CHAPTER 9

NAVIGATIONAL DUTIES

Navigation is the art or science of determining the position of a ship or aircraft and directing that ship or aircraft from one position to another. It can be regarded as an art because its application involves the exercise of special skills and fine techniques, which can be perfected only by experience and careful practice. On the other hand, navigation can be regarded as a science inasmuch as it is knowledge dealing with a body of facts and truths systematically arranged and showing the operation of general laws. Navigation has been practiced for thousands of years; however, modern methods date from the 18th century invention of the chronometer, a precision timepiece. As a Signalman, you may be required to assist the navigator by taking bearings, using the bearing circle or alidade. You may assist the officer of the deck (OOD) by sounding whistle signals and by being alert to aids to navigation.

To better prepare you for your navigational duties, this chapter contains information on navigational equipment, aids to navigation, and Rules of the Road.

NAVIGATIONAL EQUIPMENT

LEARNING OBJECTIVES: List and explain the use of navigational equipment that you will come in contact with as a Signalman.

The equipment described in this section is the equipment most likely to be used by you in performing navigational duties.

COMPASSES

There are two types of compasses in general shipboard use: the magnetic compass, which depends on Earth's magnetic field for its directive force, and the gyrocompass, which operates on the gyroscopic principle of the spinning wheel.

When you studied as a seaman, you learned that the magnetic compass points to the magnetic rather than the true North Pole, and that the magnetic pole is located some distance away from the true pole. You also discovered how the Navy standard compass is made, and how its needle is deflected by magnetic materials either in a ship itself or by magnetic materials brought near the compass.

The gyrocompass, on the other hand, points to true north by operation of the gyroscopic principle. It may, however, have a slight mechanical error of a degree or two, which is known and for which due allowance is made.

Magnetic Compass

The ship’s magnetic compasses are named or classed according to their use.

The standard compass is the magnetic compass used by the navigator as a standard for checking other compasses on the ship. It is so located that it is least affected by the internal magnetism of the ship. Courses or bearings given from it are designated per standard compass (PSC).

The steering compass is located near the helmsman. Along with the gyro repeater, it is the compass by which the ship is steered. Courses or bearings given from it are designated per steering compass (PSTCO).

Gyrocompass

The gyrocompass is not affected by variation and deviation. Headings or bearings from it are designated per gyrocompass (PGC).

When in proper running order, the gyrocompass points constantly to true instead of magnetic north. It may have a slight mechanical error, called gyro error, which is computed easily and remains constant for any heading.

Despite the excellence of the gyro mechanism, it is the magnetic compass—not the gyro—that is standard aboard ship. The reason is the magnetic compass operates through the attraction exerted by Earth. Consequently, the magnetic compass will never go out of commission because of power failure.

The gyrocompass, on the other hand, is powered by electricity. If the supply is cut off, the gyro is useless. Being an extremely complicated and delicate instrument, it is also subject to mechanical failure.

Some gyros, for instance, become erratic after the ship makes a series of sharp turns at high speeds. The possibility of a gyro malfunction does not mean, however, that great confidence cannot be placed in the gyro. When running properly, it can be depended upon to point faithfully and steadily to true north. But the magnetic compass, being more reliable, is used constantly to check the gyro's performance.

Typical shipboard installations of gyrocompasses consist of one or more master gyros, whose indications are transmitted electrically to repeaters located in conning stations, on bridge wings, and at other necessary points.

BEARING AND AZIMUTH CIRCLES

Strictly speaking, *azimuth* and *bearing* are the same in meaning: the horizontal angle that a line drawn from your position to the object sighted makes with a line drawn from your position to true north. The word *azimuth,* however, applies only to bearings of heavenly bodies. For example, it is not the bearing, but the azimuth of the Sun; and not the azimuth, but the bearing of Brenton Reef Tower.

A bearing circle is a nonmagnetic metal ring equipped with sighting devices that is fitted over a gyro repeater or magnetic compass. The bearing circle is used to take bearings of objects on Earth's surface.

The azimuth circle (fig. 9-1) is a bearing circle equipped with additional attachments for measuring azimuths of celestial bodies. Either bearings or azimuths may be taken with the azimuth circle.

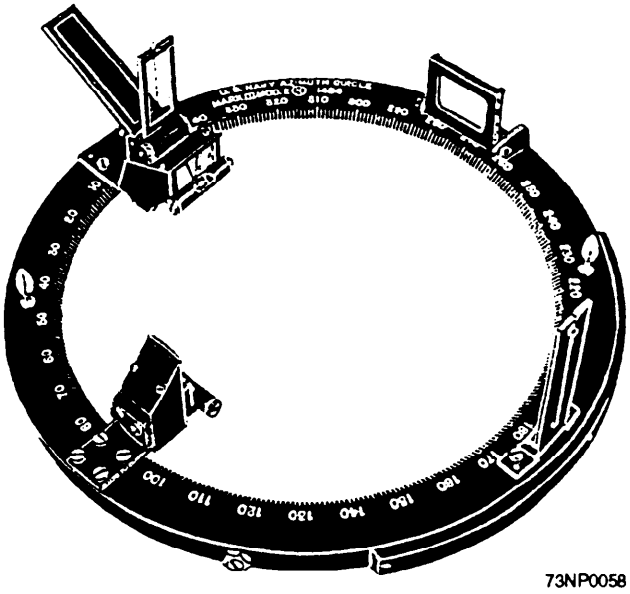

Figure 9-l.—Azimuth circle.

Taking a Bearing

Assume that you are getting a bearing on a lighthouse. Install either a bearing or azimuth circle on the gyro repeater, and make sure that the circle rotates freely. Train the vanes on the lighthouse so the lighthouse appears behind the vertical wire in the far vane. Drop your gaze to the prism at the base of the far vane, then read the bearing indicated by a hairline in the prism.

Taking an Azimuth

The azimuth circle may be used in two ways to measure the azimuth of a celestial body. The first method is used with a brilliant body such as the Sun. At the upper center in figure 9-2, you see a concave mirror; and at the lower center, a prism attachment. Sight with the mirror nearest you, and the prism toward the observed body. Light from that body is reflected from the concave mirror into the prism. The prism, in turn, throws a thin beam on the compass card. This beam strikes the graduation that indicates the azimuth.

The second method is used for azimuths of bodies whose brightness is insufficient to throw such a distinct beam. Behind the far vane on the azimuth circle is a dark glass that may be pivoted so as to pick up celestial bodies at various altitudes. When a body is sighted, its reflection appears behind the vertical wire in the far vane, and its azimuth may be read under the hairline in the prism.

The inner lip of the azimuth circle, in figure 9-2, is graduated counterclockwise in degrees. It is

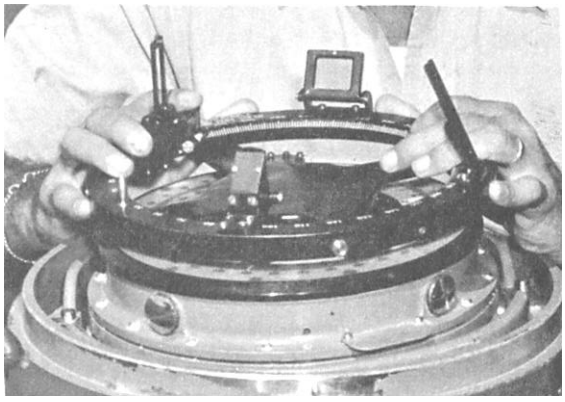

Figure 9-2.—Taking an azimuth.

possible, then, to obtain relative bearings of objects by merely training the vanes on an object, then reading the graduation on the inner circle alongside the lubber's line on the pelorus or repeater.

Each of the far vanes contains a spirit level to indicate when the circle is level. Bearings taken when the azimuth or bearing circle is not on an even keel are inaccurate.

TELESCOPIC ALIDADES

Another means of taking bearings is by using an alidade, which, like the bearing circle, is mounted on a repeater. The telescopic alidade (fig. 9-3) is merely a bearing circle with a small telescope attached to it. The image is magnified, making distant objects appear larger to the observer. A series of prisms inside the low-power telescope enables the bearing-taker to read the bearing directly from the compass card without removing the eye from the eyepiece.

Bearings and azimuths may be true, per gyrocompass (PGC), magnetic, or per steering compass (PSTCO). When you are helping the navigator in piloting, you probably will report bearings directly from the gyro repeater, and the navigator will correct them to true.

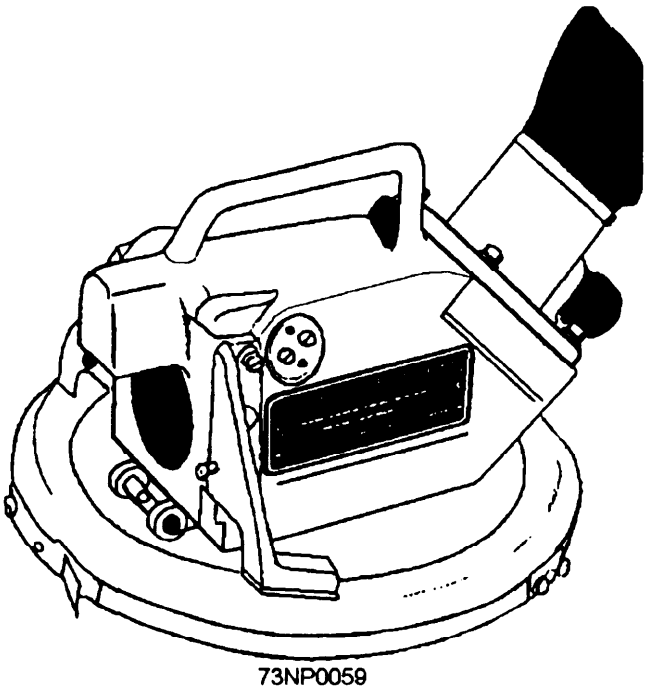

Figure 9-3.—Telescopic alidade.

CHARTS AND PUBLICATIONS

LEARNING OBJECTIVES: Explain the use of navigational charts and publications. Explain chart scales, chart sounding marks, and how to make chart corrections.

A map represents pictorially all or part of Earth's surface. Maps specially designed for navigators are called charts. Navigational charts show water depths and the nature of the bottom, together with a topography of adjacent land.

A chart is a printed reproduction of a portion of Earth's surface depicting a plan view of the land and water. A chart uses standard symbols, figures, and abbreviations that supply data on water depth, characteristics of the bottom and shore, location of navigational aids, and other information useful in navigation. Figures indicating water depth are placed throughout the water area to indicate the shape of the bottom. Normally the density of sounding on a chart increases as you approach land. A chart is normally lined with a network of parallels of latitude and meridians of longitude, which aid in locating various features.

LOCATING POSITIONS ON CHARTS

Earth is approximately an oblate (flattened at the poles) spheroid. However, for most navigational purposes, Earth is assumed to be a sphere, with the North Pole and South Pole located at opposite ends of the axis on which it rotates. To establish a feature's location geographically, it is necessary to use two reference lines, one running in a north-south direction and the other in a east-west direction. Numerical designators are applied to these reference lines. The numerical system used is circular and consists of 360°, with 60 minutes or 3,600 seconds in a degree.

Lines running in the north-south direction, called meridians, start at one pole and end at the opposite pole. (See fig. 9-4.) Lines running east-west are parallel lines and are called parallels.

Meridians

The prime (0°) meridian, which is the reference line for all meridians, passes through the Royal Observatory located at Greenwich, England. Earth is divided into Eastern and Western Hemispheres. All meridians are numbered between 0° and 180° east and west of the prime meridian. In addition to the number value, each line is identified by the letter *E* or *W*, denoting the proper hemisphere.

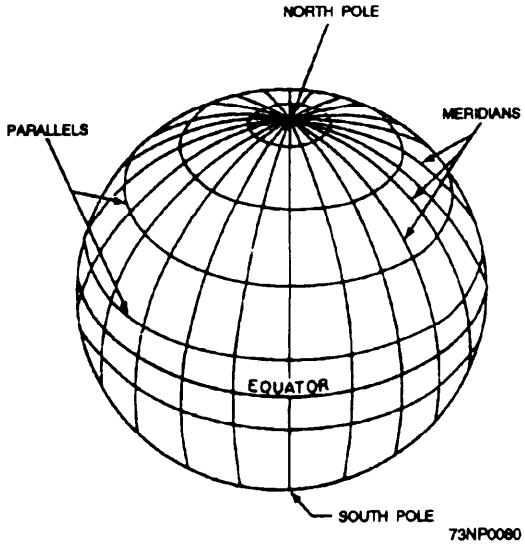

Figure 9-4.—The terrestrial sphere.

Parallels

Parallels also require a reference: the Equator. The Equator (0°) is located halfway between the poles, and divides the world into Northern and Southern Hemispheres. The letter designator *(N* or *S)* must also be used in referencing a position. The principle of the numbering system is similar to that used for meridians except that parallels range from 0° at the Equator to 90° *N* or *S* at the poles.

Latitude and Longitude

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

Latitude (parallel) is the angular position in degrees, minutes, and seconds of arc north or south of the Equator, measured along the meridian of the point. (See fig. 9-5.)

Longitude (meridians) is the angular position in degrees, minutes, and seconds of arc east or west of the 0° meridian, measured along the parallel of the point. (See fig. 9-5.)

For navigational purposes, accuracy demands are rigid. The exact position must be designated. Consequently, in giving navigational position, 1° is divided into 60 minutes, and 1 minute is divided into 60 seconds. Thus, a latitude may be 45° 12 minutes 22 seconds *N* (or *S).* The same system is used for east or west longitude. In all reports concerning navigation hazards and positions of lightships, buoys, and the like received on radio nets or read in *Notices to Mariners,* positions are given in latitude and longitude.

