

# CHAPTER 7

## SHORT RANGE AIDS TO NAVIGATION

### DEFINING SHORT RANGE AIDS TO NAVIGATION

#### 700. Terms and Definitions

A short range/visual Aids to Navigation (ATON) system is a series of interacting external reference devices intended to collectively provide sufficient and timely information with which to safely navigate within and through a waterway when used in conjunction with updated nautical charts. The system includes all navigational devices within visual, audio, or radar range of the mariner. Specifically, these aids to navigation encompass buoys (lighted and unlighted), beacons (lighthouses, lights, ranges, leading lights and daybeacons), sound signals, Radar Beacons (RACON) and Automatic Identification System - Aids to Navigation (AIS-ATON). See Section 2311 (Aids to Radar Navigation) for more information on RACONs. See Section 3024 for more information on AIS-ATON.

This chapter describes the U.S. Aids to Navigation

System (USATONS) as well as the International Association of Marine Aids to Navigation and Lighthouse Authorities (IALA) Maritime Buoyage System (MBS).

Except for minor differences in the U.S. Intracoastal Waterway and Western Rivers (Mississippi River) System, the USATONS is predominately a **lateral** system consistent with Region B requirements of the IALA MBS (Region A for U.S. possessions west of the International Date Line and south of 10 degrees north latitude).

The United States Coast Guard is responsible for establishing, maintaining, and operating marine aids to navigation in the navigable waters of the United States, its territories, and possessions. As such the Coast Guard establishes, maintains and operates lighted and unlighted buoys and beacons (lighthouses, lights, ranges, leading lights and daybeacons), sound signals, AIS-ATON and RACONs. In Addition, the Coast Guard has administrative control over privately owned navigation aids to navigation systems.

### BUOYS

#### 701. Definitions and Types

**Buoys** are floating aids to navigation, anchored at specific locations via chain or synthetic line attached to concrete or cast-steel sinkers. They are used to mark channel limits, indicate isolated dangers, shoals, and obstructions, and to warn the mariner of hazards or dangers. Buoys are typically deployed in locations where beacons would be impractical or cost-prohibited due to waterway geographic configuration and/or environmental conditions, such as water depth, prevailing wind direction and fetch, current, etc. The color, shape, number, topmark, light, and sound characteristics of buoys provide specific marine safety information to mariners.

Buoys are constructed of resilient materials such as non-ferrous steel or plastics such as ionomer polymer plastics (or combination), having structures designed to meet specific environmental factors and purpose. They are classified either lighted or unlighted; either of which can be augmented with sound signals. Unlighted and smaller lighted buoys are shape significant, indicating the type of **mark** the buoy is portraying. There are many different buoy sizes, each designed to meet specific environmental conditions, mariner need, and signal requirements. Larger

buoys are typically used in off-shore and coastal environments, while smaller buoys are deployed in less exposed settings such as inshore and inland waterways.

**Lighted buoys** are configured with three general components - the buoy hull, which rides above and below the sea surface; the counterweight, which is completely below the water surface and is designed to keep the buoy upright; and the buoy superstructure - also known as the buoy cage (see Figure 701a). Most lighted buoys are referred to as Pillar Buoys, because their superstructure is affixed to a broader circular base, i.e. the buoy hull. Lighted buoy hulls and superstructures can also be constructed with non-ferrous materials, such as ionomer foam, attached to a steel counterweight. Most lighted buoys deployed by the Coast Guard are equipped with Light Emitting Diodes (LED) lanterns, many of which contain the power system and LED within the lantern housing and are referred to as self-contained LED lanterns. Batteries for lighted buoys without self-contained LED lanterns are secured in watertight pockets in the buoy hull or in watertight boxes mounted on the buoy hull. All lighted buoys are equipped with some form of enhanced radar reflector built into or attached to the buoy superstructure. See Figure 701b.

The largest of the U.S. Coast Guard lighted buoys has



Figure 701a. Buoy with counterweight showing.



Figure 701b. Small lighted buoy.

a focal plane of 20+ feet, a radar and nominal visual range of 4 and 3.2 nautical miles respectively in calm seas and clear visibility, and can be moored using conventional buoy chain in depths up to 190 feet of water; greater water depths when moored with synthetic line.

**Unlighted buoys** are typically classified by their shape (can, nun, or special purpose). The range in size from a 1st class steel buoy weighing 6,000 pounds with a 5-3/4 foot freeboard to small plastic and ionomer foam buoys, weighing 65 pounds with a one foot freeboard. See Figure 701c and Figure 701d.



Figure 701c. Can buoy.



Figure 701d. Nun buoy.

A variety of **special purpose buoys** are owned by other governmental organizations, such as the St. Lawrence

Seaway Development Corporation (SLDC), National Oceanic and Atmospheric Administration (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 an **allision**, 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.

### 702. Buoy Moorings

Navigation buoys require moorings to hold them in position. Typically the mooring consists of chain and a large concrete or cast steel sinker. Because buoys are subjected to waves, wind and tides, the moorings must be deployed with chain lengths several times greater than the water depth, referred to as the scope of chain, typically 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 around its sinker. This is the reason charted buoy symbols have a “position approximate” circle to indicate its assigned 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. The below formula is used to calculate the buoy watch circle:

$$\text{Watch Circle Radius} = \sqrt{\text{Water Depth}^2 + \text{Chain Length}^2}$$

Buoys are assigned to specific geographic positions calculated to within a thousandth of a second, known as the assigned position (AP). The Coast Guard employs the Global Positioning System (GPS) and other methods to place a buoy as close to the AP as reasonably possible and to verify that it is anchored within positioning tolerances. However, placing a buoy at a specific geographic location is secondary to ensuring that the actual location of the buoy best marks the waterway and serves the purpose for which it was intended. Also, a buoy's AP actually indicates the assigned position of the buoy's sinker, which coupled with the buoy's watch circle results in the buoy rarely positioned at its exact assigned position.

### 703. Lights on Buoys

As mentioned in Section 701, buoy light signals in the USATONS, with rare exception, are exhibited with LEDs. They are powered with secondary lead-acid or similar batteries slow-charged via solar panels. The power config-

uration is designed to accommodate the specific light characteristic and intensity settings for specific geographic locations. For example, a buoy light in Florida, because of greater year-round sunlight, requires a smaller solar power configuration than a buoy light with the same characteristic in Alaska.

### 704. Audible Signals on Buoys

**Sound buoys** whether lighted or unlighted are configured much the same as lighted buoys. They can be outfitted with either a bell, gong, whistle, or electronic horn. All but the electronic horn produce sound from the buoy movement as influenced by the restless motion of the sea. Electronic horns, rare on buoys, are powered via electricity produced by batteries. Since bell, gong, and whistle buoys depend on the motion of the sea to produce the sound signal, these types of buoys are deployed in exposed and semi-exposed locations. Horn buoys are deployed in protected and semi-protected locations.

