CHAPTER 5

SHORT RANGE AIDS TO NAVIGATION

DEFINING SHORT RANGE AIDS TO NAVIGATION

500. Terms and Definitions

Short range aids to navigation are those intended to be used visually or by radar while in inland, harbor and approach, and coastal navigation. The term encompasses lighted and unlighted beacons, ranges, leading lights, buoys, and their associated sound signals. Each short range aid to navigation, commonly referred to as a NAVAID, fits within a system designed to warn the mariner of dangers and direct him toward safe water. An aid's function determines its color, shape, light characteristic, and sound. This chapter explains the U.S. Aids to Navigation System as well as the IALA Maritime Buoyage System.

The placement and maintenance of marine aids to navigation in U.S. waters is the responsibility of the United States Coast Guard. The Coast Guard maintains lighthouses, radiobeacons, racons, sound signals, buoys, and daybeacons on the navigable waters of the United States, its territories, and possessions. Additionally, the Coast Guard exercises control over privately owned navigation aid systems.

A **beacon** is a stationary, visual navigation aid. Large lighthouses and small single-pile structures are both beacons. Lighted beacons are called **lights**; unlighted beacons are **daybeacons**. All beacons exhibit a **daymark** of some sort. In the case of a lighthouse, the color and type of structure are the daymarks. On small structures, these daymarks, consisting of colored geometric shapes called **dayboards**, often have lateral significance. The markings on lighthouses and towers convey no lateral significance.

FIXED LIGHTS

501. Major and Minor Lights

Lights vary from tall, high intensity coastal lights to battery-powered lanterns on single wooden piles. Immovable, highly visible, and accurately charted, fixed lights provide navigators with an excellent source for bearings. The structures are often distinctively colored to aid in identification. See Figure 501a.

A **major light** is a high-intensity light exhibited from a fixed structure or a marine site. Major lights include primary seacoast lights and secondary lights. **Primary seacoast lights** are major lights established for making landfall from sea and coastwise passages from headland to headland. **Secondary lights** are major lights established at harbor entrances and other locations where high intensity and reliability are required.

A **minor light** usually displays a light of low to moderate intensity. Minor lights are established in harbors, along channels, rivers, and in isolated locations. They usually have numbering, coloring, and light and sound characteristics that are part of the lateral system of buoyage.

Lighthouses are placed where they will be of most use: on prominent headlands, at harbor and port entrances, on isolated dangers, or at other points where mariners can best use them to fix their position. The lighthouse's principal purpose is to support a light at a considerable height above the water, thereby increasing its geographic range. Support equipment is often housed near the tower.

With few exceptions, all major lights operate automatically. There are also many automatic lights on smaller structures maintained by the Coast Guard or other attendants. Unmanned major lights may have emergency generators and automatic monitoring equipment to increase the light's reliability.

Light structures' appearances vary. Lights in low-lying areas usually are supported by tall towers; conversely, light structures on high cliffs may be relatively short. However its support tower is constructed, almost all lights are similarly generated, focused, colored, and characterized.

Some major lights use modern rotating or flashing lights, but many older lights use **Fresnel** lenses. These lenses consist of intricately patterned pieces of glass in a heavy brass framework. Modern Fresnel-type lenses are cast from high-grade plastic; they are much smaller and lighter than their glass counterparts.

A **buoyant beacon** provides nearly the positional accuracy of a light in a place where a buoy would normally be used. See Figure 501b. The buoyant beacon consists of a heavy sinker to which a pipe structure is tightly moored. A buoyancy chamber near the surface supports the pipe. The light, radar reflector, and other devices are located atop the pipe above the surface of the water. The pipe with its buoyancy chamber tends to remain upright even in severe weather and heavy currents, providing a smaller watch cir-

Figure 501a. Typical offshore light station.

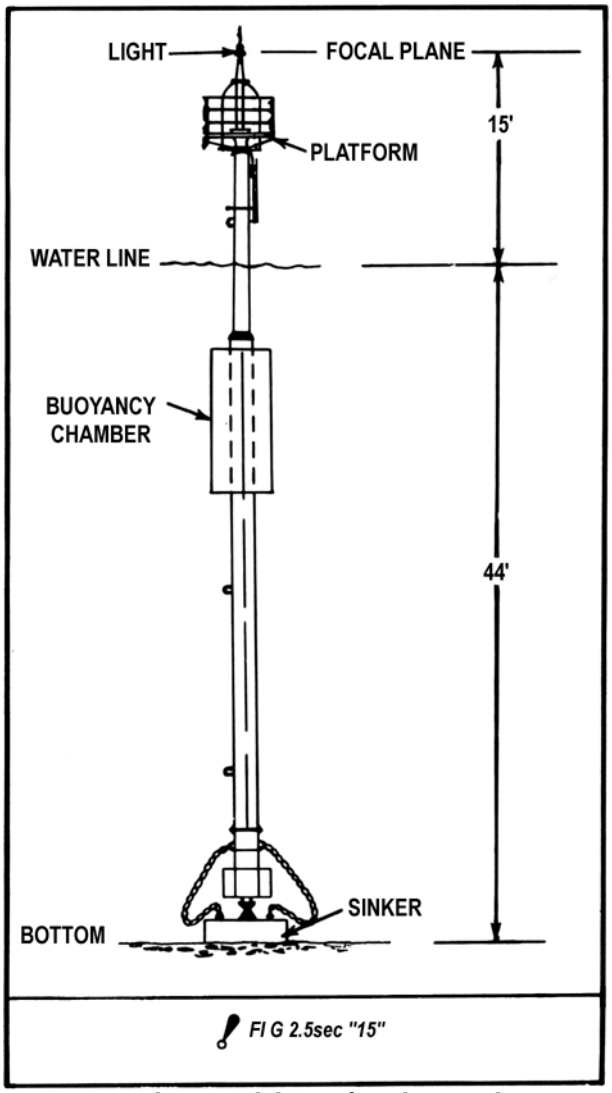


Figure 501b. Typical design for a buoyant beacon.

cle than a buoy. The buoyant beacon is most useful along narrow ship channels in relatively sheltered water.

502. Range Lights

Range lights are light pairs that indicate a specific line of position when they are in line. The higher rear light is placed behind the front light. When the mariner sees the lights vertically in line, he is on the range line. If the front light appears left of the rear light, the observer is to the right of the range line; if the front appears to the right of the rear, the observer is left of the range line. Range lights are sometimes equipped with high intensity lights for daylight use. These are effective for long channels in hazy conditions when dayboards might not be seen. The range light structures are usually also equipped with dayboards for ordinary daytime use. Some smaller ranges, primarily in the Intercoastal Waterway, rivers, and other inland waters, have just the dayboards with no lights. See Figure 502.

To enhance the visibility of range lights, the Coast Guard has developed 15-foot long lighted tubes called **light pipes**. They are mounted vertically, and the mariner sees them as vertical bars of light distinct from background lighting. Installation of light pipes is proceeding on several range markers throughout the country. The Coast Guard is also experimenting with long range sodium lights for areas requiring visibility greater than the light pipes can provide.

The output from a low pressure sodium light is almost entirely at one wavelength. This allows the use of an inexpensive band-pass filter to make the light visible even during the daytime. This arrangement eliminates the need for high intensity lights with their large power requirements.

Range lights are usually white, red, or green. They display various characteristics differentiating them from surrounding lights.

