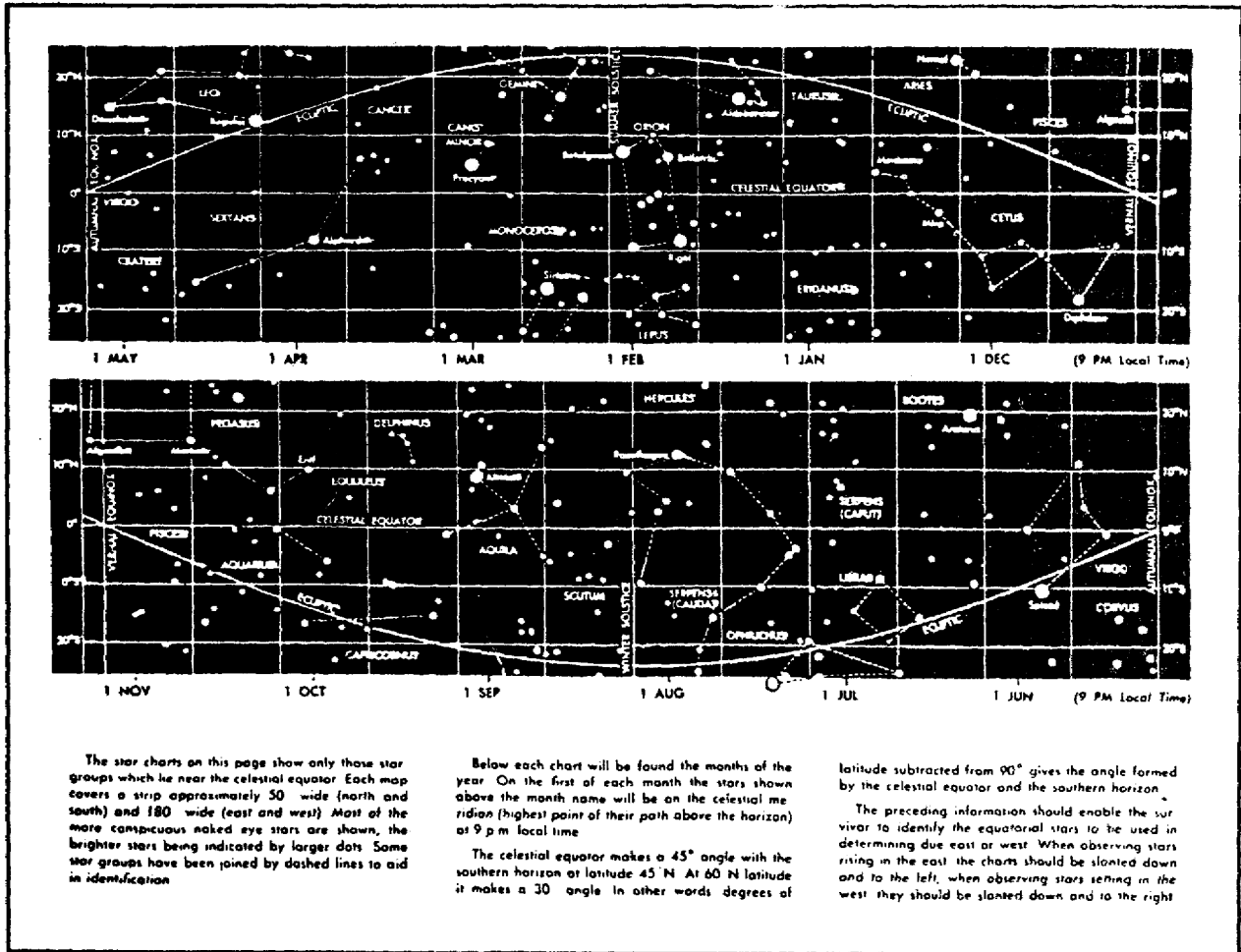
Figure 1-15. Finding direction from Southern Cross

(2) Certain difficulties arise in the practical use of this technique. Unless you are quite familiar with the constellations, it may be difficult to spot a specific rising star as it first appears above the eastern horizon. Therefore, it is probably simpler to depend on the identification of an equatorial star before it sets in the west.

(3) Atmospheric extinction causes another problem. As stars near the horizon, they grow fainter in brightness because the line of sight between the observer's eyes and the star passes through a constantly thickening atmosphere. Therefore, faint stars disappear from view before they actually set. However, a fairly accurate estimate of the setting point of a star is made some time before it actually sets. Atmospheric conditions of the area also have a great effect on obstructing a star's light as it sets. For instance, atmospheric haze is much less a problem on deserts than along temperate zone coastal strips.

(4) Figure 1-16 shows the brighter stars and some prominent star groups that lie along the celestial equator. There are few bright stars actually on the celestial equator. However, a number of stars lie quite near it, so you can make an approximation within a degree or so. A rough knowledge of the more conspicuous equatorial constellations also gives you a continuing checkpoint for maintaining orientation.

c. At times you may need to find direction (north) from overhead stars that are not in the general location of the celestial poles. You may not be able to locate Polaris (the North Star) because of a partial cloud cover or its position below the observer's horizon. Fortunately, if you wish to initially find direction or to check a course of travel during the night, you need not worry about being lost or unable to travel if Polaris cannot be identified. The stick-and-string method is an adaptation of the stick-and-shadow method of direction finding. This method is based on the principles that all the heavenly bodies (sun, moon, planets, and stars) generally rise in the east and generally set in the west. You can use this technique anywhere on earth with any stars except those that are circumpolar. Circumpolar stars are those that appear to travel around Polaris instead of apparently "moving" from east to west. To use this technique, follow the instructions in Figure 1-17 and keep in mind that you may use any star other than a circumpolar one.



The star charts on this page show only those star groups which lie near the celestial equator. Each map covers a strip approximately 50° wide (north and south) and 180° wide (east and west). Most of the more conspicuous naked eye stars are shown, the brighter stars being indicated by larger dots. Some star groups have been joined by dashed lines to aid in identification.

Below each chart will be found the months of the year. On the first of each month the stars shown above the month name will be on the celestial meridian (highest point of their path above the horizon) at 9 p.m. local time.

The celestial equator makes a 45° angle with the southern horizon at latitude 45° N. At 60° N latitude it makes a 30° angle. In other words, degrees of

latitude subtracted from 90° gives the angle formed by the celestial equator and the southern horizon.

The preceding information should enable the survivor to identify the equatorial stars to be used in determining due east or west. When observing stars rising in the east, the charts should be slanted down and to the left; when observing stars setting in the west, they should be slanted down and to the right.

Figure 1-16. Charts of equatorial stars

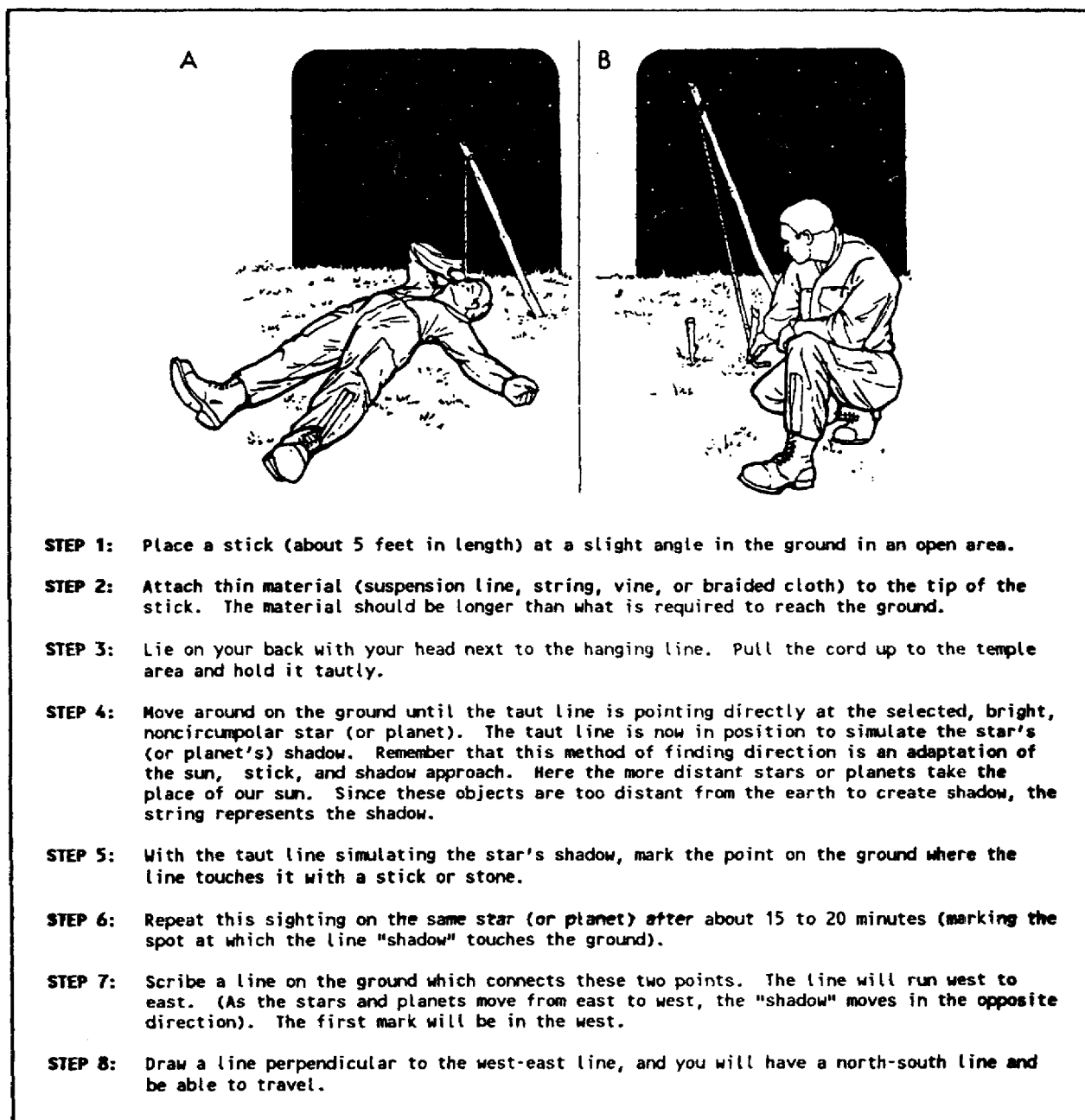


Figure 1-17. Stick and string direction finding



## LESSON 1

### PRACTICE EXERCISE

The following items will test your grasp of the lesson material. Each item has only one correct answer. When you complete the exercise, check your answers with the answer key that follows. If you answer any item incorrectly, restudy that part of the lesson.

1. In determining direction using the sun's shadow, the first shadow-tip mark always indicates which direction?
  - A. east
  - B. west
  - C. north
  - D. south
  
2. The process of locating your position by plotting the course and distance from the last known location is called
  - A. interpolation.
  - B. dead reckoning.
  - C. time-distance-heading.
  - D. intersection-resection.
  
3. How is Polaris (the Pole Star) located in relation to the Big Dipper?
  - A. Polaris is located inside the Big Dipper.
  - B. Polaris is the last star in the Big Dipper's handle.
  - C. The position of the Big Dipper cannot be used to determine the location of Polaris.
  - D. The two stars on the outer (pouring) edge of the Big Dipper point directly at Polaris.
  
4. The constellation which aids in determining direction in the southern hemisphere is the
  - A. Cassiopeia.
  - B. Little Dipper.
  - C. Southern Cross.
  - D. Southern Lights.

**LESSON 1**

**PRACTICE EXERCISE**

**ANSWER KEY AND FEEDBACK**

<u>Item</u>	<u>Correct Answer and Feedback</u>
1. B.	west  (page 1-3, Figure 1-1, STEP 5)
2. B.	dead reckoning.  (page 1-9, para 6)
3. D.	The two stars on the outer (pouring) edge of the Big Dipper point directly at Polaris.  (page 1-14, para 7a(1))
4. C.	Southern Cross.  (page 1-15, para 7a(2))

## LESSON 2

### SIGNALING AND RECOVERY

Critical Tasks: 9103.02-0001  
9103.02-0002

**ACTION:** Traverse enemy or unfriendly territory, and maintain physical capability to evade.

**CONDITION:** You will use the lesson text to complete the action.

**STANDARD:** You will traverse enemy or unfriendly territory, and maintain physical capability to evade according to this lesson.

