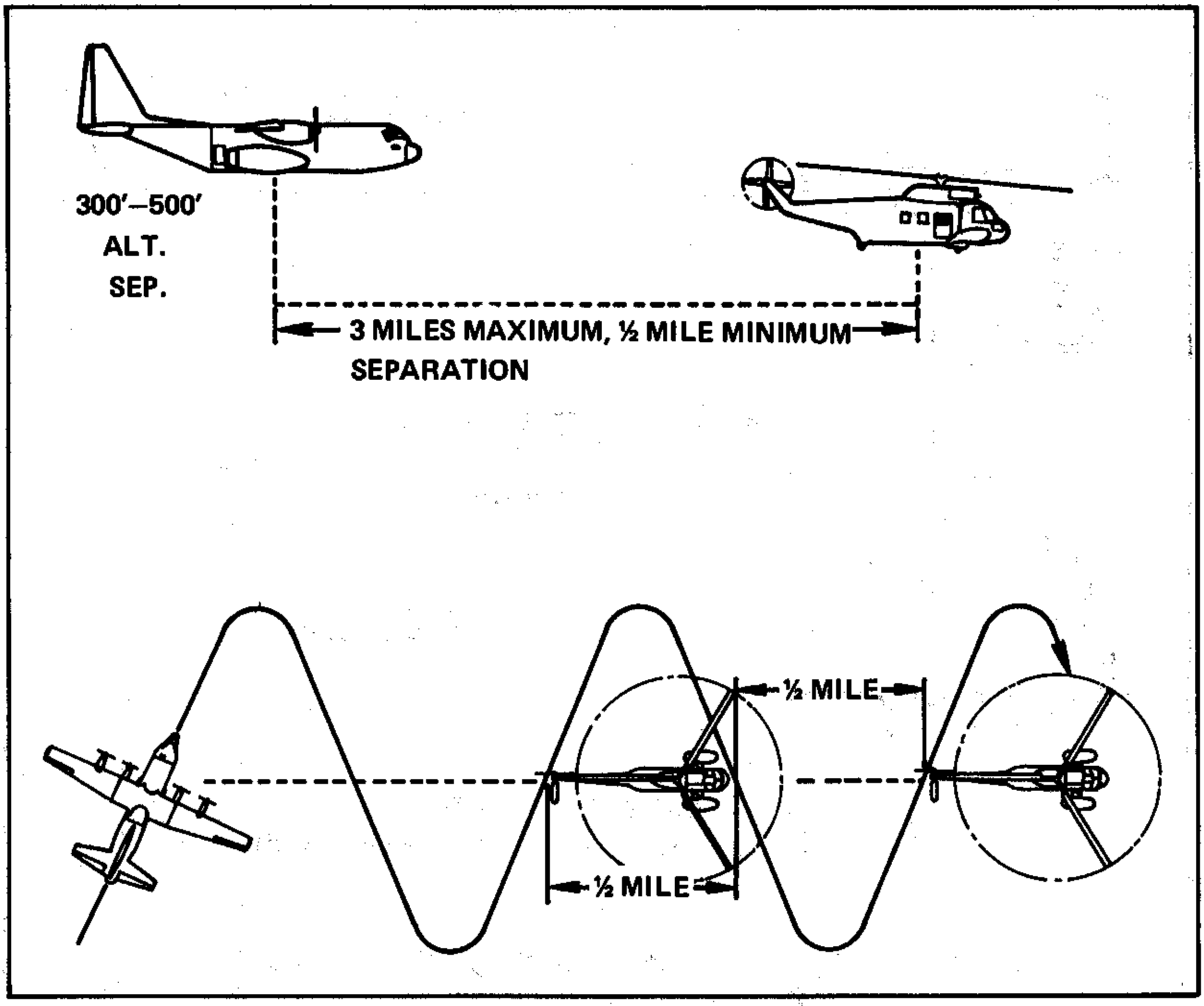
Helicopter Dogleg Escort Pattern



Escort aircraft stacks 300 to 500 feet high, flies course 40° to 50° to left and right of flight path of escorted aircraft, variable according to airspeeds and winds.

When escorted aircraft is about to disappear on either side, a turn is made to place escorted aircraft directly ahead. Maintaining this heading will normally provide a crossover approximately one-half mile behind the escorted aircraft.

FIGURE 9–24

931 Search Operating Procedures

All search preparations should be completed before the marine craft enters the search area; i.e., communications established with the OSC and other craft participating in the search, search and rescue frequencies and homing equipment guarded, observers positioned, rescue gear readied, etc.

A marine craft carrying out a systematic search of an area where no visual reference points exist should maintain a dead reckoning plot of the best known position of the incident, its own position and the position of other ships and aircraft in the vicinity. The plot should also show date, time, and possible drift of survivors. Areas searched should be indicated on a chart.

To attract the attention of survivors a marine craft should periodically make its presence known; e.g., by making smoke, preferably black, during daytime or rotating a searchlight beam around the horizon during nighttime. Turning on deck lights may also be desirable. Periodic sound signals can help when searching for canopied rafts in order to attract the atten-

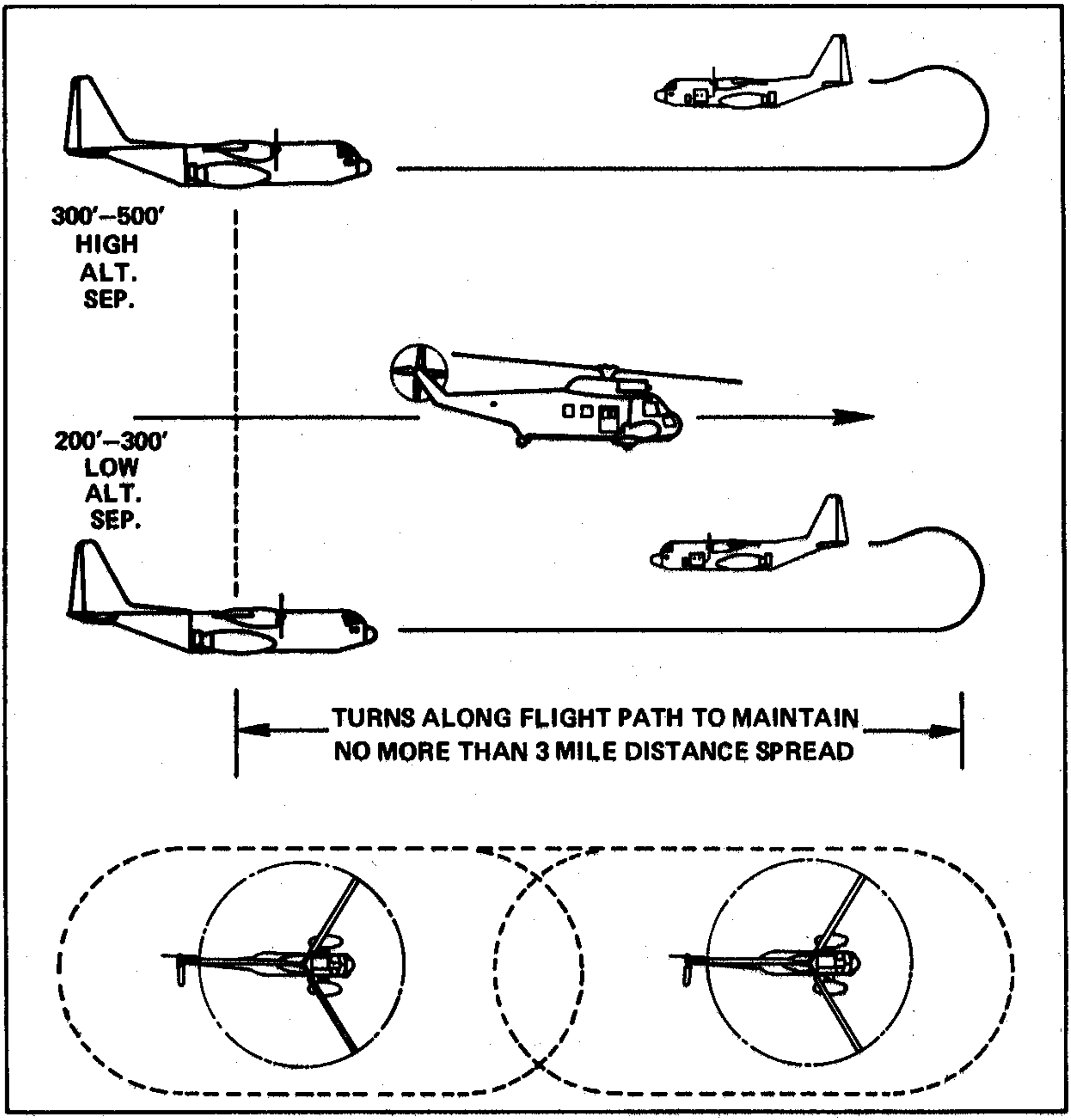


FIGURE 9-25

tion of survivors under canopies. At the same time, crewmembers should be alert for signals from survivors and other signs indicating their presence; e.g., floating wreckage or objects. When visibility is seriously restricted (e.g. at night or in fog), the engine should be stopped from time to time and a listening watch maintained for shouts or whistle signals from survivors.

Lookouts should be stationed as high as possible to increase the limited sighting range from the marine craft. A 360° lookout should be maintained.

932 Search Pattern Execution

a. Vessel Turning Diameter

Whenever executing a search pattern, every type of search unit normally begins its turn from one searchleg to the next before actually reaching the end of the searchleg. The vessel or boat is no exception to this practice, since the reason for this procedure is to place the SRU onto the next leg at the precise time that the SRU stops its turn. Therefore a vessel or boat SRU should begin its turn short of the end of each searchleg, by a distance equal to the "advance" of the craft for the search speed and amount of rudder used entering the turn. The craft will then commence the straightaway portion of the next leg—upon completion of its 90° turn—by a distance equal to the "transfer" of the craft for the search speed and rudder used entering the turn. Figure 9–26 depicts a typical vessel-turning circle, with the advance and transfer distances indicated. Note that the advance and transfer are not normally the same length. This is due to the ship being slowed during the first 90° of turn because of its initial momentum tending to push the vessel sidewise through the water. After the first 90° of turn is completed, the vessel will be stabilized at a constant rate of turn and constant speed. Figure 9–27 depicts some typical combinations of advance and transfer for different sized vessels. Thus, each leg of a pattern completed by a marine SRU should be executed and thought of as three portions: The beginning length covered by the vessel's transfer; the straightaway length in the middle of the leg; and the ending length covered by the vessel's advance while it is turning toward the next searchleg or crossleg (fig. 9–28).

940 SEARCH BY AIR/SURFACE TEAMS

a. General

Teaming one or more aircraft with a vessel for a coordinated search over water makes possible the most effective use of each craft's best advantages. The aircraft provides a more rapid coverage of the search area and a better search platform. The vessel provides better naviga-

Typical Vessel-Turning Circle

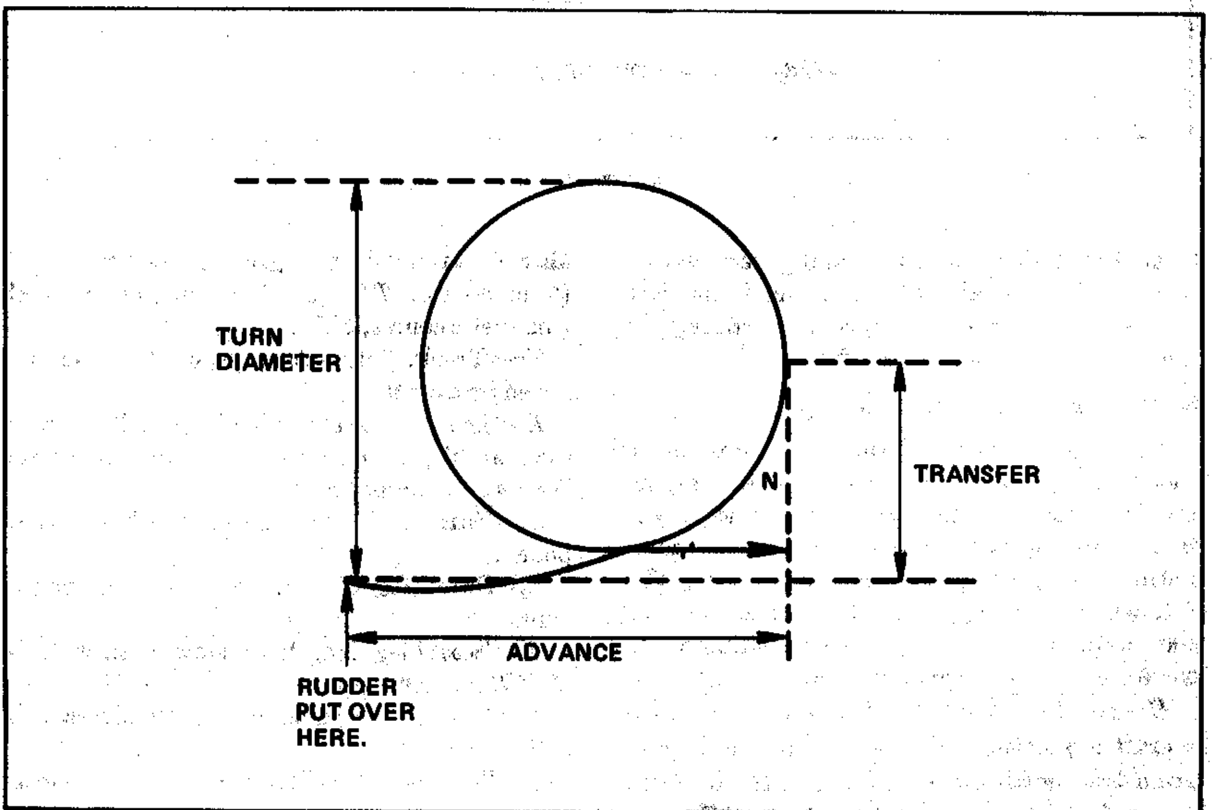


FIGURE 9–26

Typical Advance/Transfer Turning Curves

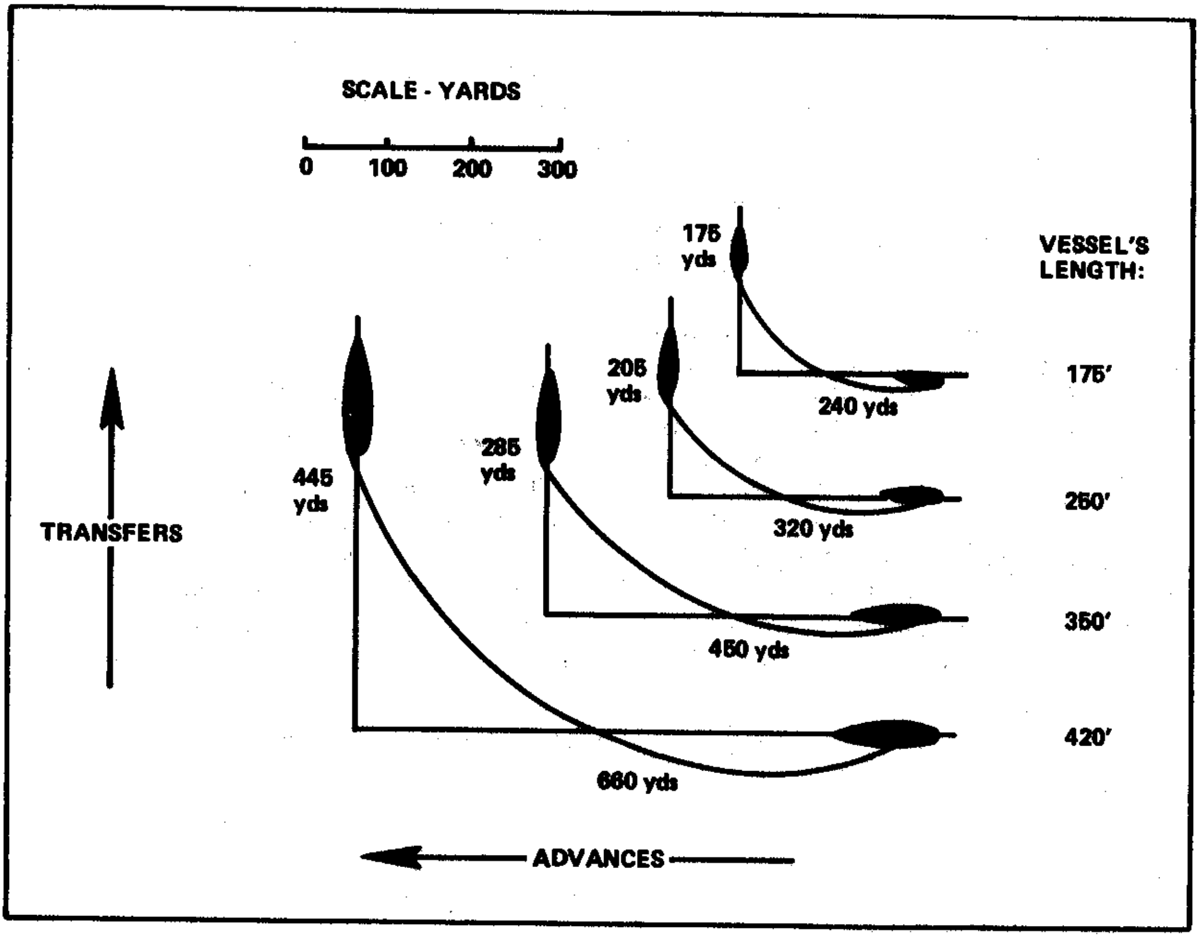


FIGURE 9-27

tional capability, both radar and general safety services for the aircraft, and the immediate and assured survivor recovery capability in the event the search is successful.

b. Coordinated Search Symbology

There are several formulae, computation sheets, and pattern layouts used when preparing for a coordinated search. In addition, certain definitions must be remembered when computing or discussing aircraft search tracks. The following symbology and definitions must be thoroughly understood before attempting to use the formulae in the next paragraph.

H=Heading. Horizontal direction in which a craft is pointing. May be oriented in degrees from true north (true heading, TH) or from magnetic north (magnetic heading, MH).

C, Cus=Course. The intended path of travel. May be oriented in degrees from true north (true course, TC) or from magnetic north (magnetic course, MC).

Tr=Track. The actual path of travel followed by a craft.

L=Searchleg or searchleg length. The sum of the searchleg straightaway (y) plus the search craft's turn diameter (TD).

L_1=Searchleg with highest headwind component.

L_2=Searchleg with highest tailwind component.

L_s=Searchleg length of slower aircraft in $CMCS$ pattern.

L_f=Searchleg length of faster aircraft in $CMCS$ pattern.

S=Track spacing. Distance between adjacent searchlegs.