A **directional light** is a single light that projects a high intensity, special characteristic beam in a given direction. It is used in cases where a two-light range may not be practicable. A **directional sector light** is a directional light that emits two or more colored beams. The beams have a pre-

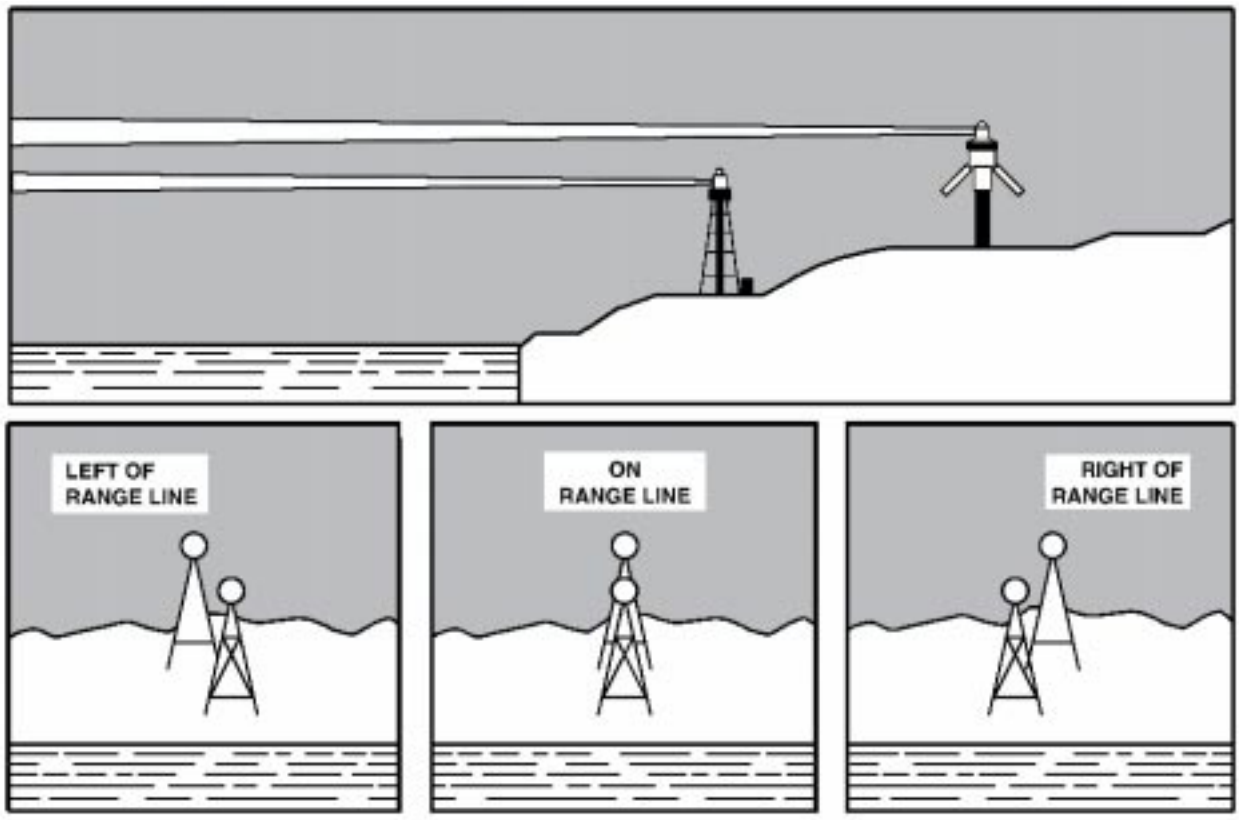


Figure 502. Range lights.

cisely oriented boundary between them. A normal application of a sector light would show three colored sections: red, white, and green. The white sector would indicate that the vessel is on the channel centerline; the green sector would indicate that the vessel is off the channel centerline in the direction of deep water; and the red sector would indicate that the vessel is off the centerline in the direction of shoal water.

503. Aeronautical Lights

Aeronautical lights may be the first lights observed at night when approaching the coast. Those situated near the coast and visible from sea are listed in the *List of Lights*. These lights are not listed in the Coast Guard *Light List*. They usually flash alternating white and green.

Aeronautical lights are sequenced geographically in the *List of Lights* along with marine navigation lights. However, since they are not maintained for marine navigation, they are subject to changes of which maritime authorities may not be informed. These changes will be published in *Notice to Airmen* but perhaps not in *Notice to Mariners*.

504. Bridge Lights

Navigational lights on bridges in the U.S. are prescribed by Coast Guard regulations. Red, green, and white lights mark bridges across navigable waters. Red lights mark piers and other parts of the bridge. Red lights are also used on drawbridges to show when they are in the closed position. Green lights mark open drawbridges and mark the centerline of navigable channels through fixed bridges. The position will vary according to the type of structure.

Infrequently-used bridges may be unlighted. In foreign waters, the type and method of lighting may be different from those normally found in the United States. Drawbridges which must be opened to allow passage operate upon sound and light signals given by the vessel and acknowledged by the bridge. These required signals are detailed in the Code of Federal Regulations and the applicable *Coast Pilot*. Certain bridges may also be equipped with sound signals and radar reflectors.

505. Shore Lights

Shore lights usually have a shore-based power supply. Lights on pilings, such as those found in the Intracoastal Waterway, are battery powered. Solar panels may be installed to enhance the light's power supply. The lights consist of a power source, a flasher to determine the characteristic, a lamp changer to replace burned-out lamps, and a focusing lens.

Various types of rotating lights are in use. They do not have flashers but remain continuously lit while a lens or reflector rotates around the horizon.

The aids to navigation system is carefully engineered

to provide the maximum amount of direction to the mariner for the least expense. Specially designed filaments and special grades of materials are used in the light to withstand the harsh marine environment.

The **flasher** electronically determines the characteristic by selectively interrupting the light's power supply according to the chosen cycle.

The **lamp changer** consists of several sockets arranged around a central hub. When the circuit is broken by a burned-out filament, a new lamp is rotated into position. Almost all lights have daylight switches which turn the light off at sunrise and on at dusk.

The **lens** for small lights may be one of several types. The common ones in use are omni-directional lenses of 155mm, 250mm, and 300mm diameter. In addition, lights using parabolic mirrors or focused-beam lenses are used in leading lights and ranges. The lamp filaments must be carefully aligned with the plane of the lens or mirror to provide the maximum output of light. The lens' size is chosen according to the type of platform, power source, and lamp characteristics. Additionally, environmental characteristics of the location are considered. Various types of light-condensing panels, reflex reflectors, or colored sector panels may be installed inside the lens to provide the proper characteristic. A specially reinforced 200mm lantern is used in locations where ice and breaking water are a hazard.

LIGHT CHARACTERISTICS

506. Characteristics

A light has distinctive **characteristics** which distinguish it from other lights or convey specific information by showing a distinctive sequence of light and dark intervals. Additionally, a light may display a distinctive color or color sequence. In the *Light Lists*, the dark intervals are referred to as **eclipses**.

An **occulting** light is a light totally eclipsed at regular intervals, the duration of light always being greater than the duration of darkness. A **flashing** light flashes on and off at regular intervals, the duration of light always being less than the duration of darkness. An **isophase** light flashes at regular intervals, the duration of light being equal to the duration of darkness.

