AIR NAVIGATION SUPPLEMENT

PREPARED BY

BUREAU OF NAVAL PERSONNEL

CHAPTER 3

MECHANICAL PLOTTING BOARD (MK3A) AND MK8 COMPUTER

The development of the mechanical plotting board has been of special value to the Navy, particularly for the rapid solution of those navigational problems experienced in long overwater flights by single-engine aircraft. The primary disadvantages found in the board are its size and the necessity for considerable care in handling and use. It is not always as easily read as a chart would be, particularly in night operations or under other bad lighting conditions.

DESCRIPTION

The mechanical plotting board is designed as a complete navigational device, requiring nothing more than a soft lead pencil for computing any dead reckoning problem within the limits of the board. The plotting surface has a matte finish on a transparent plastic base which provides a suitable writing surface that can be easily erased. A grid disc fastened to the board by a grommet or a snap fastener rotates under the plotting surface. On each side of this disc is printed a rectangular grid and a series of concentric speed circles, equally spaced. The grid and circles are usually shown in color. A different scale is used for each side of the disc. The speed of the aircraft and the length of the mission should determine the choice of scale. Space for important data and a MK8 computer is also provided. A similarly marked disc and a transparent sheet of paper may be readily substituted for the more expensive plotting board. Templates are available for certain areas of the world, eliminating the necessity of constructing a plotting sheet on the board, and adding somewhat to the accuracy and speed of locating positions. These templates are listed in the Hydrographic Office *Catalog of Aeronautical Charts and Publications.*

CARE

Cautions.—Never place the board under extreme mer sunlight for an extended period will warp the board.

Never leave the board in the plane. Rain and grease do not improve it. The plastic board should not be subjected to any strain that will bend the surface or the grid. It is expensive and not easily replaced.

The plotting board is not a toy; its versatility will amaze you. The disc grid should not be rotated at high speed for amusement purposes. The grommet should snugly fit the hole in the face of the board and the grid disc. When the true indices are lined up with 000, 090, 180, and 270, not more than ½° error should be observed. If a greater error is found, the board should be readjusted or surveyed.

Suggestions.—Always begin a problem with a clean board, using a good eraser for cleaning.

Never put a mark on the board without labeling it. Use a sharp, soft pencil.

Most important of all, establish good working habits and be consistent in their use. When an emergency arises, much time will be saved.

The board should *never* be erased in operational use until the mission is completed. The use of subscripts is recommended. (P_1, P_2, etc.)

USE

General.—The plotting board can be worked with one hand, a desirable feature in both light planes and single-engine military aircraft. In military aircraft the board is mounted on a sliding shelf either under the instrument panel or at the side of the pilot's seat. A smaller version of the MK3 board is being considered for use in the Navy jet planes. The reduction in size was necessitated by the limited cockpit space. The need for computing speeds considerably in excess of the scale shown on the present grid com-

Specific uses.—A plotting sheet can be constructed on the board.

Course and distance can be read directly from the board.

All directions should be read as true from the true index.

The standard vector diagram is easily reproduced on it. Interception, radius of action, point option, the vector diagram, and other navigation problems are quickly solved.

Pointers in drawing on the board.—The vector diagrams illustrated in this chapter are shown with broken lines drawn to a point indicating the (speed) length of the vector. This practice is recommended only for instruction and illustration. Indicating the dot by lettering *w*, *p*, *e*, or *s* is sufficient for operational use, or the vector may be shown by the use of arrows, or arrows and letters, as shown in figure *34*.

These practices are for the beginner. As proficiency is obtained there will be no necessity for drawing the