The buoy **bell** is externally mounted on a heavy steel flange, which is permanently affixed to the top center of the buoy hull. The bell produces sound when its struck by one of four (4) tappers that are affixed to the buoy cage and swing freely with the buoy motion. Bells employed by the Coast Guard come in 85 and 225 pound sizes. Gongs are similarly mounted as bells but in sets of three gongs. Each of which gives a distinct tone when struck by the tapper. The three tappers, each of different length to accommodate the gong position, are attached to the buoy cage in the same way as the bell tappers.



Figure 704. Lighted bell buoy.

**Whistle** buoys make a loud moaning sound as the buoy rises and falls in the sea swells. As the buoy raises air is



drawn into the hollow counterweight tube, which as the buoy falls with the swell is forced through the whistle valve mounted atop the buoy hull emitting the lonely mournful sound of the whistle buoy. Electronic horns are suspended from one of the buoy superstructure cross-members and are powered via a solar panel charged battery power configuration.

Audible signals are intended to provide marine safety information during periods of restricted visibility. Due to the inability of the human ear to accurately judge the direction of a sound source, they are only used to warn mariners of the proximity of a hazard or obstruction. Therefore, although sound signals are valuable, mariners should NOT exclusively rely on them to navigate.

### 705. Western Rivers Buoys

Buoys used to mark the Mississippi River System are primarily unlighted and are consistent with the following variables:

1. Can buoys are a slightly darker shade of green to improve conspicuity.
2. Unlighted buoys are not numbered.
3. Western River Buoys are not assigned positions.
4. Western River Buoys are not listed in the Light List.

Due to continuously shifting shoals and water levels, unlighted buoys in the Western Rivers are frequently moved to best mark the waterway. The Coast Guard provides buoy positions to the U.S. Army Corps of Engineers periodically, which in turn provides a buoy layer for their Inland Electronic Charts. The few lighted buoys deployed in the Western Rivers are consistent with IALA Region B without revision. See Figure 705 for an image of a Coast Guard River Buoy Tender.

### 706. Seasonal Buoys

Many lighted buoy are deployed regions that are subject to severe winter icing conditions; namely the U.S East Coast (north of the Chesapeake Bay Entrance), the Great Lakes, and section of Alaska. Ice can cause significant damage to lighted buoys. For example, moving ice can temporarily cause a buoy to heel over, submerge, and/or drag off station, destroying its light signal equipment in the process. Submerged and off-station buoys often pose a hazard to navigation. Figure 706 depicts the USCG recovering an iced damaged buoy.

To mitigate this risk, the Coast Guard replaces many lighted buoys with either unlighted buoys or specially constructed lighted buoys that are better able to survive winter ice conditions. These lighted ice buoys do not meet the same operational characteristics as the “approved lighted buoys they replace, so they’re replaced again in the spring with authorized lighted buoys. The specific seasonal buoy



Figure 705. USCG river buoy tender.



Figure 706. USCG recovering ice damaged buoys.

relief schedules are contained in the applicable Light Lists (column 8).

### 707. Buoys Marking Wrecks

Buoys used to mark wrecks typically are not placed directly over the wreck it is intended to mark for two primary reasons: First, Coast Guard ATON maintenance

units could be hazarded while approaching to perform maintenance on the buoy, especially when the buoy marks a shallow wreck. Secondly, there is a risk for buoy moorings to foul on the wreck. Therefore, a wreck buoy is usually placed as closely as possible on the seaward or channel ward side of a wreck.

In some situations more than one buoy may be deployed to mark a wreck to avoid possible confusion as to the actual location of the wreck. The *Local Notice to Mariners* should be consulted concerning details regarding the placement of wreck buoys on individual wrecks. The Notice will often define the particulars of the wreck and activities that may be in progress to clear the waterway of the wreck. Sunken wrecks may also move away from the wreck buoy(s) by storms, currents, freshets, or other causes.

Wreck buoys are required to be placed by the owner of the wreck, but they may be placed by the Coast Guard when the owner cannot comply with this requirement. Generally, privately owned aids to navigation are not as reliable as Coast Guard maintained aids to navigation.

Unless a waiver is granted by the responsible Coast Guard District Commander, buoys marking wrecks are required to be lighted and must conform to the U.S. buoyage marking system. They are also required to be marked with the letters "WR" before the buoy lateral number.

The charted depiction of wreck buoys are normally offset from the buoy's actual assigned position so that wreck and buoy symbols do not overlap. Only on the largest scale chart will the assigned position be actually depicted on the chart.

### 708. Large Navigational Buoys

**Large Navigational Buoys (LNB)**, referred to as Large Automated Navigation Buoys (LANBY) by some international aids to navigation authorities, are major floating aids to navigation sometimes deployed in international waters. They may carry one or more RACON, AIS-ATON, sound, light, and in some cases radio beacon signals. The U. S. Coast Guard no longer deploys these buoys.

### 709. Buoy Maintenance

With the exception of private aids to navigation and certain U.S. Armed Forces maintained ATON, the Coast Guard is responsible for maintaining the buoys and beacons of the USATONS.

Scheduled unit level or on-scene maintenance of buoys consists of inspecting and replacing if necessary the buoy numbers and reflective tape, light, power, sound, and buoy mooring components. Actions may include cleaning, inspecting, and repairing as necessary the buoy hull, superstructure and counterweight, and verifying that the buoy is within tolerance of its assigned position or that it best marks the waterway and serves the purpose for which



Figure 709. USCG removing marine growth from a buoy.

Periodically, buoys are relieved with a buoy of equivalent type and removed from its AP to undergo depot level maintenance at a Coast Guard or Commercial facility.

Unscheduled maintenance is performed whenever a buoy is discrepant, i.e. not exhibiting the proper characteristics as advertised in the appropriate volume of the Light List.

### 710. Buoy Limitations

Even though the Coast Guard operates a multi-layered ATON maintenance scheme, buoys cannot be relied on to maintain their precise assigned positions permanently or to display their advertised signal characteristics. Buoys are subjected to a variety of hazards including severe weather, equipment failures, mooring casualties, and allisions. Even in clear weather there is a risk of vessels alliding with a buoy. If struck head-on, a large buoy can inflict severe damage to a vessel, and can sink smaller vessels.

Reduced visibility caused by weather, smoke, or exten-

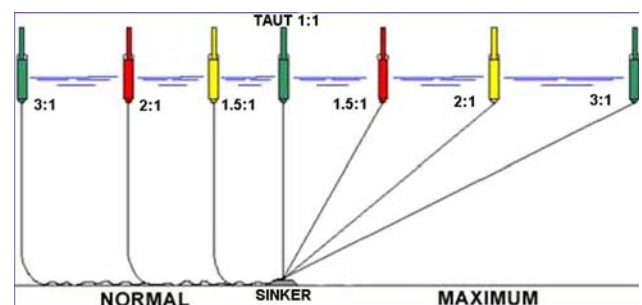


Figure 710. Watch circle radius.

sive background lighting can increase the risks of alliding with a buoy. Many buoys that reported as missing to the Coast Guard were actually run over and sunk. Tugs and towboats towing or pushing barges run a higher risk of al-

liding with buoys, especially in moderate or rough sea conditions. Mariner must report any allision with a buoy to the nearest Coast Guard unit. Failure to do so may cause the next vessel to miss a channel or hit an obstruction marked by a buoy; it can also lead to fines and legal liability.

