CHAPTER 12

CHARTS, GRIDS, AND RADAR NAVIGATION

LEARNING OBJECTIVES

After you finish this chapter, you should be able to do the following:

1. Identify important aspects of charts, such as type of projection, indicated distances, soundings, and symbols.
2. Identify and discuss the procedures for using grid systems found in CIC.
3. Explain the procedures for maintaining a chart library.
4. Discuss the CIC personnel and procedures involved in navigating a ship.

INTRODUCTION

An important aspect of CIC operations is radar navigation. Poor visibility will normally prevent ships from entering or leaving port, because of the obvious additional risk involved. However, there are times when ships must enter or leave port despite poor visibility. At these times radar navigation becomes vital and CIC personnel must perform at their best. Any time ships are underway, good weather or bad, CIC maintains a navigational picture to aid the bridge in determining the ship’s position and to provide command with an accurate strategic plot. Charts are vital to this navigational effort. When you finish this chapter, you should be familiar with the chart system, as well as the navigation procedures and techniques necessary for you to function as an Operations Specialist in CIC.

CHARTS

A nautical chart is a map designed specially for navigators. It provides a photo-like view of some body of navigable water, together with the topographic features of adjacent land. To help the navigator transit the body of water safely, the chart contains standard symbols, figures, and abbreviations that supply data on water depth, the character of the bottom and the shore, the location of navigational aids, and other useful information. Figures indicating water depth are scattered over a chart but are more numerous near approaches to land.

LOCATING POSITIONS ON CHARTS

A chart represents a section (large, medium, or small) of the Earth’s surface. The Earth is a terrestrial sphere with the North Pole and South Pole located at opposite ends of the axis on which it rotates. To establish an object’s location geographically, you must use one reference line running in a north-south (N-S) direction and another one in an east-west (E-W) direction. These lines are part of a circular navigational grid located on the surface of the Earth (See figure 12-1.)

Since the navigational grid is located on a sphere, and navigational charts are flat, the grid lines must somehow be transferred from the sphere to the
chart. This is done through a process called projection. There are two types of projection—Mercator and gnomonic.

**MERCATOR PROJECTION**

Mercator projection charts are the most commonly used charts in CIC. It is important, therefore, that you understand the construction, advantages, and disadvantages of the Mercator system.

If you cut a hollow rubber ball in half and try to flatten one of the halves, you will not be able to do so without tearing or stretching the rubber. In fact, no section of the hemisphere will lie flat without some distortion. Projection of the curved surface of the Earth onto a flat plane presents the same difficulty. Since distortion can present major problems in navigation, limiting distortion to the absolute minimum is a primary goal. The best method for projecting the surface of a sphere onto a flat surface is to project it onto the inside of a cylinder surrounding the sphere and to open the sphere and lay it flat. In this procedure, known as a Mercator projection, there is still some distortion, but it is limited and can be overcome.

The first step in drawing a Mercator projection is to project the N-S lines, or meridians. Assume that Earth is a hollow, transparent glass ball with a powerful light shining in its center. A paper cylinder is placed around it, tangent at the equator, as shown in figure 12-2. Suppose the meridians painted on the glass ball are projected onto the cylinder as vertical lines, parallel to and equidistant from one another. See figure 12-3. The cylinder now has the meridians on its surface, and half of the Mercator projection is complete.

The next step in the projection process is to draw the E-W lines, or parallels. The spacing of the parallels agrees mathematically with the expansion of the longitude scale. When parallels are projected onto the cylinder, they become farther apart as their distance from the equator increases. The North and South poles cannot appear at all, because one pole is projected out the top of the cylinder and the other pole is projected out the bottom.

If we now unroll the cylinder and look at the projection (fig. 12-4), we will see that the meridians are parallel to and equally distant from one another. The latitude lines are parallel to one another, but they gradually draw apart as they become farther north or south of the equator. Above 80°N or below 80°S latitude, the latitude lines become so far apart that a

![Figure 12-2.—Cylinder tangent to the Earth at the equator.](OS311202)

![Figure 12-3.—Projection of meridians onto the cylinder.](OS311203)

![Figure 12-4.—Meridians and parallels on the Mercator projection.](OS311204)
Mercator projection of the polar regions is seldom used.

Although the space between parallels on a Mercator chart increases with latitude, the distance represented by 1° of latitude is always the same. One minute of latitude is considered to be 1 nautical mile. On a Mercator projection, however, 1° of latitude near one of the poles appears considerably longer than 1° of latitude near the equator. It follows, then, that if both measurements represent the same actual distance, any distance as shown in high latitudes on a Mercator chart is greatly distorted.

You have only to look at figure 12-5 to realize the truth about distortion. On the globe you see the actual comparative sizes of Greenland and the United States. The United States actually is a good deal larger than Greenland. But on the Mercator chart in the background, Greenland appears to be larger than the United States. This illusion occurs because the United States, being much nearer to the equator, is not distorted nearly as much as Greenland, which is in a high latitude.

GNOMONIC PROJECTION

The details of a gnomonic projection are not especially useful to surface navigators and, therefore, are of little use to an Operations Specialist Third or Second. You simply need to know that gnomonic projection preserves the natural curvature of the meridians and parallels, so you see them as though you were looking directly at a point on the surface of the Earth. If the point happens to be one of the poles, the parallels appear as a series of concentric circles, and the meridians are straight lines radiating away from the pole.

Polar charts usually are gnomonic projections because, as you already learned, a Mercator projection of the polar regions cannot be used.

CHART TERMINOLOGY

We mentioned earlier that to locate a point on a chart, we must reference the point to a specific meridian and a specific parallel. To identify the meridians and parallels, we use numerical designators drawn from the circular grid. Each circle in the grid is divided into 360° (degrees); each degree can be divided into either 60’ (minutes) or 3600” (seconds). Remember, lines running in the N-S direction, from pole to pole, are called meridians. Lines running E-W, around the entire globe, are called parallels.

Meridians

The charting grid contains 360 meridians. The reference line for all meridians is the prime meridian (0°), which passes through the Royal Observatory at Greenwich, England. The remaining meridians are
numbered from $1^\circ$ to $180^\circ$, both east and west of the prime meridian. Meridians located east of the prime meridian are designated as $1^\circ$E to $180^\circ$E and make up the eastern hemisphere of the Earth. Meridians located west of the prime meridian are designated as $1^\circ$W to $180^\circ$W and make up the western hemisphere of the Earth.

**Parallels**

The reference for parallels is the equator. The equator ($0^\circ$) is located halfway between the poles and divides the globe into northern (N) and southern (S) hemispheres. The numbering system for parallels is similar to the numbering system for meridians, except that since parallels completely encircle the globe, $90^\circ$ is the maximum number of degrees that can be assigned to a parallel. Parallels are numbered from $0^\circ$ at the equator to $90^\circ$N at the North Pole and $90^\circ$S at the South Pole.

**Latitude and Longitude**

Every spot on the Earth is located at a point of intersection between a meridian and a parallel. Every point’s location is described in terms of latitude and longitude.

The latitude of a point is the point’s angular distance in degrees, minutes, and seconds of arc north or south of the equator, measured along the meridian that runs through the point. See figure 12-6.

The longitude of a point is the angular distance in degrees, minutes, and seconds of arc east or west of the $0^\circ$ meridian, measured along the parallel that runs through the point. See figure 12-6.

For navigational purposes, accuracy demands are rigid. The EXACT position must be designated. Consequently, when you are giving navigational distance, remember that $1^\circ$ is divided into $60^\prime$ (minutes), and $1^\prime$ (minute) is divided into $60^\prime\prime$ (seconds). Thus, a position of latitude may be $45^\circ12^\prime22^\prime\prime$N (or S). The same system is used for a position of longitude east or west. In all reports concerning navigational hazards and positions of lightships, buoys, and the like, transmitted over radio nets or published in the *Notice to Mariners*, position is given in detailed latitude and longitude.

**Nautical Distance**

On the Earth’s surface, $1^\circ$ of latitude is considered to be 60 miles in length, whereas the length of $1^\circ$ of longitude varies with latitude. This is because parallels are always equidistant from one another, whereas...
meridians converge at the poles. Hence, you must always use the latitude scale for measuring distance—NEVER use the longitude scale.

Distance is measured by placing one end of the dividers at each end of the line to be measured and, without changing the setting of the dividers, transferring them to the latitude scale with the middle of the dividers at about the middle latitude of the two points between which the distance is desired.

Scale of a Chart

The scale of a chart indicates the relationship between the size of a feature on the chart and the actual size of the feature on the Earth’s surface. A chart’s scale usually appears under its title in one of two ways: as a ratio or as a fraction. Consider the scale 1:1,200 (or 1/1,200). This particular scale indicates that 1 inch (foot, yard, etc.) on the chart represents 1,200 inches (feet, yards, etc.) on the ground. A scale of 1:14,000,000 indicates that 1 inch (foot, yard, etc.) on the chart represents 14,000,000 inches (feet, yards, etc.) on the ground.

You will hear charts referred to as “small scale” or “large scale”. A small-scale chart covers a large area, whereas a large-scale chart covers a small area. This may seem confusing until you think of “scale” as a fraction. In the examples above, the fraction 1/1,200 is much larger than the fraction 1/14,000,000. So the 1:1,200 chart is a large-scale chart, while the 1:14,000,000 chart is a small-scale chart. The choice of scale depends on how much detail is required (See figure 12-7). Large-scale charts show many more details about an area than do small-scale charts. In fact, many features that appear on a large-scale chart do not show up at all on a small-scale chart of the same area. Normally, the major types of charts fall within the following scales:

1. Harbor charts: scales larger than 1:50,000. These charts are used in harbors, anchorage areas, and the smaller waterways. Charts drawn to these scales cover a smaller area than the next three types of charts, but they show many more features.

2. Coast charts: 1:50,000 to 1:150,000. These charts are used for inshore navigation, for entering bays and harbors of considerable width, and for navigating large inland waterways.

3. General charts: 1:150,000 to 1:600,000. These charts are used for coastal navigation outside outlying reefs and shoals when the vessel is generally within sight of land or aids to navigation and its course can be directed by piloting techniques.

4. Sailing charts: 1:600,000 or smaller. These charts are used in fixing the ship’s position as it approaches the coast from the open ocean, or for sailing between distant coastal ports.

When you work with small-scale charts, be sure to exercise greater caution than you would with larger scale charts. A small error, which may be only a matter of yards on a large-scale chart, could amount to miles on a small-scale chart. For navigating the approaches to land, you should use only large-scale charts.

Soundings

Scattered all over the watery area of any navigational chart are many tiny numbers, each representing the depth of the water (usually the depth
of mean low water) in that particular locality. Depths on charts are given in feet, fathoms, or meters. A notation under the title of the chart is the key; for example, “soundings in feet at mean low water” or “soundings in fathoms at...” Most charts also contain dotted lines used as depth curves to mark the limits of areas of certain depths. In figure 12-8, notice the numerous dotted lines along the shore that indicate depths of 5, 10, 15, and 20 feet and another line near where the Thimble Shoal channel and the bridge opening meet that indicates the 30-foot limit.

Aids To Navigation

Aids to navigation are indicated on a chart by appropriate symbols, shown in the numerous graphics comprising Chart No. 1, Nautical Chart Symbols and Abbreviations. As much information as possible is printed in standard abbreviations near the symbol. For instance, look at the Thimble Shoal light (teardrop symbol) at the western end of the Thimble Shoal channel in figure 12-8. Printed near the light is “Fl 10sec 55ft 12M HORN”. This string of symbols tells us almost all that we need to know about the light.

1. Fl is the abbreviation for flashing. When a light is off for a longer period of time than it is on, it is said to be flashing. If it is on longer than it is off, it is said to be occulting (Occ). Lights can also be fixed (F), group flashing (Gp Fl), quick flashing (Qk Fl), and group occulting (Gp Occ). This list is by no means complete. You can find all of the types in the latest edition of Chart No. 1.

2. 10sec indicates the period of the light. That is, the time for the light to complete one full on-off cycle.

3. 55ft is the height of the light above mean high water.

4. 12M indicates that the light is visible, on a clear dark night, for 12 nautical miles.

5. HORN indicates that this light has a horn sound signal.

There are four standard colors for lights; red (R), green (G), yellow (Y), and white. Notice the channel in figure 12-8. The lighted buoys on the north side of the channel are labeled “Fl R 4sec”, and the southern buoys, “Fl G 4sec”, indicating the color of the lights. If there is no R, Y, or G symbol on the chart, the buoy light is assumed to be white.