**REFERENCE:** The material in this lesson was derived from the following publications: AR 95-17, AR 350-30, and AR 525-90; AFM 64-5; FM 1-302, FM 20-150, and FM 21-76; and DOD Directive 1300.7.

**SAFETY CONSIDERATIONS:** none

**TRAINING RISK ASSESSMENT CODE:** L

**ENVIRONMENTAL CONSIDERATIONS:** none

### INTRODUCTION

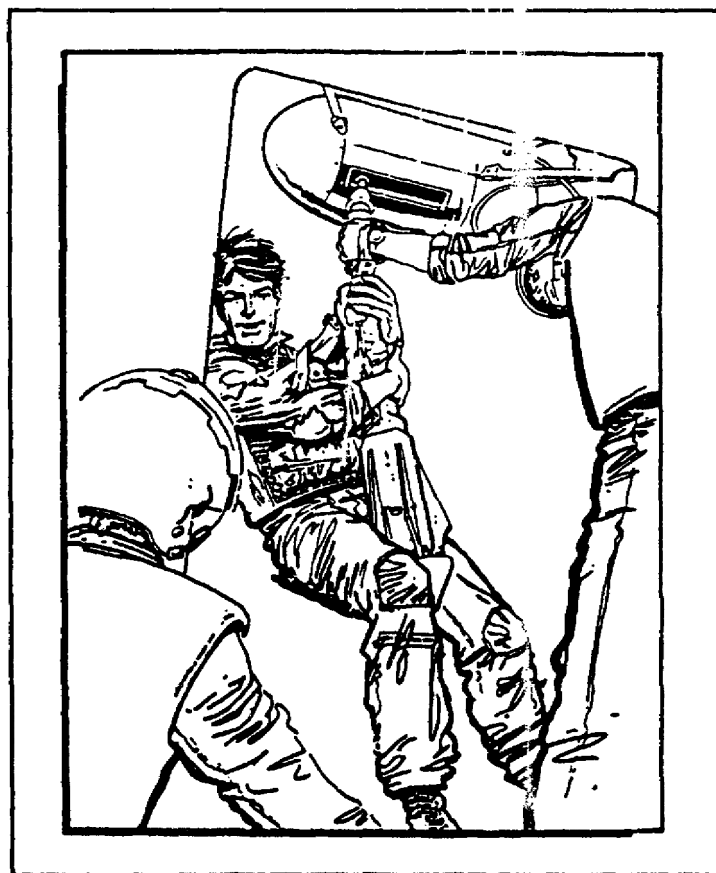
Receiving a distress call sets a highly trained and well-equipped organization into operation; however, prompt and safe recovery is by no means ensured. The success of the rescue effort depends on many factors. Availability of rescue forces, the proximity of enemy forces, and weather conditions can affect the success of the rescue. Above all, your knowledge of what to do in the rescue effort may make the difference between success and failure (Figure 2-1).

#### 1. THE SURVIVORS' ROLE IN RESCUE

a. The role of survivors in effecting their rescue changes continuously as aircraft and rescue equipment become more sophisticated. The probability of a downed aircrew member applying long-term survival training concepts under noncombat conditions continues to decrease while they increase under combat conditions. Most successful recoveries have resulted primarily

because survivors were able to assist in their own recovery. Many rescue efforts failed because survivors lacked the knowledge and ability necessary to assist. When needed, this knowledge and ability could have made the difference between life or death--freedom or captivity (Figure 2-2).

b. To assist in your own recovery, you first need to know what is being done to find you. Next, you need to know how to operate the communication equipment in the survival kit and when to put each item into use. You should also be able to improvise signals to improve your chances of being sighted and to supplement the issued equipment.



**Figure 2-1. Recovery**

c. It is not easy to spot one survivor, a group of survivors, or even an aircraft from the air especially when visibility is limited. Emergency signaling equipment is designed to make a person easier to find. Emergency equipment may be used to provide rescue personnel with information about the survivors'

condition, plans, position, or availability of a rescue site where recovery vehicles might reach them (Figure 2-3).



**Figure 2-2. Signaling and recovery**

d. A part of a survivor's plan of action should be to visualize how emergencies will develop, recognize them, and at the appropriate time, let friendly forces know about the problem. The length of time before survivors are rescued often depends on the effectiveness of emergency signals and the speed with which they are used. Carefully select signal sites. These sites should enhance the signal and have natural or manufactured materials readily available for immediate use. Avoid wasting pyrotechnic signals; they may be needed to enhance rescue efforts. Signals used correctly can hasten recovery and eliminate the possibility of a long, hard survival situation. Therefore, where emergency signals are concerned, you should know how to use them and when to use them, should be able to use them on short notice, and should use them in a manner that will not jeopardize individual safety.

e. The situation on the ground governs the type of information that you can furnish the rescue team and the type of signaling you should use. In nontactical survival situations, there

are no limitations on the ways and means you may use signals to furnish information. In hostile areas, limitations on using signals is expected. Using some signaling devices pinpoints your location to the enemy as well as to friendly personnel. Remember the signal enhances the visibility of the survivors.



**Figure 2-3. Signaling**

f. There are several independent organizations engaged in search and rescue (SAR) operations or influencing the SAR system. These organizations may be state, county, federal, international, or local governmental; commercial; or private. You are responsible for being familiar with procedures used by international SAR systems to assist in rescue efforts. Some international organizations include the International Civil Aviation Organization, Intergovernmental Maritime Consultive Organization, and Automated Mutual-Assistance Vessel Rescue System.

## 2. MANUFACTURED SIGNALS

### a. Electronic

Current line-of-sight electronic signaling devices fall into two categories--transceiver type and personal locator beacon type. The transceiver type is equipped for transmitting and receiving tone or voice. The personal locator beacon is equipped to transmit tone only. The ranges of the different radios vary depending on the weather, altitude of the receiving aircraft, terrain factors, forest density, battery strength, radio type, and interference. Interference is a very important aspect when using these radios. If a personal locator beacon is transmitting, it interferes with incoming and outgoing transceiver signals.

(1) Before using survival radios, you should observe a few basic precautions. These will help in obtaining maximum performance from the radios in survival situations.

(a) The survival radios are line-of-sight communication devices; therefore, you can obtain the best transmission range when operating in clear, unobstructed terrain.

(b) The AN/PRC-90 is a dual channel transceiver operating on guard UHF 243.0 megahertz (MHz) and 282.8 MHz voice. The AN/PRC-90 can transmit a beacon tone over 85 miles and voice contact approximately 10 miles.

(c) The AN/PRC-90 can transmit a beacon tone over 85 miles and voice contact approximately 10 miles.

(d) Extending from the top and bottom of the radio antenna is an area referred to as the "cone of silence." To avoid this problem, keep the radio or beacon antenna orthogonal to (at a right angle to) the path of the rescue aircraft. Since the radios have the capability of transmitting a tone (beacon) without being hand-held, place them upright on a flat elevated surface allowing the operator to perform other tasks.

(e) Never allow the radio antenna to ground itself on the ground, the body, clothing, or foliage. This severely decreases the effective range of the signals.

(f) Do not constantly transmit or receive. Conserve battery power by turning the radio off when not in use. Use the locator beacon to supplement the radio when transmitting is done. In tactical environments, use the radio as stated in the premission briefing.

(g) Survival radios are designed to operate in extreme heat or cold. The life expectancy of a battery, however, is reduced when exposed to both ends of the temperature spectrum. Life expectancy decreases rapidly as the temperature drops below freezing. The batteries provided with most radios operate approximately 14 hours at 68°F or 5 hours at 32°F. These times are based on a duty cycle of approximately 50 percent transmitted and 50 percent received. During cold weather, keep the battery warm by placing it between layers of clothing to absorb body heat. Also, wrap it in some type of protective material when it is not being used.

(h) Survival radios are designed to be waterproof. However, you should take precautions to protect them from any form of moisture.

(2) Presently, a satellite monitoring system has been developed to assist in locating survivors. To activate this search and rescue satellite system, key the transmitter for a minimum of 30 seconds. In a nontactical situation, leave the beacon on until rescue is heard or sighted.

#### **b. Pyrotechnic**

A device containing chemicals for producing smoke or light is known as a pyrotechnic. Hand-held flares are in this category. Take care when operating pyrotechnic signals around flammable materials.

(1) You may be required to use a variety of flares or tracer ammunition. Know the types stored in your survival kits or aircraft. Aircrew members should learn how to use each type before they face an emergency.

(a) Flares are designed for use during the day or night. Day flares produce a unique bright-colored smoke that stands out very clearly against most backgrounds. Night flares are extremely bright and are seen for miles by air, ground, or naval recovery forces.

(b) Hand-held launched flares also fall in the pyrotechnic category. They were designed to overcome the problems associated with signaling in densely vegetated terrain as well as atmospheric inversions that reduce the effectiveness of smoke signaling devices.

(c) Use signal flares with extreme caution in a combat zone. Any attempt to attract the attention of potential rescuers also attract the attention of enemy troops in your area. Because of the limited signal life of most flares, activating them at the appropriate time is also an important factor. The



survivor must exercise his best judgment in lighting them when the rescue craft is in a favorable position to see them. Ideally the survivor should ignite them so that the signal is observed a safe distance in front of the aircraft. Never fire a signal flare directly at an approaching aircraft, so that it is not interpreted as a hostile act.

(d) Tracer ammunition is another pyrotechnic with definite signaling value. With an effective range of 1,300 feet, tracer bullets have been observed from a distance of 6 miles. Like signal flares, use tracers with extreme caution. The chance is even greater that their use could be interpreted as a hostile act.

(2) The Army life support equipment (ALSE) section within each aviation organization must conduct regular classes to keep aircrews proficient in using survival vest components. Bring any specific questions pertaining to signaling equipment firing procedures to the attention of an ALSE technician.

### **c. Sea Marker Dye**

**NOTE:** Sea marker dye is used not only at sea, but also on inland lakes and streams.

(1) Of the many dyes and metallic powders tested at various times for marking the sea, the most successful is the fluorescent, watersoluble, orange powder. When released in the sea, it produces a highly visible, light green, fluorescent cast. Sea marker dye disperses rapidly. A packet spreads into a slick about 150 feet in diameter and lasts an hour or more in calm weather. Rough seas stream it into a long streak which may disperse in 20 minutes. Under ideal weather conditions, the dye can be sighted 3.5 miles at an aircraft operating at 3,000 feet for about 1 hour.

(2) Use sea marker dye in friendly areas during daytime and only when there is a chance of being sighted (aircraft seen or heard in the immediate area). It is not effective in heavy fog, solid overcast, and storms with high winds and waves. Pull the release tab on the dye packet to open it for use. In calm water, the dye is dispersed more rapidly by stirring the water with paddles or hands.

(3) If left open in the raft, escaping powder penetrates clothing; stains hands, face, and hair; and eventually may contaminate food and water. To avoid the inevitable messiness, some survivors have tied the sea marker dye to the sea anchor. Others have dipped the packet over the side, letting it drain into the sea. After using the dye, rewrap it to conserve the remainder of the packet.

d. Paulin

The paulin is a conventional signaling device used to send specific messages to aircraft. It may be packed with some sustenance kits and multiplace liferaft accessory kits. The paulin is constructed of rubberized nylon material and is blue on one side and yellow on the other. These colors contrast against each other; so when one side is folded over the other, the designs are easily distinguished (Figure 2-4). The 7-foot by 11-foot size, is a disadvantage when folded because it makes a small signal. The paulin has numerous uses. It can be used as a tent, sail, sunshade, camouflage cloth, or to catch drinking water. The space blanket, used as a substitute for the sleeping bag in some survival kits, can be used in the same manner as the signal paulin because it is highly reflective (silver on one side and various colors on the other side).