Buoy symbols depicted on charts indicate the approximate position of the sinker which secures the buoy to the seabed. As mentioned in Section 702, the buoy is always

moving and is rarely directly over its sinker (see Figure 710). Therefore, buoys should never be used for precision navigation. Nor should they be passed close aboard, as doing so risks allision with a yawing buoy or possibly striking the obstruction that the buoy marks.

To ensure the most accurate aids to navigation system, mariners are urged to report discrepancies to the appropriate Coast Guard authority.

## BEACONS

### 711. Definition and Description

A **beacon** is a stationary, short range visual aid to navigation that is fixed to terra firma or the seabed via a foundation, as such they are often referred to as **fixed aids** to navigation. They are lighted, unlighted, or audible. They range in size, type, and signal capability from large lighthouses to single-pile **daybeacons** to onshore sound signals. Beacon types include: Lighthouses, lights, ranges, leading lights, daybeacons, sound signals, RACONs and AIS-ATON.

### 712. Major and Minor Lights

Operationally, lighthouses and lights are classified as either **major** or **minor** lights. A **major light** displays a high-intensity light signal with a nominal range of at least 10-nautical miles (statute miles on the Great Lakes). They can have lateral significance but are typically used as primary seacoast, coastal navigation, or harbor entrance lights, and are rarely assigned to a lateral system. **Minor lights** display lower intensity light signals with nominal ranges of less than 10-nautical miles (statute miles on the Great Lakes). They are established in harbors, along channels, waterways, and rivers. They are typically assigned a numbering, coloring, and light scheme consistent with the appropriate lateral buoyage system.

Both major and minor lights display their light signal from a variety of ATON structures, which must have sufficient height to meet its advertised nominal range. As such major lights are necessarily supported by fairly substantial structures.

Most active lighthouses display a light signal consistent with major lights. They operate automatically, i.e. unmanned. Some major light are equipped with backup lights of lower intensity that are automatically energized should there be a causality to the main light. There are many different light optic options for major lights, depending on the operational range requirement of the light signal, atmospheric clarity, background lighting, and other limitations. As LED technology improves, the Coast Guard is converting many of its major lights to LED optics. Few major lights still operate with a classical Fresnel-type lens. Since nearly every lighthouse is unique, the day signal for most major lights is the light structure itself. Offshore major lights



*Figure 712. Typical Major Light.*

should be given a wide berth, sea room permitting. Figure 712 depicts a typical major light.

Minor light structures are usually not as substantial as major light structures. In fact many minor ATON lights consist of a single wood or steel pile driven into the seabed, with a self-contained LED, and the appropriate day signal.

### 713. Range Lights

A range consists of two or more beacons so positioned with respect to each other that when seen aligned they mark a line of definite bearing, the **range line** commonly delineating the centerline of a navigation channel. These aids to navigation are typically affixed with dual-colored vertically striped **dayboards** for alignment during daylight hours and if lighted, exhibit lighted signals during periods of darkness. Some ranges



exhibit a light signal 24-hours a day, which may or may not be equipped with dayboards. The rear range is designed and constructed so that it is higher than the front range to enable mariners to align the ranges; the rear range light will always be above the front light for the height of eye of the vessels transiting the range line. The International Association of Marine Aids to Navigation and Lighthouse Authorities (IALA) refers to ranges as Leading Lines. Figure 713 illustrates the mariner's observation of range markers from three separate aspects when transiting the Range Line: 1. Left of Range Line; 2. On the Range Line; and 3. Right of Range Line.

**Range lights** provide horizontal vessel positioning insight to mariners transiting the Range Line by vertically displaying white, red, green or yellow lights (rear light above and behind the forward light). The color is selected that presents the most conspicuous and least confusing signal to the mariner. Most range lights display a very narrow light beam of high intensity focused down the range line, hence the brilliance of the light signal decreases significantly when observed just a few degrees either side of the range line. The specific arc of high intensity for range lights can be found in Column 8 of the applicable Light List.

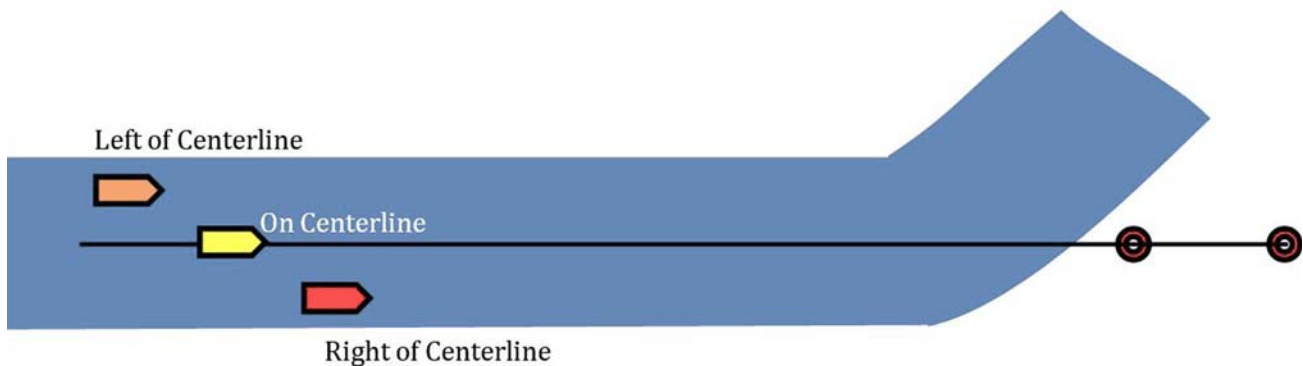
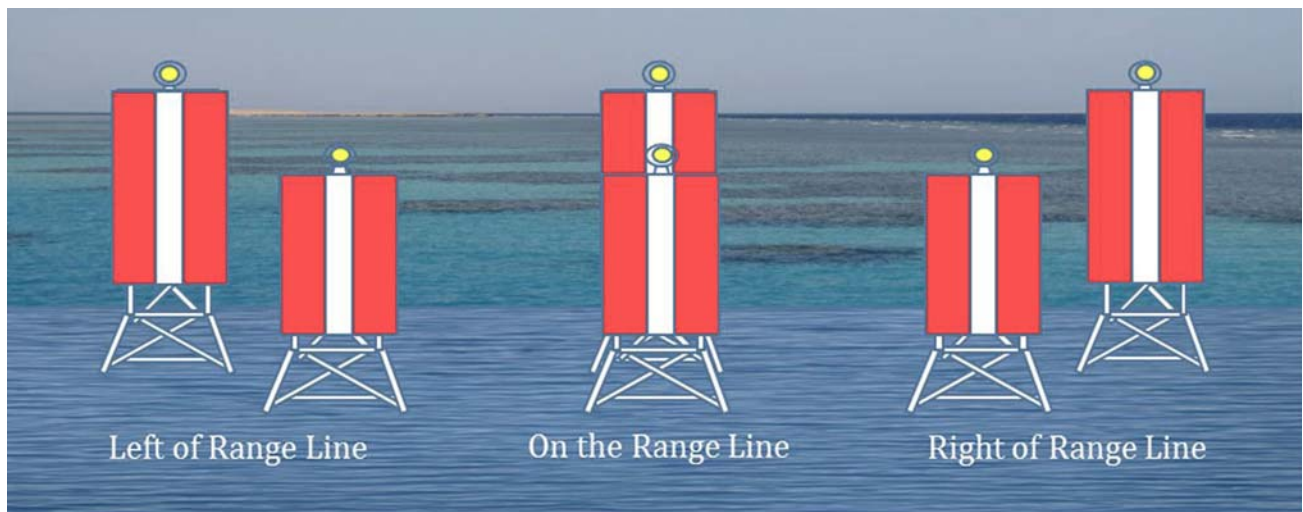


Figure 713. Example of Range Light aspects.