Nautical Distance

On Earth's surface, 1° of latitude may be considered 60 nautical miles in length; whereas the length of 1° of longitude varies with latitude. Hence, the latitude scale must be used for measuring distance. Although this scale is expanded on a Mercator chart, the expansion is exactly equal to the expansion of distance at the same latitude. Therefore, in measuring

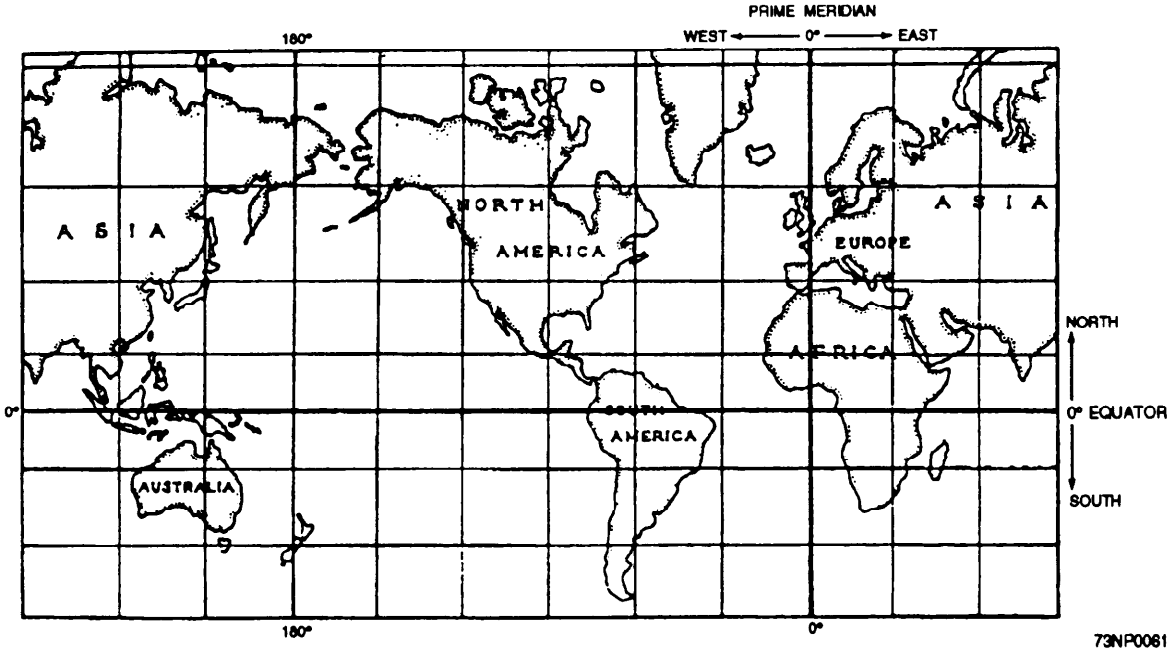

Figure 9-5.—Earth on the Mercator projection.

distance on a Mercator chart, one must be careful to use the latitude scale at the proper place.

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.

TYPES OF CHARTS

Of the types of charts used today, Mercator projection charts are the most commonly used navigational charts. Other charts used include the transverse Mercator, polyconic, and gnomonic projections. For more information on the use of these charts, consult *Dutton's Navigation and Piloting* or the *American Practical Navigator*, Pub. No. 9.

CHART SCALES

The scale of a chart refers to a measurement of distance-not area. A chart covering a relatively large area is called a small-scale chart, and one covering a relatively small area is called a large-scale chart. Scales may vary from 1:1,200 for plans to 1:14,000,000 for world charts. Normally, the major types of charts fall within the following scales:

- Harbor and Approach Charts—Scales larger than 1:50,000. These charts are used in harbors, anchorage areas, and the smaller waterways. Those charts used for approaching more confined waters are called approach charts.

- Coastal 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.

- General and Sailing Charts—l:150,000 or smaller. 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. They are also used in fixing the position as the ship approaches the coast from the open ocean and for sailing between distant coastal ports.

The size of the area portrayed by a chart varies extensively according to the scale of the chart. The larger the scale, the smaller the area it represents. It follows then that large-scale charts show areas in greater detail (fig. 9-6.) Many features that appear on a large-scale chart do not show up on a small-scale chart of the same area.

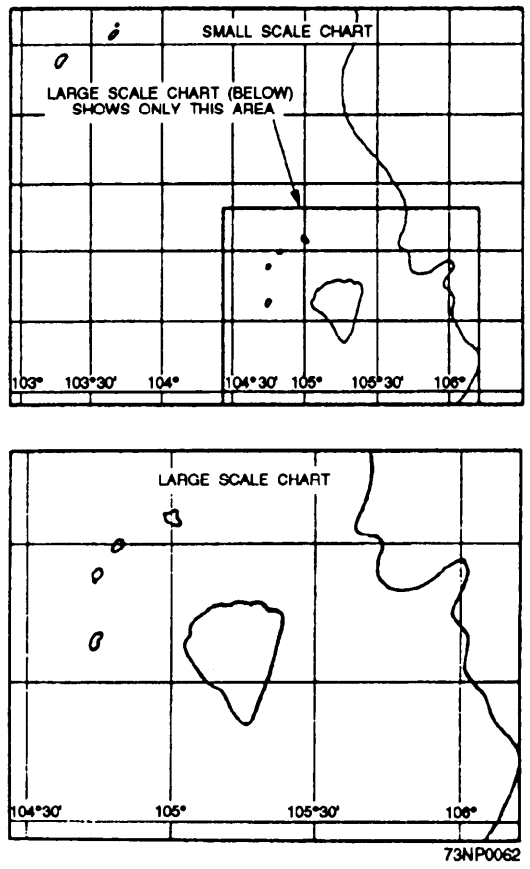

Figure 9-6.—Comparison of small- and large-scale charts.

The scale to which a chart is drawn usually appears under its title in one of two ways: 1:25,000 or l/25,000. These figures mean that an actual feature is 25,000 times larger than its representation on the chart. Expressed another way, an inch, foot, yard, or any other unit on the charts means 25,000 inches, feet, or yards on Earth's surface. Thus, the larger the figure indicating the proportion of the scale, the smaller the scale of the chart. A chart with a scale of 125,000 is on a much larger scale, for instance, than one whose scale is 1:4,500,000.

You must exercise more caution when working with small-scale charts than with large-scale charts. A small error, which may be only a matter of yards on a large-scale chart, could amount to miles on a chart depicting a much more extensive area. When navigating the approaches to land, use the largest scale charts available.

CHART SOUNDING MARKS

Scattered over the water area of each navigational chart are many tiny figures, as in figure 9-7. Each figure represents the depth of water in that locality. Depths on charts are shown in feet, fathoms, or meters. A notation under the title of the chart provides the key to its depth; for example, "Sounding in feet at mean low water," or "Sounding in fathoms at . . . ." Most charts also contain broken lines called fathom curves, marking the limits of areas of certain depths. A 10-fathom (60-foot) curve and a 15-fathom (90-foot) curve can be seen in figure 9-7.

CHART ISSUE

Charts used in the Navy may be prepared by the Defense Mapping Agency Hydrographic/ Topographic Center (DMAHTC), the National Ocean Service (NOS), the British Admiralty, or other hydrographic agencies. Whatever the source, all charts used by the Navy are issued by the Defence Mapping Agency (DMA).

The Defense Mapping Agency (DMA) Catalog of Maps, Charts, and Related Products is a four-part catalog published by the Defense Mapping Agency Office of Distribution Services (DMAODS). It provides a comprehensive reference of all DMA maps, charts, and related products that are available for information.

NOTICES TO MARINERS

The chart and publication correction system is based on the *periodical Notices to Mariners,* published weekly by the DMAHTC to inform mariners of corrections to nautical charts and publications. This

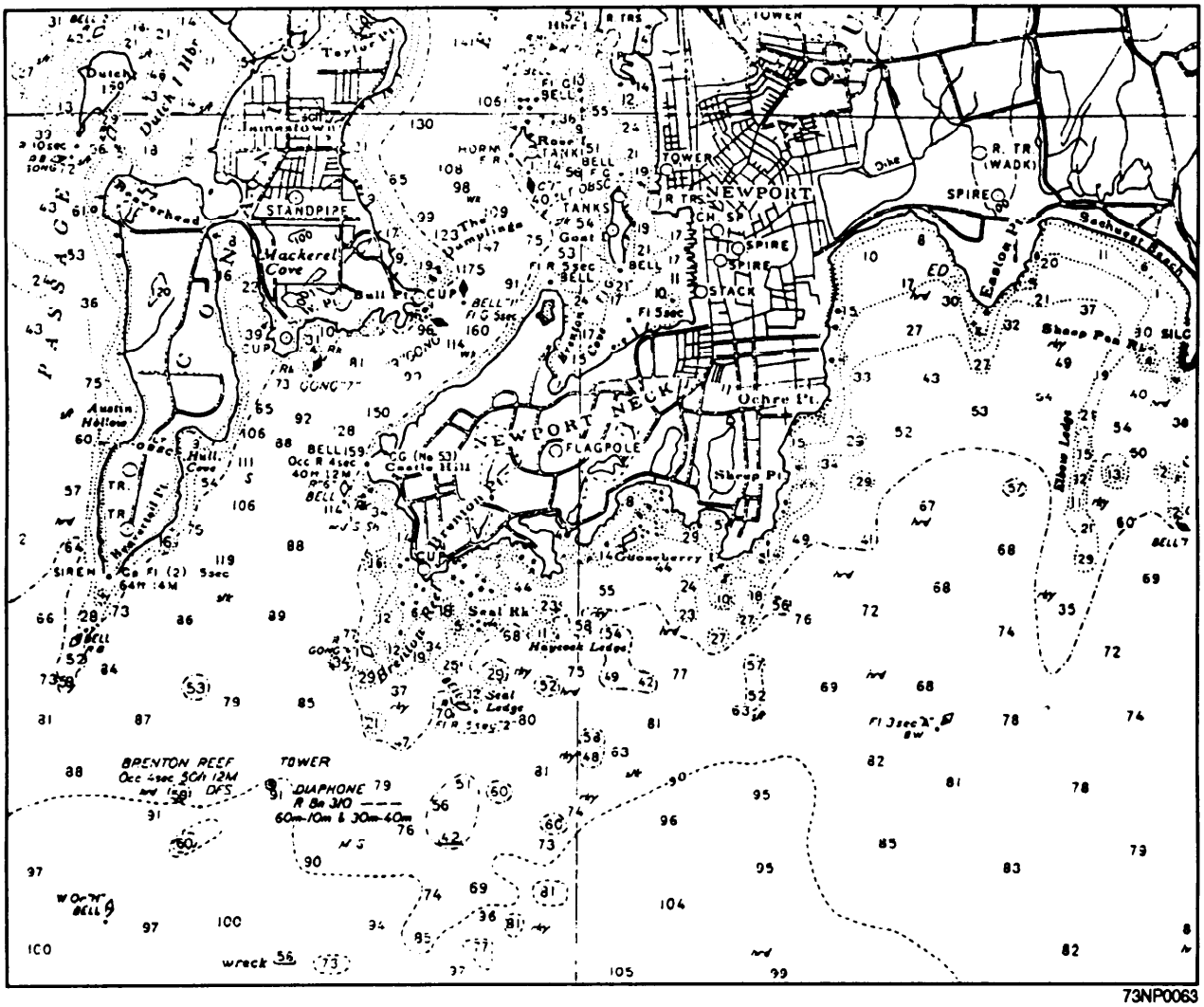

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Figure 9-7.—Navigational chart showing depths and fathom curves.

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, advise mariners of special warning or items of general maritime interest, and includes selected accounts of unusual phenomena observed at sea. Distribution of *Notices to Mariners* is made weekly to all U.S. Navy and Coast Guard ships and to most ships of the merchant marines.

The classified chart and publication correction system is based on *Classified Notices to Mariners,* published on an as-needed basis by the DMAHTC to inform mariners of corrections to classified nautical charts and publications.

HAND CORRECTIONS

Corrections on charts in writing should be kept clear of water areas as much as possible unless the objects referred to are on the water. When you are inserting written corrections, be careful not to obliterate any of the other information already on the chart.

When cautionary, tidal, and other such notes are to be inserted, they should be written in a convenient but conspicuous place where they will not interfere with any other details.

The year and number of each *Notices to Mariners* from which corrections have been made are to be entered in ink at the lower left corner of the chart. Temporary changes should be made in pencil. For more information on chart corrections, visit your local Quartermaster.

AIDS TO NAVIGATION

LEARNING OBJECTIVES: Identify and explain the aids to navigation, including lights, lighthouses, buoys, daybeacons, ranges, and fog signals.

In piloting, a ship's position is determined by bearings or ranges of objects whose exact location is shown on the area chart. Such objects are aids to navigation, and may be natural or man-made. Examples of natural objects are prominent hills, rocks, and mountains. Man-made objects include buildings, TV towers, and smokestacks that are coincidentally located where they can be of assistance to a navigator.

Aids to navigation are lighthouses, lightships, minor lights, buoys, and daybeacons. Aids are placed so that, insofar as possible, they provide a continuous and unbroken chain of charted marks for coast and channel piloting. Most harbors and some coasts are well marked with man-made aids to navigation, yet no attempt has ever been made to mark every mile of the world's coastline. Such marking would be impractical because many regions are seldom navigated. In some areas, the lack of artificial aids makes it necessary to use landmarks.

LIGHTS

A ship cannot suspend piloting operations when darkness falls and daytime navigational aids no longer can be seen. For this reason, aids to navigation are lighted whenever it is necessary. For purposes of identification, lights have individual characteristics regarding color, intensity, and system of operation. Some of a light’s characteristics may be printed near its symbol on the chart. Detailed information, including the height—which, combined with intensity and observer's height, determines the light's visibility—is set forth in either *List of Lights* or *Light Lists.*

The DMAHTC publishes seven volumes of *List of Lights.* The volumes are divided geographically, but exclude the United States and its possessions. This list contains a description of lighted aids to navigation (except harbor-lighted buoys) and fog signals. Storm signals, signal stations, radio direction finders, and radio beacons located at or near lights are also mentioned in this list.

Lights located in the United States and its possessions are described in *Light Lists,* published by the U.S. Coast Guard.

LIGHT CHARACTERISTICS

White, red, green, and yellow are the four standard colors for lights on aids to navigation. The significance of the different colors is important chiefly with regard to channel buoys; this significance is discussed later in the sections dealing with buoys.

Some navigational lights are fixed, meaning they burn steadily. The most important lights, however, go through repeated periods of systematic changes of light and darkness. Those characteristics of a navigational light are the most valuable for

identification purposes. Figure 9-8 illustrates characteristics of lights on lighthouses and lightships.

VISIBILITY OF LIGHT

The visibility of a light is the distance in nautical miles that a navigator can expect to see the aid to navigation.

When speaking of a light, the following terms will apply:

- Geographic range: The maximum distance a light can be seen under conditions of perfect visibility, limited only by the curvature of Earth. It is expressed in nautical miles for the height of the observer's eye at sea level.
- Nominal range: Maximum distance at which a light can be seen in clear weather. Clear weather is meteorologically defined as a visibility of 10 nautical miles. Nominal range is listed for all Coast Guard listed aids except range and direction lights.