TD=Turn diameter. The diameter of a

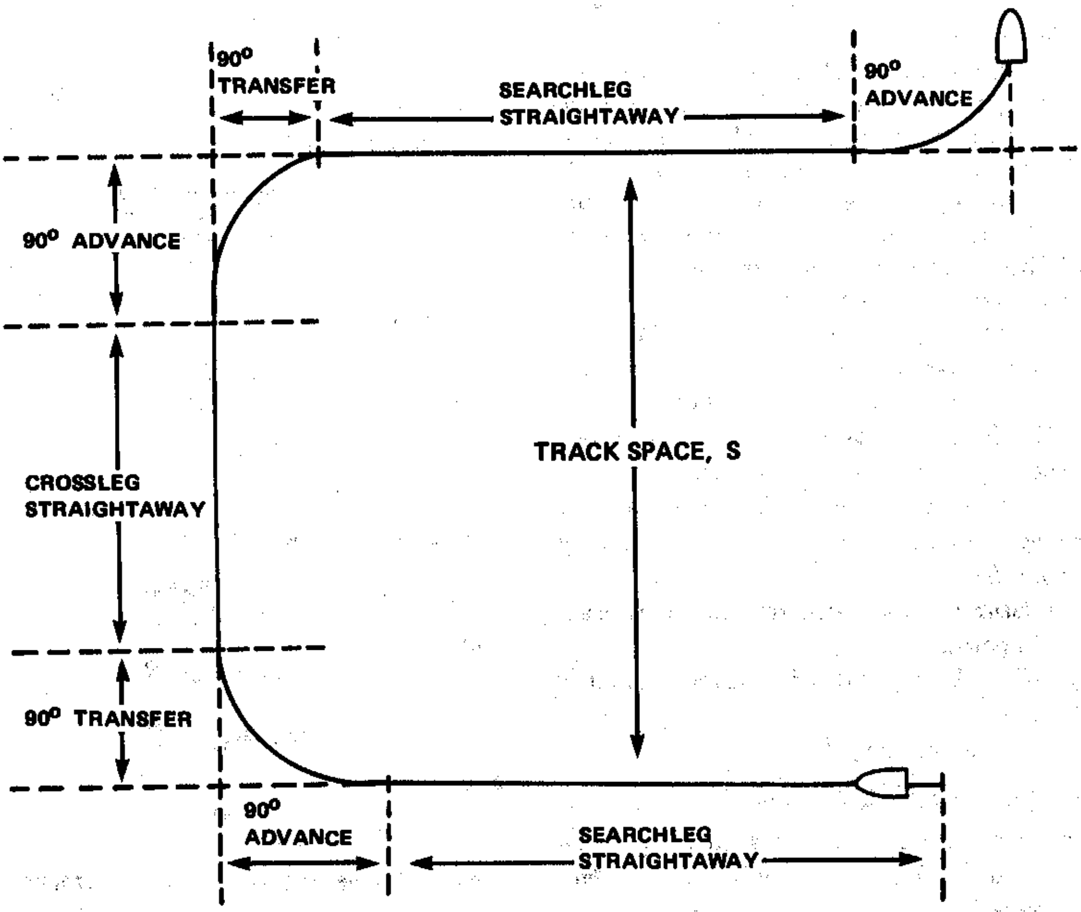


FIGURE 9–28

searchcraft's turning circle executed at a constant rate of turn, constant angle of bank (aircraft), or constant angle of rudder (vessel).

TAS = True air speed. Rate of motion (speed) of an aircraft relative to the airmass it is within.

GS = Ground speed. Rate of motion (speed) of an aircraft relative to the earth's surface.

V = Velocity or speed. Symbol used to denote either rate of motion (speed), or both rate and direction of motion (velocity), in various formulae. Subscripts further define V.

V_s = Surface craft velocity. Ship's speed.

V_a = Aircraft's *TAS*.

V_{as} = *TAS* of slower aircraft in *CMCS* pattern.

V_{af} = *TAS* of faster aircraft in *CMCS* pattern.

V_1 = Groundspeed of a searching aircraft while flying on L_1, the searchleg with the highest headwind component (into the wind).

V_2 = Groundspeed of a searching aircraft while flying on L_2, the searchleg with the highest tailwind component (downwind).

V_3 = Groundspeed of a searching aircraft while flying on the crossleg between one searchleg and the next searchleg.

t_1 = Time required for a search aircraft to fly one-half of the straightaway length (y_1) of the searchleg with the highest headwind component (L_1).

t_2 = Time required for a search aircraft to fly one-half of the straightaway length (y_2) of the searchleg with the highest tailwind component (L_2).

t_3 = Time required for a search aircraft to fly the full straightaway length (x) of the crossleg between one searchleg and the next searchleg.

TTT=Time to turn. The clock time specified for a searchcraft to commence a turn, usually onto the crossleg.

X=Distance the vessel travels while the aircraft is flying on searchleg L_1 from the time the aircraft is overhead the vessel to the "time to turn" onto crossleg (time required=t_1).

Y=Distance the vessel travels while the aircraft is flying on searchleg L_2 from the time of completing its turn off of the crossleg until overhead the vessel (time required=t_2).

x=Straightaway length of the crossleg.

y_1=Straightaway length of the searchleg with the highest headwind component.

y_2=Straightaway length of the searchleg with the highest tailwind component.

A_w=Search area width. The sum of one searchleg length and one track spacing ($A_w=L+S$).

A_{ws}=Search area width for slower aircraft in *CMCS* pattern.

A_{wf}=Search area width for faster aircraft in *CMCS* pattern.

A_1=Search area length.

c. Coordinated Search Formulae

The various formulae used to preplan or execute the various coordinated air/surface search patterns are summarized here, without explanation. Subsequent paragraphs will clarify them when they are used.

1. Ship's speed:

$$V_s=\frac{SV_a}{L+S}$$

2. Aircraft turn diameter:

$$TD=\frac{TAS+10}{100}$$

3. General half searchleg timing:

$$t=\frac{60}{GS}\times\frac{L-TD}{2}$$

(in minutes)

4. Into the wind half searchleg timing:

$$t_1=\frac{30(L-TD)}{V_1}=\frac{30y_1}{V_1}$$

(in minutes)

5. Downwind half searchleg timing:

$$t_2=\frac{30(L-TD)}{V_2}=\frac{30y_2}{V_2}$$

(in minutes)

6. Crossleg timing:

$$t_3=\frac{3600\,(S-TD)}{V_3}$$

(in seconds)

7. Bowtie solutions:

$$X=\frac{LV_s}{2V_1}$$

$$Y=\frac{LV_s}{2V_2}$$

8. CMCS solutions:

$$A_{ws}=\frac{A_wV_{as}}{V_{as}+V_{af}}$$

and

$$L_s=A_{ws}-S$$

$$A_{wf}=\frac{A_wV_{af}}{V_{af}+V_{as}}$$

and

$$L_f=A_{wf}-S$$

941 Coordinated Search Patterns

Several coordinated search patterns were described in Chapter 8. These were: FS—flare single unit; FM—flare multiunit; VSR—sector single-unit radar; VMR—sector multiunit radar; CSC—creeping line single unit, coordinated; CMC—creeping line multiunit, coordinated; CSR—creeping line single unit, radar; CMR—creeping line multiunit, radar; CMCS—creeping line multiunit, split.

The flare search patterns FS and FM are used only at night in very small search areas. The FS and FM require only a minimum amount of coordination, and no type of radar plot is required of either the vessels involved or the aircraft. The OSC merely describes the pattern and the execution details, gives the commence-search order, and the flare-dropping aircraft then maintains his relative track in the pattern by visual estimates.

The coordinated sector search patterns VSR and VMR require that the vessel maintain an air plot using both radar and visual bearing/range information. Since the vessel is stationary in the center of the VSR and VMR patterns during the execution of the patterns, the air plot may be considered as both a true, geographic plot and as a relative motion plot. (The true plot and the relative plot will be superimposed when oriented to the same directional bearing—for example, magnetic north.) The vessel provides advisories to the aircraft to assist them in keeping their search tracks coincident with the desired searchlegs. The aircraft may also use the vessel's aerobeacon to assist in keeping on the desired search track.

The most commonly used coordinated air/surface search patterns are variations of the creeping line pattern. When the only available surface craft is a boat, or is a larger vessel untrained in directing or coordinating aircraft, then either the CSC or CMC patterns are used by the air/surface team. When the CSC is executed, the surface craft establishes its track on the assigned search area axis with its heading in the direction of creep, and adjusts its speed of advance (V_s), to enable the aircraft to fly from overhead to overhead each time the surface craft advances one track spacing. When two aircraft are teamed with a similar surface craft for a CMC search pattern, the surface craft establishes its track as in the CSC pattern, but now adjusts its speed of advance to enable the guide-aircraft to fly overhead to overhead each time the surface craft advances a distance equal to twice the track spacing. The second aircraft maintains a formation position on the guide-aircraft at a distance equal to one track spacing throughout the execution of the search. The crossleg of the CMC pattern equals the track spacing (S) multiplied by the number of search aircraft (n). The aircraft executing either a CSC or CMC pattern are expected to accomplish their own navigation throughout the pattern, using the surface craft as a visual checkpoint in the middle of each searchleg.

When the available surface search craft is either a naval vessel or Coast Guard cutter which is trained in directing or coordinating aircraft, the CSR or CMR patterns are normally selected by the SAR mission coordinator. If only one aircraft is to be teamed with the vessel, the CSR pattern is selected; if two aircraft are to be used, the CMR pattern is selected. The only difference between the execution of the CSC pattern and the CSR pattern is that the vessel maintains continuous radar monitoring of the aircraft's track relative to its desired searchleg, and provides "advisories" to assist the pilot in maintaining the desired search track. Similarly, the vessel provides radar advisories to the guide aircraft in a CMR pattern, with the second aircraft maintaining a formation position on the guide aircraft at a distance of one track spacing. The second aircraft in both the CMC and CMR patterns normally uses air-to-air Tacan, IFF/SIF interrogator display, or its own radar to maintain the lateral separation of one track spacing between the aircraft.

The fifth variation of the creeping line patterns used in coordinated searches is the CMCS. This pattern is selected whenever there is a large speed differential between the two aircraft assigned to one air/surface team. The pattern is considerably harder for the vessel to prepare for and to execute, and hence is not used nearly as much as the CMR pattern. However, circumstances may force the vessel to employ this pattern when the two available search aircraft are unable to safely maintain a common search airspeed. If the vessel is a naval vessel or Coast Guard cutter trained in directing or coordinating aircraft, it should provide the full scope of radar advisories to assist the pilots to maintain their desired search tracks.

942 Vessel Preparations

The preparations taken by a vessel assigned to an air/surface coordinated search will depend upon which search pattern has been designated for use by the SMC, upon the radar and communication capability of the vessel, and upon the level of training of the aircraft control personnel of the vessel. Normally a naval vessel or Coast Guard cutter will use its combat information center (CIC) for laying out the various plots and status boards, coordinating on scene communications, monitoring search progress, issuing advisories to aircraft, executing coordinated search patterns, etc. As a general rule only those ships which operate with established CIC's are ever assigned to execute a CSR, CMR, CMCS, VSR, or VMR pattern. Aircraft coordination and radar capabilities are the governing criteria for properly executing these radar-coordinated searches.

The vessel must first compute the various headings, speeds, and times required for both the vessel and the aircraft to execute each searchleg and crossleg in a timed coordination with each other.

The vessel will next have to lay out a "surface plot" (also called a "true plot"), which depicts the geographical area to be covered during the search, and the planned search tracks of both the vessel and the aircraft. The surface plot will appear similar to figures 8–45 through 8–48 which illustrated the coordinated creeping line patterns. The tracks of other surface vessels of interest will also be depicted on this plot. If the vessel has been directed to act as the OSC at the same time as conducting a coordinated search pattern, then all other subareas assigned to other SRU's must also be depicted on the surface plot with the first two or three searchlegs plotted in each subarea to indicate the CSP, searchleg orientation, and direction of creep. Vectors to the CSP for each arriving aircraft SRU are also indicated on this plot whenever aircraft have filed a flight plan for the OSC's position as the point for entering the SAR airspace reservation.

Next, the vessel will have to layout an "air plot" (also called a "relative plot"), which depicts the relative motion pattern which will be repetitively executed during the search. The tracks of all aircraft of interest will be maintained on this plot during the search. In addition, magnetic headings, true headings, advisory cues, swell systems, and recommended ditch headings, are depicted on the air plot.

Finally the vessel will have to prepare the various "advisories" it must give to search aircraft which will be operating in the coordinated search pattern.

After the vessel's preparations have been completed, the coordinated search pattern may be executed with a minimum of delays, errors, or other inefficiencies.

943 Search Pattern Variables

a. Vessel Heading and Track

The vessel's heading will normally be the direction of creep as specified in the SMC's SAR action plan. If an ocean current set is present, the vessel's heading must be corrected to insure that the vessel's track is the desired search track. The search track of the vessel will be the axis of the search area which lies in the direction of search pattern creep, if the designated pattern is CSC, CMC, CSR, or CMR. The vessel's desired search track will be offset from the axis, but parallel to it, if the designated pattern is CMCS. There is no search track for the vessel if the designated pattern is either VSR or VMR, since the vessel will be stationary at the center of the pattern.

b. Vessel Speed

The vessel's speed (V_s) is adjusted to the aircraft's search speed (V_a) so that the time required for the aircraft to fly along one complete searchleg and one crossleg is equal to the time required for the vessel to advance one crossleg. Saying this another way, the vessel's speed and the aircraft's speed are coordinated so that the ship advances one track spacing while the aircraft flies from overhead to overhead. Also, the vessel adjusts its speed rather than the other way because most aircraft do not have a very wide range of optional search speeds. Most aircraft search at the slowest airspeed which will still permit a reasonable endurance on scene. Generally, changing the search speed of the aircraft by more than 10 knots will either cause marginal aircraft performance or a greatly decreased on scene endurance.

There are two ways to determine the vessel's search speed:

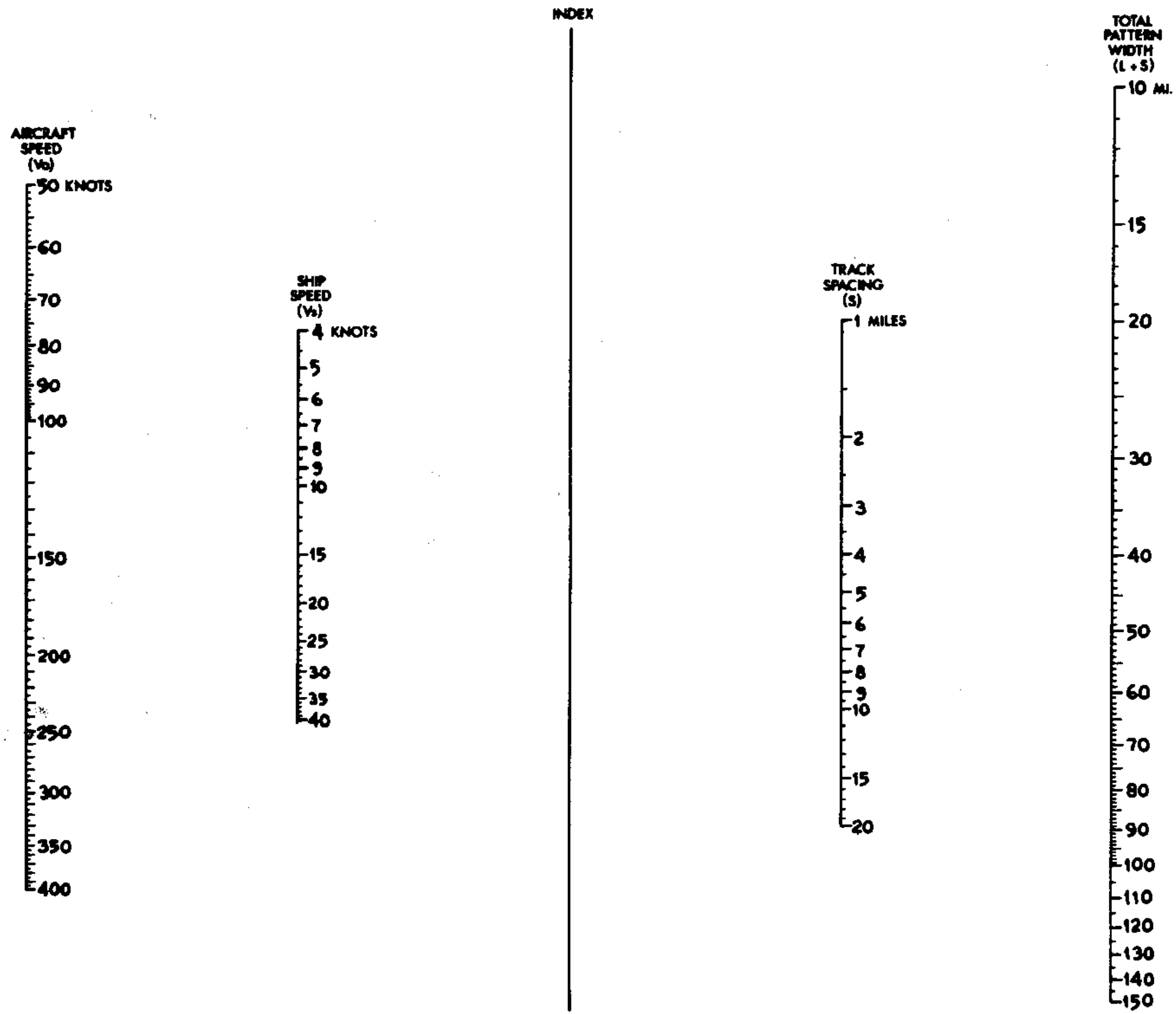
1. Use the nomograph as described in figure 9–29.
2. USE THE BASIC FORMULA:

$V_s = \frac{SV_a}{L+S}$ ADAPTED FOR THE TYPE OF PATTERN.

This can be used as a check on the nomograph solution or for those cases which are not covered by the nomograph.

c. Aircraft Headings and Speeds

After the vessel's search speed has been determined, the aircraft's wind-corrected headings and groundspeeds are computed. Any aircraft navigational computer will quickly and easily provide the wind-corrected headings, groundspeeds, and times required to fly specific searchleg lengths. The pilots of the aircraft involved should be given the necessary information to check the ship's computations for the aircraft.



CSC & CSR PATTERNS

THROUGH ANY TWO KNOWN VARIABLES ON ONE SIDE OF THE NOMOGRAPH DRAW A STRAIGHT LINE TO INTERSECT THE INDEX.

FROM THIS POINT ON THE INDEX DRAW A STRAIGHT LINE THROUGH THE THIRD VARIABLE ON THE OTHER SIDE OF THE NOMOGRAPH.

READ THE FOURTH UNKNOWN VARIABLE WHERE INDICATED BY THIS SECOND LINE.

CMC & CMR PATTERNS

WITH "n" AIRCRAFT, THE TRACK SPACING OF THE GUIDE AIRCRAFT WILL BE EQUAL TO "nS". TO SOLVE THE SEARCH PROBLEM, PROCEED AS ABOVE BUT ENTER WITH THE VALUE "nS" RATHER THAN "S".