The chart symbol for a buoy is a diamond shape. Notice that there is a small dot near every buoy symbol. That dot represents the buoy’s approximate location. If the dot is enclosed in red, as are the channel buoys in figure 12-8, the buoy is lighted. The diamond shape is not actually drawn to scale and may be set down considerably off the buoy’s actual position.

Q1. What is the major type of chart used in CIC?

Q2. How many meridians are contained in chart gridding?

Q3. On the Earth’s surface, 1° of latitude is equal to how many miles?

GRID SYSTEMS

In CIC, three types of coordinates can be used to locate any given position: geographical, polar, and grid. You are familiar with geographical coordinates (latitude and longitude) and polar coordinates (range and bearing). We will now discuss grid coordinates.

MAJOR GRIDS

Grid systems are used to simplify exchanges of positional information among ships, aircraft, and shore activities. These systems have special advantages in certain situations, by providing a rapid way to report positions. Basically, grids are lines drawn on a chart or vertical plot at right angles to each other. Some grids cover the entire globe, while others cover only a designated portion of the globe. Depending on the grid system used, the lines or the areas they represent are assigned number and letter titles or color codes.

On a grid, any point on the Earth’s surface may be located by its grid reference. A grid reference never indicates more than one point, and the grid reference of a given point never changes unless the grid origin is changed. Own ship’s position, course, and speed do not affect a fixed grid.

Three types of grids are in use in the Navy today: Cartesian coordinates, the world geographic reference (GEOREF) system, and the universal transverse Mercator grid (UTM).

The Cartesian coordinate grid system is used for position reporting in large-scale naval operations. This system is compatible with the naval tactical data system, and a single grid will include positions separated by hundreds of miles. The Cartesian system is the most widely used grid system within the Navy.
Figure 12-8.—Part of NOS chart 12221.
The world geographic reference (GEOREF) system is a worldwide reporting system and is used for exchanging position information with the U.S. Air Force and some of our allies, using cross tell long-range communication circuits. As the name of the system suggests, a single grid covers the entire world.

The universal transverse Mercator (UTM) grid is used to increase reporting accuracy in localized military operations. For example, in shore bombardment operations, the position of an enemy gun emplacement can be pinpointed for naval gunners.

As an Operations Specialist, you must be familiar enough with each of these grid systems to be able to quickly convert a position from one system to another and from a grid position to polar or geographic coordinates.

**Cartesian Coordinate (X-Y) Grid**

The Cartesian coordinate (X-Y) grid system, as mentioned above, is used to support large-scale naval operations. It is not based on chart coordinates but is an additional grid superimposed over the charts for the area of operation. The Navy adopted the Cartesian system for use with the naval tactical data system (NTDS). Computers used in NTDS compute every position, in X-Y coordinates, in relation to a known reference point.

Positions transmitted from NTDS ships to conventional ships (on circuits such as link 14), have always been given in X-Y grid coordinates. This required conventional ships to convert the X-Y grid positions to coordinates in whatever grid system they were using.

To eliminate confusion and decrease the plotting delays created by using different systems, the Navy adopted the Cartesian coordinate grid as the standard grid for contact reporting, particularly in AW. Every ship now uses the Cartesian coordinate grid system.

The OTC establishes the center of the grid, which is called the data link reference point (DLRP). It may be given as a latitude and longitude or as a geographical landmark. Every position is then reported in relation to the DLRP.

The Cartesian coordinate grid contains four quadrants, each designated by a color (fig. 12-9): RED = northwest, WHITE = northeast, BLUE = southeast, GREEN = southwest.

Grid positions are indicated by a color followed by six numbers, such as Red 060 100. The color, of course, identifies the quadrant in which the numbers are located. The first three numbers are the X component and indicate the number of miles east or west (left or right) of the DLRP. In this case, since the color is red, the X component is 60 miles to the left (west) of the DLRP. The last three numbers are the Y component and indicate the number of miles north or south (up or down) from the DLRP. In this case the Y component is 100 miles up (north) of the DLRP.

Figure 12-9 shows a Cartesian grid superimposed on a vertical plotting board. The grid reference point is located 35 miles to the southwest of own ship. In the figure, the position of track number 201 at time 05 is Blue 070 075; bogey D-1 at time 04 is Green 060 060; track number 220 at time 05 is White 165 150; and track number 217 at time 04 is Red 005 110.

The plotters behind the board plot targets in polar coordinates (bearing and range) from own ship. The plotters in front of the board plot in Cartesian coordinates, since they are receiving Cartesian coordinate positions of targets from other ships. With this arrangement, anyone observing the plot can readily see a target’s position in polar or Cartesian coordinates.

**WORLD GEOGRAPHIC REFERENCE (GEOREF) SYSTEM**

A system commonly referred to as a grid but which, in reality, is not a true military grid is GEOREF. A GEOREF is a simple and rapid method of expressing latitude and longitude. The GEOREF system enables any general position in the world to be located and is most valuable for use over large distances (primarily long-range air operations) or at great speeds.

The GEOREF system divides the Earth’s surface into divisions and subdivisions. Its coordinates are read to the right and up.

This system divides the world into 15°-by-15° quadrangles. Beginning at the 180° meridian and proceeding eastward through 360° of arc, there are twenty-four 15° longitudinal zones. These zones are lettered A through Z, omitting I and O. Beginning at the South Pole and proceeding northward through 180° of arc, there are 12 latitudinal zones of 15° each. These zones are lettered A through M, omitting I. As you can see in figure 12-10, you can locate any of these 15° quadrangles with a two-letter designator by reading to
the right to the desired longitude (alphabetical column) then up to the desired latitude (alphabetical row).

Each 15° quadrangle is subdivided into 1° quadrangles. The 1° longitudinal zones are labeled A through Q, omitting I and O, beginning at the southwestern corner of the 15° quadrangle and heading eastward. The latitudinal zones are labeled similarly, heading northward from the southwest corner. This labeling system enables you to locate or designate any 1° quadrangle in the world by using its four-letter designator.

Each 1° area is further divided into 1-minute areas. The 1-minute areas are labeled numerically (from 00 to 59) from the southwest corner of the 1° quadrangle to the east and north. Thus, you can locate any geographical point on the Earth’s surface to within an accuracy of 1 minute by using a four-letter and four-digit grid reference. (You can omit the two letters designating the 15° area if doing so will not cause confusion.).

NOTE

To measure distance, always use the latitude (vertical) scale, in which 1 minute equals 1 mile.

To locate a point on the GEOREF grid, you must use a set procedure. For example, on a GEOREF chart, Patuxent Naval Air Station is located (to the nearest minute) at position GJPJ3716. In figure 12-10, the blacked-out square (PJ) within the enlarged 15° square (GJ) indicates the 1° area that contains Patuxent. To locate the position from the coordinates, proceed as follows:

Right from the 180° longitude to longitude zone G
Up from the South Pole to latitude zone J
Right in zone GJ to the lettered 1° column P
Up in zone GJ to the lettered 1° row J
Right in the 1° horizontal zone to 37'
Up in the 1° vertical zone to 16'
The GEOREF system can also be used to designate a particular area around a reference point. This area designation follows GEOREF coordinates. The letter $S$ denotes the sides of a rectangle; the letter $R$, the radius of a circle. Both dimensions are given in nautical miles. Another letter, $H$, also is used to denote altitude in thousands of feet. Figure 12-11 shows both area and point GEOREF positions.

Designation GJQJO207S6X6 means a rectangle centered around Deal Island 6 nautical miles on each side. Designation GIPJ4103R5 means a circle around Point Lookout with a radius of 5 nautical miles. Designation GJPJ3716H17 means a height of 17,000 feet over (fig. 12-11).

If a pilot were directed to make a rectangular search around Patuxent Naval Air Station, the signal for executing the search plan might be the following: GOLF JULIETT PAPA JULIETT THREE SEVEN ONE SIX SIERRA TWO ZERO XRAY ONE THREE HOTEL ONE SEVEN. Note that the length of sides is separated by the letter X.

GEOREF position designators should not be used for shore bombardment, close fire support, close air support, or for any other purpose where positional information must be reported with accuracy. The reason for this limitation is that these missions require position designations equivalent to small fractions of a second, while GEOREF designations are generally limited to minutes or, perhaps, seconds

**CONVERTING POSITIONS**

A ship’s CIC functions best when target positions are maintained in the polar system (range and bearing). However, for this information to be sent to other units so that it can be used quickly and efficiently, it must be converted into position designators from another type of system, such as grid or geographical. Also, your ship may receive position information in one system that may need to be converted to another system before it can be used. Because of these requirements, you must be able to convert position information from one system to another.
GEOREF to Geographic Coordinates

The simplest conversion is from GEOREF to geographic coordinates, because GEOREF is only a geographic plot using letters and numbers instead of latitude and longitude. Every minute and degree of latitude and longitude has its own distinct GEOREF coordinates. Although charts are printed with GEOREF overlays, not all commands carry them in their chart portfolios. When charts are not carried on board, there is no hindrance in rapid plotting of a GEOREF position. The simplicity of this system makes it easy to plot a reference directly on a geographic presentation.

Assume that while a ship is steaming independently, it receives a message to proceed immediately to join an air-sea search for a downed aircraft last reported at a GEOREF position of HJDC3545. Speed is of the essence in this situation, so when a GEOREF chart is unavailable, a navigational chart of the area can be substituted. Some CICs maintain a folder showing world coverage of the GEOREF system. (This information is also provided in ATP 1 (C), Volume I, Chapter 2). Locate an illustration of the GEOREF grid superimposed over the Earth’s surface (or look at figure 12-10) and find the 15° zone HJ. It is the zone with the southwest square at 75°W and 30°N. The second two letters represent single degrees east and north, respectively, from the southwest corner. Thus, HJDC represents the 1° square, the southwest corner of which is located at 72°W and 32°N, and the four numerals represent minutes of latitude and longitude. Hence, the GEOREF position indicated is 71°25′W, 32°45′N. As you can see, CIC can provide conn a position and recommendation in a comparatively short time.

Polar Coordinates to Grid Coordinates

Converting polar coordinates to grid coordinates requires the use of a conversion plot. A conversion plot
consists of a grid superimposed over a polar display (or vice versa). One type of conversion plot has a grid drawn on the back of a vertical plotting board, with the center of the grid located at the center of the plotting board, such as the one shown in figure 12-9. When this type of conversion plot is used, a plotter on the “polar” side of the board plots contacts in polar coordinates. Other personnel in CIC can then read grid positions of the plots directly from the “grid” side of the board.

When necessary, the DRT can be used in the conversion process. A grid or geographic overlay is aligned and then secured to the plotting surface. Internal plotting is done in the normal manner, with own ship’s position indicated by the bug. Grid or geographic positions can then be read on the overlay. Any grid system of geographic significance must be readjusted periodically to compensate for motion caused by set and drift. The adjustment is made by moving the bug the required distance in a direction opposite the motion caused by set.

**MILITARY GRID REFERENCE SYSTEM**

The primary purpose of this system is to simplify and increase the accuracy of locating positions in military operations (shore bombardment, SAR missions in hostile areas, etc.). It may also be used to designate small areas of the Earth’s surface for other purposes.

The military grid reference system divides the surface of the Earth into two grid systems: universal transverse Mercator (UTM) and universal polar stereographic (UPS). The universal transverse Mercator (UTM) grid covers all of the Earth’s surface between latitudes 80°S and 84°N, while the universal polar stereographic (UPS) grid covers the areas from 84°N to the North Pole and from 80°S to the South Pole. The type of military coordinates a given position has depends on where that position is located. The majority of the Earth’s surface falls within the UTM grid. Therefore, most positions of concern to us have UTM coordinates, and we will limit our discussion to the UTM system.

**Universal Transverse Mercator (Grid)**

Earlier, we explained how a Mercator projection is made. A transverse Mercator projection is made in basically the same way, except that the transverse projection is rotated 90°. Instead of having the cylinder tangent to the Earth at the equator, the transverse projection has it tangent along a meridian. Creating a Mercator projection this way allows chart makers to superimpose a regular, rectangular grid on it. By dividing the surface of the Earth into a series of rectangles that are basically the same size, we can locate a position with extreme accuracy. You will have to locate given positions very accurately whenever you become involved in operations such as shore bombardment and SAR operations in hostile areas.

The UTM system provides the necessary accuracy by dividing and subdividing the Earth’s surface into squares as small as 1,000 meters on a side. On a chart, you can break down each of these 1,000-meter squares into smaller squares and, if necessary, locate a position to within ±5 meters. Now, that’s accuracy! Now, let’s discuss the UTM grid itself, so you will know how to interpret a set of UTM coordinates.