CLASS	ABBREVIATION	GENERAL DESCRIPTION	ILLUSTRATION
Fixed light	F	A continuous and steady light.	
Occulting light	Oc, Occ	The total duration of light in a period is longer than the total duration of darkness and the intervals of darkness (eclipses) are usually of equal duration. Eclipse regularly repeated.	Period 12s
Group - occulting light	Oc (2), Gp Occ (2)	An occulting light in which a group of eclipses, specified in number, is regularly repeated.	Period 14s
Composite group - occulting light	Oc (2 + 1), Gp Occ (2 + 1)	A light similar to a group-occulting light except that successive groups in a period have different numbers of eclipses.	Period 12s
Isophase light	Iso	A light in which all the durations of light and darkness are clearly equal.	5s 5s
Flashing light	F1	A light in which the total duration of light in a period is shorter than the total duration of darkness and the appearances of light (flashes) are usually of equal duration (at a rate of less than 50 flashes per minute).	Period 10s
Long - flashing light	L F1	A single-flashing light in which an appearance of light of not less than 2 sec. duration (long flash) is regularly repeated.	Period 10s
Group - flashing light	F1 (3), Gp F1 (3)	A flashing light in which a group of flashes, specified in number, is regularly repeated.	Period 15s
Composite group - flashing light	F1 (2 + 1), Gp F1 (2 + 1)	A light similar to a group-flashing light except that successive groups in a period have different numbers of flashes.	Period 20s
Quick light	Q, k F1	A light in which a flash is regularly repeated. Flashes are repeated at a rate of not less than 50 flashes per minute but less than 80 flashes per minute.	
Group quick light	Q (3), Gp F1 (3)	A light in which a specified group of flashes is regularly repeated. Flashes are repeated at a rate of not less than 50 flashes per minute but less than 80 flashes per minute.	Period 10s
	Q (9), Gp F1 (9)		Period 15s
	Q (6) + LF1, Gp F1 (6)		Period 15s

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Figure 9-8.—Characteristics of lights—sheet 1.

CLASS	ABBREVIATION	GENERAL DESCRIPTION	ILLUSTRATION
Interrupted quick light	IQ, Int Qk Fl	A light in which the sequence of quick flashes is interrupted by regularly repeated eclipses of constant and long duration.	Period 10s
Continuous very quick light	VQ, Qk Fl	A very quick light in which a flash is regularly repeated. Flashes are repeated at a rate of not less than 80 flashes per minute but less than 160 flashes per minute.	
Group very quick light	VQ (3), Gp Fl (3)	A very quick light in which a specified group of flashes is regularly repeated.	5s Period
	VQ (9), Gp Fl (9)		
	VQ (6) + LFl, Gp Fl 6 + LFl		Period 10s
Interrupted very quick light	IVQ, Int Qk Fl	A light in which the sequences of quick flashes is interrupted by regularly repeated eclipses of constant and long duration.	Period 10s
Continuous ultra quick light	UQ, Qk, Fl	An ultra quick light in which a flash is regularly repeated. Flashes are repeated at a rate of not less than 160 flashes per minute.	
Interrupted ultra quick light	IUQ	An ultra quick light in which the sequence of flashes is interrupted by eclipses of long duration.	
Morse code light	Mo (U)	A light in which appearances of light of two clearly different durations are grouped to represent a character or characters in the Morse Code.	
Fixed and flashing light	FFl	A light in which a fixed light is combined with a flashing light of higher luminous intensity.	5s Period
Alternating light	A1, A1t	A light showing different colors alternately.	

Notes: 1. Alternating lights may be used in combined form with most of the previous classes of lights. 2. The second abbreviation shown for a light if any, is alternate U.S. useage.

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Figure 9-8.—Characteristics of lights—sheet 2.

- Luminous range: Maximum distance at which a light can be seen under the existing visibility conditions. It depends only on the intensity of the light itself and is independent of the elevation of the light, the observer's height of eye, or the curvature of Earth. It should be noted that luminous range and nominal range are equal with a meteorological visibility of 10 nautical miles.

- Computed visibility: Determined for a particular light, taking into account its elevation, intensity, height of eye of the observer, and the curvature of Earth.

- Computed range: The geographic range plus the observer's distance to the horizon based on the observer's height of eye.

LIGHTHOUSES AND LIGHT STRUCTURES

Lighthouses are numerous on all the coasts of the United States, on the Great Lakes, and along many interior waterways. They are placed wherever a powerful light may be of assistance to navigators, or wherever a danger requires a warning beacon of long-range visibility. Visibility increases with height;

thus, the principal purpose of a light structure is to increase the height of a light above sea level.

> **NOTE**
>
> Remember that a light placed at a great elevation is more frequently obscured by clouds, mist, and fog than one near sea level.

A lighthouse may also contain fog signaling and radio beacon equipment. In lighthouses still staffed by keepers, the lighthouse may also contain their quarters, or the operating personnel may be housed in separate buildings grouped around the tower. Such a group of buildings is called a light station. Many lights formerly operated by keepers are now automatic.

Secondary, minor, and automatic lights are located in structures of various types. Those structures range from towers that resemble those of important seacoast lighthouses to such objects as a small cluster of piles supporting a battery box and lens.

Solid colors, bands, stripes, and other patterns are applied to lighthouses and light structures to make them easier to identify. Lighthouses and light structures may also be painted in contrasting colors and various patterns to their background. (See fig. 9-9.) Minor structures sometimes are painted red or black, like channel buoys, to indicate the side of the channel on which they are located.

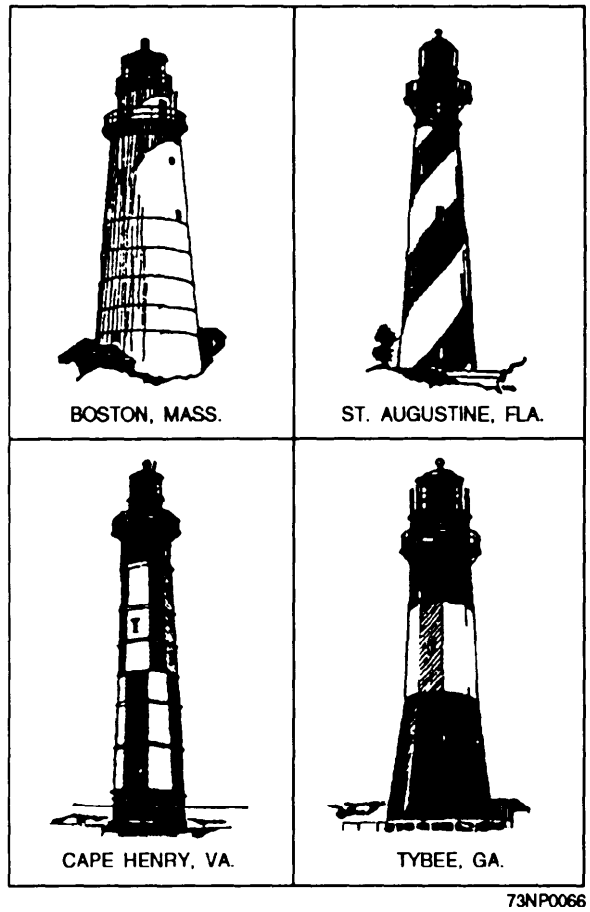

Figure 9-9.—Various patterns of typical lighthouses.

LIGHTSHIPS

A lightship is a floating lighthouse located where conditions make it impossible or impractical to build a permanent structure.

Lightships in U.S. waters are painted red on the hull, with the name of the station in large white letters on either side. Other parts of the lightship that are painted include the following: superstructure is white; mast, ventilators, lantern galleries, and stacks are buff.

The lights, fog signals, and radio beacon signals on lightships are given various characteristics for purposes of identification. Like lighthouses, lightships are described briefly on the charts and in detail in *Light Lists.*

A lightship under way or off station hoists the international code signal “LO.” This indicates that the lightship is not in the correct position. The lightship must then observe the requirements of the Rules of the Road for a vessel of that class.

At night when anchored on station, a lightship shows only its beacon light and a less brilliant light on the forestay to indicate the heading.

When a regular lightship goes in for overhaul or repairs, the lightship's place is taken by a relief lightship whose lights and signals have, as nearly as possible, the same characteristics as the ship she replaces. Relief lightships are distinguished by the word *RELIEF* painted in white on either side.

SECTOR LIGHTS

Sectors of red glass are placed in the lanterns of certain lighthouses to indicate danger bearings, within which a ship will be in danger of running onto rocks, shoals, or some other hazard. The arcs over which the red light shows are the danger sectors whose bearings appear on the chart. Although the light is red within the danger bearings, its other characteristics remain the same.

Sectors may be only a few degrees wide, marking an isolated obstruction, or they may be so wide as to extend from the direction of deep water to the beach. A narrow green sector may indicate a turning point or the best water across a shoal. The exact significance of each sector must be obtained from the chart.

All sector bearings are true bearing in degrees, running clockwise around the light as a center. In figure 9-10, for instance, the bearings of the red sectors from the light are 135° to 178°. This sector is defined in *Light Lists* in terms of bearings from the ship. These bearings are 315° to 358°, the reciprocals of the preceding bearings. The light shown in the diagram would be defined thus: Obscured from land to 315°, red thence to 358°, green thence to 050°, and white thence to land.

On either side of the line of demarcation between colored and white sectors, there is always a small sector whose color is doubtful because the edges of the sector cannot be cut off sharply in color. Moreover, under some atmospheric conditions a white light itself may have a reddish appearance. Consequently, light sectors must not be relied upon entirely, but position must be verified repeatedly by bearings taken on the light itself or by other fixed objects.

When a light is cut off by adjoining land, the arc of visibility may vary with a ship's distance away from the light. If the intervening land is sloping, for example, the light may be visible over a wider arc from a far-off ship than from one close inshore.

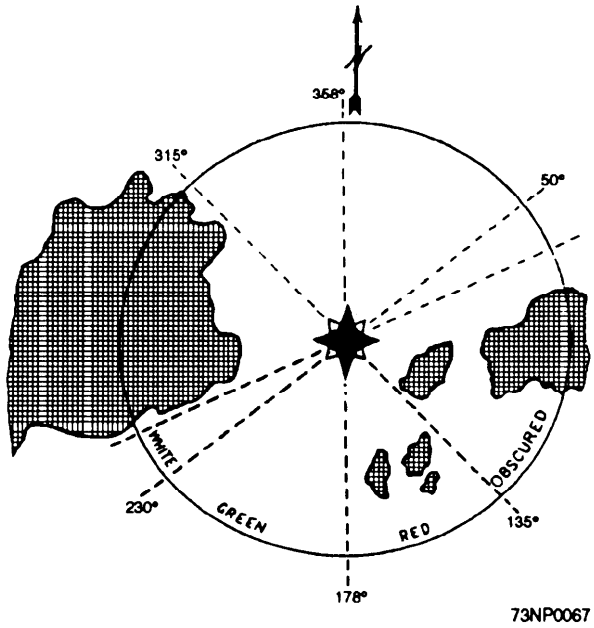

Figure 9-10.—Light sectors.

BUOYS

Buoys are perhaps the most numerous aids to navigation, and they come in many shapes and sizes. These floating objects, heavily anchored to the bottom, are intended to convey information by their shapes or color, or by the characteristics of a visible or audible signal, or by a combination of two or more of such features.

Large automatic navigational buoys (LANBY) are major aids to navigation. They provide light, sound signal, and radio beacon services, much the same as a lightship. Some LANBYs today are replacing lightships in U.S. waters. The LANBY is an all steel, disc-shaped hull, 40 feet in diameter. The light, sound signal, and radio beacon are located on the mast.

Although buoys are valuable aids to navigation, as was stated for sector lights, they must never be depended upon exclusively. Buoys frequently move during heavy weather, or they may be set adrift when run down by passing vessels. Whistles, bells, and gongs actuated by the sea's motion may fail to function in smooth water, and lights on lighted buoys may burn out.

MARITIME BUOYAGE SYSTEM

Until recently, there were numerous buoyage systems in use around the world. In 1982, most of the maritime nations signed an agreement sponsored by the International Association of Lighthouse Authorities (IALA). This agreement adopted a system known as the IALA Maritime Buoyage System. Two systems were developed because certain basic long-established international differences precluded adoption of a single system worldwide. Both systems, designated region A and region B, use a combination of cardinal marks and lateral marks plus unique marks for isolated danger, safe-water areas, and special purposes. The cardinal and unique marks are the same in both systems; the lateral marks are the major difference between the two buoy regions.

To convey the desired information to the navigator, the IALA system uses buoy shape, color, and if lighted, the rhythm of the flashes. Buoys also provide for a pattern of “topmarks,” small distinctive shapes above the basic aid, to facilitate its identification in the daytime from a distance, or under light conditions when the color might not be easily ascertained. Figure 9-11 show the international buoyage regions A and B.

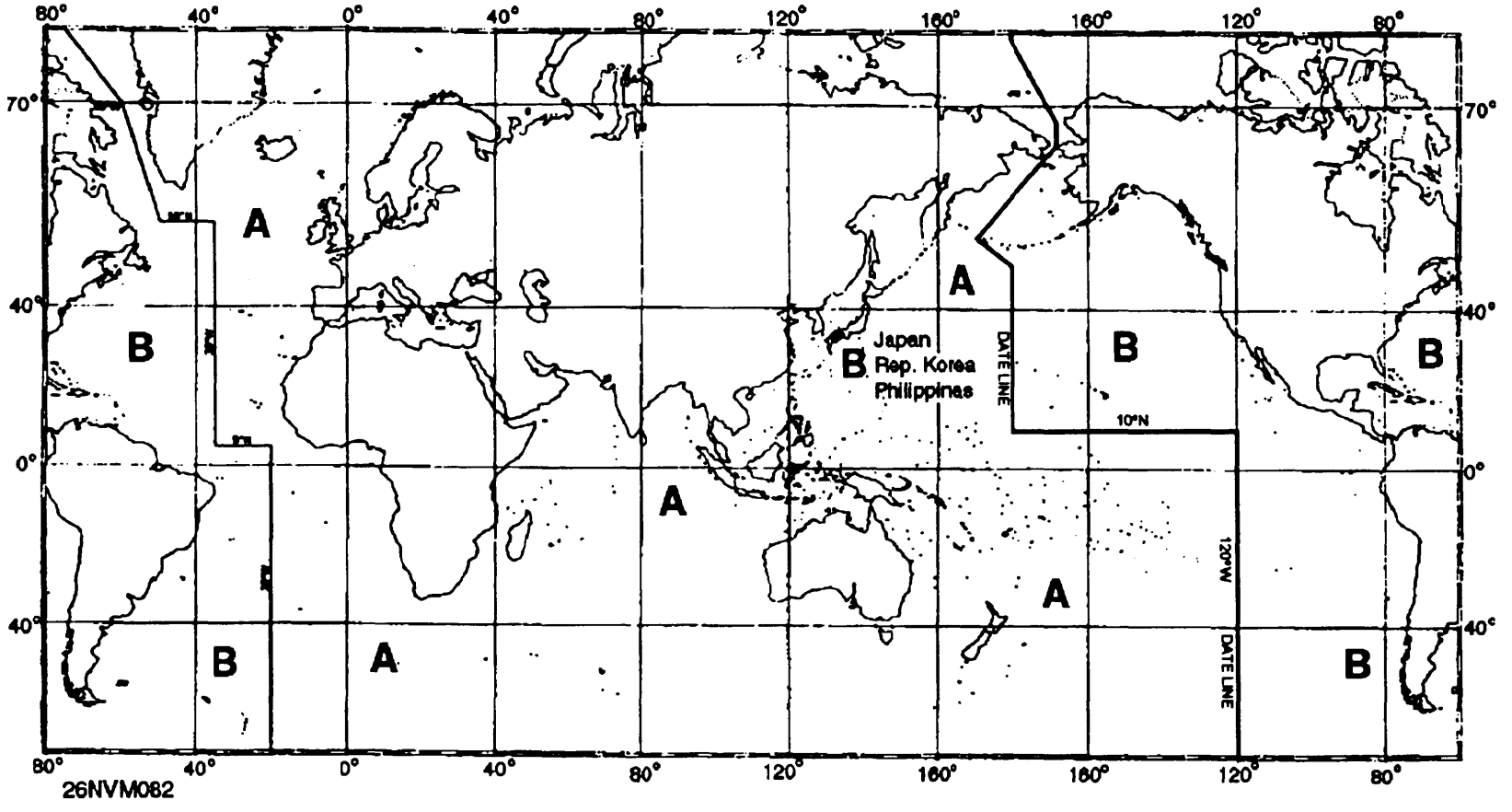

Figure 9-11.—IALA Maritime Buoyage System, buoyage regions A and B.