(L+S)

ENTER "Aw"....ON L + S SCALE
ENTER "S"........ON S SCALE
ENTER (Vas + Vaf).ON Va SCALE

READ "Vs".........ON Vs SCALE

- - - - - - - - - - - - - - -

ENTER "Vas".......ON Va SCALE
OR "Vaf"
ENTER "Vs"........ON Vs SCALE
ENTER "S" ....ON S SCALE

READ Ls + S..ON L + S SCALE
OR Lf + S

NOMOGRAPH FOR COORDINATED SHIP - PLANE SEARCH PATTERNS

FIGURE 9-29

d. Aircraft Turn Diameter

The formula for an aircraft's turn diameter is:

$$TD=\frac{TAS+10}{100}$$

where TAS = True airspeed in knots, and
TD = Aircraft turn diameter in miles.

This formula is predicated on the aircraft making all turns at a constant rate of heading change of 3° per second. This rate of turn is called a "standard rate turn." Unlike a vessel or a boat, an aircraft does not experience a noticeable difference between advance and transfer during the first 90° of its turning. Therefore it is somewhat easier to deal with when considering that each end of every straightaway will be equal in both length and time due to the aircraft's constant rate of motion and rate of heading change. An aircraft SRU will start its turn to the next leg short of the end of each searchleg, by a distance equal to one-half of the turn diameter of the aircraft. As it rolls out of its turn, it will have already covered a distance on the new searchleg equal to one-half of a turn diameter. Thus, each leg flown by an aircraft SRU may be thought of as consisting of: A beginning portion equal to one-half a turn diameter; a middle, straightaway portion; and an ending length equal to another one-half of a turn diameter. As shown in figure 9–30, the searchleg length equals the straightaway plus one full turn diameter ($L=y+TD$), and the crossleg length equals the straightaway plus one full turn diameter ($S=x+TD$).

e. Aircraft Crossleg Time

The vessel should precompute the time required for the aircraft to fly the straightaway distance of the crossleg. This information is included in one of the early advisories passed to the aircraft member of the air/surface team after its arrival. The formula used to determine the crossleg straightaway time is:

Aircraft SRU Crossleg

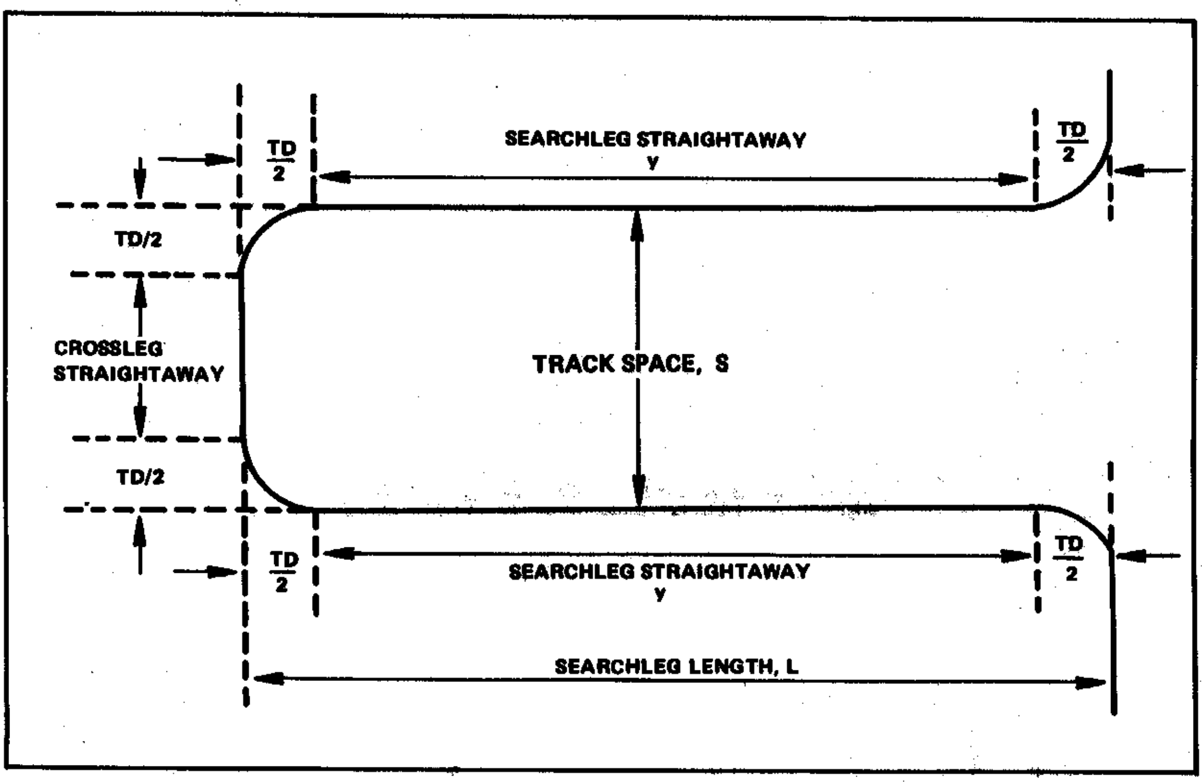


FIGURE 9–30

$$t_3=\frac{3600\,(S-TD)}{V_3}$$

where

t_3=Crossleg straightaway time in seconds,
S=Track spacing in miles,
TD=Turn diameter in miles,
V_3=Aircraft groundspeed on crossleg heading.

Another point to remember is that the aircraft requires exactly 30 seconds to execute a 90° standard rate turn. Since the aircraft will be making two 90° turns on each end of the crossleg straightaway in any creeping line pattern, it may be easier to think of all maneuvering onto and off of crosslegs as requiring 60 seconds plus t_3, the straightaway time in seconds.

f. Aircraft Searchleg Time

The vessel also precomputes the times required to fly the two searchlegs. Unless the winds are calm or perpendicular to the searchlegs, the times for flying the two search legs will be different, even though their lengths are the same. The searchleg which has the highest headwind component is designated L_1, while the leg with the highest tailwind component is designated L_2. Usually the searchlegs will be oriented so that one can be referred to as the "downwind" leg and the other can be referred to as the "into the wind" or "upwind" leg. Since it is easier for both the aircraft and the vessel to begin their stopwatches or elapsed timeclocks when the aircraft is passing overhead of the vessel, the time required to fly only one-half of each searchleg is computed. The formulae used to compute the times required to fly one-half of the searchleg straightaways are:

1. Basic formula:

$$t=\frac{60}{GS}\times\frac{L-TD}{2}$$

where

t=One-half searchleg straightaway time in minutes,
GS=Groundspeed of search aircraft in knots,
L=Searchleg length in miles,
TD=Turn diameter in miles.

2. Into the wind searchleg (L_1):

$$t_1=\frac{30(L-TD)}{V_1}\text{ or }t_1\ \frac{30y_1}{V_1}$$

where

t_1=time required to fly one-half of searchleg L_1 in minutes,
V_1=Groundspeed of search aircraft on L_1 heading in knots,
L=Searchleg length in miles,
TD=Turn diameter in miles,
y_1=Searchleg straightaway distance in miles.

3. Downwind searchleg (L_2):

$$t_2=\frac{30(L-TD)}{V_2}\text{ or }t_2=\frac{30y_2}{V_2}$$

where

t_2=time required to fly one-half of searchleg L_2 in minutes,
V_2=Groundspeed of search aircraft on L_2 heading in knots,
L=Searchleg length in miles,
TD=Turn diameter in miles,
y_2=Searchleg straightaway distance in miles.

The times t_1 and t_2 (in addition to t_3) are passed to the aircraft soon after its arrival and before commencing the pattern execution. The times t_1, t_2, and t_3 are also listed at a convenient place on the air plot and surface plot. In the event of losing radar contact during the search, these times may be quickly used to determine a dead-reckoning time to turn for the aircraft.

g. Pattern Timing

It is easier for both the aircraft and the vessel to restart their elapsed timeclocks or stopwatches every time the aircraft is passing overhead of the vessel. The second half of each searchleg straightaway is then timed by both the aircraft and vessel. When the computed searchleg straightaway time (t_1 or t_2) has elapsed, the aircraft should begin its turn onto crossleg.

In the CSC search pattern, the aircraft employs this timing procedure to control its own commencement of turn onto the crossleg. In the CMC search pattern, the guide aircraft uses this timing procedure and all aircraft execute their turns simultaneously upon command from the guide aircraft. In the CSC and CMC search patterns, the vessel may use the timing required for the aircraft to fly from overhead to overhead as a check on the aircraft's completion of the full searchlegs on both sides of the vessel. The timing on either side of the vessel, from overhead to overhead, is equal to $t_1+t_2+t_3+t_{turning}$, or $t_1+t_2+t_3+$ (60 seconds). The aircraft will require 60 seconds to execute its two 90° turns on each end of the crossleg.

In the CSR and CMR search patterns, the actual commencement of the turn onto the crossleg is controlled by the radar/visual plots aboard the vessel. In this case, timing of searchleg straightaways by the vessel will provide a backup control device in the event of radar failure. The air controller may quickly compute and provide the aircraft with the correct clock time for commencing its turn onto the crossleg. He will have to do this while simultaneously shifting from the relative plot to the true plot for information. Because of this possibility and the heavy workload on the vessel's air controller at a time of radar failure, it is a good practice for the aircraft to also time itself on each searchleg during radar-coordinated searches. The aircraft would thus be able to commence its turn onto crossleg based on the timing information already available in the cockpit, anytime the vessel suffered a radar failure.

Crossleg timing is always executed by the aircraft's pilot independently of the vessel. From the pilot's viewpoint, the procedures for executing the crossleg are the same for any type of creeping line or parallel search pattern. Immediately upon rolling out of the entering turn, the pilot resets and restarts his elapsed timeclock. After the crossleg straightaway time (t_3) has elapsed, the pilot begins his turn onto the next searchleg.

The next searchleg will take the aircraft back toward the ship. When passing overhead the vessel, the elapsed timeclocks and stopwatches are again reset and restarted for another timing cycle.

944 Surface Plot/True Plot

a. General

With known values for the vessel's course, searchleg length (L), and track spacing (S), the search pattern is layed out on the ship's dead reckoning tracer (DRT). This should be accomplished by the time the search aircraft arrives. When ready to commence the search the ship takes position one-half track spacing outside of the search area, vectors the aircraft to the ship and then onto its initial "startup" searchleg (See fig. 9–31). As the aircraft passes overhead the vessel and takes its departure on the initial searchleg, the DRT "bug" is started with the ship's search speed (V_s) cranked in. The DRT "bug" is a lighted projection on the underside of the DRT's glass top. The lighted projection will illuminate through any chart, tissue paper or overlay which is placed on top of the glass surface of the DRT. The "bug" is mechanically controlled to produce a two-dimensional, lateral movement proportional to the various headings and speed of the ship. Both the aircraft's and the vessel's positions are marked each minute on the DRT surface plot. The surface plot, or true plot, is used as a backup alternative for the relative motion plot discussed in the next paragraph. Although most of the radar advisories to the aircraft are based on the relative motion plot, the plotted information is scrubbed after each leg is completed. The surface plot thus provides the only permanent history of the search. Therefore all sightings must always be plotted on the surface plot.

Surface Plot/True Plot

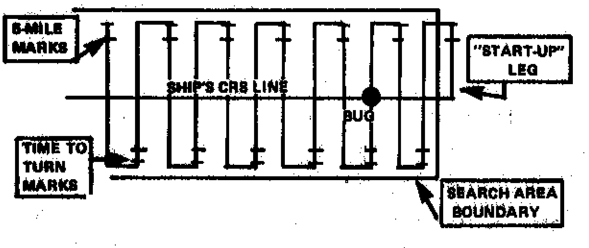


FIGURE 9–31

b. Surface Plot Data

The following specific information is depicted upon the surface plot. Within the coordinated search area—and using the largest possible scale—draw in:

1. Ship's course.
2. Search pattern. Draw in searchlegs at proper track spacing:
   (a) Mark each leg at 5 miles from end.
   (b) Mark each leg at TTT onto crossleg.
3. Coordinates of datum if known.
4. Time and position of all sightings.

Within the search areas adjacent to the coordinated search area, draw in:

5. Area designation (A–1, A–2, etc.).
6. Coordinates of centerpoint.
7. Major axis.
8. Searchlegs:
(a) Direction of creep (arrow).
(b) First two or three legs drawn in (need not be to scale).
9. Search altitude.
10. Type and call sign of search unit.
11. Vector from OSC position to commence search point (CSP).
12. IFF/SIF squawk and air-to-air Tacan channel assignments.

Outside the coordinated search area, but adjacent to it, plot:

13. Aircraft's radio call.
14. Aircraft's assigned search altitude.
15. Assigned track spacing.
16. Type of pattern.
17. Times required to fly half-searchlegs, t_1 and t_2.
18. Time to fly crossleg straightaway, t_3.

945 Air Plot/Relative Plot

a. General

Although a true plot may be used to plot and vector the search aircraft during coordinated search patterns, a simpler method is to employ a relative motion pattern. The relative motion pattern is actually laid out on the vessel's air plot or relative plot board, and is the primary source of information for the advisories furnished to the aircraft by the vessel during the search.

The true plot, or surface plot, is laid out on the vessel's DRT which is physically located in the vessel's combat information center (CIC). In close proximity to the DRT, and also inside the vessel's CIC, is the vessel's relative plot or air plot board. This board is usually edge-lighted or back-lighted, has permanently inscribed bearing lines and range circles similar to a maneuvering board, and is used to plot aircraft targets relative to the vessel's position. Hence, patterns, targets, etc., plotted on this board are referred to as either a relative plot or an air plot.

b. Relative Plot and True Plot Comparison

The air controllers of the vessel must thoroughly understand the differences between the true plot and the relative plot, as well as their relationship with each other. The air controller may have to rapidly shift from using the relative plot to using the true plot if the ship's radar fails or radar contact is lost with the aircraft.

With known values for ship's course and speed, existing wind direction and speed, length of searchlegs, and track spacing, the relative motion pattern may be computed and laid out by the vessel prior to the arrival of the search aircraft. The shape of the relative motion pattern is similar to a bowtie, when executing any of the creeping line coordinated patterns. This shape may be better understood by visualizing the coordinated movements of the vessel and aircraft simultaneously and beginning the comparison at any of the instances when the aircraft is exactly overhead the vessel. Keep in mind also that the vessel is proceeding in the direction of search pattern creep and the aircraft is proceeding back and forth at right angles to the vessel's course as far as the actual or true picture is concerned. As the vessel advances, the aircraft will move from its position overhead in a direction outward and away from the side of the vessel. To an observer aboard the vessel, the aircraft will appear to move away on one constant relative bearing line and return on another. Figure 9–32 depicts this for the starboard side of the ship.

Figure 9–33 is somewhat simplified from figure 9–32 in order to further explain the relationship between the true plot and relative plot patterns. Only four common time positions are shown for the vessel and the aircraft, and the aircraft's turning diameter is ignored. The comparison is started with the aircraft in position overhead the vessel, at position 1. The relative bearing of the aircraft from the vessel stays constant until the aircraft reaches position 2 at the end of searchleg L_1. This searchleg is labeled L_1 since it has the greatest headwind component, as defined previously. To the observer on the ship, the aircraft has gradually moved from a position abeam of the ship (when overhead) to a position behind the abeam position a distance equal to X (when at the end of searchleg L_1). When the aircraft is on its crossleg, both the vessel and the aircraft are moving in the same direction, from position 2 to position 3. The distance that the aircraft travels as the ship moves from position 2 to position 3 is not seen as relative motion by an observer aboard the ship. When the aircraft turns from the crossleg onto searchleg L_2 at position 3, it appears to the observer to be forward of the beam a distance equal to Y. The aircraft will then gradually appear to move back toward the beam position during its inbound period, reaching the abeam position when again passing over the vessel at position 4 in figure 9–33. If the shaded portions of figure 9–33 were brought together, they would be the upwind portion of the relative motion pattern on the starboard side of the vessel. That portion of the relative motion pattern on the portside or downwind side of the vessel is geometrically similar to the pattern on the opposite side, as shown in figures 9–34a and 9–34b.

Common-Time Relative Bearings

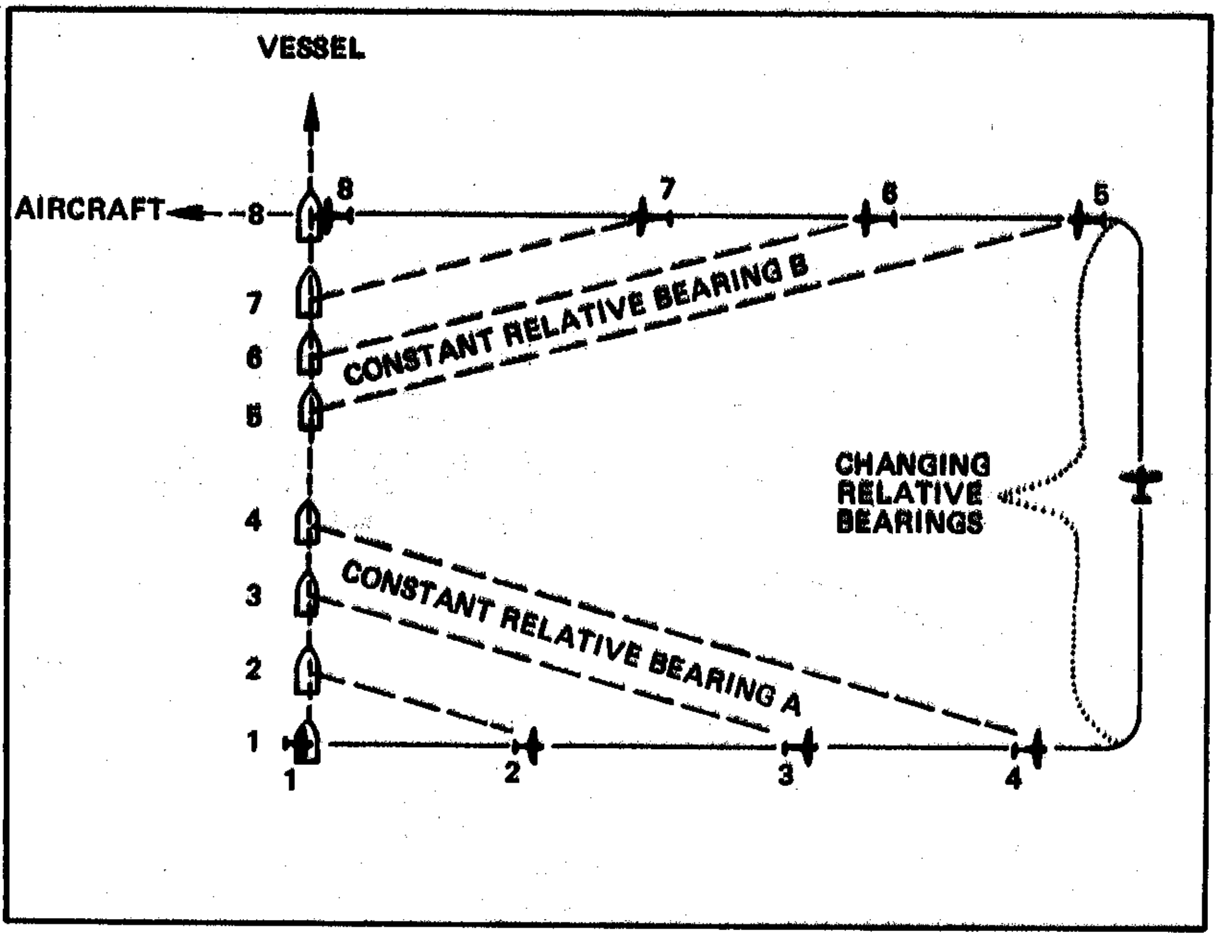


FIGURE 9–32

The relative movement crossleg may now be defined in two ways. In either definition, the relative motion crossleg is the sum of X and Y:

1. It is equal to the track spacing minus the distance the ship travels while the aircraft is on its crossleg, or

2. It is equal to the distance that the ship travels while the aircraft is moving outbound into the wind (X) plus the distance that the ship travels while the aircraft is inbound with a tailwind component (Y).

c. Relative Motion Pattern Solutions

The distances X and Y will vary with the strength and direction of the wind at search altitude. X and Y may be solved for either geometrically or algebraically. The geometrical solution is recommended over the algebraic solution method.