In the UTM system, the Earth is first divided into 6° (east-west)-by-8° (north-south) areas called grid zones (See figure 12-12). In a north-south direction, the grid zones form columns. In an east-west direction, they form rows. Columns are numbered consecutively from 1 through 60, starting at the 180° meridian and proceeding eastward. Rows are lettered C through X (except for I and O), from latitude 80°S to latitude 84°N. The letters I and O are omitted to avoid confusion with numerals 1 and 0. This number-letter system provides each grid zone with a unique number-letter designator, called a grid zone designation.

You can determine the designation for any grid zone by reading right (columns), then up (rows) on the chart. Look at figure 12-12 and find grid zone “1Q”. This grid zone is located at the intersection of column 1 and row Q. This grid zone is the only grid zone in the UTM grid that has the designation 1Q. The remainder of our discussion will be based on this grid zone, and the designation for every part of this grid zone will begin with “1Q”.

Now notice the smaller areas on figure 12-12 designated by two letters. These are 100,000-meter (100,000 meters on each side) grid squares into which the grid zones are divided, for convenience in locating positions. To identify these squares, you also read right and up. In this case, though, columns are lettered from A through Z (with I and O omitted), starting at the 180° meridian and proceeding easterly along the equator, repeating every 18°. Rows are lettered from A through V (I and O omitted), with the lettering repeated every 2,000,000 meters (20 squares). The first letter is the column letter; the second letter is the row letter.
You can locate any 100,000-meter grid square on the UTM grid by using the designation of the grid zone in which it is located, plus the grid square’s two-letter designation. For example, the 100,000-meter grid square “CU” immediately under the “1” in grid zone 1Q (fig. 12-12) has the grid designator “1QCU”.

Ideally, each grid zone should be divided into equal numbers of 100,000-meter grid squares. Unfortunately, a 6°-wide zone cannot be divided into a whole number of 100,000-meter intervals; there is always a fraction of an interval left over. To minimize the “left over” area at the edge of a zone, the 100,000-meter columns are centered on the central

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**Figure 12-12.—Basic plan of the 100,000-meter square identification of the military grid reference system.**

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meridian of the zone. This splits the left over area, so that half of it lies on the western side of the zone and half on the eastern side of the zone. For uniform identification, these partial edge columns are included in the alphabetic progression of column labeling, even though they are not full-size blocks. Also, the number of columns in a grid zone decreases as the distance from the equator increases because the distance between meridians decreases from the equator toward the poles.

Now look carefully at the 100,000-meter grid square letter designators in figure 12-12. Notice that the designators along the equator between the 180° meridian and the 174° meridian end in the letter “A”, while the designators between the 174° meridian and the 168° meridian end in the letter “F”. The designators between the 168° meridian and the 162° meridian again end in the letter “A”. This is an intentional offset in every other grid zone column and is done to help prevent confusion that might result from having the same 100,000-meter square designator reappear every 18°. All row designators within odd-numbered grid zone columns begin at the equator. All row designators within even-numbered grid zone columns are offset 500,000 meters south (The “A” squares are located five squares below the equator).

This arrangement results in a shift of five letters between the 100,000-meter row designators of each grid zone column.

So far we have divided the surface of the Earth into 100,000-meter squares. View “A” of figure 12-13 shows 100,000-meter grid square 1QCU divided into one hundred 10,000-meter (10,000 meters on a side) grid squares, each designated by a two-digit number. The first digit is the column number; the second digit is the row number. Columns and rows are both numbered from 0 to 9. In view “A”, read right to “6” and up to “5” and you will see the highlighted grid square “65”. This 10,000-meter grid square has the grid designation 1QCU65. Finally, look at view “B” of figure 12-13. This illustration shows 10,000-meter grid square 1QCU65 divided into one hundred 1,000-meter grid squares. Each 1,000-meter grid square has a four-digit number, based on the grid square number “65”. The second digit is the 1,000-meter grid square’s column number (read right); the fourth digit is its row number (read up). Notice the shaded square. Its four-digit number is 6957. Therefore, the UTM grid designation of this particular 1,000-meter square is 1QCU6957. We have now divided the surface of the Earth into 1,000-meter squares.

Figure 12-13.—A 100,000-meter grid broken down to provide 100-meter accuracy by expansion.
After all this chart work, what does the grid designation 1QCU6957 tell you? It tells you that this grid square is the 1,000-meter grid square “97”, inside the 10,000-meter grid square “65”, inside the 100,000-meter grid square “CU”, inside grid zone “1Q”. It also tells you that this 1,000-meter grid square encompasses an area 69,000 to 70,000 meters east of the southwest corner of 1QCU and 57,000 to 58,000 meters north of it. If you need to locate a specific target in this 1,000-meter grid square, simply divide it into 100- or 10-meter squares to get the accuracy that you need. Just be sure to add the appropriate additional grid numbers to the grid designation each time you subdivide the grid square. For example, a grid designation of 1QCU693578 identifies a 100-meter grid square inside grid zone 1Q, while 1QCU69315782 identifies a 10-meter grid square inside grid zone 1Q.

Thus, by using the UTM system, we have divided the surface of the Earth into easily identified squares only 10 meters on a side and have specifically identified 10-meter grid square 1QCU69315782. We can shoot a high-explosive round into this area, send a rescue helicopter to it to pick up a downed pilot, or any other job that we are tasked to do.

As in radar navigation, a conversion plot is used to convert UTM grid coordinates to bearings and ranges. Own ship’s position is plotted on the “polar” side of the plot. As target positions come in, their grid coordinates are plotted on the “grid” side of the plot. Bearings and ranges from own ship to each target can then be determined very easily.

Q4. What are the three types of grid systems used by the Navy?

Q5. What grid reference system divides the world into 15° by 15° quadrangles?

NATIONAL IMAGERY AND MAPPING AGENCY (CATALOG OF MAPS, CHARTS, AND RELATED PRODUCTS)

Charts used in the Navy may be prepared by the National Imagery and Mapping Agency (NIMA), the National Ocean Service (NOS), the British Admiralty, or by other hydrographic agencies. Whatever the source, all charts used by the Navy are listed in the National Imagery and Mapping Agency (NIMA) Catalog of Maps, Charts, and Related Products and are issued by NIMA. The NIMA Office of Distribution Services has a network of small offices and branch offices located at military bases in the United States and overseas. Their locations, message addresses, and telephone numbers are listed in Part 2, volume I of the NIMA Catalog.

The National Imagery and Mapping Agency (NIMA) Catalog of Maps, Charts, and Related Products is divided into the following seven parts:

- Part 1 - Aeronautical Products
- Part 2 - Hydrographic Products
- Part 3 - Topographic Products
- Part 4 - Target Material Products
- Part 5 - Submarine Navigation Products
- Part 6 - Special purpose/Crisis Catalogs
- Part 7 - Digital Data Products

HYDROGRAPHIC PRODUCTS

Part 2 of the NIMA catalog is the only part that you will normally use as an OS. It is a catalog of all hydrographic products (nautical charts and publications) and is divided into two volumes: Volume I (unclassified products) and Volume II (classified products). Volume I is organized into the following nine regions:

- Region 1 – United States and Canada
- Region 2 – Mexico, Central America, and Antarctica
- Region 3 – Western Europe, Iceland, Greenland, and the Arctic
- Region 4 – Scandinavia, Baltic, and Russia
- Region 5 – Western Africa, and the Mediterranean
- Region 6 – Indian Ocean
- Region 7 – Australia, Indonesia, and New Zealand
- Region 8 – Oceania
- Region 9 – East Asia

HYDROGRAPHIC BULLETINS

The Hydrographic Products Semiannual Bulletin Digest is published in April and October. It provides a complete listing of all available unclassified charts and
publications. You only need to keep the latest Semiannual Bulletin Digest to have current information on all available hydrographic products. Information appearing for the first time is marked with an asterisk.

Each of the hydrographic bulletins lists current editions of charts and publications, descriptions of all new charts, significantly changed new edition charts, and new publications and cancelled charts and publications. File these bulletins and use them to correct your catalogs. You can also use them to confirm that you hold the latest editions of charts and publications in your inventory and that you are not missing any chart from your required allowance.

NAUTICAL CHART NUMBERING SYSTEM

NIMA assigns a number to every nautical chart used by the U.S. Navy, regardless of the organization or government producing the chart. NIMA charts have numbers consisting of one to five digits. The number of digits generally indicates the scale range, and the number itself indicates the geographical area covered by the chart. The chart numbering system is as follows:

1. One-digit number (1-9) — This category consists of charts that have no scale connotation, such as symbol and flag charts.

2. Two- and three-digit numbers (10-999) — This category includes small-scale, general charts that depict a major portion of an ocean basin, with the first digit identifying the ocean basin. The first digit denotes the ocean basin containing the area covered by the chart (See figure 12-14). For example, Chart No. 15 covers the North Atlantic Ocean (northern sheet). Two-digit numbers (10-99) are used for charts having a scale of 1:9,000,000 and smaller, including world charts, while three-digit numbers (100-999) are used for charts having a scale between 1:2,000,000 and 1:9,000,000.

3. Four-digit numbers (5000-9999) — This category includes great circle tracking charts, electronic navigation system plotting charts, and special-purpose non-navigational charts and diagrams. Four-digit charts with a letter prefix (EOIOI-E8614) are bottom contour charts.

4. Five-digit numbers (11000-99999) — This category includes all standard nautical charts having a scale larger than 1:2,000,000 (large and medium scale). At scales such as this, the charts cover portions of the coastline rather than significant portions of ocean basins. The majority of the charts listed in Part 2, Volume I are five-digit charts and are based on the nine regions of the world shown in figure 12-15. The first of the five digits indicates the region to which the chart belongs. The first and second digits together indicate the geographic sub-region within the region, and the last three digits identify the geographic order of the chart within the sub-region.

5. Six-digit numbers (800000-809999) — This category consists of combat charts and combat training charts. A random numbering system is used to prevent the identification of the geographical area covered by a classified combat chart without referring to the catalog. One reason for this is to allow you to order classified combat charts with an unclassified requisition. Also included in the six-digit numbering system are mine warfare planning charts (MCMCH810000-819999). These charts show predetermined passages into and out of large ports that have been searched for any mine-like objects (Q Routes). They may also contain environmental information for selected areas. Like combat charts, these classified charts use a random numbering system to prevent the identification of the geographical area.

PORTFOLIO DESIGNATIONS

The U.S. Navy uses three portfolio (grouping) systems to assign charts into allowances for ships. These portfolio systems are Standard Nautical Charts, World and Miscellaneous Charts, and Bottom Contour Charts. Except for certain bottom contour charts, the letter in the third position of the NIMA stock number is the portfolio assignment letter. Portfolio designators are recommended by NIMA and approved by the fleet commander in whose area of responsibility the charts lie.

Standard Nautical Charts

Most standard nautical charts are assigned to either an “A” portfolio or a “B” portfolio.
Figure 12-14.—World ocean basins.
Figure 12-15.—World regions.
“A” portfolios consist of operating area charts and principal coastal and harbor and approach charts for each sub-region.

“B” portfolios supplement “A” portfolios with additional coastal and harbor and approach charts for each sub-region.

Standard nautical charts that are not assigned to a portfolio have an “X” in the third position of the NIMA stock number.

A standard nautical chart portfolio is commonly referred to by use of a sub-region number with the portfolio designation letter, e.g., Portfolio 14A.

World and Miscellaneous Charts

Most world and miscellaneous charts are assigned to either an “A” portfolio or a “P” portfolio.

“A” designates Atlantic Ocean charts.

“P” designates Pacific Ocean charts.

“B” designates other ocean regions or charts that cannot be categorized by a specific geographic region. While “X” designates charts not in a portfolio.

A world nautical chart portfolio is commonly referred to by use of the first two letters (WO) of the NIMA stock number, with the portfolio designation letter, e.g., Pacific Ocean Portfolio, WOP.

Bottom Contour Charts

Bottom chart portfolios are designated by the area they cover.

“EP” in the second and third positions of the NIMA stock number designates the Eastern Pacific Ocean.

“WP” in the second and third positions designates the Western Pacific Ocean.

“IN” in the second and third positions designates Indian Ocean.

“X” in the third position designates Atlantic Ocean.

ARRANGEMENT OF CHARTS

Charts are arranged and numbered in a geographical sequence, which permits systematic stowage aboard ship. Within each region, the geographical sub-regions are numbered (first two digits of the five-digit chart number) counterclockwise around the continents; within each sub-region, the individual charts are numbered (last three digits of the five-digit chart number) counterclockwise around the coasts. Many numbers are left unused so that charts produced in the future may be placed proper sequence.