Light phase characteristics (See Table 506) are the distinctive sequences of light and dark intervals or sequences in the variations of the luminous intensity of a light. The light phase characteristics of lights which change color do not differ from those of lights which do not change color. A light showing different colors alternately is described as an **alternating** light. The alternating characteristic may be used with other light phase characteristics.

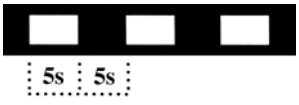
TYPE	ABBREVIATION	GENERAL DESCRIPTION	ILLUSTRATION*
Fixed	F.	A continuous and steady light.	
Occulting	Oc.	The total duration of light in a period is longer than the total duration of darkness and the intervals of darkness (eclipses) are usually of equal duration. Eclipse regularly repeated.	
Group occulting	Oc.(2)	An occulting light for which a group of eclipses, specified in number, is regularly repeated.	
Composite group occulting	Oc.(2+1)	A light similar to a group occulting light except that successive groups in a period have different numbers of eclipses.	
Isophase	Iso	A light for which all durations of light and darkness are clearly equal.	

Table 506. Light phase characteristics.

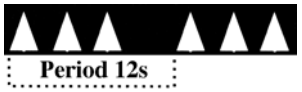
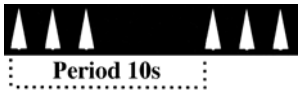
TYPE	ABBREVIATION	GENERAL DESCRIPTION	ILLUSTRATION*
Flashing	Fl.	A light for which the total duration of light in a period is shorter than the total duration of darkness and the appearances of light (flashes) are usually of equal duration (at a rate of less than 50 flashes per minute).	
Long flashing	L.Fl.	A single flashing light for which an appearance of light of not less than 2 sec. duration (long flash) is regularly repeated.	
Group flashing	Fl.(3)	A flashing light for which a group of flashes, specified in number, is regularly repeated.	
Composite group flashing	Fl.(2+1)	A light similar to a group flashing light except that successive groups in a period have different numbers of flashes.	
Quick flashing	Q.	A light for which a flash is regularly repeated at a rate of not less than 50 flashes per minute but less than 80 flashes per minute.	
Group quick flashing	Q.(3)	A light for 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.	
	Q.(9)		
	Q.(6)+L.Fl.		
Interrupted quick flashing	I.Q.	A light for which the sequence of quick flashes is interrupted by regularly repeated eclipses of constant and long duration.	
Very quick flashing	V.Q.	A light for which a flash is regularly repeated at a rate of not less than 80 flashes per minute but less than 160 flashes per minute.	

Table 506. Light phase characteristics.

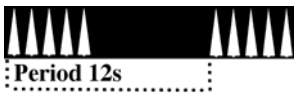
TYPE	ABBREVIATION	GENERAL DESCRIPTION	ILLUSTRATION*
Group very quick flashing	V.Q.(3)	A light for which a specified group of very quick flashes is regularly repeated.	
	V.Q.(9)		
	V.Q.(6)+L.Fl.		
Interrupted very quick flashing	I.V.Q.	A light for which the sequence of very quick flashes is interrupted by regularly repeated eclipses of constant and long duration.	
Ultra quick flashing	U.Q.	A light for which a flash is regularly repeated at a rate of not less than 160 flashes per minute.	
Interrupted ultra quick flashing	I.U.Q.	A light for which the sequence of ultra quick flashes is interrupted by regularly repeated eclipses of constant and long duration.	
Morse code	Mo.(U)	A light for which appearances of light of two clearly different durations are grouped to represent a character or characters in Morse Code.	
Fixed and flashing	F.Fl.	A light for which a fixed light is combined with a flashing light of greater luminous intensity .	
Alternate light	Al.	A light showing different colors alternately	* Periods shown are examples only.
NOTE: Alternating lights may be used in combined form with most of the previous types of lights			

Table 506. Light phase characteristics.

Light-sensitive switches extinguish most lighted navigation aids during daylight hours. However, owing to the various sensitivities of the light switches, all lights do not turn on or off at the same time. Mariners should account for this when identifying aids to navigation during twilight periods when some lighted aids are on while others are not.

507. Light Sectors

Sectors of colored glass or plastic are sometimes placed in the lanterns of certain lights to indicate dangerous waters. Lights so equipped show different colors when observed from different bearings. A sector changes the color of a light, but not its characteristic, when viewed from certain directions. For example, a four second flashing white light having a red sector will appear as a four second flashing red light when viewed from within the red sector.

Sectors may be only a few degrees in width or extend in a wide arc from deep water toward shore. Bearings referring to sectors are expressed in degrees true as observed from a vessel. In most cases, areas covered by red sectors should be avoided. The nature of the danger can be determined from the chart. In some cases a narrow sector may mark the best water across a shoal, or a turning point in a channel.

The transition from one color to another is not abrupt. The colors change through an arc of uncertainty of 2° or greater, depending on the optical design of the light. Therefore determining bearings by observing the color change is less accurate than obtaining a bearing with an azimuth circle.

508. Factors Affecting Range and Characteristics

The condition of the atmosphere has a considerable effect upon a light's range. Lights are sometimes obscured by fog, haze, dust, smoke, or precipitation. On the other hand, refraction may cause a light to be seen farther than under ordinary circumstances. A light of low intensity will be easily obscured by unfavorable conditions of the atmosphere. For this reason, the intensity of a light should always be considered when looking for it in thick weather. Haze and distance may reduce the apparent duration of a light's flash. In some conditions of the atmosphere, white lights may have a reddish hue. In clear weather green lights may have a more whitish hue.

Lights placed at higher elevations are more frequently obscured by clouds, mist, and fog than those near sea level. In regions where ice conditions prevail, an unattended light's lantern panes may become covered with ice or snow This may reduce the light's luminous range and change the light's observed color.

The distance from a light cannot be estimated by its apparent brightness. There are too many factors which can change the perceived intensity. Also, a powerful, distant light may sometimes be confused with a smaller, closer one with similar characteristics. Every light sighted should be carefully evaluated to determine if it is the one expected.

The presence of bright shore lights may make it difficult to distinguish navigational lights from background lighting. Lights may also be obscured by various shore obstructions, natural and man-made. The Coast Guard requests mariners to report these cases to the nearest Coast Guard station.

A light's **loom** is sometimes seen through haze or the reflection from low-lying clouds when the light is beyond its geographic range. Only the most powerful lights can generate a loom. The loom may be sufficiently defined to obtain a bearing. If not, an accurate bearing on a light beyond geographic range may sometimes be obtained by ascending to a higher level where the light can be seen, and noting a star directly over the light. The bearing of the star can then be obtained from the navigating bridge and the bearing to the light plotted indirectly.

At short distances, some of the brighter flashing lights may show a faint continuous light, or faint flashes, between regular flashes. This is due to reflections of a rotating lens on panes of glass in the lighthouse.

If a light is not sighted within a reasonable time after prediction, a dangerous situation may exist. Conversely, the light may simply be obscured or extinguished. The ship's position should immediately be fixed by other means to determine any possibility of danger.

