

# NAVIGATION & NAVIGATION AIDS

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## **Lights**

On a vessel, navigation lights are lights shown that are of a specific color, (white, red, green, yellow, blue), arc, range of visibility, and location, as required by law and regulations. Their basic purpose is to prevent collisions by alerting each vessel to the other's presence. Lights also indicate the relative heading of one vessel as seen from another, and give clues to her size, special characteristics, and/or current operations. Most important is her orientation to your boat-a fact you must know to determine who has the right-of-way.

Knowledge of navigation lights is important to a small-boat skipper for two separate, but both important, reasons. You are legally responsible for displaying lights of the proper color, intensity, location and visibility on your boat.

You'll depend on your knowledge of navigation lights for the safety of your boat when operating at night or in periods of reduced visibility. Vessels are required to show the proper navigation lights from sunset to sunrise in all weather conditions, good and bad. During these times, no other lights that could be mistaken for lights specified in the Rules of the Road can be displayed, nor any lights that impair the visibility or distinctive character of navigation lights, or interfere with the keeping of a proper lookout. The Rules also state that navigation lights must be shown in conditions of reduced visibility, and may be shown at other times considered necessary.

Different types and locations of lights are required for different types and sizes of boats. Here are some basic light definitions: Masthead light - A white light placed over the fore-and-aft centerline of the vessel, showing an unbroken light over an arc of 225 degrees, from dead ahead to 22.5 degrees abaft (behind) the beam on both sides of the vessel. On boats less than 12 meters (39.4 feet) in length, the masthead light may be off the fore-and-aft centerline, but must be as close to it as possible. The term "masthead light" is something of a misnomer. More often than not, this light is not at the top of the mast. On motorboats, it is often on a short staff at the top of the cabin. On sailboats, it is usually part way up the mast, and another light, the anchor light, is actually at the masthead.

### **Sidelights**

Colored lights - red on port and green on starboard - showing an unbroken arc of the horizon of 112.5 degrees, from dead ahead to 22.5 degrees abaft the beam on each side. Combination lights - On a vessel of less than 20 meters (65.6 feet) in length, the sidelights may be combined in a single fixture carried at the centerline of the vessel, except that on boats less than 12 meters (39.4 feet) in length, this combination light need be carried only as close to the centerline as possible.

### **Sternlight**

A white light showing over an unbroken arc of the horizon of 135 degrees, centered on dead astern.

Towing light - A yellow light having the same arc as a sternlight, showing 67.5 degrees to either side of dead asters

### **All-Around Lights**

A light, the color determined by its use, showing over an unbroken arc of the horizon of 360 degrees.

Flashing Light - A light flashing at regular intervals, at a rate of more than 120 or more flashes per minute. This high flashing rate is used to lessen any possibility of confusion with "quick flashing lights" on aids to navigation.

### **Special flashing light**

A yellow light flashing at a rate of 50 to 70 flashes per minute, placed as far forward and as nearly as practicable on the centerline of a tow, and showing an unbroken light over a horizontal arc of not less than 180 degrees nor more than 225 degrees centered on dead ahead.

## **Interpreting What You See**

It's great that you're learning the basics of lights - what is required and when they're required but this is only the beginning. You must also learn how to interpret the navigation lights that you see when you are underway at night-and for your safety-learn it well.

If you see a red navigation light on another vessel, you immediately know that she has the right of way, and you must yield - that's why it is red.

If you see two or three white vertical lights, that could be a tug with a tow astern. Look for the lights on the towed vessel, and don't try to pass between the tug and the tow.

And there are other lights and combinations of lights that you must be able to instantly recognize - the lights for a sailboat that is privileged over a motorboat, the special lights of various fishing vessels, a dredge or a vessel not under command. Study the requirements for navigation from the viewpoint of a "looker" as well as a boat owner.

## **It's Your Responsibility**

It is the responsibility of the owner/operator of a vessel that she show the proper navigation lights for her size and the waters in which she is operating.

It is not the responsibility of the manufacturer, importer, or selling dealer. Many boats are delivered with lights that do not meet legal requirements with respect to technical characteristics or placement on the vessel.