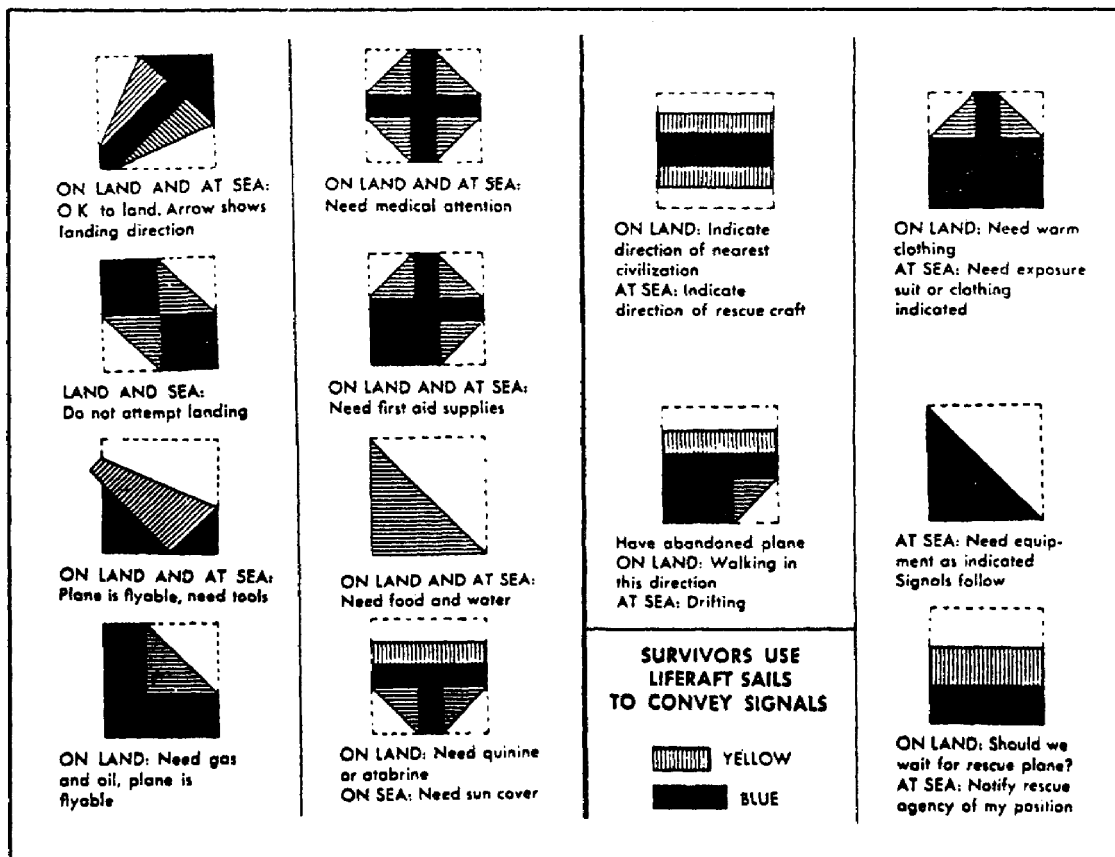


Figure 2-4. Paulin signals

**e. Audio**

Sounds carry far over water under ideal conditions; however, they are easily distorted and deadened by wind, rain, or snow. On land, heavy foliage cuts down on the distance sound travels. Survivors have used a multitude of devices to produce sound. Shouting and whistling signals are effective at short ranges for summoning rescue forces. Most contacts using these means were made at less than 200 yards, although a few reports claim success at ranges up to a mile. A weapon can be used to attract attention by firing shots in a series of three. The number of available rounds determine whether this is practical. Other audio signals include striking two poles together, striking one pole against a hollow tree or log, and improvising whistles out of wood, metal, and grass.

**f. Light**

When tested far away from other manufactured lights, aircraft lights have been seen up to 85 miles. At night, you should use any type of light to attract attention. A signal with a flashlight, or a light or fire in a parachute shelter, is seen from a long distance. A flashing light (strobe light) is in most survival kits.

**g. Mirror**

The signal mirror is probably the most underrated signaling device found in the survival kit. It is the most valuable daytime means of visual signaling and works well on overcast days. A mirror flash is visible up to 30 miles in an aircraft operating at 10,000 feet, but its value is significantly decreased unless used correctly. Practice is the key to effectively using the signal mirror. Whether the mirror is factory manufactured or improvised, aim it so the beam of light reflected from its surface hits the overflying aircraft. Instructions are printed on the back of the manufactured mirror. Follow the steps listed in Figure 2-5 to aim the manufactured mirror properly.

(1) The signal mirror's effectiveness is its greatest weakness if you are in enemy territory. It is just as bright to the enemy as to the rescuer; use it wisely! Understand that even if the mirror flash is directly on the aircraft (especially if the aircraft is using terrain masking techniques), that same flash may be visible to others (possibly the enemy) who are located at the proper angle in regard to your position.

(2) In a hostile environment, the exact location of the flash is extremely important. Cover the signal mirror when not in use. One of the easiest methods is to tie the string from the mirror around your neck and tuck the mirror in your shirt or

flight suit. When the mirror is removed from inside the clothing, place your hand over the mirror surface to prevent accidental flashing. Then raise the covered mirror toward the sky and withdraw your hand. Then direct the flash onto your free hand and locate the aiming indicator (sunspot). This minimizes the indiscriminate flashing of surrounding terrain. When putting the mirror away, remember to cover the mirror to prevent a flash.

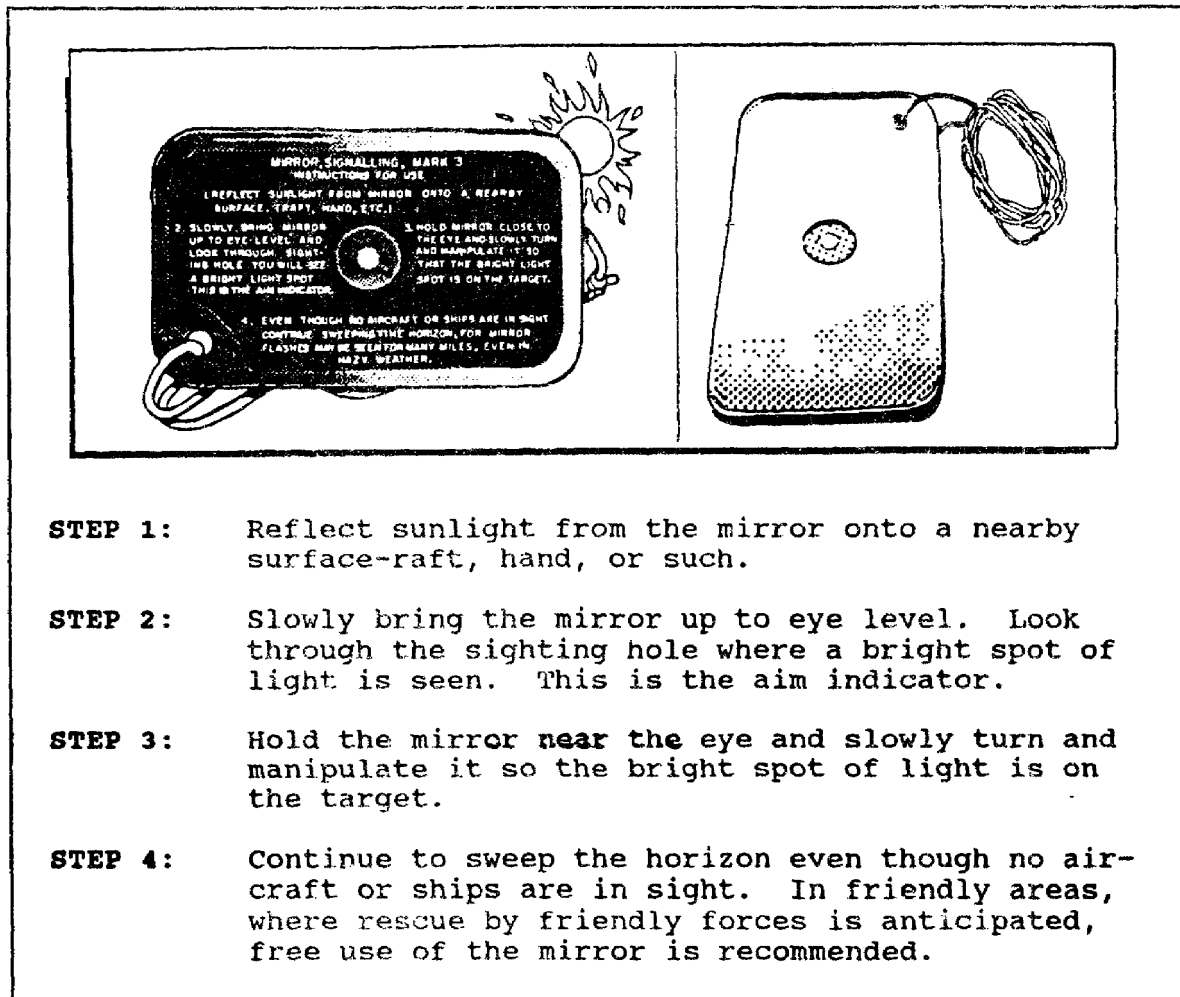


Figure 2-5. Signal mirrors

### 3. IMPROVISED SIGNALS

#### a. Mirrors

Improvised signal mirrors are made from glass, ration tins, parts from an aircraft, polished aluminum, or the foil from rations or cigarette packs. Signal mirrors are either single or double sided (shiny on both sides). However, you must accurately aim the mirror if the reflection of the sun in the mirror is to be seen by the pilot of a passing aircraft or the crew of a ship.

##### (1) **Sighting**

Hold the mirror so you can sight along its upper edge. By changing your position until the top of the stick and target line up, you should adjust the angle of the mirror until the beam of reflected light hits the top of the stick. If stick and target are then kept in the sighting line, the reflection will be visible to the rescue vehicle. You can make a sighting hole in the center of the mirror.

##### (2) **Aiming**

The simple way to aim an improvised single-sided mirror is to place one hand out in front of the mirror at arm's length and form a "V" with two fingers. With the target in the "V", manipulate the mirror so that the majority of light reflected passes through the "V" (Figure 2-6). Use this method with all mirrors. Another method is to use an aiming stake as shown in Figure 2-7. Any object 4 to 5 feet high can serve as the point of reference.

(a) When trying to attract the attention of a friendly rescue vehicle that is no more than 90 degrees from the sun, proceed as shown in Figure 2-8 using a double-faced mirror. First, hold the double-faced mirror about 3 to 6 inches away from the face; sight at the rescue target through the hole in the center of the mirror. The light from the sun shining through the hole forms a spot of light on your face. This spot is reflected in the rear surface of the mirror. Then, aiming at the rescue vehicle through the hole, adjust the angle of the mirror until the reflection of the spot on your face in the rear surface of the mirror lines up with, and disappears, into the sighting hole. When the reflected spot disappears and the rescue vehicle is still visible through the hole, you can be sure the reflected light from the sun is accurately aimed. You may also "shimmer" the mirror by moving it rapidly over the target. This ensures that the part of the bright flash the rescuers see coincides with your position. This shimmering is especially useful on a moving target.