The apparent characteristic of a complex light may change with the distance of the observer. For example, a light with a characteristic of fixed white and alternating flashing white and red may initially show as a simple flashing white light. As the vessel draws nearer, the red flash will become visible and the characteristic will apparently be alternating flashing white and red. Later, the fainter fixed white light will be seen between the flashes and the true characteristic of the light finally recognized as fixed white, alternating flashing white and red (F W Al W R). This is because for a given candlepower, white is the most visible color, green less so, and red least of the three. This fact also accounts for the different ranges given in the *Light Lists* for some multi-color sector lights. The same lamp has different ranges according to the color imparted by the sector glass.

A light may be **extinguished** due to weather, battery failure, vandalism, or other causes. In the case of unattended lights, this condition might not be immediately corrected. The mariner should report this condition to the nearest Coast Guard station. During periods of armed conflict, certain lights may be deliberately extinguished without notice. Offshore light stations should always be left well off the course whenever searoom permits.

BUOYS

509. Definitions and Types

Buoys are floating aids to navigation. They mark channels, indicate shoals and obstructions, and warn the mariner of dangers. Buoys are used where fixed aids would be uneconomical or impractical due to the depth of water. By their color, shape, topmark, number, and light characteristics, buoys indicate to the mariner how to avoid hazards and stay in safe water. The federal buoyage system in the U.S. is maintained by the Coast Guard.

There are many different sizes and types of buoys designed to meet a wide range of environmental conditions and user requirements. The size of a buoy is determined primarily by its location. In general, the smallest buoy which will stand up to local weather and current conditions is chosen.

There are five types of buoys maintained by the Coast Guard. They are:

1. Lateral marks
2. Isolated danger marks
3. Safe water marks
4. Special marks
5. Information/regulatory marks

These conform in general to the specifications of the **International Association of Lighthouse Authorities (IALA)** buoyage system.

A **lighted buoy** is a floating hull with a tower on which a light is mounted. Batteries for the light are in watertight pockets in the buoy hull or in watertight boxes mounted on the buoy hull. To keep the buoy in an upright position, a counterweight is attached to the hull below the water's surface. A radar reflector is built into the buoy tower.

The largest of the typical U.S. Coast Guard buoys can be moored in up to 190 feet of water, limited by the weight of chain the hull can support. The focal plane of the light is 15 to 20 feet high. The designed nominal visual range is 3.8 miles, and the radar range 4 miles. Actual conditions will cause these range figures to vary considerably.

The smallest buoys are designed for protected water. Some are made of plastic and weigh only 40 pounds. Specially designed buoys are used for fast current, ice, and other environmental conditions.

A variety of special purpose buoys are owned by other governmental organizations. Examples of these organizations include the St. Lawrence Seaway Development Corporation, NOAA, and the Department of Defense. These buoys are usually navigational marks or data collection buoys with traditional round, boat-shaped, or discus-shaped hulls.

A special class of buoy, the **Ocean Data Acquisition System (ODAS)** buoy, is moored or floats free in offshore waters. Positions are promulgated through radio warnings. These buoys are generally not large enough to cause damage to a large vessel in a collision, but should be given a wide berth regardless, as any loss would almost certainly result in the interruption of valuable scientific experiments. They are generally bright orange or yellow in color, with vertical stripes on moored buoys and horizontal bands on free-floating ones, and have a strobe light for night visibility.

Figure 509. Buoy showing counterweight.

Even in clear weather, the danger of collision with a buoy exists. If struck head-on, a large buoy can inflict severe damage to a large ship; it can sink a smaller one. Reduced visibility or heavy background lighting can contribute to the problem of visibility. The Coast Guard sometimes receives reports of buoys missing from station that were actually run down and sunk. Tugboats and towboats towing or pushing barges are particularly dangerous to buoys because of poor over-the-bow visibility when pushing or yawing during towing. The professional mariner must report *any* collision with a buoy to the nearest Coast Guard unit. Failure to do so may cause the next vessel to miss the channel or hit the obstruction marked by the buoy; it can also lead to fines and legal liability.

Routine on-station buoy maintenance consists of inspecting the mooring, cleaning the hull and superstructure, replacing the batteries, flasher, and lamps, checking wiring and venting systems, and verifying the buoy's exact position. Every few years, each buoy is replaced by a similar aid and returned to a Coast Guard maintenance facility for complete refurbishment.

The placement of a buoy depends on its purpose and its position on the chart. Most buoys are placed on their charted positions as accurately as conditions allow. However, if a

buoy's purpose is to mark a shoal and the shoal is found to be in a different position than the chart shows, the buoy will be placed to properly mark the shoal, and not on its charted position.

510. Lights on Buoys

Buoy light systems consist of a **battery pack**, a **flasher** which determines the characteristic, a **lamp changer** which automatically replaces burned-out bulbs, a **lens** to focus the light, and a **housing** which supports the lens and protects the electrical equipment.

The **batteries** consist of 12-volt lead/acid type batteries electrically connected to provide sufficient power to run the proper flash characteristic and lamp size. These battery packs are contained in pockets in the buoy hull, accessible through water-tight bolted hatches or externally mounted boxes. Careful calculations based on light characteristics determine how much battery power to install.

The **flasher** determines the characteristic of the lamp. It is installed in the housing supporting the lens.

The **lamp changer** consists of several sockets arranged around a central hub. A new lamp rotates into position if the active one burns out.

Under normal conditions, the **lenses** used on buoys are 155mm in diameter at the base. 200 mm lenses are used where breaking waves or swells call for the larger lens. They are colored according to the charted characteristic of the buoy. As in shore lights, the lamp must be carefully focused so that the filament is directly in line with the focal plane of the lens. This ensures that the majority of the light produced is focused in a 360° horizontal fan beam. A buoy light has a relatively narrow vertical profile. Because the buoy rocks in the sea, the focal plane may only be visible for fractions of a second at great ranges. A realistic range for sighting buoy lights is 4-6 miles in good visibility and calm weather.

511. Sound Signals on Buoys

Lighted sound buoys have the same general configuration as lighted buoys but are equipped with either a bell, gong, whistle, or horn. **Bells** and **gongs** are sounded by tappers hanging from the tower that swing as the buoy rocks in the sea. Bell buoys produce only one tone; gong buoys produce several tones. The tone-producing device is mounted between the legs of the pillar or tower.

Whistle buoys make a loud moaning sound caused by the rising and falling motions of the buoy in the sea. A sound buoy equipped with an electronic **horn** will produce a pure tone at regular intervals regardless of the sea state. Unlighted sound buoys have the same general appearance as lighted buoys, but their underwater shape is designed to make them lively in all sea states.

512. Buoy Moorings

Buoys require **moorings** to hold them in position. Typically the mooring consists of **chain** and a large concrete or cast iron **sinker**. See Figure 512. Because buoys are subjected to waves, wind, and tides, the moorings must be deployed with chain lengths much greater than the water depth. The scope of chain will normally be about 3 times the water depth. The length of the mooring chain defines a **watch circle** within which the buoy can be expected to swing. It is for this reason that the charted buoy symbol has a "position approximate" circle to indicate its charted position, whereas a light position is shown by a dot at the exact location. Actual watch circles do not necessarily coincide with the "position approximate" circles which represent them.

Figure 512. A sinker used to anchor a buoy.

Over several years, the chain gradually wears out and must be replaced. The worn chain is often cast into the concrete of new sinkers.

513. Large Navigational Buoys

Large navigational buoys are moored in open water at approaches to certain major seacoast ports and monitored from shore stations by radio signals. These 40-foot diameter buoys (Figure 513) show lights from heights of about 36 feet above the water. Emergency lights automatically energize if the main light is extinguished. These buoys may also have a radiobeacon and sound signals.