Comparison of Relative Motion and True Motion Patterns

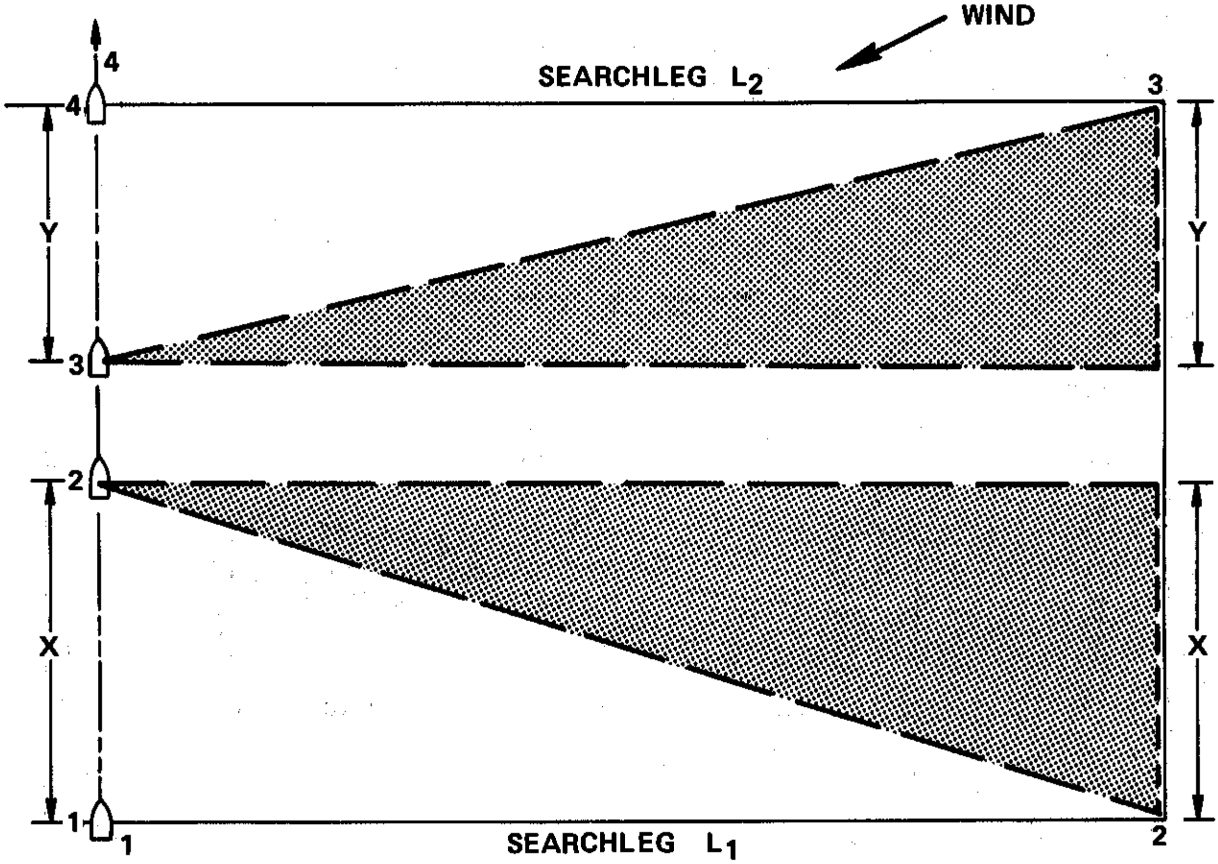


FIGURE 9–33

d. Geometrical Solution

Referring to figure 9–35:

1. Use 20:1 scale.
2. Plot vector from center representing ship's course and speed.
3. Construct a line perpendicular to ship's course through plot center.
4. Mark off V_1 on upwind side.
5. Mark off V_2 on downwind side.
6. Lay out lines parallel to ship's course at distance L/2 on each side. (Use 2:1 scale.)
7. (a) Construct a temporary line connecting the head of the ship's vector and V_1 where V_1 intersects with the line drawn perpendicular to the ship's course (3 above).

(b) Construct a line parallel to the line described above but through the tail of the ship's vector (plot center). Extend this line out to L/2 on both sides of the ship.

8. (a) Construct a temporary line connecting the head of the ship's vector and V_2 where V_2 intersects with the line drawn perpendicular to the ship's course (3 above).

Full Relative Motion Pattern

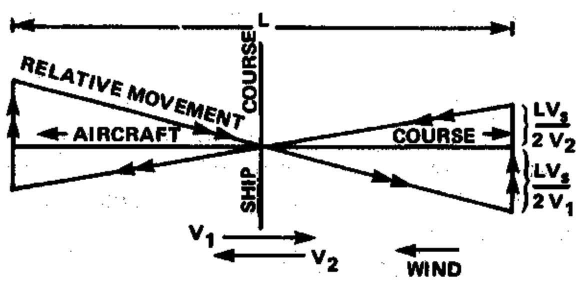


FIGURE 9–34a

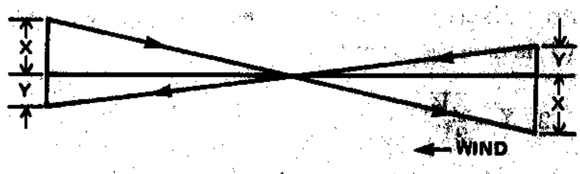


FIGURE 9–34b

Geometric Solution of Relative Motion Pattern

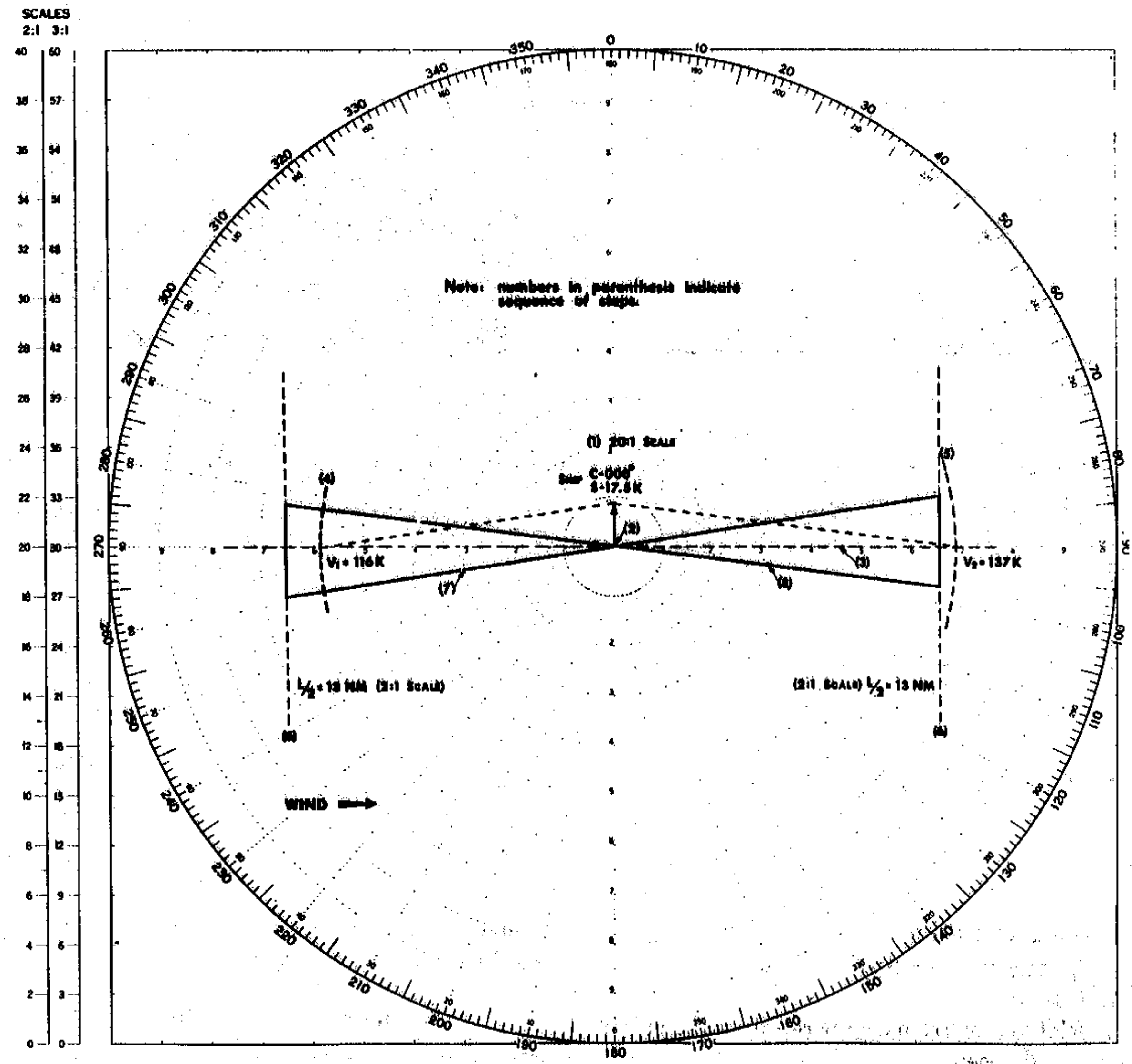


FIGURE 9-85

(b) Construct a line parallel to the line described above but through the tail of the ship's vector (plot center). Extend this line out to L/2 on both sides of the ship.

9. Erase all construction lines.

e. Algebraic Solution

1. Magnitude of X and Y depends on aircraft groundspeed for a given leg, and ship's speed (Y is never greater than X).

2. $X = \frac{LV_s}{2V_1}$

(a) V_1 is *GS* on the leg with the headwind component.

3. $Y = \frac{LV_s}{2V_2}$

(a) V_2 is *GS* on the leg with the tailwind component.

4. Layout.

(a) Indicate ship's course from plot center.

(b) Construct line perpendicular to ship's course through plot center.

(c) Lay out line parallel to ship's course on upwind side a distance L/2 from plot center.

(1) Mark off (X) abaft the beam.

(2) Mark off (Y) forward of the beam.

(d) Lay out line parallel to ship's course on downwind side a distance L/2 from plot center.

(1) Mark off (X) and (Y) reversed from upwind side.

(e) Connect points through center.

(f) Remove construction line.

f. Air Plot Data

After the relative motion pattern has been solved, it is laid out on the air plot. It should then be covered with scotch tape in lieu of plexiglass, as the tape will not introduce any parallax errors. The following specific information is depicted upon the air plot:

1. Aircraft's magnetic courses (box-in, cover with scotch tape).
2. Aircraft's wind-corrected headings (above or below box; do not cover).
3. Magnetic directions every 10° around edge of the plot.
4. Wind direction and speed.
5. Swell systems (labeled primary "P" and secondary "S").
6. Recommended ditch heading (large arrowhead labeled "DH").
7. Mark each leg at 5 miles from end.
8. Mark each leg at TTT leadpoint for turn onto crossleg.
9. Time on crossleg straightaway (t_3).
10. Times for one-half of each searchleg straightaway (t_1 and t_2).

946 Executing the CSR Search Pattern

a. Basic Sequence for Vessel

1. Position vessel one-half track spacing outside of the area on the centerline.
2. Start aircraft outbound, in either direction, from overhead and get underway. Ship will lag pattern slightly on first leg due to acceleration to search speed.
3. Direct the aircraft to correct his track to pass overhead when within 1 mile of the vessel on each inbound leg. Request the aircraft to report amount of correction needed (one-quarter mile etc.).
4. Request pilot's evaluation of pattern computations after a leg or two.
5. Obtain radar range of vessel from aircraft when aircraft turns inbound if vessel has no radar information.
6. Radar fixes of the aircraft are plotted directly on the air plot, and the aircraft kept corrected to track by use of the relative motion pattern.
7. Adjust times and headings if necessary. If other than minor changes are necessary recheck wind, TAS, computations and replot the relative motion pattern (the "bowtie").
8. Replot bowtie only when the aircraft is overhead.

b. CSR/CMR Computation Sheets

It is recommended that ships which normally serve as SAR vessels prepare computation sheets for CIC in order to efficiently preplan for the air/surface coordinated search. The sheet requires that search data be recorded in a logical order, computed in the proper sequence, and that initial advisories are readied for delivery to arriving aircraft.

c. Aircraft Advisories

Before the aircraft arrive on scene for a coordinated ship/aircraft search, the ship must prepare several advisories for the aircraft. These include the "search information", "correction to course", "searchlegs", "crossleg", and similar advisories required for efficient execution of coordinated air/surface searches. All instructional types of advisories are passed to the aircraft prior to commencing the search pattern, if at all possible. Directive types of advisories are passed to the aircraft as required during the search.

In order to give "off course" advisories to the aircraft as soon as the search pattern is commenced, the vessel should furnish the aircraft with the correction to course table for its search TAS (see fig. 9–36), together with a brief explanation of its use, prior to starting the search pattern.

The distance off course is given in quarter-mile increments, and should be based on the average of several plotted fixes. Upon being advised that it is off course, the aircraft corrects back to course by turning the number of degrees prescribed in the "Correction to Course" table, figure 9–36 and immediately reverses his turning direction to return to the searchleg heading. All aircraft correction turns are also standard rate turns of three degrees per second. The rate of rolling-in and rolling-out of the turns can vary with different pilots, but both must be at

Correction to Course Table

Aircraft execute S-turn at standard rate for number of degrees indicated to correct back to desired search course whenever off course

Distance off course (miles)	Degrees of turn for				
	TAS 110	TAS 120	TAS 130	TAS 140	TAS 150
0.25	24	23	22	21	20
.50	42	40	38	36	34
.75	56	52	50	47	44
1.00	68	64	61	57	55
1.25	78	74	71	67	65
1.50	86	82	79	76	73

FIGURE 9-36

the same rate for best accuracy in the correction maneuver. The aircraft should be instructed to visually correct as necessary in order to pass over the ship on each inbound leg which incorporates an automatic correction to course.

When the aircraft reaches a distance 5 miles from the end of each searchleg, the aircraft is advised in order to alert the pilot to the approaching crossleg.

When the aircraft arrives at the point at which it should commence its turn onto the crossleg, the pilot is directed to turn. The aircraft's turning point is short of the end of the searchleg a distance of half its turn diameter. Usually this distance is equal to that covered by 15 seconds of aircraft flight time in that direction. However, the air controller must also allow for the lag of the plots behind the aircraft's actual position. Therefore most air controllers will mark their relative plot and true plot with TTT marks at a distance equal to one-half TD+0.3 mile from the end of each searchleg. No position or off-course advisories are passed to the aircraft during the time it is executing its crossleg.

If during the search, the aircraft repeatedly drifts off the search course in the same direction, it indicates that the wind at search altitude is different from that used to originally compute the aircraft headings. A more accurate wind should be estimated from the plot fixes, or obtained from the aircraft, and the aircraft headings then recomputed. The corrected headings advisory is passed to the pilot.

The pilot is advised that, if he must break off the search to investigate a sighting, the vessel will hold relative position in the pattern by either stopping or by circling present position. If the report proves negative, the vessel will vector him to his last position in the pattern.

d. Range and Bearing Information

The CSR and CMR search patterns are respectively the same as the CSC and CMC search patterns, with one major exception; the vessel assists the aircraft to keep on the proper search course by furnishing frequent advisories based on the ship's radar/visual plots of the aircraft. Two plots are normally maintained by the vessel, a true plot and a relative motion plot, and both are a composite of information from air search radar, surface search radar, IFF/SIF interrogator displays, ECM information, Tacan/DME ranging displays, and visual bearings. When the aircraft is within visual range of the ship, visual bearings are always taken and plotted with radar ranges. This practice provides a more accurate plot than one relying entirely upon electronic information. Radar bearings are most susceptible to errors, although a constant error may also exist with radar ranges from a particular radar set. Early in the search, radar and visual bearings are compared for any difference, which would reveal a radar bearing error. If a constant radar bearing error is detected, apply a correction to all subsequent radar bearings during the search.

Visual bearings are taken by the "bearing taker" from his position on the wing of the vessel's bridge using the gyrorepeater and a pelorus. He is connected with the vessels "air plotter" stationed in CIC by the vessel's internal communication system—usually a sound-powered telephone circuit.

e. Plotting Standards

The following standard symbols should be used on both the air plot and surface plot to visually indicate the source of the fix/DR data:

×—Air search radar.

△—Surface search radar.

⊡—Radar range and visual bearing.

⊙—DR position.

A fix or DR should be plotted with a frequency of:

1. Initially every 15 seconds on the air plot. This will provide the air controller with the best possible presentation of the aircraft's track and will allow more precise control.

2. Every 30 seconds on the air plot after wind drift correction is established.

3. Every 60 seconds on surface plots.

f. Air Controller Procedures

1. Use the air plot as the primary means of coordination, and to insure that the aircraft will pass overhead the vessel on each searchleg.

2. Correct aircraft back to the search course whenever it is off one-quarter of a mile. Constructing a small ruler to measure distance off-track will aid the air controller.

3. Pin down drift as early as possible. Frequent corrections to track will reduce search effectiveness because the pilot is distracted from his scanning, and in turns, the lowered wing obstructs lookout visibility while the upwing lookout can see only sky.

4. Base corrections to track on the trend of several marks. Determine new headings by inspection of aircraft drift, if consistently into or downwind. If a heading change of more than a couple of degrees is necessary to hold aircraft on track, recheck computations for X and Y. If original computations are correct, check for change in wind or aircraft TAS. Recompute X and Y with new values and replot bowtie.

5. Direct aircraft to "execute crossleg" when it reaches the lead mark (time to turn mark). The aircraft follows crossleg instructions passed previously and keeps his own time on straightaway. The vessel does not attempt to coordinate aircraft on their crosslegs. The air controller should correct recurring overshoots or undershoots by adjusting time on straightaway.

947 Executing the CMR Search Pattern

The discussions in the preceding paragraph have generally been limited to considering only one aircraft, and hence may have inferred that the procedures apply only to the CSR search pattern. Actually the identical procedures are used with the guide aircraft in a CMR search pattern. All other aircraft must maintain their own formation position on the guide aircraft independently of any assistance from the vessel. The vessel plots only the guide aircraft on its relative motion and true plots, and speaks only to the guide aircraft. However, when the guide aircraft drifts off its desired search track, all other aircraft will likewise drift off track if they are maintaining their proper spacing from the guide. Therefore when the guide aircraft is advised by the vessel that it is off of its desired track and it is to correct back to the desired search track, all other aircraft will also execute the correction simultaneously with the guide, and without any individual commands.