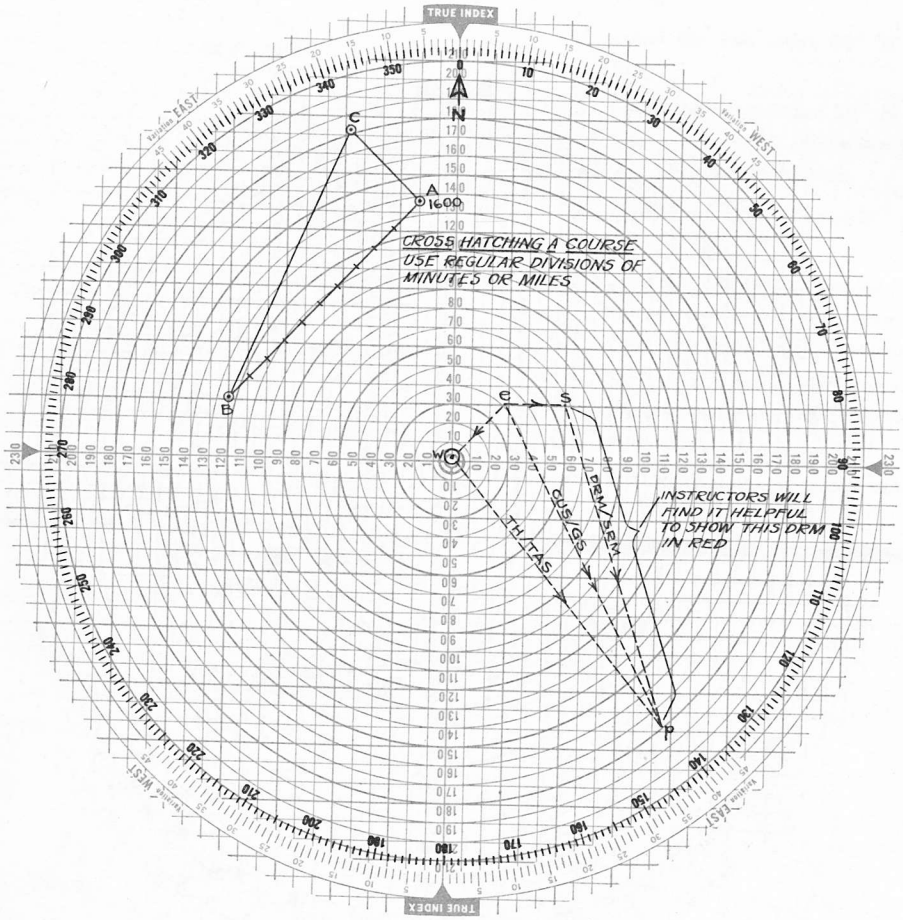


Figure 34.—Vector diagram.

A complete log may be kept on the data cards accompanying the board.

The MK8 computer, a circular slide rule, is attached to the lower right hand corner of the board and is used for solving time, speed, and distance problems, and for determining true air speed and altitude corrections.

vector or indicating the direction with the arrows. Instructors will find it helpful to their inexperienced students if they are consistent in their presentation of the vector diagram.

All geographic positions should be indicated by a circled dot, thus: ⊙. This practice has two advantages: the location of a geographic position is distinguished

from a portion of the vector diagram and the dot indicating the position remains clear and distinct for measuring distance, direction, or position when possible. Time should also be indicated when a geographic position is shown.

Much time can be saved if the mission or problem is studied before constructing the chart. The limited area of the MK3 board compels the navigator to select the mid-latitude and mid-longitude with care.

gardless of the amount of increases of speed value, directions and angles must *not* be changed. The size of the vector is thus reduced in all respects to the same proportions, as shown in figure *35*.

In all following illustrations and problems, the values given are true for all courses, tracks, headings, airspeeds, and similar measurements, unless otherwise stated.