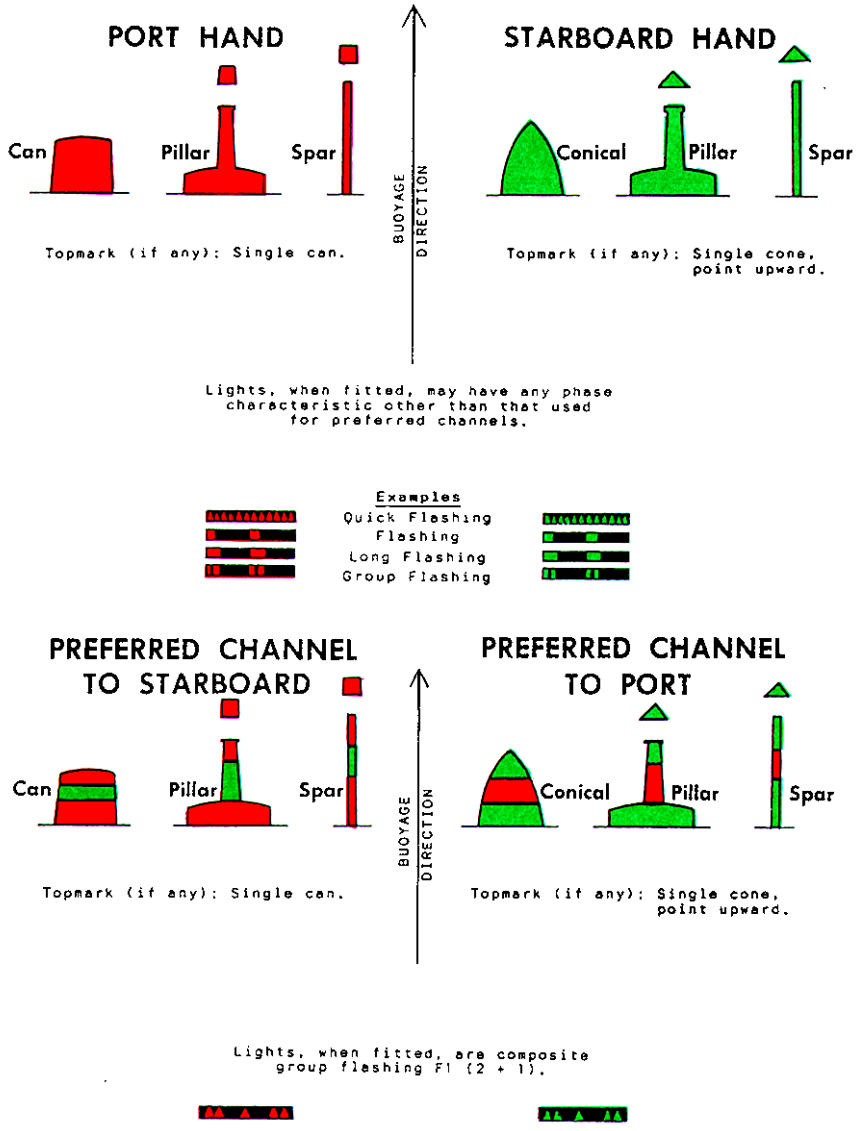

Figure 9-12.—IALA Maritime Buoyage System lateral marks, region A.

Region A

Region A (fig. 9-12) is used in Europe, Africa, and most of Asia, including Australia and New Zealand. The major rule to remember when using region A is that the lateral mark will be red buoys to port and green buoys to starboard when entering from seaward.

Region B

Region B (fig. 9-13) is used in North, Central, and South America, plus Japan, South Korea, and the Philippines. The rule to remember when using region B is the exact opposite from using region A: Lateral marks will be red to starboard and green to port when entering from seaward.

Types of Marks

The Maritime Buoyage System provides five types of marks, which may be used in any combination.

1. Lateral marks—indicate the port and starboard hand sides of channels.

2. Cardinal marks—used in conjunction with the compass, indicate that the navigable waters lie to the named side of the mark.

3. Isolated danger marks—erected on, or moored directly on or over, dangers of limited size.

4. Safe water marks—used to indicate there is safe water for navigation all around the position (example: midchannel).

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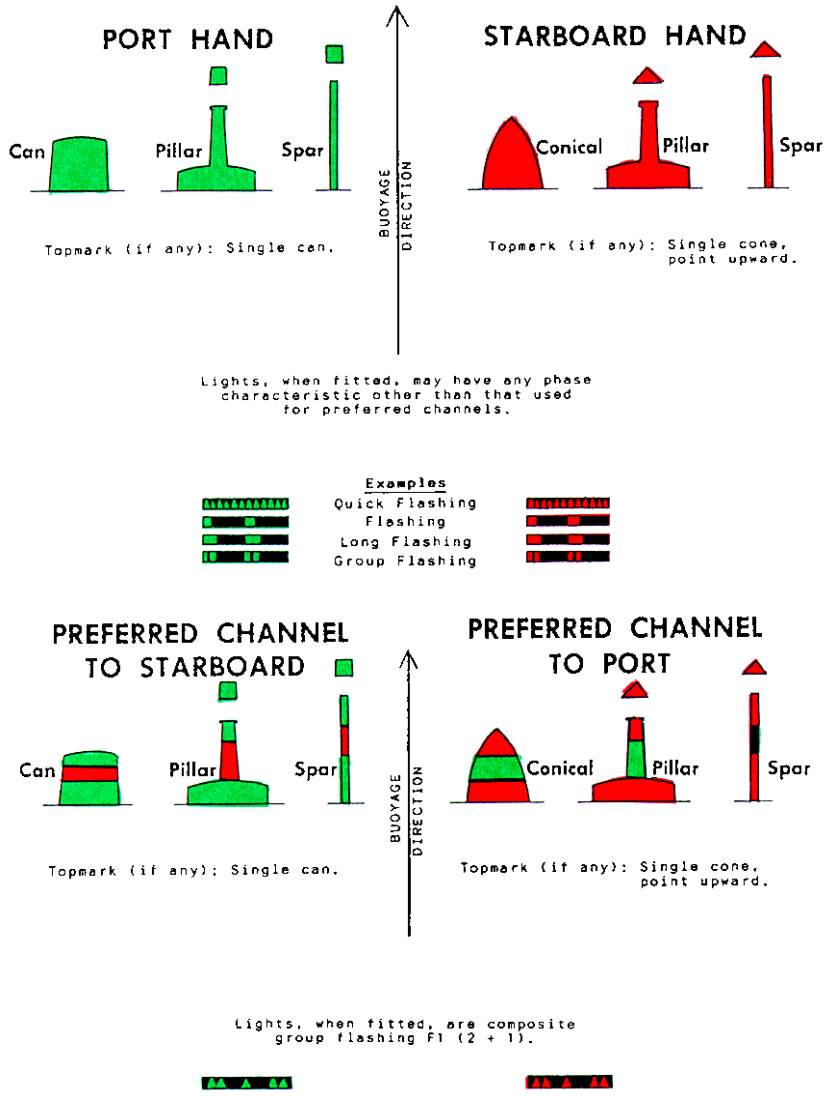

Figure 9-13.—IALA Maritime Buoyage System lateral marks, region B.

5. Special marks—call attention to an area or specific feature. Explanation of special marks may be found on *the* chart or in *Sailing Ditrections* or *Coast Pilots.*

Distinguishing Marks

The meaning of distinguishing marks depends upon one or more of the following features:

- By day—color, shape, and topmark
- By night—light color and phase characteristics

Buoy Shape

There are five basic buoy shapes (fig. 9-14): the can, nun, spherical, pillar, and spar. With the exception of the pillar and the spar buoys, the shape of the buoys indicates the correct side on which to pass. Can buoys are sometimes referred to as cylindrical buoys and nun buoys are referred to as conical buoys. The term *pillar*

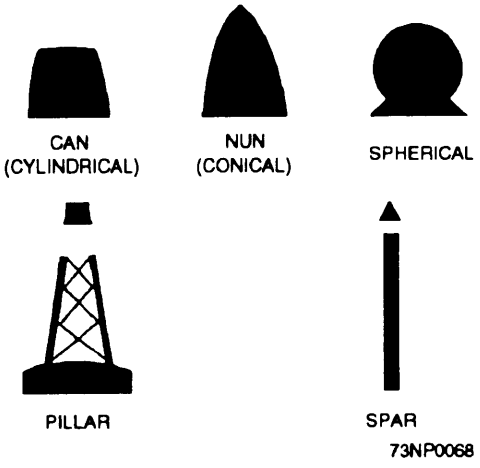

Figure 9-14.—Types of buoys.

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is used to describe any buoy that is smaller than a lighthouse buoy and has a tall, central structure on a broad base. Lighted buoys in the United States are referred to as pillar buoys.

Topmarks

The IALA Maritime Buoyage System makes use of can, nun, spherical, and X-shaped topmarks only. Topmarks on pillar and spar buoys are particularly important to indicate the side on which they will be passed and will be used, whenever practical.

Lights

Where marks are lighted, red and green lights are reserved for port and starboard or starboard and port lateral marks. Yellow lights are for special marks, and white lights are used for other types that will be discussed later in this chapter.

Buoy Color

Under region B of the IALA system, red buoys mark the starboard side of the channels, or the location of wrecks or obstructions that must be passed by keeping the buoy on the starboard (right) hand when returning from sea. Green buoys mark the port side of the channels, or the location of wrecks or obstructions that must be passed by keeping the buoy to port (left) hand when returning from sea.

Red and green horizontally banded buoys are used to mark obstructions and channel junctions. They may be passed on either side, but sometimes the channel on one side is preferable. If the top band on the buoy is red, the preferred channel will be followed by keeping the buoy to starboard. If the top band is green, the preferred channel will be followed by keeping the buoy on the port. However, in some instances it may not be feasible for larger vessels to pass on either side of such a buoy, and the chart should always be consulted. The colors indicated above would be reversed for the region A buoy system.

Red and white vertically striped buoys are “safe-water marks,” used to indicate the mid-channel, a fairway, or a landfall. These buoys are also used at the beginning of some vessel Traffic Separation Schemes at the entrances to busy ports, or in narrow passages congested with heavy traffic.

Solid yellow buoys are special-purpose buoys typically marking anchorage, fishnet areas, and dredging sites. These buoys have no lateral system significance; but as most are shown on charts, they can often serve to assist in determining one's position. Solid yellow buoys can be any shape.

Buoy Numbering

Most buoys are given numbers, letters, or combinations of numbers and letters, which are painted conspicuously on them or applied in white retroreflective material. These markings facilitate identification and location of the buoys on the chart.

Solid red or green buoys are given numbers or combinations of numbers and letters. Other colored buoys are given letters. Odd numbers are used only on solid green buoys; even numbers, on solid red. Numbers increase sequentially from seaward; numbers are sometimes omitted when there are more buoys of one type than another.

DAYBEACONS/DAYMARKS

Where daybeacons are substituted for unlighted buoys, the color of the daymark will be the same and the shape similar. Red daymarks will be triangular, approximating the shape of the top of a nun buoy. Square daymarks, corresponding to can buoys, will be green.

Daymarks equivalent to spherical buoys are octagonal. The daymarks on a daybeacon replacing a yellow special-purpose buoy are diamond-shape.

Daybeacons will be numbered or lettered with retroreflective material in the same manner as a buoy and will have a border of that material. Many have panels of red and green reflective material. Some channels may be marked with a combination of buoys, daybeacons, and lights.