Remember also, that the angles of visibility must be met when the boat is underway-if your boat rides at a significant bow-up angle, take that into consideration when installing and/or checking your lights.

## **Sound Signals**

### **Legal Requirements**

Equipment for Sound Signals is based on the length of your boat as follows: Boats less than 39.4 feet in length - must carry an efficient sound producing device. This may be a bell, whistle, or air horn.

Boats at least 39.4 feet to less than 65.6 feet in length - Must carry a whistle and a bell. The whistle must be audible for 1/2 nautical mile. The mouth of the bell must be at least 7.87 inches in diameter.

### **When and How to Sound Off**

Sound signals are to be used only when vessels are in sight of each other and are meeting or crossing at a distance within half a mile of each other. These signals must never be used in fog or other conditions of reduced visibility, where the vessels are not visible to each other by eye. Only the fog signals

of Rule 35 may be sounded at such time.

### **SIGNALS:**

Short Blast - 1 second

Prolonged Blast - 4 to 6 seconds

- **CROSS SIGNALS:** Use of cross signals, answering one signal with two or two with one, is forbidden.
- **REVERSE:** Three short blasts indicate engines going astern (in reverse).
- **CROSSING:** Give-way vessel, vessel which has the other on the starboard (right), keeps out of the way and avoids crossing ahead of stand-on vessel. Stand-on vessel holds course and speed.

### **REDUCED VISIBILITY:**

#### **Power Driven Vessels:**

Making way through water - one prolonged blast sounded at two-minute intervals. Underway but stopped and making no way through the water - two prolonged blasts in succession with two second intervals between blasts sounded at two-minute intervals.

#### **Sailboats**

Or vessels not under command, restricted in ability to maneuver, towing or pushing another vessel, or engaged in fishing with nets or trawling: One prolonged followed by two short blasts sounded at two-minute intervals.

#### **Vessels at anchor:**

A vessel at anchor shall at intervals of not more than one minute ring the bell rapidly for about five seconds. Vessels over 100 feet must ring a bell in the forepart of the vessel, and immediately afterwards in the after part of the vessel. Boats less than 12 meters (less than 40 feet) must make an efficient sound with an interval of no more than two minutes.

These are not the only rules concerning sound signals in restricted visibility; there are additional rules concerning sound signals that may be found in the Rules of the Road or in Chapman's.

## **APPROACHING A BEND OR CHANNEL OBSTRUCTION:**

Under both the International and Inland rules, a vessel nearing a bend or an area of a channel or fairway where other vessels may be obscured by an intervening obstruction shall sound one prolonged blast. Such signal shall be answered with a prolonged blast by any approaching vessel that may be within hearing around the bend or behind the intervening obstruction. This is the only time that you may sound your horn when another boat is not in view.

### **Do I Have a Potential Collision Situation?**

When the distance between two vessels decreases and the relative angle of the other vessel off the bow remains the same, then you will soon be trying to occupy the same spot in the water - a collision situation.

The main situations of collision risk are overtaking, meeting head-on, and crossing. When one of two vessels is to keep out of the way (give-way vessel), the other, the stand-on vessel must take avoiding action when it becomes apparent that the vessel required to give way is not taking appropriate action.

### **The Crossing Rule**

Both International and Inland Rules state that when two power-driven vessels are crossing so as to involve risk of collision, the vessel which has the other on her starboard side (the give-way vessel) must keep out of the way and, if circumstances permit, cross behind the other vessel (the stand-on vessel).

One way to remember this is that at night the give-way vessel will see the red (means danger) side light of the stand-on vessel and therefore must take action to pass astern. If you see a green side light, green means go, and you should maintain course and speed as the stand-on vessel.

### **The Meeting Situation**

At times there may be some doubt whether the situation is a crossing or a head-on meeting. In case of doubt, you should assume that it is a meeting situation, in which neither vessel has a clear-cut "right-of-way," and each must act to avoid the other. Each vessel in a meeting situation must alter course to starboard so that each will pass on the port side of the other.

At night, you will recognize a meeting situation if you simultaneously see a

white bow light and both red and green side lights.