NIMA STOCK NUMBERING SYSTEM

A five-digit alphanumeric series designator prefix is assigned to each standard nautical chart number (fig. 12-16). The purpose of this prefix is to speed up processing and to improve inventory management by the NIMA.

The first two digits of the prefix reflect the geographical sub-region, as do the first two digits of the basic chart number. The third position is the portfolio assignment, “A” or “B”. The letter “X” is used if the chart is not included in a portfolio. The fourth and fifth positions are alphabetical designators for the type of chart. Examples of the designators are “HA” for harbor and approach charts and “OA” for operating area charts. When you order charts, be sure to use the complete NIMA stock number.

Q6. What part of the NIMA catalog lists all hydrographic products that you will use in CIC?

Q7. The Hydrographic Products Semiannual Bulletin Digest is published during what months?

CHART/PUBLICATION CORRECTION RECORD CARD SYSTEM

To be useful, a chart must be accurate. When a chart is first issued, it is known as a new chart, or first edition. New charts are considered to be accurate, as printed, until changes are issued. Over a period of time, many changes may be issued for a particular chart. When the changes become too numerous or when new information is too extensive to be issued through the Notice to Mariners, a version of the chart that includes all accumulated changes is printed and issued. This changed version is known as a new edition. When a new edition of a chart is issued, the previous edition automatically becomes obsolete and must be destroyed.

The number of charts carried aboard ships and the frequency with which charts change, dictate that some system be used to track changes and to keep the charts up-to-date. The system currently being used throughout the fleet is the Chart/Publication Correction Record Card System.
NOTICE TO MARINERS

The chart and publication correction system is based on the periodical *Notice to Mariners*, published weekly by the NIMA to inform mariners of corrections to nautical charts and publications. This periodical announces new nautical charts and publications, new editions, cancellations, and changes to nautical charts and publications. It also summarizes events of the week as they affect shipping, advises mariners of special warnings or items of general maritime interest, and includes selected accounts of unusual phenomena observed at sea. Distribution of the *Notice to Mariners* is made weekly to all U.S. Navy and Coast Guard ships and to most ships of the merchant marine.

The classified Chart and Publication Correction System is based on the *Classified Notice to Mariners*, published on an as-needed basis by the NIMA to inform mariners of corrections to classified nautical charts and publications.

The *Notice to Mariners* provides information specifically intended for updating the latest editions of nautical charts and publications issued by NIMA, the National Ocean Service, and the U.S. Coast Guard. When you receive the *Notice to Mariners*, examine it for information of immediate value. To minimize record keeping, record the notice’s edition and date on the Chart Publication Correction Record Card of each chart and publication affected by that notice. Also check the list of new charts and new editions of charts and publications to assure that you have the latest editions on board.

In section I of the *Notice to Mariners*, you will find chart corrections listed by chart number, beginning with the lowest and progressing in sequence through each chart affected. The chart corrections are followed by publication corrections, which are also listed in numerical sequence. Since each correction pertains to a single chart or publication, the action specified applies to that particular chart or publication only. If the same correction also applies to other charts and publications, it is listed separately for each one.

Figure 12-17 illustrates the *Notice to Mariners* format for presenting corrective information affecting charts. A correction preceded by a star indicates that it is based on original U.S. source information. If nothing precedes the correction, the information was derived from some other source. The letter T preceding the correction indicates that the information is temporary; the letter P indicates that it is preliminary. Courses and bearings are given in degrees clockwise from 000° true.

SUMMARY OF CORRECTIONS

The *Summary of Corrections* is a five-volume cumulative summary of corrections to charts and publications previously published in *Notice to Mariners*. NIMA publishes each of the five unclassified volumes semiannually and the classified volume annually. The *Summary of Corrections* is organized as follows:

- Volume I — East Coast of North and South America
- Volume II — Eastern Atlantic and Arctic Oceans, including the Mediterranean Sea
• Volume III — Eastern Pacific, Antarctica, Indian Ocean, And Australia

• Volume IV — Western Pacific Ocean

• Volume V — World and Ocean Basin Charts, U.S. Pilots, Sailing Directions, Fleet Guides, and other publications

CHART/PUBLICATION CORRECTION RECORD CARD

The Chart/Publication Correction Record Card (NIMA Form No. 8660/9), shown in figure 12-18, is used to indicate that corrections to a chart or publication have been published in a Notice to Mariners and to show when the corrections were made. Normally, one card is kept for each NIMA chart and publication kept on board, but command may direct that cards also be kept for other charts and publications. Within this system, only the charts and publications of the immediate operating area need to be corrected. Charts and publications not currently needed may be updated as areas of operations change or as directed by the commanding officer.

ESTABLISHING THE CORRECTION RECORD CARD SYSTEM

If your ship does not have a Chart/Publication Correction Record Card System, you may create one. Using Part 2 of NIMA Catalog of Maps, Charts, and Related Products, prepare a card for each NIMA chart and publication carried on board, inserting the following information:

1. Chart/publication number.

2. Edition number/date.

3. Classification.

4. Latest Notice to Mariners through which the chart is corrected.

5. Title. (Abbreviate long titles as necessary.)

MAINTAINING THE CORRECTION RECORD CARD SYSTEM

To maintain the record card system, use the following procedure:

1. When you receive a new Notice to Mariners, check it to see which charts or publications need correcting. If any of the charts or publications that your ship holds require correcting, pull their associated correction record cards. On each card, record the number and year of the Notice to Mariners.

2. If any of the corrections that you need to record are identified in the Notice to Mariners as “preliminary” or “temporary”, identify them on the correction record card with a “P” or a “T”.

3. After you have entered the Notice to Mariners number and year on the cards, plot the specified corrections on the charts that are in active use (or on the charts specified by your commanding officer). After you make the correction(s) to a chart, enter on the chart’s correction record card the date that you made the correction(s) and initial the card.
NOTE

In correcting charts that have accumulated numerous corrections, make the latest correction first and work backwards, since later corrections may cancel or alter earlier corrections.

4. When you receive a new chart or a new edition of a chart, make a new card your system will reflect only the corrections (including temporary changes) that have been published since the date the new or corrected chart was published. Carry forward temporary corrections, since they are not incorporated into new editions of charts.

5. If your ship carries more than one copy of a particular chart, you only need to maintain one record card for that group. However, to preclude omitting a correction on one of the charts, correct all of the copies at the same time.

AVIATION CHARTS

All naval air stations, facilities, and aircraft-capable ships keep a permanent file of aviation charts and publications for the areas in which their aircraft may need to operate. If your ship is required to keep aviation charts, refer to Part 1, Aerospace Products, of the NIMA Catalog of Maps, Charts, and Related Products for ordering and maintenance information. Use the same procedures to keep these charts and publications up-to-date as you do nautical charts and publications (for specifics, refer to aeronautical product bulletins and the Aeronautical Chart Updating Manual.

CHART ORDERING PROCEDURE

When a ship is first commissioned, NIMA outfits it with its initial allowance of charts and publications. Your ship will receive new and revised charts and publications through the Automatic Initial Distribution (AID) System.

SHIP ALLOWANCE

The basic load of maps, charts, and publications your ship is required to hold is prescribed in allowance instructions issued by your fleet commander or type commander. In some cases a ship may have its basic allowance supplemented by another allowance that covers the area to which the ship deploys. In these cases, your type commander will normally request your deployment allowance about 3 months before your deployment. You should become familiar with
the allowance instructions that pertain to your ship, as you may be required to help maintain that allowance.

During normal operations, some charts will be worn out, while others will be required in greater quantities than were in the original issue. To order replacement charts and additional charts, submit your requisitions, using MILSTRIP ordering procedures, via the Defense Automatic Addressing System (DAPS). You can find specific ordering instructions in the Ordering Procedures section of NIMA Catalog of Maps, Charts, and Related Products, Part 2–Volume I.

AUTOMATIC INITIAL DISTRIBUTION

Automatic Initial Distribution (AID) refers to the automatic issue of predetermined quantities of new or revised products. AID is the means by which your ship’s allowances of charts and publications is kept current with no requisitioning action required on your part. Annually, the NIMAODS forwards to each U.S. Navy ship on AID a computer listing, called AID Requirements for Customer Report (R-05), to allow the command to confirm its allowance holdings.

CLASSIFIED CHARTS AND PUBLICATIONS

Your ship will undoubtedly have some classified charts and publications on board. These charts and publications must be handled and stored according to the requirements of the Department of the Navy Information Security Program Regulation, SECNAVINST 5510.36. The following basic provisions apply to the handling and storing of these materials.

1. Only persons with the necessary security clearance and a definite need to know should be granted access to the information.
2. When classified material is not under the direct observation of an authorized person, it must be locked up or given equivalent protection.
3. Charts must be stored in locked drawers. Publications must be stored in locked safes or cabinets.
4. Money, jewels, or other valuables must never be stored in containers used for storing classified material.
5. Combinations (or keys) to safes or locks must be accessible only to persons whose official duties require access to the material in the containers.

Q8. What weekly NIMA publication contains all corrections for nautical charts and publications?

NAVIGATION

Navigation is the means by which a navigator determines the ship’s position and guides the ship safely from one point to another. Operations Specialists, as members of the CIC team, assist the navigator in determining the ship’s position. Positions in navigation may be determined in the following four ways:

1. By piloting. — Position is determined through the aid of visual ranges and bearings to objects on the Earth and by soundings (measuring the depth of water by lead line or depth sounder).
2. By dead reckoning. — Position is figured by advancing a known direction and distance traveled from a known point of departure.
3. By electronics. — Position is determined by loran, Omega, satellite, radar, and other electronic devices. Electronic navigation, in some instances, overlaps piloting.
4. By celestial navigation. — Position is determined with the aid of celestial bodies (the sun, moon, planets, and stars).

The remainder of this chapter explains the assistance CIC provides to the navigator, such as informing conn concerning the ship’s position, interpreting Rules of the Road, station-keeping, and making recommendations for maneuvering.

PILOTING

Piloting is a highly accurate form of navigation involving frequent determination of a ship’s position relative to geographic references. When a ship is operating near land or when other visual aids to navigation are available, piloting is used to prevent mishaps. This method of navigation requires good judgment, constant attention, and alertness on the part of the navigator.

When a ship is moving into or out of a harbor, close to islands, reefs, or coastlines, the navigator pinpoints the position of the ship by plotting visual bearings received from a Quartermaster. The Quartermaster, stationed at the pelorus, takes bearings from visible
objects such as tanks, radio towers, lighthouses, points on shore, or other aids to navigation. By plotting successive fixes on a chart showing true positions of reference points from which bearings are taken, the navigator maintains a true track of the ship. Observations of these fixes and DR tracks of the ship enable the navigator to make recommendations to the officer of the deck concerning the course the ship should follow to reach its destination safely.

The fact that a position is determined by bearings taken on visual objects implies that a ship being piloted is in restricted—often dangerous—waters. In the open sea, there may be ample time to discover and correct an error. In restricted waters, an error can quickly cause an accident. To reduce the possibility of error to a minimum, Operations Specialists provide backup information for the navigator.

Functions Of in Piloting

One of the ways CIC assists the navigator and the officer of the deck in piloting is to plot radar fixes to create a backup plot of the ship’s position. Radar gives an excellent picture of coastlines, harbors, channels, buoys, and other objects. In addition to radar, CIC also uses underwater search equipment and depth sounding equipment.

Radar navigation places great demands upon plotters and radar operators. Thus, it requires practice at every opportunity. In good visibility, the CIC piloting team can gain experience and aid the navigator at the same time. By developing a radar plot, CIC provides the navigator a ship’s position to compare with the position developed from visual sightings. The two positions should be identical. If they differ, the navigator will take the time necessary to determine the ship’s actual position. An additional benefit of having CIC develop a radar plot during piloting is that if visibility suddenly drops so that the Quartermaster can no longer take sightings, the navigator will have a backup plot to use in navigating the ship.

The accuracy of the radar plot is dictated by the circumstances at the time the plot is made. Many functions of the ship, such as shore bombardment and amphibious operations, depend on accurate knowledge of ship’s position.