When performing CMR search pattern computations, the value "nS" will be substituted for any "S" that may appear in any formula; nS is the number of search aircraft (n) multiplied by the track spacing (S). For example, the crossleg straightaway (x) is equal to the track spacing (S) minus the aircraft's turn diameter (TD), and is denoted by the formula, $x=S-TD$. If a CMR search is using two aircraft, the formula would be $x=nS-TD$ or $x=2S-TD$; if three aircraft are used, $x=3S-TD$.

When laying out the true plot, the searchlegs of only the guide aircraft are layed out, and will be spaced a distance apart equal to nS. Similarly, when laying out the relative plot, only the guide aircraft's relative motion is layed out.

Aircraft turn together on the crosslegs and move over a distance equal to track spacing multiplied by the number of aircraft (nS). If difficulty is experienced with bearing discrimination on shipborne air search radar, the guide aircraft should take station a half mile ahead of the other aircraft to improve radar identification.

948 Executing CMCS Search Patterns

a. Required Computations

Determine the width of each aircraft's search area, where A_w is the total search area width,

A_{ws} is the width for the slow aircraft, and A_{wf} is the width for the fast aircraft. In general the width for either aircraft is equal to the total width multiplied by the *TAS* of the aircraft and divided by the sum of both aircraft's *TAS*. The individual widths are obtained from the following formula:

$$A_{ws}=\frac{V_{as}A_w}{V_{as}+V_{af}} \text{ and } A_{wf}=\frac{V_{af}A_w}{V_{as}+V_{af}}$$

where,

V_{as}=Search TAS of the slower aircraft.
V_{af}=Search TAS of the faster aircraft.
A_w=Total search area width.
A_{ws}=Slower aircraft's search area width.
A_{wf}=Faster aircraft's search area width.

Determine the length of the searchlegs for each aircraft from the following formulae:

$$L_s=A_{ws}-S$$

and

$$L_f=A_{wf}-S$$

where,

L_s=Searchleg length of the slower aircraft.
L_f=Searchleg length of the faster aircraft.
S=Track spacing (same for both aircraft).

Check the above computations with the following:

$$A_w=A_{ws}+A_{wf}$$

and

$$A_w=L_s+L_f+2S$$

Determine the ship's speed (V_s), using the nomograph of figure 9–29. If desired, V_s may also be determined from either of the following formulae:

$$V_s=\frac{SV_{as}}{S+L_s} \text{ or } V_s=\frac{SV_{af}}{S+L_f}$$

Determine both aircraft's wind-corrected headings and groundspeeds by maneuvering board solution.

Determine the straightaway times for each searchleg and crossleg. In the CMCS pattern, t_1 and t_2 are computed for the full straightaway length, instead of the half length as computed in the CSR and CMR patterns. The reason for this is that the aircraft will not be crossing overhead the vessel on each searchleg, but will be instead keeping their own timing for the full searchleg. The general formula for searchleg times in minutes is:

$$t=\frac{60\ (L-TD)}{GS}, \text{ where } GS \text{ is ground speed.}$$

The general formula for crossleg time in seconds is:

$$t_3=\frac{3600\ (S-TD)}{V_3}$$

CMCS Search Pattern

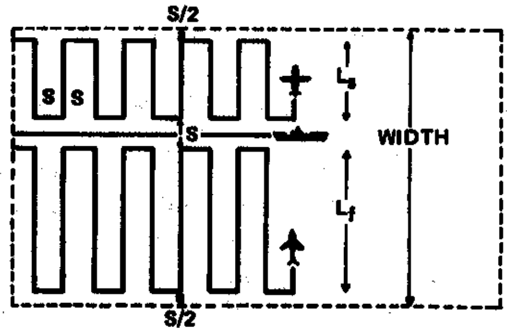


FIGURE 9–87

b. CMCS Computation Sheet

Ships which are regularly assigned to SAR duty should prepare computation sheets for use in CIC in order to efficiently preplan for the air/surface CMCS coordinated search. These sheets should require that the search data be recorded and computed in a logical sequence.

c. Air Controller Procedures

To execute the search, the ship gets underway on course prior to entering the search area. One aircraft is started on its outbound leg from a position one track spacing ahead of the ship, while the other is held in orbit over the ship. When the first aircraft has reached the outer end of his first leg, the second is started on his pattern by sending him to the position one track spacing ahead of the ship and then turning him outbound on his first leg. At the completion of each inbound leg, the aircraft will be in a position abeam of the ship, one-half a track spacing away. They then move a distance of one track spacing to the next leg and continue the pattern.

Coordination of aircraft by the ship is not as extensive as with CSR or CMR patterns. Normally the controller will pass to the aircraft such information as legs, headings, times, etc., but will let the aircraft fly their patterns using the ship as a visual reference to correct on each inbound leg.

949 Executing VSR and VMR Search Patterns

Plot the pattern on either the dead reckoning tracer (DRT) or the air plot. Searchleg computations and markings are the same as for a CSR pattern. The turn onto and off of the crossleg will always be some value greater than 90° of turn. However, the time consumed during the aircraft turning may be computed at 3° per second, since the aircraft will be making standard rate turns. Crossleg straightaway information is computed in the same manner as the CSR crossleg.

The aircraft is furnished the same type of advisories as when executing a CSR pattern. The air controller uses the radar/visual plot information from his surface plot or air plot to keep the aircraft on the desired search track and to turn the aircraft onto—and sometimes off of—the crossleg. The aircraft should assist in keeping itself on the search course by tracking inbound and outbound on the ship's aerobeacon, when available. In a VMR pattern, the aircraft must maintain vertical separation.

950 SEARCH BY LAND SRU's

a. General

Search by land parties is normally only employed when aerial search is not possible or has been ineffective, or when a closer examination of a certain area appears desirable. It can be particularly effective in forests, jungles, and mountainous areas. Selecting and evaluating land SRUs was discussed in *Chapter 3*. The procedures outlined in this section apply to any land SRU operating on the ground, whether starting overland, leaving a landed or hovering aircraft, or leaving a parachute drop zone. Regardless of how the land operation starts, the problems and procedures remain the same.

951 Land Search Preparations

a. Planning Factors

When planning for a land search, several factors must be considered before the land SRU is dispatched. These include:

1. Search schedule.
2. Equipment required by the SRU.
3. SRU transportation requirements.
4. SRU food, water, and other supply support requirements.
5. Availability of aircraft for aerial supply delivery.
6. Need for establishing a base camp.
7. Number of search personnel available.
8. Size and shape of each search area.
9. Time and number of personnel required to search the complete area and each separate search area.
10. Direction in which search tracks should be run.
11. Track spacing to use.
12. Entrance and exit points to and from each search area (if possible the two points should be in the same immediate area).
13. Employing the searchers during the period required to proceed to each search area.

b. Base Camp

It is recommended that a base camp be established at the end of the line of communications and near the actual search scene. Full support will thereby be available in the base camp in the event of inclement weather, injuries, or if rest periods are required. Plans should be made for base camp improvement to insure full benefits and maximum comfort for the land search parties. If the situation permits, the land parties will operate from the base camp, returning upon completion of each day's search effort. On scene control may be established at the base camp to insure efficiency and effectiveness of the search operation.

c. Search Personnel

Personnel used for land search should be carefully selected for physical stamina, knowledge of the outdoors, and experience in search. The size and number of search parties will necessarily be governed by available personnel and the type of terrain to be searched. The following SRU composition and equipage is recommended for typical land search operations.

1. Team Leader. The selection of team leaders for the individual search units should be made on the basis of their experience and knowledge of search operations. The team leader should complete all search preparations before the party enters the search area. He should establish communications with the SAR mission coordinator; secure all data relative to the search, out-line the team area of search on his map, select the most desirable search pattern for each area, and thoroughly brief team members. He should be equipped with radio, portable loud-hailer, whistle, and map of the search area as a minimum. The team leader is responsible for:

(a) Individual personal equipment (seasonal).

(b) Team equipment.

(c) Transportation of team to and from search area.

(d) Obtaining primary and alternate communication frequencies and schedule.

(e) Obtaining all search data from SMC and outlining assigned search areas on map.

(f) Recording search coverage.

(g) Execution of search action plan.

(h) Carrying out on scene procedures once objective is located.

2. Guide. A land party operating in unfamiliar terrain should if possible include a competent guide who is familiar with the area.

3. Flankers. Two flankers equipped with radios, portable loud-hailer, whistles, compasses, maps of area, and either machete or hand axe.

4. Linemen. Enough linemen equipped with whistles to adequately cover the assigned search area.

d. Communications

Each land SRU should have adequate communications with the SMC or OSC, either directly via two-way radio or via relay through its base camp or covering SAR aircraft. The hand-held or portable backpack types of transceivers are best for land SRU use. In the event that the radio communications link is broken, the ground-air visual codes in appendix C will have to be used to communicate with the covering aircraft. In addition, the land SRU should carry backup communications equipment such as pyrotechnics, very signals, signaling mirrors, flashlights, and whistles.

e. Dogs and Bloodhounds

If bloodhounds are to be employed in the search, it is important that the search area remain undisturbed until the dogs can be brought in. Bloodhounds can be obtained from various sources, including various law enforcement agencies. If searching for snow-buried survivors, any dog may be used successfully, Avalanche case histories show that buried victims have sometimes been located by untrained dogs who happen to be on the scene and instinctively joined in the search.

f. Snow-Covered Terrain

Under winter conditions, the only method of conducting ground search operations may be with the use of various over-snow vehicles, such as snow-cats or snowmobiles. In a recent civil airline crash (1968) the only means by which rescue parties were able to reach the crash site was on snowmobiles. Law enforcement agencies, national forest service headquarters, ski resort areas, and various State and private organizations may be able to provide manpower and equipment for operations requiring over-snow vehicles. SRU members experienced in overland travel on snowshoes or skis may be effective for limited search operations under winter conditions.

g. Orientation of Searchlegs

The search tracks should run in the same direction as the contours and if the search area is not square, they should run in the longest direction. The track spacing used must be limited to the maximum each man can effectively search in any part of the search sweep, dependent on the growth, foliage, terrain, what the search party is looking for, etc. If a search is being conducted in a large area, the area should be broken into smaller search areas in order that the high probability areas will be fully covered in the least possible time, then proceed to another search area. The shape of the area should be reasonable in length so the number of sweeps required to search it are held to a minimum, thereby providing a more efficient search. The optimum size of each search party is generally between five to 10 men. This would of course be increased in open country with easy going. Enroute searching may be employed in the same manner as with aircraft or vessel SRUs.

h. Establishing Search Area Boundaries

Natural and artificial boundaries, such as waterways, mountains, timberlines, roads, firebreaks, etc., should be used when plotting a search area. In large swamps, lowlands, or other areas void of definable boundaries or prominent landmarks, search should be accomplished as follows:

1. Initiate the parallel sweep line at a point identified on the map and on the ground.

2. Search along a plotted compass course for a predetermined distance, using either a pace system or a 25-yard length of cord. Upon completion of the predetermined distance, pivot the line and continue the search in the opposite direction. Control of the party is difficult to maintain in this type of search and the most experienced personal should be assigned as flankers with other experienced personnel strategically placed along the line of search to assist in party control.

i. Delivering the Land SRU

The members of the land SRU should be transported as close as possible to the distress scene by using aircraft, boats, trucks, or other means of rapid transport. If access to the site is likely to be particularly difficult, the SRU team leader should conduct a thorough aerial reconnaissance of his ground route into the search area.

952 Land SRU Briefing

The briefing of the members of the land SRU should follow the same general format as that for briefing an aircraft SRU crew. The land SRU briefing should include:

1. Type, serial number, and color or distinctive markings of missing aircraft or vehicle.
2. Number of persons on board.
3. Probable number and condition of survivors.
4. Expected terrain and weather to be encountered.
5. Suggested ground search pattern and technique of preparation.
6. Other agencies involved in mission or requiring contact.
7. Probable air coverage.
8. Communications schedules and frequencies.
9. Primary and alternate method of communication.
10. Proposed resupply schedule.
11. Probable method of survivor evacuation—team recovery.
12. Other pertinent information.

A land party should from time to time try to attract the attention of survivors by any means possible; e.g., sound signals, hailing, etc. At the same time it should be alert for return signals from survivors or other indications of their presence. The following are indications of proximity:

Minute bits of wreckage,
Presence of smoke by smell or sight,
Unusual sounds,
Broken or disturbed trees or underbrush,
Presence of scavengers (birds or animal),
Drops of oil and fuel,
Odor caused by decomposition,
Signs of human passage or occupancy of an area,
Landslides,
Horsetails (caused by wind blowing loose snow over an obstruction such as aircraft empennage), and
Unexplained break in terrain contour.

953 Land Search Execution

a. General

Most ground searches involve a small number of men, usually less than 25 total. Parallel-track, contour, and trackline are the usual search patterns selected for ground searches by land SRUs. The search area must be well marked and reasonably small so that the team can move in and effectively cover the entire area within the time limits imposed. Generally the maximum size will be 1 mile by one-half mile. Close track spacing and thorough area coverage are required when searching for the typical small target of a ground search.

The total search area should be subdivided into individual SRU search areas according to the terrain. The moderately level terrain should be divided into squares or rectangles for parallel-track searches. Contour patterns are used to search along and around peaks, razorbacks, steep slopes, or other montainous terrain features; or along irregular shorelines of lakes, rivers, oceans, etc. Trackline patterns are used to check out trails, paths, streams, or other natural routes which a lost person may have naturally followed.

A base line should be blazed through the area to designate each border of the individual search areas. Trail blazing with several small flags or string is preferred over methods which damage trees. Natural borders or prominent landmarks should be used whenever possible to correct any progressive errors which may develop during the search.

If lost persons are the search target, keep in mind that they often fight topography and are likely to be found in the most rugged portion of the surrounding country. Persons who follow natural routes are seldom lost for long periods. Children under 5 years of age frequently travel uphill all the time.

b. Track Spacing

In executing a ground search pattern, a constant distance is maintained between each searcher in exactly the same manner as used by aircraft SRUs, vessel SRUs, etc. Land search track spacing is determined by the distance a man can effectively search and still keep adjacent searchers in visual or audible contact. For example, if each man could effectively search 50 feet on each side of his track, the track spacing selected for that search pattern execution would be 100 feet, and the searchers would be spaced at 100 foot intervals. If the searchers were unable to see the adjacent searchers from 100 feet away, then the track spacing would have to be reduced until a visual contact could be maintained during the search.

In jungle or thick underbrush, both visual and vocal contact must be maintained between adjacent linemen. This will insure both full coverage of the search area and protection for the inexperienced volunteer linemen. Whenever contact with a lineman is lost, the team leader must be immediately notified. He will then stop the searchline until complete intrateam contact has been reestablished. If the searchline is more open, only visual contact must be maintained between adjacent linemen, although situations are rare in which vocal contact is not also maintained.

The team leader always makes the final determination of what track spacing to use within his assigned search area. Since the areas of a ground search are seldom re-searched, a very high probability of detection is strived for in the first search—and this will always require close track spacing. Generally, track spacing (S) is dependent upon:

1. Target size. (Aircraft wreckage, man, child, tracking signs.)

2. Target's Clothing/Coloring. (Contrast, brightness, etc.)

3. Terrain. (Mountainous, hilly, flat, rocky, trees, foliage, etc.)

4. Weather. (Raining, snowing, fog, clear, etc.)

Typically, the track spacing for lost persons is between 15 and 25 feet, with search progress through wooded areas conducted at a slow gait as each thicket and depression is thoroughly checked. About 1 square mile of woods can typically be searched by each land SRU in an 8-hour day under these circumstances, if each SRU is comprised of 20–25 men.

c. Searchline

Seachers may proceed in a straight line-abreast, a "V" formation, or either a right or left echelon formation. The "V" and echelon (slanting) searchlines are considered more efficient than the line-abreast searchline because it is easier for each searcher to only keep the man ahead in visual contact for distance-keeping and track spacing. The team leader takes his position in the center of a straight line-abreast or "V" formation, or as the leading man in either a right or left echelon searchline. The "dress" of the searchline is on the team leader. Two flankers are required for the line-abreast or the "V" searchlines, while only one flanker is required for an echelon searchline (see fig. 9–38). The flankers also assist in maintaining the dress of the searchline. Both the team leader and the flankers must continuously check their compasses, marked base lines, and/or topographical lineup features, to insure that correct searchlegs are maintained throughout the search.

d. Executing Parallel Patterns

This pattern is generally the most effective for land search. Its execution requires a team leader, normally two flankers, and as many linemen as the terrain will allow. The searchline is initially formed along the search area boundary, with individual linemen positioned one-track spacing apart. Overall team control is maintained by the team leader throughout the search by his team in the same manner that an OSC maintains control of a multiunit search effort. Boundary control of each successive sweep through an area is normally delegated to the pivoting flanker.

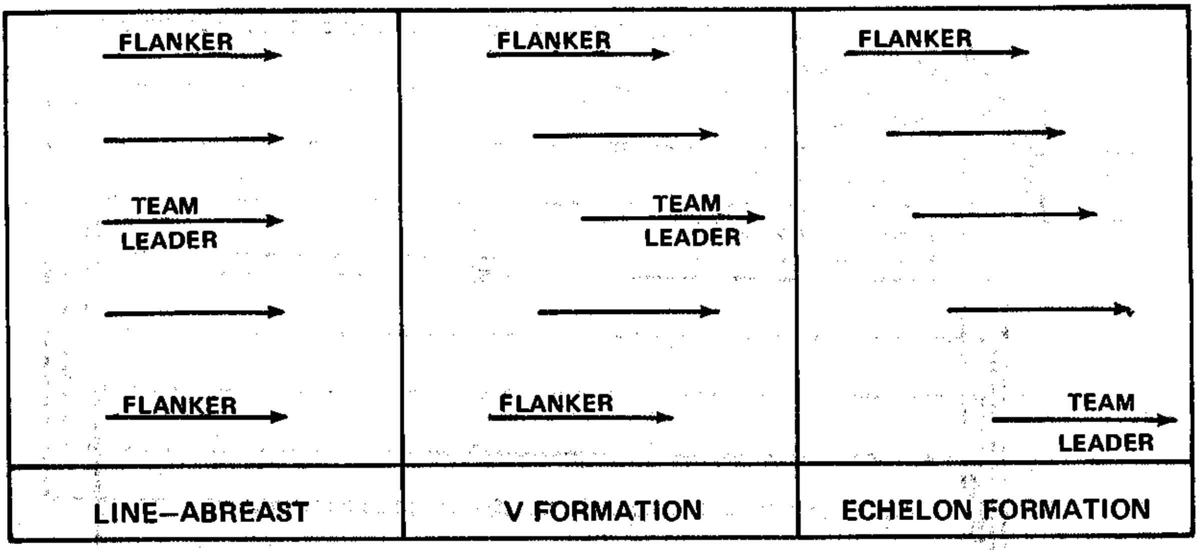


FIGURE 9–38

After the searchline is initially formed at the boundary, it moves forward on a given signal from the team leader. Linemen remain evenly spaced as the team progresses. If an obstacle is encountered by part of the team, they should check it out while the rest of the team continues just past the obstacle and halts. When the checkers have rejoined the searchline, the entire searchline again moves forward upon signal of the team leader.