While range lights are conspicuous to mariners traversing the channel for which they mark, Range structures located in adjacent navigable waters can pose a hazard to navigation. Therefore, marine range structures are typically augmented with additional or passing lights to alert mariners as to the location of the range structure.

**Additional lights** are not readily recognizable to the mariner. They mark range structures whose light have a focal plane of 40 feet or lower. Additional lights are typically mounted above the range light optic and have the same color and light characteristic as the front range light. **Passing Lights** mark ranges whose focal plane is taller than

40 feet. They are mounted closer to the water surface, typically exhibit a white light and display light characteristics different from the rear range light. Passing lights are listed separately in the Light List and as such have a separate Light List number.

#### 714. Directional Lights - Port Entry Lights

**Directional Lights** are also known as Port Entry Lights (PEL). *IALA refers to these types of lights as Sector Lights. However, the term Sector Lights in the USATONS has a distinctively different meaning - see Section 719.*

They are comprised of a single light source fitted with a very sophisticated lens that projects three or more narrow high intensity light arcs of different colors, relative to a predetermined bearing line, typically a channel centerline. Newer directional lights also include distinct light characteristics, such as flashing sectors that are readily recognizable to the observer as they move to either side away from the bearing line.

Directional lights, although usually not as sensitive as a two station range, are invaluable aids to navigation employed in those locations where establishing a two station range is impractical. They are most effective for short channel segments. Figure 714 presents an example of a three color directional light.

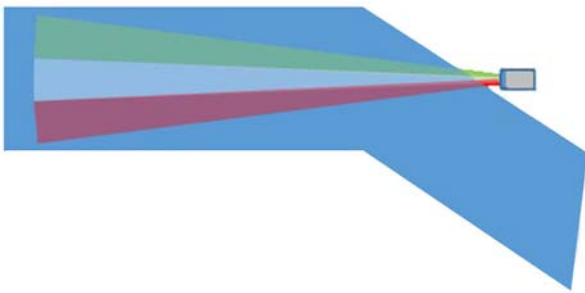


Figure 714. Example of a three color directional light.

### 715. Unlighted Beacons - Daybeacons

A daybeacon is identified by the color, shape, and lateral number. The simplest form of daybeacon consists of a single pile with a dayboard affixed at or near its top (see Figure 715). Daybeacons may be used to form an unlighted range.

Dayboards are affixed to all daybeacons and to most minor lights. They are shape-significant and usually have numbers and/or letters affixed to identify the specific aid to navigation. Retro-reflective background, edges, and numbers assist their identification at night when illuminated by an external light source, such as a vessel search light. Dayboard size, along with atmospheric visibility, will determine the range at which a dayboard can be detected and properly identified.

### 716. Aeronautical Lights

**Aeronautical lights** (also referred to as Aero beacons) may be the first lights observed at night when approaching the coast, they are intended primarily for aircraft navigation.

Those situated near the coast and visible from sea are listed in the *List of Lights* but are not listed in the Coast Guard Light Lists. They usually flash alternating white and green. Aeronautical lights are sequenced geographically in the *List of Lights*. However, since they are not maintained



Figure 715. Unlighted beacon.

for marine navigation, they are subject to changes, as such the Coast Guard may not be informed of the changes. However, they will be published in *Notice to Airmen*.

### 717. Bridge Lights

Navigational lights on bridges in the U.S. are prescribed by the Coast Guard consistent with the U.S. Code and the U.S. Code of Federal Regulations (CFR). Lighting requirements vary depending on the type of bridge structure.

**Fixed Bridges** - Each span over a navigable waterway is required to have two green range lights with a fixed characteristic that mark the center of the navigable waterway or channel. The bridge piers are required to be lighted with fixed red lights. Per 33 CFR 118.100, some lighting schemes on fixed bridges may be consistent with the waterway's lateral ATON system.

**Swing bridges** when closed are required to display three fixed red lights, one at the center of the span and one on each end of the span. When the span is open, the lights are to show fixed green in line with the horizontal axis of the bridge, so as two green lights can be seen from either direction. Bridge piers display lights similar to those for fixed bridges. **Bascule bridges**, single or double span, are required to display fixed red lights at the end of the span(s) when lifted. Once the span is completely open - fixed green lights are displayed. Bridge piers display lights similar to those for fixed bridges. The lighting requirements for **lift bridges** are similar to bascule bridges. A fixed red light is displayed at the center of the span when it is down and a fixed green light is displayed when the span is completely



open.

Refer to the U.S. Coast Guard Office of Bridge Administration pamphlet *Bridge Lighting and Other Signals* for graphic depictions of bridge lighting regulations.

Bridges may also be augmented with reflective materi-

al, radar reflectors, RACON signals - typically marking the center span of the navigable waterway - or AIS-ATON signals - typically marking the bridge piers and other obstructions.

### AIDS TO NAVIGATION LIGHT CHARACTERISTICS

#### 718. Characteristics

An aid to navigation light has a distinctive rhythm or characteristic, which is the sequence of light and dark periods within a specified time period; or when the light is on or off. The period of darkness within the sequence is referred to as the **eclipse**. The sequence includes the number of light and eclipse periods within a specified time duration. For example, the sequence of an aid to navigation displaying a standard Flashing 4 second light signal would be observed as 0.4 second period of light followed by a 3.6 second eclipse per each 4 second sequence.

The light signal color does not impact the light characteristic but adds to the distinguishing features of the ATON light signal. If, in the previous example, the light signal color was green, then the light's characteristic would be further refined as Flashing Green every 4 seconds.

Generally, **Flashing** light signals display light for a much shorter period than the accompanying eclipse. The period of light is greater than the eclipse with an **Occulting**

light signal. **Isophase** light signals display equal periods of light and eclipse. **Group Flashing** signals display a specified number of flashes followed by a longer eclipse period. An **Alternating** light characteristic will display more than one light within the specified sequence.

The light characteristic of an aid to navigation is one of the methods for distinguishing one light signal from another and for conveying specific marine safety information. For example, a quick flashing light in a lateral system typically indicates that the axis of the waterway or channel changes direction at or near that location.

Most lighted aids to navigation are equipped with light sensors, daylight controls, that turn the light signal off during daylight. Due to a variety of factors, not all ATON lights in an area turn off or on at the same time. It is not uncommon to observe some ATON lights on while others are off, especially during twilight or during heavy overcast conditions.