A velocity vector may be represented by a straight

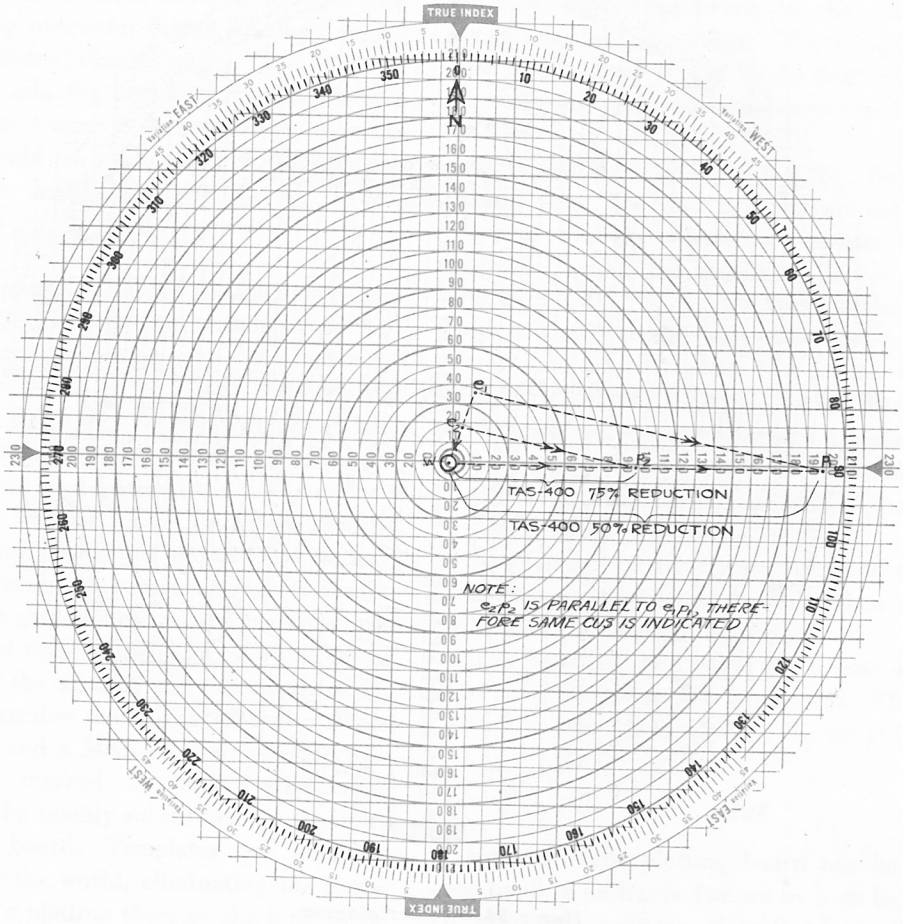


Figure 35.—Proportional reduction of a vector.

Select the side of the disc whose maximum speed circle is nearest to the true air speed of the plane. If the plane speed exceeds the maximum true air speed circle, the wind vector may be solved by increasing all speed circles proportionately. But remember, re-

line with an arrow head on one end. It indicates both direction and speed. The direction of a vector is indicated by the angle that it makes with true north while the speed is represented by the length of the vector drawn to some preselected scale.

1 HOW TO CONSTRUCT THE CHART

Given

Mid-latitude 20° N

Mid-longitude 05° W

Procedure

1. Set the true index directly under 0° or N.
2. Label the true index 05° W (Mid-long.).
3. Label the cross index 20° N (Mid-lat.) and every 60′ above and below with appropriate latitude.
4. Revolve the disc clockwise 20° (Mid-lat.).
5. Draw a line directly across the board coinciding with the cross index. This is the reference line for longitude.
6. Draw a short pencil line across the reference line every 60′ on each side of the grommet.
7. Label with the appropriate longitude.