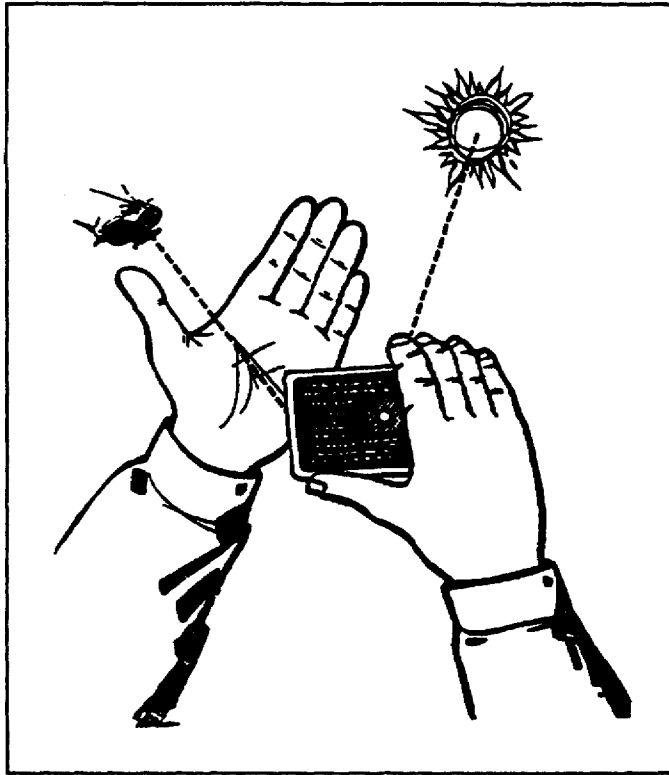


Figure 2-6. Aiming signal mirror

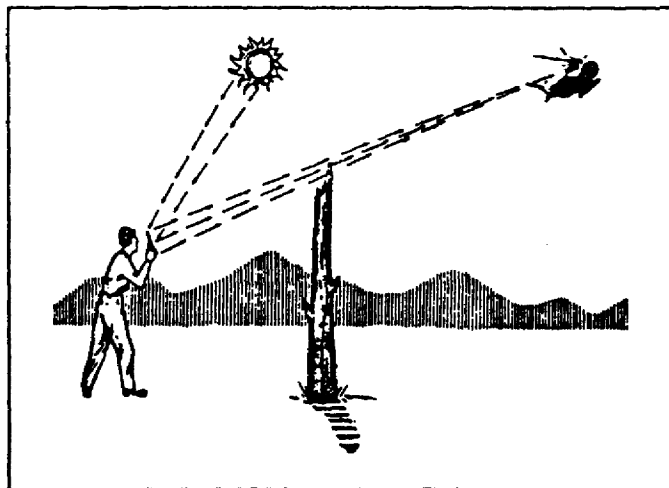
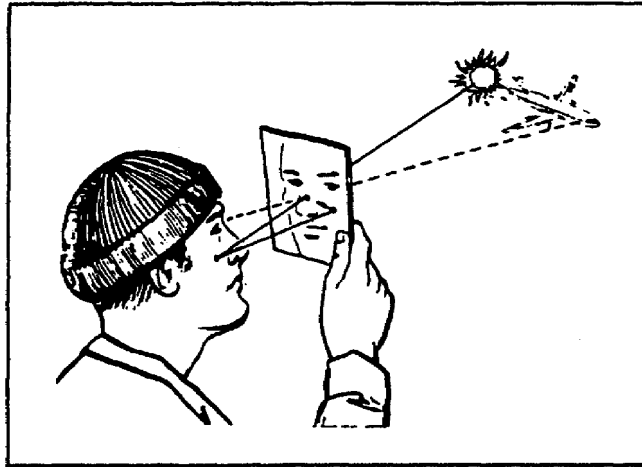


Figure 2-7. Aiming signal mirror stationary object



**Figure 2-8. Aiming a double-faced signal mirror (no more than a 90-degree angle)**

(b) When the angle between the target and the sun is more than 90 degrees (when you are between the rescue vehicle and the sun), you may use a different method for aiming. Adjust the angle of the mirror until the spot made by the sun's rays passing through the hole in the mirror lands on your hand instead of on your face. The reflection in the back of the mirror that comes off your hand may then be manipulated in the same way (Figure 2-9).

(c) Another method used when the angle is greater than 90 degrees is to lie on the ground in a large clearing. Aim the mirror using one of the methods previously discussed (Figure 2-10).

**WARNING**

DO NOT continually flash a mirror at an aircraft. This action could possibly white-out the cockpit and blind the pilot who is trying to rescue you.

**b. Fire and Smoke**

Fire and smoke is also used to attract the attention of recovery forces. One signal fire usually works for a survivor. However, three evenly spaced fires, 100 feet apart, arranged in a triangle or in a straight line, serve as an international distress signal. To increase its effectiveness, prepare the signal

fire before the recovery vehicle enters the area. The fires you use for heating and cooking may be used as signal fires as long as the necessary materials are available in the immediate vicinity. You should supplement the fire to provide the desired signal. During the night, the flames should be as bright as possible; during the day, you should produce as much smoke as possible.

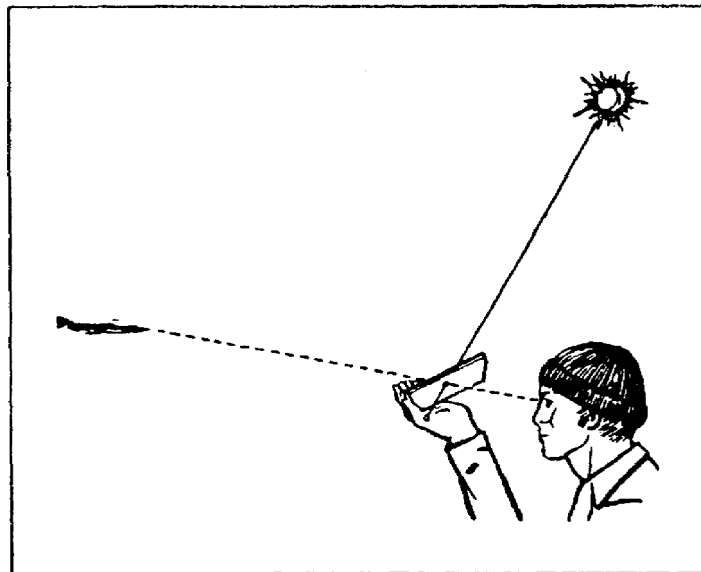


Figure 2-9. Aiming signal mirror  
(angle greater than 180 degrees)

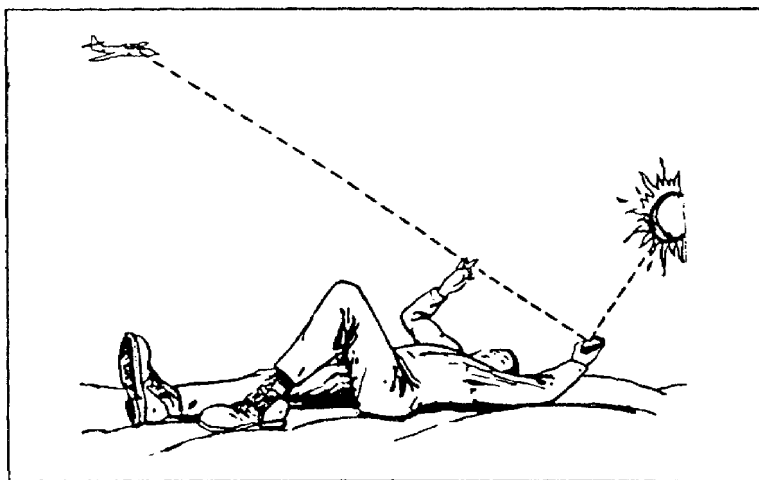


Figure 2-10. Aiming signal mirror  
(angle greater than 180 degrees)



(1) Smoke signals, most effective on clear and calm days, have been sighted from up to 50 miles away. Rain, snow, or high winds tend to disperse the smoke and lessen the chances of it being seen. Smoke signals are not dependable when used in heavily wooded areas.

(2) The smoke produced should contrast with its background. Against snow, dark smoke is often most effective. Likewise, against a dark background, white smoke is best. Smoke is darkened by burning matting, plastic, pieces of rubber, electrical insulation, or rags soaked in oil. Hydraulic oil should not be burned since it produces a toxic smoke. Green leaves, moss, ferns, or water produce white smoke. Several ways to generate smoke are discussed below.

(a) **Raised platform generator.** To use this form of smoke generator, build a raised platform above wet ground or snow (Figure 2-11). Place highly combustible materials on the platform, and then place smokeproducing materials over the platform. Light the material when a search aircraft is in the immediate vicinity.

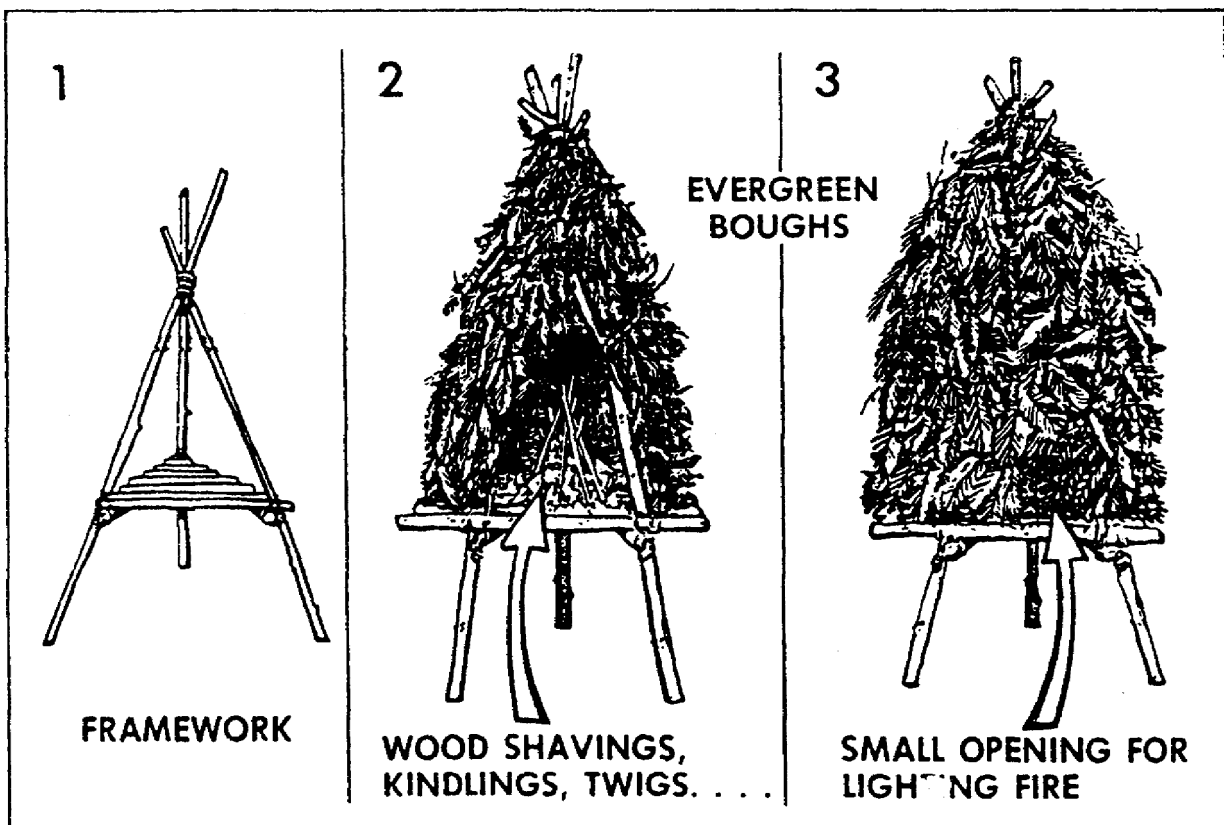


Figure 2-11. Platform smoke generator

(b) **Ground smoke generator.** For this type of smoke generator, build a large log cabin fire configuration on the ground (Figure 2-12). This provides good ventilation and supports the green boughs used for producing smoke. Then place smoke-producing materials over the fire lay. Ignite the material when a search aircraft is in the immediate vicinity.