### **The Overtaking Situation**

Any vessel overtaking any other vessel must keep out the way of the vessel being overtaken. The former is the give-way vessel and the latter is the stand-on vessel. This rule applies even if the overtaking vessel is propelled by wind, oars, or rubber band paddlewheel.

A vessel is deemed to be overtaking when coming up with another vessel from a direction more than 22.5 degrees abaft (behind) her beam. This is the angle prescribed by the stern light. At night, the overtaking vessel will see only the white stern light of the vessel being overtaken. If you see either side light, it is a crossing situation.

When in meeting or crossing situation, the following signals are required: one short blast means, "I intend to leave you on my port side." two short blasts mean, "I intend to leave you on my starboard side."

Under the Inland Rules, the vessel hearing the signal of the other vessel must, if in agreement, sound the same whistle signal and take steps to effect a safe passing. If in disagreement or doubt, the only allowed alternative signal is the doubt or danger signal (5 or more short and rapid blasts). Giving a danger signal does not relieve a vessel of her obligations or responsibilities under any Rule.

**DANGER:** FIVE or more blasts sounded in rapid succession indicates risk of collision or intent of other vessel not understood.

Another option is to use your VHF radio to reach agreement with another vessel in a meeting or crossing situation. The Rules state that vessels that reach agreement over VHF radio do not need to make the required sound signals.

### **Navigation Aids**

Unlike the roads and highways that we drive on, the waterways we go boating on do not have road signs that tell us our location, the route or distance to a destination, or of hazards along the way. Instead, the waterways have AIDS TO NAVIGATION, all of those man-made objects used by mariners to determine position or a safe course.

These aids also assist mariners in making a safe landfall, mark isolated dangers, enable pilots to follow channels, and provide a continuous chain of

charted marks for precise piloting in coastal waters.

The term "aids to navigation" includes buoys, day beacons, lights, lightships, radio beacons, fog signals, and Loran and other electronic systems. It covers all the visible, audible and electronic symbols that are established by government and private authorities for piloting purposes. The Coast Guard uses the acronym ATON.

The Coast Guard is the agency responsible for maintaining aids to navigation on U.S. waters that are under federal jurisdiction or that serve the needs of the U.S. armed forces. On bodies of water wholly within the boundaries of a single state, and not navigable to the sea, the state is responsible for establishing and maintaining aids to navigation.

### **Types of Aids to Navigation**

The term "aids to navigation" encompasses a wide range of floating and fixed objects (fixed meaning attached to the bottom or shore), including:

1. Buoys - floating objects that are anchored to the bottom. Their distinctive shapes and colors indicate their purpose and how to navigate around them.
2. Fog Signals - audible signals sounded to assist mariners during periods of low visibility. They are generally part of a buoy, light, or larger aid to navigation.
3. Ranges - pairs of unlighted or lighted fixed aids that when observed in line show the pilot to be on the centerline of a channel.
4. Lightships - specially equipped vessels anchored at specific locations, they are of distinctive shape and color, and have lights, sound signals, and radio beacons.
5. Radio beacons - transmitters broadcasting a characteristic signal specifically to aid navigation at night, in fog, or at distances exceeding normal visibility.
6. Radio navigation Systems - radio transmitters, usually in groups, that emit special signals for use in navigation in fog or when beyond sight of land or offshore aids.

### **International System**

The U. S. Coast Guard maintains aids to navigation in conformance to the International Association of Lighthouse Authorities (IALA). This is the familiar RED RIGHT RETURNING system, meaning that on all navigable waters returning from sea, the red even-numbered marks are on the starboard (right) side of the channel and the green odd-numbered marks are on the port (left) side of the channel. Numbers on the marks ascend when traveling from

sea to harbor--if you don't have a compass and become disoriented on the water you will always know you are heading upstream if the buoy numbers get larger as you are traveling.

### **Intracoastal Waterway**

For the sea buoys that delineate channels off the coast of the United States, and for the Intracoastal Waterway (ICW), red is on the right (shore side) when proceeding clockwise around the U. S. from the East Coast to the Gulf Coast, or proceeding north along the West Coast.

ICW marks are further identified by a small yellow reflector at the bottom of the mark.