LATERAL MARKS

Lateral marks are generally used for well-defined channels. They indicate the route to be followed and are used in conjunction with a conventional direction of buoyage. This direction is defined in two ways, as follows:

Local direction of buoyage—The direction taken by a mariner when approaching a harbor, river estuary, or other waterway from seaward

General direction of buoyage—In other areas, a direction determined by the buoyage authorities, following a clockwise direction around continental

landmasses given in *Sailing Directions*, and, if necessary, indicated on charts by a symbol

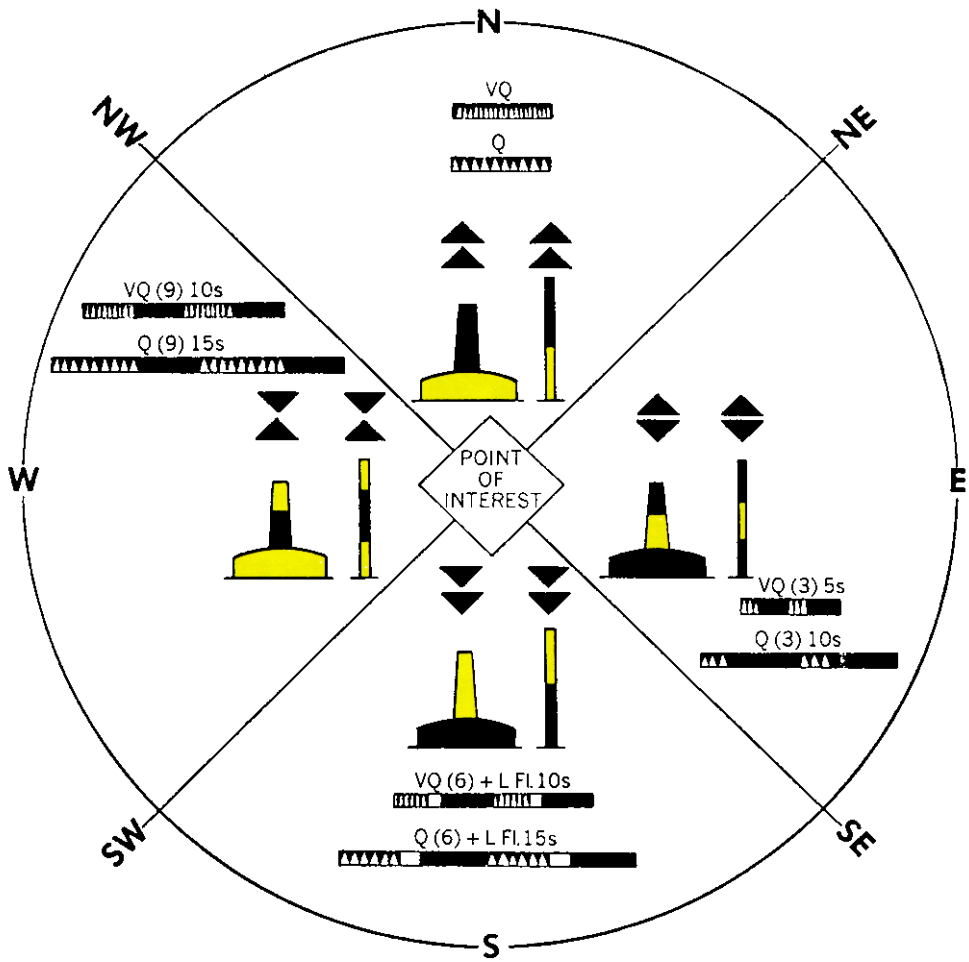
CARDINAL MARKS

A cardinal mark is used in conjunction with the compass to indicate the best navigable water. It is placed in one of four quadrants (north, east, south, or west) from the best water. A cardinal mark takes its name from the compass point in which it is placed. Figure 9-15 shows the IALA Maritime Buoyage System cardinal marks.

The mariner is safe if he/she passes north of a north mark, east of a east mark, south of a south mark, and west of a west mark. A cardinal mark may be used to do the following:

- Indicate that the deepest water is an area on the named side of the mark.
- Indicate the safe side on which to pass a danger.
- Draw attention to a feature in a channel, such as a bend, junction, branch, or end of a shoal.

Topmarks are always fitted (when practicable).
Buoy shapes are pillar or spar.



Lights, when fitted, are **white**, Very Quick Flashing or Quick Flashing; a South mark also has a Long Flash immediately following the quick flashes.

Figure 9-15.—IALA Maritime Buoyage System cardinal marks.

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Topmarks

By day, topmarks are the most important features of cardinal marks. The arrangement of the cones must be memorized. For north, the points of the cones is up; and for south, the points of the cones is down. An aid to help you memorize the west topmark is that it resembles a wineglass. Cardinal marks carry topmarks, whenever practical, with cones as large as possible and clearly separated.

Color

Black and yellow horizontal bands are used to color cardinal marks. The position of the black band, or bands, is related to the point of the black topmarks. The black and yellow horizontal bands are used as follows:

- North—Black bands above yellow bands
- South—Black bands below yellow bands
- West—Black band with yellow bands above and below
- East—Black bands above and below yellow band

The shape of a cardinal mark is not important; but in the case of a buoy, it will be pillar or spar.

Light Characteristics

When lighted, a cardinal mark exhibits a white light. The characteristics are based on a group of quick (Q) or very quick (VQ) flashes, which distinguishes it as a cardinal mark and indicates its quadrant. The distinguishing quick or very quick flashes are as follows:

- North—Very quick flashing (VQ) or quick flashing (Q)
- East—Very quick flashing every 5 seconds (VQ (3) 5s) or quick flashing every 10 seconds (Q (3) 10s)
- South—Very quick flashes followed by a long flash every 10 seconds (VQ FL (6) + LFl 10s) or quick flashing followed by a long flash every 15 seconds (Q (6) + LFl 15s)
- West—Very quick flashing light every 10 seconds (VQ (9) 10s) or quick flashing every 15 seconds (Q (9) 15s)

As a memory aid, associate the number of flashes in each group with a clock face (3 o'clock, east; 6 o'clock, south; and 9 o'clock, west).

The long flash immediately following the group of flashes from a south cardinal mark is to ensure that its six flashes cannot be mistaken for three or nine.

Quick flashing lights flash at a rate of either 50 or 60 flashes per minute. Very quick flashing lights flash at a rate of either 100 or 120 flashes per minute. It is necessary to have a choice of quick or very quick flashing light to avoid confusion. Two north buoys that are placed near enough to each other to be mistaken is one example where the quick flashing or very quick flashing lights would be needed.

ISOLATED DANGER MARKS

An isolated danger mark (fig. 9-16) is erected on, or moored above, an isolated danger of limited extent. An isolated danger mark has navigable water all around it. The extent of the surrounding navigable water is not important. The isolated danger mark can, for example, indicate either a shoal that is well

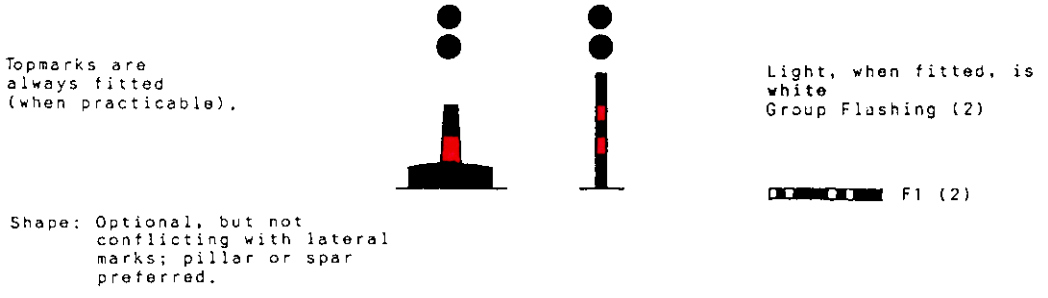

Figure 9-16.—IALA Maritime Buoyage System isolated danger marks.

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offshore or an islet separated by a narrow channel from the coast.

A black double-sphere topmark is, by day, the most important feature of an isolated danger mark. Whenever practical, this topmark will be carried with the spheres as large as possible, mounted vertically, and clearly separated.

Black, with one or more red horizontal bands, is used for isolated danger marks. The shape of an isolated danger mark is not significant, but in the case of a buoy, it will be either pillar or spar.

When lighted, a white flashing light showing a group of two flashes (FL (2)) is used to denote an isolated danger mark. The association of two flashes and two spheres in the topmark may be a help in remembering these characteristics.

SAFE-WATER MARKS

A safe-water mark (fig. 9-17) is used to indicate there is navigable water all around the mark. Such a mark may be used as a centerline, midchannel, or landfall buoy.

Red and white vertical stripes are used for safe-water marks. The vertical stripes are used to distinguish them from the black-banded danger marks. Spherical, pillar, or spar buoys may be used as safe-water marks. Whenever practical, a pillar or spar buoy used as a safe-water mark will carry a single red sphere topmark.

When lighted, a safe-water mark exhibits a white light. The phase characteristics of the light will be occulting, equal intervals, one long flash every 10 seconds, or Morse *A*. The association of a single flash and a single sphere in the topmark may help you to remember its characteristics.

SPECIAL MARKS

A special mark (fig. 9-18) may be used to indicate to the mariner a special area or feature. The nature of the special area or feature may be found by consulting the chart, *Sailing Directions*, or *Notices to Mariners*. The use of a special mark includes the following:

- Ocean Data Acquisition System (ODAS) buoys carrying oceanographic or meteorological sensors
- Traffic separation marks

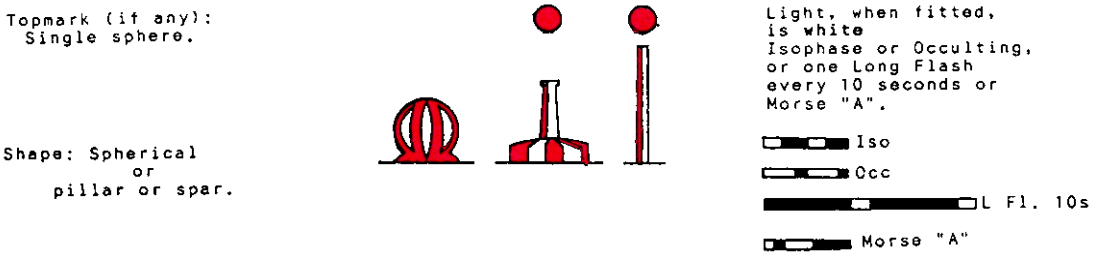

Figure 9-17.—IALA Maritime Buoyage System safe-water marks.

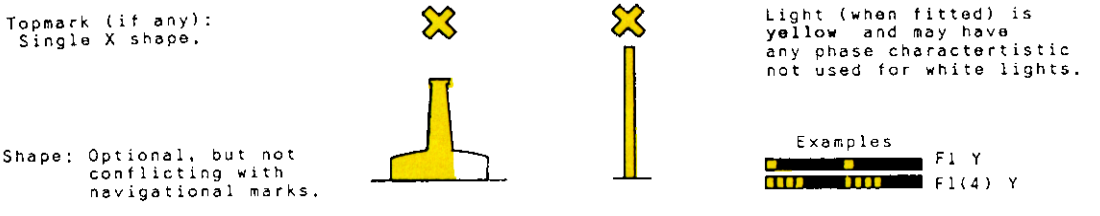

Figure 9-18.—IALA Maritime Buoyage System special marks.

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- Spoil ground marks
- Military exercise zone marks
- Cable or pipeline marks, including outfall pipes
- Recreation zone marks

Another function of a special mark is to define a channel within a channel (for example, a channel for deep-draft vessels in a wide approach area where the limits of the channel for normal navigation are marked by red and green lateral buoys).

Yellow is the color used for special marks. The shape of a special mark is optional but must not conflict with a lateral or a safe-water mark.

When a topmark is carried, it takes the form of a single yellow *X*. When a light is exhibited, it is yellow. The phase light characteristics may be any other than those used for white lights of cardinal, isolated danger, and safe-water marks.

NEW DANGER

A newly discovered hazard to navigation, not yet shown on charts or included in *Sailing Directions* or sufficiently announced by *Notices to Mariners*, is called a "new danger." New danger covers naturally occurring obstructions, such as sandbanks and rocks, or man-made dangers, such as wrecks.

A new danger is marked by one or more cardinal or lateral marks, following the IALA Maritime Buoyage System guidelines. If the danger is especially grave, it will be marked by two marks that are identical until the danger has been announced.

If a lighted mark is used for a new danger, it must be a quick flashing or very quick flashing light. If it is a cardinal mark, it must exhibit a white light; if a lateral mark is used, it must exhibit a red or green light.

AIDS IN THE INTRA COASTAL WATERWAY

The Intracoastal Waterway, called the inland waterway, is a channel in which a lightdraft vessel can navigate coastwise from the Chesapeake Bay almost to the Mexican border, remaining inside natural or artificial breakwaters for almost the entire length of the trip. The following paragraphs describe special markings for the Intracoastal Waterway proper and for those portions of connecting or intersecting waterways that must be crossed or followed in navigating it.

Every buoy, daymark, or light structure along the Intracoastal Waterway has part of its surface painted yellow, the distinctive coloring adopted for this waterway. Lighted buoys have a band or border of yellow somewhere.

Red buoys and daymarks are to the right, and green to the left, as you proceed from the Chesapeake Bay toward Mexico. As in other channels, red buoys have even numbers; green buoys, odd numbers. Because the numbers would increase excessively in such a long line of buoys, they are numbered in groups that usually contain no more than 200 buoys. At certain natural dividing points, numbering begins again at 1.

Lights on buoys in the Intracoastal Waterway follow the standard system of red or white lights on red buoys, and green lights on green buoys. Lights on lighted aids besides buoys also agree with the standard rules for lights on aids to navigation.

RANGES

Two daybeacons located some distance apart on a specific true bearing constitute a daybeacon range. Two lights similarly located comprise a lighted range. When a ship reaches a position where the two lights or beacons are seen exactly in line, it is on the range. Ranges are especially valuable for guiding ships along the approaches to or through narrow channels.

Lights on ranges may show any of the four standard colors, and they may be fixed, flashing, or occulting, the principal requirement being that they stand out distinctly from their surrounding. Range light structures are usually fitted with colored daymarks for daytime use. Range lights appear to lose brilliance rapidly as a ship veers from the range line of bearing.

Ranges should only be used after a careful examination of the charts; it is particularly important to determine how far the range line can be followed safely. This information is available on the chart.

FOG SIGNALS

Most lighthouses, light towers, and large navigational buoys are equipped with fog-signaling apparatus, generally sounded automatically by mechanical means. For purposes of identification, each station has its own assigned number of blasts, recurring at specified intervals. A definite time is required for each station to sound its entire series of blasts, providing additional identification.

The different types of apparatus used will produce corresponding variances of pitch and tone, thus giving your ear a chance to compare the sound of a station with its description in *Light Lists*. The types of apparatus and the sounds produced are as follows:

- **Diaphones** create sound by means of slotted reciprocating pistons actuated by compressed air. The resulting sound consists of two tones of different pitch, the first part of the blast being high-pitched, the remainder low.
- **Diaphragm horns** are sounded by a disk diaphragm that is vibrated by compressed air, steam, or electricity. Duplex or triplex horn units of differing pitch give a time signal.
- **Reed horns** emit sound through a steel reed that is vibrated by compressed air.
- **Sirens** produce sound by either a disk or a cupshaped rotor. They are actuated by compressed air, steam, or electricity.
- **Whistles** make sound by compressed air or steam admitted through a slot into a cylindrical chamber.
- **Bells** are sounded by gas or electricity, or possibly by a hand-hammer; on buoys, wave action is used.

RULES OF THE ROAD

LEARNING OBJECTIVES: Identify and explain the differences between International and Inland Rules of the Road.

As a Signalman, you must become acquainted with basic Rules of the Road. Rules of the Road are published by the Coast Guard in a booklet entitled *Navigation Rules, International—Inland,* COMDTINST M16672.2B. You should use it to become more familiar with the different Rules of the Road.

International Rules are specific rules for all vessels upon the high seas and on connecting waters navigable by seagoing vessels. Inland Rules apply to all vessels upon 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.

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

The Inland Navigational Rules discussed in this chapter replace the old Inland Rules, the Western Rivers Rules, the Great Lakes Rules, their respective pilot rules, and parts of the Motorboat Act of 1940. The new rules went into effect on all United States inland waters except the Great Lakes on 24 December 1981. The Inland Rules became effective on the Great Lakes on 1 March 1983.