Navigational Plot

When the ship is near land, Operations Specialists must maintain a continuous navigational plot for the following reasons:

1. To warn the bridge the moment the ship begins to stand into danger
2. To supply radar information on short notice to the navigator and conning officer, as requested
3. To aid in identifying enemy targets
4. To provide gun ranges and bearings for indirect fire shore bombardment
5. To assist in directing boat waves during landing operations
6. To navigate the ship from radar information, if ordered
7. To assist in making landfalls and to identify land masses
8. To assist landing ships and craft in their beach approach

One important point you must remember whenever you plot on a chart is to use the correct colors in marking the chart. While color doesn’t matter much on charts that are marked in daylight or in normally lighted areas, it matters greatly in blacked-out areas. Recall times that you entered darkened areas. For the first few minutes, you could not see your surroundings. Gradually, however, you began to make out shapes. During that brief period, your night vision was taking over from your day vision. Night vision sensors in your eyes are very sensitive to white light and can be instantly overwhelmed by it. These same sensors, though, work very well in areas lighted by red light. This is why areas that require low light are frequently lighted by red lights. So what is the problem with colors on charts? Under red light, the colors buff, orange, and red are invisible. You will not be able to see anything printed or written on a chart in these colors. The NIMA has met this situation by using gray, magenta, purple, and blue on the charts. These colors appear as different shades, not as different colors, under red light. Be very careful in using old charts under a red light. If any vital features or markings are shown on the charts in red, orange, and yellow colors, redraw them in some color that will show, such as blue, green, brown, or purple. And when you draw on a chart in daylight, do not use a red marker. If you do and later have to use the chart under a red light, you will not be able to see any of your marks.

Tactical Data

Every ship has specific maneuvering characteristics known as the ship’s tactical data.
These data are determined by the navigation department and are available on the bridge, in CIC, and in the engine room. Two of the maneuvering characteristics, advance and transfer, are extremely important in plotting a dead-reckoned track in radar piloting and also in tactical maneuvers. The ship’s tactical data consist of the following information:

1. Acceleration — The rate of increase in ship’s speed.
2. Deceleration — The rate of decrease in speed.
3. Acceleration/deceleration distance — The distance covered between the point where an increase or a decrease in speed is ordered and the point where the ship is steady on the new speed.
4. Advance — The distance gained in the direction of the original course when the ship is turning. See figure 12-19. It is measured in the direction of the original course from the point where the rudder is first put over. The advance will be at maximum when the ship has turned 90°. If the turn is less than 90°, it is measured to the point where the ship is steadied on the new course.
5. Transfer. — The distance gained at right angles to the original course when the ship is turning, to the point of completion of the turn. See figure 12-19.
6. Tactical diameter. — The distance gained to the right or left of the original course when a turn of 180° has been completed, when constant rudder angle is used. Figure 12-19 illustrates that the tactical diameter is the transfer for a turn of 180°.
7. Final diameter: The diameter of the turning path of the ship when it has completed 360° of steady turning.
8. Standard rudder. — The amount (in degrees) of rudder that will turn a ship on the turning circle of a prescribed standard tactical diameter.

Use of Tactical Data

As we mentioned earlier, a folder containing the ship’s tactical characteristics is kept on the bridge, in CIC, and in the engine room. Usually this folder contains the following tables:

1. The number of revolutions per minute necessary to make desired speeds. This information is posted also at the annunciators and the throttles.
2. Time versus distance the ship will continue until no forward motion is evident when the engines are stopped at 5, 10, and 15 knots.
3. Time versus distance required to stop the ship when the engines are backed one-third, two-thirds, and full speed while the ship is steaming ahead at normal speed.
4. Time required to turn 45°, 90°, 135°, and 180°, using normal, stationing, and operational speeds for rudder angles of 10°, 15°, 25° and full rudder.
5. Time versus reach-ahead (acceleration distance) in accelerating from normal speed to stationing and operational speeds.
6. Number of yards from station at which speed should be dropped to formation speed in order to coast into station.
7. Diagrams of turning circles, showing the tactical diameter for 180° and transfer for 90° for rudder angles of 10°, 15°, 20°, 25°, and full rudder at speeds of 10, 15, 20, and 25 knots (or as many of these speeds as the ship can make).

Table 12-1 shows sample turning characteristics of a ship. (These figures are for example purposes only. When you plot a DR track in restricted waters, use the correct tactical data for your ship.)

Computing Turning Bearing and Turning Range

The piloting officer must know at what position the rudder must be put over, so that when allowance is
made for advance and transfer the ship will steady on the new heading at the desired point. This procedure involves using a predetermined bearing to a known object (turning bearing) and a predetermined range to a prominent point of land to indicate where the rudder should be put over. The navigator uses the turning bearing, since the bridge personnel use bearings to take visual fixes. CIC uses the range to take a radar fix. Figure 12-20 shows how turning bearing and range are determined. In the figure, a ship is steaming at 15 knots on course 180° and must round a bend in the channel to a new course of 255°. Your job is to find the turning bearing to the lighthouse and the turning range to the point of land labeled D, where the rudder should be put over to have the ship on course 255° and on the desired track after it rounds the bend.

First, draw a line parallel to the ship’s present course (180°) on the side toward which the turn is to be made at a perpendicular distance equal to the transfer for a 75° turn. (Table 12-1 shows the transfer for a 75° turn at 15 knots to be 270 yards.) The intersection of this line with the new course (255°) is the point (labeled C) where the turn will be completed. From this point, measure back along the line a distance equal to the advance for a 75° turn. (From the table, this distance is 445 yards.) Label this point (point B in the illustration). From point B draw a line perpendicular to the original course line. The intersection of this perpendicular line and the course line (labeled point A) is where the rudder must be put over. The true bearing of the lighthouse from point A is the turning bearing, 218°, and the turning range to point D is 600 yards (a round figure determined for simplicity’s sake). Thus the ship should remain on course 180° until the lighthouse bears 218°, at which point the navigator should recommend right standard rudder. CIC should make the same recommendation when point D is 600 yards away. An accurate way of achieving that is for the scope operator to put the range strobe on 600 yards and the bearing cursor toward point D. When the strobe touches point D, CIC should recommend that the ship begin its. The turn should be completed, with the ship heading 255° at point C. If the ship is not on track as it approaches point A, a line constructed parallel to ship’s new course (255°) and drawn through point A will provide the turning point. In figure 12-20, the solid line represents the proposed track of the ship.

### Determining Position

The most important part of piloting is establishing the position of own ship. Without an accurately plotted own ship position, called a fix, all other piloting actions are meaningless.
Piloting involves using lines of position that are determined in relation to easily identified and charted landmarks. A fix is obtained from the intersection of two or more lines of position. Basically, there are two general types of lines of position: bearing lines and range arcs. See figure 12-21.

A bearing line of position is drawn from the landmark in a reciprocal direction because the bearing indicates the direction of the landmark from the observer. If a lighthouse bears 000°, for example, then your ship is located on the 180° bearing line from the lighthouse.

The tangent is a special type of bearing line that provides a line of position to the edge of a point of land that is sufficiently abrupt to provide a definite point for measurement. When a bearing is obtained to the right edge of a projection of land, as viewed by the observer, the bearing is a right tangent. Similarly, a bearing to the left edge of a projection of land is a left tangent.

A range arc is a circular line of position. When the distance from an observer to a landmark is known, the observer’s position is on a circle having a radius equal to the measured distance, with the landmark as the center. The entire circle need not be drawn, because in practice the observer normally knows the position near enough that drawing an arc of the circle suffices.

Normally, the navigator obtains fixes by plotting lines of bearing to landmarks, while CIC obtains fixes by plotting radar range arcs from prominent points. However, any combination of lines of position may be used to determine own ship’s position. The following methods are used to obtain radar fixes.

**TWO OR MORE BEARINGS.**—Cross bearings by radar are plotted in the same manner that the navigator plots visual bearings. The most rapidly changing bearing (usually closest to the beam) is taken first, followed quickly by the remaining bearings.

Search radar bearings are not normally considered very accurate. However, radar-bearing information can be nearly as accurate as visual bearings when the radar system is properly calibrated and aligned and the operator takes bearings only on well-defined targets. Objects located offshore and away from the landmass, such as small islands, lighthouses, and large rocks, are the best targets for radar bearings. Center bearings taken to isolated targets should be very accurate and can be used to obtain a radar fix. See figure 12-22.

**TANGENT BEARINGS.**—Tangent bearings to the edges of a large object, such as an island, are perhaps the least accurate of all radar bearings. The beamwidth distortion of the radar accounts for the inaccuracy.

Earlier we discussed the effects of beamwidth on a radar target. We determined that every target is distorted one-half beamwidth either side of its actual shape. With this in mind, whenever a tangent bearing is taken on a radar target, the bearing must be corrected. The rule for correcting tangent bearings to radar targets is simply this: Add one-half beamwidth to the left tangent, and subtract one-half beamwidth from the right tangent.

![Figure 12-21.—Lines of position.](OS311221)

![Figure 12-22.—Three-bearing fix.](OS311222)
To further explain the tangent conversion problem, let’s consider the situation in figure 12-23. Tangent radar bearings are being taken on an island. The dark form shows the actual shape of the island as it appears on the chart. The light outline around the island shows how it appears on a PPI scope. (The radar has a horizontal beamwidth of 10°.) The bearings obtained from the radarscope are left tangent 342° and right tangent 016°. If you plot these bearings tangent to the island on the chart, they will cross at some point between the island and the actual position of own ship, as shown on the left in figure 12-23. Such a large error cannot be tolerated in radar navigation.

To correct the radar bearings in this situation, we add one-half beamwidth to the left tangent (342° + 5° = 347°) and subtract one-half beamwidth from the right tangent (016° - 5° = 011°). If these corrected bearings are plotted tangent to the island on the chart, they will cross at own ship’s position, as shown on the right in figure 12-23.

RANGE AND BEARING TO A SINGLE OBJECT.—A radar fix may be obtained by taking a range and bearing to one object, preferably a small prominent target offshore, as shown in figure 12-24. This method may not be as accurate as one using several lines of position, but it certainly is more rapid.

Normally, a single-object fix is used to supplement other fixes by providing a quick fix of own ship’s position. Continuous fixes may be plotted when this method is used. This type of fix can be very helpful during the time between regular fixes, especially in restricted waters or when approaching a turn.

TWO OR MORE RANGES.—In most situations, the most accurate position obtained by radar is determined by using two or more (preferably three) ranges. Radars are usually more accurate in range than in bearing. In using the range method, there is no chance for mistakes caused by gyro error or beamwidth distortion.

Figure 12-25 shows a three-range fix taken on three offshore targets. However, range-only fixes may also be obtained by using prominent points along the coastline.

Thus, using two or more ranges is the best method to obtain a fix in CIC. Ranges can be plotted on the chart quickly, and fixes obtained by this method are far more accurate than any of the other methods used in CIC.

You may have noticed that we use a triangle for each fix shown in the illustrations. A triangle indicates that the fix was obtained by electronic means (radar, DF equipment, loran, etc.). Figure 12-26 shows three other symbols used in piloting. The triangle and the half-circle are the symbols most used in CIC.
Set and Drift

Anyone who has ever rowed a boat across a river or stream in a strong current knows the boat must be pointed in a slightly different direction from the point where it is supposed to land. In other words, a course and speed correction must be applied to offset the effects of wind and current to reach the destination. Ships often experience the same difficulty, requiring the navigator and CIC to respond in the same way.

Two words are used to describe the effect that external forces, usually wind and current, have on a vessel—set and drift. Set is the direction toward which the forces tend to push a vessel. Drift is the velocity of the force, in knots.

The navigator must check through various publications, tide tables, and current tables to predict the amount of set and drift the ship will experience while entering port. Winds, variations in stream discharges produced by heavy rain, and other weather conditions frequently cause actual wind and current conditions to vary from those predicted. It thus becomes necessary for both the navigator and CIC to determine set and drift periodically, especially in restricted waters.

In CIC, you can use the following method to determine set and drift. See figure 12-27.

1. Obtain an accurate fix (shown as time 1405 in the illustration).
2. Dead-reckon (DR) the ship ahead 3 minutes, on course and speed, from the 1405 position. (In figure 12-27 the ship is headed 200° at 12 knots.) When you apply the 3-minute rule, the ship will travel 1200 yards in 3 minutes, or 400 yards per minute. Plot the three DR positions, 400 yards apart, in the direction of 200° from the 1405 fix.
3. At time 1408, or 3 minutes later, obtain another accurate fix.