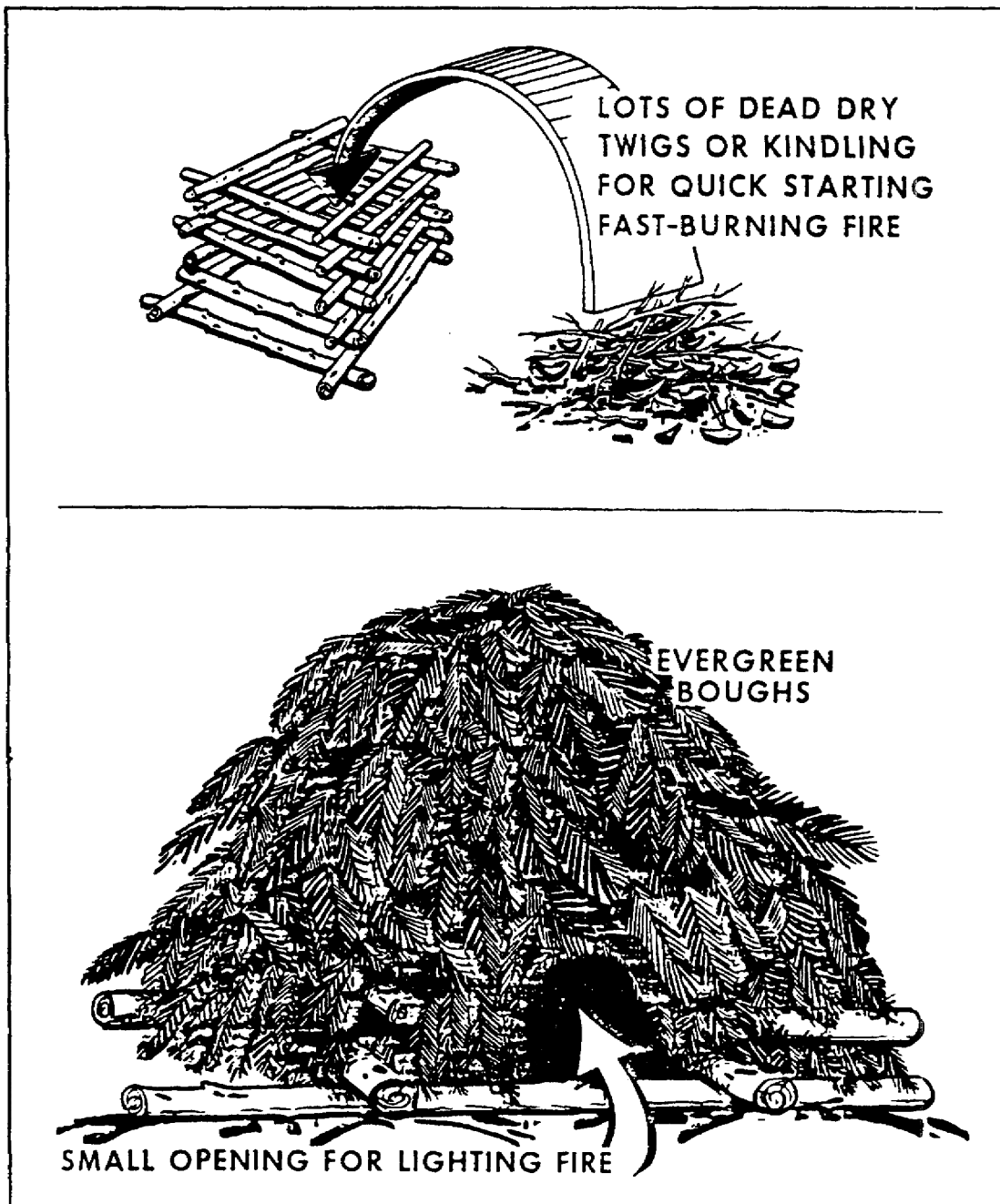
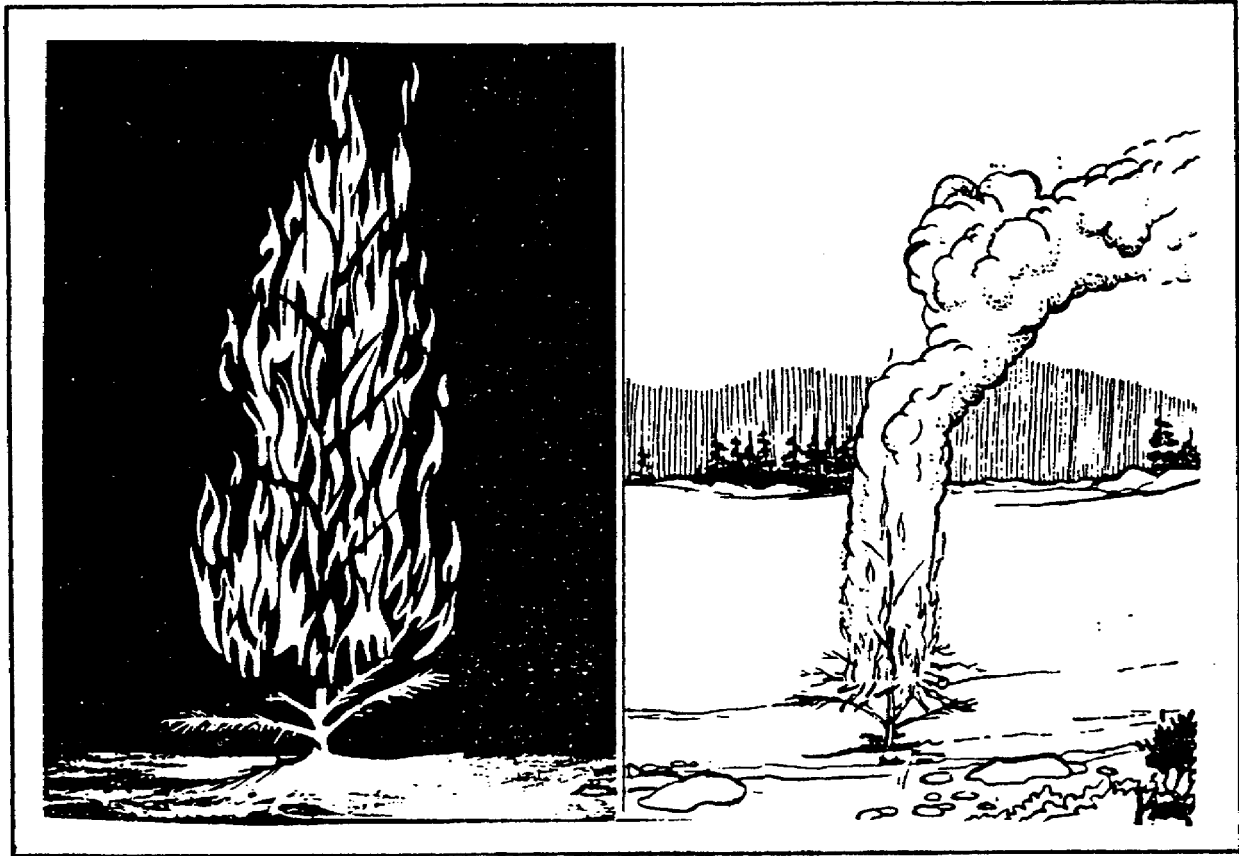


Figure 2-12. Ground smoke generator

(c) **Tree torch smoke generator.** To build this device, locate a tree in a clearing to prevent a forest fire hazard (Figure 2-13). Add additional smoke-producing materials and an igniter. Then, light the material when a search aircraft is in the immediate vicinity.



**Figure 2-13. Tree torch**

(d) **Fuel smoke generator.** If survivors are with the aircraft, they can improvise a generator by burning aircraft fuels, lubricating oil, or a mixture of both. Place 1 to 2 inches of sand or fine gravel in the bottom of a container and saturate it with fuel. Use care when lighting the fuel, as an explosion may occur. If there is no container available, dig a hole in the ground, fill it with sand or gravel, saturate it with fuel, and ignite it. Remember to take care to protect your hands and face.

c. Patterns

Constructing and using pattern signals must take many factors into account. Size, ratio, contrast, meaning, location, and angularity are each important if your signals are to be effective. The type of signal constructed depends on the material available to you. Ingenuity plays an important role in constructing the signal. Remember to judge your signals from the standpoint of the aircrew members who are flying over your location searching for you.

(1) **Size**

The signal should be as large as possible. To be most effective, the signal should have no lines less than 3 feet wide and 18 feet long (or a ratio of 1 to 6) (Figure 2-14).

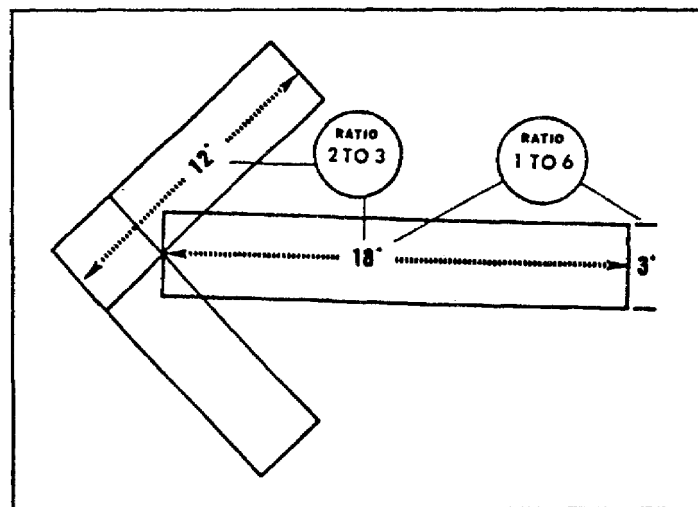


Figure 2-14. Pattern signal sizes

(2) **Ratio**

Also remember proper proportion. If the baseline of an "L" is 18 feet long, then the vertical line of the "L" must be longer (27 feet), a 2 to 3 ratio, to keep the letter in proper proportion.

(3) **Contrast**

The signal should stand out sharply against the background. The idea is to make the signal look larger. On snow, use the fluorescent sea dye available in the liferaft accessory kit to add contrast around the signal. Do everything possible to

disturb the natural look of the ground. When in snow, a trampled out signal is very effective. Use only one path to and from the signal to avoid disrupting the signal pattern. In grass and scrubland, stamp the grass down or turn it over to allow the signal to be easily seen from the air. A burned grass pattern is also effective. Avoid using orange signal panels on a green or brown background as they have a tendency to blend in. Contrast can be improved by outlining the signal with green boughs, piling brush and rocks to produce shadows, or raising the panel on sticks to cast its own shadow.

**(4) Meaning**

If possible, the signal should tell the rescue forces something pertaining to the situation, such as "require medical assistance" or a coded symbol used during evasion. Figure 2-15 shows internationally accepted symbols.

NO	MESSAGE	CODE SYMBOL
1	REQUIRE ASSISTANCE	V
2	REQUIRE MEDICAL ASSISTANCE	X
3	NO or NEGATIVE	N
4	YES or AFFIRMATIVE	Y
5	PROCEEDING IN THIS DIRECTION	↑

**Figure 2-15. Signal key**

**(5) Location**

Locate the signal so it can be seen from all directions. Make sure the signal is located away from shadows and overhangs. A large high open area is preferable. It serves the dual function of signaling and for rescuing aircraft to land.

(6) **Angularity**

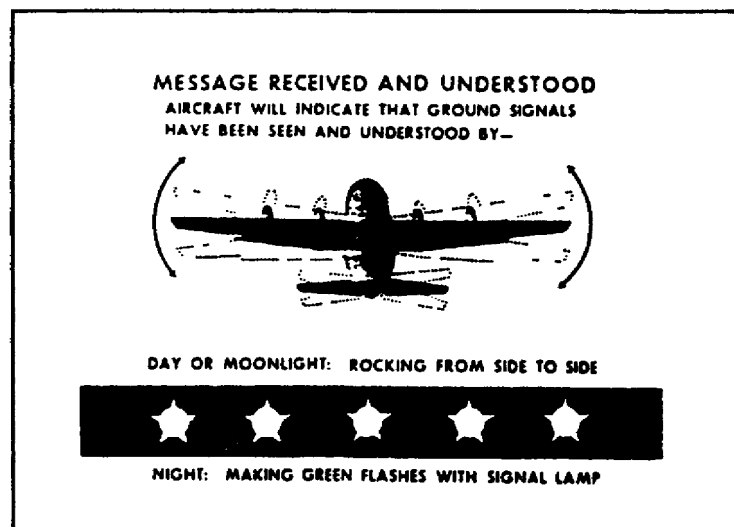
Straight lines and square corners are not found in nature. For this reason, make all pattern signals with straight lines and square corners.

d. **Shadows**

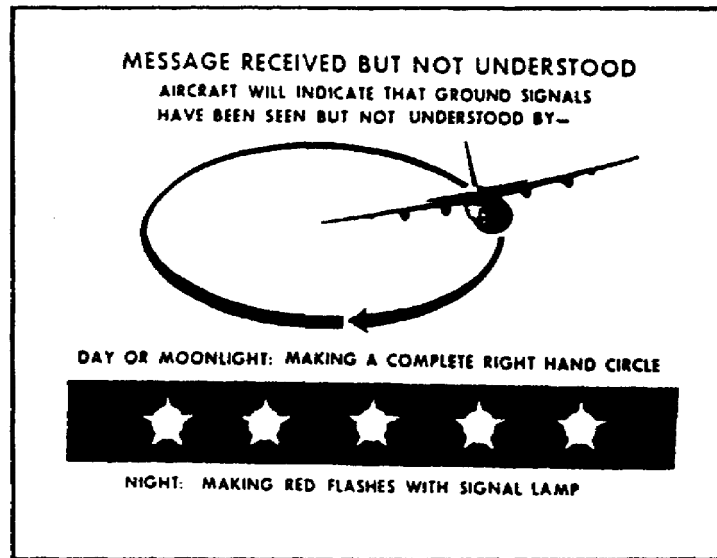
If no other means are available, you may have to construct mounds oriented to the sun to produce the best shadow. You may use brush, rocks, foliage, or snow blocks. Construct them in one of the international distress patterns. In areas close to the equator, a north-south line gives a shadow at any time except noon. Areas farther north or south require an east-west line or some point of the compass in between to give the best results.