The International/Inland Rules contain the 38 rules that comprise the main body of the rules, and five annexes, which are regulations. The International/ Inland Rules are broken down into five parts as follows:

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

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 Roads are important, the steering and sailing are the most essential to know to avoid collision. The risk of collision can be considered to exist if the bearing of an approaching vessel does not change within reason.

In International Rules, whistle signals are signals of actions; and in Inland Rules, they are signals of intention. The following is a list of International and Inland whistle signals.

SIGNALS	INTERNATIONAL RULES	INLAND RULES
One short blast	I am altering my course to starboard	I intend to leave you on my port side
Two short blasts	I am altering my course to port	I intend to leave you on my starboard side
Three short blasts	I am operating astern propulsion	(Same as International)
Five or more short blasts	Danger signal	(Same as International)
One prolonged blast	Will be sounded by a vessel when nearing a blind bend around which vision is obscured	(Same as International)

Head-on Situation

When two ships meet head-on or nearly so (fig. 9-19), 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 from each other to pass clear on their present courses, no signal is needed. Rule 14 of the *International Rules of the Road* applies here.

Crossing Situation

When two power-driven vessels are crossing so as to involve the risk of collision (fig. 9-20), the vessel having the other to starboard must keep out of the way and will avoid, if circumstance permits, crossing ahead of the other vessel. Rule 15 applies here.

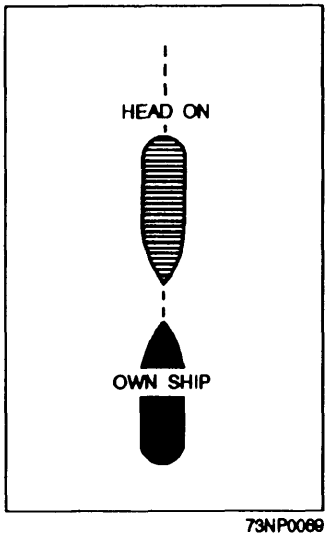

Figure 9-19.—Meeting (head-on) situation.

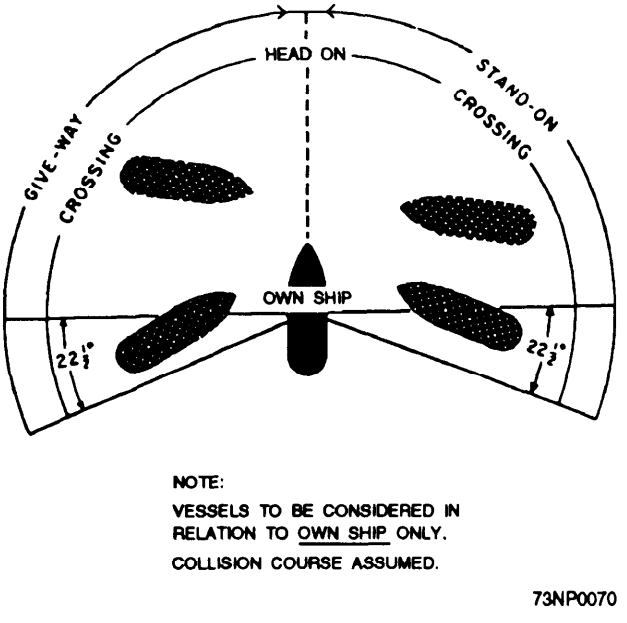

Figure 9-20.—Crossing situation.

Overtaking Situation

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. 9-21). When in doubt, assume you are overtaking and act accordingly. Rule 13 applies here.

Sailing Vessel

A sailing vessel has the right-of-way over power-driven vessels except when the power-driven vessel is engaged in fishing, is not under command or is restricted in her ability to maneuver. Rule 12 applies here.

Stand-on/Give-away Situation

The stand-on vessel is the vessel that stays on course and speed. The give-away vessel is the vessel that keeps out of the way of the other vessel. In a head-on situation, both vessels are the give-away vessel. Each vessel shall alter her course to starboard, so that they will pass on the port side of each other. Rules 16 and 17 apply here.

Take a little time and learn these rules. They will be useful to you.

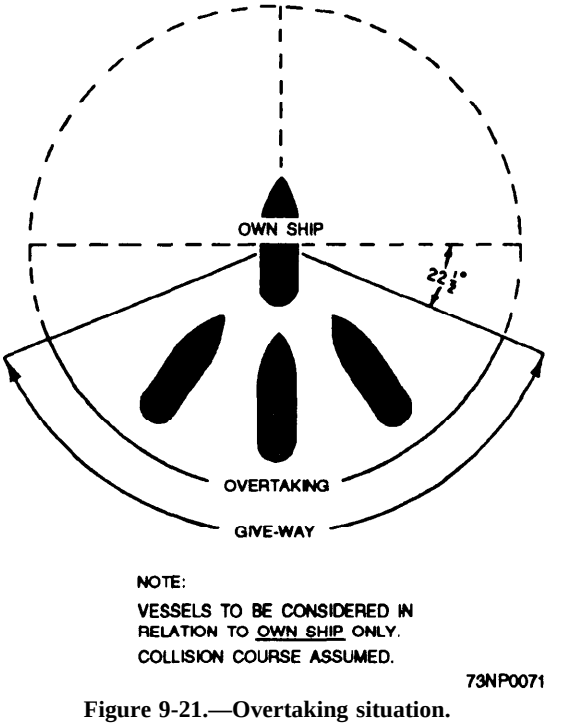

Figure 9-21.—Overtaking situation.

LIGHTS AND SHAPES

Rules for lights must be complied with in all weather, from sunset to sunrise, as specified by both International and Inland Rules of the Road.

Navigational lights and dayshapes of another vessel convey information such as clues to the type and size of vessel, its heading in relation to your vessel, type of operation in which it may be engaged, and other data that is helpful in determining right of way and preventing a collision.

Various navigational light and dayshape displays prescribed by the rules are discussed in the following topics.

Running Lights

When the rules refer to a power-driven vessel, they mean one propelled by any kind of machinery, as distinct from a sailing ship under sail. A vessel under way means a ship not at anchor, not made fast to the shore, or not aground. The ship does not actually have to be making headway.

Both rules state that the rules for lights must be complied with in all weather from sunset to sunrise, and should also be exhibited from sunrise to sunset in restricted visibility. These lights may be exhibited in all other circumstances when it is deemed necessary. Ships usually are darkened during wartime conditions; but even then, lights are kept ready for immediate display.

MASTHEAD LIGHT.—You are aware that a power-driven vessel underway carries a white light (masthead light) placed over the fore and aft centerline of the vessel, showing an unbroken light over an arc of the horizon of 225° and so fixed as to show the light from right ahead to 22.5° abaft the beam on either side of the vessel. The light at the fore masthead, or some other elevated point forward, is between 20 and 40 feet above the deck. This light must be visible from 2 to 6 miles, depending on the length of the vessel. You know, too, that under both rules, a power-driven vessel over 50 meters in length shows another white light aft, at least 15 feet higher than the fore masthead light. The horizontal distance between these lights should not be less than one-half the length of the vessel but need not be more than 100 meters. The after light, called the aft masthead light, is mandatory under both rules except for vessels less than 50 meters in length. A power-driven vessel less than 12 meters may show an all-round white light in lieu of the masthead light.

SIDELIGHTS.—Sidelights mean a green light on the starboard side and a red light on the port side, each showing an unbroken light over an arc of the horizon of 112.5° and so fixed as to show the light from right ahead to 22.5° abaft the beam on its respective side. In a vessel of less than 20 meters, the sidelights may be combined in one lantern carried on the fore and aft centerline of the vessel.

Side lights must be visible from 1 to 3 miles, depending on the size of the vessel. A sailing vessel or a ship being towed displays side lights and a stern light only—never masthead lights. A vessel under oars or a sailing vessel of less than 7 meters in length need carry only a lantern showing a white light, which it must exhibit in time to prevent collision. If practicable, a sailing vessel of less than 7 meters must exhibit the lights prescribed for a sailing vessel under way.

STERNLIGHT.—A white light placed as nearly as practicable at the stern, showing an unbroken light over an arc of the horizon of 135° and so fixed as to show the light 67.5° from right aft on each side of the vessel.

TOWING LIGHT.—The towing light is a yellow light having the same characteristics as a sternlight.

Lights, Pilot Vessels

An OOD or conning officer often is most anxious to sight the pilot boat and signal it alongside without being forced to lie to when conditions may be setting the ship toward a lee shore. Signalmen should recognize a pilot vessel the instant it is sighted.

Pilot vessels, when engaged on their stations on pilotage duty, should not show the lights required for other vessels. A pilot vessel should exhibit at or near the masthead two all-round lights in a vertical line, the upper being white and the lower red, and when under way (fig. 9-22), in addition, sidelights and a sternlight. When at anchor, in addition to those lights previously described, the pilot vessel should show the anchor light, lights, or shape prescribed for anchored vessels. The daytime display for a pilot vessel is the display of the HOTEL flag.

Pilot vessels, when not engaged on pilotage duty, should exhibit the lights or shapes prescribed for similar vessels of their length.

Vessel at Anchor

A vessel at anchor (fig. 9-23) should show, where it can best be seen, an all-round white light or one ball in the forepart of the vessel, and, at or near the stern,

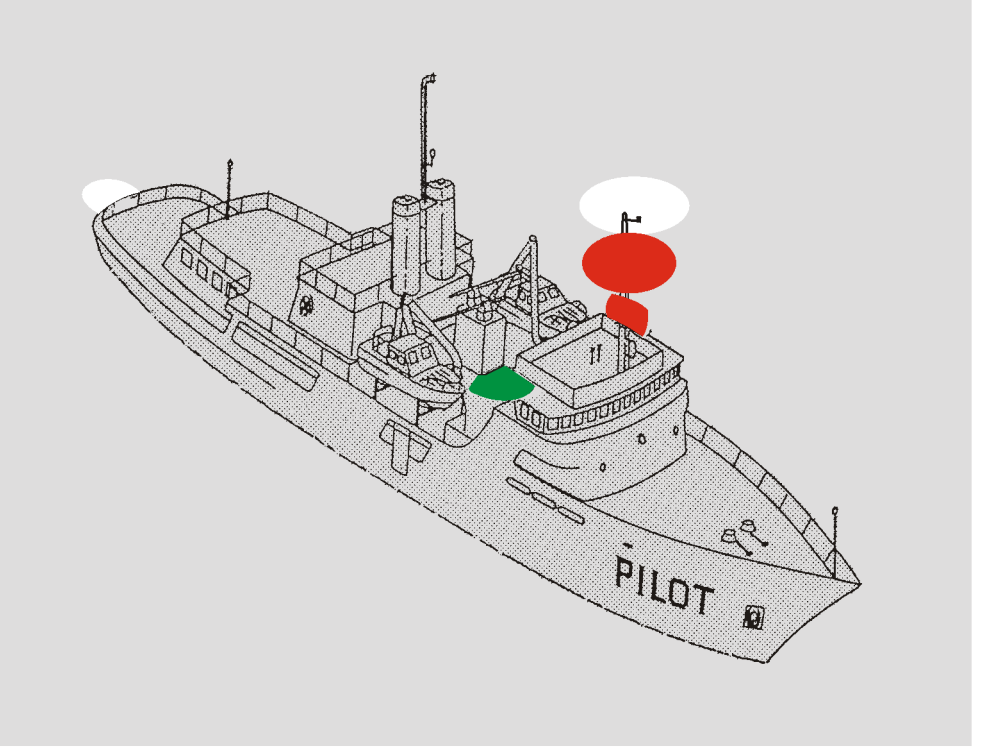

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Figure 9-22.—Pilot vessel, under way.

an all-round white light at a level lower than the light in the forepart of the vessel. Rule 30 applies here.

> **NOTE**
>
> A vessel less that 50 meters may substitute one white light where best seen. A vessel 100 meters or greater is required to illuminate its decks.

Towing Vessels

There are various light signals for towing (fig. 9-24). We will discuss a few in the following paragraphs.

LESS THAN 50 METERS.—A power-driven vessel less than 50 meters that is towing astern and the length of the tow does not exceed 200 meters is required to display two masthead lights, sidelights, and a yellow-over-white sternlight.

GREATER THAN 50 METERS.—A power-driven vessel greater than 50 meters that is towing astern and the length of tow does not exceed 200 meters is required to display two masthead lights, an after masthead light, sidelights, and a yellow-over-white sternlight.

LESS THAN 50 METERS, TOW EXCEEDS 200 METERS.—A vessel less than 50 meters that is towing astern with the length of tow exceeding 200 meters must display three masthead lights, sidelights, and a yellow-over-white sternlight. The dayshape display will be a DIAMOND.

TOWING, RESTRICTED MOVEMENT.—A vessel unable to deviate from its course and the length of tow does not exceed 200 meters is to display two masthead lights, sidelights, a yellow-over-white sternlight, and the light signal RED-WHITE-RED. The dayshape display will be BALL-DIAMOND-BALL and a DIAMOND.

When the length of tow exceeds 200 meters, the vessel is to display three masthead lights, sidelights, a yellow-over-white sternlight, and the light signal RED-WHITE-RED. The dayshape display will be the same as above. Rule 24 applies here.

Not-Under-Command Lights

A vessel not under command (fig. 9-25) should display the following lights: RED-RED displayed vertically, sidelights, and a sternlight. The sidelights and sternlight are only displayed when making way through the water. The dayshape signal for a vessel not under command is two black balls displayed vertically. Rule 27 applies here.