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**Table:**

<table>
<thead>
<tr>
<th>SYMBOL</th>
<th>DESCRIPTIVE LABEL</th>
<th>MEANING</th>
</tr>
</thead>
<tbody>
<tr>
<td>•</td>
<td>FIX</td>
<td>An accurate position determined without reference to any previous position. Established by visual or celestial observations.</td>
</tr>
<tr>
<td>△</td>
<td>FIX</td>
<td>A relatively accurate position, determined by electronic means, without reference to any former position.</td>
</tr>
<tr>
<td>◻</td>
<td>DR</td>
<td>Dead reckoned position. Advanced from a previous known position or fix. COURSE AND SPEED ARE RECKONED WITHOUT ALLOWANCE FOR WIND OR CURRENT.</td>
</tr>
<tr>
<td>○</td>
<td>EP</td>
<td>Estimated position. IS THE MOST PROBABLE POSITION OF A VESSEL, DETERMINED FROM DATA OF QUESTIONABLE ACCURACY, SUCH AS APPLYING ESTIMATED CURRENT AND WIND CORRECTIONS TO A DR POSITION.</td>
</tr>
</tbody>
</table>

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**Figure 12-25.—Three-range fix.**

**Figure 12-26.—Navigation plotting symbols.**

**Figure 12-27.—Determining set and drift.**

12-29
4. Determine the set. The set is the bearing of the 1408 fix from the 1408 DR position. In figure 12-27, the 1408 fix bears 080° from the 1408 DR position. Therefore, the set is 080°.

5. Determine the drift. Drift is the speed that the ship is being offset from its intended course and is determined by measuring the distance between the fix and the DR position. In figure 12-27 this distance is 300 yards. According to the 3-minute rule, 300 yards translates to a drift of 3 knots.

6. By examining the plot on the chart, we can see that although the ship is heading 200° at 12 knots, it is actually tracking (or making good a course of) 185° at 10.8 knots, because of the 080° set and the 3-knot drift.

Should a situation such as the one in figure 12-27 arise, where own ship is being set off course, your first concern should be to determine the course and speed to get back on track within a specified time. To do so, use the following procedure (See figure 12-28). In this case, we want to be back on track in 3 minutes.

1. After determining set and drift, draw a second set and drift vector from the 1408 fix. (This second vector is the amount of offset your ship will encounter during the next 3 minutes.)

2. Draw a line from the end of the second set and drift vector to the time 11 DR position. This is the course own ship must steer to get back on track. The length of the line indicates the speed that we must use to arrive on track at time 1411. In this case, the course is 219°, and the distance is 1,600 yards. When you apply the 3-minute rule, the speed to use is 16 knots.

An experienced Operations Specialist should be able to recommend a course and speed to return to track in a matter of seconds. Normally, you will use a PMP to determine a course; but if a PMP is not available, you can determine the course, using parallel rulers, by paralleling the course lines to the compass rose printed on the chart. You can use dividers or a compass to measure distance if a PMP ruler is not available.

After you determine the course and speed for returning to the desired track, your next concern should be to determine the course and speed for making good the desired track. Use the following procedure: (See figure 12-29.)

Q9. What elements make up a ship’s tactical data?

CIC Piloting Team

Getting CIC ready and stationing personnel in their proper position are necessary before CIC can assist in piloting. Unless each person in CIC knows exactly what everyone else in CIC is doing, CIC cannot work as a team.

Figure 12-30 shows a typical CIC station setup. Depending on the type of ship and personnel available, ships could expand or modify the setup as necessary. Consult your ship’s CIC Doctrine and Class Combat Systems Doctrine for the exact setup for your ship.
The sound-powered circuits shown are for standard ships. When circuits are not available or are different, they may be modified. If modifications or substitutions are necessary, however, certain groups still should be tied together. For example, groups 1, 2, and 3 should be on the same circuit; 6, 7, and 8 on the same circuit; and P, S, and 10 on the same circuit. For the exact sound-powered phone circuits or IVCS channels for your ship, consult your CIC Doctrine or Class Combat Systems Doctrine.

**PILOTING OFFICER.**—In communication with the JA talker on the bridge, the piloting officer in our radar piloting setup mans the JA sound-powered phone circuit. The piloting officer keeps the navigational plotter and other concerned members of the team informed of helm and engine orders. The piloting officer also has the following responsibilities:

1. Making piloting recommendations to the conning officer based on the navigation chart, the ship’s position, PPI observations, lookout reports, and the policies and preferences of the commanding officer

2. Giving adequate and timely warning to the conning officer concerning all dangers to navigation by effectively evaluating the radar navigation track, surface shipping displays, and collected information

**NAVIGATIONAL PLOTTER.**—The navigational plotter maintains a plot of own ship’s position and determines corrections necessary to return own ship to the desired track. Any flat surface can serve as a desk for the navigational chart. A practical surface available in CIC is the top of the dead-reckoning tracer (DRT). Accordingly, the navigational plotter (No. 2 in figure 12-30) works on the south side of the DRT. The plotter must be thoroughly familiar with (1) reading and interpreting chart symbols, (2) correct navigational procedures, (3) computing set and drift, (4) dead reckoning own course and speed made good, and (5) determining compensating and correcting courses and speeds.

The navigational plotter wears the 21JS sound-powered phone and receives information from the navigational PPI operator, the radar navigation log recorder, and the fire control radar talker stationed nearby. It is the navigational plotter who tells the radar navigation log recorder when to obtain fix information. The navigational plotter also directs the fire control radars to lock on targets via the fire control radar talker. The navigational plotter checks in advance with the
CIC officer or the navigator concerning the planned approach track and lays out the proposed track on the chart. Then the plotter determines advance and transfer for expected course changes and indicates turning points and turning bearings or ranges on the chart. The navigational plotter also determines set and drift and informs the navigator and the piloting officer.

In summary, the navigational plotter should do the following:

1. Maintain a complete navigational plot on the chart according to prescribed procedures and techniques. He should obtain fixes, based on at least three lines of position, at intervals no greater than 2 minutes. From each successive fix, the plotter should plot an accurate track 1-minute increments and for periods of at least 2 minutes.

2. Assist the piloting officer in determining from the chart the following data:

   • Relation of the ship’s actual position to proposed track position.
   • Location of hazards to navigation (such as shoal water, obstructions, etc.).
   • Location of buoys.
   • Comparisons of depth sounding equipment readings and charted depths.
   • Geographic position of the ship in relation to land references, designated anchorage areas, and the like.
   • Distance and time to turning points and the time for course change.

3. Continuously determine set and drift.

**RADAR NAVIGATION LOG RECORDER.**—The radar navigation log recorder gives marks and records times, ranges, and bearings of objects used for piloting. He also records recommendations that makes to the conning officer.

During a gunfire support problem, because it is difficult for the navigational plotter to wear phones, the radar navigation log recorder is stationed next to the plotter and records all data in a form that the plotter can see easily. If the plotter wears phones during shore bombardment, he will be cut off from the problem as it rapidly develops upon receipt of a fire mission. When the fire mission is assigned, the navigational plotter hears it over the speaker and also sees the data on the status board. The navigational plotter and the target plotter then quickly locate the target and prepare for the problem. Essentially, the navigation log recorder and the navigational plotter perform as a team during gunfire support, just as in piloting.

**NAVIGATIONAL PPI OPERATOR.**—Before beginning any navigational problem, the surface radar and PPI operators must study the chart with the navigational plotter and the navigation log recorder. They should then decide the reference points to use. The reference points should be designated using standard alphabetical designations. The surface radar and PPI operators should set all controls at the proper selection for the ranges of primary interest. In general, these operators perform the following functions:

- As requested, they furnish the navigation log recorder and the navigational plotter range and bearing information on designated reference points.
- As applicable, they advise the navigation log recorder and the navigational plotter of the best reference points to use (as they appear on the scope).
- They inform the navigational plotter and the navigation log recorder when ship reaches predetermined turning ranges and bearings.

**FIRE CONTROL RADAR TALKER/RECORDER.**—The fire control (FC) radar talker stands next to the navigation log recorder and wears the sound-powered phones connected to the fire control radar operators. The FC talker is responsible for:

- coaching the fire control radar operators onto reference points designated by the navigational plotter or the navigation log recorder, and
- passing to the navigation log recorder and the navigational plotter any navigation information received from the fire control radar stations.

**SONAR/DEPTH SOUNDER TALKER/RECORDER.**—The sonar/depth sounder talker/recorder on the 61JS sound-powered phone circuit is stationed next to the DRT when he is communicating with the sonar and depth sounder operators. Aboard ships that have no sonar, another circuit must be used for communicating with the
depth sounder operator. The duties of the sonar/depth sounder talker/recorder are as follows:

- Coaches sonar operators onto designated objects, such as buoys, reefs, shoals, and ships at anchor, assisted by the navigational plotter.

- Records range and bearing information on buoys, shoals, and the like received from sonar operators for use by the navigational plotter in fixing the ship’s position.

- Advises the piloting officer or shipping officer of unusual changes such as screw beats heard and the Doppler of contacts.

- Records and reports depth sounder readings to the navigational plotter and piloting officer.

- Requests readings as directed by the piloting officer or according to the doctrine of the ship. (Typically, depth sounder readings should be taken and recorded at least every 30 seconds when the ship is in restricted waters.)

**SHIPPING OFFICER.**—Usually, the shipping officer supervises the surface picture, while the piloting officer takes care of the piloting detail. In smaller ships, it may be necessary to combine the duties of the piloting and shipping officers. If this happens, a supervisor should oversee and coordinate the surface displays. Whoever is designated the task wears the S/P phones connected to the bridge. The shipping officer must have a thorough knowledge of sound signals for both inland and international waters. The shipping officer is responsible for

- supervising CIC personnel charged with maintaining the surface displays (other than the navigational chart);

- ensuring that the bridge receives timely warning of all shipping of concern to the ship in passage and any amplifying information on this shipping, including an evaluation of fog signals reported by lookouts;

- coordinating the use of the sound-powered circuit with the piloting officer on a time-sharing basis; and

- designating contacts to be tracked, watched, or scrubbed, based on the specific situation and the desires and policies of the commanding officer.

**SURFACE-SEARCH RADAR/REMOTE PPI OPERATORS.**—Remote PPI operators for the shipping picture actually are standard surface-search operators during normal steaming. They maintain their scopes at a high level of performance and presentation, setting all controls at the proper selections for ranges of primary interest. In the performance of their duties, they also

- provide range and bearing information on contacts designated by the shipping officer or the surface supervisor to enable the surface summary plotter and surface contact status board keeper to maintain the required surface displays;

- report CPAs and bearing drifts of contacts directly from the PPI scope if directed by the shipping officer or the surface supervisor; and

- report new contacts appearing on scopes, according to ship’s doctrine.

**SURFACE SUMMARY PLOTTER AND SURFACE CONTACT STATUS BOARD KEEPER.**—The duties of the surface summary plotter and surface status board keeper, during navigation, are the same as for normal steaming. These personnel are responsible for maintaining complete displays that show designations, times, bearings, ranges, courses, speeds, CPA and times of approach, compositions, and (when known) identifications.

**LOOKOUT TALKER/ PLOTTER IN CIC.**—The lookout talker/plotter in CIC acts as liaison for lookout stations and has the following duties:

- Alerts lookouts to surface contacts approaching the ship from outside visual or audio range

- Passes to the piloting officer reports received on surf, obstructions, buoys, and other objects within visibility range

As a plotter the CIC lookout talker/plotter displays on the surface contact status board any reports received from lookouts as visual identifications.

**LOOKOUTS AND TALKERS AT LOOKOUT STATIONS.**—Lookout talkers at lookout stations pass to CIC any information on objects within visibility range. Reports include such data as bearing, estimated distance, identification, target angle, and closing or opening range of vessels.
Lookouts must be trained to know what fog signals to expect from a ship underway, a ship underway but with no way on, a ship at anchor, small craft underway, and the like. They should be briefed on diaphones and other anticipated fixed signals. Moreover, they should know how to differentiate between the sound of a ship’s whistle and a hand-operated horn.

Reports include bearings and what the lookouts heard: whistles, horns, etc.; how many blasts; duration of the blasts (short or prolonged); whether the blasts are becoming louder or weaker; and whether the other vessel is passing up the starboard side, down the port side, or crossing ahead. Lookouts report when the ship is abeam of buoys. This information aids the radar-piloting officer in establishing the ship’s position and acts as a check against electronic information.

**CIC Watch Log Recorder.**—We will discuss the CIC watch log at length in a later chapter. Because of the volume of traffic during radar piloting, it is advisable to have the JA circuit manned for the purpose of recording the information flow between CIC and the bridge. Recommendations made by CIC should be logged in the CIC watch log as well as in the radar navigation log.

Q10. What member of the navigation team gives timely warning to the conning officer concerning all dangers to navigation?

**Radar-Assisted Piloting**

The navigator and the CIC officer must agree on when fixes will be taken and must that the time is the same in both the bridge and CIC. By pre-arrangement, the navigator and CIC determine simultaneously. The radar navigation log recorder announces a “Stand by” at 10 seconds before the minute and a “Mark” on the minute. The navigator takes the most rapidly changing bearing (closest to the beam) on the mark, then other bearings. At the same time, the radar operator in CIC gives the most rapidly changing range (ahead or astern) on the mark, then subsequent ranges.