514. Wreck Buoys

A **wreck buoy** usually cannot be placed directly over the wreck it is intended to mark because the buoy tender may not want to pass over a shallow wreck or risk fouling the buoy mooring. For this reason, a wreck buoy is usually

Figure 513. Large navigational buoy.

placed as closely as possible on the seaward or channelward side of a wreck. In some situations, two buoys may be used to mark the wreck, one lying off each end. The wreck may lie directly between them or inshore of a line between them, depending on the local situation. The *Local Notice to Mariners* should be consulted concerning details of the placement of wreck buoys on individual wrecks. Often it will also give particulars of the wreck and what activities may be in progress to clear it.

The charted position of a wreck buoy will usually be offset from the actual geographic position so that the wreck and buoy symbols do not coincide. Only on the largest scale chart will the actual and charted positions of both wreck and buoy be the same. Where they might overlap, it is the wreck symbol which occupies the exact charted position and the buoy symbol which is offset.

Wreck buoys are required to be placed by the owner of the wreck, but they may be placed by the Coast Guard if the owner is unable to comply with this requirement. In general, privately placed aids are not as reliable as Coast Guard aids.

Sunken wrecks are sometimes moved away from their buoys by storms, currents, freshets, or other causes. Just as shoals may shift away from the buoys placed to mark them, wrecks may shift away from wreck buoys.

515. Fallibility of Buoys

Buoys cannot be relied on to maintain their charted positions consistently. They are subject to a variety of hazards including severe weather, collision, mooring casualties, and electrical failure. Mariners should report discrepancies to the authority responsible for maintaining the aid.

The buoy symbol shown on charts indicates the approximate position of the sinker which secures the buoy to the seabed. The approximate position is used because of practical limitations in keeping buoys in precise geographical locations. These limitations include prevailing atmospheric and sea conditions, the slope and type of material making up the seabed, the scope of the

mooring chain, and the fact that the positions of the buoys and the sinkers are not under continuous surveillance. The position of the buoy shifts around the area shown by the chart symbol due to the forces of wind and current.

A buoy may not be in its charted position because of changes in the feature it marks. For example, a buoy meant to mark a shoal whose boundaries are shifting might frequently be moved to mark the shoal accurately. A *Local Notice to Mariners* will report the change, and a *Notice to Mariners* chart correction may also be written. In some small channels which change often, buoys are not charted even when considered permanent; local knowledge is advised in such areas.

For these reasons, a mariner must not rely completely upon the position or operation of buoys, but should navigate using bearings of charted features, structures, and aids to navigation on shore. Further, a vessel attempting to pass too close aboard a buoy risks a collision with the buoy or the obstruction it marks.

BUOYAGE SYSTEMS

516. Lateral and Cardinal Systems

There are two major types of buoyage systems: the **lateral system** and the **cardinal system**. The lateral system is best suited for well-defined channels. The description of each buoy indicates the direction of danger relative to the course which is normally followed. In principle, the positions of marks in the lateral system are determined by the **general direction** taken by the mariner when approaching port from seaward. These positions may also be determined with reference to the main stream of flood current. The United States Aids to Navigation System is a lateral system.

The cardinal system is best suited for coasts with numerous isolated rocks, shoals, and islands, and for dangers in the open sea. The characteristic of each buoy indicates the approximate true bearing of the danger it marks. Thus, an eastern quadrant buoy marks a danger which lies to the west of the buoy. The following pages diagram the cardinal and lateral buoyage systems as found outside the United States.

517. The IALA Maritime Buoyage System

Although most of the major maritime nations have used either the lateral or the cardinal system for many years, details such as the buoy shapes and colors have varied from country to country. With the increase in maritime commerce between countries, the need for a uniform system of buoyage became apparent.

In 1889, an International Marine Conference held in Washington, D.C., recommended that in the lateral system, starboard hand buoys be painted red and port hand buoys black. Unfortunately, when lights for buoys were introduced some years later, some European countries placed red lights on the black port hand buoys to conform with the red lights marking the port side of harbor entrances, while in North America red lights were placed on red starboard hand buoys. In 1936, a League of Nations subcommittee recommended a coloring system opposite to the 1889 proposal.

The **International Association of Lighthouse Authorities (IALA)** is a non-governmental organization which consists of representatives of the worldwide community of aids to navigation services. It promotes information exchange and recommends improvements based on new technologies. In 1980, with the assistance of IMO and the IHO, the lighthouse authorities from 50 countries and representatives of 9 international organizations concerned with aids to navigation met and adopted the **IALA Maritime Buoyage System**. They established two regions, **Region A** and **Region B**, for the entire world. Region A roughly corresponds to the 1936 League of Nations system, and Region B to the older 1889 system.

Lateral marks differ between Regions A and B. Lateral marks in Region A use red and green colors by day and night to indicate port and starboard sides of channels, respectively. In Region B, these colors are reversed with red to starboard and green to port. In both systems, the conventional direction of buoyage is considered to be returning from sea, hence the phrase “red right returning” in IALA region B.

518. Types of Marks

The **IALA Maritime Buoyage System** applies to all fixed and floating marks, other than lighthouses, sector lights, range lights, daymarks, lightships and large navigational buoys, which indicate:

1. The side and center-lines of navigable channels
2. Natural dangers, wrecks, and other obstructions
3. Regulated navigation areas
4. Other important features

Most lighted and unlighted beacons other than range marks are included in the system. In general, beacon topmarks will have the same shape and colors as those used on buoys. The system provides five types of marks which may be used in any combination:

1. Lateral marks indicate port and starboard sides of channels.
2. Cardinal marks, named according to the four points of the compass, indicate that the navigable water lies to the named side of the mark.
3. Isolated danger marks erected on, or moored directly on or over, dangers of limited extent.
4. Safe water marks, such as midchannel buoys.

5. Special marks, the purpose of which is apparent from reference to the chart or other nautical documents.

Characteristics of Marks

The significance of a mark depends on one or more features:

1. By day—color, shape, and topmark
2. By night—light color and phase characteristics

Colors of Marks

The colors red and green are reserved for lateral marks, and yellow for special marks. The other types of marks have black and yellow or black and red horizontal bands, or red and white vertical stripes.

Shapes of Marks

There are five basic buoy shapes:
1. Can
2. Cone
3. Sphere
4. Pillar
5. Spar

In the case of can, conical, and spherical, the shapes have lateral significance because the shape indicates the correct side to pass. With pillar and spar buoys, the shape has no special significance.

The term "pillar" is used to describe any buoy which is smaller than a large navigation buoy (LNB) and which has a tall, central structure on a broad base; it includes beacon buoys, high focal plane buoys, and others (except spar buoys) whose body shape does not indicate the correct side to pass.

Topmarks

The IALA System makes use of **can, conical, spherical,** and **X-shaped** topmarks only. Topmarks on pillar and spar buoys are particularly important and will be used wherever practicable, but ice or other severe conditions may occasionally prevent their use.

Colors of Lights

Where marks are lighted, red and green lights are reserved for lateral marks, and yellow for special marks. The other types of marks have a white light, distinguished one from another by phase characteristic.