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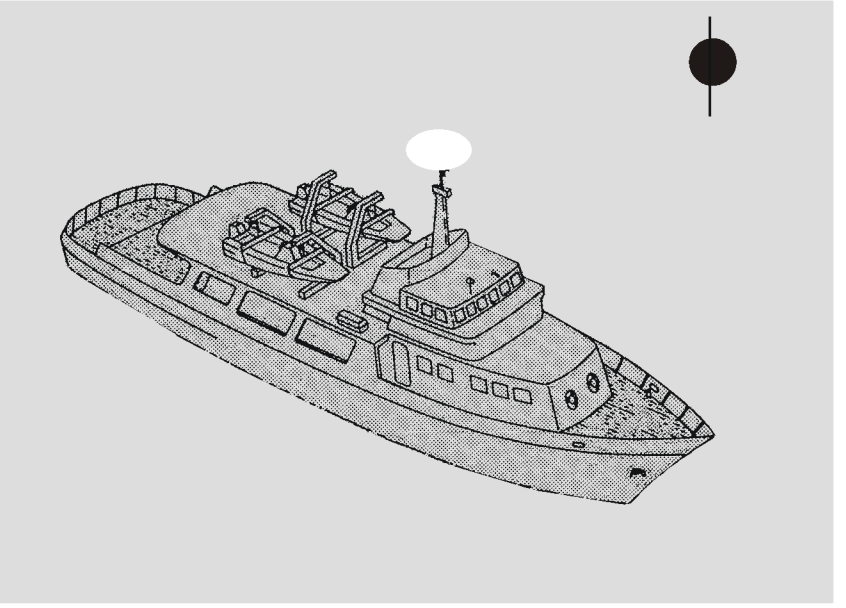

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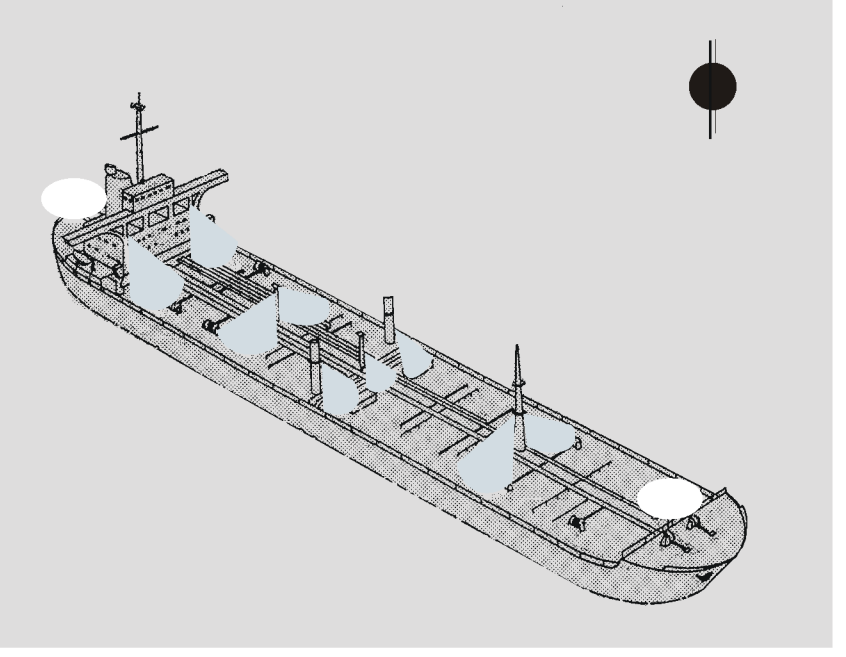

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Figure 9-23.—Vessels at anchor: (A) vessel less than 50 meters; (B) vessel greater than 50 meters.

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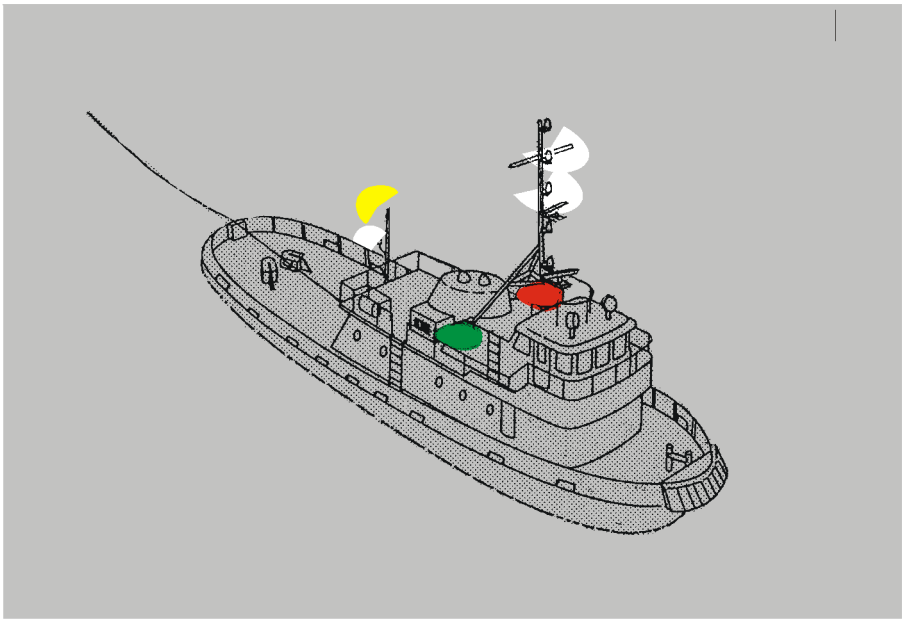

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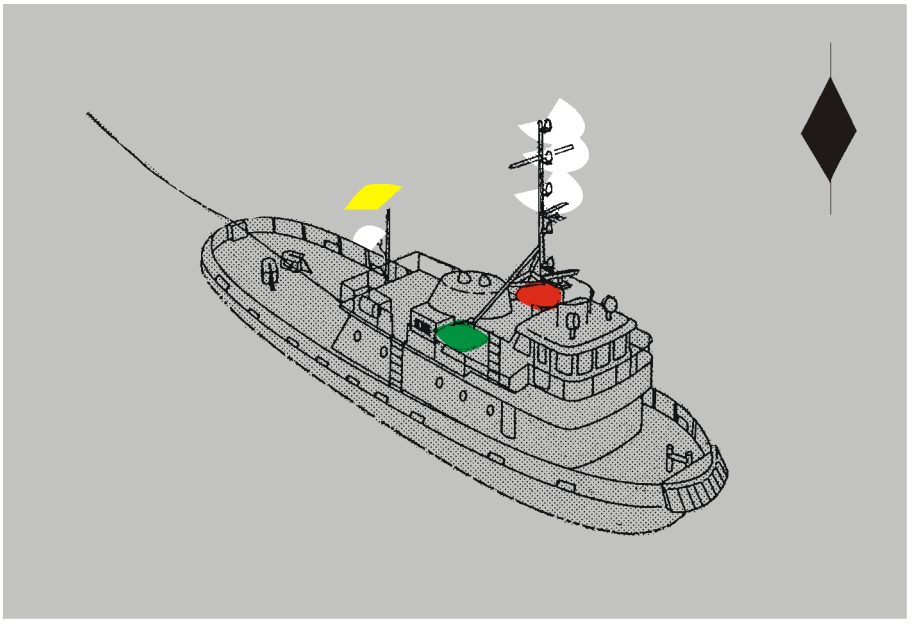

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Figure 9-24.—Towing vessels less than 50 meters in length: (A) length of tow is 200 meters or less; (B) length of tow exceeds 200 meters.

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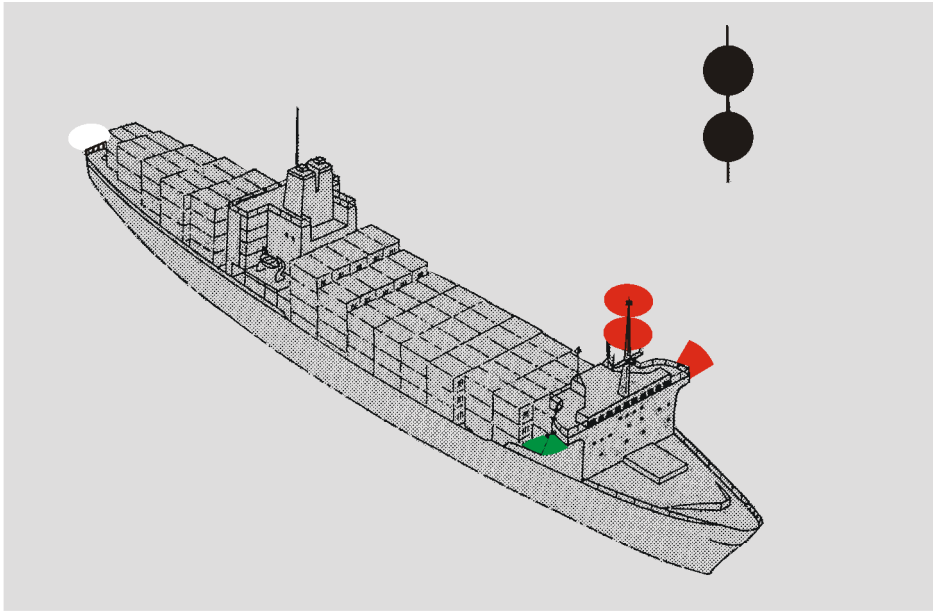

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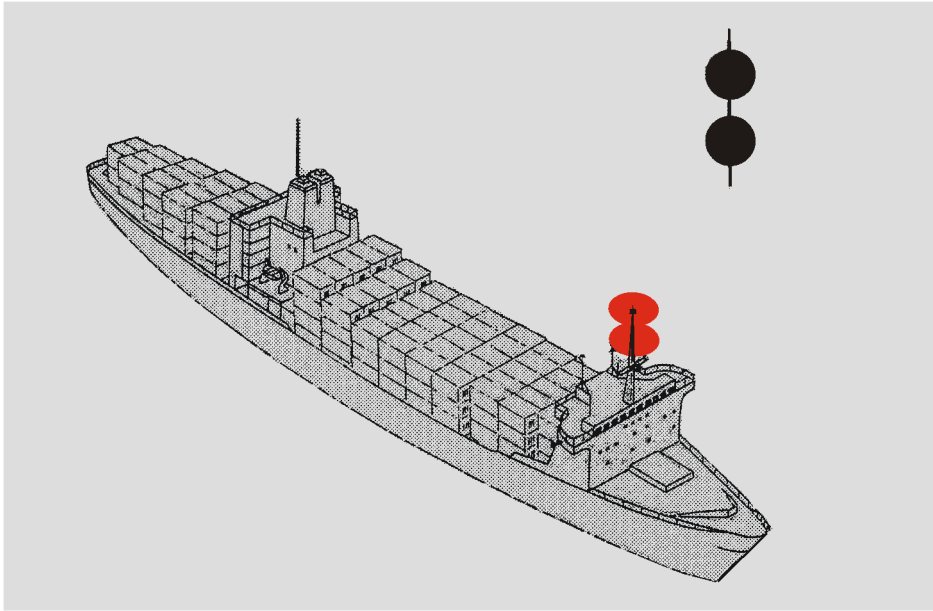

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Figure 9-25.—Vessels not under command: (A) making way; (B) not making way.

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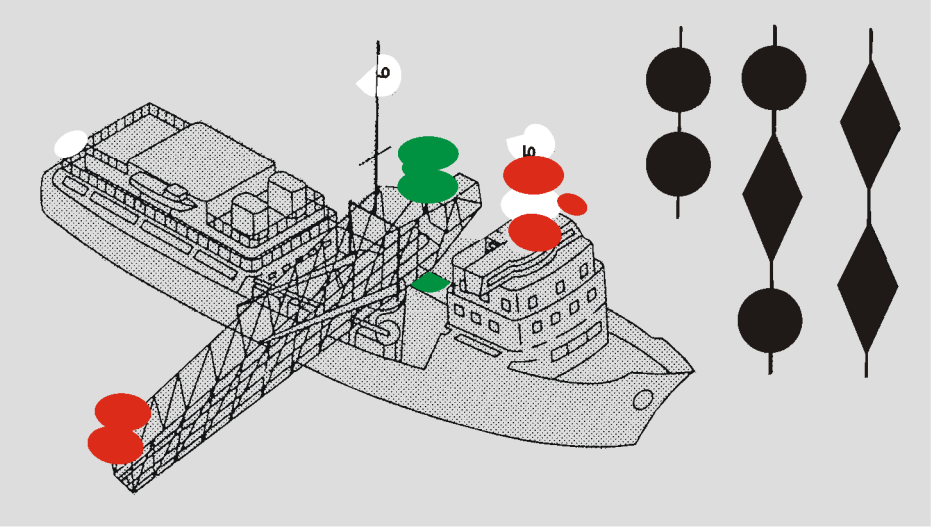
Dredging/Underwater Operation

When a vessel is dredging or is involved in underwater operations (fig. 9-26), the following light signals are required: RED-WHITE-RED displayed vertically, RED-RED on the obstructed side, GREEN-GREEN on the clear side, a masthead light, a sternlight, and sidelights. The masthead, sternlight, and sidelights are only used when making way. The dayshape signal is BALL-DIAMOND-BALL displayed vertically, two black balls vertically displayed on the obstructed side, and two black diamonds displayed vertically on the clear side. Rule 27 applies here.



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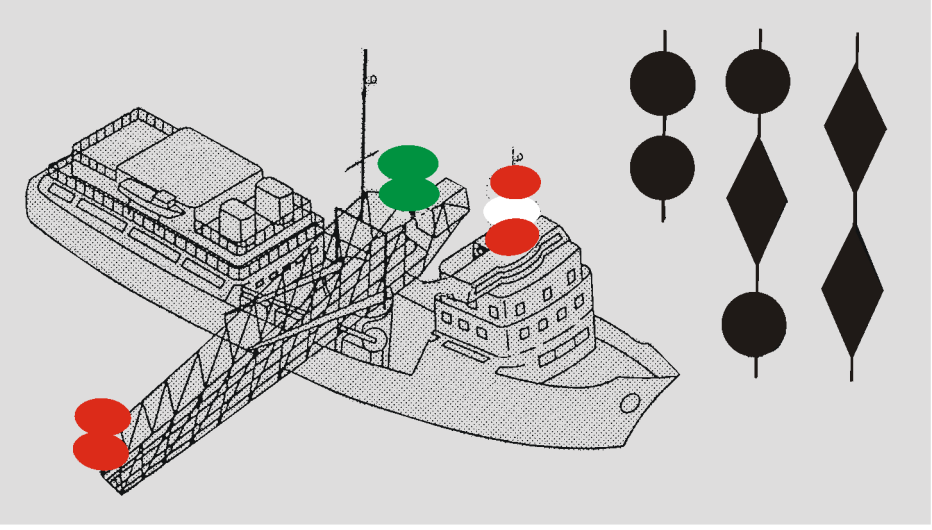

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Figure 9-26.—Vessels engaged in dredging or underwater operations: (A) making way; (B) not making way.

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Vessel Aground

The light display for a vessel aground (fig. 9-27) is RED-RED displayed vertically and the normal anchor lights for a vessel of her length. The dayshape display is three black balls displayed vertically. Rule 30 applies here.

Pushing Ahead or Alongside

The International and Inland Rules differ when it comes to pushing (fig. 9-28). The international display is two masthead towing lights, sidelights, and a sternlight. The inland display is two masthead lights, sidelights, and a yellow-over-yellow sternlight. Rule 24 applies here.

> **NOTE**
>
> When the pushing vessel and the vessel being pushed are connected into a composite unit, they are regarded as a power-driven vessel and must exhibit the lights for that class of vessel.