Before a ship leaves or enters port or steams into restricted waters, the navigator studies charts and various other publications, then lays down a safe course for the ship and discusses the proposed track with the commanding officer. As soon as possible, the CIC officer confers with the navigator.

Items of interest to the CIC officer include positions where the navigator desires to change speed, turning reference points, desired time of arrival at the destination, points to use for visual plotting, and the expected current. The CIC officer should have the navigator’s proposed track copied on appropriate charts, then study the charts carefully, noting such objects as hazards to navigation. Information indicated on charts includes danger lines, points on the track where the ship should change course or speed or possibly drop anchor (with additional tactical data as required), lines indicating the desirability of changing charts, and other applicable data. Next, the CIC officer should hold a briefing with radar operators to determine the most desirable targets to use in establishing radar fixes and to designate alternate targets. Other problems should be anticipated at this time so that they may be analyzed carefully and solved in advance insofar as possible. Any photographs that are scale models of the terrain should be studied to see what targets the radar will receive. All radar piloting personnel should study the charts carefully. When the special sea and anchor detail is set, the radar piloting team should be well-prepared and ready to work.

**COASTAL NAVIGATION**

While your ship is within radar range of land, CIC is required to keep a coastal navigation plot on a chart by plotting radar fixes. Make sure that the plot displays the following information:

- The intended track, marked with reference points and all proposed changes of course and speed. (These data are available from the navigation department and from the bridge.)
- Radar fixes every 30 minutes or as required by own ship’s doctrine. (Compare these fixes with those the or navigator obtains.)
- The boundaries of the area(s) in which the ship is operating or expects to operate.
- The set and drift of the current.
- The wind direction and velocity.
- The positions of any hazards to navigation.
- The locations of any objects of potential interest.

**NAVIGATION AT SEA**

Whenever a ship is beyond radar range of land, CIC cannot get navigational information on its own, but must get data from the navigator and maintain an up-to-date plot on the navigational chart. In these
situations, CIC maintains the following information on the chart:

- The ship’s position the navigator determined from loran, Omega, satellite, or celestial (stars) data. At these times, the settings of the and NTDS should be compared with the navigator’s position and reset if necessary.
- An accurate dead-reckoning plot, showing all course and speed changes and DR positions every 30 minutes (more often when maneuvering).
- The boundaries of the operating area(s) in which the ship is steaming or intends to exercise.
- The location of all hazards to navigation.
- The location, course, speed, and predicted track of all storms.
- The position and estimated time of radar landfall.
- The location of any objects of possible interest, such as ships in distress or position of own or enemy forces.
- PIM (Position and Intended Movement) information.
- When aircraft are being controlled, a plot of the air defense identification zone (ADIZ) line, and a plot of areas in which gun or missile firing is scheduled to take place.
- Radiological fallout reports.

Whether the ship is near land or in the open ocean, Operations Specialists can use navigational plots to aid in the following actions:

- Scope interpretation. — Small isolated islands, for example, often appear to be ships. A check against the chart, from the ship’s present position on the chart to the target, will verify whether the target is a ship or land and prevent reporting land as a ship.
- Search and rescue. — Normally, Operations Specialists in CIC are among the first to know when an aircraft is in peril or when a ship is in danger. Thus, by knowing the correct position of the ship and plotting the position of the aircraft or ship in trouble, Operations Specialists can make recommendations immediately to the bridge.
- Conversion plotting. — By using a chart with a grid reference system superimposed, Operations Specialists can change the bearing and range of an object to the reference system or to latitude and longitude.

**CHANNEL NAVIGATION IN A FOG**

Channel navigation in a fog requires accurate identification of buoys and close coordination between CIC and the bridge.

The first step in CIC is to lay off the track through the channel and make up the buoy check-off list. Most harbors have some channel buoys equipped with radar reflectors. Make special note of these buoys; they will be seen on radar earlier and can be identified more easily than the other buoys.

Through the JL talker, keep the lookouts informed of the bearing of the channel buoys and have them send any visual sightings to CIC. Alert the bridge talker to transmit all visual sightings of buoys by bridge personnel.

Channel navigation in a fog is one of the most nerve-wracking experiences a conning officer encounters. The conning officer is intently peering into a blanket of white fog, with CIC the main source of navigational information. If you maintain a rapid flow of information on course, distance, buoys, and other shipping, the conning officer is assured you are in control of the situation. If the conning officer must ask repeatedly for this information, he has little or no confidence in the ability of CIC.

Just as fog reduces visibility, so do water droplets reduce radar performance. You may not be able to get the same ranges in foggy weather as you can in clear weather. This makes the requirements for peak performance of the radar of even more importance. Make full use of your other important aids—fire control radar, depth finder, and sonar (where installed).

Whenever you obtain an unreliable fix in CIC, plot it as an estimated position, and attempt to obtain a more accurate fix as soon as possible. Swamp and lowland areas in some harbors make it particularly difficult to navigate by radar.

If a ship enters a harbor during reduced visibility, the responsibility for safe piloting is placed in CIC. Under these circumstances, if a situation arises where CIC cannot obtain an accurate radar fix within 2-minutes, CIC must recommend all stop until it can determine an accurate position for own ship.
Figure 12-31 shows a ship’s track, as plotted in CIC, entering Charleston Harbor. Note that the estimated positions are immediately followed by a fix. Also note that a turning bearing has been plotted according to the navigator’s proposed track. Set and drift were figured at time 0705 and course and speed were adjusted in order to make good the desired track. The time 0710 fix is a single bearing and range fix that was taken quickly as the turning point was approached. In this case, CIC would recommend turning as soon as the 0710 fix was plotted.

The scale of the chart used in figure 12-31 is 1:20,000. A distance scale (not shown in the illustration) is provided at the bottom of the chart for measuring ranges and laying out DR positions.

The time-distance-speed scale, shown in figure 12-32, is a convenient item that you can draw on any chart (to the scale of the chart being used) and use to measure distance traveled at any of the various speeds during 1-, 2-, or 3-minute intervals. For example, if your ship is making 10 knots and you want to plot a 2-minute DR, simply measure up the 2-minute line from the bottom line to the point where the 10-knot line crosses the 2-minute line. That distance indicates how far your ship will travel in 2 minutes at 10 knots.

The time-distance-speed scale is based upon the 3-minute rule and is very accurate. It also takes all of the guesswork out of laying out a DR. It’s a good idea to have one of these scales drawn on each of the frequently used harbor charts for a convenient and ready reference.

ANCHORING A SHIP

Often, CIC is given the responsibility for piloting the ship to anchorage. For this phase of piloting, lay off on the charts the complete track (indicate course and speed) of the ship from the time land is first detected until the ship is anchored.

Anchorage charts for the principal harbors of the United States and its possessions are issued to every ship. These anchorage charts are harbor charts with anchorage berths overprinted in colored circles of various diameters. On these charts, series of berths of the same size are laid out in straight lines and are called lines of anchorage. Adjacent circles usually are tangent to each other. The center of the circle is the center of the berth. Each berth is designated by a number, a letter, or a combination of both, printed inside the circle.

If you are to anchor in a harbor for which there is no standard anchorage chart, a berth is assigned by giving the bearing and distance of the center of the berth from a known object, together with the diameter of the berth.

When your ship is ordered to anchor in a specific berth, CIC personnel must take the following actions:

- From the center of the berth, draw the letting-go semicircle. Use a radius equal to the horizontal distance between the hawsepipe and the antenna position of the surface-search radar. (The navigator uses the position of bridge wing gyro repeaters.)
- From the center of the berth, lay off the intended track, using the appropriate approach courses and navigational aids for determining the ship’s position. Where turns are necessary, locate turning bearings and ranges. If possible, the final approach should be made with the ship heading into the current or the wind. The effects of current and wind and the presence of shipping often preclude a straight course to the anchorage.
- Determine the distance from the hawsepipe of the ship to the radar antenna. Lay this distance off from the center of the berth to locate the letting-go point. From there, draw range semicircles. The usual practice is to draw arcs every 100 yards out to 1,000 yards, then arcs at 1,200, 1,500, and 2,000 yards. Also from the center of the berth, draw bearing lines at 5° and 10° in the direction of your approach and label these lines, using reciprocal bearings. These lines and arcs enable the piloting officer to make recommendations to anchorage without interfering with the navigational fixes being taken.

Figure 12-33 shows an anchorage track. In this track, the ship makes its final approach to the anchorage, using a beacon as a range. Notice the course and speeds, DR positions, turning bearing, final approach course, semicircles indicating yards from the center of the berth, letting-go circle, and anchorage bearing. The ship will turn to the approach course when it reaches the turning bearing and anchor when the stack bears 090°T. Remember, the speed of the ship should be such that it has no headway upon reaching the letting-go point. Slight sternway should be on the ship as soon as the anchor is let go for the anchor to take hold, to lay out the anchor chain properly, and to protect bow-mounted sonar domes.
Figure 12-31.—Navigation track as plotted in CIC.
RULES OF THE ROAD

OSs must know and understand the nautical Rules of the Road; the safe navigation of your ship requires the application of various regulations to prevent collisions. There are two sets of rules—International Rules and Inland Rules.

International Rules are specific rules for all vessels sailing on the high seas and in connecting waters navigable by seagoing vessels. The Inland Rules apply to all vessels sailing on the inland waters of the United States and to vessels of the United States on the Canadian waters of the Great Lakes to the extent that there is no conflict with Canadian law.

The International Rules were formalized at the convention on the International Regulations for Preventing Collisions at Sea, 1972. These rules are commonly called the 72 COLREGS.

The Inland Rules discussed in this chapter replace the old Inland Rules, Western River Rules, Great Lakes Rules, their respective pilot rules, and parts of the Motorboat Act of 1940. Many of the old navigation rules were originally enacted in the last century. Occasionally, provisions were added to cope with the increasing complexities of water transportation. Eventually, the navigation rules for the United States inland waterways became such a confusing patchwork of requirements that in the 1960s several unsuccessful
attempts were made to revise and simplify them. Following the signing of the 72 COLREGS, a new effort was made to unify and update the various Inland Rules. This effort was also aimed at making the Inland Rules as similar as possible to the 72 COLREGS. The Inland Navigation Rules of 1980, now in effect, was the result.

The International and Inland Rules contain 38 rules that compose the main body of the rules and five annexes, which are the regulations. The International and Inland Rules are divided into the following parts:

- Part A — General
- Part B — Steering and Sailing Rules
- Part C — Lights and Shapes
- Part D — Sound and Light Signals
- Part E — Exemptions

In this chapter we will present a short discussion of the steering and sailing rules, but the majority of our discussion will be about Part D, which concerns sound signals.

Definitions

Before we get into the requirements for whistle signals, you must first understand the terms we will use.

- The word **vessel** includes every description of, including non-displacement craft and seaplanes, used or capable of being used as a means of transportation on water.
- The term **power-driven vessel** means any vessel propelled by machinery.
- The term **sailing vessel** means any vessel under sail, provided that propelling machinery, if fitted, is not being used.
- The term **vessel engaged in fishing** means any vessel fishing with nets, lines, trawls, or other fishing apparatus that restricts its maneuverability, but does not include a vessel fishing with trolling lines or other fishing apparatus that does not restrict its maneuverability.
- The word **seaplane** includes any aircraft designed to maneuver on the water.
- The term **vessel not under command** means a vessel that, through some exceptional circumstance, is unable to maneuver as required by these rules and is therefore unable to keep out of the way of another vessel.
- The term **vessel restricted in its ability to maneuver** means a vessel that, from the nature of its work, is restricted in its ability to maneuver as required by these rules and is therefore unable to keep out of the way of another vessel.
- The term **vessel constrained by its draft** means a power-driven vessel that, because of its draft in relation to the available depth of water, is severely restricted in its ability to deviate from the course it is following (International Rules only).
- The word **under way** means that a vessel is not at anchor, made fast to the shore, or aground.
- The words **length** and **breadth** of a vessel mean its length overall and its greatest beam or width.
- Vessels are deemed to be **in sight of one another** only when one can be seen from the other.
- The term **restricted visibility** means any condition in which visibility is restricted by fog, mist, falling snow, heavy rainstorms, sandstorms, or any other similar causes.
- The term **inland waters** means the navigable waters of the United States shoreward of the navigational demarcation lines dividing the high seas from harbors, rivers, and other such bodies of waters of the United States, and the waters of the Great Lakes on the United States side of the International Boundary.
- **Demarcation Lines** are the lines delineating waters upon which mariners must comply with the 72 COLREGS and waters upon which mariners must comply with the Inland Navigation Rules. (The boundaries for the demarcation lines are listed in the back of the Coast Guard publication *Navigation Rules*.)
- The word **whistle** means any sound-signaling appliance capable of producing the prescribed blast and which complies with the specifications in Annex III of the International and Inland Rules. (When your ship was built and the whistle was installed, all of the specifications listed in Annex III were considered.)
- The term **short blast** means a blast of about 1 second’s duration.
• The term *prolonged blast* means a blast of from 4 to 6 seconds’ duration.