When the searchline completes its first searchleg, it does not use the flanking movement as the multiaircraft or multivessel searchlines would to reposition themselves for the second searchleg. The land SRU will instead use a pivoting movement about the flanker. The reason for this procedure is that as each sweep is being made, the inboard flanker is blazing the line of his search, say with string. At the end of the searchleg, the searchline pivots about that flanker, and then is guided by the same flanker on the return searchleg, as he retraces his string blaze line. In the meantime the other flanker is blazing his search track during the second searchleg, and will be the pivot flanker for the maneuver between the second and third search sweeps. This procedure is illustrated in figure 9–39.

e. Executing Contour Patterns

Contour patterns are normally used for mountainous or steep terrain. Their execution requires a team leader, normally two flankers and up to 25 linemen. The searchline is initially formed on a line perpendicular to the ridgeline or on a radial from the mountain top. Overall control of the team is maintained by the team leader, with the sweep boundary control delegated to the upper flanker.

The searchline of the contour pattern starts at the highest level to be searched. It maintains a constant altitude during each sweep, and progresses down the slope on successive sweeps. When each sweep is completed by the searchline, it re-forms on the low side of the bottom flanker, reversing its order of lineup in the same manner as with the parallel pattern pivoting maneuver between each search sweep, and then continues the search moving in the same direction around the mountain as followed on previous search sweeps. Searchline control, checking, starting, stopping, etc. are all controlled by the team leader in the same manner as when executing a parallel pattern.

Contour patterns are also useful for terrain which prevents using straight searchlegs efficiently. Thus contour patterns are used to search along irregular shorelines or other irregular terrain. Following this procedure will always require special search units to cover the areas missed by the weaving searchline.

PM Search Pattern for Land SRU

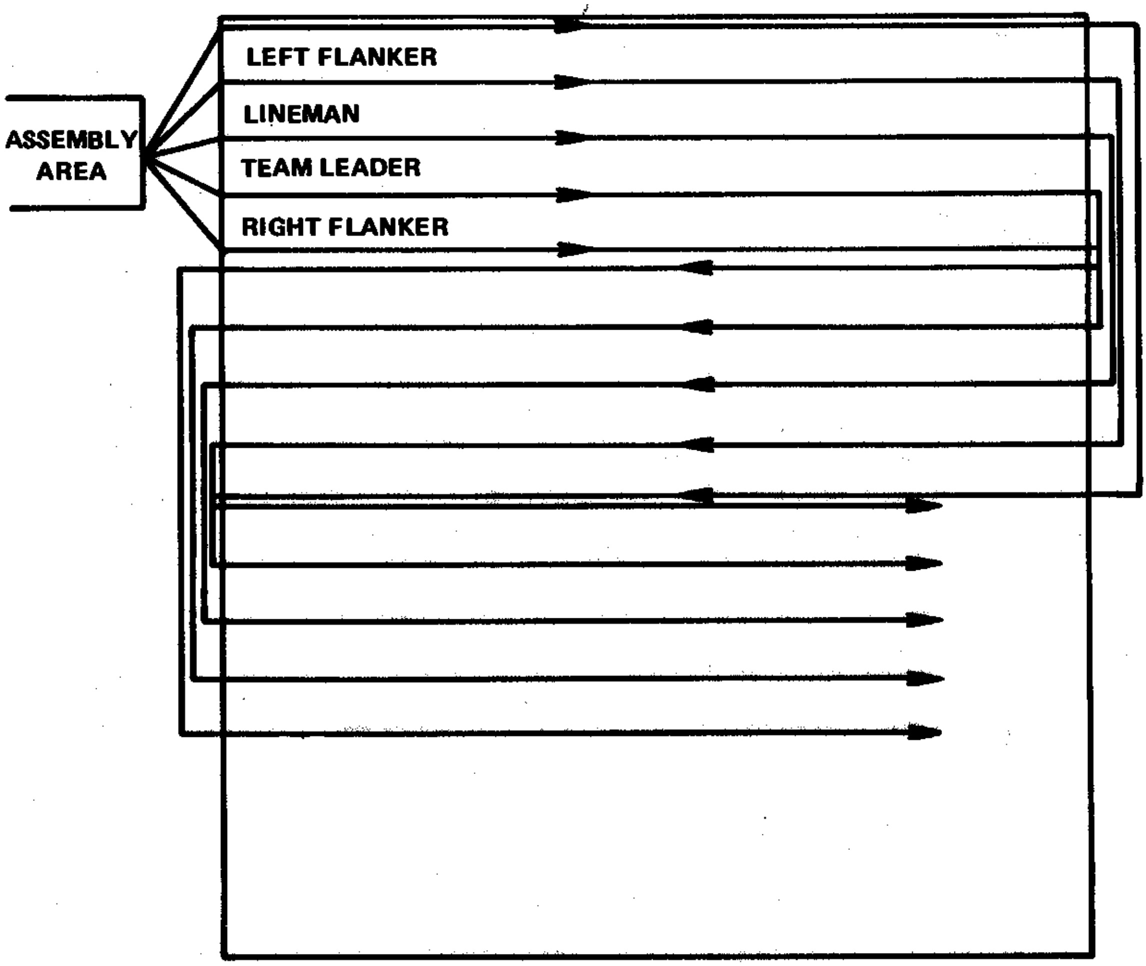


FIGURE 9–89

f. Executing Trackline Patterns

Trackline patterns are executed by one or more men in searching along a trail or given track which is suspected of having been followed by a survivor or lost person. When three or more men are assigned for a trackline search, a team leader and two flankers must be designated by the SMC or OSC. Normally a "V" searchline is used in this situation with the team leader following the center of the suspected path and an equal number of linemen placed on either side of the track.

g. Use of Helicopters

The use of helicopters, if available, should be considered to keep searchlines straight and to improve search effectiveness in dense wooded areas.

954 Recording Search Coverage

a. General

In order to efficiently execute a land search, insure that no sections of the search area are overlooked. To accurately plot the positions of various finds, an accurate and large-scale grid plot of the search area should be made. As the search progresses, search sweeps are shown on the plot, providing an exact position of each search sweep. Forward distances may be estimated by pacing off the forward movement of the searchers as they proceed. The exact location of finds may then be shown as the relative position is known both forward and across on each search sweep or searchleg. These findings may then be transcribed from the large-scale plot to a smaller scale chart as necessary. When the search of an area has been completed, the team leader should cross-hatch the areas searched, note the areas that were not searched and report these areas to the OSC or SMC, along with the search results, weather and other standard debriefing information.

b. Geological Survey Charts

The U.S. Geological Survey's topographic charts are the best available charts for executing land searches. The topographical charts of greatest interest to SAR personnel are of four scales:

1. Scale 1:24,000. This chart is the best available scale for land searches as it depicts the greatest detail. 2,000 feet of horizontal topography are reduced to 1 inch on this chart. Each chart covers 7.5 minutes of latitude and longitude.

2. Scale 1:62,500. This chart reduces 1 mile of horizontal topography to 1 inch on the chart. Each chart covers 15 minutes of latitude and longitude.

3. Scale 1:125,000. This chart reduces 2 miles of horizontal topography to 1 inch on the chart. Each chart covers 30 minutes of latitude and longitude.

4. Scale 1:250,000. This chart reduces 4 miles of horizontal topography to 1 inch on the chart. Each chart covers 60 minutes of latitude and 120 minutes of longitude. This scale is useful to the team leader, OSC, and SMC when a large view of the search area and surrounding terrain is desired.

Topographical charts are overprinted with four coordinate systems: latitude and longitude; universal transverse mercator grid (UTM); State plane; and the system of rectangular surveys. When reporting the positions of any finds, only the latitude and longitude should be used backed up by a bearing and distance from a prominent geographic feature or navigational aid.

c. Search Area Plot

When making the plot of the ground search area, the following procedure is recommended:

1. Plot the search area on a topographical chart, showing all search area boundaries and sweep boundaries. Designate two adjacent sides as baselines, each running from a common corner point of the search area.

2. Using a sheet of paper of suitable size, draw an area sized in proportion to the search area depicted on the topographical chart, and mark each side of the expanded search area with a proportionally expanded scale, using marks for every 10th of a mile.

3. Grid the plotted search area into usable grids. Normally grids 0.1 mile (or 528 feet) on a side are suitable for this purpose. Divide 528 into the length, in feet, of each boundary of the search area, to obtain the number of 10ths of a mile on each side. Draw in the 0.1-mile-square grids.

4. Number the grid lines in two directions, starting from zero to any convenient corner. Thus each grid can now be identified by referring first to its vertical grid line then to its horizontal grid line. Furthermore, found objects can be referred to by fractional estimates of the grid lines at their locations, if desired. Figure 9-40 depicts a typical, gridded search area plot. The grid lines are numbered only for the convenience of the team leader. The positions of found objects are always converted to latitude and longitude for reporting to the OSC or SMC.

5. The gridded, large scale plot of the search area is now ready to have each search sweep depicted on it, as well as any findings. To determine the positions of the search sweep boundaries, first estimate the track spacing that will be used during the search by the team leader. Multiply the track spacing by the number of searchers in the team to obtain the full width of the area searched on each search leg of the team. Measuring this off on the search area plot, use double lines to indicate the boundaries of each sweep. Indicate by arrows the direction of each sweep. The actual progress of the land SRU can now be easily followed or monitored during the search by using the search area plot, and findings can readily be plotted. Transcribing the position of findings from the search area plot is easily done by first estimating at least to the nearest 10th of a mile along each grid coordinate that the found object is from the common corner. Then plot this on the topographical chart from the same common corner of the search area. Figure 9-40 depicts a typical search area plot.

Ground Search Area Plot

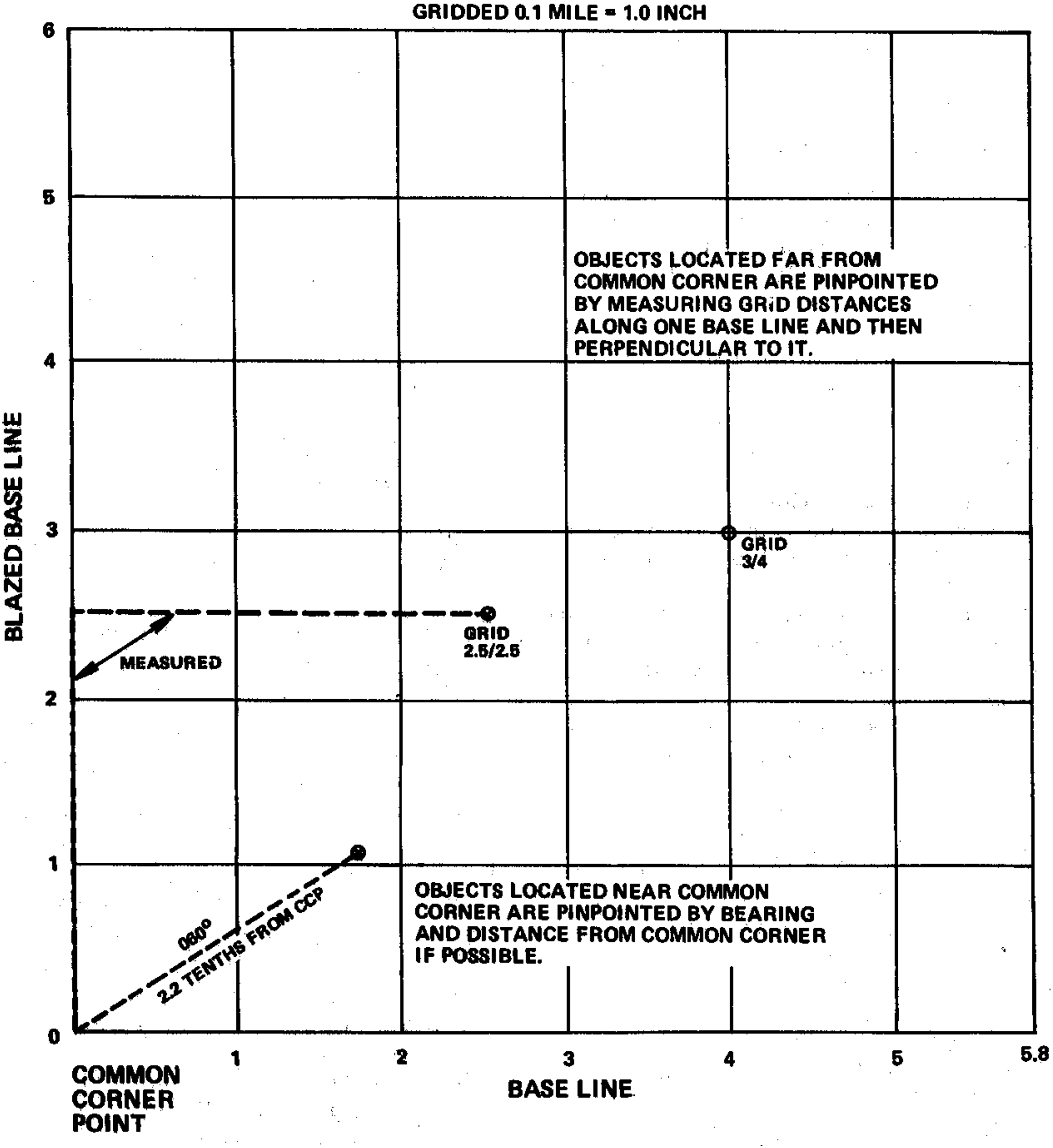


FIGURE 9–40

955 Interrogation by Land SRUs

a. General

Appeals for information through press and radio, on-the-spot interrogation or interviewing of the local population may lead to the discovery of the whereabouts of the object of the search. Land SRUs are often used as interrogation parties or as the nucleus of such parties; however, before assigning this function, the SMC must insure that another SRU is readily available for entry to the incident site. Normally, SMC will use two team members as a nucleus for an interrogation party.

b. Selection of Personnel

The nature of interrogation missions and the resultant close personal contact with civilian or foreign nationals requires careful selection of personnel. Interrogator selection should be based on their:

1. Knowledge of local language and customs.
2. Clarity of speech.
3. Ability to invite confidence.
4. Social acceptance (in areas where interracial or intergroup relations are strained).
5. Dependability.
6. Tact.

c. Equipment and Supplies

Normal ground SRU communication equipment with the addition of a small portable tape recorder will suffice for interrogation parties.

d. Conduct of Interviews

Individuals seeking publicity, those with imagination, or those who desire to help despite lack of information must be interviewed with caution. Leading questions should be avoided. Factual data, such as size, color, number of engines or probable course of the lost aircraft, will influence interviewed personnel who have lively imaginations. At times, it may be desirable to volunteer misleading information to eliminate false leads based on imagination or the power of suggestion.

e. Processing Information

Information obtained should be transmitted to the SMC at the first opportunity. Details are important and may furnish key information to the SMC, who is familiar with all aspects of the mission.

f. Lead Followup

Normally, the SMC will take action on leads. However, when the urgency of the lead or lack of communication prohibits his direction, the interrogation party should follow the lead to completion. In instances of this nature, the party will inform the SMC of the party's itinerary and actions at the first opportunity.

960 RESCUE OPERATIONS

During this part of the operations stage facilities proceed to the scene and conduct rescue operations until distressed persons or craft are rescued or accounted for. Since search operations do not end until all survivors or distressed craft have been located, there may be an overlap in search operations and rescue operations when more than one person or craft is involved.

961 Events

There are seven specific events which may occur sequentially during rescue operations. These are: rescue crew/team briefing, dispatch of rescue units, SRU en route time, on-scene rescue, SRU on-scene relief, SRU return to base, and rescue crew/team debriefing.

962 General

All SAR personnel who may be in a position of being assigned either SMC or OSC duties should have an understanding of the rescue techniques and methods employed by SAR units other than the type to which they may be currently assigned. For example, an aircraft commander may be assigned to coordinate a rescue plan which involves not only other aircraft, but also vessels and boats. Safety considerations also are involved. No SAR unit should be directed to execute a particular maneuver, technique, or method that is hazardous to its crew, or the craft itself, unless a thorough evaluation of the circumstances indicate that acceptance of the risk is required. In these circumstances the OSC and SMC should have not only the experience, training and authority to make the evaluation, but should also have a knowledge of the capabilities, techniques, and limitations of the executing SRU. However, in all cases, the commanding officer of the rescue unit has the ultimate authority and responsibility of determining if the operation can be executed safely.

963 Rescue Crew/Team Briefing

The members or crew of the SAR unit dispatched to conduct a rescue operation should be thoroughly briefed on the rescue action plan developed by the SMC. In the event that the SMC or OSC has been unable to develop a rescue plan, the aircraft commander, vessel commanding officer, team leader, or other individual in command of the SRU is responsible for developing a rescue action plan and executing appropriate rescue actions on scene.

The briefing of SRUs assigned to execute the rescue follows the same general format and scope as that given to search units with the exception that the rescue details are substituted for the search details. In other words, briefing will include the situation, the weather, access routes, rescue unit assignments, recommended rescue method and technique, on scene communications, coordinating instructions, evacuation plan, safe delivery point, expected relief times, expected support for SRUs conducting the rescue from other SAR facilities, and anything else that might effect successful execution of the rescue plan.

964 Dispatch of Rescue Units

When the circumstances of the mission indicate that search units will be unable to complete a rescue if they locate the search object, appropriate rescue units must be alerted and possibly prepositioned. Rescue units can then be dispatched, respond promptly and arrive on scene with minimum time delay as soon as survivors are located. At times, prepositioning considerations will dictate that the rescue unit be dispatched to the scene prior to the location of the survivors. In this case they will standby and maintain an immediately available status.

965 SRU En Route Time

The time it will take a rescue unit to depart from its operating location, or its prepositioned location, and its arrival on scene must be considered continuously during a mission by the SMC. Locating survivors in a hostile environment but then being unable to rescue them due to arrival delays of rescue units should be avoided, if at all possible.