Phase Characteristics of Lights

Red and green lights may have any phase characteristic, as the color alone is sufficient to show on which side they should be passed. Special marks, when lighted, have a yellow light with any phase characteristic not reserved for white lights of the system. The other types of marks have clearly specified phase characteristics of white light: various quick-flashing phase characteristics for cardinal marks, group flashing (2) for isolated danger marks, and relatively long periods of light for safe water marks.

Some shore lights specifically excluded from the IALA System may coincidentally have characteristics corresponding to those approved for use with the new marks. Care is needed to ensure that such lights are not misinterpreted.

519. IALA Lateral Marks

Lateral marks are generally used for well-defined channels; they indicate the port and starboard hand sides of the route to be followed, and are used in conjunction with a **conventional direction of buoyage**.

This direction is defined in one of two ways:

1. **Local direction of buoyage** is the direction taken by the mariner when approaching a harbor, river estuary, or other waterway from seaward.
2. **General direction of buoyage** is determined by the buoyage authorities, following a clockwise direction around continental land-masses, given in sailing directions, and, if necessary, indicated on charts by a large open arrow symbol.

In some places, particularly straits open at both ends, the local direction of buoyage may be overridden by the general direction.

Along the coasts of the United States, the characteristics assume that proceeding "from seaward" constitutes a clockwise direction: a southerly direction along the Atlantic coast, a westerly direction along the Gulf of Mexico coast, and a northerly direction along the Pacific coast. On the Great Lakes, a westerly and northerly direction is taken as being "from seaward" (except on Lake Michigan, where a southerly direction is used). On the Mississippi and Ohio Rivers and their tributaries, the characteristics of aids to navigation are determined as proceeding from sea toward the head of navigation. On the Intracoastal Waterway, proceeding in a generally southerly direction along the Atlantic coast, and in a generally westerly direction along the gulf coast, is considered as proceeding "from seaward."

520. IALA Cardinal Marks

A **cardinal mark** is used in conjunction with the compass to indicate where the mariner may find the best navigable water. It is placed in one of the four quadrants (north, east, south, and west), bounded by the true bearings

NW-NE, NE-SE, SE-SW, and SW-NW, taken from the point of interest. A cardinal mark takes its name from the quadrant *in which it is placed*.

The mariner is safe if he passes north of a north mark, east of an east mark, south of a south mark, and west of a west mark.

A cardinal mark may be used to:

1. Indicate that the deepest water in an area is on the named side of the mark.
2. Indicate the safe side on which to pass a danger.
3. Emphasize a feature in a channel, such as a bend, junction, bifurcation, or end of a shoal.

Topmarks

Black double-cone topmarks are the most important feature, by day, of cardinal marks. The cones are vertically placed, one over the other. The arrangement of the cones is very logical: North is two cones with their points up (as in "north-up"). South is two cones, points down. East is two cones with bases together, and west is two cones with points together, which gives a wineglass shape. "West is a Wineglass" is a memory aid.

Cardinal marks carry topmarks whenever practicable, with the cones as large as possible and clearly separated.

Colors

Black and yellow horizontal bands are used to color a cardinal mark. The position of the black band, or bands, is related to the points of the black topmarks.

N	Points up	Black above yellow
S	Points down	Black below yellow
W	Points together	Black, yellow above and below
E	Points apart	Yellow, black above and below

Shape

The shape of a cardinal mark is not significant, but buoys must be pillars or spars.

Lights

When lighted, a cardinal mark exhibits a white light; its characteristics are based on a group of quick or very quick flashes which distinguish it as a cardinal mark and indicate its quadrant. The distinguishing quick or very quick flashes are:

North—Uninterrupted
East—three flashes in a group
South—six flashes in a group followed by a long flash
West—nine flashes in a group

As a memory aid, the number of flashes in each group can be associated with a clock face: 3 o'clock—E, 6 o'clock—S, and 9 o'clock—W.

The long flash (of not less than 2 seconds duration), immediately following the group of flashes of a south cardinal mark, is to ensure that its six flashes cannot be mistaken for three or nine.

The periods of the east, south, and west lights are, respectively, 10, 15, and 15 seconds if quick flashing; and 5, 10, and 10 seconds if very quick flashing.

Quick flashing lights flash at a rate between 50 and 79 flashes per minute, usually either 50 or 60. Very quick flashing lights flash at a rate between 80 and 159 flashes per minute, usually either 100 or 120.

It is necessary to have a choice of quick flashing or very quick flashing lights in order to avoid confusion if, for example, two north buoys are placed near enough to each other for one to be mistaken for the other.

521. IALA Isolated Danger Marks

An **isolated danger mark** is erected on, or moored on or above, an isolated danger of limited extent which has navigable water all around it. The extent of the surrounding navigable water is immaterial; such a mark can, for example, indicate either a shoal which is well offshore or an islet separated by a narrow channel from the coast.

Position

On a chart, the position of a danger is the center of the symbol or sounding indicating that danger; an isolated danger buoy may therefore be slightly displaced from its geographic position to avoid overprinting the two symbols. The smaller the scale, the greater this offset will be. At very large scales the symbol may be correctly charted.

Topmark

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

Color

Black with one or more red horizontal bands are the colors used for isolated danger marks.

Shape

The shape of an isolated danger mark is not significant, but a buoy will be a pillar or a spar.

Light

When lighted, a white flashing light showing a group of two flashes is used to denote an isolated danger mark. As a memory aid, associate two flashes with two balls in the topmark.

522. IALA Safe Water Marks

A **safe water mark** is used to indicate that there is navigable water all around the mark. Such a mark may be used as a center line, mid-channel, or landfall buoy.

Color

Red and white vertical stripes are used for safe water marks, and distinguish them from the black-banded, danger-marking marks.

Shape

Spherical, pillar, or spar buoys may be used as safe water marks.

Topmark

A single red spherical topmark will be carried, whenever practicable, by a pillar or spar buoy used as a safe water mark.

Lights

When lighted, safe water marks exhibit a white light. This light can be occulting, isophase, a single long flash, or Morse "A." If a long flash (i.e. a flash of not less than 2 seconds) is used, the period of the light will be 10 seconds. As a memory aid, remember a single flash and a single sphere topmark.

523. IALA Special Marks

A **special mark** may be used to indicate a special area or feature which is apparent by referring to a chart, sailing directions, or notices to mariners. Uses include:

1. Ocean Data Acquisition System (ODAS) buoys
2. Traffic separation marks
3. Spoil ground marks
4. Military exercise zone marks
5. Cable or pipeline marks, including outfall pipes
6. 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 estuary, where the limits of the channel for normal navigation are marked by red and green lateral buoys, may have its boundaries or centerline marked by yellow buoys of the appropriate lateral shapes.

Color

Yellow is the color used for special marks.

Shape

The shape of a special mark is optional, but must not conflict with that used for a lateral or a safe water mark. For example, an outfall buoy on the port hand side of a channel could be can-shaped but not conical.

Topmark

When a topmark is carried it takes the form of a single yellow X.

Lights

When a light is exhibited it is yellow. It may show any phase characteristic except those used for the white lights of cardinal, isolated danger, and safe water marks. In the case of ODAS buoys, the phase characteristic used is group-flashing with a group of five flashes every 20 seconds.

524. IALA New Dangers

A newly discovered hazard to navigation not yet shown on charts, included in sailing directions, or announced by a *Notice to Mariners* is termed a **new danger**. The term covers naturally occurring and man-made obstructions.