**4. SIGNAL ACKNOWLEDGMENT**

Rescue personnel normally inform survivors they have been sighted by flying low with landing lights on (Figure 2-16), rocking the wings, or by using an emergency radio. Figure 2-17 depicts standard body signals which can be used if electronic signaling devices are not available.



**Figure 2-16. Standard aircraft visual acknowledgements**



**Figure 2-17. Close-in visual signals**

Part B--RECOVERY

**5. NATIONAL SEARCH AND RESCUE PLAN**

The national SAR manual (FM 20-150) provides a long-range rescue plan. Personnel should study this manual for additional information. The national SAR plan is implemented the instant an aircraft is known to be down. There are three primary SAR regions: the Inland Region, the Maritime Region, and the Overseas Region.

a. The Inland Region encompasses the continental United States. The Air Force is the SAR coordinator for the Inland Region.

b. The Maritime Region includes the Carribean Area and Hawaii. The Coast Guard is the SAR coordinator for this region.

c. The inland area of Alaska is considered a part of the Overseas Region. The Secretary of Defense designates certain Defense Department officers as United Commanders of specified areas where US Forces are operating. Wherever such commands are established, the Unified Commander is the Regional SAR Coordinator. Overseas regions are normally served by the Joint Rescue Coordination Center operated under the Unified Action Armed Forces.

## **6. SURVIVORS' RESPONSIBILITIES**

a. The very first responsibility you have as a survivor begins at the onset of the emergency. This is when you should send an immediate radio message. The radio message should include position, course, altitude, ground speed, and actions planned. This information is essential for initiating efficient recovery operations.

b. Once recovery operations have been initiated, you have a continuing responsibility to furnish information. Ground and radio signals should be immediate considerations. If a group of survivors become separated, each member, when contacted by rescue forces, should provide information on the dispersal of the group.

c. The greatest responsibility of an aircrew member is to follow all instructions to the letter. The intelligence officer will brief aircrew members on procedures for tactical situations. These instructions must be followed explicitly since it could mean the difference between life and death. When rescue personnel tell you to unhook from the raft, do it immediately! If instructions are not followed, you could be responsible for causing your own death or the death of rescue personnel.

## **7. RECOVERY SITE**

Your major considerations for a recovery site are the type of recovery vehicle carrying out the recovery and the effects of the weather (heat, wind, updrafts, and downdrafts) and terrain on the rescue aircraft. Try to pick the highest terrain possible in the immediate area for pickup. When locating this rescue site, watch for obstacles (trees, cliffs, and so forth) that could limit the aircraft's ability to maneuver. Avoid cliffs, overhangs, or sides of steep slopes. Such terrain features restrict the approach and maneuverability of the rescue vehicle and require increased rescue time. Even though you should select a recovery site, you must be prepared to move quickly to an alternate location if the rescue crew feels it is more suitable for a pickup attempt. The survivor can increase the speed in which he is picked up by selecting a general area containing more than one potential landing area.

## **8. RECOVERY PROCEDURES**

Since procedures involving recovery vary with changes in equipment and rescue capability, always know the current procedures and techniques. This is particularly true of the procedures used for wartime recovery (AR 525-90). In deciding whether or not supplies should be dropped, rescue forces consider such factors as the relative locations of the distress site to rescue unit bases, the time lapse expected before rescue is initiated,



and the danger of exposure. If a delay is expected, supplies are usually dropped to survivors to help sustain and protect them while they await rescue. Survivor mobility on land generally makes it possible to recover equipment dropped some distance away, but air drops at sea must be accurate. Aircraft with internal aerial delivery systems, such as the HC-130, are the most suitable for delivering supplies to survivors. Aircraft having bomb bays or exterior racks capable of carrying droppable containers or packages of survival requisites are the next most suitable for dropping supplies. However, these aircraft are not always available for supply dropping operations, so aircraft not specifically designed for this function may have to be used.

**a. Fixed-Wing Aircraft Rescue Capabilities**

(1) The most significant roles played by fixed-wing aircraft in rescue operations is providing immediate assistance to survivors and serving as the "eyes" of approaching rescue units. This is done by pinpointing the survivors' position, orbiting the survivors, and dropping survival equipment. This type operation improves the morale of the survivors, fixes the survivors' location to prevent additional searching, and saves valuable time in getting the pickup unit on the scene.

(2) The role of fixed-wing aircraft in actually performing a rescue is limited to instances where there is a suitable runway near the survivor or where the aircraft is designed to operate from rough and improvised strips. Fixed-wing aircraft rescues often have been made in extremely cold climates where the aircraft have either used frozen lakes or rivers as runways or, when fitted with skis, have operated from snowcovered surfaces and glaciers. However, landing in unknown terrain under what appears to be ideal conditions is extremely hazardous.

**b. Water Rescue Considerations**

**(1) Survivor Preparations**

(a) On sighting rescue craft approaching for pickup (boat, ship, helicopter, or conventional aircraft), quickly clear any lines (fishing lines, desalting kit lines, and so forth) or other gear that could cause entanglement during rescue. Secure all loose items in the raft. Take down canopies and sails to ensure a safer pickup. After all items are secure, put on the helmet (if available). The life preserver should be fully inflated with the oral valve locking nut tight against the mouthpiece. Remain in the raft, unless otherwise instructed, and disengage all gear except the preservers. If possible, rescue personnel will be lowered into the water to assist survivors.

**NOTE:** Remember to follow all instructions given by rescue personnel.

(b) If helicopter recovery is unassisted, before pickup you will be expected to secure all loose equipment in the raft, accessory bag, or in pockets and deploy the sea anchor, stability bags, and accessory bag. Partially deflate the raft and fill it with water. Unsnap the survival kit container from the parachute harness. Grasp the raft handhold and roll out of the raft. Allow the recovery device, cable, or both to ground out on the water's surface. Maintain a handhold until the recovery device is in the other hand. Mount the recovery device and ensure you avoid raft lanyard entanglement. Finally, signal the hoist operator for pickup.

## (2) **Ship recovery**

When a distress craft or survivors are a considerable distance from shore, rescue is normally by long-range ships, such as specialized SAR ships, warships, or merchant ships. The rescue methods used by these ships vary considerably according to their displacement and whether the rescue is made in midocean or close to land. Tides, reefs, weather, currents, sea conditions, shallow water, daylight, or darkness may be important factors.

(a) Although it appears obvious that a marine craft should be used for rescue operations, it may be advisable to initiate an alternate recovery method. For instance, helicopters may be used to evacuate survivors that were picked up by marine craft in order to speed their delivery to an emergency care center.

(b)

The most difficult phase of a maritime SAR mission may be removing survivors from the water, liferafts, lifeboats, or other vessels to the safety of the rescue vessel deck. In most cases, survivors have to be assisted aboard. For this reason, all SAR vessels are usually equipped and prepared to lift survivors from the water without help from the survivors. Numerous methods for rescuing survivors may be used by SAR vessels. The most commonly used methods are generally grouped as rescue from water and rescue from their distressed vessel. When rescuing people from water, the methods generally used are the ship alongside swimmer, ship alongside with line thrower, ship alongside with small boat, and ship circle with trail line. The most commonly used methods for rescuing personnel aboard distressed vessels are ship to ship direct, ship to ship with raft haul, ship to ship with raft drift, ship to ship with small boat, and ship to ship with haulaway line.

### (3) **Boat Recovery**

(a) When survivors are located on lakes, rivers, sheltered waters, or coastal areas, rescue is often made by limited range fast boats based close to the survivors or by private boats operating in the vicinity. Rescue boats are usually small and may not be able to take all survivors on board at one time; therefore, a sufficient number of boats to offset the rescue should be dispatched to the distress scene. When this is not possible, each boat should deploy its rafts so that those survivors who cannot be taken aboard immediately can be towed ashore or kept afloat while they are waiting. The boat crew should make sure any survivors who must be left behind are made as secure as circumstances permit.

(b) Assistance to an aircraft that has crashed or ditched on the water usually consists of transferring personnel from plane to boat and picking up survivors from the water or liferafts. It may also include towing an aircraft that is disabled on the water.

#### **c. Land and Water Rescue**

(1) Helicopters make rescues by landing or hoisting. Landings are usually required at high altitudes due to limitations of helicopter power for maintaining a hover. Helicopter landings are made for all rescues when a suitable landing site is available and danger from enemy forces is not a problem. After landing, a crew member usually departs the aircraft. If for some reason this cannot be done, as in combat, the survivor should approach the helicopter from the 3 o'clock-to-9 o'clock position relative to the nose of the helicopter and follow instructions (Figure 2-18).

(2) Hoist recovery is the preferred method for effecting a water rescue. Hovering the helicopters and hoisting the survivor aboard requires more helicopter power than landing and presents a hazard to the aircraft and the survivor.

#### **d. Coordinated Helicopter and Boat Rescues**

Occasionally, boats and helicopters are dispatched for a rescue operation. Generally the first rescue unit to arrive in the vicinity of the survivors attempts the first rescue. If the helicopter arrives first, the boat takes a position upwind of the helicopter in the 2 o'clock position at a safe distance and stands by as a backup during the rescue attempt. If the helicopter must abort the rescue attempt, the pilot departs the immediate area of the survivor and signals for the boat to move in and make its rescue attempt. Additionally, the helicopters may turn out the anticollision rotating beacon to indicate they require

boat assistance or are unable to complete the rescue. In certain operations where helicopter and boat coordinated rescue can be foreseen, prearrange specific signals. If the boat arrives first and makes the rescue, it transfers the survivor to the helicopter to effect a rapid delivery to medical facilities.