966 On Scene Rescue

a. Simultaneous SRU Arrival

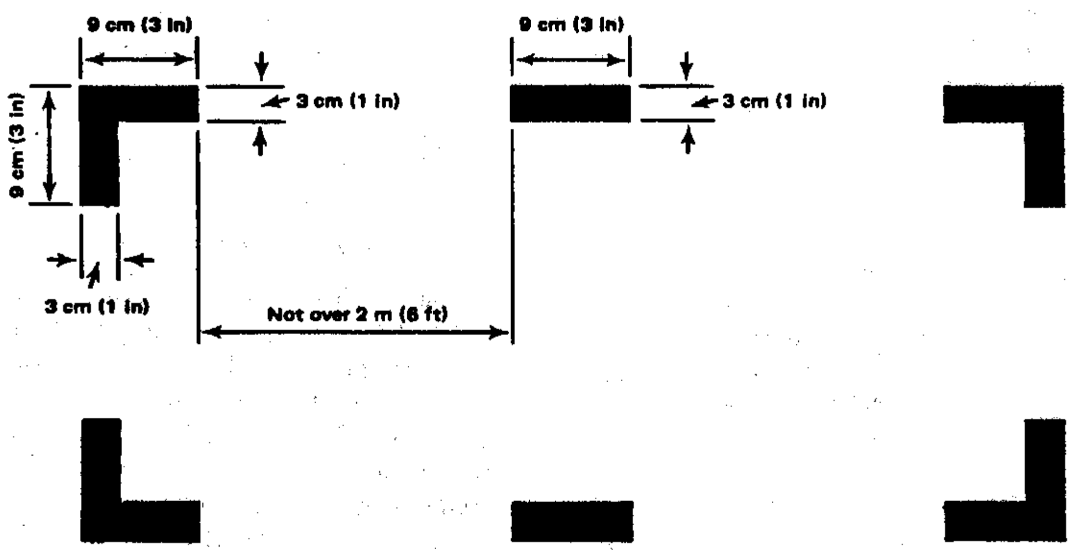
When two or more SRUs capable of conducting the rescue operation arrive on the scene and the SMC or OSC has not specifically designated one SRU to conduct the rescue, the general rule to observe is that the first SRU to arrive will make the first rescue attempt. The second and subsequent SRUs that arrive will standby as backup rescue units in the event that the first SRU is unsuccessful in its rescue attempt.

b. SMC Support

The SMC will provide the same general form of support to rescue units as he provides search units during the SAR mission. This includes coordinating and scheduling the dispatch of relief rescue units and other support personnel or equipment as required by the OSC during the operation.

c. Civil Aircraft Break-in Points

If areas of the fuselage of civil aircraft suitable for break-in by rescue crews in emergency are marked on the aircraft, the areas are usually



Civil Aircraft Break-in Points Marking
FIGURE 9-41

marked as shown in figure 9–41. The color of the markings will be red or yellow, and if necessary they will be outlined in white to contrast with the background. If the corner markings are more than 2 m (6 ft) apart, intermediate lines 9 cm x 3 cm (3 in x 1 in) will be inserted so that there is no more than 2 m (6 ft) between adjacent marks.

967 SRU on Scene Relief

The relief of rescue units on scene follows the same general procedures as the relief of search units on scene. A complete briefing must be given, when possible, to the relieving rescue unit prior to its assuming its role in the rescue operation.

968 SRU Return to Base

The time required for a rescue unit to return to base must be considered for those units which have a limited on scene endurance, such as limited fuel. The SMC must coordinate the on scene reliefs to insure that the relieving SRU arrives prior to the required departure time of the SRU currently on scene.

970 TYPES OF RESCUE OPERATIONS

971 Aerial Delivery

In deciding whether or not supplies should be dropped to survivors the SMC should consider such factors as the relative locations of the distress site and rescue unit bases, the time delay expected before rescue can be effected, the danger of exposure, etc. When a search has been prolonged, supplies are usually dropped to survivors to help them to sustain and protect themselves while they await rescue, even though this may not be far off. Supplies may also have to be dropped to augment those carried by approaching rescue units. Mobility of personnel on the land generally makes possible the recovery of equipment dropped some distance away, but air drops to survivors at sea require a high degree of accuracy.

a. Selecting Delivery Aircraft

Aircraft with internal aerial delivery systems such as the HC–130 type are the most suitable for delivery of supplies to survivors at large distances from available airports.

Aircraft having bomb bays or exterior racks capable of carrying droppable containers or packages of survival stores are the next most suitable for dropping supplies.

Such aircraft are, however, not always available for supply dropping operations, so that other aircraft, not specifically designed for this function, may have to be used. Care should be taken in the selection of these aircraft and notices on any supply dropping techniques peculiar to them should be available for ready reference by all personnel likely to take part in these operations.

Other factors in the selection of supply dropping aircraft are the position of hatches and doors, the ease with which doors may be removed and the aircraft's ability to operate at low airspeeds.

b. Color Coding of Equipment and Instructions for Use

Colored streamers should be attached to survival equipment before dropping in accordance with the following international color code:

1. Red—medical supplies and first aid equipment.
2. Blue—food and water.
3. Yellow—blankets and clothing.
4. Black—miscellaneous equipment.

Where supplies of a mixed nature are dropped in one container or package, the color code should be used in combination.

Instructions on the use of droppable survival equipment should be enclosed in each package. The instructions should be printed in at least three languages of which one shall be English.

c. Aerial Delivery Procedures

Aerial delivery procedures should be conducted in accordance with own service directives.

d. Coordination With ATC

A supply dropping operation should, just like a search operation, be coordinated with appropriate ATC agencies. The SMC or aircraft commander should submit the flight plan for approval so that separation from other traffic will be provided during the flight to and from the drop zone and during the drop. This is particularly essential if the drop zone is far from base and the flight to the drop zone must be made at a high level. The margin between endurance and the time required for the mission, taking into account the descent to and climb out from the drop zone, may not be very great.

It is advisable to notify ATC of the details of the intended flight as far in advance of the mission as possible, to avoid any delays in the issuance of air traffic clearances. The flight plan should include routes and cruising levels to and from the drop zone, the time and place of descent, required drop height, estimated time in the drop zone and climbout procedure after completion of the drop. Close contact should be maintained between the SMC and the air traffic control center during all phases of the operation.

972 Rescue by Helicopter

Helicopters accomplish rescues by either landing or hoisting. Landings are usually required at high altitudes, as in mountains, due to limitations of helicopter power for maintaining a hover. Landings are usually preferred for water rescues by amphibious helicopters. Landings are made for all rescues by helicopters when a suitable landing site is available. Hovering the helicopter and hoisting the survivor aboard not only requires more helicopter power, but it also presents a greater hazard to both the aircraft and survivor. There is a danger if helicopters are operated close to collapsed parachutes. Parachute inflation by rotor downwash can cause injury to an attached survivor or the parachute can be sucked into the rotor of the helicopter.

Pilots must exercise extreme caution when hoisting from carriers of flammable/explosive cargo, or in the vicinity of a flammable mixture spillage. The hoist rig must be grounded clear of the spillage, or the carrier's tank venting area to preclude a possible fire or explosion from an electrostatic discharge.

973 Rescue by Fixed-Wing Land Aircraft

The most significant role played by fixed-wing land aircraft in rescue operations is that of providing immediate assistance to survivors and serving as the eyes of approaching rescue units. Orbiting the survivors; dropping survival equipment; confirming the position; serving as a radio and radar beacon; showing lights, dropping flares or using other visual signals; and providing DF steers all serve to improve the morale of the survivors, provide for their immediate emergency needs, fix the location to prevent additional long searching, and save valuable time in getting a rescue unit on scene.

The role of the landplane in actually performing a rescue is usually limited to instances where there is a suitable landing runway at or near a distress scene or where the aircraft is designed to operate from rough and improvised strips. Fixed-wing land plane rescue has, for instance, often been done in extremely cold climates where the aircraft have either used frozen lakes or rivers as runways or, when fitted with skis, have operated from snow-covered surfaces and glaciers.

However, effecting a landing under what may appear to be ideal conditions in unknown terrain, even with an aircraft with marked potentialities for operating without runways, is extremely hazardous and the urgency of the situation should be carefully considered before attempting it. Thus, when the pilot sees a ground-air visual signal meaning "Probably safe to land here," "OK to land in this direction," or "Land here" he should try to ascertain whether the person making the signal is competent to make this judgment and knows the landing and takeoff characteristics of the aircraft involved.

If the survivors are at or near a place which appears to be suitable for aircraft to operate from, and aerial evacuation would offer sufficient advantages, it may be expedient to have someone qualified to report on the situation parachuted in, or flown in by a light aircraft able to contend with conditions not suitable for a heavier aircraft.

974 Water Rescue by Amphibious Aircraft and Seaplanes

a. Sheltered Waters

Since seaplanes and amphibians are able to operate from lakes, rivers, sheltered waters, and bays, it will be possible to land close to survivors located in such areas. It should be realized, however, that, since it may not always be possible to detect sandbanks, submerged logs, or snags from the air, a landing in uncharted or unknown waters may be very risky.

b. Semisheltered Waters

Under favorable weather and water or sea conditions, and if no other means of rescue (i.e., rescue vessels or helicopters) are immediately at hand, or in case of great urgency, some of these aircraft could also be used for rescue operations in less protected waters, such as inland seas, large lakes, bays, or coastal areas. As the SMC may have information about the prevailing conditions in the area from surface units near the distress scene or about other means of rescue not known to the pilot, the pilot should normally contact the SMC before landing. However, the final decision to make the landing rests with the pilot and he should base his decision on his own assessment of the circumstances, the number and condition of survivors (who may be fairly secure and reasonably comfortable, e.g., in liferafts), the expected time of arrival of other more suitable units, the risk to his own crew and aircraft, and other factors considered part of good airmanship, seamanship, and judgment.

c. Open Seas

Open sea landings should only be contemplated with amphibians or sea-planes designed for rough waterwork and which have good maneuvering and taxiing qualities. Any open sea landing or takeoff is extremely hazardous, even in the most favorable circumstances, and involves the acceptance of a calculated risk. Waves, swells, and winds and their influence on each other, determine the sea conditions affecting landings and takeoffs. They may appear in a myriad of combinations of heights, lengths, velocities and directions. While a seaplane may be able to operate safely under one set of conditions, it may be almost helpless under another, which would be no rougher to a surface vessel. A decision to land should therefore be based on a very careful study of the sea and an equally careful evaluation of the merits of the situation. A landing should never be made in the open sea, if rescue can be assured by dropping airborne supplies and survival equipment, diverting or dispatching surface vessels, or using a helicopter, hovercraft or any other type of marine craft. Guidance for evaluation of sea conditions is contained in "Aircraft Emergency Procedures Over Water" (CG 306; AFM 64–6; OPNAV INST 3740.4A; FM 20–151).

975 Rescue by Ship

a. General

When a distressed craft or survivors are a considerable distance from shore, rescue will normally be by long range ships (specialized SAR ships, warships, or merchant ships). The use of helicopter equipped ships should also be considered. The rescue methods employed by these ships vary considerably according to their displacement and whether the rescue is made in mid-ocean or close to land. Weather, tides, currents, sea conditions, shoals, reefs, daylight, or darkness may also be important factors.

Although it may be immediately obvious that a marine craft should be used for rescue operations, it is often advisable to initiate an alternative method of recovery. For example helicopters may be used for evacuating survivors picked up by marine craft in order to speed their delivery to an emergency care center. Rendezvous between a marine SRU and a helicopter can be made at appreciable distance offshore for this purpose.

Removal of survivors from the water, life rafts, lifeboats, or other vessels to the safety of the rescue vessel's deck may be the most difficult phase of a maritime search and rescue mission. It is likely that the condition of the survivors, whether in the water, a liferaft, or a small boat, will be such that they are unable to help themselves. In the majority of cases survivors will have to be assisted aboard or actually hoisted aboard. For this reason all SAR vessels and SAR boats should be equipped and prepared to lift survivors from the water without expecting any help from the survivors.

b. Rescue Methods

There are numerous methods for rescuing survivors that may be used by SAR vessels. The most commonly used methods are listed in this section, and are generally grouped as: Rescue of survivors in the water; and rescue of survivors directly from their distressed vessel. When rescuing persons from the water the following methods are most used:

Ship alongside/swimmer.

Ship alongside/line thrower.

Ship alongside/small boat.
Ship circle/trail line.

The most commonly used methods for rescuing personnel who are still aboard distressed vessels are:

Ship to ship/direct.
Ship to ship/raft haul.
Ship to ship/raft drift.
Ship to ship/small boat.
Ship to ship/haulaway line.

976 Rescue by Boat

When survivors are located on lakes, sheltered waters, rivers, or coastal areas, rescue will often be made by fast boats of limited range based close to the distress scene or by private boats operating in the vicinity.

Since boats are generally small in size and may not be able to take all survivors on board at one time, a sufficient number of boats should be dispatched to the distress scene. When this is not possible, each boat should deploy its raft/rafts so that those survivors that cannot be taken aboard immediately can either be towed ashore, or be kept afloat while they await their turn or the arrival of another boat. If survivors must be left behind, crews should ensure that they are made as secure as the circumstances permit.

Assistance to an aircraft that has crashed or ditched on the water will generally consist of transferring personnel from plane to boat and picking up survivors from the water or liferafts. It may also include the towing of an aircraft that is disabled on the water.

977 Coordinated Helicopter/Boat Rescues

Occasionally both a SAR helicopter and a SAR boat will be dispatched for a rescue operation. The general rule is, the first rescue unit to arrive in the immediate vicinity of the survivors will make the first attempt to rescue.

When the helicopter arrives first and commences its rescue attempt, the boat should take position upwind of the helicopter in the 2 o'clock position at a safe distance and stand by as a backup.

If for any reason, the helicopter must abort its rescue attempt, the pilot will depart the immediate area of the survivor and signal for the boat to move in and make its rescue attempt. Helicopters may turn out the anticollision rotating beacon to indicate that they require boat assistance or are unable to complete the rescue. In certain operations where helicopter and boat coordinated rescue can be foreseen, specific signals may be prearranged.

The boat must be careful not to cross over the helicopter's hoisting cable, not to cross between the survivor and the helicopter, and to always stay within the pilot's range of vision.

If the boat arrives first and makes the rescue, it will sometimes be wise to make a further transfer to the helicopter in order to effect a more rapid delivery of survivors to medical facilities.

978 Underwater Rescue

a. Military Submarine Rescue

The U.S. Navy has the responsibility for, and the facilities for, military submarine rescue and recovery. The organization and procedure for submarine rescue is described in the USN Addendum to this manual (NWP 37A Add). The function of the normal SAR organization in these efforts is to lend all the support of the organization as is necessary and possible.

b. Civilian Submersible Rescue

The term submersible is usually used for those underwater craft which are designed for other than combat purposes. If a submersible, operated by or for the Navy is in distress, the same procedure will be used as for submarines. If the submersible is operated by civilian organizations, the SAR coordinator can obtain the use of the Navy's submarine rescue capability by requesting the Chief of Naval Operations to declare SUBMISS/SUBSUNK. This will put the Navy's submarine rescue forces into operation. Specific procedures are contained in U.S. Coast Guard COMDT INST 3130.7 series and U.S. Navy OPNAV INST 3130.4 series. Additional assistance may be obtained from the civilian operating agency of the distressed submersible.

The use of civilian submersibles is a relatively new development. Detailed rescue procedures and specific rescue facilities for use with them have not been refined as yet. In general, the procedure that promises the most success for saving lives in the relatively short time available for rescue is the raising of the entire submersible. Until more experience is gained there will be a premium on good judgment and ingenuity in any specific instance where rescue from a submersible is required.

979 Rescue by Land SRU

Rescue procedures used by land SAR units are dictated by the wreckage within which survivors may be trapped, by the rescue equipment available, by the environment of the rescue site, and by the experience and training of the members of SRUs. Most of the established land SRUs are specialized in only one area of rescue operations. These may be mountain rescue, avalanche rescue, cliff rescue, desert rescue, aircraft crash rescue, collapsed building rescue, motor vehicle wreck rescue, and many others. The rescue techniques employed by each specialized team are similar, and involve an immediate extraction of survivors from some entrapment or hostile environment.

980 EMERGENCY CARE

Emergency care is provided to rescued survivors from the time of rescue to the point of safe delivery.

a. Emergency Care Events

There are seven specific events which may occur sequentially during emergency care. These are: triage (the sorting and assignment of priorities for attendance, care, treatment and transportation of survivors), giving first aid and emergency care to stabilize the survivors' condition, survivor debriefing, transport to a safe delivery point, life support during transport to insure that injured survivors' stabilized condition is maintained, transfer/delivery of survivors to the selected safe delivery point, and briefing of appropriate receiving authorities at the selected safe delivery point.

b. Degree of Emergency Care

The degree of emergency care received by survivors is continually upgraded as the SAR mission progresses. The differing degrees are:

1. Self help.
2. On scene care by rescue units.
3. En route care by transporting facility.
4. Hospital care at delivery point.

981 Triage

Triage is the process of sorting survivors and assigning them priorities for emergency care, treatment, and evacuation.

Any situation producing more than one casualty presents the problem of triage to the individual who must initiate emergency care. A priority treatment order must be established if maximum use is to be made of available resources. A rapid assessment of injuries and mental classification of all survivors is required to determine the order in which treatment will be administered, and evacuation will be commenced.

a. Triage Groupings

Generally, five types of casualties can be noted following any situation involving large numbers of casualties. These are:

1. **Group I.** Those survivors with either minimal, simple first aid type injuries amenable to self care or no injuries at all.

2. **Group II.** Those survivors whose injuries will require trained medical care but whose treatment may be delayed with little added risk.

3. **Group III.** Those survivors with significant injuries whose ultimate recovery will be determined by the timely institution of proper initial treatment. It is this group of survivors who most urgently need competent emergency medical care and who will benefit most from it.

4. **Group IV.** Those survivors whose injuries are so critical that their chances for life would be marginal even if an ideal medical treatment situation existed. Some medical training is necessary in order to recognize survivors to be placed in this group.

5. **Group V.** Those obviously deceased.

b. Triage Objective

This survivor classification and treatment program has certain inherent compromises. However, its objective is to restrict initial treatment efforts to the simplest possible procedures for the greatest number of individuals with the potential to survive. Sorting of casualties is a difficult problem, but it is a task which must be accomplished when limited medical personnel, supplies, and equipment are available, and a large number of injured must be cared for.

982 SRU Procedures

The first thing a SAR unit does after arrival at the scene is to insure that all persons trapped in a hazardous environment have been rescued. Survivor processing commences as soon as the survivor comes aboard a rescue craft, or as soon as the survivor is extracted from any wreckage in which he may be entrapped. The differences in handling of survivors is dictated by the amount of aid that can be provided by the SAR unit to the survivor.

a. Survivor Processing

The following general procedures are recommended for processing of survivors. Note that the scope and numbers of casualties, the type of SRU and the medical resources available will dictate the extent of survivor processing which can be accomplished.

1. Begin triage. Administer any lifesaving first aid which is required. If survivor processing tags are used, attach one to each survivor. If not used begin medical log on each survivor.
2. Account for all occupants of distressed craft. Limited debriefing of survivors should be conducted for this purpose as possible.
3. Complete triage and administer emergency care within capabilities.
4. Report survivor status to OSC, initiate steps to locate any missing survivors, and initiate steps for evacuation if not already done.
5. Safeguard personal effects of survivors.
6. Examine personal effects of deceased persons for identification purposes.
7. If on land and evacuation cannot be immediately accomplished, establish the best possible camp for the protection of the survivors.
8. Preserve medical evidence, physical evidence, mail and classified matter for future disposal and use.
9. More detailed debriefing of survivors should be undertaken at an appropriate later time for use in reports and use by accident investigation authorities. There is a particular value to statements given by survivors shortly after accidents occur which is significant for prevention of other accidents and for revising procedures.