The following table lists some of the more common ATON light signal rhythms/characteristics (see Table 718).

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 718. Light rhythm characteristics.






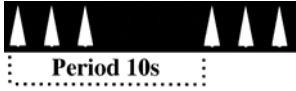







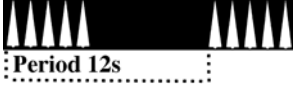





TYPE	ABBREVIATION	GENERAL DESCRIPTION	ILLUSTRATION*
Flashing	Fl.	A light for which the total duration of light in a period is shorter than the total duration of darkness and the appearances of light (flashes) are usually of equal duration (at a rate of less than 50 flashes per minute).	
Long flashing	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 718. Light rhythm 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.	
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.	
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	<p>* Periods shown are examples only.</p>

NOTE: Alternating lights may be used in combined form with most of the previous types of lights

Table 718. Light rhythm characteristics.



### 719. Light Sectors

A light sector is the arc over which a light is visible, described in degrees true, as observed from seaward

towards the light. Sectors may be used to define the distinctive color difference of two adjoining sectors, or an obscured sector.

When different color sectors are displayed from a sin-

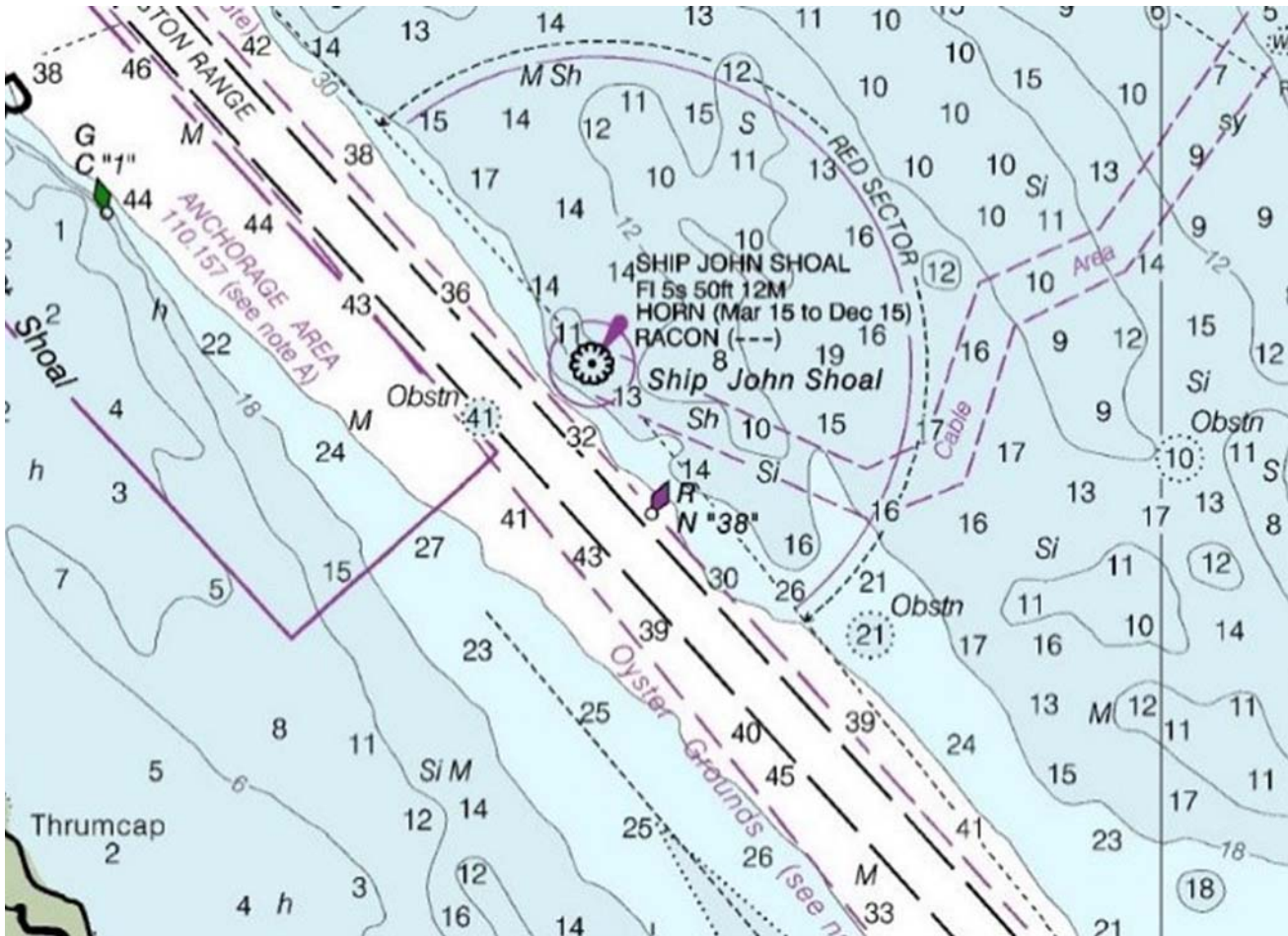


Figure 719. Portion of a chart depicting a light sector.

gle light (not to be confused with Directional or Port Entry Lights) one or more of the sectors are typically red indicating danger areas that mariners should avoid. Usually the color of the light is white with the red sector(s) annotated on the chart and column 4 of the Light List entry for the light. For example, the characteristic for a typical shoal light is entered in the Light List as “FL W 5s (R Sector).”

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. Figure 719 depicts a light sector example as found on a nautical chart.

### 720. Factors Affecting Range and Characteristics

Atmospheric conditions have a considerable impact on

the distance at which an ATON light can be detected and recognized. Fog, smoke, haze, dust, and various forms of precipitation usually reduce detection and recognition distance. On the other hand, the atmospheric refraction of light may actually cause a navigation aid to be detected at a greater distance than ordinary circumstances would dictate. Some atmospheric conditions coupled with the geographic distance from a light may reduce the apparent duration of a light's flash, or give white lights a reddish hue. At times in clear weather green lights may appear to have a more whitish hue. Aid to navigation light signals placed at higher elevations are more frequently obscured by clouds, mist, and fog than those near sea level. In regions where ice conditions prevail, ice and snow may cover the optic of the light signal reducing its luminous range and/or altering the apparent signal color seen by the observer.

The distance from a light cannot be estimated by its apparent brightness. There are too many factors that can

affect a light signal's perceived intensity. Also, a powerful, distant light may sometimes be confused with a smaller closer light with similar characteristics. Every light signal observed should be carefully evaluated to ensure that the light signal is properly identified with its proper aid to navigation.

The presence, location, and number of **shore lights** and background lighting may make it difficult to distinguish aid to navigation light signals from the background lighting. Aid to navigation lights may be obscured by various shore obstructions, be they natural or man-made. Mariners should report any such obstruction to the nearest Coast Guard unit.

A light signal'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.

At short distances, some light signals inside a lighthouse copula emitted via rotating lanterns may show a faint continuous light, or faint flashes, between regular flashes. This is likely due to reflections of a rotating lens on panes of glass in the lighthouse copula.