Numbers on the marks ascend when traveling in this direction. Where the IALA-B and

ICW marks meet, one must be very careful to observe the change in meaning by referral to local charts.

### **Buoy Characteristics**

Buoys may be lighted or unlighted, sound buoys or combination buoys (having both an audible and a visual signal). Unlighted buoys may be further classified by their shape:

Can Buoys have a cylindrical above-water appearance, like a can or drum floating on its axis vertical and flat end upward. They are numbered with odd numbers, are green in color, and may be lighted.

Can buoys are located on the left side of the waterway as you travel upstream, and the buoy numbers will increase as you head upstream.

Nun Buoys have an above-water appearance line that of a cylinder topped with a cone, pointed end up. The cone may come to a point or be slightly rounded. Nuns are red in color, evenly numbered, and will be on your right side as you travel upstream.

Buoy numbers increase as you head upstream.

### **MOORING BUOYS**

Mooring buoys come in two different shapes; spherical and cylindrical.

- Both have white bodies with a solid blue horizontal band on the center of the buoy.

- Mooring buoys may have a white reflector, or a white light attached to them.
- Mooring buoys are the ONLY buoys to which you may legally tie your boat.
- Buoys are generally placed in marked anchorage areas, and you must take caution if you are traveling near buoy areas.
- Check your state boating guide for particular operating restrictions in anchorage areas.

### **Lighted Aids**

- At entrance buoys or where the direction of the channel changes, the aid is usually lighted by a flashing light of the appropriate color.
- The characteristics of the lights (termed light rhythms) are designated on the chart.
- The rhythm of a light allows it to be distinguished from other nearby lights.
- This knowledge is essential when operating at night.

### **Unlighted Aids**

- Day beacons are marks fixed on piles.
- They are generally constructed of plywood signs, painted, and affixed with a reflective border of the same color.
- Red marks are triangular.
- Green marks are square.

### **Caution in Using Buoys**

- Do not count on floating aids always maintaining their precise charted positions, or unerringly displaying their characteristics.
- The Coast Guard works constantly to keep aids on station and functioning properly, but obstacles to perfect performance are so great that complete reliability is impossible.

### **Electronic Navigation Equipment**

Today, there are more electronic equipment options than ever to help boaters safely pilot their boats. When properly understood and used, this equipment can make boating a safer and more pleasurable experience.

Remember, it's always important to rely on more than one type of equipment when navigating. For example, check the reading on your depth sounder against the numbers on your chart. And, in the event your Global Positioning System fails, you may need to know how to chart your course on a chart. Here's an overview of some electronic equipment commonly used for navigating.

### **Depth Sounders**

Depth sounders have been popular for many years. They are very versatile, as they can be used on lakes, rivers, bays, and offshore. The device measures depth by measuring the round-trip time for a pulse of ultrasonic energy to travel from the boat to the bottom of the water and be reflected back to the boat.

When left on, depth sounders provide a continuous read of the depth under your boat which changes as actual depth changes.

### **Radio Direction Finders**

Installed primarily as a safety item, radio direction finders (RDFs) can also be a great convenience to a boat operator. It is the primary radio aid to navigation for small craft. A complete RDF system has four essential components:

1. One or more radio transmitters at known locations.
2. An RDF set on the boat.
3. Charts covering both the location of the transmitters and the area of operation of the boat.
4. A person who knows the operation of the system.

Basically, RDF is a radio receiver with two additional features:

- First is the directional antenna. Usually, this antenna can rotate so the set can be secured firmly in a convenient place.

A RDF set's directional antenna is an improved version of the simple loop used on portable receivers, the directional characteristics of which are familiar to most boaters. The antenna may take the form of an open loop a foot or so in diameter, or it may appear as a plastic bar measuring about an inch square by some six inches in length. Both types are normally mounted on the tops of the set; either will do the job.

- The second special feature is the visual null indicator. While the operator can judge by ear the position of an antenna at minimum signal with fair accuracy, he can get a more precise bearing by

observing a visual indicator. This is normally a small electric meter, read for either a maximum or a minimum deflection of its needle in accordance with the set's instructions.

### **How to Take a Radio Bearing**

To take a radio bearing, follow these steps:

Set the scale built into the set, usually around the base of the antenna, so that 000 degrees is straight ahead.