Draft

A vessel constrained by draft (fig. 9-29) is required to display the following lights: normal light for a power-driven vessel and three red lights displayed vertically. The required dayshape is a cylinder. Draft display is for International use only. Rule 28 applies here.

Conclusion

As you can see, there are numerous lights and dayshapes to be displayed. For more detailed information, see *Navigation Rules, International—Inland,* COMDTINST M16672.2B.

> **NOTE**
>
> When you are using lights and dayshapes, remember that they should always be displayed where best seen.

SOUND SIGNALS IN RESTRICTED VISIBILITY

Restricted visibility is defined as anything that reduces visibility below the range that a vessel would normally be visible. It can be caused by rain, fog, smoke, hail, snow, or any other condition that reduces visibility.

Rules to remember during restricted visibility are the following:

- The vessel must proceed at SAFE speed. Safe speed is determined by factors such as state of visibility; the maneuverability of the vessel; the state of the wind, sea, and current; the proximity of navigation hazards; draft in relation to the available depth of water; the traffic density, including the concentration of fishing vessels; and the characteristics and capabilities of radar, if installed.

- Power-driven vessels must have their engines ready for immediate maneuver.

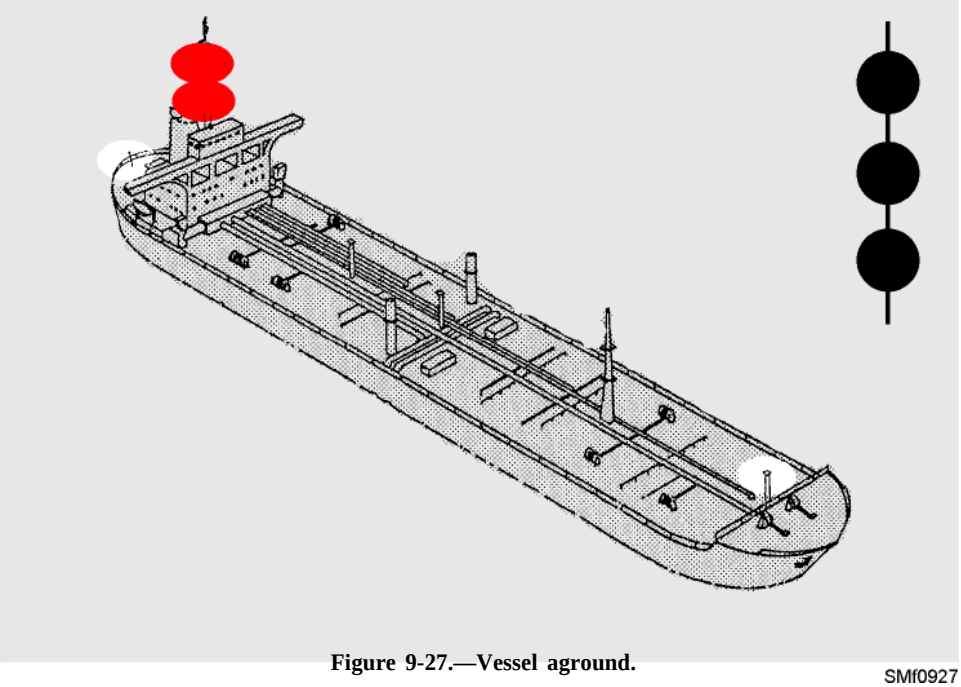

Figure 9-27.—Vessel aground.

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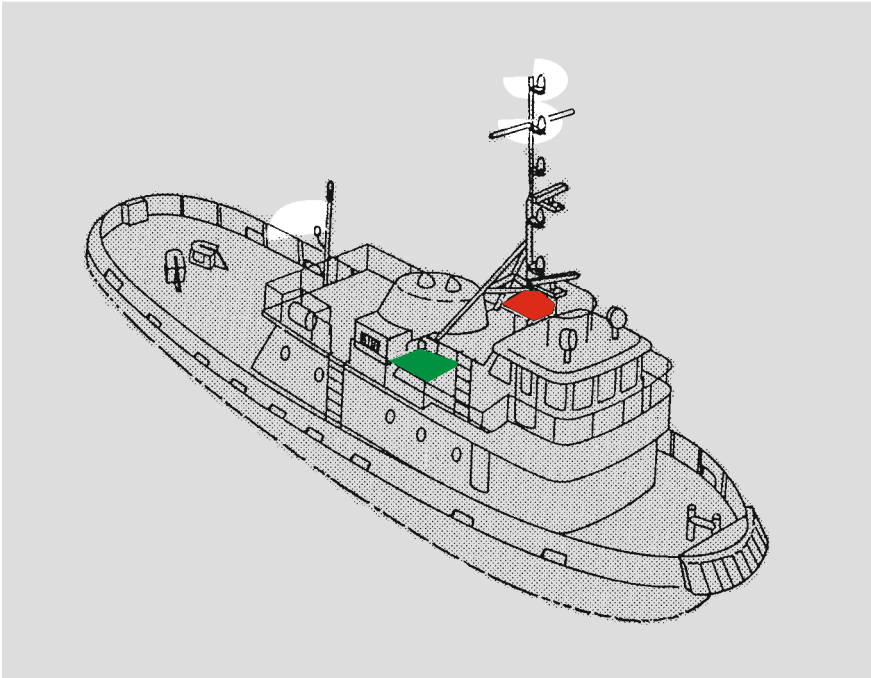

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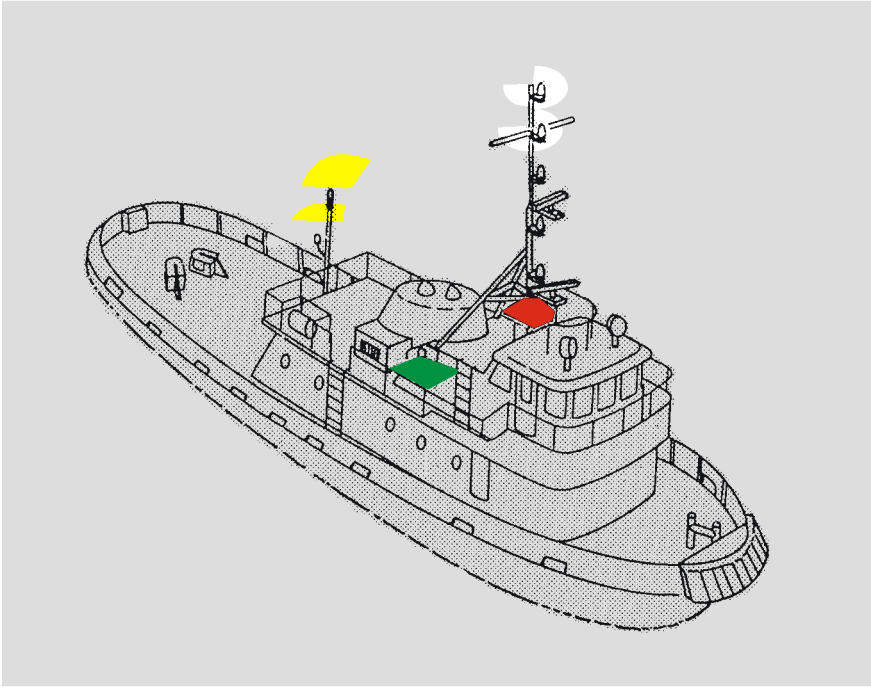

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Figure 9-28.—Pushing ahead or towing alongside: (A) International and (B) Inland.

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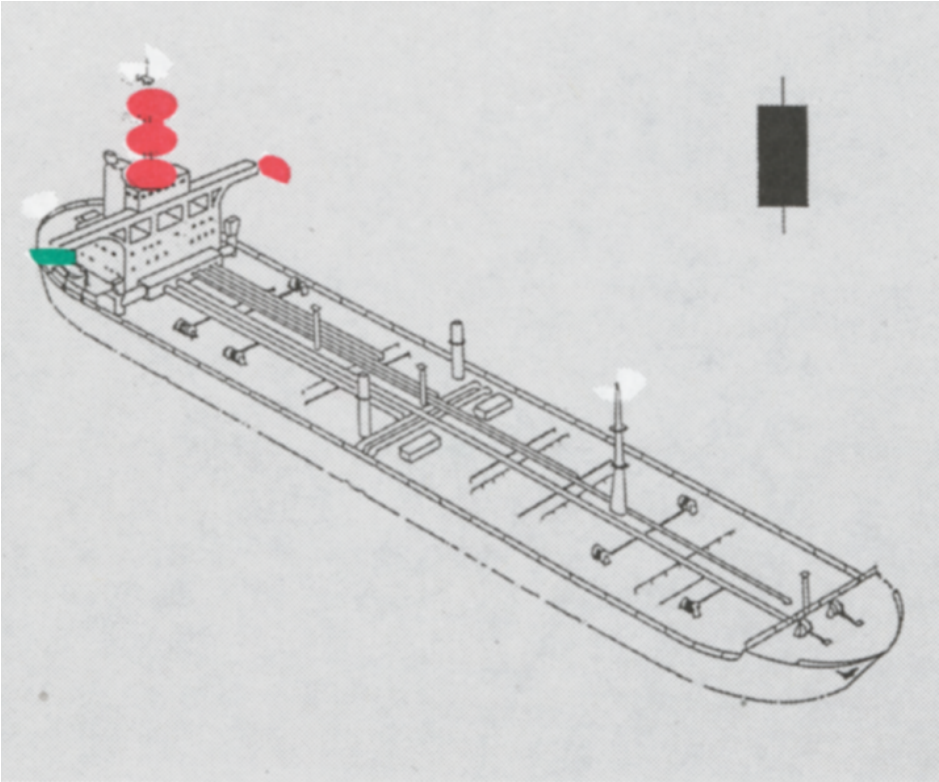

Figure 9-29.—Vessel constrained by her draft.

- Navigation lights must be exhibited from sunrise to sunset.
- Except when it has been determined that a risk of collision does not exist, every vessel that hears apparently forward of the beam the fog signal of another vessel must reduce her speed to the minimum that she can be kept on course; take all way off if necessary; or navigate with extreme caution until the risk of collision is over.

Lookout

In restricted visibility, lookouts are placed as far forward and as low to the water as possible. There must be two at each station, one to serve as the lookout and the other as the phone talker. They report everything they see or hear.

Give-way Vessels

All vessels are give-way vessels in restricted visibility. They are required to maneuver to avoid each other and to avoid turning towards any fog signals heard. Only the required fog signals will be sounded unless vessels sight each other, in which case the normal steering and sailing whistle signals will be sounded.

Equipment

Each power-driven vessel must have a whistle, a bell mounted in the forward part of the vessel, and for a vessel 100 meters or more in length, a gong in the after part of the vessel. Vessels less than 12 meters are not required to have the whistle, bell, and gong, but they must have the means to make an efficient signal.

Types of Sound Signals

A prolonged blast is one of from 4 to 6 seconds in duration; a short blast is about 1 second in duration. As can be seen in figure 9-30, fog signals are sounded at 2-minute intervals unless otherwise noted.

A power-driven vessel making way through the water in a fog or thick weather of any kind is required by the International and Inland Rules to sound a prolonged blast at intervals of not more than 2 minutes. Under both sets of rules, a power-driven vessel under way but stopped, and having no way on sounds two prolonged blasts, with about 2 seconds between them, at intervals of not more than 2 minutes.

INTERNATIONAL		INLAND	
—	MAKING WAY	—	MAKING WAY
— —	UNDERWAY BUT STOPPED AND MAKING NO WAY	— —	UNDERWAY BUT STOPPED AND MAKING NO WAY
— · ·	VESSEL NOT UNDER COMMAND, VESSEL RESTRICTED IN HER ABILITY TO MANEUVER, VESSEL CONSTRAINED BY DRAFT, SAILING VESSEL, VESSEL ENGAGED IN FISHING, VESSEL ENGAGED IN TOWING OR PUSHING	— · ·	VESSEL NOT UNDER COMMAND, VESSEL RESTRICTED IN HER ABILITY TO MANEUVER UNDERWAY OR AT ANCHOR, SAILING VESSEL, VESSEL ENGAGED IN FISHING UNDERWAY OR AT ANCHOR, VESSEL ENGAGED IN TOWING OR PUSHING ANOTHER VESSEL
— · · ·	VESSEL BEING TOWED OR LAST VESSEL OF TOW	— · · ·	VESSEL BEING TOWED OR LAST VESSEL OF TOW
RAPID RINGING OF BELL FOR 5 SEC. EV. MIN.	ANCHORED	RAPID RINGING OF BELL FOR 5 SEC. EV. MIN.	ANCHORED
· — ·		· — ·	
RAPID RINGING OF BELL FOR 5 SEC. FOLLOWED BY RAPID RINGING OF GONG EVERY MINUTE	ANCHORED OVER 100 METERS	RAPID RINGING OF BELL FOR 5 SEC. FOLLOWED BY RAPID RINGING OF GONG EVERY MINUTE	ANCHORED OVER 100 METERS
3 SEPARATE & DISTINCT STROKES ON BELL IMMEDIATELY BEFORE & AFTER RAPID RINGING OF BELL	AGROUND	3 SEPARATE & DISTINCT STROKES ON BELL IMMEDIATELY BEFORE & AFTER RAPID RINGING OF BELL	AGROUND
· · ·	PILOT VESSEL ENGAGED ON PILOTAGE DUTY	· · ·	PILOT VESSEL ENGAGED ON PILOTAGE DUTY
NOTE: SIGNAL INTERVALS ARE 2 MINUTES UNLESS OTHERWISE NOTED.			

Figure 9-30.—Sound signals in restricted visibility.

A vessel not under command; a vessel restricted in her ability to maneuver, whether under way or anchored; a sailing vessel; a vessel engaged in fishing, whether under way or anchored; and a vessel engaged in towing or pushing another vessel will sound one prolonged blast, followed by two short blasts at 2-minute intervals.

A vessel at anchor must, at intervals of not more than a minute, ring the bell rapidly for about 5

seconds. On a vessel of 100 meters or more, the bell must be sounded in the fore part of the ship, followed immediately by the rapid ringing of the gong for 5 seconds in the after part of the ship. A vessel at anchor may, in addition, sound three blasts in succession—one short, one prolonged, and one short—to give warning of its position and of the possibility of collision with an approaching vessel.

SUMMARY

In this chapter, you learned about some of your navigational duties. You learned about the compass, bearing and azimuth circle, and telescopic alidades. You learn about navigational charts and publications and the different aids to navigation. You learned about the Rules of the Road, including steering, sailing, lights, shapes, and sound signals for restricted visibility. This chapter is just an introduction to your navigational duties, so it is up to you to learn as much as you can when you get the chance. While steaming independently, ask your supervisor if you may go down to the bridge to stand watch with the Quartermaster of the watch. On some ships today, Signalmen stand Quartermaster watches.