If a light is not observed within a reasonable time after prediction the prudent mariner will, without delay,

ascertain the vessel's position via other position fixing methods to determine the possibility of standing into danger. The inability to observe a light signal may be caused by the light being obscured or extinguished.

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 A I W R). This phenomenon results from the greater luminous intensity generated by the white light signal. White lights can produce the greatest luminous intensity, green lights less so, and red lights are the least of the three. This fact also accounts for the different ranges given in the Light Lists for some multi-color sector lights. A light signal with the same light source has different luminous and nominal ranges according to the color of the lens or glass.

All observed aid to navigation discrepancies should be reported immediately to the nearest Coast Guard unit.

## SOUND SIGNALS

### 721. 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 circum-

ferential slot into a cylindrical bell chamber.

**Bells** and gongs are sounded with a mechanically operated hammer.

### 722. 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. Navigator can never rely on sound signals alone; they should continuously monitor both the radar and fathometer when in low visibility. They 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*.

Mariners should never assume:

1. That they are out of ordinary hearing distance because s/he fails to hear the sound signal.
2. That because they hear a sound signal faintly, they are far from it.
3. That because they hear it clearly, they are 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 they do not hear it, even when in close proximity.
6. That the sound signal is emanating from the apparent direction the sound heard.

## MARITIME BUOYAGE SYSTEMS

### 723. Buoyage System Types

There are two major types of buoyage systems in the maritime world today, 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.

### 724. The IALA Maritime Buoyage System

There has long been disagreement over the way in which buoy lights should be used since they first appeared towards the end of the 19th century. In particular, some countries favored using red lights to mark the port side of channels when entering from sea while others favored them for marking the starboard side. Another major difference of opinion revolved around the principles to be applied when designing buoy systems. Most countries adopted the principle of the **Lateral** system while several other countries also favored using the principle of the **Cardinal** system.

In 1957 the, **International Association of Lighthouse Authorities (IALA)** was formed in order to support the

goals of the technical lighthouse conferences which had been convening since 1929. Attempts to bring complete unity had little success. Fresh impetus was given to the task of the IALA Committee, by a series of disastrous wrecks in the Dover Strait area in 1971. These wrecks, situated in one lane of a traffic separation scheme, defied all attempts to mark them in a way that could be readily understood by mariners.

To meet the conflicting requirements, it was deemed necessary to formulate two Lateral systems, one using the color red to mark the port side of the channels entering from sea and the other using the color red to mark the starboard side of channels. These were called System A and System B respectively. The rules for System A, which included both cardinal and lateral marks, were completed in 1976 and agreed by the International Maritime Organization (IMO). The System was introduced in 1977 and its use has gradually spread throughout Europe, Australia, New Zealand, Africa, the Gulf and some Asian Countries.

The rules for System B were completed in early 1980. These were considered suitable for application in North, Central and South America. Japan, Republic of Korea and Philippines.

The rules for the two Systems were so similar that the IALA Executive Committee was able to combine the two sets of rules into one, known as "The **IALA Maritime Buoyage System**". This single set of rules allows Aids to Navigation Authorities the choice of using red to port or red to starboard, on a regional basis; the two regions being known as **Region A** and **Region B**.

At a Conference convened by IALA in November 1980 with the assistance of IMO and the International Hydrographic Organization (IHO) Aid to Navigation Authorities from 50 countries and the representatives of nine International Organizations concerned with aids to navigation met and agreed to adopt the rules of the new combined system. The boundaries of the buoyage regions were also decided and illustrated on a map annexed to the



rules.

Today IALA operates as a non-governmental non-profit international organization, devoted to the harmonization of marine aids to navigation. It promotes information exchange and recommends improvements based on new technologies

## 725. 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.

## 726. 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.”

### 727. 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 they pass 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.

### Cardinal System 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 displays 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.

### 728. 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, positioned 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.

**729. 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.

**730. 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.

**731. 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.

**Racon**

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



### 732. 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 when 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.

#### Automatic Identification System (AIS)

Magenta circle with AIS text to the Navigation Aid depicts the existence of an AIS station. These aids broadcast their presence, identity, position and status at least every three minutes or as needed. These broadcasts can originate from a station located on an existing physical aid to navigation (Real AIS ATON) or from another location (Synthetic AIS ATON). A Virtual AIS is electronically charted, but non-existent as a physical aid to navigation (Virtual AIS ATON).

#### Radar Reflectors

According to IALA rules, radar reflectors are not necessarily charted for several reasons. First, all major 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.

## UNITED STATES AIDS TO NAVIGATION SYSTEM (USATONS)

### 733. General U.S. Aids to Navigation System

The United States has adopted the major features of the IALA system, consistent with Region B for the United States Aids to Navigation System (USATONS).

The primary objective of the USATONS is to mitigate transit risks to promote the safe, economic, and efficient movement of military, commercial, and other vessels by assisting navigators in determining their position, a safe course, and warning them of dangers and obstructions.

#### Colors

Under this system, green buoys and beacons with green square dayboards mark a channel or waterway's port (left) side when entering port from sea and obstructions which must be passed by keeping the aid to navigation to port. Red buoys and beacons with red triangle dayboards mark a channel or waterway's starboard (right) side when entering port from sea and obstructions which must be passed by keeping the aid to navigation to starboard. Hence the phrase *Red Right Returning*.

Red and green horizontally banded **preferred channel** buoys and beacons (see Figure 733a) with red and green horizontally banded dayboards mark junctions or bifurcations in a channel or obstructions which may be passed on either side. If the topmost band is green, then the preferred channel will be followed by keeping the aid to navigation to port when entering port from sea. If the topmost band is red, then the preferred channel will be followed by keeping the



Figure 733a. Preferred channel or "junction" buoy.

Red and white vertically striped **safe water** buoys and beacons (see Figure 733b) with red and white vertically striped dayboards mark a fairway or mid-channel.

Reflective material is placed on buoys and beacon dayboards to assist in their detection at night with a searchlight. The color of the reflective material agrees with the aid to navigation color. Red or green reflective material may be placed on preferred channel (junction) ATON; red if topmost band is red, or green if the topmost band is green. White reflective



Figure 733b. Safe water buoy.

material is used on safe water ATON. Special purpose buoys and beacons display yellow reflective material. Warning or regulatory buoys and beacons display orange reflective horizontal bands and a warning symbol.

### 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.

Beacon dayboards also have shape significance. Red boards are triangle-shaped and green boards are square. Safe water beacons are marked with octagonal-shaped red and white vertically colored boards. A range is marked with rectangular-shaped board vertically striped (one color running down the center flanked by another color - a red board with a white center stripe for example).

There are also diamond-shaped special purpose and square-shaped information and regulatory boards.

### Numbers

All solid colored buoys and beacons are numbered, red

ATON exhibiting even numbers and green ATON odd numbers. The number values increase from seaward upstream or toward land. Other multiple colored ATON are not numbered but they may exhibit a letter for identification. In fact any ATON may be assigned a letter for identification.

### Light Colors

Red lights are used only on red or red and green horizontally banded buoys and beacons with red triangle-shaped dayboards or horizontally banded triangle-shaped dayboards with red being the topmost band.