Rotate the directional antenna until a null point is precisely located, read the angle from the scale; this is the uncorrected relative radio bearing. Caution:

1. The boat must be taken directly on course at the moment that the bearing is taken, as any error in heading will be reflected in the resultant radio bearing.
2. If there is any doubt about whether the reading just taken is the direct or reciprocal bearing, use the sense antenna to identify it. If the reading is the reciprocal, do not add or subtract 180 degrees-take a new bearing.
3. Having determined the direct bearing angle, apply the proper RDF deviation correction; the sum is the corrected relative radio bearing.
4. Add the boat's true heading, subtracting 360 degrees if the sum exceeds that amount. This is now the true radio bearing from the boat; plot this in the same manner as with a visual bearing.

### **Radar**

Radar is an excellent means of marine navigation and it is used on vessels of all size down to about 30 feet. Although space and cost limit its use on recreational boats, boaters should know its capabilities and limitations, for their own safety when cruising on waters navigated by radar-equipped vessels.

Radar sends out brief pulses of super-high-frequency radio waves that are reflected by objects at a distance. The time it takes for the pulse to go out and the echo to return is a measure of the distance to the reflecting object. In broad principles, this is the same technique as described for depth sounders, except that transmission is through air rather than water, and radio waves have been substituted for ultrasonic waves.

There are four major components of a radar set:

1. The transmitter - generates radio waves and includes the modulator which causes energy to be sent out in brief pulses.
2. The antenna - which radiates the pulses and collects the returning

- echoes. The antenna is highly directional in its horizontal characteristics, but eight to ten times wider vertically.
3. The receiver - detects the returned reflections and amplifies them to usable strength.
  4. The indicator - provides visual display of objects sending back reflections.

### **Radionavigation Systems (LORAN-C)**

There are a number of Radionavigation systems available to skippers of offshore cruising and fishing boats as well as to navigators of larger ships. These vary in degree of complexity and cost of receiving equipment. Even if it is equipment you will never use personally, you should be familiar with this equipment.

The Radionavigation system most commonly used by boaters in U.S. Waters is LORAN-C. LORAN - the name is derived from Long Range Navigation - is an electronic system using shore-based radio transmitters and shipboard receivers to allow mariners to determine their position at sea. Loran will work in all kinds of weather, 24 hours a day.

### **Satellite-Based Equipment**

Satellite technology has proven invaluable for boaters over the past several years.

Boaters can rely on satellite technology to help them navigate and to notify rescue authorities of their need for assistance. Satellite telephones can be used to initiate voice communication. All of this can be done from virtually any point on earth, 24 hours a day.

### **Global Positioning System (GPS)**

GPS transceivers give boaters almost exact position readout, in degrees of longitude and latitude, almost instantly. GPS transceivers can be mounted on your boat, or carried as hand-held units. Many units let you store waypoints and automatically plot reverse courses. Every year, GPS technology and units improves.

Today, highly accurate and feature-intense GPS units can be carried in the palm of the hand, and can be purchased for under \$300.

### **Emergency Position Indicating Radio Beacon (EPIRB)**

Designed for use in an offshore emergency, an EPIRB sends a distress signal to a series of satellites. The signal is immediately forwarded to the nearest rescue unit. Coverage is worldwide, and a host of nations participate in this

international treaty program. Your distress signal is encoded with a unique identifier number that identifies your boat. It is required by law that you register 406 MHz EPIRBs with the National Oceanic and Atmospheric Administration (NOAA). Even better, the satellites calculate the position of your EPIRB, and thus of your boat, and relay it to rescue authorities. The position is accurate to within one mile, which seriously cuts down on the time it will take rescue workers to find you. In an emergency, time can be a precious commodity. EPIRBs are available at most major marine retailers and range from \$800-\$1,200 depending on model type. If you would like to rent an EPIRB, the BOAT/U.S. Foundation has a new EPIRB Rental Program. Reserve yours early since they go fast!

Precise bearing by observing a visual indicator, this is normally a small electric meter, read for either a maximum or a minimum deflection of its needle in accordance with the set's instructions.