Marking

A new danger is marked by one or more cardinal or lateral marks in accordance with the IALA system rules. If the danger is especially grave, at least one of the marks will be duplicated as soon as practicable by an identical mark until the danger has been sufficiently identified.

Lights

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

Racons

The duplicate mark may carry a Racon, Morse coded D, showing a signal length of 1 nautical mile on a radar display.

525. Chart Symbols and Abbreviations

Spar buoys and spindle buoys are represented by the same symbol; it is slanted to distinguish them from upright beacon symbols. The abbreviated description of the color of a buoy is given under the symbol. Where a buoy is colored in bands, the colors are indicated in sequence from the top. If the sequence of the bands is not known, or if the buoy is striped, the colors are indicated with the darker color first.

Topmarks

Topmark symbols are solid black except if the topmark is red.

Lights

The period of the light of a cardinal mark is determined by its quadrant and its flash characteristic (either quick-flashing or a very quick-flashing). The light's period is less important than its phase characteristic. Where space on charts is limited, the period may be omitted.

Light Flares

Magenta light-flares are normally slanted and inserted with their points adjacent to the position circles at the base of the symbols so the flare symbols do not obscure the topmark symbols.

Radar Reflectors

According to IALA rules, radar reflectors are not charted, for several reasons. First, all important buoys are fitted with radar reflectors. It is also necessary to reduce the size and complexity of buoy symbols and associated legends. Finally, it is understood that, in the case of cardinal buoys, buoyage authorities place the reflector so that it cannot be mistaken for a topmark.

The symbols and abbreviations of the IALA Maritime Buoyage System may be found in *U.S. Chart No. 1* and in foreign equivalents.

526. Description of the U.S. Aids to Navigation System

In the United States, the U.S. Coast Guard has incorporated the major features of the IALA system with the existing infrastructure of buoys and lights as explained below.

Colors

Under this system, green buoys mark a channel's port side and obstructions which must be passed by keeping the buoy on the port hand. Red buoys mark a channel's starboard side and obstructions which must be passed by keeping the buoy on the starboard hand.

Red and green horizontally banded **preferred channel buoys** mark junctions or bifurcations in a channel or obstructions which may be passed on either side. If the topmost band is green, the preferred channel will be followed by keeping the buoy on the port hand. If the topmost band is red, the preferred channel will be followed by keeping the buoy on the starboard hand.

Red and white vertically striped safe water buoys mark a fairway or mid-channel.

Reflective material is placed on buoys to assist in their detection at night with a searchlight. The color of the reflective material agrees with the buoy color. Red or green reflective material may be placed on preferred channel (junction) buoys; red if topmost band is red, or green if the topmost band is green. White reflective material is used on safe water buoys. Special purpose buoys display yellow reflective material. Warning or regulatory buoys display orange reflective horizontal bands and a warning symbol. Intracoastal Waterway buoys display a yellow reflective square, triangle, or horizontal strip along with the reflective material coincident with the buoy's function.

Shapes

Certain unlighted buoys are differentiated by shape. Red buoys and red and green horizontally banded buoys with the topmost band red are cone-shaped buoys called **nuns**. Green buoys and green and red horizontally banded buoys with the topmost band green are cylinder-shaped buoys called **cans**.

Unlighted red and white vertically striped buoys may be pillar shaped or spherical. Lighted buoys, sound buoys, and spar buoys are not differentiated by shape to indicate the side on which they should be passed. Their purpose is indicated not by shape but by the color, number, or light characteristics.

Numbers

All solid colored buoys are numbered, red buoys bearing even numbers and green buoys bearing odd numbers. (Note that this same rule applies in IALA System A also.) The numbers increase from seaward upstream or toward land. No other colored buoys are numbered; however, any buoy may have a letter for identification.

Light Colors

Red lights are used only on red buoys or red and green horizontally banded buoys with the topmost band red. Green lights are used only on the green buoys or green and red horizontally banded buoys with the topmost band green. White lights are used on both "safe water" aids showing a Morse Code "A" characteristic and on Information and Regulatory aids.

Light Characteristics

Lights on red buoys or green buoys, if not occulting

or isophase, will generally be regularly flashing (Fl). For ordinary purposes, the frequency of flashes will be not more than 50 flashes per minute. Lights with a distinct cautionary significance, such as at sharp turns or marking dangerous obstructions, will flash not less than 50 flashes but not more than 80 flashes per minute (quick flashing, Q). Lights on preferred channel buoys will show a series of group flashes with successive groups in a period having a different number of flashes - composite group flashing (or a quick light in which the sequence of flashes is interrupted by regularly repeated eclipses of constant and long duration). Lights on safe water buoys will always show a white Morse Code "A" (Short-Long) flash recurring at the rate of approximately eight times per minute.

Daylight Controls

Lighted buoys have a special device to energize the light when darkness falls and to de-energize the light when day breaks. These devices are not of equal sensitivity; therefore all lights do not come on or go off at the same time. Mariners should ensure correct identification of aids during twilight periods when some light aids to navigation are on while others are not.

Special Purpose Buoys

Buoys for special purposes are colored yellow. White buoys with orange bands are for informational or regulatory purposes. The shape of special purpose buoys has no significance. They are not numbered, but they may be lettered. If lighted, special purpose buoys display a yellow light usually with fixed or slow flash characteristics. Information and regulatory buoys, if lighted, display white lights.

BEACONS

527. Definition and Description

Beacons are fixed aids to navigation placed on shore or on pilings in relatively shallow water. If unlighted, the beacon is referred to as a **daybeacon**. A daybeacon is identified by the color, shape, and number of its **dayboard**. The simplest form of daybeacon consists of a single pile with a dayboard affixed at or near its top. See Figure 527. Daybeacons may be used to form an unlighted range.

. Dayboards identify aids to navigation against daylight backgrounds. The size of the dayboard required to make the aid conspicuous depends upon the aid's intended range.

Most dayboards also display numbers or letters for identification. The numbers, letters, and borders of most dayboards have reflective tape to make them visible at night.

The detection, recognition, and identification distances vary widely for any particular dayboard. They depend upon the luminance of the dayboard, the Sun's position, and the local visibility conditions.

Figure 527. Daybeacon.

SOUND SIGNALS

528. Types of Sound Signals

Most lighthouses and offshore light platforms, as well as some minor light structures and buoys, are equipped with sound-producing devices to help the mariner in periods of low visibility. Charts and *Light Lists* contain the information required for positive identification. Buoys fitted with bells, gongs, or whistles actuated by wave motion may produce no sound when the sea is calm. Sound signals are not designed to identify the buoy or beacon for navigation purposes. Rather, they allow the mariner to pass clear of the buoy or beacon during low visibility.

Sound signals vary. The navigator must use the *Light List* to determine the exact length of each blast and silent interval. The various types of sound signals also differ in tone, facilitating recognition of the respective stations.

Diaphones produce sound with a slotted piston moved back and forth by compressed air. Blasts may consist of a high and low tone. These alternate-pitch signals are called "two-tone." Diaphones are not used by the Coast Guard, but the mariner may find them on some private navigation aids.

Horns produce sound by means of a disc diaphragm operated pneumatically or electrically. Duplex or triplex horn units of differing pitch produce a chime signal.