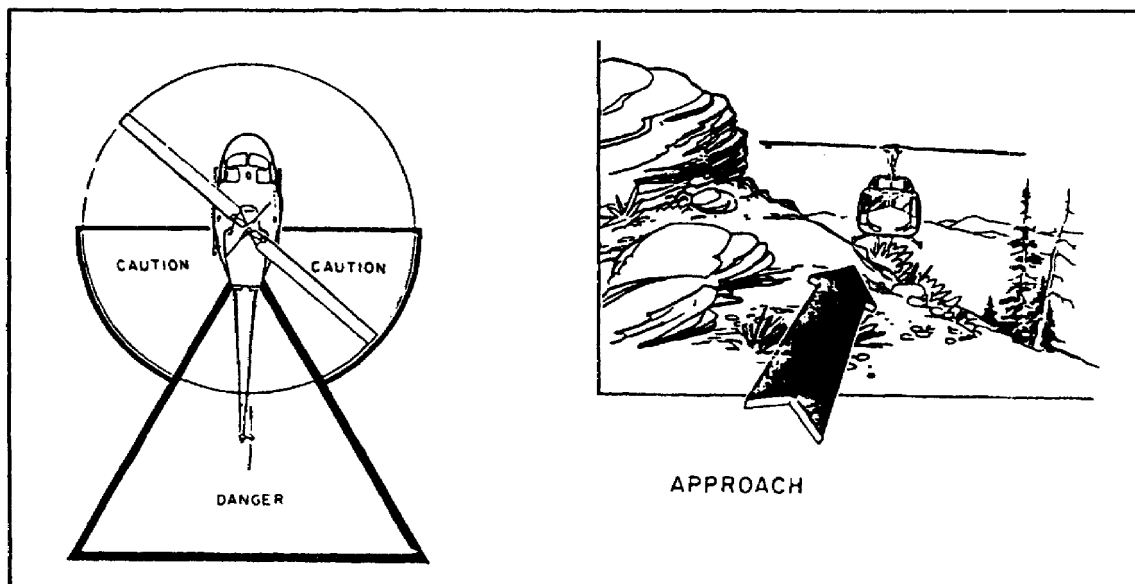


Figure 2-18. Approaching helicopter

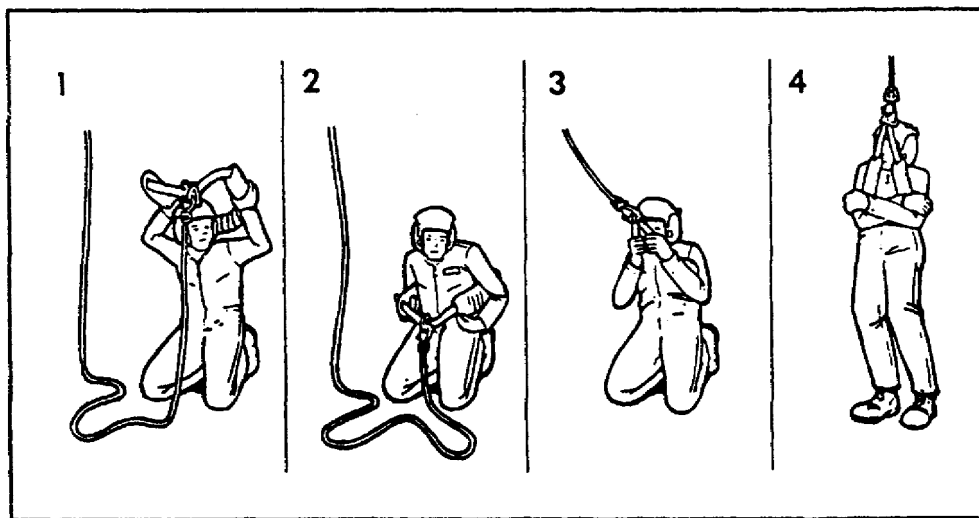
## 9. PICKUP DEVICES

When rescue forces are in the immediate area of survivors, they will, if conditions permit, deploy pararescue personnel to assist the survivors. Unfortunately, conditions may not always permit this, so you should know how to use different types of pickup devices. Most devices are used as a sling (strop), but allow all devices to ground to discharge static electricity before donning. To ensure stability, sit or kneel when donning a pickup device. Do NOT straddle the device. If no audio is available, visually signal the hoist operator when ready for lift-off—"thumbs up" or vigorously shake the cable from side to side. Remember to follow all instructions provided by the rescue crew. When lifted to the door of the helicopter, do NOT attempt to grab the door or assist the hoist operator in any way. Do NOT try to get out of the pickup device. The hoist operator will remove the device after you are well inside the aircraft.

**a. Rescue Sling**

Before donning the rescue sling (strop), face the drop cable. Make sure the cable has touched the water or ground and has lost its charge of static electricity.

(1) The most commonly accepted method for donning the rescue sling (strop) is the same as putting on a coat. After connecting the ring to form the sling, insert your arms one by one into the sling as it swings behind. The sling loop should be against your back with an arm around each side of the strop (Figure 2-19). Hold the webbing under the metal ring until tension is put on the cable. Then interlock your hands and rest them on your chest. This tends to lock you into the sling as upward pressure is applied.

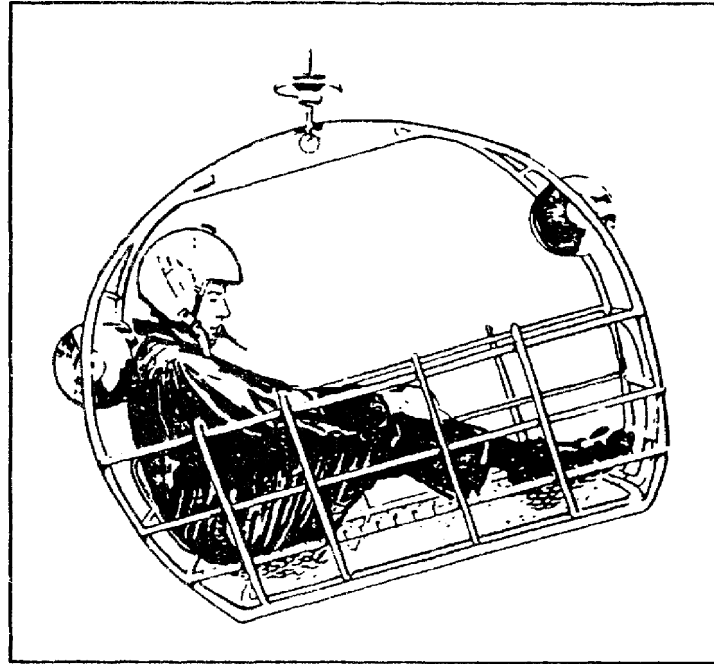


**Figure 2-19. Horse collar**

(2) Another way to enter the sling is to grasp the sling with both hands and lift it over the head to bring it down under the arms and around the body. Regardless of the method used, remember that the webbing and metal hardware of the device should be directly in front of your face.

**b. Basket**

If a basket is used, a member of the helicopter crew will probably accompany it to the water or ground. This crew member assists survivors into the basket. There are two types of baskets: the litter type in which you lie flat and the seat type where you enter and sit down in it as you would in a chair (Figure 2-20).



**Figure 2-20. Basket**

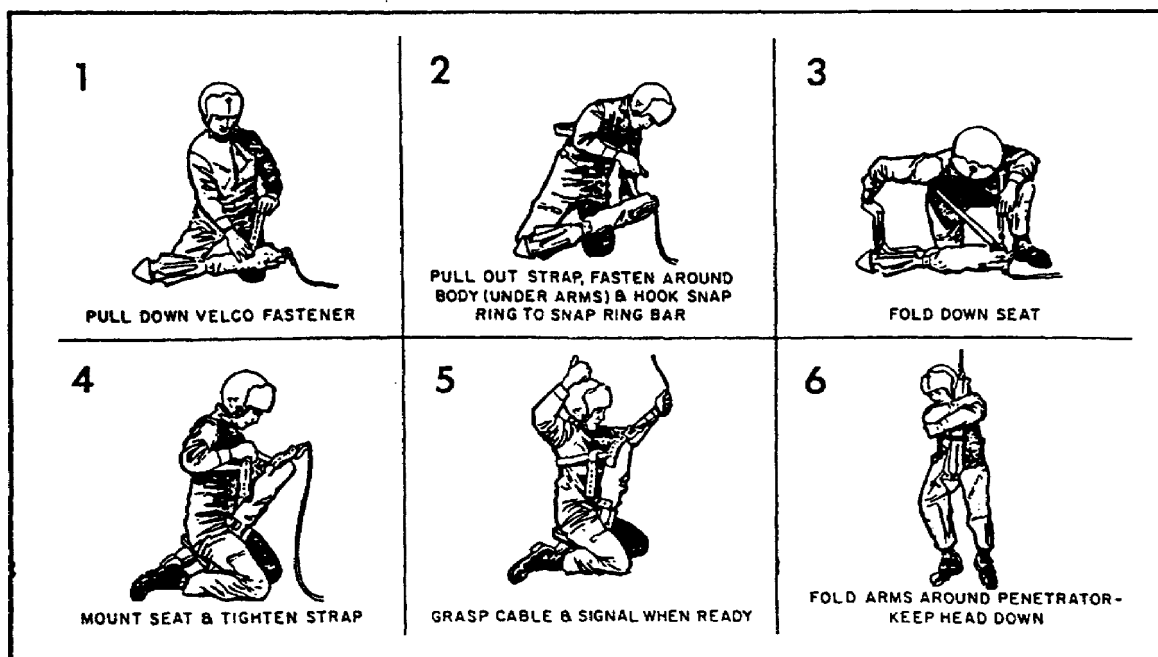
**c. Forest Penetrator**

With all types of devices, it is necessary to watch the device as it is lowered. The devices weigh about 23 pounds. If the device were to hit a survivor, it could cause serious injury or death. The survivor should not attempt to grab the cable or the device until it contacts the ground.

(1) The forest penetrator rescue seat is designed to make its way through interlacing tree branches and dense jungle growth as well as in open terrain or over water. The device is equipped with three springloaded seats folded against the body or main shaft and must be pulled down to the locked position for use. On the main shaft of the tube, above the seats, is a zippered fabric storage pouch for safety (body) straps. These straps are stowed when lowered to the survivor for a land pickup.

(2) If the forest penetrator is used for water pickup, it will be equipped with the flotation collar. The collar enables the device to float with approximately the upper one-third of the device protruding above the water. Additionally, one strap will be removed from the stowed position, and one seat will be locked in the down position to assist the survivor in using the penetrator.

(3) To use the penetrator, pull the safety strap from the storage pouch and place it around the body to hold the person on the penetrator seat. The strap should not be unhooked unless there is no other way to fasten it around the body. The survivor must make certain the safety strap does not become fouled in the hoist cable. After the strap is in place, pull the seat down sharply to engage the hook which holds it in the extended position; then the survivor can place the seat between his legs. The survivor should pull the safety strap as tight as possible ensuring the device fits snugly against his body. The survivor must always keep his arms down, locking the elbows against the body. After making certain the body is not entangled in the hoist cable, give the signal to be lifted (Figure 2-21).



**Figure 2-21. Forest penetrator**

(4) In a combat area, under fire, you may be lifted out of the area with the cable suspended before being brought into the helicopter. It is important to be correctly and securely positioned on the pickup device. Always hold the seat tightly against your crotch to prevent injury when slack in the cable is taken up. Keep your hands below and away from the swivel on the cable with your arms around the body of the penetrator. Keep your head close to the body of the penetrator so that tree branches or other obstructions will not come between your body and the hoist cable.

(5) When you reach a position level with the helicopter door, the hoist operator will turn you so you face away from the helicopter and then pull you inside. The crew member disconnects you from the penetrator once the device is safely inside the helicopter.

(6) The forest penetrator is designed to lift as many as three persons. When two or three survivors are picked up, keep heads tucked in and draw each individual's safety strap tight. The penetrator can be used to lower a paramedic or crew member to assist injured personnel, and both (survivor and paramedic) can be hoisted to the helicopter. If the forest penetrator seat blades have been lowered in a tree area and if for any reason the pickup cannot be made, return the blades to the folded position to prevent possible hangup on tree limbs or other objects while the device is being retracted.

#### **d. Other Devices**

Other devices could be used to pick up survivors. Some of them are the Motley and McGuire rigs, the Swiss Seat and stabo rig, and the rope ladder.

##### **(1) Motley and McGuire Rigs**

These devices (Figures 2-22 and 2-23), may be carried by Army helicopters either designated as the recovery aircraft in assault or for use to insert or extract special ground forces. The device is normally packed in a weighted canvas container and dropped by rope to the survivor who is allowed time for donning. The helicopter then returns trailing a rope which is then fastened to the device for pickup. Generally, the survivor is not hoisted into the helicopter; therefore, all safety straps should be securely fastened.

##### **(2) Swiss Seat and Stabo Rig**

These devices (Figures 2-24 and 2-25), are carried by special ground forces who may require instant extraction by helicopter. Special ground forces put their devices on and wait for the helicopter to drop ropes. These ropes are snapped into the devices for rapid extraction. Although not normally carried aboard the aircraft, the Army helicopter may supply one of these devices to the survivor. Again, the survivor would not be hoisted into the helicopter.

##### **(3) Rope Ladder**

This device (Figure 2-26), is used primarily by the Army and special ground forces. If this device is used, approach it from the side and the front. Climb up a few rungs, sit down



on a rung, and intertwine your body with the rungs. Do NOT try to climb up the ladder and into the helicopter.