983 Administration of Emergency Care

Emergency medical care should be administered whenever possible by a doctor, corpsman, emergency care SAR crewman, paramedic or similarly trained individual. Other personnel engaged in SAR should be trained in emergency first aid in order to care for the injured when trained medical personnel are not available. This training should include the following general areas:

(a) Cardiopulmonary resuscitation.
(b) Shock.
(c) Hemorrhage and other wounds.
(d) Fractures.
(e) Spinal injuries.
(f) Burns.
(g) Heat stress and dehydration.
(h) Hypothermia and other cold injuries.
(i) Multiple injuries.

984 Survivor Emotions

SAR personnel must be alert to the psychological condition of the survivors. Such factors as grief, despair, or the ordeal of survival may cause the survivors to manifest irrational behavior such as neglect of personal safety, attempts at suicide or other irrational acts both during and after the rescue. Rescued persons should not be left alone, especially if injured or showing signs of physical or mental exhaustion. Both the physical condition and the mental condition of each survivor should be taken into consideration. It may be possible for an uninjured survivor to be on the verge of a complete mental collapse due to his basic makeup or occurrences he encountered or witnessed during the accident. This condition could cause the survivor to go into a state of uncontrollable shock.

Handling survivors who have just lost their loved ones or friends in a disaster requires sensitive understanding from others. Most people go through three periods of grief: shock, suffering, and recovery. The time spent in each period varies with the individual, ranging from days to months. In general, SAR personnel will be involved while the survivors are in varying levels of shock and suffering. Generally a survivor in a condition of shock due to grief will perform actions mechanically, doing only what he has to do—if that much. A survivor in the suffering period starts to perform actions he is forced to do by either convention or his own restlessness. As he grows bolder he will venture away from the surrounding security offered by others. He then enters the recovery period in which his actions are of his own free choice.

Survivors who are rescued from disasters at sea may take several days to be transported by ship to a safe delivery point. For this reason it is possible that SAR personnel may be required to handle survivors in both grief periods of shock and suffering. In general SAR personnel must render sympathetic understanding, should be empathic, and should be quietly present to be of value to a grieving individual.

Survivors may find a great need to talk of the person or persons they have just lost. Therefore SAR personnel should above all be good listeners. Allowing the survivor to talk of his loved one will do much to hasten his recovery. Survivors who have lost loved ones should not be left alone, if at all possible. Under these circumstances, survivors will normally feel a strong need to cry to release their tense feelings and emotions, and should be allowed to do so.

When encountering survivors who are undergoing violent unruliness such that they may cause injury to themselves or others the following actions are recommended:

(a) Assign a man to attend the survivor continuously.

(b) Strap survivor to litter or bunk securely. His arms, legs, chest, waist, and knees should be strapped securely.

(c) If suffering from convulsions, a rolled-up handkerchief or similar device between the teeth may prevent biting of the tongue.

(d) Obtain medical advice in respect to medication that might be helpful.

985 Survivor Debriefing

There are four main interest areas that survivors should be debriefed about. These are: Self-help medical treatments, other survivor/occupant information, survival experiences, and accident cause/prevention.

The first thing survivors should be questioned about is whether any self-help emergency medical care has been rendered to themselves, and particularly if they have taken any medication. If a survivor has a past history of a particular type of recurring disease, such as heart trouble, diabetes, epilepsy, or similar condition, this should be noted on their survivor processing tag or in the medical log entry on the person. This is for the information of future attending medical personnel.

The next thing the survivor should be questioned about is the total number of occupants in the distressed craft, the possibility of other survivors being unaccounted for, and any leads as to their whereabouts. This is of particular importance in cases involving bailouts of multiseat aircraft in which survivors may be scattered some distance apart. Usually when bailout is required and circumstances permit, the pilot of an aircraft will place his aircraft into a circle while all of his crew bails out. He will then straighten out the aircraft in a direction away from those in his crew who have bailed out and then will bail out himself. In a case such as this it is important to know how many occupants actually left the aircraft, and whether or not it was in level flight or in a bank at the time of bailout. Additional information such as bailout altitude and position is important in determining the probable surface datum for subsequent search efforts. Figure 9–42 is a form which can be used for survivor debriefing after bailout and figure 9–43 is one which can be used for marine casualties.

The third area of questioning is delayed until survivors are adeqately cared for and rested. In this case the survivor is questioned about his experiences during the survival, search, and rescue phases. By explaining his experiences he may aid the SAR System in evaluating its effectiveness and other performance factors.

The fourth area concerns pertinent factors that caused the accident to occur. This is usually developed during the accident investigation, although any statements made to SAR personnel may be of great value to the accident investigation. The purpose of this type of questioning is to prevent future accidents of a similar nature from occurring.

a. Survivor Debriefing Kit

Just as survival often depends upon the availability of a survival kit, successful debriefing will often depend upon the availability and effective use of a survivor debriefing kit. The kit should contain at least the following:

1. Survivor debriefing forms.
2. A small, portable tape recorder.
3. A simple camera.
4. Scratch pads, ballpoint pens, and felt-tip marker pens.

The survivor debriefing form should permit the gathering of data important for SAR planning in the immediate future. It should enable the questioner to ask a logical and orderly set of questions without omitting any essential information. Its use will also provide an on-the-spot record of information which might be forgotten prior to the completion of the mission and its documentation. It should be a short self-explanatory form and should be eventually filed in the SAR mission documentation folder. Tape recorders range in size from subminiature to large fixed models. A small, portable recorder should be chosen for its compactness, battery operation, ruggedness, and all weather protection. Tape recorders provide a permanent record of information obtained during the debriefing, or immediately after if summarized by the questioner. They permit a faster debriefing which will reduce fatigue and help the survivor maintain continuity of thought. Using a tape recorder will also interfere the least with any emergency medical care which is being administered to the survivor at the same time.

The camera is used as a third permanent record of the distress situation. Camera sizes and types vary considerably, but generally a rugged, simple, compact type is best suited. If no camera is available at the distress scene, and the location is on land, the scene should be sketched showing all pertinent data, such as wreckage location, terrain scars, survivor and occupant locations, and the direction of magnetic or true north.

b. Debriefing Techniques

Since about 60 percent of all survivors will have experienced injury and all the survivors will have just been through a harrowing experience, it is likely that all survivors will be in a state of shock. Care must be taken to avoid worsening a survivor's condition by excessive questions.

If the survivor is frightened or excited, the questioner should consider the survivor's statements with respect to the situation as he observes it. The validity of answers from such a survivor are questionable at best.

The questioner should ask questions in a calm voice and adjust his pace to that of the survivor. He should avoid putting words in the mouth of the survivor. He should explain that the information sought is essential for the success of the present SAR mission or may be of great value in future missions.

The key element in survivor questioning is the interviewer. He must at all times be considerate, tactful, sympathetic, calm, authoritative, and knowledgeable.

990 SURVIVOR TRANSPORT

After location, rescue and the initiation of emergency medical treatment of the injured survivor, medical evacuation (MEDEVAC) to a medical care facility must be accomplished. Since this is usually accomplished by using the most expeditious means of transportation available, the injured survivor is often subjected to aerial flight. Medical evacuation may also be indicated in cases of sick or injured persons on ships or in isolated areas.

When relying on medical advice from doctors who are not well versed in operational medicine, it is necessary for the operational authority to explain to the doctor in some cases, the operational hazards involved so that a decision can be reached as to whether a medical evacuation may do more harm than good. One of the most common types of medical situations encountered by SAR personnel is the evacuation of a "heart attack" victim from a ship or remote area. If the victim is suffering from the condition known as myocardial infarction, the basic principle in the immediate care of the patient is to allay apprehension. Transfer of such a patient to a helicopter or small boat may produce sufficient apprehension to cause the death of the patient. Therefore, operational authorities should advise the consulting doctor of the fear inducing nature of any operation which is necessary if the patient is to be evacuated.

991 Evacuation From Marine Craft

In any evacuation at sea, the primary controlling factor is distance. Generally the evacuation will be by helicopter unless the vessel is in coastal waters within range of SAR boats. The maximum radius of action of helicopters is decreased by wind, weather conditions, and added weight factors. Only under the most favorable conditions would maximum radius of action distances be attempted.

Survivor Debriefing Form (Aircraft Bailout)

1. Aircraft type and number ______________?
2. Date/time of leaving aircraft ______________?
3. Position of aircraft at time of jump ________ latitude ________ longitude ________?
4. Height of aircraft ________ above sea level ________ above terrain ________?
5. Course of aircraft ________ Magnetic ________ True ________?
6. True air speed ______________?
7. Aircraft in level flight or bank ______________?
   If in bank, degree of bank ______________?
8. Wind velocity at height of jump and method of calculation ______________?
9. Compartment of aircraft occupied and exit used in jumping ______________?
10. Total number of occupants ______________?
11. Names of others present in compartment at jump time ______________?
12. Order of jumping from compartment occupied ______________?
13. If known, did all those occupying compartment leave the aircraft ________ If not, how many got out ________?
14. Compartment(s) occupied by missing men ______________?
15. Did missing men leave the aircraft ______________?
16. Time interval between first and last man leaving your compartment ______________?
17. Method of navigation immediately prior to abandoning aircraft ______________?
18. Was radar being used to assist in navigation ______________?
19. Range on radar scope ______________?
20. Was radar picture clear ______________?
21. Clothing worn by missing men ______________?
22. Was any type of exposure suit worn or carried ______________?
23. Was emergency seat pack worn ________ If so was it marine or land kit ________?
24. Were life vests worn ______________?
25. Were any type of survival kits dropped ______________?
26. Exact position of landing after jump ______________?
27. Remarks or additional information likely to assist in location of missing men ______________?
28. Sketch distress scene on reverse ______________?
29. Survivor's name and crew position ______________?

____
Debriefing Officer

FIGURE 9–42

Normally the SMC controlling the mission will request the vessel to divert and head for a certain position or port. The sooner the vessel acknowledges by message that he will divert and gives his estimated time of arrival at such a position, the sooner the helicopter flight can be planned and lauched. If the vessel is already within range of the helicopter, it is still necessary for him to divert in the direction of the helicopter's departure point to expedite the removal of the patient.

A fixed-wing aircraft may also be dispatched to serve as escort, navigation aid, and communication relay unit for single-engine helicopters. The vessel should provide as accurate a position as possible, time of position, course, speed, weather and sea conditions, wind direction, and velocity. Also the medical information on the patient should include whether he is ambulatory or not. SAR helicopters do not normally carry a stretcher, therefore if one is needed, this information should be obtained prior to dispatching the helicopter so one can be placed aboard.

After the helicopter has departed its base, the vessel should be advised of its estimated time of arrival (ETA). The vessel should stand a continuous radio guard of 2182 kHz or any other frequency specified if 2182 is not available. It is most probable that initial communications will be established with the fixed-wing escort and later with the helicopter as it gets closer. Frequent transmissions may be requested from the ship for homing purposes.

When personnel are removed from vessels it is necessary that all immigration, quarantine, and customs laws are observed. Therefore agencies concerned with these laws are normally advised in addition to public health services and

Survivor Debriefing Form (Marine Casualty)

Initial Questioning

1. Type craft and number ______?
2. Date/time of casualty ______?
3. Location of casualty ______?
4. Nature of casualty ______?
5. Total number aboard ______?
6. Number of known dead ______?
7. Number of other known survivors:
   a. On damaged craft ______?
   b. In lifeboats ______?
   c. In liferafts ______?
   d. In water with lifejackets ______?
   e. In water without lifejackets ______?
8. Description of survival craft launched ______?
9. Detection aids available to survivors ______?
10. Environmental protection (clothing or devices) available to survivors ______?
11. Other information helpful for location and rescue of other survivors ______?

Subsequent Questioning

1. Names of persons in vicinity of the survivor at the time of abandoning ship ______?
2. Type of lifesaving equipment used (lifeboat, inflatable or rigid raft, lifefloat, buoyant apparatus, ring buoy, life preservers, or combinations thereof) ______?
3. How long was survivor in water ______?
4. Did a personal lifesaving device (life preserver, ring buoy) aid or hinder in any way his chance of survival ______?
5. At what point was the device donned or grasped ______?
6. Was the device difficult to manipulate ______?
7. Any suggestions regarding device ______?
8. How long did it take to abandon ship after the decision to do so was made ______?
9. Difficulties, if any, with the launching of lifeboats or liferafts ______?
10. Serviceability of the equipment at the time it was used ______?
11. Clothing worn by survivor and protection afforded from exposure by the lifesaving equipment ______?
12. Personal injuries caused by lifesaving equipment ______?
13. Were distress signals used as an aid in showing the survivor(s) location? Include their description, effectiveness and the times (day or night) at which they were used ______?
14. A description of any malfunctions of the lifesaving equipment with a description of its possible cause ______?
15. State recommendations for improvement of the equipment or the need for more, less or other tyoes of equipment ______?
16. Was the lifesaving equipment used in any unusual way that aided in the rescue or prevented injuries to the survivors ______?
17. Were the means of egress on the stricken vessel to its lifeboat stations adequate ______?

______
Debriefing Officer

FIGURE 9-48

the vessel's owners or agent. If the patient evacuated is of foreign nationality, then his country's embassy, consulate, or consular agent must also be notified.

If the vessel is far at sea, MEDEVAC's are often accomplished successfully by another vessel. Ocean station vessels or Naval vessels may be diverted to effect the transfer. Usually these are selected if they have a medical officer on board. However, there are times when they are used because they are the most convenient means of transportation. Other merchant vessels with doctors or superior medical facilities may be in the vicinity, providing a means of transferring the patient to a ship which can provide medical treatment. Or, the patient may be transferred from an outbound merchant vessel to one which is inbound. The Automated Mutual-assistance Vessel Rescue (AMVER) system can be of great help in finding a suitable merchant vessel for transfer. In dealing with merchant vessels for MEDEVACs, the SAR mission coordinator acts in the role of an intermediary. He cannot direct merchant vessels. The procedure which should be used is: Provide the master of the ship with the patient with available information about ships in his vicinity which can help, and recommend that the master communicate directly with the selected ship so as to make mutually satisfactory arrangements with the other master.

992 Evacuation From Land Areas

Evacuation of survivors will be relatively simple, if they are located in an area where medical and rescue facilities are available locally and where aerial, road, or water transport is possible. If it is possible to evacuate the survivors by air, the rescue party should select the most desirable landing area for a fixed-wing aircraft, or a landing or hovering site for a helicopter, and then clear it of brush, rocks or other hazards and mark the landing site. Appropriate ground/air signals should be prepared in case radio contact is lost with the aircraft.

If, because of the condition of survivors, time of day, weather conditions, or other reasons, early evacuation is considered undesirable, camp should be established in as favorable a site as possible. The site should afford protection from the elements, tide-rise or river floods, and from dangerous animals or reptiles. It should also be close to aircraft-landing or supply dropping zones, sources of fuel and potable water, and to the planned evacuation route.

If AIRMEDEVAC is not possible from the distress scene, the evacuation will have to be made on foot to a place from which aerial, road or water transport can be provided. The land SRU/ground party must evaluate the possible methods of overland travel during their stay at the distress scene. Routes to possible connection points with transport facilities must be selected with care and made known to the SAR mission coordinator. This will simplify the provision of continuous aerial coverage and support, and enable the party to be supplied frequently from the air with food, water, and medical supplies, so that they need not carry large and heavy loads of essential items. Additional factors to be considered in route selection are ease of constructing new shelters en route, ease of travel, expected weather, location of food and water, mode of transportation, and number and condition of land SRU members.

Before the decision is made to remain or to depart the distress scene, the following factors should be considered:

1. The condition of the survivors.
2. The practicability of aerial evacuation (particularly the availability of suitable landing or hovering sites for fixed-wing aircraft or helicopters).
3. The mode of overland travel (motorized, foot, snowmobile, sled).
4. The number and condition of land SRU members.
5. The ability of the party to give medical attention to survivors en route.
6. The difficulties that are likely to be encountered (i.e. provision of shelter, food, water, weather, conditions, etc.).
7. The methods of maintaining communication with the SMC.

The medical effects of travel must be weighed against the comfort and quality of care possible at the incident site. Hasty decisions to travel before the survivors are fully capable of travel may cause more harm than good, and may often sever the line of communication and resupply with support forces.

Single file is usually the best method of advancing through bush and the greatest care should be taken that the party stays together. However, if the party must spread out, such as to find a trail, constant contact must be maintained. If it is forced to divide, such as to give seriously injured survivors a day of rest, each section should be placed under the charge of a competent leader.

993 Transportation of Bends Victims

SAR authorities are often called upon to assist victims of the bends (Aeroembolism), usually recreational divers. These persons are suffering from a forming of gas bubbles in the tissues. It is necessary to get them to a hyperbaric chamber as soon as possible in order to properly decompress them and eliminate the gas bubbles. A listing of hyperbaric chamber locations is contained in a *Directory of World-Wide, Shore Based Hyperbaric Chambers* (Volume I, *U.S. and Canada*, NAVSHIPS 0994–010–4011 and Volume II, *Other than U.S. and Canada*, NAV-

SHIPS 0994-010-4012). These volumes can be obtained from Commander, Naval Sea Systems Command, Navy Department, Washington, DC 20362. If no hyperbaric chambers are readily available, consideration should be given to the use of the decompression capability of Navy submarines if they are available.

Since the bends is caused by gas bubbles in the tissues, increases in altitude can aggravate the condition of the patient. Air transportation must therefore be conducted at the lowest possible altitude. When available, a portatable hyperbaric chamber should be carried by the aircraft and the patient treated while en route. Personnel qualified in the operation of the portable chamber should accompany it to the scene. If pressurized aircraft are used, cabin pressure shall be maintained at sea level (not at the usual 8,000 feet). Administration of oxygen during transportation, if possible, is recommended. While transporting a bends victim he should be kept lying down, feet slightly higher than his head, with his body tilted 20° to the left side. He should be kept warm and his condition must be constantly monitored.

A more complete discussion on the treatment of diving casualties is given in the U.S. Navy Diving Manual, NAVSHIPS 0994-001-9010 (available from Commander, Naval Sea Systems Command) and the National Oceanic and Atmospheric Administration Diving Manual (available from the Superintendent of Documents, Government Printing Office, Washington, DC 20402, Stock No. 003-017-00283).

994 Ambulance Service

When a patient is not delivered directly to a medical facility, the SMC should make arrangements for a suitable ambulance to meet the transporting facility at its point of arrival.

995 Survivor Delivery

a. Briefing of Receiving Facility

When survivors are delivered to a medical facility, the person in charge of the delivering unit should provide information on all first aid and emergency treatment given to the survivors. The degree of this briefing will depend upon the medical competence of the personnel who administered emergency treatment. A unit with a doctor aboard will be able to provide much more detailed information than a unit which was only able to provide first aid. Among the important information which should be transmitted are:

1. Type of injury or condition suffered by the patient.
2. Treatment given.
3. Medications given (amounts and times when administered).
4. Times when tourniquets, splints, or compress bandages were applied.

b. Medical Record Delivery

The survivor processing tag, medical logs, and any other medical records pertaining to the survivor should be delivered to the medical personnel of the receiving hospital.