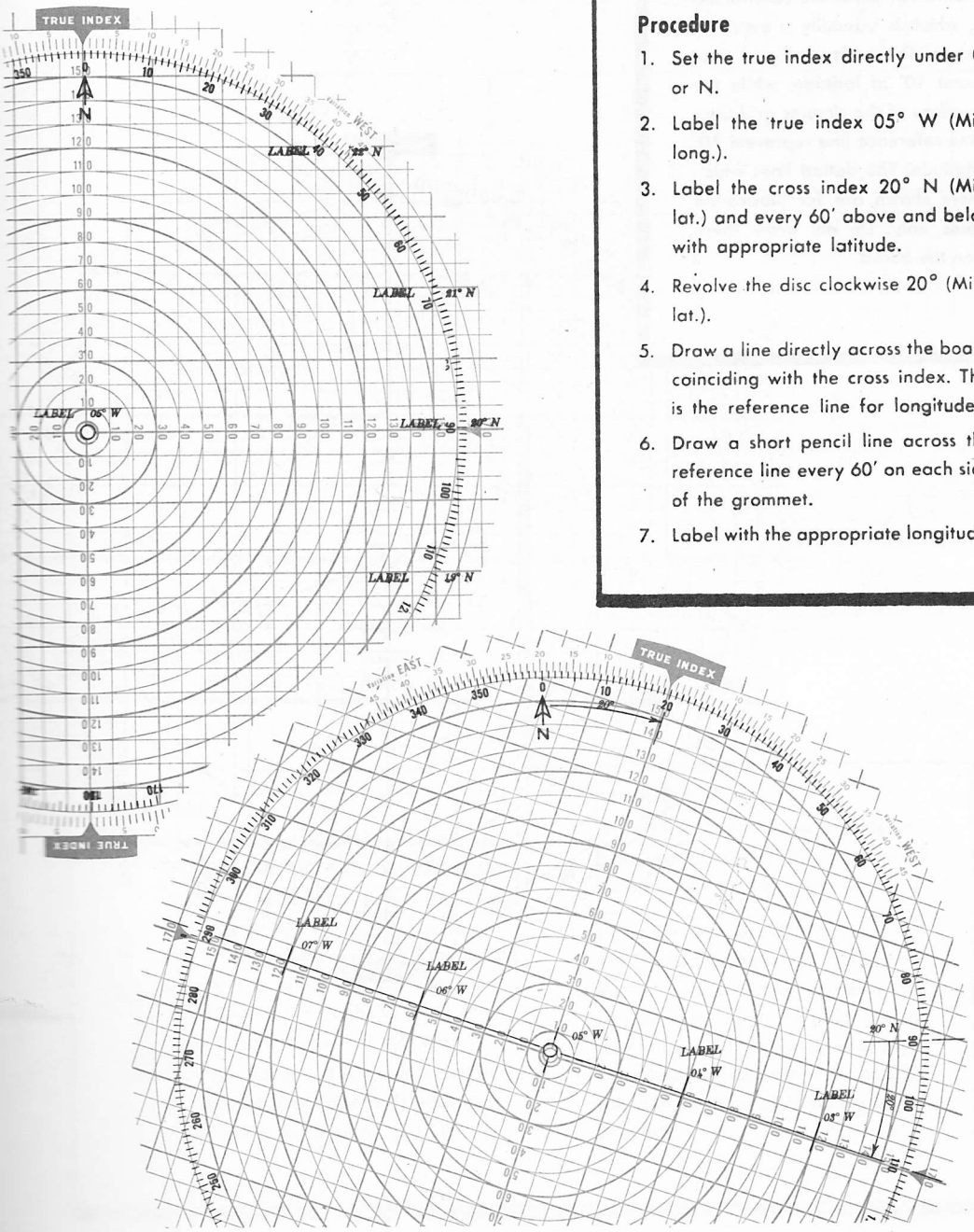
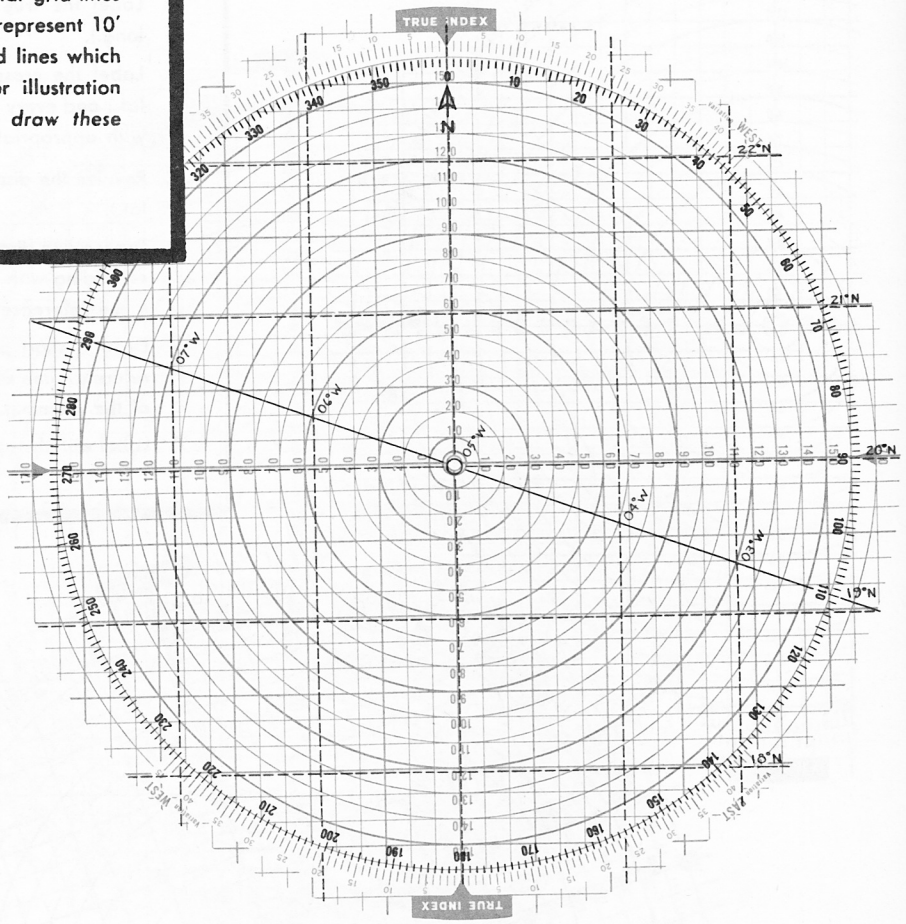