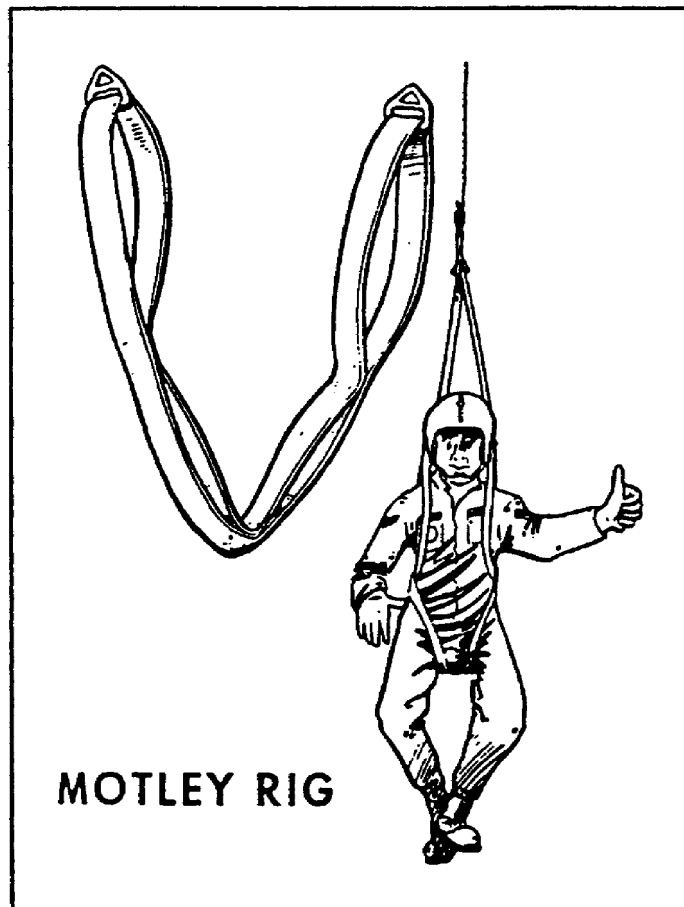


Figure 2-22. Motley rig

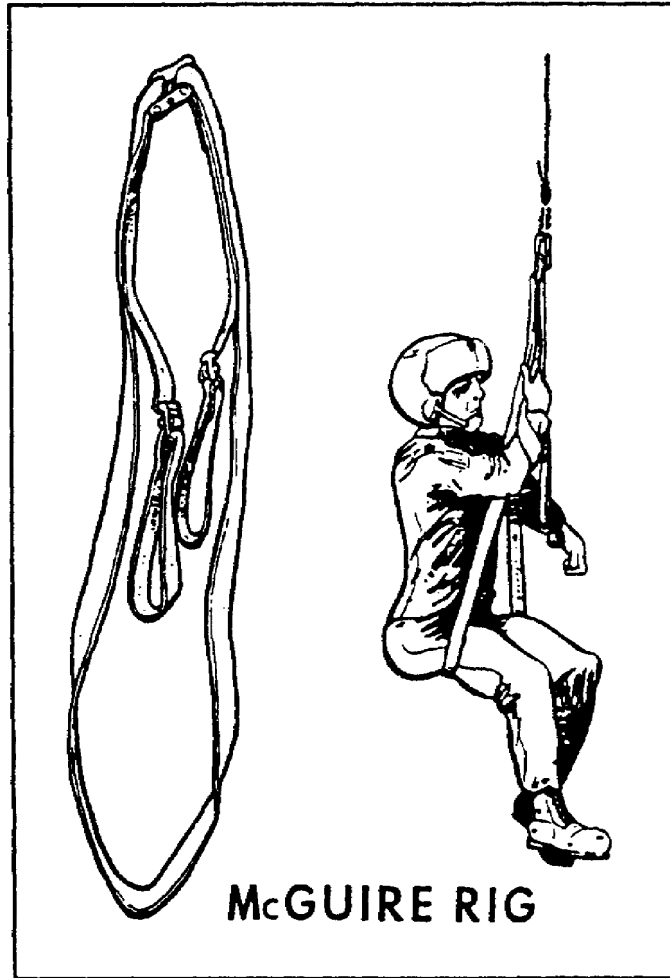


Figure 2-23. McGuire rig

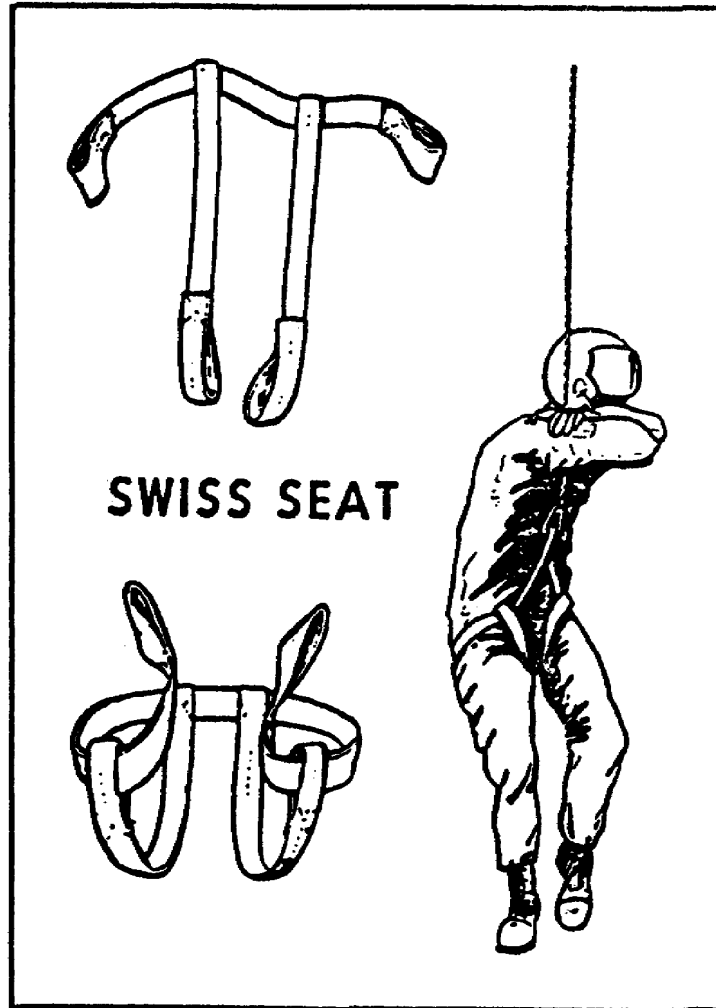


Figure 2-24. Swiss seat

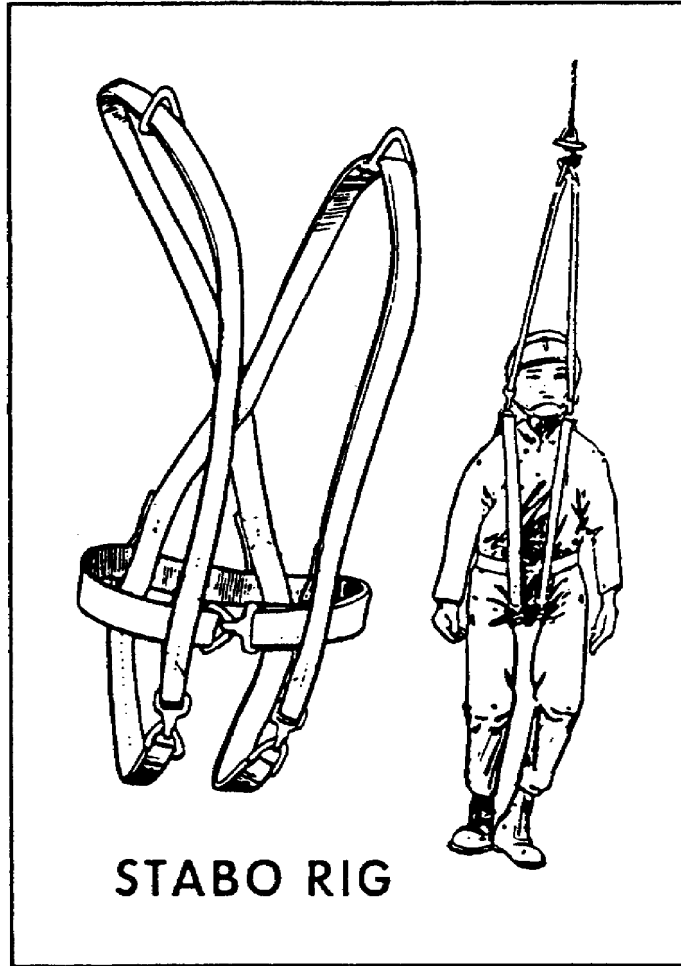


Figure 2-25. Stabo rig

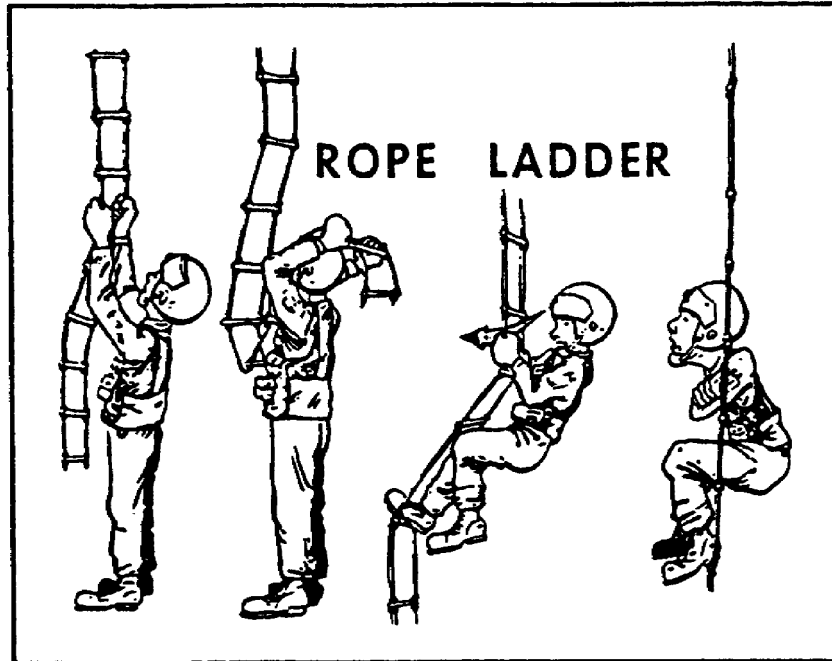


Figure 2-26. Rope ladder

## PRACTICE EXERCISE

The following items will test your grasp of the lesson material. Each item has only one correct answer. When you complete the exercise, check your answers with the answer key that follows. If you answer any item incorrectly, restudy that part of the lesson.

1. Before using a survival radio you should
  - A. place it on the ground devoid of leaves and grass.
  - B. allow the antenna to ground itself on clothing, body, foliage, or the ground.
  - C. keep the radio antenna at an acute angle to the path of the approaching aircraft.
  - D. locate an area to transmit that provides good line of sight with the rescue aircraft.
  
2. The most underrated signaling device found in the aircrew survival kit is the
  - A. paulin.
  - B. mirror.
  - C. pin flare.
  - D. strobe light.
  
3. In selecting a potential aircraft recovery site, you should select an area that
  - A. cannot be observed by the enemy.
  - B. is sheltered by prominent terrain features.
  - C. is the highest elevation in the immediate area.
  - D. offers cover and concealment for the rescue aircraft.
  
4. When lifted to the helicopter door during rescue using a hoist device, you must
  - A. grasp the rescuer's hand as soon as it is reached.
  - B. grasp the door handle as soon as it is within reach.
  - C. NEVER assist the hoist operator or grab the door in any way.
  - D. assist the rescue operator by unbuckling from the rescue harness.

5. During unassisted sea helicopter recovery operations, you must
- A. completely deflate the raft.
  - B. secure loose equipment, partially deflate raft, and fill it with water.
  - C. hoist sail devices and attempt to move toward the approaching aircraft.
  - D. repack the floatation device and survival equipment for recovery during rescue.

## LESSON 2

### PRACTICE EXERCISE

#### ANSWER KEY AND FEEDBACK

<u>Item</u>	<u>Correct Answer and Feedback</u>
1. D.	locate an area to transmit that provides good line of sight with the rescue aircraft.  (page 2-5, para 2a(1))
2. B.	mirror  (page 2-9, para 2g)
3. C.	is the highest elevation in the immediate area.  (page 2-22, para 7)
4. C.	NEVER assist the hoist operator or grab the door in any way.  (page 2-26, para 9)
5. B.	secure loose equipment, partially deflate raft, and fill it with water.  (page 2-24, para 8b(1)(b))