Green lights are used only on the green buoys or green and red horizontally banded buoys with the topmost band green and beacons with green square-shaped dayboards or green and red horizontally banded square-shaped dayboards with the green as the topmost band.

White lights are used on **safe water** buoys and beacons showing a Morse Code "A" characteristic and on Information and Regulatory buoys and beacons

### 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.

### 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.

## 734. Intracoastal Waterway Aids to Navigation

The Intracoastal Waterway (ICW) consists of three non-contiguous segments: The Atlantic Coast Intracoastal Waterway - from Manasquan Inlet, New Jersey to Florida Bay, Florida; Florida Gulf Intracoastal Waterway - from Fort

Myers to Tarpon Springs, Florida; and Gulf Intracoastal Waterway - from Carrabelle, Florida to Port Brownsville, Texas near the U.S. border with Mexico. The ICW includes about 3,000 miles of navigable waterways using sounds, bays, rivers, sloughs, estuaries, and other natural waterway features connected as necessary with dredged channels and canals.

*There is a fourth ICW segment that runs across Florida for about 150 miles from St. Lucie Inlet to Fort Myers, Florida, but it is quite shallow and not recommended for most commercial traffic.*

Aids to Navigation marking the ICW are numbered clockwise along the Atlantic and Gulf Coast and display distinctive yellow retro-reflective bands, squares, and triangles.

Red buoys and beacons with red triangle-shaped dayboards, with a yellow triangle affixed and even numbers mark the starboard (right) side of the ICW channel when traveling in a general clockwise direction along the coast. Green buoys and beacons with green square-shaped dayboards, with a yellow square affixed, and odd numbers mark the port (left) side of the ICW channel. Non-lateral aids to navigation, such as safe water marks, isolated danger marks, and front range boards are marked with a horizontal yellow band. Rear range boards do not display the yellow band. Where the ICW intersects with another U.S. Federal-maintained channel, the ICW yellow triangle or square affixed to the buoy or dayboard will indicate the ICW channel. Junctions between the ICW and privately maintained waterways are not marked with preferred channel buoys or beacons.

### 735. U.S. Western Rivers

The term Western Rivers includes the Mississippi River System, i.e. the Mississippi River from Lower Mississippi River Mile 155 to Upper Mississippi River Mile 857. In addition, the Western River System includes either in whole or portions of the Alabama, Arkansas, Black Warrior, Green, Missouri, Monongahela, Ohio, and Tennessee Rivers, the Tennessee-Tombigbee Waterway, and various other associated rivers and waterways.

The aids to navigation system marking the Western Rivers System conforms with Region B of the IALA Maritime Buoyage System with the following variations:

1. Buoys are not numbered and shore structures are not numbered laterally Buoys are not numbered.
2. Numbers on shore structures indicate mileage from a designated point (normally the river mouth).
3. Diamond-shaped non-lateral daymarks, red/white or green/white as appropriate, are used instead of triangular or square lateral daymarks where the river channel crosses from one bank to the other.
4. The conventional direction of buoyage, for the purpose of installing the proper aid signals, is upstream. Local terminology, however, refers to

the “left” and “right” banks viewed from a vessel proceeding downstream.

5. Lights on the right descending bank show single flashing rhythms and may be green or white. Lights on the left descending bank show “group-flashing-two” rhythms and may be red or white.
6. In pooled waters (behind dams), buoys set to mark the nine-foot contour for normal pool elevations.
7. In unstable waters (free-flowing rivers), buoys are set to mark the project depth (12-foot contour) for the prevailing river stage.
8. Isolated danger marks are not used.

### 736. State Waterways Aids to Navigation System

In accordance with Title 33 of the Code of Federal Regulations, Subpart 66.05 - State Aids to Navigation:

*“With the exception on the provisions of subpart 66.10, which are valid until December 31, 2003, aids to navigation must be in accordance with the United States Aids to Navigation System in part 62 of this subchapter.”*

Therefore, the Uniform State Waterway Marking System (USWMS) is no longer a recognized aid to navigation system within any U.S. waterway, federal or state. Specifications for the superannuated USWMS can still be view in 33 CFR 66.10-15.

### 737. Private Aids to Navigation

Private Aids to Navigation (PATON) are those aids to navigation established, operated, and maintained by entities other than the Coast Guard, U.S. Armed Forces, or State authorities. There are three classes of PATON:

1. Class I: Aids to navigation on marine structures or other works which the owners are legally obligated to establish, maintain and operate as prescribed by the Coast Guard.
2. Class II: Aids to navigation exclusive of Class I located in waters used by general navigation.
3. Class III: Aids to navigation exclusive of Class I located in waters not ordinarily used by general navigation. Buoys are not numbered and shore structures are not numbered laterally Buoys are not numbered.

Per 33 CFR 66.01-1, “No person, public body, or instrumentality not under the control of the Commandant, exclusive of the Armed Forces, will establish and maintain, discontinue, change or transfer ownership of any aid to maritime navigation, without first obtaining permission to do so from the Commandant”, i.e. the Coast Guard.

In addition to Coast Guard approval, per 33 CFR 66.01-30, “Before any private aid to navigation consisting of a fixed structure [beacon] is placed in the navigable waters of the United States, authorization to erect such structure shall first be obtained from the District Engineer,