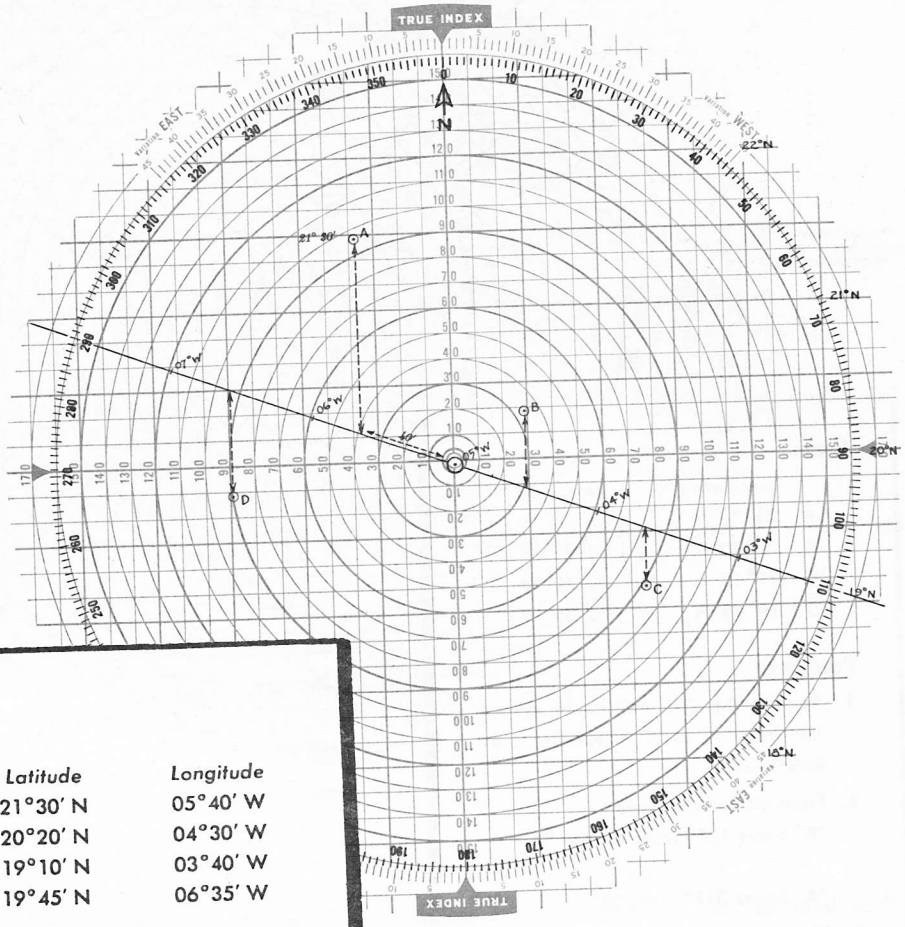
Figure 36a.

1 (CONTINUED)

8. Reorient the disc to 0°.
   The illustration shows the constructed chart, which is basically a mercator projection. The horizontal grid lines represent 10′ of latitude, while the intersections of the circular grid lines with the reference line represent 10′ of longitude. The dotted lines which are here shown are for illustration purposes only. *Do not draw these lines on the board.*