Sirens produce sound with either a disc or a cup-

shaped rotor actuated electrically or pneumatically. Sirens are not used on U.S. navigation aids.

Whistles use compressed air emitted through a circumferential slot into a cylindrical bell chamber.

Bells and gongs are sounded with a mechanically operated hammer.

529. Limitations of Sound Signals

As aids to navigation, sound signals have serious limitations because sound travels through the air in an unpredictable manner.

It has been clearly established that:

1. Sound signals are heard at greatly varying distances and that the distance at which a sound signal can be heard may vary with the bearing and timing of the signal.
2. Under certain atmospheric conditions, when a sound signal has a combination high and low tone, it is not unusual for one of the tones to be inaudible. In the case of sirens, which produce a varying tone, portions of the signal may not be heard.
3. When the sound is screened by an obstruction, there are areas where it is inaudible.
4. Operators may not activate a remotely controlled sound aid for a condition unobserved from the controlling station.
5. Some sound signals cannot be immediately started.
6. The status of the vessel's engines and the location of the observer both affect the effective range of the aid.

These considerations justify the utmost caution when navigating near land in a fog. A navigator can never rely on sound signals alone; he should continuously man both the radar and fathometer. He should place lookouts in positions where the noises in the ship are least likely to interfere with hearing a sound signal. The aid upon which a sound signal rests is usually a good radar target, but collision with the aid or the danger it marks is always a possibility.

Emergency signals are sounded at some of the light and fog signal stations when the main and stand-by sound signals are inoperative. Some of these emergency sound signals are of a different type and characteristic than the main sound signal. The characteristics of the emergency sound signals are listed in the *Light List*.

The mariner should never assume:

1. That he is out of ordinary hearing distance because he fails to hear the sound signal.
2. That because he hears a sound signal faintly, he is far from it.
3. That because he hears it clearly, he is near it.
4. That the distance from and the intensity of a sound on any one occasion is a guide for any future occasion.
5. That the sound signal is not sounding because he does not hear it, even when in close proximity.
6. That the sound signal is in the direction the sound appears to come from.

MISCELLANEOUS U.S. SYSTEMS

530. Intracoastal Waterway Aids to Navigation

The Intracoastal Waterway (ICW) runs parallel to the Atlantic and Gulf of Mexico coasts from Manasquan Inlet on the New Jersey shore to the Texas/Mexican border. It follows rivers, sloughs, estuaries, tidal channels, and other natural waterways, connected with dredged channels where necessary. Some of the aids marking these waters are marked with yellow; otherwise, the marking of buoys and beacons follows the same system as that in other U.S. waterways.

Yellow symbols indicate that an aid marks the Intracoastal Waterway. Yellow triangles indicate starboard hand aids, and yellow squares indicate port hand aids when following the ICW's conventional direction of buoyage. Non-lateral aids such as safe water, isolated danger, and front range boards are marked with a horizontal yellow band. Rear range boards do not display the yellow band. At a junction with a federally-maintained waterway, the preferred channel mark will display a yellow triangle or square as appropriate. Junctions between the ICW and privately maintained waterways are not marked with preferred channel buoys.

531. Western Rivers System

Aids to navigation on the Mississippi River and its tributaries above Baton Rouge generally conform to the lateral system of buoyage in use in the rest of the U.S. The following differences are significant:

1. Buoys are not numbered.
2. The numbers on lights and daybeacons do not have lateral significance; they indicate the mileage from a designated point, normally the river mouth.
3. Flashing lights on the left side proceeding upstream show single green or white flashes while those on the right side show group flashing red or white flashes.
4. Diamond shaped crossing daymarks are used to indicate where the channel crosses from one side of the river to the other.

532. The Uniform State Waterway Marking System (USWMS)

This system was developed jointly by the U.S. Coast Guard and state boating administrators to assist the small craft operator in those state waters marked by participating states. The **USWMS** consists of two categories of aids to navigation. The first is a system of aids to navigation, generally compatible with the Federal lateral system of buoyage, supplementing the federal system in state waters. The other is a system of regulatory markers to warn small craft operators of dangers or to provide general information.

On a well-defined channel, red and black buoys are established in pairs called **gates**; the channel lies between the buoys. The buoy which marks the left side of the channel viewed looking upstream or toward the head of navigation is black; the buoy which marks the right side of the channel is red.

In an irregularly-defined channel, buoys may be staggered on alternate sides of the channel, but they are spaced at sufficiently close intervals to mark clearly the channel lying between them.

Where there is no well-defined channel or where a body of water is obstructed by objects whose nature or location is such that the obstruction can be approached by a vessel from more than one direction, aids to navigation having cardinal significance may be used. The aids conforming to the cardinal system consist of three distinctly colored buoys as follows:

1. A white buoy with a red top must be passed to the south or west of the buoy.
2. A white buoy with a black top must be passed to the north or east of the buoy.
3. A buoy showing alternate vertical red and white stripes indicates that an obstruction to navigation extends from the nearest shore to the buoy and that the vessel must not pass between the buoy and the nearest shore.

The shape of buoys has no significance under the USWMS.

Regulatory buoys are colored white with orange horizontal bands completely around them. One band is at the top of the buoy and a second band just above the waterline of the buoy so that both orange bands are clearly visible.

Geometric shapes colored orange are placed on the white portion of the buoy body. The authorized geometric shapes and meanings associated with them are as follows:

1. A vertical open faced diamond shape means danger.
2. A vertical open faced diamond shape with a cross centered in the diamond means that vessels are excluded from the marked area.
3. A circular shape means that vessels in the marked area are subject to certain operating restrictions.
4. A square or rectangular shape indicates that directions or information is written inside the shape.

Regulatory markers consist of square and rectangular shaped signs displayed from fixed structures. Each sign is white with an orange border. Geometric shapes with the same meanings as those displayed on buoys are centered on the sign boards. The geometric shape displayed on a regulatory marker tells the mariner if he should stay well clear of the marker or if he may approach the marker in order to read directions.

533. Private Aids to Navigation

A **private navigation aid** is any aid established and maintained by entities other than the Coast Guard.

The Coast Guard must approve the placement of private navigation aids. In addition, the District Engineer, U.S. Army Corps of Engineers, must approve the placement of any structure, including aids to navigation, in the navigable waters of the U.S.

Private aids to navigation are similar to the aids established and maintained by the U.S. Coast Guard; they are specially designated on the chart and in the *Light List*. In some cases, particularly on large commercial structures, the aids are the same type of equipment used by the Coast Guard. Although the Coast Guard periodically inspects some private navigation aids, the mariner should exercise special caution when using them.

In addition to private aids to navigation, numerous types of construction and anchor buoys are used in various oil drilling operations and marine construction. These buoys are not charted, as they are temporary, and may not be lighted well or at all. Mariners should give a wide berth to drilling and construction sites to avoid the possibility of fouling moorings. This is a particular danger in offshore oil fields, where large anchors are often used to stabilize the positions of drill rigs in deep water. Up to eight anchors may be placed at various positions as much as a mile from the drill ship. These positions may or may not be marked by buoys. Such operations in the U.S. are announced in the *Local Notice to Mariners*.

534. Protection by Law

It is unlawful to impair the usefulness of any navigation aid established and maintained by the United States. If any vessel collides with a navigation aid, it is the legal duty of the person in charge of the vessel to report the accident to the nearest U.S. Coast Guard station.