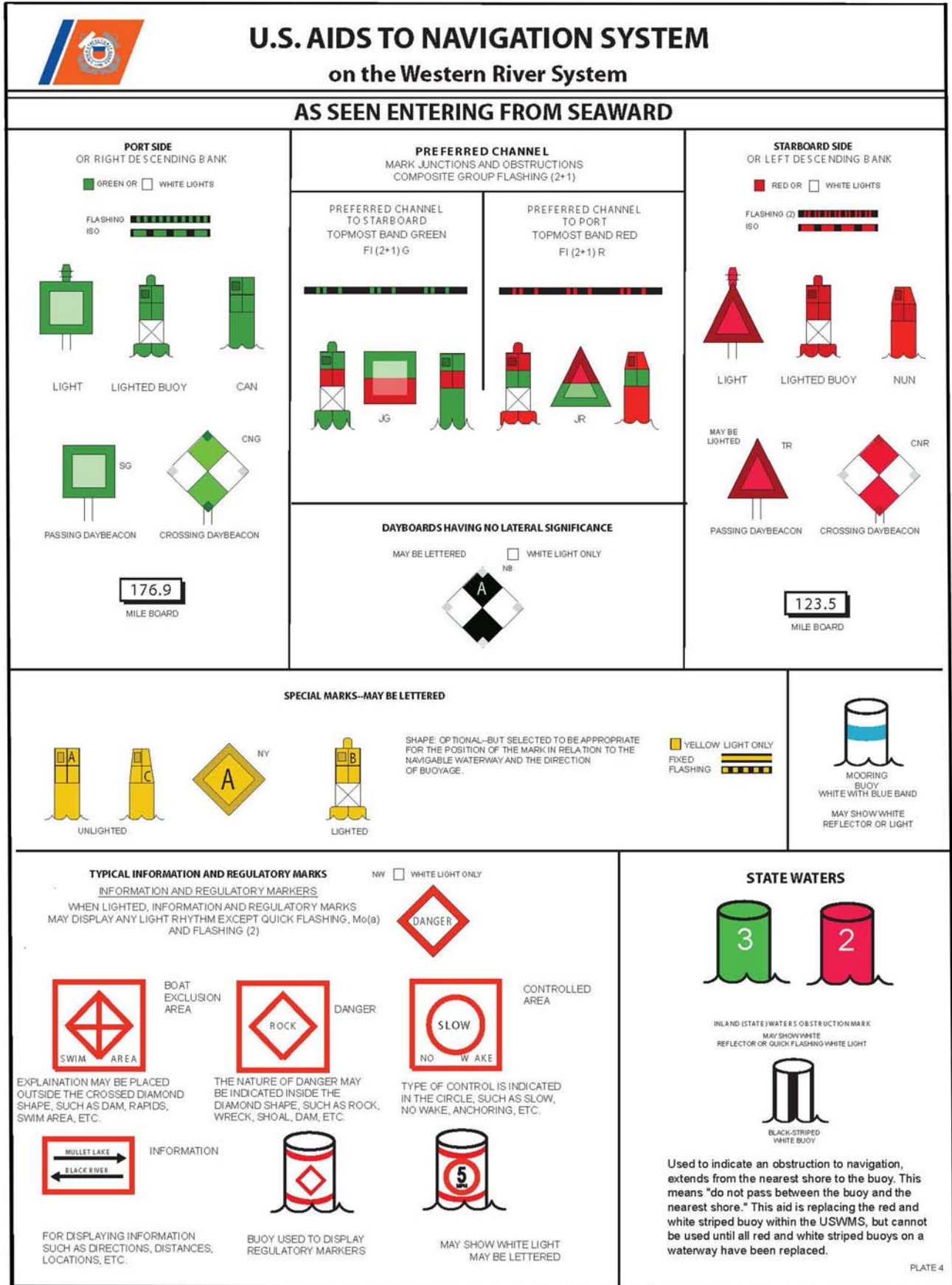


Figure 737a. U.S. Aids to Navigation - Plate 4.



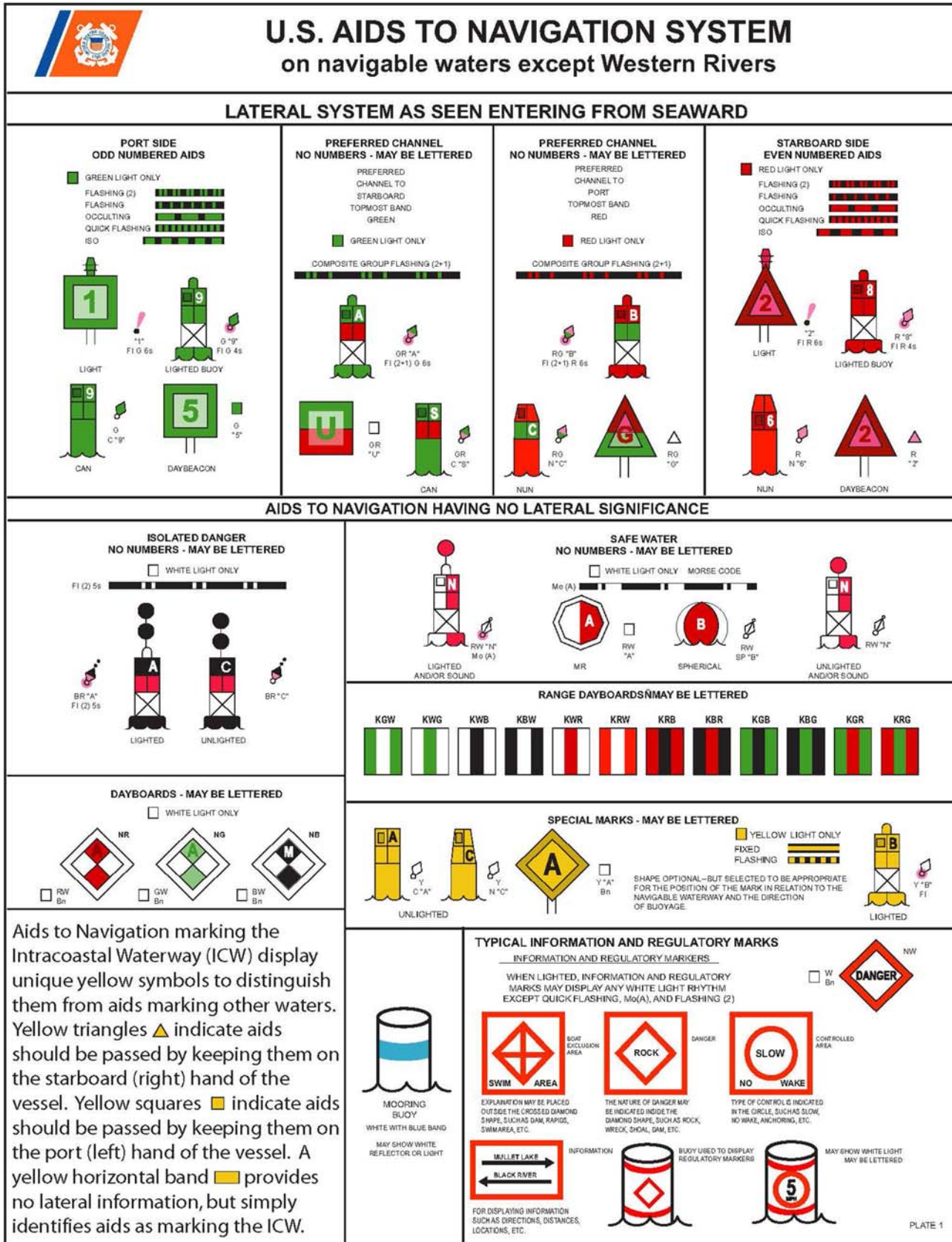


Figure 737b. U.S. Aids to Navigation - Plate 1.



U.S. Army Corps of Engineers in whose district the aid will be located.”

The characteristics of a private aid to navigation must conform to those prescribed by the United States Aids to Navigation System.

Private ATON owners are responsible for maintaining their PATON, which are subject to inspection by the Coast Guard at any time without prior notice

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*.

### **738. Interference with or Damage to Aids to Navigation**

Per 33 CFR 70, “*No person, excluding the Armed Forces, shall obstruct or interfere with any aid to navigation established and maintained by the Coast Guard, or any private aid to navigation...*”

Subpart §70.01-5 states: “*Any person violating the provisions of this section shall be deemed guilty of a misdemeanor and be subject to a fine not exceeding the sum of \$500 for each offense, and each day during which such violation shall continue shall be considered a new offense.*”

If any vessel collides with an aid to navigation, the person in charge of the vessel is required by law to report the accident to the Officer in Charge of the nearest Coast Guard Marine Inspection unit.

### **739. U. S. ATONS Graphics**

See Figure 737b and Figure 737a for plates to the U.S. Aids to Navigation System (on navigable waters, including the Western River System).