2 HOW TO LOCATE POSITIONS



Given

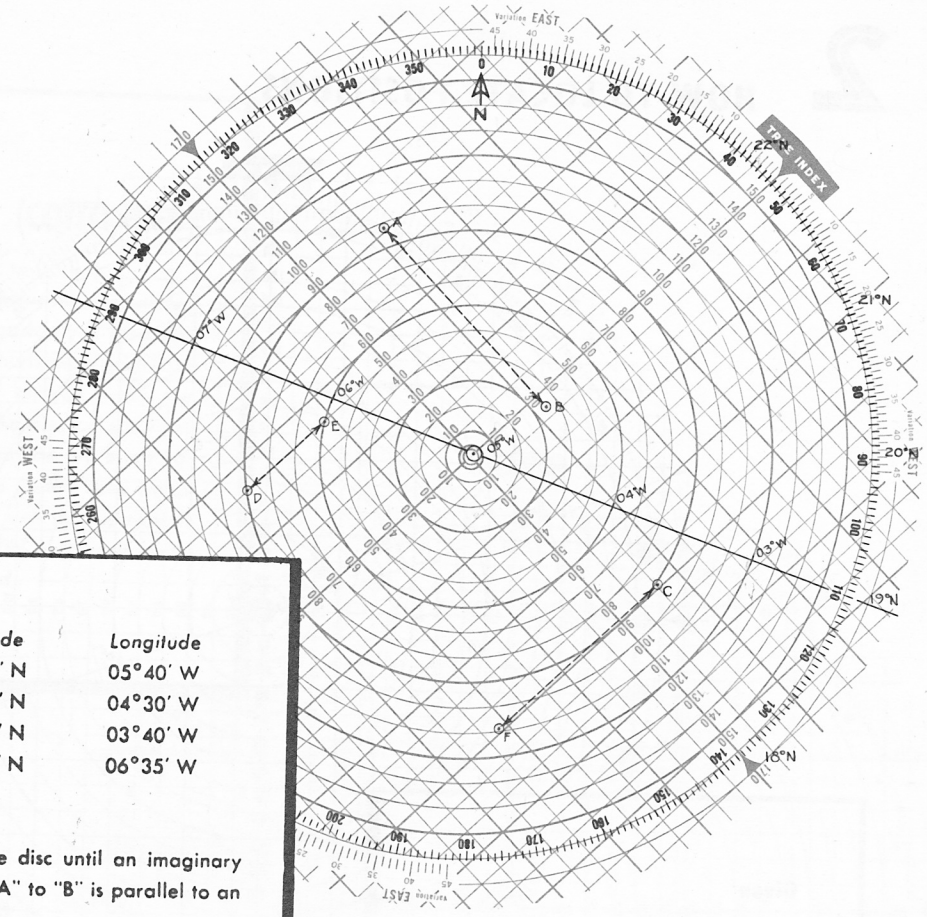
	Latitude	*Longitude*
A	21°30′ N	05°40′ W
B	20°20′ N	04°30′ W
C	19°10′ N	03°40′ W
D	19°45′ N	06°35′ W

Procedure

1. Find the longitude. The longitude of "A" is 05°40′ W. From the Mid-long. (05° W) follow the reference line left (W) to the 40 circle. The intersection of the 40 circle with the reference line is 05°40′ W longitude. A vertical line through this point contains all points on that meridian.
2. Find the latitude. The latitude can be determined from the horizontal grid lines above the Mid-lat. (20° N).
3. The intersection of these latitude and longitude lines gives the location of positions, as on any other chart.

In similar manner "B," "C," and "D" are located to the left or right of the Mid-long. and above or below the Mid-lat. For south latitude and/or east longitude the chart is constructed in an identical manner. *Care must be taken at all times to orient the board properly.*

Figure 37.



Given

	Latitude	Longitude
A	21°30′ N	05°40′ W
B	20°20′ N	04°30′ W
C	19°10′ N	03°40′ W
D	19°45′ N	06°35′ W

Procedure

1. Revolve the disc until an imaginary line from "A" to "B" is parallel to an index line.
2. From the compass rose
   "B" bears 137° from "A"
   or
   "A" bears 317° from "B"
3. The distance between "A" and "B" is 96 mi.
4. Find "E," bearing 047°, distance 40 miles from "D." The true index is set at 047°. From "D" in a straight line toward 047° mark off 40 mi. to locate "E."
5. In similar manner "F" bears 227°, distance 82 mi. from "C."
6. Reorient the board and locate "E" and "F."

3

21 CELESTIAL LINE OF POSITION

Given

Mid-lat.	26° N
Mid-long.	75° W
Jan. 25, 1945	1900
Sun GHA	101°53′
Long.	75°53′ W
Sun LHA	26°
H_c	38°26′
H_o	38°06′
Intercept	20′ Away
Zn	147°

Find

Line of position

Procedure

1. Set up chart.
2. Locate assumed position, 26° N Lat., 75°53′ W, Long.
3. Revolve the disc until the true index is on the true azimuth (Zn = 147°)
4. From assumed position mark off intercept, 20′ Away. Label "A."
5. Through "A" draw line of position (LOP) parallel to the cross index.