**Steering and Sailing Rules**

You must understand the steering and sailing rules and be able to apply them to various traffic situations. Although all rules of the road are important, the steering and sailing rules are the most essential to know to avoid collision.

Your vessel may be at risk of colliding with an approaching vessel if the approaching vessel does not change its course. However, when you are approaching a very large vessel or when you are in close quarters, a bearing change alone does not necessarily mean that a collision cannot happen. Figures 12-34, 12-35, and 12-36 illustrate the three situations in which the danger of collision might exist: head-on, crossing, and overtaking. The illustrations and the following summary will help you learn the rules and appropriate actions:

1. When two ships meet head-on or nearly so (fig. 12-34), each ship must change course to starboard and pass port-to-port. In international waters, a whistle signal is sounded only when a course change is actually made. If the meeting ships are already far enough off each other to pass clear on their present courses, no signal is sounded.

2. When two power-driven vessels are crossing so as to involve risk of collision (fig. 12-35), the vessel having the other to starboard must keep out of the way and avoid, if circumstances permit, crossing ahead of the other vessel.

3. A sailing vessel has right-of-way over power-driven vessels except when the sailing vessel is overtaking, and when the power-driven vessel is engaged in fishing, is not under command, or is restricted in its ability to maneuver.

4. Any vessel overtaking another must keep clear of the overtaken vessel. An overtaking vessel is one that is approaching another vessel from any...
direction more than 22.5° abaft its beam (fig. 12-36). When in doubt, assume you are overtaking and act accordingly.

**Equipment for Sound Signals**

A vessel of 12 meters or more in length must be provided with a whistle and a bell. Vessels that are 100 meters or more in length must also have a gong. The tone of the gong cannot be confused with the tone of the bell. Both the bell and the gong must comply with the specifications listed in Annex III. (As with the whistle, these specifications were taken into account when the ship was outfitted.)

A vessel of less than 12 meters in length is not required to carry the sound signaling equipment mentioned above, but must carry some efficient means of sound signaling.

**Maneuvering and Warning Signals**

Since there are major differences between the international and the inland maneuvering and warning signals, we will presented them separately, and will note the differences on the inland version.

**INTERNATIONAL RULES**

When vessels are in sight of one another, a power-driven vessel underway maneuvering as authorized or required by these Rules, must indicate its maneuver with one of the following whistle signals:

- One short blast: “I am altering my course to starboard”;
- Two short blasts: “I am altering my course to port”;
- Three short blasts: “I am operating astern propulsion.”

Any vessel may supplement these whistle signals with light signals, repeated as appropriate while it carries out the maneuver. These light signals have the following meaning:

- One flash: “I am altering my course to starboard”;
- Two flashes: “I am altering my course to port”;
- Three flashes: “I am operating astern propulsion.”

The duration of each flash should be about 1 second; and the interval between successive signals must not be less than 10 seconds. The light used for this signal must be an all-round white light, visible at a minimum range of 5 miles, and must comply with the provisions of Annex I to the International Rules.

When two vessels are within sight of one another in a narrow channel or fairway, the vessel intending to overtake the other must indicate its intention with one of the following whistle signals:

- Two prolonged blasts followed by one short blast: “I intend to overtake you on your starboard side”;
- Two prolonged blasts followed by two short blasts: “I intend to overtake you on your port side.”

The vessel about to be overtaken must indicate agreement with one of the following whistle signals:

- One prolonged blast, one short blast, one prolonged blast, and one short blast, in that order.

When two vessels in sight of one another are approaching each other, they must understand each other’s intentions. If one of them fails to understand the intentions or actions of the other or is in doubt whether the other is taking sufficient action to avoid collision, it must immediately indicate its doubt by giving at least five short, rapid blasts on the whistle. It may supplement the whistle signal with a light signal of at least five short, rapid flashes.

A vessel nearing a bend or an area of a channel or fairway where other vessels may be obscured by an intervening obstruction must sound one prolonged blast loud enough to be heard around the bend or obstruction.

If whistles are fitted farther apart than 100 meters on a vessel, only one of the whistles may be used for giving maneuvering and warning signals.

**INLAND RULES**

When power-driven vessels maneuvering as authorized or required by the Inland Rules are in sight of one another and meeting or crossing at a distance within half a mile of each other, each vessel must indicate its maneuver by giving one of the following whistle signals:

- One short blast: “I intend to leave you on my port side”;
Two short blasts: “I intend to leave you on my starboard side”;

Three short blasts: “I am operating astern propulsion.”

**NOTES**

1. International Rules do not specify a distance for sounding signals.


When one vessel hears a one- or two-blast signal from another vessel, the first vessel must, if it agrees to the maneuver, sound the same whistle signal and take the steps necessary to make a safe passing. If, however, the first vessel doubts the safety of the proposed maneuver, it must sound the danger signal of at least five short, rapid whistle blasts. Both vessels must then take appropriate precautionary actions until they agree that they can make a safe passing.

A vessel may supplement the above whistle signals with the following light signals:

- One flash: “I intend to leave you on my port side”;
- Two flashes: “I intend to leave you on my starboard side”;
- Three flashes: “I am operating astern propulsion.”

Each flash must have a duration of about 1 second, and the light must be one all-round white or yellow light, visible at a minimum range of 2 miles, synchronized with the whistle, and must comply with the provisions of Annex I to the Inland Rules.

**NOTES**

1. Inland Rules do not specify an interval between flashes or an interval between successive signals.

2. International Rules do not allow a yellow light to be used for light signals.

3. The minimum visible range for light is 2 miles for Inland Rules and 5 miles for International Rules.

4. Inland Rules require that light signals and sound signals be given at the same time (synchronized).

When two power-driven vessels are in sight of one another and one intends to overtake the other, the vessel intending to do the overtaking must indicate its intention with one of the following whistle signals:

- One short blast: “I intend to overtake you on your starboard side”;
- Two short blasts: “I intend to overtake you on your port side.”

**NOTES**

1. Inland Rules require signals for overtaking vessels when in sight of one another in a narrow channel or fairway.

2. International Rules require two prolonged blasts preceding the short blast(s) required by the Inland Rules.

3. Overtaking signals are signals of intention only and must be answered by the vessel that is being overtaken, in both International and Inland Rules.

If the power-driven vessel about to be overtaken agrees to the maneuver, it must sound a similar sound signal. If it is in doubt about the maneuver, it must sound the danger signal of at least five short, rapid blasts.

**NOTE**

Inland Rules require the vessel being overtaken to answer with a signal similar to the one sounded by the overtaking vessel, if it agrees. The International Rules require the vessel being overtaken to sound one prolonged, one short, one prolonged, and one short blast, in that order, if it agrees. The Inland Rules for overtaking vessels apply only to power-driven vessels; International Rules apply to all vessels.

When two vessels in sight of one another are approaching and either vessel fails to understand the intentions or actions of the other, or is in doubt whether the other is taking sufficient action to avoid collision, the vessel in doubt must immediately indicate its doubt by giving at least five short, rapid blasts on the whistle. It may supplement this signal with a light signal of at least five short, rapid flashes.
A vessel nearing a bend or an area of a channel or fairway where other vessels may be obscured by an intervening obstruction must sound one prolonged blast. Any vessel within hearing around the bend or behind the intervening obstruction must answer this signal with a prolonged blast.

If whistles are fitted on a vessel at a distance apart of more than 100 meters, only one whistle may be used for giving maneuvering and warning signals.

NOTE

There are no provisions made in the International Rules for the following situations:

1. When a power-driven vessel is leaving a dock or berth, it must sound one prolonged blast.

2. A vessel that reaches agreement with another vessel in a meeting, crossing, or overtaking situation by using the radio-telephone, as prescribed by the Bridge-to-Bridge Radiotelephone Act (85 Stat. 165; 33 U.S.C. 1207), is not obliged to sound the whistle signal prescribed by Inland Rules, but may do so. If the two vessels cannot reach agreement on the radio-telephone, they must exchange whistle signals in a timely manner.

Sound Signals In Restricted Visibility

The sound signals for restricted visibility required by International and Inland Rules are very similar. In this part of the text, we will present only the Inland Rules, but we will note any difference between the International and Inland rules.

In or near an area of restricted visibility, whether by day or night, the following signals apply:

- A power-driven vessel making way through the water must sound one prolonged blast at intervals of not more than 2 minutes.

- A power-driven vessel under way but stopped and making no way through the water must sound two prolonged blasts in succession, with an interval of about 2 seconds between them, at intervals of not more than 2 minutes.

- The following vessels must sound one prolonged blast followed by two short blasts at intervals of not more than 2 minutes: A vessel not under command; a vessel restricted in its ability to maneuver, whether under way or at anchor; a sailing vessel; a vessel engaged in fishing, whether under way or at anchor; and a vessel engaged in towing or pushing another vessel.

NOTES

1. In the Inland Rules, no provisions are made for a vessel constrained by its draft.

2. International Rules address vessels engaged in fishing while at anchor and vessels restricted in their ability to maneuver when carrying out work at anchor separately. The sound signals required for these situations are the same as those for the same situations in the Inland Rules.

A vessel towed, or if more than one vessel is towed, the last vessel of the tow, if manned, must sound one prolonged followed by three short blasts at intervals of not more than 2 minutes. When practical, this signal must be made immediately after the signal made by the towing vessel.

When a pushing vessel and a vessel being pushed ahead are rigidly connected in a composite unit, they are regarded as a power-driven vessel and give the signals prescribed earlier for a power-driven vessel making way through the water or a vessel under way but stopped and making no way through the water.

A vessel at anchor must, at intervals of not more than 1 minute, ring the bell rapidly for about 5 seconds. In a vessel of 100 meters or more in length, the bell must be sounded in the forepart of the vessel, and immediately after the ringing of the bell, the gong must be sounded rapidly for about 5 seconds in the aft part of the vessel. A vessel at anchor may, in addition, sound one short, one prolonged, and one short blast to give warning of its position and of the possibility of collision to an approaching vessel.

A vessel aground must give the bell signal and, if required, the gong signal prescribed above and must, in addition, give three separate and distinct strokes on the bell immediately before and after the rapid ringing of the bell. A vessel aground may, in addition, sound an appropriate whistle signal.

A vessel of less than 12 meters in length is not required to give the above-mentioned signals but, if it does not, the vessel must make some other efficient sound signal at intervals of not more than 2 minutes.
A pilot vessel, when engaged on pilotage duty, may, in addition to the signals prescribed for a power-driven vessel under way making way through the water; under way but stopped and not making way through the water; or at anchor; sound an identify signal consisting of four short blasts.

NOTE

The International Rules do not cover the following situations:

The following vessels are not required to sound signals prescribed for an anchored vessel when anchored in a special anchorage area:
1. Vessels of less than 20 meters in length
2. A barge, canal boat, scow, or other nondescript craft

Responsibility

Where collision is so imminent that it cannot be avoided by the give-way vessel alone, it immediately becomes not only the right but the expressed duty of the stand-on vessel to take whatever action will best help to avert collision. Each vessel must do all in its power to avert the collision no matter which one may have the right-of-way.

The responsibility rule (International and Inland rule 2) makes it impossible for a stand-on vessel to escape responsibility after standing into danger simply because its skipper decided not to haul off when he or she had the right-of-way. Rule 2(b) is as follows:

“In construing and complying with these Rules due regard shall be had to all dangers of navigation and collision and to any special circumstances including the limitations of the vessels involved, which may make a departure from these Rules necessary to avoid immediate danger.”

Q11. The Inland Rules of the Road apply to what vessels in what bodies of water?

ANSWERS TO CHAPTER QUESTIONS

A2. 360.
A3. 60.
A4. Cartesian coordinates, the world geographic reference (GEOREF) system, and the universal transverse Mercator grid (UTM).
A5. The world geographic reference (GEOREF) system.
A7. April and October.
A9. Acceleration, deceleration, acceleration/deceleration distance, advance, transfer, tactical diameter, final diameter, and standard rudder.
A10. The piloting officer.
A11. All vessels sailing on the inland waters of the United States and vessels of the United States on the Canadian waters of the Great Lakes to the extent that there is no conflict with Canadian law.